The Why of Science and the How of Religion

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Though it is commonplace in discussions of science and religion to make the distinction between scientific explanations of how and religious explanations of why, the distinction does not hold up under close examination. In recent discussions of big bang cosmology, scientists are more and more addressing of the questions of why, particularly in discussions of the role of symmetry in contemporary physics and in debates about the relevance of the anthropic principle.

As a part of an introductory course on Western Religious Thought, I normally include a discussion of Genesis 1-2. As students work to make sense of these stories in light of their own common sense and scientific understandings, they quite frequently hit on the distinction between how and why. In some form or other their responses take up the familiar stance that Genesis tells the story of why God created the world, and science tells how God did it. When the discussion goes in this direction, it is becoming more common for students who are up on their scientific cosmology to bring in the big bang. Then the distinction takes this specific form: The story of Genesis tells us why God created the universe and the big bang theory tells us how.

Even though this how/why distinction is commonplace in academic discussions of science and religion, I am ambivalent when students get such high explanatory mileage from this simple distinction. I suppress my ambivalence in the class discussion, however, because I always want to encourage students who make an attempt to understand any text, but especially a biblical text, with any complexity beyond a one-dimensional literal reading. Another reason for my ambivalence is that Genesis 1-2 does not make any direct attempt to say why God created the world.

In its academic use, the distinction of how and why is only slightly more sophisticated than the common sense one used by students in an introductory course. Science and religion are totally separate. Science can explain only how things work in terms of causal relationships described by the application of natural laws but it cannot explain any events in terms of their purpose or why they happen. On the other hand, religion gives an understanding of why things are as they are, especially in terms of the origins, nature, and destiny of human beings.

It is not surprising that these arguments are so common when we remember that the distinction is in many ways built into the origins of the way modern science saw itself from its beginnings in the seventeenth century. One of the goals of the new experimental natural philosophy was to understand nature strictly in term of efficient causes and to eliminate any appeal to Aristotle's teleological causes that would explain nature in terms of purpose.

This early commitment of natural science was quickly put to political use in the famous compromise between the Catholic church and Galileo. The first examination of Galileo ended with the compromise that Galileo would be able to continue his work as long as he never claimed any more than that his theories were "a convenient mathematical device for describing the phenomena" of the apparent motions of the heavenly bodies. The elimination from Galileo's descriptions of any notion of why things are as they are was all that was needed to remove any claim to truth that could challenge the truth of the Church. In spite of the political charade, there were no abstract intellectual difficulties in the compromise that Galileo had to make, given how he saw the nature of his scientific enterprise. As he put it in his "Letter to the Grand Duchess Christina," he did not see a necessary conflict between science and the deeper truths of the Bible. He argued that "the Bible taught how to go to heaven, not how the heavens go".[1] The problems leading up to the second examination of Galileo and his subsequent conviction came about more from political changes in the Vatican than from a failure of the abstract division between descriptive calculation and truth.

This basic split between how and why continues with Isaac Newton later in the same century. For him science could not address issues of purpose because the laws of nature he discovered, and the existing universe to which he applied these laws, were separate fundamental givens. The laws could not be derived from objects and the objects could not be derived from the laws. He could only use these laws to explain how objects fell to the surface of the earth and how the objects of the solar system moved around the sun. The very use of the metaphor of law implied a grounding in a law-giver whose laws must be obeyed. For Newton there was no conflict between his scientific views and his appeal to God as the giver of these universal laws. He could not explain why there was gravity with the property of universal attraction; he could only accept it as a law-governed force that allowed him to explain how it affected the motions of all material bodies.

This same distinction lies at the heart of the positivistic view of science that developed in the late nineteenth and early 20th centuries. Science can describe how the world works according to verifiable observations, and this account is the only one that gives true knowledge. It is not that verified scientific knowledge was in conflict with religious beliefs, but that religious beliefs not being susceptible to universal generalization and empirical verification were not even qualified to count as knowledge. (If the positivist didn't know it, it wasn't knowledge.) Of course the distinction of how/why is not the only split involved in a positivistic understanding of science. Associated with it are others such as fact and value, objective and subjective, cognitive and emotive, logical and psychological, all with the attending belief that only the first terms of these distinctions are really of importance to science or to anyone interested in genuine knowledge.

