
Theistic Evolution: A Design Theory at the Level of Genetic Information

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The author has recently proposed a theory of theistic evolution as an alternative to the naturalistic theory. If one accepts the possibility, as most Christians do, that God has been involved in the origin and development of living organisms, then the question becomes: when and in what manner has divine agency acted? I believe that there are a minimum of three possible positions,¹ each affirming the sovereignty of God over all his creation and over all natural law but differing in regard to the manner of that divine activity. In the first position (View SC), the activity of God has been expressed in the appearance of fully formed organisms at various levels of taxonomic complexity. In contrast to the above is the second position (View EC), as expressed by Van Till, that "molecules and organisms have in fact accomplished the changes envisioned in the macroevolutionary paradigm simply by employing their resident capacities."² Elsewhere, Van Till expresses this same view in a slightly different manner:

In each case the Creator calls upon earthly material to do something. . . The Creator does not speak words of magic that have coercive or manipulative power over earthly material, but words of royal edict that call upon the earth and water to use their resident capacities-- the gifts of active being already given to them by the Creator-to produce the plants and animals that the Creator had in mind.³

This view then clearly holds that the creator has endowed atoms and molecules with the capacity to initially form living organisms, and once formed these organisms would proceed through the developmental stages that we see represented in the paleontological record.

A third position (View TTE) as expressed by the present author is as follows:

that in the history of the origin and development of living organisms, at various levels of organization, there has been a continuing provision of new genetic information by an intelligent cause.⁴

Although I have included the phrase: "the origin . . . of living organisms" in the statement of the theory, it must be noted that more than genetic information would be required for the formation of the first living cells. In that case, certain structures and metabolic processes would also need to be supplied by that intelligent cause in order to utilize any provided genetic information. For a theist that intelligent cause is God.

There are clearly some distinctions between these different views as they relate to our understanding of the relationships of organisms. First of all, they differ in regard to the evolutionary concept of genealogical continuity or common ancestry. In the first view (SC), similarities of multicellular organisms would be a consequence of having a common creator, but ancestral relationships would be more limited. Different phyla of eukaryotic organisms (those with a cell nucleus) need not have an ancestral relationship, nor necessarily would all classes or orders of organisms. For the more simple organisms (prokaryotes, or cells without a cell nucleus), the relationship would be that of having a common creator with some measure of ancestral relationships. In contrast, the second position (View EC) would place the activity of the creator at the level of the initial creation of atoms and molecules and in general would accept the views of evolutionary theorists regarding genealogical continuity. It should be noted, however, that Van Till clarifies his own position by saying: "every one of these processes and every connective pathway in the possibility space of viable creatures is itself a mindfully designed provision from a Creator possessing unfathomable intelligence."⁵ It is not clear, however, how Van Till believes the creator could express himself in this manner if he believes the creation has already been fully equipped. Presumably it is by God's governance at a level which is not in any way amenable to scientific study. My own position (View TTE) would appear to be between the other two views since it provides for divine provision of genetic information to already existing organisms. Hence there could be considerable genealogical continuity, but that continuity would not necessarily be absolute. However, the continuity in this case would be clearly subject to designs of genetic information provided by the creator. In regard to similarities of organisms, these would be a consequence in some measure of ancestral relationships, but these similarities would also share the informational provisions of a common creator.

In regard to correspondence to current scientific evidence, the first (SC) and third (TTE) views consider evidence for the spontaneous origin of life by chance events to be totally inadequate as an explanation. The second view (EC) would appear to accept this evidence as the best available and hence the perspective that should be taught in our schools. The author and his coauthors have recently critiqued the adequacy of the evidence for the origin of life and for evolution in current high school biology textbooks.⁶ Errors and overstatements in those books were noted that appear to be designed to convince students of the validity of completely naturalistic⁷ explanations for the origin and development of living organisms. The authors have noted the statement by prominent origin of life researcher Klaus Dose in regard to the present state of origin of life research:

More than 30 years of experimentation on the origin of life in the fields of chemical and molecular evolution have led to a better perception of the immensity of the problem of the origin of life on Earth rather than to its solution. At present all discussions on principal theories and experiments in the field either end in stalemates or in a confession of ignorance.⁸

Reviews that are critical of origin of life research have been presented in books by Thaxton, Bradley and Olsen, and by Shapiro.⁹ In addition, the probability of obtaining by chance events the genetic information in cytochrome c, a simple protein molecule with a sequence of ca. 100 amino acids has been calculated to be 2×10^{-65} .¹⁰ Thus the evidence weighs heavily against the plausibility of the second view (EC), i.e., that God has endowed atoms and molecules with the capacity to form living organisms. This type of evidence regarding the properties of molecules will be considered in more detail subsequently.

