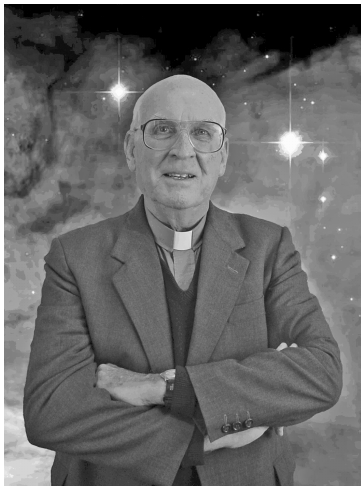


Biography



Professor George V. Coyne, S.J. (Societas Jesu), obtained his PhD in Astronomy from Georgetown University (Washington, DC) in 1962 and the Licentiate in Theology from Woodstock College (Maryland) in 1966. In addition he has received PhD degrees *honoris causa* from St. Peter's University (New Jersey), Loyola University (Chicago), The University of Padua (Italy), the Jagellonian University (Krakow, Poland), Marquette University (Milwaukee) and Boston College (Chestnut Hill, Massachusetts). Since 1966 he has been associated with astronomy programs at the University of Arizona (Tucson) and from 1976 to 1980 he served in various capacities in the administration of the astronomical

observatories at that university. From 1978 to 2006 he was Director of the Vatican Observatory (Specola Vaticana), which has its headquarters at Castel Gandolfo (Rome, Italy) and a research branch at the University of Arizona in Tucson. His research interests have ranged from the study of the lunar surface to the birth of stars; and he pioneered a special technique, polarimetry, as a powerful tool in astronomical research. Currently he is studying cataclysmic variable stars, the interstellar dust in the Magellanic Clouds and the detection of protoplanetary disks. Parallel to his scientific research he has developed an interest in the history and philosophy of science and in the relationship between science and religion. In 2008 he received the Mendel Medal.[†] “The Mendel Medal is awarded to outstanding scientists who have done much by their painstaking work to advance the cause of science, and, by their lives and their standing before the world as scientists, have demonstrated that between true science and true religion there is no intrinsic conflict.”

[†]Villanova University (2008). Villanova Co-sponsors “Gregor Mendel: Planting the Seeds of Genetics,” at Academy of Natural Sciences, May 24 - Sept. 28, <http://www.villanova.edu/events/yearofmendel>.

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Evolution and Intelligent Design. Who Needs God?

GEORGE V. COYNE

*Vatican Observatory
V-00120 Vatican City State
gcoyne@specola.va*

1. Introduction

One of the principal issues involved in the debate about the supposed insufficiency of neo-Darwinian evolution and the contested validity of intelligent design explanations for biological phenomena is that to do with the meaning of science itself, as it has been understood since the time of Galileo. As a background to defending my claim that the intelligent design explanations are not science, I wish to present a fundamental distinction which is at the basis of understanding what science does and what it cannot, as such, do. This is the distinction between what is meant by “origins” and what is meant by “creation.” In so doing I wish to set a cosmological background to the discussion of biological evolution. Then I will give a brief history of scientific methodology in order to substantiate my claim that the intelligent design movement lies outside of that methodology.

2. Origins and Creation

The key to understanding the difference between creation and origins is the notion of change (Carroll 2003). 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 did life originate from this something is a scientific question. Why is there 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 actually 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.

To affirm creation or to deny it on the basis of scientific theories represents a fundamental misunderstanding of both origins and creation. The Big Bang described by modern cosmologists is not creation. The evolution of life in the universe is not creation. Creation is not one of the ways in which the universe itself or life in it might have come to be. Creation speaks to the ultimate reason for the existence of all things. The natural sciences seek for the ways in which things came to be, their origins. It is mistaken, therefore, to conclude that there are implications for a creator if the universe is completely self-contained, with no singularities or boundaries, and completely described by a unified theory. One mistake which is made by those who use scientific theories to deny creation is the old error of thinking that to create means to be an agent cause of change.

Some cosmologists speak of “self-reproducing universes”; but these are not self-creating universes. Others speak of the universe’s inflating itself “out of nothing in an instant.” Such physical-mathematical theories serve to explain much that is observed of the universe as a whole. However, the need to explain the existence of things does not disappear as a result of new scientific explanations which propose to account for various changes which have occurred in the universe.

