§ 4. Excursus on Natural Theology
Lecture 11
First Scientific Confirmation for the Second Premise

We have been looking at philosophical arguments for the second premise of the *kalam* cosmological argument. We saw that the impossibility of forming an actually infinite collection of things adding one member after another implies that the universe began to exist, which is the second premise of that argument. We can summarize this argument as follows:

1. A collection formed by successive addition cannot be an actual infinite.

2. The temporal series of events is a collection formed by successive addition.

3. Therefore the temporal series of events cannot be an actual infinite.

Now we have two philosophical arguments for the second premise of the cosmological argument – one based upon the impossibility of the existence of an actually infinite number of things, and the other based upon the impossibility of forming a collection of an actually infinite number of things by successive addition (adding one member after another one at a time).

Lest we lose the forest for the trees, let's just step back a moment and ask what we've done here. What we've basically argued is that the idea of an infinite past is absurd. The past cannot be infinite, and therefore it must have a beginning. These arguments, though seemingly very complex and mind-stretching, can be shared in a very simple way. That is important to understand lest you just throw up your hands and say *all this mathematics is too difficult for me*.

The first argument based on the impossibility of an actually infinite number of things – what I often do in a debate situation is to simply say that the existence of an actually infinite number of things is impossible because of the absurdities that would result if it could exist. For example, what is infinity minus infinity? That is a simple question. You get self-contradictory answers, and that shows that infinity is just an idea in your mind, not something that exists in reality. So there can't be an actually infinite number of past events. That is a very simple statement of that first argument.

The second argument – you can simply give an illustration of an infinite series of dominoes and say, *How can the present domino ever fall if an infinite number of earlier dominoes had to fall first one after another?* You'd never get to the present domino. We know that the past can't be infinite; it must have had a beginning – it must be finite.

There you see I've shared those two arguments in about 45 seconds. Even though there is this wealth of interesting material below the surface, the tip of the iceberg can be shared in a relatively simple and straightforward way.

Now we want to go on to scientific confirmations of the beginning of the universe.

In one of the most astonishing developments of modern astronomy and astrophysics, which our Muslim theologian friend al-Ghazali could never have anticipated, is that we now have pretty strong scientific evidence for the beginning of the universe. I like to think of these scientific arguments as confirmations of the philosophical arguments. They are confirmation of a conclusion already reached by philosophical argument. That is to say, given the scientific evidence, the statement "the universe began to exist" is more probable than it would have been without that evidence. The evidence confirms the truth of that premise that the universe began to exist. So if someone says to you, as they very often do, *Nobody knows how the universe began. Nobody knows whether the universe had a beginning or is eternal,* what they are usually thinking of by the word "know" is "know with certainty." Of course that is not what we are claiming here – that somebody knows with certainty.[1] Science doesn't deal in certainties. What we are saying is that given the scientific evidence that we have it is more probable than not that the universe did have a beginning. It seems to me that it is almost undeniable, at least, to say that the scientific evidence confirms that the universe began to exist. That statement is more probable given the scientific evidence we have today than it would have been without it – than it was, say, in the 19th century before the Big Bang model was ever broached or the expansion of the universe discovered. The evidence at least confirms the second premise even if it doesn't render it certain. Certainty is a will-o-the-wisp that we don't need to be concerned about. The question is: is the premise more probable than not given the evidence that we have? I think that it is.

Let's look at the first scientific confirmation which comes from the expansion of the universe.

All throughout history men have always assumed that the universe as a whole was unchanging. Of course, things in the universe were moving about and changing, but the universe as a whole was just there, so to speak. This was also Albert Einstein's assumption when he first began work on his General Theory of Relativity.

In 1917 Einstein applied his gravitational theory which is called the General Theory of Relativity. It is really not a theory of relativity. It is a theory of gravitation. It is the theory of gravitation that is accepted in physics today. In 1917 Einstein began to apply his newly discovered gravitational theory to the universe as a whole.

