Cosmology – A Religion for Atheists?

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SUMMARY

In the award-winning film, "The Theory of Everything" a young Stephen Hawking introduces himself to his wife-to-be Jane as a student of cosmology. When she asks what that is, he replies, "It's a kind of religion for intelligent atheists." In this article Dr. Craig examines critically that claim as it unfolds in the movie.

COSMOLOGY – A RELIGION FOR ATHEISTS?

In the award-winning movie *A Theory of Everything* Stephen Hawking introduces himself to his wife-to-be Jane by describing himself as a cosmologist. When Jane asks what that is, he replies "it's a kind of religion for intelligent atheists."

The remark is both provocative and revealing. Cosmology is obviously not literally a religion. It is a branch of astrophysics which studies the large-scale structure of the universe. Now if one is a naturalist, that is to say, someone who believes that all that exists is spacetime and its contents, then in a sense someone who studies the universe is studying the ultimate reality. This is the same project in which the theologian is engaged, except that for the theologian the ultimate reality is God, not the universe. The theologian has a wider, more encompassing view of reality than the naturalist, for he believes in a reality which transcends the universe. The universe is a subordinate reality which is created by God. For cosmologists who are theists—such as George Ellis, perhaps the world's greatest living cosmologist, who is also portrayed in this movie—cosmology is therefore not a kind of religion, but the scientific study of a subordinate reality. But for the naturalist, it's easy to see how cosmology could become quasi-religious.

Now cosmology is divided into two sub-disciplines, which once again both have intriguing parallels in theology. The first sub-discipline is *cosmogony*, which is the study of the universe's origin. Parallel to this is the theological *locus* or category or doctrine of creation, particularly *creatio originans*, or originating creation. Christian theology holds that God created the universe from nothing a finite time ago. Therefore the universe is not eternal in the past but had a beginning.

The second sub-discipline of cosmology is *eschatology*, which is the study of the future fate of the universe. Those of you who are familiar with theology will immediately recognize that this term is actually *borrowed* from theology. For the theological *locus* or doctrine of the last things is called eschatology. Once again, theological eschatology has a wider scope than physical eschatology.

For while physical eschatology studies the future fate of the universe, given present conditions and the laws of nature, theological eschatology also comprises broader themes, such as the state of the soul after death, the resurrection, the new heavens and the new earth, and heaven and hell. Once again, we can see how the naturalistic cosmologist studying cosmogony and physical eschatology might think of himself as engaged in a sort of religious pursuit.

While physical eschatology makes a brief appearance in the movie *A Theory of Everything,* it is cosmogony that dominates. The film focuses on two cosmogonic theories which Hawking has defended, the first being the standard Big Bang model based entirely on the General Theory of Relativity and the second being the so-called "no boundary" proposal which Hawking developed in collaboration with James Hartle of the University of California, Santa Barbara, based on the incorporation of quantum physics into the standard model to yield a quantum theory of gravity. The film explores the alleged theological implications of these two theories.

So that we might better understand these alleged implications, let me say a bit about these two approaches to cosmogony. First, the standard general relativistic model. 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 (GR). To his chagrin, Einstein found that GR would not permit an eternal, static model of the universe unless he fudged the equations in order to offset the gravitational effect of matter. During the 1920s the Russian mathematician Alexander Friedman and the Belgian astronomer Georges LeMaître decided to take Einstein's equations at face value, and as a result they came up independently with models of an expanding universe.

In 1929 the American astronomer Edwin Hubble, through tireless observations at Mt. Wilson Observatory, made a startling discovery which verified Friedman and LeMaître's theory. He found that the light from distant galaxies appeared to be redder than expected. This "red shift" in the light was most plausibly due to the stretching of the light waves as the galaxies are moving away from us. Wherever Hubble trained his telescope in the night sky, he observed this same red-shift in the light from the galaxies. It appeared that we are at the center of a cosmic explosion, and all of the other galaxies are flying away from us at fantastic speeds!

Now according to the Friedman-LeMaître model, we are not *really* at the center of the universe. Rather an observer in *any* galaxy will look out and see the other galaxies moving away from him.

This is because, according to the theory, it is really space itself which is expanding. The galaxies are actually at rest in space, but they recede from one another as space itself expands.