In this positivistic interpretation there is no assumed need for scientific laws as laws from a law giver. The universal regularities of nature are but generalized descriptions of how nature always works. A claim to any other status would be an unverifiable claim of metaphysics. In this view it is not a case of merely making a distinction between how and why. Rather, the question of why is excommunicated from the legitimate realm of knowledge, and we are left only with a utilitarian view of how things work.

In theological treatments of the relationship of science and religion, this simple distinction reached its high point in the various forms of Protestant Neo-orthodoxy. Such figures as Karl Barth, Rudolph Bultmann, Paul Tillich, and Langdon Gilkey, for all their differences, all had a common commitment. All of them distinguish scientific knowledge from religious knowledge by accepting an understanding of science and a view of Christianity that stresses the primacy of revealed knowledge as purely separate from science or any form of knowledge achieved by human beings. Again science has the power to figure out with reason how the natural world works, but only a theology of the word can give knowledge of the true purposes of God in his creation. In using this abstract distinction to keep science and religion separate, theologians were not simply imposing a theological invention on science but were capitalizing on a distinction that stems from one to the assumed tenants of science's understanding of itself. This may have worked well for the apologetic task of making a place for religious knowledge, but it did so by appealing to an understanding of science that is not only antithetical to religion, but has in recent years been shown to be a totally inadequate interpretation of the scientific enterprise.

Like most simple distinctions, this one proves to be more effective in simple abstract situations than in the complicated interactions of people going about the tasks of making sense of themselves in the world—whether these tasks are seen as scientific or religious. Many forms of religion clearly do not forfeit the right to draw upon religious commitments to understand how the world works, with the most obvious being religious fundamentalism and literalism. And scientists have never been timid about moving beyond the technical limitations of their scientific enterprises to bring their thought to bear on understanding everything, including human behavior, ethics, politics, art, and religion. More and more, scientists are breaking the accords of the how/why truce and are speaking to issues ranging from the purpose of human life to the purpose of the cosmos. Or in the terms being developed here, people doing science make a claim on why, just as people who think about religion make a claim on how things are described.

In the seventies, discussions of science and religion were conducted more and more against the backdrop of twentieth century physics and the theories of general relativity and quantum mechanics. I think particularly of Fritjof Capra's 1975 work, *The Tao of Physics,* in which he relates science and religion by showing parallels between Eastern mysticism and the scientific theories of high energy physics in terms of more holistic, non-causal approaches to science. Not only did he think this cast light on the relationships between science and religion, he felt that the application of nonreductive, and holistic systems to physics would also help clear up the disarray that the field of particle physics found itself in during the seventies. The last ten years have been marked by the discussion of non-mechanistic views of science. This has ranged from emerging postmodern understandings of science to the popular views of cosmology presented by Carl Sagan (*Cosmos*) and Stephen Hawking (*A Brief History of Time*).

I now want to explore some of the ways that science is more and more blurring the distinction between explaining how and explaining why by focusing on some issues associated with the big bang theory. Last year I was walking through an airport terminal when I noticed a *Time* magazine on the rack with a cover showing a star-filled cosmic background with this question written in the foreground: "What Does Science Tell Us About God?" I must admit that my first reaction was to mutter "nothing," and keep on walking, but I bought a copy to see why *Time* was picking up on the topic. Their lead-in centered on the discussions that have been generated by the recent discovery of small fluctuations in the cosmic background radiation. These fluctuations are seen as further support for understanding this cosmic radiation as the residue of the big bang that took place some 15 billion years ago. Last spring when announcing the finding of these fluctuations in the cosmic radiation, a physicist with the project, George Smoot, added the comment: "If you're religious, this is like looking at God."[2]

The cosmic background radiation predicted by big bang theory was originally discovered in 1965 by Arno Penzias and Robert Wilson while they were trying to tune a large microwave antennae at the Bell labs. They found a slight but puzzling background static that they could not eliminate and which seemed to be the same intensity no matter in which direction in the sky they pointed the antennae. The signal seemed to be coming from everywhere in the universe. Later, when they became aware that there were plans to conduct an experiment to try to detect the theoretically predicted residue of radiation released by the big bang, Penzias and Wilson realized that they had already discovered it. From that point on, the big bang theory came to the forefront as the only serious model for investigating the origins of the universe.

