# Evolution is not the enemy; intelligent design is not the solution

Carlos Frank Amory Pinkham

Abstract

There is a need to intelligently bridge the gap between religious fundamentalists and the scientific community. The bridge is the existence of nine phenomena that suggest that the universe is more than just a random accident; that in actuality it was designed by a creator, God. The phenomena are consequences of the necessary preciseness and racy required of numerous fundamental constants, forces, and masses for the universe to support the evolution of intelligent life. The phenomena are: I) Many "requisite singularities" are required for the evolution of life. 2) Conditions in the universe act like "poised pendulums" and 3) like "compelling attractors" that ensure that the requisite singularities will occur. 4) Furthermore, conditions in the universe ensure that each requisite singularity will occur in an "ample sample." 5) Each requisite singularity is an "optimal solution" to design considerations. 6) Thus the requisite singularity will be found by evolution with "statistical certainty." 7) Once found, each requisite singularity results in "narrowing options" for future evolution. 8) This gives rise to an "essential sequencing" of requisite singularities. Finally, 9) the above often results in an "intricate simplicity" of requisite singularities.

## Introduction

This paper introduces seven major themes. Each has its elements of supporting evidence. In fact most of these major themes and many of their examples of supporting evidence could be expanded into a book or books, and in many instances, they have been.

## Themes and Phenomena

The major themes are: 1) cosmological and biological evolution are real. 2) God, the Creator of the universe is real. 3) Neodarwinian evolution assumes some important phenomena of God's creation without openly acknowledging them. 4) Intelligent design misses these phenomena altogether, although it is based upon their consequences. 5) These phenomena need to be enumerated. 6) Once enumerated each needs to be elucidated with a few, selected, concrete examples. And 7) there is a compelling need for a concerted effort to add further to these examples and expand upon their underlying precepts in an attempt to build interfaces between science and faith.

It is presumed that many of the readers will be familiar with the corpus of evidence for either or both themes 1 and 2. Accordingly, these two themes form the common, underlying assumptions of the paper, without the evidence for either being its focus. Although this paper is written for the scientist and the faithful alike, the latter are the primary audience, thus the first theme will receive more attention than the second. Themes 3, 4 and 5 will be briefly addressed and themes 6 and 7 will make the bulk of the paper. In the end, these themes will lead to some ultimately testable propositions to three of modern science's "most compelling questions: Where and how did life originate? Are radically different forms of life possible? And how common is life in the universe?" (Warmflash and Weiss, 2005).

## Neodarwinian Evolution Assumes Some Important Phenomena of God's Creation without Openly Acknowledging Them.

Before presenting the arguments, it is prudent to understand the mechanism behind neodarwinian evolution. Survival of the fittest is really survival of the advantaged. Fitness or advantage comes in two ways: 1) the organism is slightly better at doing what other organisms in the breeding population are capable of doing or 2) the organism is capable of doing something slightly different than what other organisms in the breeding population are capable of doing. In both instances, selection works only when the advantaged organism is enabled to utilize one or more available resources more competitively than its peers. Neodarwinian evolution can happen only if three conditions can be met: 1) there is some mechanism for the random appearance of variability. 2) This variability is expressed as a trait on which selection can work. And 3) the surviving organism can pass on this advantageous trait to its offspring.

Until the middle of the last century, science did not have a very clear understanding of the source of these three mechanisms. Then in a single discovery, Watson and Crick (1953) found that source, deoxyribonucleic acid (DNA), and showed that it simultaneously fulfilled all three requirements. DNA is structured such that it codes for 1) the structural proteins that make the bulk of the cellular organelles and 2) the cellular enzymes so necessary for cell function. These two roles of protein combine to make the traits on which selection can act. The portion of DNA that codes for a protein is called a gene and all the genes in an individual cell make up the genome. Further, DNA is structured such that this genome can be replicated into two identical copies and these two copies can be transferred into two offspring cells. Finally, a gene, although almost always replicated perfectly, is, on very rare occasions, replicated imperfectly. Imperfect replications are known as mutations. Some mutations produce no change in the protein coded for, but of those that do, the simplest ultimately cause a substitution of just one the hundreds of amino acids found in a structural protein or enzyme. Although the effects of most mutations are either neutral or produce detrimental traits, every now and then one arises that confers a new advantage on the offspring. At this point, it is absolutely essential that it be made clear that mutations are mostly random as they relate to the location on the DNA where they occur, and thus to the suite of traits that they can affect.

