

Quantum Cosmology and Creation

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Abstract

The results of modern cosmology represent an amazing feat in the combination of our knowledge of elementary particle physics and observational astrophysics. But the nagging questions remain: how did it all begin? When it began were there not certain initial conditions which determined how it would evolve? Most approaches require an origin of our specific universe from quantum fluctuations of a previous state: a collapsing previous state, a region of flat space-time, a previous black hole final state, etc. Such approaches, therefore, only address relative beginnings. They still leave us wondering about the origins of the previous state upon which the quantum fluctuations played out their game. What, if anything, do these quantum gravity considerations of the origin of the universe have to do with the theological considerations of the creation of the universe in time and from nothing (*creatio ex nihilo*)? Any attempt to simply identify the nothing (*nihilo*) of the theologians with the quantum fluctuations of one of the preexisting states or with the unbounded regime of quantum cosmology would only create confusion. But the one concept may illuminate the other.

Introduction

It is arguably difficult to find a more heated topic of discussion than that concerning the origins of the universe, and especially of life and of intelligence, and whether such origins can be understood without evoking a Creator God. Responses range from the extremes of some quantum cosmologists or a Church leader to almost all conceivable intermediate positions. Some quantum cosmologists claim that, if certain quantum cosmological theories of the origins of the universe without boundary conditions are correct, then we have no need of God. Pius XII attempted to claim that with Big Bang cosmologies scientists were coming to discover what had already been known from the Book of Genesis, namely that the universe had a beginning in God's creative action. In between we have such positions as evolutionary naturalism and episodic divine intervention. Evolutionary naturalists would claim that, although our scientific knowledge of evolution is limited, the best explanation of the universe and all that it contains is through the building of ever more complex entities in an expanding, evolving universe in which both deterministic and chance processes play out their roles in a universe abundant with opportunities, 13.8 billion years old and containing about 10^{22} stars. Those who profess episodic divine intervention would claim that divine

activity is required, at least in some phases of the evolutionary process and, in particular at the occurrence of human life and intelligence, because natural processes alone are not adequate to explain the end result. What is one who is both a believing Christian and a scientist to make of all of this?

The Search for Truth in Science

Skeptics, dubious of ever being able to find a widely accepted definition of science, say that science is what scientists do. The element of truth in this statement is that science is not a univocal concept. It varies from one discipline to another, even, for instance, among the so-called hard sciences. But there is also sufficient commonality among them that the name "science" can be legitimately given to each analogically. What do scientists do? We begin with controlled data, that is, data which any other trained professional could independently verify. From the observed data we develop a model which best explains the data. We will later on discuss what constitutes a "best explanation." There are many assumptions involved in this process of developing, for instance, our knowledge of the origin of the universe and of life within it. One of the principal ones is to assume that it is valid to apply the scientific laws which are derived from our knowledge of what happens on the earth to the universe as a whole. At any rate the movement from data to models is a continuously reciprocal process. We use the best model to determine what further data must be obtained. We then perfect the model with the new data, etc. There is a constant going back and forth from data to the model to the data. It is important to note that in the very nature of this process of reciprocity we admit that we do not possess the truth. The most that we can expect is that we are continually approaching the truth.

How do we know we are on the path to the truth in the scenario for the origins of the universe and of life within it? In the natural sciences there are a number of criteria whereby an explanation is judged to be best. We might list the principal criteria as the following: (1) verifiability or falsifiability, i.e., there is, at least in principle, a way of judging whether the explanation fits the data or not; (2) predictability, i.e., from data on past or present events it is possible to predict future events and then observe to see that the future events actually occur; (3) simplicity or economy, i.e., the least assumptions are made to get the greatest explanatory power; (4) beauty, i.e., the explanation has an aesthetic quality about it; although, especially for the natural sciences, this may appear to be a very subjective criterion, almost all great scientific discoveries have benefited from its application; (5) unifying explanatory power; i.e. not only are the observations at hand explained but the attempt to understand is also in harmony with all else that we know, even with that which we know outside of the natural sciences.