There were, and still are, difficulties with the model. One of them was that the cosmic background radiation Penzias and Wilson discovered was too uniform. This uniformity created problems because it could not account for the fact that the universe is not uniform but lumpy with its myriad of galaxies and other complicated celestial bodies. But the recent experiment that measured the very slight fluctuations in the radiation level helped overcome that problem, and this became further evidence for the accuracy of the big bang model.

Beyond Smoot's ironic or perhaps facetious remark that seeing these fluctuations of background radiation was like looking at the fingerprints of God, this latest round of discussions about God and the big bang has led to a wide range of reactions. On one side George Lindbeck of the Yale Divinity School expressed disappointment on hearing the new discovery for fear that Christian theologians would use this as a way of confirming the Christian doctrine of creation. At the other end of the spectrum, theologians like Ted Peters saw this as further evidence for his theory of a consonance or harmony between science and theology.[3]

I now want to focus on three areas in which uses of the big bang theory blurs how/why. They are (1) the commitment that physicists have to symmetry as a part of their methodological approaches, (2) the speculative appeals to what has been labeled the anthropic principle, and (3) the implied narrative generated by the big bang theory.

The Role of Symmetry.

One of the most interesting aspects of the big bang is that it is one of the places where the two theories of general relativity and quantum mechanics come together. We normally think of these two major revolutions of twentieth century physics as theories with two separate applications. Relativity applies to the realm of the very large and the very fast, involving speeds at or near the speed of light. Quantum theory applies to the realm of the very small in the non-deterministic domain of subatomic particle physics. The big bang model involves general relativity because the big bang depends on the four dimensional world of a space-time continuum, and it depends on quantum mechanics because in the earliest moments after the big bang the entire universe was so infinitesimally small that it had the same dimensions that are today associated with the sub-atomic realm of quantum mechanics.

In this early universe where explanations must be both relativistic and quantum, the classical laws of Newton no longer apply. But the relation of these twentieth century approaches to the mechanical world of Newton is even more complex than this. The Newtonian world has three main components—the objects of mass, the forces that act on these masses, and the universal laws that provide the rules for how these forces and objects behave. For Newton, these three have to remain independent of each other to guarantee the universality of his system. Forces could not be derived from objects because the uniqueness of each object could not produce forces that were uniform enough to be subject to invariable laws. And certainly the laws could not be derived from either the objects or the forces without a similar threat to their universality. And Newton argued that it was absurd to believe that gravity could be inherent in matter.[4] This brings us back to the split of how and why. Newton could show how the solar system worked, but he could not explain why there were forces or objects or laws that governed the objects. No one of the three could be derived from the other, so all three remained separate irreducible givens, perhaps given by God, but nevertheless they could only be described.

In describing the earliest moments of the universe of the big bang, all of this breaks down. All the basic theories of general relativity and quantum mechanics and the associated theories of particle physics depend on a fundamental concept of symmetry which is more basic than particles or forces or universal laws applied to particles and forces.

In physics, a symmetry is the concept of an invariance in a system that is maintained even when there has been a transformation of the system. Symmetries are seen as underlying fundamental invariances that, like Platonic ideals, remain unchanged even though changes have taken place on the surface.

A simple example of symmetry that can be visualized and that also keeps some of the ordinary meaning of the word is the symmetry of a cylinder rotating around its vertical axis. Even when you change the cylinder by rotating it, the underlying symmetry always remains, and in this case the symmetry always remains visible. That is, the cylinder that has been rotated any number of degrees remains indistinguishable from the original state of the cylinder. Or in two dimensions, we can apply this to a hexagon. If you rotate a hexagon 60 degrees around its center, the symmetry of the hexagon is preserved. That is, the symmetry of the hexagon is such that its appearance is invariant in transformations of multiples of 60 degrees.