3. A Brief History of Scientific Methodology

In order to understand the nature of modern science it will be useful to review its history. All ancient civilizations in Egypt, Mesopotamia, Greece and many other parts of the world have left evidence of an early stage of intellectual development at which the discourse about nature was framed in the ordinary language of interpersonal communication between human beings. Consequently, nature was conceived as a kind of all-embracing society or state, the rulers of which were a number of more or less powerful gods, spirits and demons (Jacobsen 1949, Pritchard 1955). The arbitrary will of the gods of nature was behind everything, serving the human as a reasonable, or at least intelligible, explanation of all phenomena. There was no split between nature and culture.

The old mythological conception of nature gradually began to yield to the new idea that the phenomena of nature did not appear as a consequence of the free decisions of its gods, but because they had to appear as a consequence of an inner necessity which forced them to do so. This was a stark denial of the wisdom of all previous ages and as such it provoked an intellectual upheaval compared with which all later “scientific revolutions” appear as mere ripples on the surface of that ocean of thought which was first stirred by that band of innovators who have become known as the Presocratic Philosophers.

Looking back upon this development, which ultimately changed the intellectual outlook of a great part of all mankind, one cannot help but be struck by the sheer linguistic difficulties of the whole undertaking. We have no evidence that the Ionian thinkers stated this problem in so many words; but we can clearly see how they grappled with it and tried to solve it in two very different ways: by metaphor and by mathematics.

Throughout the centuries the Greek philosophers pursued numerous experiments in the metaphorical use of ordinary language. The result was a new vocabulary of technical terms the metaphorical origin of which went into oblivion in the course of the long process which gradually made the Greek world familiar with the idea of a non-mythological account of the ways of nature. The age-long mythological discourse on nature had been framed in the ordinary language of human affairs in which there simply were no words for the abstract ideas which the new discourse tried to work out. For example when Herodotus tried to say that the sun was the “cause” of the inundation of the Nile river he had no such word at his disposal. What he actually said was that the sun was the *aitia*

(Herodotus, *Historia*, II, 26) of the swelling of the waters, using a well known Greek word which was in common use as a term denoting the guilt which a criminal brings upon himself by committing his offence. In other words, Herodotus said that the sun was “guilty” of the inundation. Taken in the literal sense this was a rather astonishing and perplexing statement. It made the sun a criminal and even an habitual criminal since he committed his “crime” year after year. Moreover, his crime was no crime at all, but a universal blessing for all the land of the Egyptians.

What has happened is a good example of a general pattern in which a common word is lifted out of its everyday context and used metaphorically in a different field of thought as a means of expressing an idea that is homeless in ordinary language. Examples of similar procedures are legion. For instance, the fundamental idea of the inherent necessity in nature with which the new discourse would stand or fall was expressed by the word *ananke*. This belonged to ordinary language in a sense which appears in Herodotus’ story about a criminal cowherd who was apprehended by the guards and forced to confess his offence under stress of “necessity” (*ananke*, Herodotus, *Historia*, I, 116; cf. the similar use of the word in Homer, *Odyss.*, VI, 136). In general the word *ananke* was used of all the means, from persuasion to torture, by which a criminal could be forced to confess because he was unable to resist them. Now it was adopted by the new philosophers who used it to denote that hidden connection in nature which forces the phenomena to appear in an irresistible way.

A very different solution than metaphor was discovered by the Pythagoreans. This discovery of a mathematical alternative to the metaphorical discourse about nature had far-reaching consequences. Since then science has never forgotten that nature contains necessary, internal connections which only mathematics is able to disclose and express. However, this new insight had to fight for its survival. Aristotle had already fought this special conception of the mathematical discourse on nature on several fronts. In the final chapter of the *Metaphysics* he raised his voice against numerological speculations in a rhetorical manner in marked contrast with his usual style, as if he were almost emotionally involved in this question (Heath 1949). This stems from Aristotle’s particular concept of philosophical knowledge in general and natural knowledge in particular. Here the key word is “cause.” The point is that any account of nature must remain incomplete if it ignores one or more of the four causes: material, formal, efficient and final. If a philosopher does not discover them he has not reached his goal. While the mathematician is not concerned with final

causes the natural philosopher is obliged to study all the four types of causation (Aristotle, *Phys.*, II, 7, 198a). When all is said and done Aristotle would have refused to admit not only the mathematician but also the mathematical physicist to the kingdom of final causation with the obvious inference that the purely mathematical discourse on nature contributes nothing to the quest for wisdom and is unable to shed any light upon the ultimate questions of human existence.