The Friedman-LeMaître model eventually came to be known as the Big Bang theory. But that name can be misleading. Thinking of the expansion of the universe as a sort of explosion could mislead us into thinking that the galaxies are moving out into a pre-existing, empty space from a central point. That would be a complete misunderstanding of the model. The theory is much more radical than that.

As you trace the expansion of space back in time, everything gets closer and closer together. Eventually the distance between any two points in space becomes zero. You can't get any closer than that! So at that point you've reached the boundary of space and time. Space and time cannot be extended any further back than that. It is literally the beginning of space and time.

To get a picture of this we can portray our three-dimensional space as a two-dimensional disk which shrinks as you go back in time (Fig. 1).

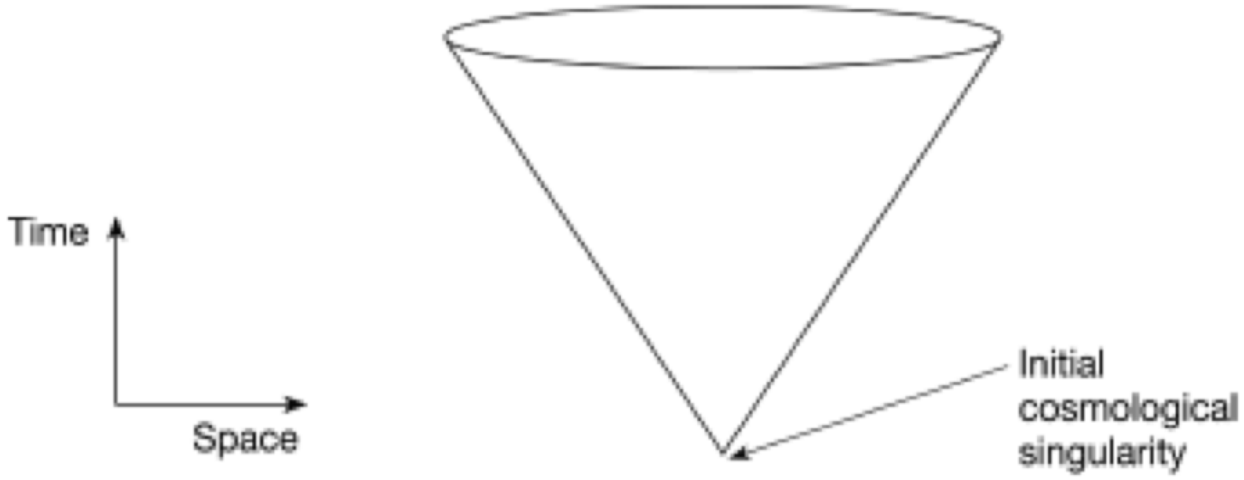

Fig. 1. Geometrical representation of space-time. The two-dimensional disc represents our three-dimensional space. The vertical dimension represents time. As one goes back in time, space shrinks until the distance between any two points is zero. Space-time thus has the geometry of a cone. The point of the cone is the boundary of space and time.

Eventually, the distance between any two points in space becomes zero. So space-time can be represented geometrically as a cone. What's significant about this is that while a cone can be

extended indefinitely in one direction, it has a boundary point in the other direction. Because this direction represents time and the boundary point lies in the past, the model implies that past time is finite and had a beginning.

Because space-time is the arena in which all matter and energy exist, the beginning of space-time is also the beginning of all matter and energy. It's the beginning of the universe.

Notice that there's simply nothing prior to the initial boundary of space-time. Let's not, however, be misled by words. When cosmologists say, "There is nothing prior to the initial boundary," they do *not* mean that there is some state of affairs prior to it, and that is a state of nothingness. That would be to treat nothing as though it were something! Rather they mean that at the boundary point, it is false that "There is something prior to this point."

The standard Big Bang model thus predicts an absolute beginning of the universe. In the movie the standard model is described in the following exchange between Hawking and Jane:

Stephen: . . . if Einstein is right, if General Relativity is correct, then the universe is expanding, yes?

Jane: Yes.

Stephen: So, if you reverse time, the universe would get smaller.

