Beyond The Big Bang[*]

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THE FUNDAMENTAL QUESTION

From time immemorial men have turned their gaze toward the heavens and *wondered*. Both cosmology and philosophy trace their roots to the wonder felt by the ancient Greeks as they contemplated the cosmos. According to Aristotle,

> it is owing to their wonder that men both now begin and at first began to philosophize; they wondered originally at the obvious difficulties, then advanced little by little and stated difficulties about the greater matters, *e.g*., about the phenomena of the moon and those of the sun and the stars, and about the origin of the universe.[1]

Aristotle himself held that the universe is past eternal but that there must exist a Unmoved Prime Mover, whom he identified as God, as the source of motion or change within the cosmos.

During the Christian era early Church Fathers, despite their reliance on Greek philosophical thought for the enunciation of Christian doctrine, refused to compromise the biblical doctrine of *creatio ex nihilo* out of

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[*]   This is the text of a conference bearing the same title delivered by W.L. Craig on April, 17, 2009 at the Faculty of Divinity of Ankara University.

[1]   *Metaphysics* A. 2. 982^{b}10-15.

deference to the Aristotelian doctrine of the eternity of matter.[2] Because Aristotle had not merely *asserted* but *argued* for the eternity of world, Christian theologians could not rest content with citing biblical proof-texts but engaged Greek thinkers in philosophical discussion of their competing paradigms, seeking to provide arguments on behalf of the past finitude of the world and, hence, of creation. The last great champion of *creatio ex nihilo* prior to the advent of Islam was the Alexandrian Aristotelian commentator John Philoponus (d. 580?), who in his works *Against Aristotle* and *On the Eternity of the World against Proclus* argued for *creatio ex nihilo* on the basis of the impossibility of an infinite temporal regress of events. Following the Muslim conquest of North Africa, the tradition mediated by Philoponus was taken up and subsequently enriched by medieval Muslim and Jewish theologians before being transmitted back again to Christian scholastic theology. The debate over the world's past eternity eventually came to be enshrined during the modern era in the thesis and antithesis of Immanuel Kant's First Antinomy concerning time.

The basic form of the argument, which I have dubbed the *kalam* cosmological argument in recognition of the Muslim contribution to its development, is simple:

1. Whatever begins to exist has a cause.

2. The universe began to exist.

3. Therefore, the universe has a cause.

Conceptual analysis of what it means to be a cause of the universe then aims to establish some of the theologically significant properties of this being.

After suffering several centuries of eclipse, this argument has enjoyed a resurgence of interest in recent decades, doubtlessly spurred by the startling empirical evidence of contemporary astrophysical cosmology for a beginning of space and time. It repays careful examination.

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[2]   On the doctrine of *creatio ex nihilo* see Paul Copan and William Lane Craig, *Creation out of Nothing: A Biblical, Philosophical, and Scientific Exploration* (Grand Rapids, Mich.: Baker Bookhouse, 2004).

WHATEVER BEGINS TO EXIST HAS A CAUSE

Premiss (1) seems obviously true—at the least, more so than its negation. First and foremost, it is rooted in the metaphysical intuition that something cannot come into being from nothing. To suggest that things could just pop into being uncaused out of nothing is to quit doing serious metaphysics and to resort to magic. Second, if things really could come into being uncaused out of nothing, then it becomes inexplicable why just anything and everything do not come into existence uncaused from nothing. Finally, the first premiss is constantly confirmed in our experience. Non-theists who are scientific naturalists thus have the strongest of motivations to accept it.

THE UNIVERSE BEGAN TO EXIST

If we agree that whatever begins to exist has a cause, what evidence is there to support the crucial second step in the argument, that the universe began to exist? We shall examine both deductive, philosophical arguments and inductive, scientific evidence in support of (2).

