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Ethical Implications of Human Origins in the Universe

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Introduction

The thrust of my paper is to draw conclusions, from our scientific knowledge of the universe and our place in it, about the ethical nature of the universe and, therefore, of ourselves. It is my opinion that most of the time discussions on morality and ethics lack this fundamental basis. On the other hand, concrete ethical decisions concerning the sciences are directed to the research methods used or to the engineering use of the results of scientific research. The fundamental right to seek the truth and, therefore, to pursue scientific research as such, is neutral with respect to morals and ethics.

We are evolutionary products of an expanding evolving universe. But, as far as we know up this point of our research, we are also special products. The natural sciences (physics, chemistry, biology and the sciences that derive from them) are by their own methodology limited to the material world. Religious,

philosophical or theological implications that are drawn from scientific results are not science; they, if you will, transcend the natural sciences. I would like first to discuss the best scientific theories we have to date on the coming to be of the human being in the universe. When I say "theories" I do not mean sheer speculation. On the other hand, no scientist would claim to have the ultimate truth about anything. I will return later to discuss this.

The Evolutionary Universe

Let us take a sweeping view of a reasonable scientific picture of things. If we look today in infrared light at the center, for instance, of the Orion Nebula or any other such nebula we see boiling gas and dust. The fact is that stars are being born in this gas. And where the hottest, most massive and, therefore, brightest stars are already born, they are irradiating the gas, and it is giving off hydrogen alpha radiation which is in the red region of the spectrum. In this way we can identify star birth regions. The region of star birth in Orion is just a little part of our Milky Way. Our Milky Way, like most other spiral galaxies measures 100,000 light years across and it contains about a hundred billion stars. It has several extensive spiral arms and the sun is located in one of the outer arms, about two-thirds of the distance from the nucleus of our galaxy. Like all spiral galaxies our Milky Way is a very flattened system. It is about 200 times longer than it is thick. We are located in this "equatorial plane" of the Galaxy.

How is a star born? It happens by the laws of physics. A cloud of gas and dust, containing about 100 to 1,000 times the mass of our sun gets shocked by a supernova explosion or something similar and this causes an interplay between the magnetic and gravity fields. The cloud begins to break up and chunks of the cloud begin to collapse. And as any gas collapses, it begins to heat up; as it expands, it cools down. In this case the mass is so great that the internal temperature reaches millions of degrees and thus turns on a thermonuclear furnace. A star is born. Thermonuclear energy is the source whereby a star radiates to the universe. You need a very hot piece of the universe to do this, and so you can only get this thermonuclear furnace by having a cloud collapse and raise the temperature. You can only get it, in other words, in stars, with one exception, namely, in the very hot early universe before galaxies or stars were born. But the universe expanded rapidly and cooled down so that it could no longer support a thermonuclear furnace.

Stars also die. A star at the end of its life can no longer sustain a thermonuclear furnace and so it can no longer resist against gravity. It collapses for a final time, explodes and expels its outer atmosphere to the universe. So stars are born and stars die. And as they die they spew left over star matter out to the universe. The birth and death of stars is very important. If it were not happening, you and I would not be here, and that is a scientific fact. In order to get the chemical elements to make the human body, we had to have

three generations of stars. A succeeding generation of stars is born out of the material that is spewed out by a previous generation. But now notice that the second generation of stars is born out of material that was made in a thermonuclear furnace. The star lived by converting hydrogen to helium, helium to carbon, and if it were massive enough, carbon to oxygen, to nitrogen, all the way up to iron. As a star lives, it converts the lighter elements into the heavier elements. That is the way we get carbon and silicon and the other elements to make human hair and toe nails and all of those things. To get the chemistry to make amoebas we had to have the stars regurgitating material to the universe.