Jane: All right…

Stephen: So, what if I reverse the process all the way back to see what happened at the beginning of Time itself?

Jane: The beginning of time itself?

Stephen: The universe, getting smaller and smaller, denser and denser, hotter and hotter as…

Jane: …as we wind back the clock?

. . .

Stephen: . . . Keep winding! You've got to get back to the beginning of time... Keep winding... until you get -. . . . A spacetime singularity.

The standard model thus predicted an initial singularity. There were, however, suspicions that, since the real universe is not perfectly similar to Friedmann and Lemaître's ideal model, their prediction of a singular beginning to the universe would ultimately fail. Perhaps the distribution of

matter and energy in the real universe is not homogenous enough for the universe to shrink down to a singularity. In 1970, however, Hawking in collaboration with Roger Penrose proved that the assumption of ideal homogeneity was irrelevant. The Hawking-Penrose singularity theorems showed that so long as the universe is governed by GR, our past must include an initial singularity.

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, opined that the expansion of the universe was so preposterous and incredible that "I feel almost an indignation that anyone should believe in it — except myself." [1] He finally felt forced to conclude, "The beginning seems to present insuperable difficulties unless we agree to look on it as frankly supernatural." [2]

In a scene deleted from the final cut of the movie, Jane and Hawking reflect on the implications of the Hawking-Penrose singularity theorems:

Jane: Isn't it amazing? This is poetry…

Stephen: Well, it's black hole theory.

Jane: …Time began, at a certain point… there was a *moment* of Creation…

Stephen: ….yes…

Jane: …This is God's work!

Stephen: I think you'll find that the equations are mine… but… good point!

The standard Big Bang model thus predicts an absolute beginning of the universe. If this model is correct, then we have amazing scientific confirmation of the theological doctrine of creation out of nothing.

So is the standard model correct, or, more importantly, is it correct in predicting a beginning of the universe? Despite its empirical confirmation, the standard Big Bang model will need to be modified in various ways. The model is based, as we've seen, on Einstein's General Theory of Relativity. But Einstein's theory breaks down when space is shrunk down to sub-atomic proportions. We'll need to introduce quantum physics at that point, and no one is sure how this is to be done.

The second cosmogonic model mentioned in the film is just such an attempt to marry quantum physics to General Relativity to craft a quantum theory of gravity that will enable us to describe the

early universe. The so-called “no boundary” proposal developed by Stephen Hawking in collaboration with James Hartle (who, oddly enough, is never mentioned in the film) is known as the Hartle-Hawking model.

The Hartle-Hawking model eliminates the initial singularity by transforming the conical geometry of classical space-time into a smooth, curved geometry having no edge, so that spacetime resembles a badminton shuttlecock (Fig. 2).

