

# The Caused Beginning of the Universe: A Response to Quentin Smith

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Quentin Smith has recently argued that (I) the universe began to exist and (II) its beginning was uncaused. In support of (II), he argues that (i) there is no reason to think that the beginning was caused by God and (ii) it is unreasonable to think so. I dispute both claims.

His case for (i) misconstrues the causal principle, appeals to false analogies of *ex nihilo* creation, fails to show how the origin of the universe *ex nihilo* is naturally plausible, and reduces to triviality by construing causality as predictability in principle. His case for (ii) ignores important epistemological questions and fails to show either that vacuum fluctuation models are empirically plausible or that they support his second claim.

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## I. Introduction

Quentin Smith [1988] has recently argued that there is sufficient evidence at present to warrant the conclusions that (i) the universe probably began to exist and that (ii) it began to exist without being caused to do so. While I am inclined to agree with (i), {1} it seems to me that Smith has overstated the case for (ii).

As part of his argument for (ii), Smith takes on the task of disproving what we may call the theistic hypothesis (TH), that the beginning of the universe was caused by God. It is apparently Smith's contention that the theist who believes in divine *creatio ex nihilo* must fly in the face of the evidence in order to do so. But is this in fact the case? As I read him, Smith's refutation of (TH) basically falls into two halves: (i) there is no reason to regard (TH) as true, and (ii) it is unreasonable to regard (TH) as true. Let us, therefore, examine each half of his refutation in turn.

## II. No Reason to Regard (TH) as True

In order to show that there is no reason to think that God caused the beginning of the universe, Smith attacks the universality of the causal principle, variously construed. After arguing that "... it belongs analytically to the concept of the cosmological singularity that it is not the effect of prior physical events" and that "this effectively rules out the idea that the singularity is an effect of some prior natural process" (p. 48), Smith turns to the "more difficult question" of whether the singularity or the Big Bang is the effect of a supernatural cause. He presents the following argument (incorrectly attributed to me) as a basis for inferring a supernatural cause of the universe's origin:

1. We have reason to believe that all events have a cause.
2. The Big Bang is an event.
3. Therefore, we have reason to believe that the Big Bang has a cause.

While admitting that this argument does not violate singularity theorems, since the cause is not conceived to be a spatio-temporal object, Smith maintains that the argument fails because (1) is false. Quoting me to the effect that "the causal proposition may be taken as an empirical generalization enjoying the strongest support experience affords," Smith rejoins that quantum mechanical considerations show that the causal principle is limited in its application, so that a probabilistic argument for a cause of the Big Bang cannot succeed. For according to Heisenberg's Uncertainty Principle, it is impossible to predict precisely the conditions of the values of momentum or position of some particle  $x$  at some time  $t_2$  on the basis of our knowledge of the conditions of  $x$  at  $t_1$ . Since it is sufficient to understand causality in terms of a law enabling precise predictions of individual events to be deduced, it follows from Heisenberg's Principle that there are uncaused events in this sense. {2} Therefore, the causal proposition is not universally applicable and may not apply to the Big Bang.

But what exactly is the causal proposition which is at issue here? The proposition which I enunciated was not (1), as Smith alleges, but rather

- 1.' Whatever begins to exist has a cause.

The motions of elementary particles described by statistical quantum mechanical laws, even if uncaused, do not constitute an exception to this principle. As Smith himself admits, these considerations "at most tend to show that acausal laws govern the *change of condition* of particles, such as the change of particle  $x$ 's position from  $q_1$  to  $q_2$ . They state nothing about the causality or acausality of absolute beginnings, of beginnings of the existence of particles" (p. 50).

Smith seeks to rectify this defect in his argument, however, by pointing out that the Uncertainty relation also permits energy or particles (notably virtual particles) to "spontaneously come into existence" for a very brief time before vanishing again. It is therefore false that "all beginnings of existence are caused" and,

hence, "... the crucial step in the argument to a supernatural cause of the Big Bang ... is faulty" (pp. 50-51).

But as a counterexample to (1'), Smith's use of such vacuum fluctuations is highly misleading. For virtual particles do not literally come into existence spontaneously out of nothing. Rather the energy locked up in a vacuum fluctuates spontaneously in such a way as to convert into evanescent particles that return almost immediately to the vacuum. As John Barrow and Frank Tipler comment, "... the modern picture of the quantum vacuum differs radically from the classical and everyday meaning of a vacuum-- nothing. ... The quantum vacuum (or vacuua, as there can exist many) states ... are defined simply as local, or global, energy minima ( $V'(O)=0$ ,  $V''(O)>0$ )" ([1986], p. 440). The microstructure of the quantum vacuum is a sea of continually forming and dissolving particles which borrow energy from the vacuum for their brief existence. A quantum vacuum is thus far from nothing, and vacuum fluctuations do not constitute an exception to the principle that whatever begins to exist has a cause. It therefore seems that Smith has failed to refute premiss (1').