I consider the view (TTE) of theistic evolution that I have proposed to be fully in accord with the evidence of the paleontologic record and with studies of modern biochemistry and molecular biology. It appears to the author that it would be somewhat more difficult to correlate the first view (SC) with each of these two fields of research endeavor simply because of the many discontinuities inherent in that view. Likewise, for the same reason it is more difficult to propose research studies which might support that view (SC) because major groups of organisms would have no ancestral link but would be related only by having a common creator.

In regard to the philosophical or theological question: "Where does new genetic information come from?", a fully naturalistic view of evolution would insist that it be accounted for by chance events alone. However, there would appear to be no way that scientific experiments could *verify* that chance events actually were the causative agent in the appearance of new genetic information, although the scientific data might be *consistent* with that explanation. On the other hand, it is equally clear that modern science because of its assumptions and methodologies simply cannot *verify* supernatural creative acts of God. However, it is possible that many scientific experiments could be carried out that might provide evidence that would be *consistent* with the theory of theistic evolution (TTE) that I have proposed. It is also possible that experiments could provide evidence that is not consistent with the theory or that might suggest that one of the other views (SC or EC) is more nearly correct.

The view of Van Till (EC) appears to provide for acceptance of the proposals and speculations of evolutionary scientists who have a naturalistic explanation for all of life. It appears to this author that view EC has failed to challenge critically the presuppositions and evidence on which those fully naturalistic views are based. The author¹¹ has previously examined some presuppositions dealing with the origin of life and with evolution, and the more recent book by Philip Johnson¹² argues persuasively from a philosophical standpoint against completely naturalistic views of evolution.

In the sections to follow, I will deal first with a more detailed explanation of the concept of genetic information and the probability considerations that I have used in support of a role for divine agency in creation. I will then critique in more detail Van Till's concepts

of theistic evolution and functional integrity and will contrast my own views with the atheistic views of Richard Dawkins in his proposal of cumulative selection. Possible relationships of my theory to hypotheses of ancestral descent, natural selection and punctuated equilibria will be considered as well as a few additional closing theological implications.

What is Genetic Information?

For those not familiar with modern biochemistry or molecular biology, one may most readily explain genetic information by considering the analogy to human language. In the English language we use twenty-six letters, and if we neglect the spaces and punctuation marks we may combine these letters to make words of varying length. The words may be combined into sentences, the sentences into paragraphs, etc. However, only specific sequences of letters, words, sentences, etc. provide meaning. One does not obtain meaningful sentences from random sequences of letters. Similarly, for genetic information in protein molecules twenty different amino acids are linked together end-to-end in specific sequences. Smaller proteins may be made up of chains of possibly one hundred amino acids, while larger proteins may have up to one thousand amino acids in the linear chain. Again, however, the proteins must have specific sequences of amino acids to be functional. Random sequences are nonsense (i.e., they are not functional).¹³ However, in living organisms the sequence of amino acids in proteins is always determined by the genetic information residing in DNA. DNA is made up of linear polymers of four different nucleotides arranged in specific sequences. The variety of possible arrangements of these nucleotides provides DNA with a tremendous capacity for storage of information. The nucleotides contain one of four purine or pyrimidine bases, adenine or guanine, and cytosine or thymine. For coding regions of DNA, these bases are arranged into groups of three (triplet codes or codons), with each codon providing information for a particular amino acid. Consequently, the sequence of codons in a coding region of DNA determines the sequence of amino acids in a protein molecule.¹⁴ DNA also has additional genetic information providing for specific sequences of nucleotides in transfer RNA and in ribosomal RNA; also it has other sequences of bases that provide for coordinated control of all protein and RNA production. It must be emphasized again, however, that random sequences of DNA are nonsense.

The Significance of Genetic Information

In a 1989 article by Werner Gitt, one notes the following statements:

Throughout physics, the natural sciences, and technology as well, energy and matter are considered to be basic, universal quantities. But the concept of information has become just as fundamental and far-reaching . . . information has rightly become known as the third fundamental, universal quantity.¹⁵