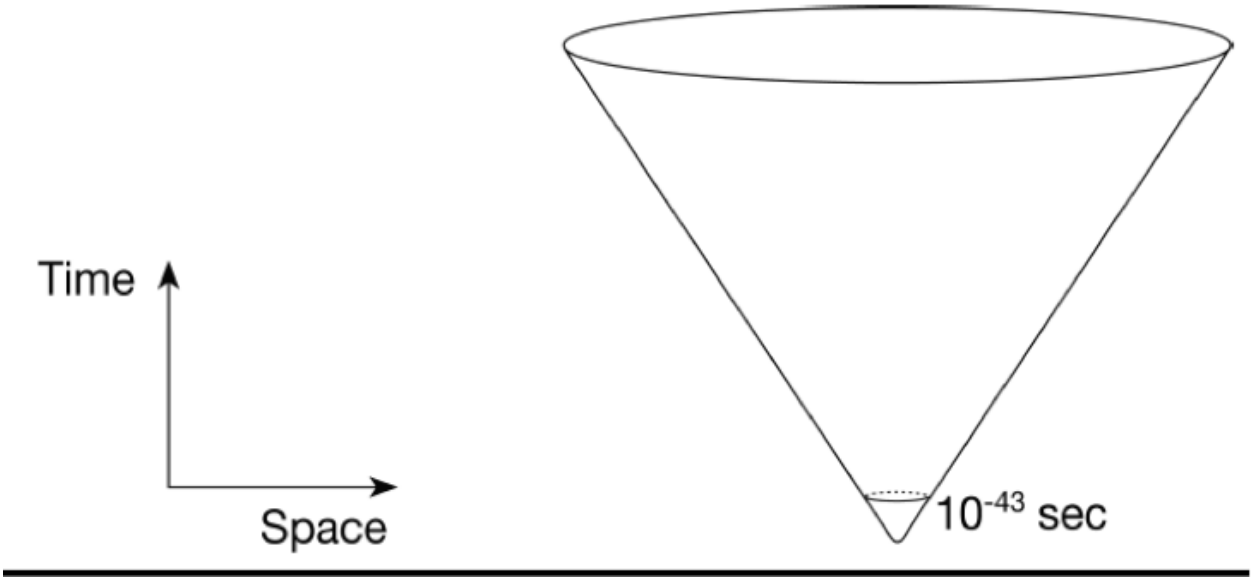

Fig. 2: Quantum Gravity Model. In the Hartle-Hawking version, space-time is “rounded off” prior to the Planck time, so that although the past is finite, there is no edge or boundary point.

This is accomplished by the introduction of imaginary numbers like Ö-1 for the time variable in Einstein’s gravitational equations, which effectively eliminates the singularity. The laws of physics thus do not break down at any point, allowing complete description of spacetime.

In his best-selling popularization of his theory, *A Brief History of Time*, Hawking reveals an explicitly theological concern. He concedes that on the Standard Model one could legitimately identify the Big Bang singularity as the instant at which God created the universe. [3] Indeed, he thinks that a number of attempts to avoid the Big Bang were probably motivated by the feeling that a beginning of time “smacks of divine intervention.” [4] He sees his new model as preferable to the Standard Model because there would be no edge of space-time at which one “would have to appeal to God or some new law.” [5] Hawking sees profound theological implications in the new

model:

> The idea that space and time may form a closed surface without boundary . . . has profound implications for the role of God in the affairs of the universe . . . . So long as the universe had a beginning, we could suppose it had a creator. But if the universe is really completely self-contained, having no boundary or edge, it would have neither beginning nor end. What place, then, for a creator? [6]

Hawking does not deny the existence of God, but he does think his model eliminates the need for a Creator of the universe.

In the movie the theological implications of the Hartle-Hawking model are raised in a conversation between Jane, Stephen, and their friend Jonathan:

Jane: Stephen's done a U-turn. The big new idea is that the universe has no boundaries at all. No boundaries… no beginning…

Jonathan: … And no God… Oh… Oh I see, I *(laughs awkwardly)* I thought that, um, you'd proved the universe had a beginning and thus a need for a creator? My mistake.

Stephen: No… mine.

Jane: Stephen is looking for a single theory that explains all the forces in the universe. Therefore, God must die.

Jonathan: Er… why must God die? I don't see.

Jane: The two great pillars of physics are Quantum Theory – the laws that govern the very small -- electrons, particles and so on - and General Relativity…

Jonathan: …Ah, yes, Einstein!

Jane: …Einstein's theory – the laws that govern the very large -- planets and such. But, Quantum and Relativity…

Jonathan: …don't tell me… they're different!

Jane: … They don't remotely play by the same rules. If the world were all potatoes then, easy, you can trace a precise beginning, as Stephen once did. A moment of creation… Hallelujah, God lives. But if you incorporate peas into the menu then, then it all goes a little…Haywire. This all becomes a godless mess.

Jonathan: Oh dear.

Jane: God is back on the Endangered Species list.

Jonathan: *(laughs)* Well, I expect he'll cope.

As Jonathan rightly discerned, the theological implications which Hawking seeks to draw from his model are highly suspect. There is no reason at all why God could not have created a universe described by the Hartle-Hawking model. When I spoke with James Hartle in his office at UCSB, he saw absolutely no theological implications in the model.