The simplest mutation referred to above is now captured in the cell's DNA. Upon each subsequent division of that cell, either both or one of the two offspring cells (depending upon whether it is a prokaryotic cell [belonging to a simple organism] or eukaryotic cell [belonging to a complex organism]) will also have that same advantage. If this offspring cell represents a new organism (as it would in a single-celled organism) or if it represents one of the reproductive cells of a multicelled organism that eventually forms an offspring, then the advantaged trait can be selected for in the offspring and its frequency in the population of surviving individuals will increase. If it confers a large enough advantage, it will quickly swamp out and replace the parent version of the gene. When enough mutations occur, the population of new individuals will be incapable of breeding with the parent population (if they are still around) and a new species will have been formed, a process known as speciation. It is precisely this understanding of the pivotal role of DNA in evolution that transformed Darwinism into Neodarwinism.

In short, it is the appearance of individuals with advantages over other individuals in their populations and the dissemination of these advantages into the other members of their populations through natural selection that produces new species. And it is the accumulation of these advantages over time in the surviving populations that results in the increasing biodiversity and biocomplexity known as biological evolution.

The reader may detect a contradiction in this process. It appears to fly squarely in the face of one of the fundamental laws of the operation of the universe: the second law of thermodynamics. "A closed system will remain the same or become disordered over time, i.e., its entropy will always increase." (Chalmers, 2002).

Needless to say, biological evolution does not violate the second law because the earth is not a closed system, it is receiving energy from the sun. Nevertheless, biological evolution does produce more variety and complexity in a universe headed in the opposite direction. That the universe has mechanisms that counter increasing entropy is interesting, at the very least.

What about abiogenesis (the evolution of life from non-living precursors)? Abiogenesis lacked reproducing organisms upon which selection could work, so how did it manage to produce the complex reactions of life from less complex reactions of chemistry? Or to put it another way, how did life come to be, life centered on that marvelous macromolecule, DNA?

The explanation for abiogenesis, although it invokes processes that include one analogous to natural selection, also contains others, including a more thorough understanding of the second law of thermodynamics than that given above. However, enough has been said here to establish the fact that life and its evolution is quite extraordinary. Neodarwinian evolution assumes some of this extraordinariness without directly acknowledging it. Discussion of what is assumed will have to be delayed to theme 5) of this paper: the introduction of the phenomena that reflect this extraordinariness.

Intelligent Design Misses These Phenomena Altogether.

Michael Behe (1996) introduced intelligent design (ID), which assumes the concept of "irreducible complexity." This concept is based upon the accurate observation that metabolic processes in cells and interactions among cells and cellular products outside of cells involve many steps and each of these processes, from one starting point to an obvious end point (e.g., glucose to adenosine triphosphate [ATP]) is very complex. No biological scientist argues with this. Behe goes on to introduce the next observation: these metabolic pathways are so complex, that removal of one step causes them to completely fail. Again, this is generally true for most if not all metabolic pathways currently used by cells, and most biological scientists would agree with this, although they would hasten to add that there is often redundancy in the system which provides a backup mechanism when they do fail. But the big problem arises when Behe takes one final step and posits that this failure upon removal of one step proves that there is no way the cell could have evolved these steps in piece-meal fashion, as evolution claims thus the concept of irreducible complexity. To his credit, Belie was trying to find a bridge between the scientifically unsupported claim that God created the universe in six literal days with several independent steps of creation as presented literally in the Bible and a strong, personal conviction that God was definitely behind the existence of the universe. In irreducible complexity, the cell, or at least a simplified cell, was created intact by God, and then evolution as science understands it, took over. His position is understandable in light of the genuine and continuing ignorance we have over the details of how abiotic processes led to biotic evolution.