Gitt, who is Head of Data Processing at the Federal Institute of Physics and Technology in Germany, deals with the topic of information very broadly, considering it from the standpoint of languages (including mathematical signs, engineering plans, various biological signaling systems, etc.), but he notes especially the capacity for information storage in the amino acid sequences of proteins and the nucleotide sequences of nucleic

acids. Regarding information storage in the DNA molecule, he notes: "In this super storage device, the storage density is exploited to the physicochemical limit: its value for the DNA molecule is 45×10^{12} times that of the mega chip" (p. 2). Gitt discusses five levels of information and provides fourteen theorems or empirical principles related to information theory. In his concept of information, several principles are of special importance to the present paper: "No information chain can exist without a mental origin. . . No information can exist without an initial mental source. . . No information can exist without a will" (p. 7). This brings me to the fundamental question that I have posed: What is the source of *new genetic information*? Since living organisms have a tremendous amount of genetic information stored in their DNA, it seems that one must logically pose an intelligent cause as the ultimate source of that information. Since eukaryotic organisms have much more genetic information than prokaryotes and since higher multicellular organisms have much more genetic information than simpler forms, it appears essential to postulate a *continuing* provision for that information. Consequently, the author (Mills, 1995) has proposed a theory of theistic evolution as noted earlier (view TTE).

An important consideration in this theory of theistic evolution is the meaning of *new genetic information*. I must carefully differentiate the introduction of new genetic information into the genome of cells from the transfer of genetic information. As noted elsewhere (Mills, 1995), interspecies transfer of genetic information occurs in bacteria and occasionally in higher organisms. In the latter case, the transferred gene appears to be carried by a viral vector. Intraspecies transfer of genetic material is known to occur in all organisms. Consequently, in my theory I choose to exclude transferred genetic information from the basic theory. Likewise, in regard to coding sequences of DNA I have arbitrarily chosen to consider only DNA coding for proteins of at least one hundred amino acids in length. In addition, as discussed in more detail in my previous paper (Mills, 1995), protein families, genes responsible for antibody production, and genes for certain peptides require special consideration. Even with these possible exceptions, I include genes for nearly all proteins and the different types of RNA. The proteins include not only the protein enzymes and other structural proteins but also receptor proteins, protein hormones, and especially proteins involved in the control of cell and organ development.

In addition to the basic statement of my theory of theistic evolution, I have listed the following as postulates to that theory (Mills, 1995): (1) that coding sequences of DNA need not be expressed immediately when the information is provided. They could remain dormant (repressed) for hundreds, thousands or possibly millions of years with subsequent expression possibly, but not necessarily, being triggered by chance events (mutations, gene crossovers, gene conversions, etc.); (2) that genetic information for events generally termed as macroevolution might be supplied over either a short period of time or over a somewhat longer period of time with the possibility of initial repression of that information; (3) that genetic information once expressed might become dormant (repressed), only to be expressed again hundreds, thousands or possibly millions of years later. Postulate 1 is proposed to consider possibilities for rapid diversification of species particularly following various mass extinctions. Postulate 2 is proposed to provide for

macroevolutionary events that might require a number of new genes and control factors; in these cases the expression of some of these genes would be of no value until all were expressed. Postulate 3 is proposed to consider, for example, possible explanations for the appearance of fins or flippers in marine reptiles (presumably arising from land reptiles) or the appearance of fins or flippers in marine mammals (presumably arising from land dwelling mammals). In postulating repression of genes for extended periods, the author is aware that these genes would need protective mechanisms (copy editing, repair enzymes, etc.) to prevent deleterious mutations prior to the time they were fully expressed. I would also note that my concept of genetic information would include not only DNA coding sequences but also those DNA sequences adjacent to coding sequences, as well as those found elsewhere in the cellular genome, that are involved in regulating the expression or repression of coding sequences. It should be clear that the basic statement of my theory of theistic evolution is not dependent upon the validity of the three postulates. Presently used technology should provide the means of searching for various developmental genes at different taxonomic levels of animal organisms and indicate whether these genes are retained and also repressed or expressed as suggested in the three postulates.

Probability Considerations

I have noted previously that the probability of obtaining by chance the specific sequence of amino acids in a functional protein was extremely small (2×10^{-65} for cytochrome c). Yet, many hundreds of protein molecules are required for the simplest living bacterial cell. The tremendous complexity of eukaryotic cells is indicated in the following statement from a recent review: "Animal cells must express over 100,000 genes in a temporally and spatially controlled fashion during cellular differentiation and development."¹⁶ When I first proposed my view of theistic evolution, several scientists expressed to me their view that we do not have sufficient information about living organisms to use probability considerations in any argument. When one attempts to calculate the probability of forming a living cell from any reasonable prebiotic materials, so many assumptions are necessary that no precise probability value could be obtained, although one might calculate upper and lower limits of probability. When applied to a particular protein molecule such as cytochrome c, we have a great deal of information regarding which of the twenty amino acids may occupy each of the one hundred four positions in the linear chain of the protein molecule. We know that in twenty-one positions the particular amino acid is invariant (i.e., it cannot be changed without a loss of function); in twenty other positions only two or three very similar amino acids will provide a functional enzyme.¹⁷ Consequently, the probability of achieving by chance a protein molecule with the complexity of cytochrome c can be calculated with considerable accuracy. Since cytochrome c is reasonably typical of small protein enzymes and many proteins are much larger than cytochrome c, the probability of achieving by chance the correct sequences in many hundreds or thousands of proteins is clearly vanishingly small. Russell Maatman deals with probability considerations from a similar standpoint in his recent book.¹⁸