Let us pursue Smith's argument further, however. He proceeds to argue that there is no reason to think that the causal principle applies to the Big Bang, whether one adopts a model based exclusively on the General Theory of Relativity or whether one uses a model adjusted for quantum effects during the Planck era. Consider on the one hand a model in which quantum physics plays no role prior to  $10^{-43}$  second after the singularity. Since the classical notions of space and time and all known laws of physics break down at the singularity, it is in principle impossible to predict what will emerge from a singularity. If we regard the Big Bang as the first physical state, {3} then the particles that constitute that state must be regarded as being randomly and spontaneously emitted from nothing at all. Smith states, "This means, precisely put, that if the Big Bang is the first physical state, then every configuration of particles that does constitute or might have constituted this first state is as likely on *a priori* grounds to constitute it as every other configuration of particles. In [this] case, the constitution of the Big Bang<sub>1</sub> is impossible in principle to predict and thus is uncaused (for 'uncaused' minimally means 'in principle unpredictable')" (p. 52). Moreover, since spacetime curves cannot be extended beyond the singularity, it cannot have causal antecedents.

On the other hand, consider a model in which quantum processes do predominate near to the Big Bang. If the defender of the causal principle maintains that the proposition

4. There are some uncaused beginnings of existence *within* spacetime

is irrelevant to and thus cannot increase the probability of

5. The beginning of the existence of spacetime itself is uncaused,

then Smith will respond that the same holds for the parallel argument for a supernatural cause of four-dimensional spacetime. For the proposition

6. All beginnings of existence *within* spacetime are caused

would by the same token be irrelevant to and thus not increase the probability of

7. The beginning of the existence of four- dimensional spacetime is caused.

So whether one adopts a classical relativistic model or a quantum model, there is no reason to postulate a cause, natural or supernatural, of the Big Bang.

Is this a sound argument? It seems to me not. To pick up on a point noted earlier, Smith's argument throughout his paper appears to be infected with positivism, so that it is predicated upon a notion of causality that is drastically inadequate. Smith assumes uncritically the positivistic equation between

predictability in principle and causation. But this verificationist analysis is clearly untenable, as should be obvious from the coherence of the position that quantum indeterminacy is purely epistemic, there existing hidden variables which are in principle unobservable, or even the more radical position of die-hard realists who are prepared to abandon locality in order to preserve the hidden variables. Clearly, then, to be "uncaused" does not mean, even minimally, to be "in principle unpredictable."

This single point alone seems to me to vitiate Smith's entire argument for his conclusion (ii) and against (TH) in particular. For now we see that Smith's argument, even if successful, in no way proves that the universe began to exist without a cause, but only that its beginning to exist was unpredictable. What is ironic about this conclusion is that it is one with which the theist is in whole-hearted agreement. For since according to classical theism creation is a freely-willed act of God, it follows necessarily that the beginning and structure of the universe were in principle unpredictable even though it was caused by God. The theist will therefore not only agree with Smith that "That there are uncaused events *in this sense* follows from Heisenberg's uncertainty principle" (p. 49), but even more insist that such uncaused events are entailed by classical theism's doctrine of creation. He will simply deny that this is the relevant sense when we are inquiring whether the universe could have come into being uncaused out of nothing.

When we ask that question, we are asking whether the whole of being could come out of non-being; and here a negative answer seems obvious. Concerning this question, even genuine quantum indeterminacy affords no evidence for an affirmative response. For if an event requires certain physically necessary conditions in order to occur, but these conditions are not jointly sufficient for its occurrence, and the event occurs, then the event is in principle unpredictable, but it could hardly be called uncaused in the relevant sense. In the case of quantum events, there are any number of physically necessary conditions that must obtain for such an event to occur, and yet these conditions are not jointly sufficient for the occurrence of the event. (They are jointly sufficient in the sense that they are all the conditions one needs for the event's occurrence, but they are not sufficient in the sense that they guarantee the occurrence of the event.) The appearance of a particle in a quantum vacuum may thus be said to be spontaneous, but cannot be properly said to be absolutely uncaused, since it has many physically necessary conditions. To be uncaused in the relevant sense of an absolute beginning, an existent must lack any non-logical necessary or sufficient conditions whatsoever. Now at this juncture, someone might protest that such a requirement is too stringent: "For how could *anything* come into existence without *any* non-logical necessary or sufficient conditions?" But this is my point exactly; if absolutely nothing existed prior to the Big Bang--no matter, no energy, no space, no time, no deity--, then it seems impossible that anything should begin to exist.