But it is impossible to realize what happened in both Hellenistic and later science without admitting the existence of another great tradition, which may be properly named after Archimedes. This tradition is characterized by a consistent use of the language of mathematics and by a general disregard of causal and teleological explanations (Drachman 1967). The Archimedean approach was fruitfully adopted by medieval scholars and both Galileo and Kepler used it to lay the foundations of modern mechanics and astronomy. So, even if Archimedes failed to comply with Aristotle's insistence on causal explanations as the hallmark of a scientific description, it is impossible to ignore the fact that over the ages the Archimedean tradition was able to produce an ever increasing body of insights into the connections of the phenomena of nature, insights that were obtained thanks to mathematical discourse and could not have been obtained or expressed in any other way. And it gives food for thought that Archimedes' results in mechanics are valid even today when Aristotle's causal explanations have largely fallen into oblivion.

Into this world torn by conflicting views on the proper discourse on nature and the true relations between God and human beings Christianity emerged from its obscure origin in Palestine. At first sight it would seem that it must stay out of the philosophical battle as a non-combatant who was singularly uninterested in the scientific achievements of the Greeks. There is no treatise on cosmology in the New Testament and extremely few references to particular elements of the Greek account of the universe. All efforts are spent on the proclamation of the belief that the birth, life, death and resurrection of Jesus had radically changed the way in which the relations between God and the world should be envisaged.

From the religion of Israel, Christianity also inherited the belief that the one Lord of the world is also its Creator (Clifford 2000, Anderson 1984). Time and again the Old Testament underlines the fact that the world is created. This is almost always understood in the sense that it has come into being independently of man and without human assistance. "Where were you when I laid the foundations of the earth?" (Book of Job, 38, 4) was God's question to Job.

However, the Biblical doctrine of creation seems to be marked by a paradox. On the one hand there is a chasm between God and His creatures. Nothing in nature is divine. On the other hand, the created world is said to testify to the divinity of its creator. God must be present within it in such a way than man can recognize it as created. The beginning of the gospel of St. John indicates a solution of this dilemma. "In the beginning was the logos, and the logos was with God, and the logos was God. He was in the beginning with God. All things came into being through him, and without him not one thing came into being." (Gospel of John, I, 1) When the fourth Gospel opens by saying that: "In the beginning was the logos," it looks at first sight like the introduction to a Greek philosophical treatise. To use the word in a Christian context was an important step towards assimilating the conception of the world as a rational structure according to the basic tenet of Greek philosophy.

Despite its apparent ignorance of all matters scientific the New Testament presented Christianity in a way that contained a number of seminal ideas out of which the future relationships, between the scientific discourse on the laws nature and the religious belief that these laws revealed a divine plan, would develop. The belief in One God implied a demythologization of the discourse on nature. That nature was created meant that its inner connections were established independently of the human mind which had to respect them when they were discovered. Finally the logos Christology made the idea of an all-permeating rationality at home in a religion which hailed Christ as the Lord of the World. It is difficult not to see a connection between this insight and the emergence of experimental methods in science.