Obviously this story of star birth and death is very important for us. Out of this whole process around one star, which we call the sun, a group of planets came to be, among them the little grain of sand we call the Earth. An amazing thing happened with that little grain of sand when, in the 16^{th} and 17^{th} centuries with the birth of modern science, we developed the capacity to put the universe in our heads. We do that by using mathematics, physics, chemistry and biology. Once this happened, we became moral beings with a responsibility to the universe, to ourselves and to one another. We shall discuss this later on in more detail.

Let us now review what we know of the history of the expanding universe (Fig. 1). As it aged, distances got larger in the universe. As this happened certain key events took place. Quarks combined to form elementary particles,

which in turn formed atoms and then molecules. The universe became transparent and the cosmic background radiation came to be. Galaxies and stars were formed. The first microscopic life forms came to be after 10 to 12 billion years in a 14 billion year old universe. Why did it take so long to make even an amoeba? We have already discussed one reason. We did not have the chemistry to make even an amoeba until we had had three generations of stars.

Human Origins

How did we humans come to be in this evolving universe? It is quite clear that we do not know everything about this process. But it would be scientifically absurd to deny that the human brain is a result of a process of chemical complexification in an evolving universe (Fig. 2). After the universe became rich in certain basic chemicals, those chemicals got together in successive steps to make ever more complex molecules (Figs. 3 and 4). Finally in some extraordinary chemical process the human brain came to be, the most complicated machine that we know. I should make it clear that, when I speak about the human brain as a machine, I am not excluding the spiritual dimension of the human being. I am simply prescinding from it and talking, as a scientist, about the human brain as a biological, chemical mechanism, evolving out of the universe.

It is clear from the above 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.

Did we come to be by chance or by necessity in this evolving universe? Was it destined to happen? The first thing to be said is that the problem is not formulated correctly. It is not just a question of chance or necessity because, first of all, it is both. Furthermore, there is a third element here that is very important. It is what I call “fertility.” What this means is that the universe is so prolific in offering the opportunity for the success of both chance and necessary processes that such a character of the universe must be included in the discussion. The universe is 13.7 billion years old, it contains about 100 billion galaxies each of which contains 100 billion stars of an immense variety.

We might illustrate what fertility means in the following way. Einstein said

that God does not play at dice. He was referring specifically to quantum mechanics, but it can be applied in general to his view of the universe. For him God made a universe to work according to established laws. This is referred to as a Newtonian Universe. It is like a clock that just keeps ticking away once you supply it energy. Today we might be permitted to challenge this point of view. We could claim that God does play at dice because he is certain to win. The point being made is that God made a universe that is so prolific with the possibilities for these processes to have success that we have to take the nature of the universe into consideration when we talk about how we came to be.

For 13.7 billion years the universe has been playing at the lottery. What do I mean by the lottery? I mean challenging chance. When we speak about chance we mean that it is very unlikely that a certain event would happen. The "very unlikely" can be calculated in mathematical terms. Such a calculation takes into account how big the universe is, how many stars there are, how many stars would have developed planets, etc. In other words, it is not just guesswork. There is a foundation in fact for making each successive calculation.

A good example of a chance event would be two very simple molecules wandering about in the universe. They happen to meet one another and, when they do, they would love to make a more complex molecule because that

is the nature of these molecules, the laws of chemical combination. But the temperature and pressure conditions are such that the chemical bonding to make a more complex molecule cannot happen. So they wander off, but they or identical molecules meet billions and billions of times, trillions if you wish, in this universe, and finally they meet and the temperature and pressure conditions are correct. This could happen more easily around certain types of stars than other types of stars, so we can throw in all kinds of other factors.

The point is that from a strictly mathematical analysis of this, called the mathematics of nonlinear dynamics, one can say that as this process goes on and more complex molecules develop, there is more and more direction to this process. As the complexity increases, the future complexity becomes more and more predetermined. In such wise did the human brain come to be and it is still evolving. Can we call this process “destiny?”. An approach to answering this question is illustrated by the tree to the left in Fig. 5. It represents everything that has ever happened in the universe, the interactions of chance and necessity in a fertile universe, as I have explained. Even those processes that failed due to chance are represented. If we clean the tree by blowing a nice breeze through it, we will see what is represented to the right in Fig. 5, which represents what we might call an “intrinsic destiny.” By this I mean an apparent destiny that has come about by the very nature of the universe and which, therefore, from a scientific point of view does not require a designer. Note that, as a scientist, I have neither denied nor affirmed that God created the universe to have this nature. If asked, I will certainly as a religious believer

affirm it to be so.