As for Smith's two cases, then, in the case of the classical relativistic theory, the fact that the universe originates in a naked singularity only proves that we cannot *predict* what sort of universe will emerge therefrom (and Smith does not claim otherwise), and it leaves the coming-into-existence of the singularity itself unexplained. If we interpret the singularity as a mathematical idealization whose ontological counterpart is nothing, then it becomes clear why the universe is unpredictable and why its unpredictability in no way implies the possibility of its coming into being without a cause. {4} As for Smith's consideration that a singularity is a point beyond which spacetime curves cannot be extended, this only proves that the creation event cannot have been brought about by any natural cause; but it does not prove that a being which transcended space and time could not have caused it.

As for the quantum case, the problem with the inference from (4) to (5) is not that it moves from existents within the universe to the universe as a whole, but rather that Smith's faulty concept of causation makes the notion of "uncaused" equivocal. For some beginnings of existence within spacetime are uncaused in the sense of being spontaneous or unpredictable, but one cannot conclude that therefore spacetime itself could come into being uncaused in the stronger sense of arising from nothing in the utter absence of physically necessary and sufficient conditions. But the inference from the necessity of causal conditions for the origin of existents in spacetime to the necessity of causal conditions for the origin of spacetime itself is not similarly equivocal. Indeed, our conviction of the truth of the causal principle is not based upon an inductive survey of existents in spacetime, but rather upon the metaphysical intuition that something cannot come out of nothing. {5} The proper inference, therefore, is actually from "Whatever begins to exist has a cause" and "The universe began to exist" to "The universe has a cause," which is a logically impeccable

inference based on universal instantiation. It seems to me, therefore, that not only has Smith failed to show that the Big Bang does not require a supernatural cause, but that, on the contrary, we see from these considerations that if the universe did originate from nothing, then that fact does point to a supernatural cause of its origin. {6}

Hence, I conclude that Smith has failed to show that there is no reason to regard (TH) as true.

### III. Unreasonable to Regard (TH) as True

If Smith is to prove his point (ii), in any case, he has to do much more than show that there is no reason to adopt (TH). He has to show that in light of the evidence, (TH) has now become unreasonable. Smith believes the evidence for vacuum fluctuation models of the origin of the universe is such as to render (TH) unreasonable. For it is physically necessary for quantum effects to predominate near to the Big Bang, and quantum mechanical models of the origin of the universe as or on the analogy of a vacuum fluctuation provide the most probable account of the origin of the universe out of nothing.

Now Smith's line of reasoning raises some intriguing epistemological issues, to which, unfortunately, Smith gives no attention. {7} Under what circumstances would it be irrational to believe in supernatural *creatio ex nihilo*? Under what circumstances would it be rational? When is a supernatural explanation preferable to a naturalistic one and *vice versa*? Rather than seek to adjudicate these questions, let us assume for the sake of argument that it would be unreasonable, all things being equal, to posit a supernatural cause for the origin of the universe when a plausible empirical explanation is available or even likely to become available. Notice that in such a case (TH) would not be *falsified*; it would simply be *unreasonable*, all things being equal, to believe it. The question is, then, whether vacuum fluctuation models of the origin of the universe are or are likely to become plausible empirical explanations.

The answer to the question as to whether such models now provide plausible empirical explanations for the universe's origin is, of course, no, both because the theories are so problematic and underdeveloped and because there is no empirical evidence in their favor. Christopher Isham comments,

None of the schemes proposed so far are in any sense rigorous theories. This stems partly from the lack of any proper unification of general relativity and quantum theory. However, even setting this aside, the extant proposals are incomplete; in particular it is by no means clear that they do in fact lead to a unique quantum state. Major conceptual problems arise when trying to apply quantum theory to the universe as a whole. This problem is so severe that many highly respectable theoretical physicists think the whole subject of quantum cosmology is misconceived.

It follows from the above that theories of the quantum origin of the universe are highly speculative and do not have anything like the scientific status of, say, even the more exotic branches of modern elementary particle physics (Isham [1992], sec. 1.5).

It is remarkable that Smith has so high a degree of confidence in quantum fluctuation models that he thinks it unreasonable to believe in (TH), for this is tantamount to saying that in light of these theories it is no longer reasonable to hold to a Big Bang model involving a singularity. But these theories are so inchoate, incomplete, problematic, and poorly understood that they have not commended themselves to most scientists as more plausible than traditional Big Bang models. Of course, quantum effects will become important prior to  $10^{-43}$  sec, but it is pure speculation that the initial singularity will be averted. {8}

Smith's bold assertions on behalf of these models greatly overshoot the modest, in some cases almost apologetic, claims made by the proponents of the models themselves. Brout, Englert, and Gunzig, for example, advised: "We present our work as a hypothesis; . . . For the present all that can be said in favor of our hypothesis is that these questions can be examined and on the basis of the answers be rejected or found acceptable ([1978], pp. 78, 98). Atkatz and Pagels offered the following justification: "While highly speculative, we believe this idea is worth pursuing" ([1982], p. 2072). All that Vilenkin claimed on behalf

of his model was, "The advantages of the scenario presented here are of aesthetic nature ([1982], p. 27). Other proponents of such models claim no more than that their model is *consistent* with observational data--and sometimes they do not even claim that much. In fact, it is ironic that--apparently unbeknownst to Smith--several of the original proponents of these models have, as we shall see, already abandoned the vacuum fluctuation approach to cosmogeny as implausible and are seeking elsewhere for explanations of the universe's origin.