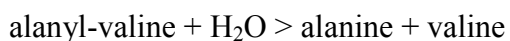
Another aspect of probability considerations comes from statements such as that of George Murphy: "For it has to be remembered that there is nothing scientifically

impossible about the spontaneous emergence against fantastic odds of a protein from a prebiotic soup. ..." ¹⁹Murphy makes the above statement even though he had previously made several qualifying statements" ...we can say that the spontaneous emergence of protein-nucleotide systems under equilibrium conditions seems to be extremely improbable," and " ...claiming the Spirit's involvement in the low probability emergence of life" (p. 165). There are several important considerations to note regarding the quotations from Murphy's article. (1) Probability calculations are dependent upon chance or random events. If divine agency (the Holy Spirit) is involved, the events are no longer random. (2) If divine agency is involved, the pathways and processes for the formation of a protein (or of living organisms) from a hypothetical prebiotic soup need not follow the schemes suggested in origin of life scenarios. (3) Murphy does not say precisely what he means by the term "low probability." One might consider winning the Texas lottery (probability of 0.64×10^{-10}) an event of low probability, but someone selects the correct listing of six numbers between one and fifty at least once a month because of the large number of tickets sold. However, there is a vast difference between a probability value of 10^{-10} and 10^{-65} and especially of

10^{-1000} . These differences become even more marked when one notes that events for the origin of proteins or of life would have to occur in a very limited time in a very limited spatial volume.

Critique of Van Till's View on Evolutionary Creation and Functional Integrity

As noted previously, view EC of Van Till postulates that the creation has been equipped by the creator to do whatever the creator calls upon it to do. As expressed by Van Till (1993, p. 392): "...by God's thoughtful provision of those potentialities from the beginning of space and time until here and now - these awesome wonders have been achieved." If those creative potentialities had been placed by God in atoms and molecules, then those potentialities would have been discovered in our study of the chemical and biochemical properties of molecules over the past fifty or more years of research activity. All sorts of biochemical reactions have been classified into those that will proceed, sometimes in both directions (reversible reactions), those that react spontaneously and those that react at an appreciable rate only in the presence of a catalyst (often an enzyme). Surely God's creative acts are responsible for all of these types of reactions and the limitations that are placed upon them. For example, the hydrolysis of the dipeptide made up of the amino acids alanine and valine will yield with an appropriate enzymatic catalyst a molecule each of alanine and valine.



This is essentially an irreversible reaction in an aqueous solution; it does not proceed in both directions. Alanine and valine do not react in an aqueous solution to form a dipeptide. Speculation regarding origin of life scenarios requires many reactions to proceed that have been demonstrated to be irreversible (e.g., amino acids to proteins, purines and pyrimidines to nucleic acids, etc.). Should one conclude that this world is

developmentally incomplete because God's laws of chemistry do not provide for the reversal of these reactions? Modern biochemistry has dealt with hundreds of similar biochemical reactions and the means utilized by living organisms to supply alternate sources of energy (e.g., adenosine triphosphate) to drive reactions that would not otherwise proceed. Origin of life researchers are aware of this problem, and much of their efforts are directed toward proposing means (often very implausible) of supplying energy to drive reactions.