It is this last criterion which I would like to discuss, since it appears to me to extend the semantics of the natural sciences towards the realm of other disciplines, especially in the limited discussion of this paper, to Christian faith. Put in very simple terms this criterion is nothing else than a call for the unification of our knowledge. One could hardly be opposed to that. The problem arises with the application of this criterion. When is the unification not truly unifying but rather an adulteration of knowledge obtained by one discipline with the presuppositions inherent in another discipline? History is full of examples of such adulterations. It is for this reason that scientists have always hesitated to make use of this criterion. And yet, if applied cautiously, it appears to me to be a quite creative one for the advancement of our knowledge and, therefore, of religious faith. To what extent can what we know from science about the origins of the universe and the evolution of life influence our religious beliefs? And, on the other hand, to what extent can religious thought make a contribution to our scientific understanding of the origins and evolution of life in the universe? This twofold question poses the serious risk of transgressing upon the epistemological independence of the various disciplines: theology, philosophy, astrophysics, biology and cosmology, and creating, thereby, more confusion than understanding. As the discussion proceeds we must maintain a consistent posture of preserving the integrity of each of the disciplines, especially that between cosmology and theology. History has already shown how disastrous an effect the failure to preserve the integrity of the respective disciplines has had.

The supposition is that there is a universal basis for our understanding and, since that basis cannot be self-contradictory, the understanding we have from one discipline should complement that which we have from all other disciplines. One is most faithful to one's own discipline, be it the natural sciences, the social sciences, philosophy, literature, religious thought etc., if one accepts this universal basis. This means in practice that, while remaining faithful to the strict truth criteria of one's own discipline, we are open to accept the truth value of the conclusions of other disciplines. And this acceptance must not only be passive, in the sense that we do not deny those conclusions, but also active, in the sense that we integrate those conclusions into the conclusions derived from one's own proper discipline. This, of course, does not mean that there will be no conflict, even contradictions, between conclusions reached by various disciplines. But if one truly accepts the universal basis I have spoken of above, then those conflicts and contradictions must be seen as temporary and apparent. They themselves can serve as a spur to further knowledge, since the attempt to resolve the differences will undoubtedly bring us to a richer unified understanding.

The Search for Truth in Religious Belief

Too often discussions of the relationship between science and religion are carried out in very general terms. Such discourse can be quite unfruitful for two reasons. First, as compared to the natural sciences religion contains a larger measure of the subjective, of human experiences not totally verifiable by objective reasons. Such subjective experiences are not, of course, limited to religion. They are present in many areas of our lives. Nor need these experiences, religious or otherwise, necessarily conflict with reason. They simply are not limited to rational explanation. They go beyond what can be rationally justified. Secondly, while for the natural sciences we have a rather acceptable idea of what we mean by science, the very notion of religion is ill-defined. Does it mean worship? Does it mean being a "good person"? Does it mean accepting certain moral dictates that go beyond what is commonly accepted as good and bad? Does it mean accepting those dictates out of personal conviction or out of loyalty to a certain tradition? Does it mean believing in certain doctrines? Does it mean accepting a certain authoritative and hierarchical structure, i.e. being affiliated with a certain Church? To most of us religion would imply more of an affirmative than a negative answer to all of the above. And yet the situation is further complicated by the multiplicity of religions which differ among themselves, have even warred among themselves, over the responses given to such questions as the above. Even today, if we look at some of the main religious traditions: Islam, Judaism, Christianity, Buddhism, etc., we see not only vast differences among them, but enormous divisions within any one of the traditions.