Are these models then likely to become plausible empirical explanations of the universe? Again it would be somewhat presumptuous to give an affirmative answer to this question. Such models are provocative and worth pursuing, but there is no reason to think that they are likely to become plausible empirical explanations of the universe's origin. Indeed, there is some reason to doubt that such models can ever become plausible *empirical* explanations, since such models, by their very nature, tend to posit events which are in principle inaccessible to us, causally discontinuous with our universe or lying beyond event horizons. According to Vilenkin, the only verifiable prediction made by his model is that the universe must be closed--a prediction which observational cosmology tends to falsify. Smith likes Gott's model because it makes empirical predictions (Smith, [1986]). But so far as I can see, his only prediction is that the universe is open, which is so general as to be useless in serving as evidence for the model. None of the proponents of such models has to my knowledge laid down conditions which would verify his theory. J. P. Van der Weele concludes, "We will never be able to determine which one of the possibilities is actually true (if any), so all our ideas about the outer universe are doomed to remain metaphysical speculations" ([1983], p. 36). At present, then, such models are perhaps best viewed as naturalistic metaphysical alternatives to (TH).

But even so construed, their superiority to theism is far from obvious:

(1) Such models make the metaphysical presupposition that the observed expansion of the universe is not, in fact, the expansion of the Universe- as-a-whole, but merely the expansion of a restricted region of it. Our expanding universe is contained in some sort of wider space (whether a Minkowski space as in the Brout, Englert, Gunzig model or a curved de Sitter space as in Gott's model) in which the quantum fluctuations occur in the spacetime geometry which "pull" particles into existence out of the energy locked up in empty space. Thus, throughout this broader Universe-as-a-whole, which is considered to be a quantum mechanical vacuum, fluctuations occur which blow up into distinct material universes. But immediately the question arises, why, since all the evidence we possess suggests that space is expanding, should we suppose that it is merely our *region* of space (and regions like it) that is expanding rather than *all* of space? This thesis would appear to be in violation of the Copernican Principle, which holds that we occupy no special place in the universe. This methodological principle, which underlies all of modern astronomy and astrophysics, would be violated because what we observe would not be typical of the Universe at large. A violation of the principle in this case would appear to be entirely gratuitous. Moreover, it is not just the postulate of a different wider space that is required, but a good deal of fine-tuning is necessary in order to get the space to spawn appropriate universes. But there is no independent reason to think that such a different wider space exists or, indeed, that a different wider space of any sort at all exists. In this sense, the postulation of such a wider space is an exercise in speculative metaphysics akin to the postulate of theism--except that theism enjoys the advantage that there are at least putative independent reasons for accepting the existence of God.

(2) Moreover, it is questionable whether the models at issue are anything more than mathematical constructs lacking any physical counterpart. For, as David Lindley [1987] points out, such models depend on the use of certain mathematical "tricks" for their validity. For example, quantities derived from the conformal factor most naturally belong to the geometrical side of Einstein's equation, but by being put on the other side of the equation they can be imagined to be part of the stress energy tensor instead. This "rather arbitrary procedure" allows one to think of the conformal factor as a physical field. But this seems to be a clear case of unjustified ontologizing of a mathematical notion into a physical entity. To make matters worse, proponents of such models then propose the trick of coupling these conformal fields dynamically to other more conventional physical components of the stress energy tensor, such as the fields associated with particles similar to gauge bosons in high energy physics. In this way the conformal field can be made to generate regions of distorted geometry and a local density of particles. But what reason or evidence is there to regard such a procedure as anything more than mathematical legerdemain? As Barrow

and Tipler point out, "It remains to be seen whether any real physical meaning can be associated with these results ([1986], p. 441). Brout and Spindel, who pioneered work on vacuum fluctuation models, now admit that the field theoretical foundations of the production mechanisms as well as the instability of the background space "are flimsy at best" ([1989], p. 216).

Nor does the comparison of the universe's origin to the spontaneous production of a virtual particle serve to render these models plausibly realistic. For if this comparison is meant to be reasoning by analogy, then it seems extraordinarily weak, since the disanalogies between the universe and a virtual particle are patent. If we are to believe with Tryon [1973] that the universe literally *is* a virtual particle, then this seems even more preposterous, since the universe has neither the properties nor behavior of a virtual particle. One might ask, too, why quantum fluctuations are not now spawning universes in our midst? Why do vacuum fluctuations endure so fleetingly rather than grow into mini- universes inside ours?