Recently, the direction of origin of life research has appeared to turn more to RNA as the primordial precursor of living organisms. This stems from the fact that some types of RNA have been found to have catalytic activity, and RNA nucleotide sequences could potentially serve as a template for DNA synthesis. This origin of life hypothesis is totally inadequate for the following reasons: (1) The four possible precursor ribonucleotides have never been shown to be formed in prebiotic simulations, partly because the number of possible incorrect isomers that might be formed are so numerous (c.f., Fig. 4-4 of *The Mystery of Life's Origin*, note 9). (2) RNA with catalytic activity (a ribozyme) has very specific nucleotide sequences²⁰ (i.e., it has genetic information) and would not be formed by chance. (3) The catalytic activity of ribozymes is very limited; it is predominantly a nuclease or a nucleotidyl transferase activity with some slight esterase activity (Cech, 1993). These catalytic activities would be totally inadequate for any living organism. The primary thesis of Van Till's "doctrine of functional integrity" as applied to origin of life studies seems to be that the most fundamental molecules such as hydrogen, methane, ammonia, cyanide, etc., or at a higher level, amino acids, purines, pyrimidines, sugars, etc., all have the innate capacity within themselves to react and form living organisms. I would argue that the innate capacities of these molecules are those that we observe in the laboratory and that those are the capacities that God *chose* to give to those molecules. This explains why, in my theory of theistic evolution (view TTE), I have proposed a *continuing* provision of new genetic information by an *intelligent cause* to account for life's origin and for macroevolutionary events. Only in that way can the thermodynamic and informational barriers to the first living organisms be overcome and the later developmental changes in these organisms be accounted for.²¹

Van Till has also criticized view SC and my view (TTE) by saying that they imply that the economy of this world must be developmentally incomplete. He indicates that these views would require: "...that the Creator is required to perform extraordinary creative acts in the formative history of the world in order that new forms of life (including the first form of life) might appear at the times indicated in the paleontological record."²² Van Till argues that if the creator did not provide initially for all of the innate capacities residing in atoms and molecules, this world would be developmentally incomplete; that there would be gaps and deficiencies in his creation. Van Till has chosen to call his view the "doctrine of creation's functional integrity." Is this, however, a valid position? Is it not limiting God in the manner he chooses to create? Surely, God could create in whatever manner, in whatever time sequence that he chooses. John Stek, in a book chapter entitled "What Says the Scripture?" has this to say regarding the use of the term *bara'*, which is translated in English as create.

... it is silent as to the utilization of pre-existent materials *or the time* (whether at the beginning of time or in the midst of time, whether instantaneously or over a period of time) *or the means involved*. In biblical language, *bara'* affirms of some existent reality *only that God conceived, willed, and effected it.*²³

Although Stek later in that same chapter takes a position similar to that of Van Till, it should be clear that the "doctrine of functional integrity" as applied to biological origins is not derived from the meaning of the word *bara'*,

Critique of Richard Dawkins' Cumulative Selection

Richard Dawkins, in his book *The Blind Watchmaker* has convinced many that his arguments for "evolution by cumulative natural selection"²⁴ are perfectly plausible. He also repeatedly demeans any possible theistic explanations of evolution. Indeed, a primary thrust of his book is to demonstrate that there is no need for a belief in God. It is of interest to note what Dawkins says regarding the probability of life:

The essence of life is statistical improbability on a colossal scale. Whatever is the explanation for life, it cannot be chance. The true explanation for the existence of life must embody the very antithesis of chance. . . Cumulative selection, by slow and gradual degrees, is the explanation, the only explanation that has ever been proposed, for the existence of life's complex design.²⁵

Dawkins says that "chance" cannot explain life but then proceeds to say that "cumulative selection," which is dependent upon chance events, can explain life. He takes this step by attaching "purpose" to his cumulative selection. Since purpose is usually associated with an intelligent being, it appears Dawkins is really requiring an intelligent cause while denying that there is a God.

How does Dawkins propose to overcome extremely improbable events? He notes: "However improbable a large scale change may be, smaller changes are less improbable. And provided we postulate a sufficiently large series of sufficiently finely graded intermediates, we shall be able to derive anything from anything else, without invoking astronomical improbabilities" (p. 317). Let us examine this proposed solution of Dawkins more closely. First of all, the overall probability of an event is not changed by breaking it down into small steps, although breaking it down into steps would increase the overall time available. Secondly, every one of the finely graded intermediates would have to be an improvement, i.e., have selective value. Thirdly, Dawkins is still dependent upon very improbable events for his finely graded intermediates. He argues that with 10^{20} planets in the universe, even probabilities of 10^{-40} can be reasonably overcome. This is very deceptive reasoning because we are considering life on earth, not life in the universe. Also Dawkins readily postulates that probabilities of 10^{-20} present no significant barrier. He classifies this as a reasonable "ration of luck." If the probability of achieving fifteen functional proteins was 10^{-1000} , one might break this down into one hundred "finely graded intermediates" each with a probability of 10^{-10} . Each of these one hundred intermediates would have to have improved functional value and be produced within reasonable spatial and time limits. For the production of functional proteins, it would appear to be nearly impossible even to suggest what those "finely graded intermediates," each with improved function might be. Surely, it must take a great deal of *faith* in the

accomplishments of *chance* and *cumulative natural selection* to make a proposal such as that of Dawkins. Can one really postulate as a *scientific theory* something that depends on a "ration of luck" as Dawkins has and then proceed to argue that it is not only reasonable but probable? I believe not.