But in later centuries there were to be diverse Christian traditions as to the implications involved in affirming a rational structure to the universe. What is characteristic, for instance, of Thomas Aquinas is his insistence that the natural knowledge of God must be acquired in the same way as all other knowledge (*Summa contra Gentiles*, III, 47. Cf. I, 3). Bonaventure represented a much more traditional theology which gave natural reason a more limited scope (*Itinerarium mentis in Deum*). Bonaventure is imbued with the Augustinian notion of the interior light by which God illuminates the soul so that it cannot look at the world except as something which is related to him. This was consciously a polemical stand against Aquinas who upheld the autonomy of human reason within its proper bounds without the special assistance of grace. Another great tradition in Christian thought is that of Duns Scotus (Gilson 1952). He claims that the philosopher is unable to describe creation except in terms of cause and

effect with the consequence that the world derives from God by necessity. On the other hand, the theologian knows that the world came into being through a free act of God just as man is saved by a free gift of grace. This meant that the laws of nature are such as they are because of a free decision by God. If God had so willed, they might have been different. The recognition of the laws of nature as contingent upon the Divine will was more than a theological subtlety. It had implications of immediate importance for the scientific approach to nature.

The increasing use of mathematical arguments in the 14th century went hand in hand with a new awareness of how thought experiments based on common sense and everyday experience could contribute to the critical re-examination of the discourse on nature. Johannes Kepler and Galileo Galilei became the heralds of a new era in which mathematical physics would go from strength to strength. They both speak of the Book of Nature, a metaphor which goes back to the age of the Fathers but it took quite a long time before it got off the ground. Its prehistory is as old as theology itself since the fundamental idea was already expressed by St. Paul's assertion that the works of God disclose His divinity, invisible being and eternal power (Romans 1, 18 - 20). With Kepler the Book of Nature reached the summit of its metaphorical life as the vehicle of the self-understanding of a first rate scientist who was deeply committed to the Christian Faith. But with Galileo the Book of Nature was confronted with the Book of Scripture in a dramatic encounter which has ever since been regarded as one of the most decisive interactions between the world of science and the world of belief. Many polemicists have even taken it as the final proof of the alleged incompatibility of these two worlds and evidence of an essential enmity between the Church and the scientific attitude. However, the framework of traditional cosmology, based principally on Aristotle and Ptolemy, had no room for such discoveries as those reported by Galileo in his *Sidereus Nuncius* (Drake 1957) and it would collapse under their weight.

The results of Kepler and Galileo provided a completely new point of departure for the science of mechanics. The philosophers were duly impressed and already in 1637 Descartes proposed a general theory of the universe in terms of purely mechanical interactions between various types of fundamental particles supposed to fill all space and influencing each other by their mutual collisions. On the other hand more mathematically inclined scientists became increasingly aware that Descartes had built his physics on shaky foundations. In Book I of the *Principia* (Koyré and Cohen 1972) Newton showed how all problems of motion could be mathematically stated on the basis of a few fundamental

axioms, now called Newton's Laws, so that their solutions would depend only on appropriate mathematical techniques.

Newton argued that nature exhibits a number of mechanical phenomena for which no theoretical explanation could be found within a theory that was designed to comprehend all the motions of the bodies in the whole universe. From these premises he had constructed his argument for the existence of a Deity whose direct intervention would explain the gaps in the theoretical discourse. But this manner of reasoning made Newton's natural theology extremely vulnerable. His argument would clearly lose its strength at the moment when this discourse itself became sufficiently advanced to close the gaps by its own force. In the beginning of the 19th century the work of Laplace and his colleagues produced a growing feeling that at long last Newtonian mechanics itself had become able to stop the gaps in which Newton had found room for the Deity. This is the background of the popular anecdote of Laplace replying to Napoleon, when the Emperor asked him why God did not figure in his *Mécanique céleste* (1799 CE and later): "Sir, I have no need of that hypothesis."

From these first centuries in the development of modern science we move rapidly to today. There appear to be two strains in modern science which are in tension with one another. On the one hand, there is the increasing mathematization of physics. On the other hand, through studies in chaos and complexity there is the recognition that the world of sense experience has an innate unpredictability which prevents it from being subject to ultimate mathematical analysis.

From this historical overview we can garner the following characteristics which contribute to our understanding of the laws of nature and the search for purpose in the universe. In the age of mythology there was no split between nature and culture. For the Pythagoreans nature contains necessary, internal connections which only mathematics is able to disclose and express. While Aristotle insisted that nature could only be understood by searching out the four causes, Archimedes emphasized that knowledge of nature came through sense experience and experimentation with the use of mathematics. Christianity at its very birth asserted that the Lord and Savior was also the Creator of the world and, through the logos theology of John, that there was a rational structure in creation which derived from the very triune nature of the Creator. Thus, the world of the senses was worth investigation through the experimental method.