(3) Vacuum fluctuation models are incompatible with observational cosmology. As Isham ([1990], p. 10; [1992], sec. 2) points out, there is in such models simply no way in which the mathematics can select one particular moment within the pre-existent, infinite, and homogeneous time at which a fluctuation should occur which will spawn a universe. Similarly, no way exists for specifying a certain point in space at which such a creation event should occur. Rather vacuum fluctuation theories tend to predict a creation event at every time  $t$ , or more precisely, as quantum theories they predict a non-zero probability of a creation event within any finite time interval, with an infinite number of creation points distributed evenly throughout space. This leads at once to an infinite number of creation events within the wider spacetime. But then the fluctuation-formed universes would inevitably collide with each other as they expand, which contradicts the findings of observational cosmology, since we do not see such "worlds in collision," to borrow a phrase. {9}

Gott [1982] attempts to avoid this difficulty by simply laying down conditions where the fluctuations are allowed to occur in the wider space. For any universe-spawning event  $E$ , there must not exist another similar event  $E'$  in the past light cone of  $E$ . The volume of this region which must be free of events like  $E$  is infinite. In order to prevent any  $E'$  from occurring in this region, Gott stipulates that the probability of randomly producing events like  $E$  per unit four-volume be infinitesimal. Since de Sitter space is infinite, one can thus construct a model of an infinite number of disjoint universes formed by fluctuations. But not only is this scenario extraordinarily *ad hoc*, but it does not seem even to avoid the difficulty. {10} For given infinite past wider time, each of the infinite regions of the de Sitter space will have spawned an open universe which will have filled the volume of that region completely, so that all the bubble universes will by now have collided or coalesced. About the only way to avoid this consequence is to postulate an expansion of the background space itself. But then we seem constrained to posit some origin of the wider spacetime--and thus we are right back to where we started. Isham regards this difficulty as "fairly lethal" to vacuum fluctuation models and reports that "theories of this type have not found wide acceptance," commenting that their interest "lies mainly in some of the rather general problems" that they raise ([1990], p. 10; [1988], p. 387).

(4) It is obvious from what has been said above that vacuum fluctuation models have, in fact, nothing to do with the origination of the universe *ex nihilo*. They posit metaphysical realities of precise specifications in order to generate our universe. Some of them are really more closely related to inflationary scenarios than to cosmogeny. Interpreted cosmogenically, vacuum fluctuation models constitute in the final analysis denials that the universe began to exist, for it is only our observable segment of the universe that had a beginning, not the Universe- as-a-whole. As Barrow and Tipler comment, "It is, of course, somewhat inappropriate to call the origin of a bubble Universe in a fluctuation of the vacuum 'creation *ex nihilo*,' for the quantum mechanical vacuum state has a rich structure which resides in a previously existing substratum of space-time, either Minkowski or de Sitter space-time. Clearly, a true 'creation *ex nihilo*' would be the spontaneous generation of everything--space-time, the quantum mechanical vacuum, matter--at some time in the past ([1986], p. 441). Smith admits that "A disadvantage of . . . theories that postulate a background space from which the universe fluctuates, is that they explain the existence of the universe but only at the price of introducing another unexplained given, viz., the background space" (p. 54). In that case, Smith has not only failed to carry his point (ii), but (i) as well.

But Smith asserts that there are even more radical models of a quantum origin of the universe that do not postulate the existence of a wider space, but hold that the universe is the result of some sort of quantum transition out of nothingness into being. For example, in the Vilenkin model, the origin of the universe is understood on the analogy of quantum tunneling, a process in which an elementary particle passes through a barrier, though it lacks the energy to do so, because the Uncertainty relation allows it to acquire spontaneously the energy for the period of time necessary for it to pass through the barrier. Vilenkin proposes that spacetime itself tunnels into existence out of nothing, except that in this case there is no prior state of the universe, but rather the tunneling itself is the first state that exists.

Unfortunately, Smith seems to have misinterpreted in a literal way Vilenkin's philosophically naive use of the term "nothing" for the four-dimensional Euclidean space out of which our spacetime emerged. {11} Be that as it may, if the quantum tunneling is supposed to be literally from nothing, then such models seem to be conceptually flawed. For as Thomas Aquinas saw (*Summa contra gentiles* 2.17), creation is not properly any kind of a change or transition at all, since transition implies the existence of an enduring subject, which is lacking in creation. In a beginning to be out of nothing, there can be no talk whatsoever of transition, quantum or otherwise. It is therefore incoherent to characterize creation as a quantum transition out of nothingness.