The only way, therefore, that dialogue as a rational experience can take place is that, on the part of religion, the dialogue be limited to the rational foundations for religious belief. Even then, the only way that any such dialogue could have universal significance is that we could assume that there existed common rational foundations across all religious traditions and that is simply not the case. It seems, therefore, that any fruitful dialogue requires that the rational basis for certain specific religious beliefs in certain specific religious traditions be confronted with what is known from the natural sciences. The natural sciences, in particular, have made great advances by adhering rigidly to canons of what is scientifically true. In fact, in recent years the norms for judging the scientific truth of a given theory of life's origins and evolution have been extended, as I have discussed above, in the direction of inviting dialogue with philosophy and theology, and specifically within Christianity.

The best scientists are usually well aware of the limitations of their knowledge. Religious thinking also has its limitations. The excessively dogmatic approach which sometimes characterizes theology would do well to recognize this as it seeks for the understanding which truly nourishes Christian faith. Theology must deal with the linguistic interpretation of written documents; it must interpret oral

traditions; it must reconstruct history. It must establish a rational basis for accepting witnesses to historical events and it must determine when authority alone can be the source of certain truths. Above all there are the serious epistemological problems that arise from the relationship of theology to faith. Although theology is a science, a rational way of knowing in its own right, it is said to proceed from faith and to lead to an understanding of the faith (*fides quaerens intellectum*). This makes it subject to all of the false illusions that can arise from purely subjective behavior, and it must always struggle to separate those illusions from what is objectively true. It must above all in today's world confront our scientific knowledge of the origins of the universe and of the evolution of life.

In the Judaeo-Christian tradition the Creator is a conscious and loving person. The religious believer is tempted by science, however, to make God "explanation." We bring God in to try to explain things that we cannot otherwise explain. How did the universe begin? How did we come to be? We seize upon God, especially if we do not feel that we have a good and reasonable scientific answer to such questions. She is brought in as the Great God of the Gaps. True belief in God does not come about by proving God's existence through anything like a scientific process. God is not found as the conclusion of a rational process like that. God gave himself to us. That was not a miracle. It does make sense that there is a personal God who deals with us and loves us and who has given himself to us. Faith consists in coming to love God because we have accepted the fact that she first made the move towards us. The claim that all things are created is a religious claim that all that exists depends for its existence on God. It says nothing scientifically of how things came to be, although beautiful stories are told in the Book of Genesis, to elaborate on the dependence of all things for their existence upon God.

A Mutual Interaction: Scientific Cosmology and Christian Faith

Let us now examine the interaction between scientific cosmology and Christian faith. What is being proposed, for instance, when we speak of the fine tuning of the universe may be an invitation to return to an examination of the religious concept of the creation of the universe by God against the background of modern cosmologies. The inability to provide thus far a strictly scientific explanation to what is a strictly scientific problem, the fine tuning, may be an invitation to think that the explanation lies in a teleological consideration. It is important here to emphasize the word "invitation", so as to preserve the epistemological independence of the various disciplines. One is perfectly free to accept the invitation or not. One can stay firmly put within one's own discipline and continue to seek the answer there, uncontaminated by possible solutions arising elsewhere. But it seems to me that the invitation is a very real one and well-founded; it, therefore, also seems to me that it

requires serious reasons to reject it. Those serious reasons must confront the long history of religious thought that there is a person at the source of the existence of the universe and that said person had a purpose or a design in "creating" the universe, a design which included, perhaps even centered upon, our existence.

One of the most productive areas of research in modern cosmology is the application of quantum mechanics to an analysis of the origins and very earliest stages of the universe. It is important to note that our observational knowledge of these early stages of the universe is very limited. But we can argue back quite rigorously to the physical conditions which characterized those stages by applying physics and mathematics to what we observe in the universe today. Amidst the myriads of such observational data there are three principal observations which emerge and which allow us to reconstruct the early universe: (1) from the measurements of distant galaxies and clusters of galaxies we know that the universe is expanding with very precise conditions; (2) from the measurement of the abundances of helium, lithium, deuterium and other light elements, we know that much of that material had to be created under extremely high temperature and density conditions in the early universe; (3) from a measurement of the current temperature of the universe, the so-called cosmic background radiation, we can establish the temperature conditions of the early universe and the development of structure within the universe. When we combine all of this and other observations we can determine the age of the universe, its approximate mass and its mean density.