There are many other portions of Dawkins' book that I could critique, but space will not permit me to do so. I hope that with the above illustration, I have shown that Dawkins' view is not really based on science but is dependent upon faith, faith in the direction and purpose attributed to "cumulative natural selection," which in turn is dependent upon chance events.

Simplicity, Complexity and Ancestral Descent

One of the significant aspects of my theory of theistic evolution (View TTE) is that there is no need to postulate *initial simplicity* in regard to the origin of life. An intelligent cause could have provided genetic information for whatever degree of complexity that was necessary. A major component of the naturalistic theory of evolution has been that the earliest living organisms must have been very simple, with this requirement being applied to structures of enzymes, morphological structures (membranes, intracellular organelles, etc.), and even to a simpler genetic code. However, if we examine living simple organisms we find no data in support of this postulated simplicity requirement. The enzymes and other components necessary for all of the most fundamental life processes are very complex. This is true for enzymes involved in transcription of information (synthesis of messenger RNA using a DNA template) and in translation of information (synthesis of proteins utilizing messenger RNA, ribosomes, transfer RNA, etc.). This complexity extends as well to the enzymes and processes in the storage and utilization of energy and to those enzymes involved in the synthesis of the various macromolecular components of the cell. I must conclude that the evidence, when examined closely, provides no support for the hypothesis that all aspects of life must have been simple in the beginning. It would seem that the view of Van Till (EC) would also have a requirement for simplicity while the other view (SC) would, of course, have no such requirement.

Another component of the broad view of the general theory of evolution is *descent through common ancestry*. It is such an important component because the theory presupposes the monophyletic origin of life (i.e., all life began with an original archetypal cell). Therefore, all present living organisms have descended from the original living cell and must be related by lines of descent. The role of ancestral descent or genealogical continuity is not nearly as essential to my view of theistic evolution (TTE). Where the evidence is lacking there is no compelling need to postulate that all organisms will one day be linked by ancestral relationships. When the evidence for common ancestry is sound and is established by experimental observations, there is no problem in accepting the data. It should be emphasized that in my view (TTE) consideration of ancestral descent would include the possibility of new genetic information provided by an intelligent cause.

Natural Selection and Punctuated Equilibrium

The Darwinian view of evolution was one of gradualism-tiny progressive changes in organisms with natural selection serving as the directive force for establishing these changes. The initial mechanism of change was considered to be advantageous mutations. Eldredge and Gould²⁶ recognized that gradualism was not consistent with the record of paleontology and proposed their theory of punctuated equilibria. They noted that new life forms often appeared suddenly in the geological record with little or no evidence of transitional groups. They changed from "gradualism" to the idea of "sudden jumps" interspersed with periods of minimal or no change (stasis). It should be noted, however, that in terms of paleontology, suddenly may mean periods of thousands of years. The theory of punctuated equilibria is still dependent upon mutations of various types to produce the initial change in the genome with natural selection supplying the mechanisms for establishment of the modified genome. My view (TTE) would not contradict Eldredge and Gould's proposal but would add an additional explanation for the appearance of new life forms when these new forms required new genetic information. Many of the lesser changes in organisms, particularly at the species level, might be accounted for by some of the newer concepts of intraspecies or interspecies gene transfer as well as the more traditional explanations (gene conversions, gene crossovers, gene duplications, mutations, etc.). I would consider natural selection to have played a significant role in establishing these changes in life forms only after they were produced.

Additional Theological Considerations

A major question that has been raised in regard to view SC and will surely be raised in regard to my view (TTE) is how do they differ from a "God of the gaps" theology? I have dealt with this question in more detail in my previous paper (Mills, 1995) but will simply summarize my position here. When one speaks of a creator as having a continuous involvement in creation, not only in providing infusions of genetic information but also as Author, Sustainer and Finisher of all natural processes, then surely any charge of a "God of the gaps" theology is avoided. In my view (TTE) there would be no limitation or interference in the scientific study of natural events; the normal processes of scientific inquiry could proceed without interruption. My view differs only slightly from that of Van Till when he considers God's governance of natural events. His view of governance as providing direction would not cause a disruption of the natural order. In my proposal for the provision of new genetic information, I have suggested a means by which a creator may have provided that direction.