Indeed, by positing a finite (imaginary) time on a closed surface prior the Planck time rather than an infinite time on an open surface, such a model actually seems to support, rather than undercut, the fact that time and the universe had a beginning. Such a theory, if successful, would enable us to model the beginning of the universe without an initial singularity involving infinite density, temperature, pressure, and so on. But as physicist John Barrow of Cambridge University points out, "This type of quantum universe has not always existed; it comes into being just as the classical cosmologies could, but it does not start at a Big Bang where physical quantities are infinite . . ." [7] Barrow points out that such models are "often described as giving a picture of 'creation out of nothing'," the only caveat being that in this case "there is no definite . . . point of creation." [8]

Hawking's crucial misstep is his assumption that having a beginning entails having a beginning point. Ancient Greek paradoxes about starting and stopping have long since taught us otherwise. Imagine that a cannonball has a last instant at which it is at rest before being fired from the gun. In such a case there is no point at which the cannonball first begins to move. For at any point after its final instant of rest, there will be prior instant at which it was already in motion, *ad infinitum*. Yet no one would say that the cannonball does not have a finite trajectory and a cause of its beginning to move.

Having a beginning does not imply having a beginning point. Time begins to exist just in case for any finite temporal interval you chose, there are only a finite number of equal temporal intervals earlier than it. That condition is fulfilled for the Hartle-Hawking model as well as for the Standard Model.

Moreover, it is far from clear that on any realistic interpretation of the Hartle-Hawking model, it does not in fact have a beginning point. By using the mathematical artifice of imaginary time,

Hawking is able to re-describe the universe in such a way that it has no initial singularity. Hawking admits, “Only if we could picture the universe in terms of imaginary time would there be no singularities. . . . When one goes back to the real time in which we live, however, there will still appear to be singularities.” [9] Hawking’s model is thus a way of re-describing a universe with a singular beginning point in such a way that that singularity is transformed away; but it is the same universe with a beginning that is being described. Thus, Quantum Gravity models, like the Standard Model, imply the beginning of the universe.

In his later book *The Grand Design*, co-authored with Leonard Mlodinow, Hawking himself seems to endorse this interpretation of his model. They write,

> Suppose the beginning of the universe was like the South Pole of the earth, with degrees of latitude playing the role of time. As one moves north, the circles of constant latitude, representing the size of the universe, would expand. The universe would start as a point at the South Pole, but the South Pole is much like any other point. To ask what happened before the beginning of the universe would become a meaningless question, because there is nothing south of the South Pole. In this picture space-time has no boundary—the same laws of nature hold at the South Pole as in other places (pp. 134-5).

This passage is fascinating because it represents a rather different interpretation of the model than what we had in *A Brief History of Time*.

Let me explain. In his model Hawking employs imaginary numbers (like Ö-1) for the time variable in his equations in order to get rid of the initial cosmological singularity, which is the boundary of spacetime in the standard big bang model. The initial segment of spacetime, instead of terminating in a point (like a cone), is “rounded off” (like a badminton shuttlecock). The “South Pole” of this rounded off surface is like any other point on that surface (hence, the idea that there is “no boundary”). Since “imaginary time” behaves like a dimension of space, Hawking interpreted his “no-boundary” universe to “just BE.”

But in *The Grand Design* the South Pole is interpreted to represent the beginning point to both time and the universe. Hawking allows the circles of latitude to play the role of time, which has a beginning point at the South Pole. When Hawking speaks of “the problem of time having a beginning,” what he means is “the age-old objection to the universe having a beginning” (p. 135), an objection which his model removes. So what is that age-old objection? That objection, he says,

is the question, “What happened before the beginning of the universe?” Hawking is right that this question is meaningless on his model; but what he fails to mention is that the question is equally meaningless on the standard big bang model, since there *is* nothing prior to the initial cosmological singularity. Or either model the universe has an absolute temporal beginning, so that it is meaningless to ask what happened before.

Rather the *real* question is, why did the universe begin to exist? The Hartle-Hawking model doesn’t address that question. How could it? Physics only begins at the “South Pole” in the no boundary model. There is no physics of non-being. Moreover, there isn’t anything in the model that implies that that point came to be without a cause. Indeed, the idea that being could arise without a cause from non-being seems metaphysically absurd.

Thus, both the standard model and the Hartle-Hawking quantum gravity model are united in predicting the finitude of the past and the beginning of the universe, and Hawking’s inferences about the theological implications of the model are based on philosophical mistakes. It is sad that so gifted a scientist should have been misled by such philosophical missteps. Both models are thus perfectly in accord with the Judaeo-Christian doctrine of creation out of nothing.