The question arose, however, as to whether there is a necessary connection between the Creator and the rationality of the universe or whether God freely chose that rational structure. With the birth of modern science the delicate balance between the search for necessity and for spontaneity in the evolution of the universe was threatened and no scientist could afford to be too facile in arguing for intelligent design from our knowledge of the laws of nature.

4. The Life Sciences

In the context of this discussion of origins and creation and of the historical overview of the development of scientific methodology I would like to introduce a discussion of the life sciences. Such a scientist observes changes that take place in living systems and he seeks to understand those changes by looking for natural processes. In seeking such natural explanations a scientist, as such, takes no position on any elements that lie outside nature. So creation, a creator, an intelligent designer are simply outside the confines of scientific investigation. To be more specific it is simply not possible within the confines of the sciences to have recourse to an intelligence at the origin of natural phenomena. Always realizing the limits of their methodology, scientists by profession seek only natural causes for natural phenomena. If they do not succeed today, they seek to do so tomorrow. That methodology places no limits on the total reality of the universe and of life. It simply admits that it cannot as such say anything about what lies outside natural causes. Anyone who does so is not doing science. And this is precisely what a recourse to intelligent design to explain natural phenomena does.

The great achievement of Charles Darwin was precisely to bring the study of life into the ambit of the sciences already well established in physics and chemistry (Ayala 1998). With him the origins of the many life forms about us became truly a scientific study. It attempted to explain all natural living phenomena by natural causes. And the attempt is just that: an attempt. And it has to our day had immense success. To date there is no other scientific explanation that rivals that whereby all living beings, including ourselves, come about by chance mutations in the original being which result in stepwise changes in the products carried out by natural selection in the environment in which the products come to exist. Those products survive which can best adapt to their environment. There is, therefore, an apparent destiny towards more perfect beings, i.e. better able to adapt, in this process; but the apparent destiny can be explained by the natural

process itself. Needless to say, we do not yet know the natural processes whereby life first came to be.

5. The Fallacies of Intelligent Design

The principal fallacy of the intelligent design movement is to have recourse to an explanation for the origins of life forms, which is both non-scientific and not necessary. What I have said above should suffice to establish that intelligent design is non-scientific. It has recourse to explanations that are not natural, not within the ken of scientific explanation. A general statement should first be made about why I say such explanations as intelligent design are not necessary. To repeat, a fundamental tenet of the sciences is to seek for natural causes for natural phenomenon. When these natural causes are found, science has succeeded. When they are not yet found, scientists continue to search but they will not allow that it is necessary to seek for a cause outside nature, an intelligent designer, a “God of the gaps.” History has shown, as we have seen with Isaac Newton, that the “God of the gaps” eventually surrenders to a natural explanation. For this reason and for methodological consistency science will always find recourse to non-natural causes unnecessary.

In the case of intelligent design every case of a biological system that has been proposed as requiring intelligent design has failed. A natural explanation within evolutionary biology has been found. This holds for the flagellum, the cilium and the blood clotting cascade in vertebrates (Miller 2004), all of which have been claimed to require intelligent design. The fallacy here is the failure to accept what is at the heart of neo-Darwinian evolution, namely, that by a step-by-step process of mutations and adaptation through natural selection an organism which is the result of former mutations and adaptations and which has a certain function before mutating and adapting again, can have another function afterwards and can, in fact, be integrated into a more complex organism of which it now constitutes a part. Evolution is a creative process. The claim of intelligent design that there are complex systems which could not function unless all of their parts were assembled at the same time according to a design is wrong. At least no such system has been yet proposed which passes the test of requiring design.

Intelligent design is seen by most scientists, and has thus far been judged by the judicial system in the United States, to have a hidden religious agenda and a

fundamentalist inspiration at that. Whether this is true or not, one might examine the influence of the intelligent design movement upon religious belief. In the next section I would like now to show that here again the intelligent design movement fails.