Philosophical Argument:
The Impossibility of an Actual Infinite

This argument can be formulated in three steps:

4. An actually infinite number of things cannot exist.

5. A beginningless series of events in time entails an actually infinite number of things.

6. Therefore, a beginningless series of events in time cannot exist.

Let us examine each premiss in turn.

An actually infinite number of things cannot exist. Critical to an understanding of the first premiss is the distinction between a potential infinite and an actual infinite. An actual infinite is a collection of definite and discrete members whose number is greater than any natural number 0, 1, 2, 3, ... This sort of infinity is used in set theory to designate sets that have an infinite number of members, such as {0, l, 2, 3, ...}. By contrast, a potential infinite is a collection that is increasing toward infinity as a limit

but never gets there. Such a collection is really indefinite, not infinite. For example, any finite distance can be subdivided into potentially infinitely many parts. One can just keep on dividing parts in half forever, but one will never arrive at an actual "infinitieth" division or come up with an actually infinite number of parts. Now (4) asserts, not that a potentially infinite number of things cannot exist, but that an actually infinite number of things cannot exist.

It is frequently alleged that this sort of argument has been cut off at the knees by the work of the 19th century mathematician Georg Cantor on the actual infinite and by subsequent developments in set theory, which have legitimized the notion of the actual infinite. But this allegation is far too hasty. It not only begs the question against denials of the mathematical legitimacy of the actual infinite on the part of certain mathematicians (so-called Intuitionists), but, more seriously, it begs the question against anti-realist views of mathematical objects.[3] Most anti-realists would not go to the Intuitionistic extreme of denying mathematical legitimacy to the actual infinite. They would simply insist that acceptance of the mathematical legitimacy of certain notions does not imply a commitment to the metaphysical reality of various objects. Cantor's system and set theory may be taken to be simply a universe of discourse, a mathematical system based on certain adopted axioms and conventions. On anti-realist views of mathematical objects such as Fictionalism, Figuralism, or Constructibilism, mathematical discourse is not in any way abridged, but there are, notwithstanding, no mathematical objects at all, let alone an infinite number of them.[4] One may consistently hold that while the actual infinite is a fruitful

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[3]   These are distinct questions, run together by such recent critics of the argument as Jordan Howard Sobel, *Logic and Theism: Arguments for and against Beliefs in God*. Cambridge: Cambridge University Press, 2004), pp. 181-9, 198-9; Graham Oppy, *Philosophical Perspectives on Infinity* (Cambridge: Cambridge University Press, 2006), pp. 291-3.

[4]   See Mark Balaguer, *Platonism and Anti-Platonism in Mathematics* (New York: Oxford University Press, 1998), part II; idem, "A theory of Mathematical Correctness and Mathematical Truth," *Pacific Philosophical Quarterly* 82 (2001): 87-114; *Stanford Encyclopedia of Philosophy*, *s.v.* "Platonism in Metaphysics," by Mark Balaguer (Summer 2004), ed. Edward N. Zalta, http://plato.stanford.edu/archives/sum2004/entries/platonism/; Stephen Yablo, "A Paradox of Existence," in *Empty Names, Fiction, and the Puzzles of Non-Existence*, ed. Anthony Everett and Thomas Hofweber (Stanford: Center for Study of Language and Information, 2000), pp. 275-312; idem, "Go Figure: A Path through Fictionalism," in *Figurative Language*, ed. Peter A. French and Howard K. Wettstein, Midwest Studies in Philosophy 25 (Oxford: Blackwell, 2001), pp. 72-102;

and consistent concept within the postulated universe of discourse, it cannot be transposed into the real world, for this would involve counter-intuitive absurdities.