Even more fundamentally, however, what we are being asked to believe is surely metaphysical nonsense. Though dressed up in the guise of a scientific theory, the thesis at issue here is a philosophical one, namely, can something come out of nothing? Concerning his own model, even Vilenkin admits, "The concept of the universe being created from nothing is a crazy one ([1982], p. 26). He tries to alleviate this craziness by comparing it to particle pair creation and annihilation--an analogy which we have seen to be altogether inadequate and in any case irrelevant to the Vilenkin model as Smith interprets it, since he supposedly lacks either the embedding quantum mechanical spacetime or the Euclidean 4-space. The principle *ex nihilo nihil fit* seems to me to be a sort of metaphysical first principle, one of the most obvious truths we intuit when we reflect seriously. If the denial of this principle is the alternative to a theistic metaphysic, then let those who decry the irrationality of theism be henceforth forever silent!

If this fourth criticism is on target, then vacuum fluctuation models say nothing against divine *creatio ex nihilo*, for even if some such model turns out to be correct, the theist will maintain that God created the wider spacetime from which our material universe emerged. It might be rejoined that there would then be no grounds for positing God as the creator of the embedding spacetime, since there is no scientific evidence that it began to exist. Not only is that not the case, as we have seen, but divine *creatio ex nihilo*, as I have defended it elsewhere, is grounded in revelation and philosophical argument, and the scientific evidence merely serves as empirical *confirmation* of that doctrine. The theist, after all, has no vested interest in denominating the Big Bang as the moment of creation. He is convinced that God created all of spacetime reality *ex nihilo*, and the Big Bang model provides a powerful suggestion as to when that moment was; on the other hand, if it can be demonstrated that our observable universe originated in a broader spacetime, so be it--in that case it was this wider reality that was the immediate object of God's creation. But unless the conceptual difficulties in such models can be overcome and some empirical evidence for them is forthcoming, the theist will probably apply Ockham's Razor and be content to regard the Big Bang as the creation event.

(5) I earlier alluded to the fact that vacuum fluctuation models have been abandoned as plausible accounts of the origin of the universe by some of their principal expositors and to that extent are already somewhat dated. Brout, Englert, and Spindel of the Free University of Brussels, where much of the theoretical work on these models was done, have, for example, moved beyond such models and have criticized the attempt of some of their colleagues to refurbish the old, untenable models (Brout and Spindel, [1989], pp. 215-16). They now contend that an explanation of the origin of the universe "must await the yet-to-come quantum theory of gravity." The quantum gravity model that seems to have fired the imagination of many current theorists is the model of Hartle-Hawking [1983] based on the assigning of a wave function to the universe.

Unfortunately, models of this sort confront acute philosophical difficulties concerning the metaphysics of time. {12} (i) Such models presuppose a geometrodynamical interpretation of spacetime that suppresses

objective temporal becoming in favor of a Parmenidean, static construal of the dynamics of spacetime in terms of positions on a leaf of history in superspace. {13} Already this reduction of spacetime to a leaf of history in superspace has completed the Parmenidean reinterpretation of the dynamics of time along static lines, for the arena of geometrodynamics is not a super-spacetime, but a superspace alone. But the introduction of quantum theory into geometrodynamics--a move essential to wave functional models of the origin of our 4-geometry--not only makes spacetime ontologically derivative from superspace, but, far more, actually expunges spacetime altogether, for quantum theory makes it impossible to distinguish sharply between 3-geometries on a leaf of history in superspace and those not on it, due to indeterminacy. Misner, Thorne, and Wheeler state,

That object which is central to all of classical general relativity, the four-dimensional spacetime geometry, simply does not exist, except in a classical approximation.

. . . one has to forego that view of nature in which every event, past, present, or future, occupies its pre-ordained position in a grand catalog called 'space-time' . . . There is no spacetime, there is no time, there is no before, there is no after ([1973], pp. 1182-3).