6. Biological Evolution and Religion

The intelligent design movement claims that certain complex living organisms require an intelligent design and, therefore, a designer. While it is claimed that this designer is not necessarily the God of religious faith, it is difficult to imagine whom it might be. At any rate, at the heart of life in the universe is placed a designer. This belittles the God of religious faith by making him one who plans or assigns his minions to plan every step in the coming to be of life in the universe and in its evolution. This is far from the God who has truly revealed himself in the universe he created. But before elaborating upon that let us review a bit of history.

For historical reasons, and not truly religious ones, biological evolution has been the enigma of religions. Fundamentalist religious thought denies it. Catholic thought, as it has matured, accepts it as scientifically verified, but hesitates in how to deal with it. Why the denial and the hesitancy? Because God must be omnipotent and have everything under his control. The dynamism intrinsic in the universe in evolution seems to escape this omnipotence. I would like to discuss the most recent example of ‘Catholic hesitancy’ in light of the positive turn that it has taken.

A message of John Paul II on evolution was received by the members of the Pontifical Academy of Sciences on 22 October 1996 during the Plenary Session of the Academy being then held at the seat of the Academy in the shadow of St. Peter’s Basilica and was subsequently made public (John Paul II 1996). It stirred a vast interest among both scientists and the public, an interest that went well beyond the usual attention paid to Papal statements. While the encyclical of Pope Pius XII in 1950, *Humani Generis*, considered the doctrine of evolution a serious hypothesis, worthy of investigation and in-depth study equal to that of the opposing hypothesis, John Paul II states in his message:

“Today almost half a century after the publication of the encyclical [Humani Generis], new knowledge has led to the recognition that the theory of evolution is no longer a mere hypothesis.”

In order to set the stage for dialogue the message distinguishes in traditional terms the various ways of knowing. The correct interpretation of observed, empirical, scientific data accumulated to date leads to a theory of evolution which is no longer a mere hypothesis among other hypotheses. It is an established scientific theory. But since philosophy and theology, in addition to the scientific analysis of the empirical facts, enter into the formulation of a theory, we do better to speak of several theories. And some of those theories are incompatible with revealed, religious truth. It is obvious that some theories are to be rejected outright: materialism, reductionism, spiritualism. But at this point the message embraces a true spirit of dialogue when it struggles with the opposing theories of evolutionism and creationism as to the origins of the human person. And this is obviously the crux of the message.

The dialogue progresses in the following way: The Church holds certain revealed truths concerning the human person. Science has discovered certain facts about the origins of the human person. Any theory based upon those facts which contradicts revealed truths cannot be correct. Note the antecedent and primary role given to revealed truths in this dialogue; and yet note the struggle to remain open to a correct theory based upon the scientific facts. The dialogue proceeds, in anguish as it were, between these two poles. In the traditional manner of Papal statements the main content of the teaching of previous Popes on the matter at hand is reevaluated. And so the teaching of Pius XII in *Humani Generis* that, if the human body takes its origins from pre-existent living matter, the spiritual soul is immediately created by God. And so, is the dialogue resolved by embracing evolutionism as to the body and creationism as to the soul? Note that the word “soul” does not reappear in the remainder of the dialogue. Rather the message moves to speak of “spirit” and “the spiritual”.

If we consider the revealed, religious truth about the human being, then we have an “ontological leap”, an “ontological discontinuity” in the evolutionary chain at the emergence of the human being. Is this not irreconcilable, wonders the Pope, with the continuity in the evolutionary chain seen by science? An attempt to resolve this critical issue is given by stating that:

“The moment of transition to the spiritual cannot be the object of this kind of [scientific] observation, which nevertheless can discover at the experimental level a series of very valuable signs indicating what is specific to the human being.”

The suggestion is being made, it appears, that the “ontological discontinuity” may be explained by an epistemological discontinuity. Is this adequate or must the dialogue continue? Is a creationist theory required to explain the origins of the spiritual dimension of the human being. Are we forced by revealed, religious truth to accept a dualistic view of the origins of the human person, evolutionist with respect to the material dimension, creationist with respect to the spiritual dimension. The message, I believe, when it speaks in the last paragraphs about the God of life, gives strong indications that the dialogue is still open with respect to these questions.