Symmetries are so important in contemporary physics because, in the sub-atomic quantum realm, all particles of the same type are all identical to each other within that type. All protons are identical, as are all neutrons, or to put it more colloquially, “if you’ve seen one electron you have seen them all.” Also, each of the identical particles exists only in a finite number of quantum states that can be thought of as rotations, leading to a universal application of underlying symmetries even in transformed states of the particles. This applies equally to those particles we associate with matter and to those particles associated with forces.[5]

The understanding of symmetry in the four elementary forces of gravity, the strong nuclear force, the weak force of radioactive decay, and the electromagnetic force is, of course, much more complex and more difficult to visualize than the symmetry of shapes transformed through rotation in space. Physicists talk about the underlying symmetry behind the seemingly two different forces of electromagnetism and the weak force of radioactive decay. The underlying symmetry behind the two is understood through the development of the theory of the electroweak force—a force whose symmetry existed in reality in the earliest moments after the big bang. Today one of the major efforts of theoretical physics is to develop a Grand Unified Theory that will explain the even deeper symmetry of the electroweak with the strong nuclear force, leaving only the two fundamental forces: the force of gravity and the force of the Grand Unified Theory. The ultimate goal of this theoretical pursuit is the construction of a theory of everything that reveals the beautifully simple supersymmetry of all forces and particles underlying the broken symmetries of the complex physical world we live in—a single symmetry that existed in the first 10 to the minus 43 second after the big bang.

The role of symmetry in particle physics has no simple analogy with the classical triad of objects, forces, and laws in the Newtonian world that has become the intellectual common sense world we have come to see ourselves inhabiting. Rather the symmetry or invariance underlying the most fundamental structures of the physical world leads to a blurring of these distinctions. Forces are not Newtonian forces working on objects but are interactions of subatomic particles acting on particles in ways that must maintain underlying symmetries. These underlying symmetries account for the particles, the force carrying particles, and the rules that are to be observed.

As pointed out by the British astronomer John Barrow, this also blurs the traditional distinction between how and why that traces back to Galileo and Newton. As Barrow puts it: “Curiously, modern particle physicists are quite different. Gauge theories show that physicists need not be content to possess theories that are perfectly accurate in the description of *how* particles move and interact. They can know something of *why* those particles exist and *why* they interact in the manner seen.” These symmetries “dictate what forces of Nature exist and the properties of the elementary particles which they govern.”[6] For readers who like to take note of metaphors, Barrow’s metaphor suggests that instead of God as a lawgiver we now have symmetry as a dictator.

At the most fundamental level of the cosmology informed by the big bang theory, some physicists are not content to restrict their questions to theoretical descriptions of how the cosmos works, but venture into why the cosmos is as it is and why everything in the cosmos is related in the way that it is. But this is more than boldness; it is also related to the basic methods they use to construct theories. These theories are constructed in ways that do not conform to the classical Newtonian divisions of explaining how and explaining why.

The Anthropic Principle

In discussions of the big bang theory, physicists frequently raise the question of purpose in terms of what they call the anthropic cosmological principle, which, among other things, reopens the general issues of teleological processes and explanations as well as the design argument. In fact, most physicists who write accounts of the big bang theory for a general audience include issues related to this principle that was first discussed in the seventies by the physicist Brandon Carter, who was a colleague of Stephen Hawking.