(ii) Such models convert time into a spatial dimension by employing imaginary numbers for the time coordinate prior to the Planck time. {14} Construed realistically, this is just bad metaphysics. Space is a dimension ordered by a relation of *betweenness*: for three successive points  $x$ ,  $y$ , and  $z$  on a spatial line,  $y$  is between  $x$  and  $z$ . But time is ordered in addition by a unique relation of *earlier/later than*: for two successive moments  $t_1$  and  $t_2$  in time,  $t_1$  is earlier than  $t_2$ , and  $t_2$  is later than  $t_1$ . While spatial points are not ordered by any such relation, this relation is essential to the nature of time; as Schlesinger points out, "The relations 'before' and 'after' have generally been acknowledged as being the most fundamental temporal relations, which means that time deprived of these relations would cease to be time" ([1975], p. 171). It is thus metaphysically impossible for time to be a dimension of space. Moreover, as an ardent A-theorist who holds to the objective reality of tensed facts, Smith regards moments of time as essentially possessing the shifting properties or relations of presentness, pastness, and futurity. Nothing even remotely like these A-determinations characterizes units of space. Thus, Smith must agree that the notion of imaginary time, a sort of spatialized time, is metaphysically impossible. Now perhaps quantum gravitational models could be interpreted as holding, not that time in the earliest stages of the universe is imaginary, but rather that as one goes back in time one arrives at a regime in which time (gradually) ceases to exist and is replaced by a fourth spatial dimension. But such an interpretation is still metaphysically problematic. First, it would imply that the earliest segment of the universe was timeless, which contradicts the claim that this era existed *before* real time began. As Smith himself demands, "If the four-dimensional space does not possess a real time value, how can it stand in relation to the four-dimensional spacetime of being earlier than it? If the four-dimensional space is not in a real (Lorentzian) time, then it is not really earlier than, later than, or simultaneous with the four-dimensional spacetime manifold" ([1993], p. 318). Secondly, it seems impossible for this Euclidean 4-space to "hook up," so to speak, with the real temporal history of the universe. Once the first moment of time had elapsed, that moment was in the past. But the timeless, Euclidean 4-space cannot be in the past, since it is timeless. Thus, there never could have been a time when it was "hooked up" to our temporal universe, since then it would have been present, which is impossible. Hawking seems to realize the impossibility of having two stages of the universe, one timeless and the other temporal, and so he is driven to the Parmenidean position that our universe's existing in real time is just an illusion ([1988], p. 139)! But as Smith points out, such an interpretation is "preposterous . . . at least observationally, since it is perfectly obvious that the universe in which we exist lapses in real rather than imaginary time" ([1993], p. 319).

In order to avert the metaphysical difficulties of the Parmenidean construal of the nature of time inherent in such theories, Smith is forced to interpret quantum gravitational models' employment of geometrodynamics and imaginary time instrumentally rather than realistically and to take the beginning of the universe out of nothing to occur at the first moment of real time ([1993], p. 321). But then we are right back to the metaphysical absurdity of something's coming into being uncaused out of nothing. Smith interprets Hawking's model as establishing a certain probability for the first three-dimensional slice of spacetime to appear uncaused out of nothing. But this is a mistake, for the probability of finding any three-dimensional

cross-section of spacetime in such quantum models is only relative to some other cross-section given as one's point of departure (Isham [1988], pp. 395-400). As Isham emphasizes, quantum models hope to give a *description* of the earliest state of the universe, but do not purport to *explain* it: "Note that the one question which even a very ambitious creation theorist cannot (or, perhaps, should not) address is 'Why is there anything at all?' That is strictly a job for philosophers and theologians!" (Isham [1992], p. 4)

It seems to me, therefore, that even if we concede that it would be unreasonable, all things being equal, to posit divine *creatio ex nihilo* when a plausible, empirical hypothesis for the origin of the universe is available or even likely to become available, Smith has failed to show that (TH) is unreasonable. Moreover, for the theist, it is not the case that all things are equal in this matter, for he has independent reasons (from philosophy and revelation) for accepting *creatio ex nihilo* apart from the scientific evidence. If these reasons are sound, then he would be rational in accepting (TH) even if a plausible, empirical account of the world's origin were available--which at present it most certainly is not--though he might not in such a case have a clue as to the moment of creation.

#### IV. Conclusion

In conclusion, then, I think it is clear that Smith has failed to carry the second prong of his argument, namely, that the universe began to exist without being caused to do so. In his attempt to show that there is no good reason to accept the theistic hypothesis, he misconstrued the causal proposition at issue, appealed to false analogies of *ex nihilo* creation, contradicted himself in holding the singularity to be the source of the universe, failed to show why the origin of the universe *ex nihilo* is reasonable on models adjusted or unadjusted for quantum effects, and, most importantly, trivialized his whole argument through the reduction of causation to predictability in principle, thus making his conclusion an actual entailment of theism. Nor has he been any more successful in proving that the theistic hypothesis is unreasonable in light of the evidence. For he ignores the important epistemological questions concerning the circumstances under which it would be rational to accept divine *creatio ex nihilo*; he has failed to show that vacuum fluctuation models are or are likely to become plausible, empirical explanations of the universe's origin; on the contrary, such models are probably best regarded as naturalistic metaphysical alternatives to the theistic hypothesis, but as such are fraught with conceptual difficulties; and, most importantly, such models, on pain of ontological absurdity, do not in fact support Smith's (ii), so that they do not render unreasonable the hypothesis that God created the universe, including whatever wider spatio-temporal realms of reality might be imagined to exist.

#### Endnotes

{1} See Craig [1979], pp. 65-140; Smith has offered refutations of some of my philosophical arguments against an infinite temporal regress of events in Craig and Smith [1993], pp. 77-91; his objections do not, however, seem decisive, as I try to show in Craig and Smith [1993], pp. 92-107.