This summary of the results of modern cosmology represents an amazing feat in the combination of our knowledge of elementary particle physics and observational astrophysics. But the nagging questions remain. How did it all begin? When it began were there not certain initial conditions which determined how it would evolve? Did the universe really come to be in all its specificity from quantum fluctuations at its origin? Such considerations also suffer from problems of verifiability. The question also arises as to whether they really provide ultimate explanations.

It is precisely here, I believe, that the semantics of science and of Christian faith might fruitfully interact. Many of the concepts which are essential ingredients in the cosmological models have important implications in religious thought and those implications must also enrich cosmological thinking, so that the latter may have the greatest unifying explanatory power, a criterion for its veracity. In exploring these implications, however, it is essential that the fundamental significance of the concepts in the various disciplines not be confused. On the other hand the precise thrust of interdisciplinary dialogue is that a wider perspective will be gained on the

fundamental reality by inter-relating the concepts arising from the diverse disciplines.

In most of the Hot Big Bang cosmological models the universe had a beginning. That beginning at time equals zero is a mathematical singularity. It cannot be addressed by classical mathematics or physics. To avoid that singularity it is claimed that quantum gravity must be applied at the extreme conditions of the universe's beginning. During this quantum gravity regime, however, the concept of time is inapplicable in any simple way. Most approaches require an origin of our specific universe from quantum fluctuations of a previous state: a collapsing previous state, a region of flat space-time, a previous black hole final state, etc. Such approaches, therefore, only address relative beginnings. They still leave us wondering about the origins of the previous state upon which the quantum fluctuations played out their game. What, if anything, do these quantum gravity considerations of the origin of the universe have to do with, for instance, the religious considerations of the creation of the universe from nothing (*creatio ex nihilo*)?

Any attempt to simply identify the nothing (*nihilo*) of the religious thinker with the quantum fluctuations of one of the preexisting states would, to my mind, create nothing but confusion. But the one concept may illuminate the other. The thrust of the "from nothing" for the religious thinker is to assert the total and exclusive dependence of the universe upon God the Creator. There was no rival to God preexisting before the universe began and in its beginning and continuation it depends on God. I cannot see how the scientific concepts deny or challenge the religious ones and they may even be illuminated by them. It would be equally confusing to deny the existence of God by stating that, since no boundary conditions were required for the quantum cosmological origin of the universe, God is not required. The God of the religious person is not a boundary condition for the universe. She is the creator, whatever content that notion of creator might have.

The key to understanding the difference between creation and origins is the notion of change. Changes in nature are the object of study for the natural sciences. From pure energy to matter, from hydrogen to hydrocarbons, from giant molecular clouds to star clusters, from single cells to organs, from amino acids to the human brain - these are all objects of investigation for the natural sciences. They all require an existing entity which changes. The natural sciences do not deal with the issue of existing at all; they deal with existing in a specific way and the changes in nature, which bring about specific ways of existing. Creation, on the other hand, speaks to the very existence of whatever exists. It does not speak to change. Creation does not deal with the chain of events which bring about a specific kind

of being. It deals with the source of being of whatever exists. It does not address the evolution of one kind of being from another. To create, therefore, is not to work on or with some already existing material. Creation is not, therefore, a cause in the usual sense of the word. Or, if you wish, creation is the *complete* cause of all things. Such a complete causing is precisely what the act of creation is. Thus, to create is to give existence to whatever exists in a specific way. To create does not mean to take “nothing” and make “something” out of it, in the sense of changing it from not being to being. To exist means to depend upon a source of existence. So, creation is not exclusively, nor even primarily, some distant event; to create is the continual, complete causing of the existence of whatever is.