But he found that something was terribly amiss. His equations described a universe which was either blowing up like a balloon or else collapsing in upon itself. During the 1920s the Russian mathematician Alexander Friedman and the Belgian astronomer Georges LeMaître independently discovered models of the universe which took Einstein's

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equations at face value, and as a result they discovered models of an expanding universe. In 1929 the American astronomer Edwin Hubble, through tireless observations at Mt. Wilson Observatory, confirmed Friedman and LeMaître's theory. He found that the light coming to us from distant galaxies appears to be redder than expected. This "red shift" in the light was most plausibly explained because the galaxies are moving away from us and therefore the light waves (the wavelengths) are stretched so that they appear to be redder than expected. Wherever Hubble trained his telescope in the night sky, he observed this same redshift 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 tremendous 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 flying away from him. This is because, according to the theory, it is really space itself which is expanding. The galaxies are actually at rest with respect to space, but they recede from each other as space itself expands. The best way to visualize this, I think, is to imagine a balloon with buttons glued on the surface. The buttons are glued in place so they cannot move across the surface of the balloon. The buttons are stuck in place. But as you blow up the balloon, the buttons will get further and further apart because the balloon itself is inflating.[2] Those buttons are just like the galaxies in outer space. The galaxies are actually at rest with respect to expanding space but they recede from one another as space itself expands.

The Friedman-LeMaître theory eventually came to be known as the Big Bang theory. But that name can be misleading. The Big Bang sounds like an explosion, doesn't it? But 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 theory. As we've seen, the theory is much more radical than that. It is space itself which is expanding.

As you trace this expansion back in time, the galaxies will get 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 have reached the boundary of space and time. Space and time cannot be extended any further back than that. It is literally the beginning of the universe.

To imagine this, we can think of our three-dimensional space as a two-dimensional disk. As you go back in time, space shrinks down until the distance between any two points in space becomes zero. That is the beginning of the universe. The vertical dimension represents time. Over time the universe is expanding. We can represent the expansion of

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space geometrically as a cone. What is interesting about a cone is that although it can be extended indefinitely in one direction, it has a boundary point in the other direction and cannot be extended in that direction. Because this direction represents time and the boundary point lies in the past, that point represents the beginning of the universe. It implies that the past is finite and that therefore time and the universe began to exist.

Since space-time is the arena in which all matter and energy exist, the beginning of space-time is the beginning of all the matter and energy in the universe. It is the beginning of the universe itself.

Notice that there's simply nothing prior to the initial boundary point. There's nothing prior to the beginning of the universe. Here it is very important that we not be misled by words. When scientists say, "There is nothing prior to the initial boundary," they do not mean that there is some something prior to it, and that is a state of nothingness. That would be to treat nothing as though it were something! Remember when we talked about what "nothing" means. It is just a term of universal negation meaning "not anything." So when they say there is nothing prior to the Big Bang or nothing prior to the boundary point, what they mean is there was not anything prior to the boundary point. At that boundary point, it is false that there is something prior to this point.

Incredibly, 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 second premise of the *kalam* cosmological argument – the universe began to exist.

START DISCUSSION

Student: Is that zero-point also the limit of time?[3]

Dr. Craig: Yes. Both time and space.

Student: Do the cosmologists consider the singularity to be a thing? A being? An actually existing object?

Dr. Craig: That is a really, really good question. He is saying when you get to this boundary point, is that an actual physical state of reality? My impression is that among many cosmologists, they would say no; that this is an idealization. It would be . . .

Student: Like an asymptote?

Dr. Craig: Right. It wouldn't be an actual physical state. It would be kind of like the series of fractions converging toward zero as a limit. You'd have 1/2, 1/4, 1/8, 1/16. There the endpoint is simply an ideal limit that doesn't actually exist. It isn't an actual physical state of affairs. In this case there wouldn't be an actual T=0 at the singularity. It would just be like that descending series of fractions.

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Student: But that doesn't do anything to avoid a beginning even if there is no beginning point.

Dr. Craig: Exactly.