I mentioned that physical eschatology makes scant appearance in the film *A Theory of Everything*. It comes only in the penultimate, poignant scene of the movie. Hawking is asked, “You have said that you do not believe in God. Do you have a philosophy of life that helps you?” He answers by appealing to the religion of cosmology:

> It is clear that we are just an advanced breed of primates on a minor planet, orbiting around a very average star, in the outer suburb of one among a hundred billion galaxies. But, ever since the dawn of civilization, people have craved for an understanding of the underlying order of the world. There ought to be something very special about the boundary conditions of the universe. But what can be more special than that there is no boundary? And there should be no boundary to human endeavor. We are all different. However bad life may seem, there is always something you can do and succeed at. While there is life, there is hope.

Yes, applause for this remarkable man’s courage and perseverance in the face of almost impossible obstacles. But even if it were true that while there is life, there is hope, the lesson of physical eschatology is that, absent God, there will someday be no life and, hence, no hope. Already in the nineteenth century, scientists realized that the application of the Second Law of

Thermodynamics to the universe as a whole implied a grim eschatological conclusion: given sufficient time, the universe will eventually suffer “heat death.” Yale University astronomer Beatrice Tinsley described the fate of an expanding universe:

> If the universe has a low density, its death will be cold. It will expand forever at a slower and slower rate. Galaxies will turn all of their gas into stars, and the stars will burn out. Our own sun will become a cold, dead remnant, floating among the corpses of other stars in an increasingly isolated Milky Way. [10]

Elementary particle physics suggests that thereafter protons will decay into electrons and positrons, so that space will be filled with a rarefied gas so thin that the distance between an electron and a positron will be about the size of the present galaxy. Eventually all black holes will completely evaporate and all the matter in the ever-expanding universe will be reduced to a thin gas of elementary particles and radiation. There is no hope of a reversal of this descent into oblivion. The universe will inevitably become increasingly cold, dark, dilute, and dead.

Reflection on this eschatological conclusion has led some philosophers to question the meaning of life itself. In a famous passage, the British philosopher Bertrand Russell lamented,

> That man is the product of causes which had no prevision of the end they were achieving; that his origin, his growth, his hopes and fears, his loves and his beliefs, are but the outcome of accidental collocations of atoms; that no fire, no heroism, no intensity of thought and feeling, can preserve an individual life beyond the grave; that all the labours of the ages, all the devotion, all the inspiration, all the noonday brightness of human genius, are destined to extinction in the vast death of the solar system, and that the whole temple of Man’s achievement must inevitably be buried beneath the debris of a universe in ruins -- all these things, if not quite beyond dispute, are yet so nearly certain, that no philosophy which rejects them can hope to stand. Only within the scaffolding of these truths, only on the firm foundation of unyielding despair, can the soul’s habitation henceforth be safely built. [11]

Russell’s keen philosophical mind saw more clearly than Hawking the correct implications of a godless cosmos.

Russell, however, was unaware of the evidence for a beginning of the universe and thus of the need of a cosmic Creator. When asked to explain the existence of the universe, Russell replied, “The universe is just there, and that’s all.” This response is understandable on a pre-Einsteinian

view of an eternal universe, but it becomes inept when confronted with the fact of the universe's temporal beginning. Such a beginning points beyond the universe to its ground in a transcendent Creator. If such a Creator of the universe does exist, He offers the best hope of deliverance from the somber implications of physical eschatology.

Footnotes

[1] Arthur Eddington, The Expanding Universe (New York: Macmillan, 1933), p. 124.

[2] Ibid., p. 178.

[3] Stephen Hawking, A Brief History of Time (New York: Bantam Books, 1988), 9.

[4] Ibid., 46.

[5] Ibid., 136.

[6] Ibid., 140-1.

[7] John D. Barrow, Theories of Everything (Oxford: Clarendon Press, 1991), p. 68.

[8] Ibid., pp. 67-68.

[9] Hawking, Brief History of Time, pp. 138-9.

[10] Tinsley, "Big Bang," p. 105.

[11] Bertrand Russell, "A Free Man's Worship."