{2} Notice that Smith's claim that such events are uncaused is predicated on the very dubious equivalence between "unpredictability in principle" and "uncausedness," an equivalence which I shall criticize in the text. If all that quantum indeterminism amounts to is "uncausedness" in the sense of "unpredictability in principle," then the demonstration that quantum events are uncaused in this sense fails to confute the causal proposition at issue in the first premiss of the *kalam* argument, unpredictability being an epistemic affair which may or may not result from an ontological indeterminism. For clearly, it would be entirely consistent to maintain determinism on the quantum level even if *we* could not, even in principle, predict precisely such events. In this paper, however, I shall not assume some controversial "hidden variables" view, but shall for the sake of argument go beyond Smith and assume that indeterminism does hold on the quantum level. For discussion see Shimony [1978], pp. 3-17; Aspect and Grangier [1986], pp. 1-15; and Bhave [1986], pp. 467-75.

{3} Smith's own view that the universe began to exist at  $t_0$  and that the state of affairs existing at  $t_0$  in 0, 1, or 2 dimensions is the source of the universe contradicts his claim that the universe began to exist

uncaused, for on his view the universe did not come from nothing but is causally connected to the singularity, whose existence remains unexplained. Smith rejects Newton-Smith's demand for a cause of the singularity. Therefore, his argument for (ii) fails.

{4} I cannot refrain from referring again to Anscombe [1973-74], p. 150. As she points out, we can form various pictures in our minds and give them appropriate titles, *e.g.* "Superforce Emerging from the Singularity" or "Gravitons Emerging from the Singularity," but our ability to do that says absolutely nothing about whether it is ontologically possible for something to come into being uncaused out of nothing.

{5} My defense of the causal proposition as an "empirical generalization enjoying the strongest support experience affords" cited by Smith was in its original context a last ditch defense of the principle designed to appeal to the hard-headed empiricist who resists the metaphysical intuition that properly grounds our conviction of the principle (Craig [1979], pp. 141-48). It does seem to me that only an aversion to the theism implied by the principle in the present context would lead the empiricist to think that the denial of the principle is more plausible than the principle itself.

{6} Such a cause would have to be uncaused, eternal, changeless, immaterial, and spaceless; it would, as I have argued elsewhere, also have to be personal and therefore merits the appellation "God" (Craig [1979], pp. 149-53; Craig [1991]).

{7} See, however, Morris [1987], pp. 151-60, for some initial and interesting analysis of these issues.

{8} See also the interesting discussion by Barrow and Tipler [1988], pp. 31-34, in which they explain that since we have no tested theory of quantum gravitation to supersede General Relativity nor any observational evidence for the existence of matter fields which violate the strong or weak energy conditions, the initial cosmological singularity has not been eliminated. In fact, they point out that the finiteness of the action in Friedman models is due to the cosmological singularities. "Thus in general there is a trade-off between space-time singularities: a singularity in the action is avoided only at the price of a singularity in curvature invariants, and *vice versa*. In cosmology some sort of singularity seems inevitable" (pp. 32-33).

{9} See the similar objection urged against the quantum tunneling model of Atkatz and Pagels by M. Munitz, *Cosmic Understanding* (Princeton: Princeton University Press, 1986), p.136, who observes, "For if the actual closed universe arose by a process of quantum tunneling from a prior stable initial state, then the universe in its pre-creation state could not remain indefinitely long in that state, if indeed it is unstable with respect to quantum tunneling." Atkatz and Pagels have admittedly no answer to the question of how the universe got into its pre-creation state. Cf. the analogous reasoning of Davies [1978], p. 336.

{10} See a similar objection urged by Barrow and Tipler [1986], pp. 602-07, who point out that although Gott's model posits a causal structure of the background space consisting of infinitely many non-intersecting, open bubble universes, there must be such a bubble universe in the past light cone of any event  $p$ , given a constant probability of bubble formation in the de Sitter space. Notice that because Gott's bubbles are potentially infinite in their expansion, so long as the bubbles are formed after  $p$  they will not intersect; the walls of each bubble reach spacelike infinity at an infinite time in the future. But since "the volume of an open bubble becomes infinite in an infinite time," then given an infinite past prior to  $p$ , it follows that the past light cone of any  $p$  will already contain an open bubble universe that has already expanded to infinity. So also Isham [1988], p. 387.

{11} See Isham [1992], sec. 5.4.

{12} For more on this see Craig [1990], pp. 473-91.

{13} For discussion, see Misner, Thorne, and Wheeler [1973], pp. 1180-95. Cf. "There is no such thing as spacetime in the real world of quantum physics. . . . superspace leaves us space but not spacetime and therefore not time. With time gone the very ideas of 'before' and 'after' also lose their meaning" (Wheeler [1973], p. 227; see also Wheeler [1980], pp. 346-50 and the therein cited literature.

{14} Isham remarks, "Although these schemes differ in their details they all agree on the idea that space and time emerge in some way from a purely quantum mechanical region which can be described in some respects as if it were a classical, imaginary-time four-space" ([1992], sec. 5.6).

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