So there can, in principle, be no necessary conflict between the doctrine of creation and any scientific explanation of origins. The natural sciences seek to account for change and the origins of change. Whether the changes described are biological or cosmological, have a beginning or not, are unending or temporally finite, they remain processes. Creation accounts for the existence of things, not for changes in things. So, given that something exists, how life originated from this something is a scientific question. Why there is something rather than nothing is not a scientific question.

Religious perceptions of beginnings speak of creating out of nothing (*creatio ex nihilo*). There is a persistent confusion between cosmological and metaphysical/religious conceptions of “nothing.” Quantum cosmological views of the beginning of the universe speak of “vacuum fluctuations” and some are tempted to equate this “vacuum” with the “nothing” of the theologians. This is quite incorrect. The “vacuum” of quantum mechanics is something, if only a mathematical concept. To speak of “creation out of nothing” in philosophy or theology means that one is denying that any matter at all is changed or transformed into something else. The expression “out of nothing” or “from nothing” is, at its root, a denial of any material cause whatsoever in the act of creation.

In our discourse on beginnings we find it necessary to speak in a temporal framework. The creator is considered to be prior to what is created, but the priority is in fact not temporal. The relationship is metaphysical not temporal. To be created out of nothing does not mean that the creature is *first* nothing and *then* something. It means that the creature has a dependent existence. Ancient philosophers of nature thought that the universe was eternal in the sense that it had no beginning. Some cosmologists propose that the very notion of temporality is a subsidiary concept. Neither view challenges the fundamental metaphysical truth that the universe is created. Some also propose that there is “eternal inflation,” an endless series of universes within universes. Still, all such universes would require

creation in order to be. Nor is there a contradiction in the notion of an eternal created universe. For, even if the universe had no temporal beginning, it still would depend upon a creator for its very being. The radical dependence on a fundamental source of being as the “cause” of being is what creation means.

Scientific Evolution and the Quest of Christian Faith

If we were to pursue the dialogue which I have outlined in this paper, we might soon come to see that a teleology and design in the universe, derived from a religious point of view, are not incompatible with our scientific knowledge of life’s origins and evolution. Or we would come to realize that inevitable tendency in the physical universe towards more complex structures is an invitation to think beyond science to a deeper synthesis of our understanding of scientific evolution and our Christian faith. The important thing to realize is that in both the scientific and the religious approaches to understanding we are searching for the truth, which we do not yet possess. But it is clear that evolution is an intrinsic and proper characteristic of the universe. Neither the universe as a whole nor any of its ingredients can be understood except in terms of evolution. And evolution is a daily happening. We, for instance, are constantly exchanging atoms with the total reservoir of atoms in the universe. Each year 98% of the atoms in our bodies are renewed. Each time we breath we take in billions and billions of atoms recycled by the rest of breathing organisms during the past few weeks. Nothing in my genes was present a year ago. It is all new, regenerated from the available energy and matter in the universe. My skin is renewed each month and my liver each six weeks. In brief, human beings are among the most recycled beings in the universe.

How are we to interpret the scientific picture of life’s origins in terms of religious belief? Does our knowledge of scientific evolution affect the semantics of Christian faith? It would be a mistake, I think, to require a belief in God to provide a scientific explanation of origins and evolution. In fact, to need God would be a very denial of God. God is not the response to a need. One gets the impression from certain religious believers that they fondly hope for the durability of certain gaps in our scientific knowledge of evolution, so that they can fill them with God. This is the exact opposite of what human intelligence is all about. We should be seeking for the fullness of God in creation. We should not need God; we should accept her when she comes to us.

It is unfortunate that creationism has come to mean some fundamentalist, literal, scientific interpretation of Genesis. Judaic-Christian faith is radically creationist, but in a totally different sense. It is rooted in a belief that everything depends upon God,

or better, all is a gift from God. The universe is not God and it cannot exist independently of God. Neither pantheism nor naturalism is true.