I also hope I have avoided the pitfalls that undermined the design argument of William Paley's Natural Theology in the nineteenth century. Brooke notes that Paley argued: "...that every part of every organism has been meticulously designed for its function. ..." ²⁷ My view of theistic evolution clearly encourages the search for mechanisms of change and avoids the claim "that every part of every organism is perfectly designed." Ian Barbour notes:

Chance as well as law contributes to evolutionary change and the appearance of higher levels of organization, but it makes the outcome unpredictable. In such a world we would have to think of design as a general direction rather than a detailed plan. We can stand in awe at the magnificent sweep of cosmic history without assuming that everything in it represents a specific expression of divine wisdom.²⁸

I believe the above quotation to be in accord with my theory of theistic evolution (View TTE). The provision of genetic information might appear at first glance to provide a detailed plan, but there is sufficient freedom in the expression of that information to provide for many variations. I believe I have avoided the question of divine determinism by leaving many evolutionary changes, particularly those at the species level, to chance events.

There are clearly aspects of God's governance of his creation that I have not touched upon. As one compares lower and higher levels in any phylogenetic tree, the marked similarities in sequence structure for particular protein molecules (e.g., cytochrome c) are clearly evident. It is true that each step in these pathways could be a consequence of one or more point mutations. But is there not also a need for guidance in the selection of viable pathways? The possibility seems remote that all of the dead ends have necessarily been selected by random mutational events and lost because they are not viable. This is an area that is not considered in my theory of theistic evolution but is certainly worth considering as an aspect of God's governance in an overall Christian theistic view. It could also be true that the continuing provision of new genetic information by an intelligent cause could be far more extensive than my arbitrary dividing line would suggest. My intention in proposing this theory is to open up such possibilities for serious consideration and possible experimentation.

Conclusion

I wish to make clear that my understanding of theistic evolution, which I present as *a* Christian view, not *the* Christian view, should be freely open to criticism by the entire scientific community. If the scientific evidence shows that my proposal is clearly wrong, it should be rejected. If my view needs to be modified to bring it more completely into accord with the facts of science, it should be modified. At the same time, I would argue that this view should not be rejected by definition, by saying it is not science, but should be evaluated in the light of scientific evidence. It is true that my view of theistic evolution involves a theological or philosophical presupposition, but I believe one can show that completely naturalistic views of evolution are undergirded as well by a philosophical presupposition: namely, that chance alone can account for the origin and evolution of all living organisms.

My understanding of theistic evolution can be phrased in terms that should permit it to be included as an alternate view in chapters on the origin of life and on evolution in high school and college textbooks. The dominance of a completely naturalistic view on these topics in high school textbooks in the United States has been the subject of a recent critique by this author and coauthors.²⁹

Dr. Gordon C. Mills argues in favor of a version of theistic evolution on the basis of newer concepts of information which indicate that naturalistic explanations of the origin and development of living organisms cannot account for new genetic information in organisms. He suggests that theistic evolution is in accord with findings of modern molecular biology and paleontology and would be appropriate for incorporation into secular biology textbooks. Dr. Mills is Emeritus Professor in the Department of Human Biological Chemistry and Genetics at the University of Texas Medical Branch, Galveston, Texas.

References and Footnotes

¹The first view might be categorized as special creation (SC), progressive creation, or creation by intelligent design. Van Till has suggested that the second view be referred to as evolutionary creation (EC) although it may also be considered to be theistic evolution. Although I have chosen to call the third view a theory of theistic evolution (TTE), it could also be called progressive creation or creation by intelligent design. For convenience, I shall refer to these three views as SC, EC and TTE. I have given no consideration at this point to the time aspect of divine activity in discussing these views except as noted for EC and TTE. Russell Maatman has an extensive discussion of the time aspect in Chapter 10 of his recent book, *The Impact of Evolutionary Theory: A Christian View* (Dordt College Press, 1993).

²H. J. Van Till and P. E. Johnson, "God and Evolution: An Exchange," *First Things* (June/ July, 1993): 32-41.

³H. J. Van Till, "Is Special Creationism a Heresy," *Christian Scholar's Review* XXII:4 (June, 1993): 380-395. Subsequent references to this paper will be identified in the text by Van Till (1993).

⁴G. C. Mills, "A Theory of Theistic Evolution as an Alternative to the Naturalistic Theory," *Perspectives on Science and Christian Faith*, in press (1995). Subsequent references to this paper will be identified in the text by Mills (1995).

⁵H. J. Van Till, "God and Evolution," 38..

⁶G. C. Mills, M. Lancaster and W. L. Bradley, "Origin of Life and Evolution in Biology Textbooks-A Critique," *American Biology Teacher* 55 (1993): 78-83.

⁷I use the term "naturalistic" in this paper in the broad sense, i.e., a naturalistic view of evolution is one guided entirely by chance events.