The best way to support (4) is by way of thought experiments which illustrate the various absurdities that would result if an actual infinite were to be instantiated in the real world. José Benardete, who is especially creative and effective at concocting such thought experiments, puts it well: "Viewed *in abstracto*, there is no logical contradiction involved in any of these enormities; but we have only to confront them *in concreto* for their outrageous absurdity to strike us full in the face."[5]

Let us look at just one example: David Hilbert's famous brainchild "Hilbert's Hotel."[6] As a warm-up, let us first imagine a hotel with a finite number of rooms. Suppose, furthermore, that all the rooms are occupied. When a new guest arrives asking for a room, the proprietor apologizes, "Sorry, all the rooms are full," and that is the end of the story. But now let us imagine a hotel with an infinite number of rooms and suppose once more that *all the rooms are occupied.* There is not a single vacant room throughout the entire infinite hotel. Now suppose a new guest shows up, asking for a room. "But of course!" says the proprietor, and he immediately shifts the person in room #1 into room #2, the person in room #2 into room #3, the person in room #3 into room #4, and so on, out to infinity. As a result of these room changes, room #1 now becomes vacant, and the new guest gratefully checks in. But remember, before he arrived, all the rooms were occupied! Equally curious, there are now no more persons in the hotel than there were before: the number is just infinite. But how can this be? The proprietor just added the new guest's name to the register and gave him his keys--how can there not be one more person in the hotel than before?

But the situation becomes even stranger. For suppose an infinity of new guests show up at the desk, asking for a room. "Of course, of course!" says the proprietor, and he proceeds to shift the person in room #1 into room #2,

Charles S. Chihara, *Constructibility and Mathematical Existence* (Oxford: Clarendon Press, 1990); idem, *A Structural Account of Mathematics* (Oxford: Clarendon Press, 2004).

[5] José A. Benardete, *Infinity: An Essay in Metaphysics* (Oxford: Clarendon Press, 1964), p. 238. See esp. what he calls paradoxes of the serrated continuum (pp. 236-237).

[6] The story of Hilbert's Hotel is related in George Gamow, *One, Two, Three, Infinity* (London: Macmillan, 1946), p. 17.

the person in room #2 into room #4, the person in room #3 into room #6, and so on out to infinity, always putting each former occupant into the room number twice his own. Because any natural number multiplied by two always equals an even number, all the guests wind up in even-numbered rooms. As a result, all the odd-numbered rooms become vacant, and the infinity of new guests is easily accommodated. And yet, before they came, all the rooms were occupied! And again, strangely enough, the number of guests in the hotel is the same after the infinity of new guests check in as before, even though there were as many new guests as old guests. In fact, the proprietor could repeat this process *infinitely many times* and yet there would never be a single person more in the hotel than before.

But Hilbert's Hotel is even stranger than the German mathematician made it out to be. For suppose some of the guests start to check out. Suppose the guest in room #1 departs. Is there not now one fewer person in the hotel? Not according to transfinite arithmetic! Suppose the guests in rooms # 1, 3, 5 ... check out. In this case an infinite number of people has left the hotel, but there are no fewer people in the hotel. In fact, we could have every other guest check out of the hotel and repeat this process infinitely many times, and yet there would never be any fewer people in the hotel. Now suppose the proprietor does not like having a half-empty hotel (it looks bad for business). No matter! By shifting guests in even-numbered rooms into rooms with numbers half their respective room numbers, he transforms his half-vacant hotel into one that is completely full.

One might think that by means of these maneuvers the proprietor could always keep this strange hotel fully occupied. But one would be wrong. For suppose that the persons in rooms # 4, 5, 6 ... checked out. At a single stroke the hotel would be virtually emptied, the guest register reduced to three names, and the infinite converted to finitude. And yet it would remain true that as many guests checked out this time as when the guests in rooms # 1, 3, 5 ... checked out! Can anyone believe that such a hotel could exist in reality?