The Search for Truth

Let us pause for a moment to review the degree of certainty which we can place in the above scenario. We certainly do not have the scientific knowledge to say how each living creature came to be in detail. We do not know precisely how each more complex chemical system came to contribute to the process of self organization which brought about the diversity of life forms as we know them today. Most importantly, we do not know with scientific accuracy the sufficient elements in nature to have brought about the unbroken genealogical continuity in evolution that we propose actually happened. There are, in brief, epistemological gaps which prevent natural science from saying that a detailed theory of biotic evolution has been proven. What we have presented is the most adequate account conceivable at this time considering the available empirical data. And that empirical data, with respect to biotic evolution, comes from various independent scientific enterprises, including molecular biology, paleontology, comparative anatomy, cosmology, etc.

How do we know we are on the path to the truth in the scenario of life's origins just described? In other words how do we judge what is the best way to explain life's origins. In the natural sciences there are a number of criterion whereby an explanation is judged to be best. I would list the principal criteria

as the following: (1) verifiability, i.e., there is, at least in principle, a way of judging whether the explanation fits the data; (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 benefitted 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 epistemological nature of the natural sciences towards the realm of other disciplines, such as religious thought, and, therefore, provides a basis for discussing morality and ethics. 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 most creative one for the

advancement of our knowledge.

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.

If we were to pursue the integration which I have outlined above, 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 cosmological models, derived from the scientific point of view. Or we would come to realize that the inevitable tendency in the physical universe towards more complex structures is not incompatible with, for instance, human free will. In fact, as a deeper synthesis of the understanding of the whole unfolded through dialogue among the various disciplines it is very likely that the questions peculiar to each discipline would receive a more satisfactory answer. 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.

Schema for Ethical Considerations

The integration of the scientific and religious approaches, including philosophy and theology, are absolutely necessary to have an ethics. A schema which outlines the basis for such an integration by showing a hierarchy of objects which have evolved in the universe, is shown in Fig. 6 and a schematic representation of the various ways of knowing, consequent upon the hierarchy in Fig.6, is shown in Fig.7. From these an attempt at representing the integration itself is shown in Fig. 8.

In Fig. 6 we show an emergence of increasingly complex objects in the expanding universe from the Big Bang (13.7 billion years ago) until today. At each increasing level of being new objects emerge which are not simply an assemblage of objects a the lower level: a molecule is not simply an assemblage of atoms; an insect or a human being are not simply assemblages of cells or organs. Corresponding to this ontological ladder of beings is an increasing complexity in our way of knowing as shown in Fig. 7. I summarize all of this in Fig.8 where there is shown a branching in our knowledge after biology and the other basic sciences to the natural sciences to the left and the social sciences to the right. I have indicated in the figure what I have previously

mentioned, that it is the capacity of self-reflection that determines the branching leading to ethics. For our purposes the most important elements for the discussion of ethics are contained in the box at the top of the figure and delineated by the dashed lines. But I must also add the importance, as we shall see, of the line to the left leading up to cosmology and, transcending the natural sciences, carrying on to morality. By morals I mean the foundations for ethical decisions, partially based upon but transcending our scientific knowledge (hence the dashed lines). With this foundation ethics is placed at the top of the social sciences branch to the right in that ethics is the process of making moral decisions in a social context. God, of course, must be placed in the top center of the box since he is not only the source of all else but also because God's nature, together with our knowledge of the universe, determine our ethical decisions. And so in this context we must say a word about God and then about the universe.