In brief, the principle takes two major forms known as the weak anthropic principle and the strong anthropic principle. The weak form simply claims that any account of the origins and evolution of the universe must assume initial values that are in a range that are consistent with a universe that contains an intelligent, carbon-based life form capable of observing the universe. The principle is expressed many ways, but one of Carter’s briefest formulations was “What we can expect to observe must be restricted by the conditions necessary for our presence as observers.”[7]

Carter also developed a second form of the principle called the strong anthropic principle that suggests that the initial conditions of the universe and the workings of elementary particle physics require a universe that *must* have those conditions that give rise to an intelligent observer. In addition to the claim of the weak form, the strong form adds the assertion that the we live in a universe that *must necessarily* produce intelligent observers. The strong principle is based in part on the many exact coincidences that must be assumed in the initial conditions of the big bang to be able to account for intelligent observers. For example, if during the very first second of the universe after the big bang the rate of expansion had been less by one part in a million million, the universe would have collapsed before it cooled down enough for life to form. Or if the expansion had been more by one part in a million, the universe would have expanded too fast for stars to form. Without stars no carbon or other heavy elements could have formed, and again no life would be possible. In that first second after the big bang, if the strong nuclear force had been the least bit stronger, the bond of the helium nucleus would have been so strong that the universe would consist entirely of helium. The full list of these exact values and ratios is quite long, but the point of their importance remains the same.

One of the questions raised by the anthropic principle is how to explain the exact fine tuning of these initial values, ratios, and universal constants whose precise values are absolutely necessary for life as we know it to exist?

Another question is why is the universe 15 billion years old? The answer from the anthropic principle is that we should expect the universe to be that old because it takes five billion years after the big bang for hydrogen to form as stars, and another five billion years after that for carbon to be created in these first stars before they blow up and reform as heavy element stellar systems, and yet another five billion years for our solar system to develop from this and for the earth to cool enough for biological life to evolve into an intelligent observer. All this adds up to 15 or so billion years before the universe has a carbon-based life form that can ask the question of why is the universe 15 billion years old.

The role of the weak anthropic principle is obvious enough, so obvious in fact that it is frequently dismissed as true but trivial. Of course astrophysicists must understand their scientific observations of the universe from the point of view of a universe that includes astrophysicists as a part of that universe. So what!

The strong version of this principle has generated more complicated discussions. Just what is the strong anthropic principle? Even John Wheeler, the distinguished theoretical physicist who is a strong supporter of the anthropic principle, admits that he is not sure. In response to the question of the status of this principle he replies, "Is it a theorem? No. Is it a mere tautology, equivalent to the trivial statement, 'The universe has to be such as to admit life, somewhere, at some point in its history, because *we* are here?' No. Is it a proposition testable by predictions? Perhaps."[8] But he concludes that he does not know.

To Wheeler's list we can add, "Is the strong version simply a reformulation of the argument from design for the existence of a designer?" If the answer is yes, then we expect Darwin to rise up and strike it down. But here is where the complications begin. A Darwinian attack on the design argument depends on a countless multitude of similar organisms undergoing random mutations. From these many possibilities, the contingencies of the environment determine which of these changes will survive and which will not. In a Darwinian critique, for example, the fact that we are oxygen breathing creatures in a world whose atmosphere contains exactly the right percentage of oxygen—any less and we suffocate and any more and we burn up—is not seen as evidence of design for our sake, but only that the multitude of mutations that could not breath oxygen died out and those that could had a chance to live.

But what about the fundamental processes involved in the formation of the universe? Here the critique of natural selection does not work. As far as we know there is only one universe and this universe includes intelligent life. Unless we imagine many or even an infinite number of universes,[9] the dynamics of a process that selects from many possibilities cannot be applied to a situation where there is only a singular example. And as far as we know there is only one universe.

The strong anthropic principle can be taken up in the apologetic task of religion to assert a purpose that unfolds in the universe. A good example of this is Rupert Sheldrake's treatment in his recent book, *The Rebirth of Nature: The Greening of Science and God*. In a discussion of cosmic evolution Sheldrake appeals to the anthropic principle as a part of his overall attempt to find a sense of purpose in the scientific understandings of nature. After uncritically stating the anthropic principle, Sheldrake quickly speculates that

> Again, God could provide one kind of answer: He designed this universe, skillfully selecting the values of the numerical constants of nature, and he then maintained them by remembering them. Alternatively, the 'constants' could be remembered within nature herself rather than by a mind transcending nature. ... Perhaps the numerical constants of physics and the properties of the known physical fields are in fact long-established habits. They could have been different, but only a universe that developed these particular habits could hang together as ours does and allow the evolution of habits of chemical,biological,cultural, and mental organization within it.[10]

My point is a more modest one than Sheldrake's. The fact that the debates about the anthropic principle are even taking place and that at least some scientists are having conversations about the big bang theory in terms of human purpose is another indication that the old classical distinction of how and why is being further eroded. There are enough important issues to be pursued in the first or weak form of the anthropic principle without quickly jumping to the strong version as a springboard for grand religious visions.