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

What can the argument's critic say at this point? He has little choice but to try, in Graham Oppy's words, to "outsmart" the proponent of the

argument by embracing the conclusion of his *reductio ad absurdum* argument: Hilbert's Hotel is possible after all.[7] The obvious drawback of the outsmarting strategy is that it could used to legitimize any conclusion, no matter how absurd, so long as one has the temerity to embrace it. What we want is some sort of *reason* to think that such a hotel is really possible. Here Oppy has no more to say than "these allegedly absurd situations are just what one ought to expect if there were . . . physical infinities."[8] This response only reiterates, in effect, that if an actual infinite were to exist, then the relevant situations would result, which is not in dispute. The problem cases would, after all, not be problematic if the alleged consequences would not ensue! Rather the question is whether these consequences really are absurd.

All parties agree that if an actually infinite number of things were to exist, then we should find ourselves landed in an Alice in Wonderland world populated with oddities like Hilbert's Hotel. Merely reiterating that "If there were physical infinities, these situations are just what we ought to expect" does nothing to allay one's suspicions that such a world is metaphysically absurd. Moreover, Oppy says nothing about what would happen in cases of inverse operations like subtraction with infinite quantities, as when an infinite number of guests check out of the hotel. In transfinite arithmetic, inverse operations of subtraction and division are prohibited because they lead to contradictions; but in reality, one cannot stop people from checking out of the hotel if they so desire!

A beginningless series of events in time entails an actually infinite number of things. This premiss is pretty obvious. If the universe never began to exist, then prior to the present event there have existed an actually infinite number of previous events. Thus, a beginningless series of events in time entails an actually infinite number of things, namely, events.

Therefore, a beginningless series of events in time cannot exist. If the above two premises are true, then the conclusion follows logically. The series of past events must be finite and have a beginning. Since the universe is not distinct from the series of events, the universe therefore began to exist.

[7]   Oppy, *Philosophical Perspectives on Infinity*, p. 48; cf. John L. Mackie, *The Miracle of Theism* (Oxford: Clarendon Press, 1982), p. 93; Sobel, *Logic and Theism*, pp. 186-7.
[8]   Oppy, *Philosophical Perspectives on Infinity*, p. 48

Scientific Evidence:

The Expansion of the Universe

I now turn to an examination of remarkable scientific confirmation of the conclusion already reached by philosophical argument alone. The physical evidence for the beginning of the universe comes from what is undoubtedly one of the most exciting and rapidly developing fields of science today: astronomy and astrophysics. Prior to the 1920s, scientists had always assumed that the universe was stationary and eternal. Tremors of the impending earthquake that would topple this traditional cosmology were first felt in 1917, when Albert Einstein made a cosmological application of his newly discovered gravitational theory, the General Theory of Relativity. To his chagrin, Einstein found that his theory would not permit an eternal, static model of the universe unless he fudged the equations in order to offset the gravitational effect of matter. As a result Einstein's universe was balanced on a razor's edge, and the least perturbation—even the transport of matter from one part of the universe to another—would cause the universe either to implode or to expand. By taking this feature of Einstein's model seriously, the Russian mathematician Alexander Friedman and the Belgian astronomer Georges Lemaître were able to formulate independently in the 1920s solutions to his equations which predicted an expanding universe.

In 1929 the American astronomer Edwin Hubble showed that the light from distant galaxies is systematically shifted toward the red end of the spectrum. This red-shift was taken to be a Doppler effect indicating that the light sources were receding in the line of sight. Incredibly, what Hubble had discovered was the expansion of the universe predicted by Friedman and Lemaître on the basis of Einstein's General Theory. It was a veritable turning point in the history of science. "Of all the great predictions that science has ever made over the centuries," exclaims John Wheeler, "was there ever one greater than this, to predict, and predict correctly, and predict against all expectation a phenomenon so fantastic as the expansion of the universe?" [9]

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[9]   John A. Wheeler, "Beyond the Hole," in *Some Strangeness in the Proportion,* ed. Harry Woolf (Reading, Mass.: Addison-Wesley, 1980), p. 354.