Student: According to certain models of M-Theory, scientists have put forth of an idea of a variable dark energy that sometimes is positive and sometimes negative and allows for an oscillating universe. What would your response be to something like that?

Dr. Craig: I will raise the question in a minute about other models than the standard model. I wanted us to first understand what does the standard Big Bang model say and imply. As you say, there have been over the decades scores of alternative models proposed including oscillating models where the universe wouldn't actually go down to a singularity. It would kind of be like an hourglass. It would go down and then it would expand out again. That would represent a contracting universe which then somehow reverses itself and expands. That contraction was preceded by a prior expansion, and that by a contraction. So the universe is sort of like an accordion expanding and contracting from infinity past. This model was floated during the 1960s primarily by Russian cosmologists who wanted to restore the eternality of matter and the universe. The singularity theorems that were developed by Stephen Hawking and Roger Penrose (that I'll talk about and are featured in this movie *The Theory of Everything*) pretty much put the kibosh on these oscillating models because what it showed was that in a universe that is contracting down like this a singularity is inevitable. You can't really escape the singularity. Moreover, even if you could, entropy is conserved from cycle to cycle which has the effect of making each cycle longer and larger than the previous cycle so you still couldn't have an infinite past. You would still have a beginning prior to the smallest cycle. Joseph Silk, who is an astronomer, in his book called *The Big Bang* says that based on current entropy levels in the universe it couldn't have gone through more than about one hundred previous oscillations. So there are all kinds of problems with these oscillating models as a result of which they haven't really commended themselves to the cosmological community at large as more plausible than a more straightforward model.

Student: At the beginning of space and time, my understanding is God put into place a series of events in time and starting at that point. There was nothing prior to that point. No energy. Nothing. Going to a cosmological understanding, what is the difference? In other words, does it state that you have to have a God to start? If you agree the Big Bang, the collapsing, the coming together of space and time, did in fact happen, how would they address what was the initial cause if you don't have a God that is outside of space and time to create that initial beginning? Do they have an answer to that or does it get into the oscillating universe and all the String theories?[4]

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Dr. Craig: Here it seems to me that the scientist, as a scientist, says that *I will simply offer a description of the universe back to its beginning, but beyond that, that is metaphysics not physics.*

Student: So it is God-of-the-gap. In other words, they are saying, we don't know but . . .

Dr. Craig: No, I think they are saying that that is not a scientific question unless you are raising an alternative model like an oscillating model to avoid the beginning. But once you have an absolute beginning the question as to why the universe came into being is really a metaphysical question, not one that lies within the province of science. It is important to understand that the theist is not offering here an alternative theory to the Big Bang theory. It is not as though he is offering a theistic creation account or something. The evidence that I'm appealing to simply confirms the second premise of the cosmological argument that the universe began to exist. That is a theologically neutral statement that you can find in any textbook on astronomy and astrophysics. So it is not God-of-the-gaps. God doesn't come into the picture at all at this point. One is simply saying that the best evidence of contemporary science confirms that premise that the universe began to exist. Whether or not that has theistic implications is a further philosophical question.

Student: Is the reason that the scientific arguments are merely confirmations because the *kalam* must seek to prove a metaphysical beginning to time and not merely a physical beginning? I've heard some stress what is really the importance of even studying the scientific arguments if that doesn't really seek to show the beginning of time that we would need to show in order for the *kalam* to be successful.

Dr. Craig: I think that there is some truth to what you are saying because if you just approach the question purely scientifically then the committed naturalist could just appeal to unknown natural laws, unknown physics, to explain how the universe came into being and resort to a kind of naturalistic metaphysics. For example, someone might say maybe our universe just blew up in the laboratory of some sort of mega-gigantic scientific study somewhere and we are really just a test universe inside of this other greater massive thing. Scientifically, that is a non-starter. How do you even assess something like that? In that sense I think it is true to say that the scientific evidence is confirmatory of an argument that is already reached by philosophical argument, and it will be the philosophical argument that will exclude these sorts of other metaphysical alternatives. But, again, as one is just doing pure science and not speculating metaphysically, it seems to me that it is virtually undeniable that that premise – the universe began to exist – is more probable than not given the current state of the evidence which is all one is claiming.