But if we confront what we know of origins scientifically with religious faith in God the Creator, in the senses described above, what results? I would claim that the detailed scientific understanding of origins has no bearing whatsoever on whether God exists or not. It has a great deal to do with my knowledge of God, should I happen to believe she/he exists. Our scientific knowledge of evolution should definitely have a bearing on the semantics of Christian faith. Let me explain.

Take two rather extreme scientific views of origins: that of Stephen Gould of an episodic, totally contingent and, therefore, non-repeatable evolutionary process as contrasted to a convergent evolutionary process such as that of Christian de Duve, in which the interplay of chance, necessity and opportunity leads inevitably to life and intelligence. In either case, it is scientifically tenable to maintain an autonomy and self-sufficiency of the natural processes in a natural world, so that recourse to God to explain the origins of all that exists, is not required. It is not a question of chance in nature, excludes God; destiny in nature requires God. In neither case is God required.

If, however, I believe in God then what nature tells me about God in one case is very different from what nature tells me about God in the other. Please note that I am not calling upon faith to adjudicate between contrasting scientific viewpoints. I do think that convergent evolution is more consistent with God's revelation of himself in the Book of Scripture, so that, as Galileo was fond of stating, the Book of Scripture and the Book of Nature speak of the same God.

If we take the results of modern science seriously, it is difficult to believe that God is all-powerful and all-knowing in the sense of the scholastic philosophers. Science tells us of a God who must be very different from God as seen by the medieval philosophers and theologians. Could, for instance, God after a billion years in a fourteen billion year old universe have predicted that human life would come to be? Let us suppose that God knew all of the laws of biology, chemistry and physics, knew all of the fundamental forces. Even then could God know with certainty that human life would come to be? If we truly accept the scientific view that, in addition to necessary processes and the immense opportunities offered by the fertile universe, there are also chance processes, then it would appear that not even God could know the outcome with certainty. God cannot know what is not knowable. The theologian, of course, would have a different answer. God is transcendent, outside of space and time. All events are simultaneous to him. But I have wished to

stress God's immanence in a universe where our scientific knowledge of the origins of life must have a bearing upon the semantics of our Christian faith.

This stress on God's immanence is not to place a limitation upon God. Far from it. It reveals a God who made a universe that has within it a dynamism and thus participates in the very creativity of God. Such a view of creation can be found in early Christian writings, especially in those of St. Augustine in his comments on Genesis. If they respect the results of modern science, religious believers must move away from the notion of a dictator God, a Newtonian God who made the universe as a watch that ticks along regularly. In the semantics of religious faith God should perhaps be seen more as a parent or as one who speaks encouraging and sustaining words. Scripture is very rich in these thoughts. It presents, indeed anthropomorphically, a God who gets angry, who disciplines, a God who nurtures the universe. Theologians already possess the concept of God's continuous creation. To integrate the results of modern science with this notion of continuous creation would be a very enriching experience for theologians and religious believers. God is working with the universe. The universe has a certain vitality of its own like a child does. It has the ability to respond to words of endearment and encouragement. You discipline a child but you try to preserve and enrich the individual character of the child and its own passion for life. A parent must allow the child to grow into adulthood, to come to make its own choices, to go on its own way in life. Words which give life are richer than mere commands or information. In such wise does God deal with the universe.

These are very weak images, but how else do we talk about God. We can only come to know God by analogy. The universe as we know it today through science is one way to derive analogical knowledge of God. For those who accept that modern science does say something to us about God, it provides a challenge, an enriching challenge, to traditional beliefs about God. God in his infinite freedom continuously creates a world which reflects that freedom at all levels of the evolutionary process to greater and greater complexity. God lets the world be what it will be in its continuous evolution. She does not intervene, but rather allows, participates, loves. Is such thinking adequate to preserve the special character attributed by religious thought to the emergence not only of life but also of spirit, while avoiding a crude creationism? Only a protracted dialogue will tell.