According to the Friedman-Lemaître model, as time proceeds, the distances separating the galaxies become greater. It is important to appreciate that as a model based on the General Theory of Relativity, the model does not describe the expansion of the material content of the universe into a pre-existing, empty space, but rather the expansion of space itself. The galaxies are conceived to be at rest with respect to space but to recede progressively from one another as space itself expands or stretches, just as buttons glued to the surface of a balloon will recede from one another as the balloon inflates. This has the astonishing implication that as one reverses the expansion and extrapolates back in time, the universe becomes progressively denser until one arrives at a state of infinite density at some point in the finite past. This state represents a singularity at which space-time curvature, along with temperature, pressure, and density, becomes infinite. It therefore constitutes an edge or boundary to space-time itself. The term "Big Bang," originally a derisive expression coined by Fred Hoyle to characterize the beginning of the universe predicted by the Friedman-Lemaître model, is thus potentially misleading, since the expansion cannot be visualized from the outside (there being no "outside," just as there is no "before" with respect to the Big Bang).

The standard Big Bang model, as the Friedman-Lemaître model came to be called, thus describes a universe which is not eternal in the past, but which came into being a finite time ago. Moreover, —and this deserves underscoring—the origin it posits is an absolute origin out of nothing. For not only all matter and energy, but space and time themselves come into being at the initial cosmological singularity. As physicists John Barrow and Frank Tipler emphasize, "At this singularity, space and time came into existence; literally nothing existed before the singularity, so, if the Universe originated at such a singularity, we would truly have a creation *ex nihilo*."[10] On such a model the universe originates *ex nihilo* in the sense that at the initial singularity it is true that *There is no earlier space-time point* or it is false that *Something existed prior to the singularity*.

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[10] John Barrow and Frank Tipler, *The Anthropic Cosmological Principle* (Oxford: Clarendon Press, 1986), p. 442.

Now such a conclusion is profoundly disturbing for anyone who ponders it. For the question cannot be suppressed: *Why did the universe come into being?* Sir Arthur Eddington, contemplating the beginning of the universe, finally felt forced to conclude, "The beginning seems to present insuperable difficulties unless we agree to look on it as frankly supernatural."[11] The problem of the origin of the universe, in the words of one astrophysical team, thus "involves a certain metaphysical aspect which may be either appealing or revolting."[12]

Revolted by the stark metaphysical alternatives presented by an absolute beginning of the universe, certain theorists have been understandably eager to subvert the standard model and restore an eternal universe. To date no such attempt has been successful. Models of continuous creation, classical models of oscillatory universes, and vacuum fluctuation models have all come and gone. Today if the standard model's prediction of an absolute beginning of the universe is to be averted, the escape will have to come through either of two ongoing research programs in cosmogony, namely, eternal inflation or quantum gravity.

In 1994, however, Arvind Borde and Alexander Vilenkin showed that any spacetime eternally inflating toward the future cannot be "geodesically complete" in the past, that is to say, there must have existed at some point in the indefinite past an initial singularity. Hence, the inflationary scenario cannot be past eternal. In 2003 Borde and Vilenkin in co-operation with Alan Guth were able to strengthen their conclusion by crafting a new theorem independent of the assumption of the so-called "weak energy condition," which partisans of past-eternal inflation might have denied in an effort to save their theory.[13] The new theorem, in Vilenkin's words, "appears to close that door completely."[14] Their new theorem has only one assumption: that the universe has, on average, been in a state of cosmic

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[11] Ibid., p. 178.
[12] Hubert Reeves, Jean Audouze, William A. Fowler, and David N. Schramm, "On the Origin of Light Elements," *Astrophysical Journal* 179 (1973): 912.
[13] Arvind Borde, Alan Guth, and Alexander Vilenkin, "Inflation Is Not Past-Eternal," http://arXiv:gr-qc/0110012v1 (1 Oct 2001): 4. The article was updated in January 2003.
[14] Alexander Vilenkin, "Quantum Cosmology and Eternal Inflation," http://arXiv:gr-qc/0204061v1 (18 April 2002): 10.

expansion throughout its history. Any universe which meets this condition cannot be extrapolated into the infinite past.