I would like to use the inspiration of those closing paragraphs to suggest that reflections upon God’s continuous creation, in light of what we have said above in the section on “Origins and Creation,” may help to advance the dialogue with respect to the dualistic dilemma mentioned above. We might say that God creates through the process of evolution and that creation is, therefore, continuous. Since there can ultimately be no contradiction between true science and revealed, religious truths, this continuous creation is best understood in terms of the best scientific understanding of the emergence of the human being, which I think is given in the following summary statement by the eminent evolutionary chemist, Christian de Duve, in his paper at the very Plenary Session of the Pontifical Academy of Sciences to which the Papal message on evolution was directed (de Duve 1997):

“Evolution, though dependent on chance events, proceeds under a number of inner and outer constraints that compel it to move in the direction of greater complexity if circumstances permit. Had these circumstances been different, evolution might have followed a different course in time. It might have produced organisms different from those we know, perhaps even thinking beings different than humans.”

Does such contingency in the emergence of the human being contradict religious truth? Not, it appears to me, if theologians can develop a more profound understanding of God’s continuous creation. 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. 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 of spirit, while avoiding a crude creationism? Only a protracted dialogue will tell. The spirit of the closing paragraphs of the message of John Paul II on evolution is, I believe, an invitation to just such dialogue.

It is obviously much too early in his papacy to discern how, with Pope Benedict XVI, the sequel to the Church's view in modern times on evolution will go. Nevertheless, on several occasions Pope Benedict has given some indications. At his general audience on 9 November 2005 he continued the series of talks in his catechesis of the prayer of the Church as derived from the Psalms (Benedict XVI 2005). On this occasion he addressed the so-called "Pascal Hymn" of God's ancient chosen people (Psalm 135) which expresses the glory of God revealed in his creation as it celebrates God's love and fidelity to his alliance with his chosen people. The Pope uses the opportunity to speak indirectly of evolution.

"The first manifestation of this love and fidelity," says the Pope, "is to be found in God's creation: the heavens, the earth, the waters, the sun, the moon and the stars." "Consequently, there exists," affirms His Holiness, "a divine message, inscribed secretly in creation as a sign of God's love and fidelity ...". The discourse then moves on to more modern concerns with allusions to evolution as the Pope, recalling the thoughts of St. Basil the Great, states: "There are some who, tricked by their deeply imbedded atheistic stance, imagine a universe with no guidance or order, as if floating along by sheer chance." The Pope, at that point departing from his written text, wonders about how many of those "some" among scientists today, drawn by atheism, see only chance in the world's unfolding, when we know from God's love and fidelity that he created the world out of love according to an intelligent design.

The Pope is speaking, of course, from a purely theological point of view in expressing God's love in creating a world which, to respect his fidelity, is orderly and does not evolve by sheer chance. I must recall at this point that neo-Darwinian evolution does not claim that the world evolves by sheer chance. The Pope says nothing about whether the natural sciences, respecting their own methodology, are capable of discovering God's intelligent design — and this is the critical issue. The Pope's position is that God's love and fidelity are at the

source of his creation of the universe. If we use our best scientific knowledge of the “fertile” expanding and evolving universe to reflect upon the nature of God the Creator, we will find, as the Pope suggests, that God is not primarily a “designer”, an attribute which diminishes his magnificence. He is primarily a lover who in creating shares his love.

In his homily at the Easter Vigil liturgy of 2006 Pope Benedict again alludes to evolution when he suggests that the greatest “mutation” in the history of mankind is found in the Lord’s Resurrection (Benedict XVI 2006). Through God’s special intervention the human and the divine have been definitively united. These are, of course, religious and theological reflections but it is interesting that the Pope clearly adopts the language of evolution in expressing them.

7. The God of a Believing Scientist

Cosmological and biological evolution reveal a God who made a universe that has within it through evolution a certain dynamism and thus participates in the very creativity of God. 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. Scripture is very rich in this thought. 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 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. 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. In such wisdom 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. But there is

always the temptation in this reasoning to make God into our own image and likeness. This would be idolatry. And I am afraid that the intelligent design movement has unwittingly fallen into this idolatry by making God or his minions designers.