⁸K. Dose, "The Origin of Life: More Questions than Answers," *Interdisciplinary Science Review* 13 (1988): 348-356.

⁹C. B. Thaxton, W. L. Bradley and R. L. Olsen, *The Mystery of Life's Origin: Reassessing Current Theories* (Dallas: Lewis & Stanley, second printing 1992); R. Shapiro, *Origins: A Skeptic's Guide to the Creation of Life on Earth* (New York: Summit Books, 1986).

¹⁰H. P. Yockey, "A Calculation of the Probability of Spontaneous Biogenesis by Information Theory," *Journal of Theoretical Biology* 67 (1977): 377-398.

¹¹G. C. Mills, "Presuppositions of Science as Related to Origins," *Perspectives on Science and Christian Faith* 42 (1990): 155-161.

¹²P. E. Johnson, *Darwin on Trial* (Downers Grove, Illinois: Intervarsity Press, 1991).

¹³ It should be noted that by dry heating of amino acid mixtures containing very high concentrations of the two dicarboxylic amino acids, aspartic and glutamic acids, Sidney Fox and others have produced random polymers. They refer to these as proteinoids. These polymers contain not only the usual peptide linkages found in proteins but also branched chains linked to the epsilon amino group of lysine, the 4-carboxyl group of aspartic acid, or the 5-carboxyl group of glutamic acid. These polymers do have very limited catalytic activity, usually for very simple hydrolytic reactions. They do not have the capacity for catalyzing any significant sequential reactions necessary for living organisms. Since they are a mixture of random polymers, they cannot be said to contain genetic information. Likewise, they have no capacity to reproduce themselves. For a more detailed discussion, the reader is referred to Thaxton, Bradley and Olsen, *The Mystery of Life's Origin*, 155-158.

¹⁴ For illustrative purposes, I have omitted messenger RNA (mRNA) in my discussion. Information from DNA is first transcribed into mRNA, and then the message is translated into protein in a very complex process utilizing ribosomes and transfer RNA.

¹⁵ W. Gitt, "Information: The Third Fundamental Quantity," *Siemens Review* 56, No.6 (1989): 2-7.

¹⁶R. Tijian, J.-L. Chen, G. Gill, G. Goodrich, S. Ruppert, C. Thut, P. Verrijzer, E. Wang, R. Weinzierl and K. Yokomori, "Dissection of the Eukaryotic Transcriptional Machinery Reveals Complex Interplay between Activators, Coactivators, and Basal Factors," *R. A. Welch Conference Proceedings, 40 Years of the DNA Double Helix* (1993), 79-87.

¹⁷G. C. Mills, "Structure of Cytochrome c and c-like Genes: Significance for the Modification and Origin of Genes," *Perspectives on Science and Christian Faith* 44 (1992) 236-245.

¹⁸R. Maatman, 86-89.

¹⁹G. Murphy, "The Third Article in the Science-Theology Dialogue," *Perspectives on Science and Christian Faith* 45 (1993): 162-168.

²⁰T. R. Cech, "Mechanism and Structure of a Catalytic RNA Molecule," *R. A. Welch Conference Proceedings, 40 Years of the DNA Double Helix* (1993), 91-110.

²¹The reader is referred to chapters 7, 8 and 9 of Thaxton, Bradley and Olsen, *The Mystery of Life's Origin* for an extensive discussion of thermodynamic barriers to the chance formation of proteins.

²²H. J. Van Till, "Is Special Creationism a Heresy," 384, and personal communication.

²³J. H. Stek, "What Says the Scripture?" *Portraits of Creation*, by H.J Van Till, R. E. Snow, J. H. Stek and D. A. Young (Grand Rapids: Eerdmans Publishing, 1990), 203-265.

²⁴R. Dawkins, *The Blind Watchmaker* (New York: W. W. Norton Company, 1986).

²⁵R. Dawkins, 317.

²⁶N. Eldredge and S. J. Gould, "Punctuated Equilibrium, an Alternative to Phyletic Gradualism," *Models in Paleobiology* ed. T.J.

M. Schopf (San Francisco: Freeman Cooper & Company, n.d.), 82-115.

²⁷J. H. Brooke, *Science and Religion* (Cambridge: Cambridge University Press, 1991), 192.

²⁸J. G. Barbour, "Science, Technology and the Church," text of a lecture presented at a Conference on Science, Technology and the Christian Faith, Concordia College, Moorhead, MN, n.d., p. 3.

²⁹Mills, Lancaster and Olsen, "Origin of Life and Evolution," 7S-83.