When the weak form of the anthropic principle is looked at in relation to the powers of human knowing, it is neither a trivial statement of the obvious nor is it some puzzling cosmological principle whose origins are out there, or back there, at the big bang. I think it is revealing that almost all of the discussions of the weak anthropic principle use the expression "intelligent observer" to describe the entity for which the principle is trying to account. But scientists are more than intelligent observers. They are human beings who rely on much more than their powers of intelligent observation. Among other things, they rely on a sense of the history and purpose of the scientific enterprise in which they are actively engaged. I think physicists use a more instructive metaphor to describe their work as constructions. When they talk about theories, they almost always do it in terms of the construction of theories, and the act of constructing is certainly more than intelligent observation. If physicists want to construct theoretical models that account for physicists, they are attempting something that cannot be accomplished by developing an anthropic principle in terms of intelligent observers.[11]

When physicists, or any inquirers in any discipline, take seriously the question of their own role in the knowledge they are relying on to advance the knowledge they are creating, then the possibility arises that even simple, abstract distinctions that seem to have such an objective status can be seen for what they are, distinctions made by the inquirers as a part of the inquiry. And that introduces something more puzzling than an anthropic principle, namely, human beings who have the power to know and who have the power to describe their world because they are already rooted in a sense of the world as a world of purpose. But simultaneously, they are able to articulate their sense of purpose only by relying on their understanding of how they think the world works.

The Implied Narrative of the Big Bang Theory

Beyond such specific points as the role of symmetry or the anthropic principle, the most important way that the big bang theory makes claims on our understandings of purpose is the way that this theory is being transformed into the apparent form of a narrative structure, allowing it to be taken up by our culture as a means of fundamental understanding. When you listen to popular lectures by physicists or read their works written for the well-educated public, you realize that these scientists assume a grand coherent scheme of things running from the singularity of an infinitely dense point when space and time were infinitely curved, to the big bang, all the way to themselves as physicists constructing these understandings.

The basic assumption they start from is that there is a single evolutionary process that in reality runs in an unbroken line from the big bang to the present. Starting with singularity, they move from the big bang to an expanding universe to the broken symmetry of four fundamental forces and to protons and neutrons. This leads to the formations of atoms and the elements of hydrogen and helium. As the space of the universe expands, it cools down and the hydrogen gives birth to stars and galaxies are formed. These stars in turn produce heavy elements like carbon through the process of thermonuclear reaction, and then these stars die as supernova, releasing these heavy elements that in turn become a part of the birth of new stars and solar systems, parts of which cool to the right temperature for carbon based molecular structures to form organic compounds which become the building blocks of life. Finally, these organisms evolve through natural selection until the process evolves into homo sapiens who give rise to the world we inhabit.

The vision is total even though scientists are quick to point out that there are major gaps that need to be filled in to clean up what is being assumed. For example, the gap between an early universe of hydrogen and the formation of galaxies is not well understood, and the process cannot be predicted *a priori* from the big bang theory. But the ever present assumption of scientific inquiry is the conviction that the gaps will one day be thoroughly accounted for in scientific terms that are completely consistent with the grand coherent scheme.