With the formulation of their stronger theorem Borde, Guth, and Vilenkin were able to generalize their earlier results on inflationary models in such a way to extend their conclusion to other models. Indeed, the new theorem implies that any universe which has on average been globally expanding at a positive rate is geodesically incomplete in the past and therefore has a past boundary. Specifically, they note, "Our argument can be straightforwardly extended to cosmology in higher dimensions," specifically so-called brane-cosmology.[15] According to Vilenkin, "It follows from our theorem that the cyclic universe is past-incomplete,"[16] that is to say, the need for an initial singularity has not been eliminated.

Previously, theorists intent on avoiding the absolute beginning of the universe could always take refuge in the period prior to the Planck time, an era so poorly understood that one commentator has compared it with the regions on the maps of ancient cartographers marked "Here there be dragons!"—it can be filled with all sorts of chimaeras. But the Borde-Guth-Vilenkin theorem does not depend upon any particular physical description of the universe prior to the Planck time, being based instead on deceptively simple physical reasoning which will hold regardless of our uncertainty concerning that era. Vilenkin pulls no punches: "It is said that an argument is what convinces reasonable men and a proof is what it takes to convince even an unreasonable man. With the proof now in place, cosmologists can no longer hide behind the possibility of a past-eternal universe. There is no escape, they have to face the problem of a cosmic beginning."[17]

The Borde-Guth-Vilenkin theorem is now widely accepted by cosmologists. As a result, theorists who would avert the beginning of the universe are forced to deny the single assumption of that theorem: that the universe's history has been one of cosmic expansion. This has led to speculative models of the universe involving such conjectures as infinite

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[15] Borde, Guth, and Vilenkin, "Inflation Is Not Past-Eternal," p. 4. See also Alexander Vilenkin, "Quantum cosmology and eternal inflation," in *The Future of Theoretical Physics and Cosmology*, Proceedings of the conference in honor of Stephen Hawking's 60th birthday (2002), preprint: http://arxiv.org/abs/gr-qc/0204061, p. 11.

[16] Alexander Vilenkin, personal communication.

[17] Vilenkin, *Many Worlds in One,* p. 176.

contraction from eternity past prior to the Big Bang, or a static state existing at infinity past from which our universe emerged, or an infinite series of oscillations prior to our observed expansion, or even the deconstruction of time itself. All of these conjectures encounter seemingly insurmountable difficulties, both observationally and theoretically.[18] Hence, to date no plausible theory has managed to avert the beginning predicted by the standard model.

Of course, in view of the metaphysical issues raised by the prospect of a beginning of the universe, we may be confident that the quest to avert the absolute beginning predicted by the standard model will continue unabated. Such efforts are to be encouraged, and we have no reason to think that such attempts at falsification of the prediction of the standard model will result in anything other than further corroboration of its prediction of a beginning. While scientific evidence is always provisional, there can be little doubt in this case where the evidence points.

THE CAUSE OF THE UNIVERSE

On the basis of our arguments for the finitude of the past, we have good grounds for affirming the second premiss of our original argument, that *the universe began to exist*. From the first premiss—that *whatever begins to exist has a cause*—and the second premiss, it follows logically that *the universe has a cause*. This conclusion is staggering, for it means that the universe was brought into existence by *something* which is greater than and beyond it.

Conceptual analysis enables us to recover a number of striking properties which must be possessed by such an ultra-mundane being. For as the cause of space and time, this entity must transcend space and time and therefore exist atemporally and non-spatially (at least without the universe).[19] This transcendent cause must therefore be changeless and

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18   See discussion in William Lane Craig and James Sinclair, "The *Kalam* Cosmological Argument," in *Blackwell Companion to Natural Theology*, ed. Wm. L. Craig and J. P. Moreland (Oxford: Blackwell, 2009).