Student: Wouldn't the constancy of the CBR temperature speak against any kind of oscillation or even multi-universe? I would think you would see oscillation or perturbation or change in CBR from different directions.

Dr. Craig: What you are talking about is a discovery made by a couple of Bell Telephone laboratory scientists in 1965 where they detected a kind of low-grade microwave background radiation in the universe. The same kind of radiation that is in your microwave oven at home. They found that the entire universe is permeated by this background microwave radiation. The best explanation of this is that this is a vestige of a very hot and very dense state of the early universe. This is one of the other pieces of evidence for the Big Bang besides the redshift observed by Hubble. The redshift evidence has been around ever since Hubble in the late 20s, but this cosmic background radiation was only discovered in 1965 and helped put the nails in the coffin of the old steady state model which couldn't explain why this background radiation [is there].[5] Whether or not this is compatible with oscillating models . . .

Student: I would say it disproves oscillating models because of the constancy of the temperatures is the same in all directions.

Dr. Craig: Yes, right. What you are pointing out is that this is incredibly homogeneous in every direction to one part in a hundred-thousand. It doesn't vary. It is extraordinarily evenly distributed. The suggestion is that if the universe were the result of a prior oscillation then that contracting phase would create all sorts of black holes and density perturbations that would then be reflected in the microwave background in the next expansion. That is, in fact (I think you are right), a huge problem. A contracting universe would be filled with these black holes and other objects that are formed by gravitational self-collapse that wouldn't just get smoothed out when the universe starts to expand again. That is one of the challenges, I think.

END DISCUSSION

The question then is: is the standard model correct? Or, I think more importantly, is it correct in predicting a beginning of the universe? Despite the empirical confirmation from the redshift, microwave background radiation, and other evidence, the standard model will need to be modified in various ways. The model is based, as I've mentioned, on Einstein's gravitational theory – the General Theory of Relativity. But the General Theory of Relativity breaks down when the universe is shrunk down to sub-atomic proportions. At that point, you've got to introduce quantum physics in order to describe the earliest split-second of the universe. You need a theory that would combine General Relativity (or gravity) with quantum physics to have a quantum theory of gravity to describe the first split-second of the universe. The problem is nobody knows how to do

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this yet – the theory doesn't exist. Moreover, the expansion of the universe is probably not constant as it is in the standard model. It's probably accelerating (as I think someone alluded to with the dark energy). The universe is actually speeding up in its expansion and may have had a brief period of super-rapid (or inflationary) expansion very early on in the history of the universe. So the standard model is going to need to be modified in various ways if it is to be empirically adequate.

But none of these adjustments need affect the fundamental prediction of the model that the universe had an absolute beginning. Indeed, as I've mentioned, over the decades physicists have proposed scores of alternative models since Friedman and LeMaître in order to avoid the absolute beginning of the universe. And those models that do not feature an absolute beginning have been repeatedly shown to be untenable. To put it more positively, the only viable non-standard models are those that involve an absolute beginning to the universe. That beginning may or may not involve a beginning point. But even those that do not have a point-like beginning are still finite in the past. The past is not infinite, but finite. On these models (like Stephen Hawking's so-called "no boundary" proposal) the universe has not existed forever. Rather, it came into existence even if it didn't do so at a sharply defined point.

In one sense, the history of twentieth century cosmology can be seen as a parade of one failed attempt after another to avoid the absolute beginning predicted by the standard model. That prediction has now stood for nearly 100 years through a period of enormous advances in observational astronomy and creative theoretical work in astrophysics.[6]

With that I will bring it to a close today. Next week we will continue to discuss the significance of more recently discovered singularity theorems that also imply that the universe began to exist.[7]

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7 Total Running Time: 31:04 (Copyright © 2015 William Lane Craig)