The religious believer is tempted by science 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?" and all such questions. We sort of latch onto God, especially if we do not feel that we have a good and reasonable scientific explanation. He is brought in as the Great God of the Gaps. I have never come to believe in God, nor do I think anyone has come to believe in God, by proving God's existence through anything like a scientific process. God is not found as the conclusion of a rational process

like that. I believe in God because God gave himself to me. That was not a miracle. It does make sense that there is a personal God who deals with me and loves me and who has given himself to me. I have never come to love God or God to love me because of any of these reasoning processes. I have come to love God because I have accepted the fact that he first made the move towards me.

Although God transcends the universe, he is working in it through his providence and continuous creation. 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 certain dynamism and thus participates in the very creativity of God. In such wise God emptied himself so that he could share his infinite love with his creation. Such a view of God's relationship to his 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. Perhaps God should 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. I think to explore modern science with this notion of continuous creation and of God's emptying of himself 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 believe 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 love and 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. He 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.

To my mind the universe, seen scientifically by cosmologists as we have

described it above, reflects this notion of God. In evolving the universe empties itself. Stars must die that we might come to be. In the evolution of living systems natural selection leaves only a very few to survive by adaption to the environment. To date about 95 % or more of living species have disappeared so that the universe might realize ever more complex systems. If the grain of wheat does not fall into the ground and die, there will be no crop next year. In this context I would like to cite the words of St. Paul in his *Letter to the Romans* (8: 22-24):

> From the beginning till now the entire creation, as we know, has been groaning in one great act of giving birth; and not only creation but all of us who possess the first fruits of the Spirit ..."

"All of us" makes it quite clear that we participate in the universe in its process of emptying itself as it evolves.

The conclusion to be drawn for both what we know of the universe and what we can surmise about God is that the supreme moral principle which should guide all of our ethical decisions is to empty oneself for the good of others. While this may appear to be quite idealistic and unrealizable in society, it must be accepted, in my opinion, as the fundamental way to judge the good or the bad of ethical decisions. It aims to raise the morality of the group, of our whole social structure, to create a community in which each individual accepts a responsibility for the others so that ideally no one is lacking. Such

a morality cannot be imposed by coercion or by law, it can only be a guiding principle, an invitation to be freely chosen. It entails self sacrifice based upon love, a participation in God's love who emptied himself in creating the universe.

Figure Captions:

Fig. 1: The expanding universe. As time passed since the origins in the Big Bang until today (13.7 billion years later) the distances between objects that have emerged has continued to increase.

Fig. 2: The human brain is the result of an evolutionary process in the expanding universe through which ever more complex organisms came to be. This happened through what is called "chemical complexification" (see Figs. 3 and 4).

Fig. 3: Chemical complexification. As evolution continued the simplest atoms and molecules (H, C, N and O) combined to form ever more complex molecules such as the sugars and amino acids, the building blocks towards life.

Fig. 4: A complex molecule as the result of "chemical complexification." Note that H, C, N and O are the fundamental elements. Carbon is especially noteworthy.

Fig. 5: A tree represents the evolutionary universe. At the left the tree still bears all of its dead leaves and branches; nothing that has emerged in the universe has disappeared, even those objects and events which did not succeed in surviving through the process of increasing "chemical complexity." If we allow a pleasant breeze to blow away all of those failed objects and processes we see something like the branching trunk at the right. Because of the nature of "chemical complexity" there is a certain natural intrinsic direction to the tree's branching.

Fig. 6: A hierarchy of ever more complex objects which have appeared as the universe aged.

Fig. 7: The various ways of knowing which result from the degree of complexity of the objects that have emerged in the evolution of the universe, as shown in Fig. 6.

Fig. 8: A schematic attempt to integrate our ways of knowing as a basis for morality and ethics. The rectangle at the top is defined by dashed lines to indicate that knowledge contained there transcends scientific knowledge. However, the line to the left leading up through the natural sciences is directed towards "morals." and that to the right to "ethics." This is to illustrate that those sciences are at the basis of morals and ethics.