Or I can put the specific contents of the theories into even more of a story form that is only slightly more stylized than the version Carl Sagan tells us on PBS. My version begins like this:

> Long, long ago before there was time, even before time was collapsed as a dimension of space, there was singularity. Not the singularity that can be spoken, not even the singularity that can be mathematically expressed, but the singularity that erupted into an incredibly tiny universe whose density during that first part of the first second cannot even be imagined. Supersymmetry reigned and everything was all the same in beautiful simplicity. But supersymmetry spontaneously broke into gravity and the unified symmetry; and the unified symmetry spontaneously broke into the symmetries of the strong, the weak, and the electromagnetic forces, and there were protons and there were neutrons. Then there was one second. For a 100,000 years the universe was so dense that everything was optically opaque, but, as space expanded, room was created and photons began to move freely. The universe became optically light, and there was light. Millions of years passed and atoms formed and hydrogen prevailed over helium, and hydrogen gave birth to stars. . . .

Even without the help of this stylized rhetoric, it is clear that a story something like this is sinking deeper into the contemporary mythic consciousness. It has mythic themes; it is about radical beginnings; it has a middle and connects to the present, and even though it offers several possible endings, all of the them are radical endings. This story even has the advantage of being presented along with computer generated graphics that can be shown in classrooms and on public television to make the whole process seem concrete—certainly more concrete than an invisible spirit who creates out of nothing and who does not readily translate well as a dramatic computer generated visual presentation.

It appears that we have completed a cycle. The traditional world, whose meaning was conveyed fundamentally through stories, has given rise to a scientific world that generates scientific theories. But it appears that the cycle has turned back on itself and that the contents of the scientific theories can be put into a story form that can be given back to the mythic consciousness of the culture. But something is missing. Even though there is the surface structure of a narrative, no actual story is told. At least this story is not like the mythic stories of old. There are no actors who perform deeds and there is no drama. Singularity explodes and supersymmetry spontaneously breaks, but no character is revealed. Stars are born but they only evolve and die. No community forms and no heroes rise up to do great deeds that shape the community that remembers them. With these deficiencies, how can such a truncated story as the big bang to the present gain such a hold on the popular imagination?

I think the answer lies in deeper stories. Western scientific culture still relies on the linear sense of a history of purpose that in western culture is rooted back in stories of a God who creates a world in which people act and a drama unfolds. In short, I think the question of whether or not new evidence for the big bang theory gives support for belief in the God of Genesis makes just as much sense when turned the other way round. The reformulated question then becomes: Does a fundamental cultural awareness of the story of the God of Genesis make the story that is generated from the big bang theory more cogent by underwriting all the mythic deficiencies in the big bang story? I am not sure what the answer is to the question of whether the big bang theory helps the Genesis story, but I am fairly certain the answer to the reformulated question is yes. The surface cogency of the story generated from the big bang theory, as it more and more functions mythically, is not only helped but is supported by the underlying sense of purpose that western sensibilities still trace back to Genesis in ways that are more fundamental than can be categorized by simple distinctions like why and how.

ENDNOTES

Part of an earlier version this article was presented at the Southeastern Regional Meeting of the American Academy of Religion held in Charleston, SC, March 1993.

1. John Hedley Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge University Press, 1991), p. 46.
2. *Time.* Vol. 140, No. 26, December 28, 1992, p. 39.
3. *The Christian Century*. Vol. 109, No. 23. July 29-August 5, 1992., p. 705.
4. John D. Barrow, *Theories of Everything: The Quest for Ultimate Explanation* (Clarendon Press, 1991), p. 72.
5. James S. Trefil, *The Moment of Creation* (Charles Scribners's Sons, 1983), pp. 87-96.
6. Barrow, p. 74.
7. Ian G. Barbour, "Creation and Cosmology," in *Cosmos as Creation: Theology and Science in Consonance,* edited by Ted Peters (Abingdon, 1989), p. 131.
8. John A. Wheeler, "Foreword," in John D. Barrow and Frank J. Tipler. *The Anthropic Cosmological Principle*

(Clarendon Press, 1986), vii-viii.
9. Quantum mechanics does allow this to be imagined mathematically.
10. Rupert Sheldrake, *The Rebirth of Nature: The Greening of Science and God* (Bantam Books, 1991), p. 133.
11. Michael Polanyi has written extensively on the futility of developing a theoretical understanding to human beings in impersonal terms; even though I have not made any direct references to his work, I am obviously deeply indebted to him.