19   Or, alternatively, the cause exists changelessly in an undifferentiated time in which temporal intervals cannot be distinguished. On this view God existed literally before creation but there was no moment, say, one hour or one million years before creation.

immaterial, since timelessness entails changelessness, and changelessness implies immateriality. Such a cause must be beginningless and uncaused, at least in the sense of lacking any antecedent causal conditions, since there cannot be an infinite regress of causes. Ockham's Razor (the principle which states that we should not multiply causes beyond necessity) will shave away further causes. This entity must be unimaginably powerful, since it created the universe without any material cause.

Finally, and most remarkably, such a transcendent cause is plausibly to be taken to be personal. The personhood of the cause of the universe is implied by its timelessness and immateriality. The only entities we know of which can possess such properties are either minds or abstract objects, like numbers. But abstract objects do not stand in causal relations. Indeed, their acausal nature is definitive for abstract objects; that is why we call them abstract.[20] Numbers, for example, cannot cause anything. Therefore, the transcendent cause of the origin of the universe must be an unembodied, personal mind. And this, as Thomas Aquinas was wont to remark, is what everybody means by "God."

Now some thinkers have objected to the picture I have painted of a timeless, personal deity, for such a being lacks all inter-personal relationships, and such relationships, they believe, are essential to personhood. If God is to be personal, He must be engaged in relationships with other persons. But the give-and-take of personal relationships inherently involves temporality.

The assumption underlying this objection is that the persons to whom God is related must be *human* persons. But on the Christian conception of God, at least, that assumption is false. Within the fullness of the divine being itself, the persons of the Father, the Son, and the Holy Spirit enjoy the inter-personal relations afforded by the Trinity which God is. As a Trinity, God is eternally complete with no need of fellowship with finite persons. It is a marvel of God's grace and love that He would freely create finite persons and invite them to share in the love and joy of the inner Trinitarian life of God.

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[20]   See discussion in Copan and Craig, *Creation out of Nothing*, pp. 168-70.

But would the existence of these Trinitarian inter-relationships necessitate that God be temporal? I see no reason to think that the persons of the Trinity could not be affected, prompted, or responsive to one another in an unchanging and, hence, timeless way. To use a mundane example, think of iron filings clinging to a magnet. The magnet and the filings need not change their positions in any way in order for it to be the case that the filings are stuck to the magnet because the magnet is affecting them and they are responding to the magnet's force. The example illustrates how on a macroscopic level action and response can be simultaneous and, hence, involve neither change nor temporal separation. How much more is this so when we consider the relationship between the members of the Trinity! Since intra-Trinitarian relations are not based on physical influences or rooted in any material substratum but are purely mental, the response of the Son to the Father's love implies neither change nor temporal separation. Just as we speak metaphorically of two lovers who sit, not speaking a word, gazing into each other's eyes as "lost in that timeless moment," so we may speak literally of the timeless mutual love of the Father, Son, and Spirit for one another.

The ancient doctrine of *perichoreisis,* championed by the Cappadocian Church Father Gregory of Nazianzus, illuminates the timeless interaction of the persons of the Godhead. According to that doctrine, there is a complete interpenetration of the persons of the Trinity, such that each is intimately bound up in the activities of the other. Thus, what the Father wills, the Son and Spirit also will; what the Son loves, the Father and Spirit also love, and so forth. Each person is completely transparent to the others. There is nothing new that the Son, for example, might communicate to the Spirit, since that has already been communicated. There exists a full and perfect exchange of the divine love and knowledge, so that nothing is left undone which needs to be completed. In this perfect inter-penetration of divine love and life, no change need occur, so that God existing alone in the self-sufficiency of His being would, on a relational view of time, be timeless. Thus, I think it is evident that God can enjoy inter-personal relations and yet be timeless.

On the basis of a conceptual analysis of the conclusion implied by our argument, we may therefore infer that a personal Creator of the universe exists, who is uncaused, beginningless, changeless, immaterial, timeless, spaceless, and unimaginably powerful.