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Dialogue

Victor J. Stenger

Introducing myself, I am a retired professor of physics and astronomy from the University of Hawaii where I spent 37 years in research on elementary particle physics and astrophysics. In 2000 I moved to Colorado where I am an adjunct professor of philosophy at the University of Colorado in Boulder. I am the author of seven published books and countless articles and essays on the interface between physics, cosmology, theology, pseudoscience, and alternative medicine. My last book, *God: The Failed Hypothesis--How Science Shows That God Does Not Exist* made the *New York Times* bestseller list in March 2007.

You can access most of my writing at:
<http://www.colorado.edu/philosophy/vstenger/>.

I enjoyed reading George's essay (I am assuming we will go by first names), which is well written and deeply thought out.

I found myself agreeing with much of section 2 (except for the most important assertion, which I will discuss later). This agreement comes, I think, from the fact that George has come a lot closer to the modern cosmological view than any other theologian I have read. He seems to accept the fact that science can, in principle, offer an explanation for the transition of nothing to something, at least where nothing is as defined by physicists as the state of no particles and zero energy. Such a state can be defined perfectly well mathematically as the bottom step in the ladder of energy levels one gets when one quantizes free boson and fermion fields under the assumption of supersymmetry. One simply keeps applying the annihilation operator to states with particles until no particles remain.

Another way to look at nothing is the state of complete lack of structure, the state of maximum entropy. If a system has structure then it is something. Nothing would be expected to have no structure. And this is what we get when we extrapolate back to the earliest definable moment — a state of maximum entropy. This does not violate the second law of thermodynamics since the expansion of the universe that follows allows increasing room for order to form.

Thus the universe began in total chaos and retains no memory of a “creator” in the traditional temporal sense. Furthermore, one can write down a complete mathematical description of (at least) two possible scenarios: (1) our universe appearing from that chaos and (2) our universe appearing by quantum tunneling through the chaos from an earlier universe.

Now, George says that the physicist’s nothing is not the “nothing” of theologians since it is still “something.” I hate this playing with words. Certainly the nothing of the theologians is something, too! Making a concept vague and undefined does not give one the right to claim it is meaningful.

Similarly George redefines the traditional meaning of “creator” as not temporal but the “source of all being.” I am actually OK with that since, in my view time is just a human invention anyway. Of course, it has something to do with reality. But we have no reason to believe that time is anything more than what we read on a clock and the arrow of time of common experience is anything more than a definition, too, namely the direction in which the total entropy of the universe increases. All of the basic equations and interactions of both classical and modern physics are time reversible (though not necessarily exactly time symmetrical, as in the case of macroscopic observations). Thus, notions of cause and effect must not distinguish between the two. It follows that, the traditional notion of a creator is meaningless, so it is nice that George replaces it with something timeless or tenseless.

But, then, what does his definition mean? I don’t see the need for any creation at all.

Parenthetically, it is to be noted that Pope Pius XII was happy to associate God with the originator of the big bang. At least George admits that what most people believe about the creation of the universe, including most theologians, is ruled out by science.

I found section 3 very informative until George took off his philosopher’s hat and put on his apologist’s one and moved to Christianity. Then it ceased to be very convincing to me. It seems really stretching it to say that the simple use of the word “logos” in John’s gospel implies any kind of connection with the “emergence of experimental methods in science” and a “rational structure in creation which derived from the very triune nature of the Creator.” Is there any concept in human thought more irrational than the triune God?

I do not agree with George's main theme, which is that intelligent design is outside the confines of scientific investigation. This is an application of the principle he asserts in section 2 that the natural sciences just deal with changes and can say nothing about origins. I have written a paper published in a philosophical journal that works out in mathematical detail the Hartle-Hawking model of the origin of the universe (Stenger VJ: A scenario for a natural origin of our universe using a mathematical model based on established physics and cosmology. *Philo* 2006, 9(2):93-102). Other physicists and cosmologists have published their own scenarios.

I am of the opinion that the intelligent design theorists Dembski and Behe fully comprehended that they needed to do more than just exploit gaps in scientific knowledge to prove the existence of God. That had to demonstrate that there was no way that a natural explanation ever could be found for the phenomena they discussed. Of course they did not do this, and that's why intelligent design is a failure, not because it wasn't science.