Behe presented several examples of irreducible complexity, including the bacterial flagellum and the blood clotting mechanism in mammals. Looking at the former, Belie correctly points out that the multiple proteins in the bacterial flagellum form a motor, a universal joint, a propeller, and other complex features. This, he claims, forms a structure of irreducible complexity. A recent review (Rennie, 2002) retorts with the following,

"First, there exist flagella with forms simpler than the one Behe cites, so it is not necessary for all those components to be present for a flagellum to work. The sophisticated components of this flagellum all have precedents elsewhere in nature, as described by Kenneth R. Miller of Brown University and others. In fact, the entire flagellum assembly is extremely similar to an organelle that Yersinia pestis, the bubonic plague bacterium, uses to inject toxins into cells. The key is that the flagellum's component structures, which Belie suggests have no value apart from their role in propulsion, can serve multiple functions that would have helped favor their evolution. The final evolution of the flagellum might then have involved only the novel recombination of sophisticated parts that initially evolved for other purposes. Similarly, the blood-clotting system seems to involve the modification and elaboration of proteins that were originally used in digestion, according to studies by Russell F. Doolittle of the University of California at San Diego. So some of the complexity that Belie calls proof of intelligent design is not irreducible at all."

For further criticisms of Intelligent Design, the reader is referred to Pennock (2001), Shanks (2004) and Young and Edis (2004).

The explanation for what Belie is missing goes beyond the above critiques and is the same as the unacknowledged phenomena in theme 3), "Neodarwinian evolution assumes some important phenomena of God's creation without openly acknowledging them." As there, although the explanation will be given in the next theme, enough has been said here to make it clear that the scientific community does not consider intelligent design to be an idea with scientific merit. It is not rejected because it attempts to prove creation, it is rejected because it is not supported by the evidence.

These Phenomena Need to be Enumerated.

"One beauty of Darwinism is the intellectual freedom it allows. As the archevolutionist Richard Dawkins has observed, 'Darwin made it possible to be an intellectually fulfilled atheist.' But Darwinism permits you to be an intellectually fulfilled theist, too. That is why Pope John Paul II was comfortable declaring that evolution has been 'proven true' and that 'truth cannot contradict truth.' If God created the universe wholesale rather than retail--endowing it from the start with an evolutionary algorithm that progressively teased complexity out of chaos--then imperfections in nature would be a necessary part of a beautiful process." (Holt, 2005).

What follows is an attempt to begin to penetrate the algorithm alluded to.

This penetration begins with the queries, "Is it reasonable to expect evolution to follow the same trajectory elsewhere in the universe as it did on earth?" And its corollary, "If it is reasonable, and if eventually it is shown that it did, what are the implications?"

On the way to answering these queries satisfactorily, it is appropriate to recognize the existence of this algorithm in the way the universe is put together and in the subsequent way the universe and life evolved. More specifically, chance and selection can create complexity and diversity of the kind seen in the cosmic structures in the universe and the complexity and diversity we know to exist in biological entities in at least one instance in the universe, only when they work within the confines of this algorithm. If so, it implies a Creator.

The algorithm can be expressed as a thesis in which conditions that came into existence with the big bang established a pattern of nine phenomena that would prevail during cosmological and biological evolution. The nine phenomena will be listed here, elaborated on below and then provided with examples: Evolution reveals many 1) "requisite singularities." 2) Conditions in the universe act like "poised pendulums" and 3) like "compelling attractors" that ensure that the requisite singularities will occur. 4) Furthermore, conditions in the universe ensure that each requisite singularity will occur in an "ample sample." 5) Each requisite singularity is an "optimal solution" to design considerations. Thus requisite singularities are found by evolution with 6) "statistical certainty." Once found, each requisite singularity results in 7) "narrowing options" for future evolution, thus giving rise to 8) an "essential sequencing" of these requisite singularities. Finally, the above often results in 9) an "intricate simplicity" of the forms these requisite singularities take.

To distinguish this larger view of evolution from neodarwinian evolution--volution that has no identifiable long-term goal, this will be referred to as Elohimian evolution because 1) the first verse of the first chapter of Genesis is the first place Elohim as a name for God is used and 2) Elohim is the most common word used for God in the Old Testament. As will be shown, the mechanisms of neodarwinian evolution have their rightful place in Elohimian evolution, but it is used here as a convenient moniker to encompass the various phenomena of this thesis.

To put ligaments on the skeletal framework of Elohimian evolution introduced above, each phenomenon will be briefly described below.

## Requisite Singularities

At many places along the evolution Way, God left His calling card in what can be labeled "requisite singularities." They are requisite because if they did not happen/work the way they did/do, people would not be here to ponder them. (In fact, in many cases, little or nothing would be here.) They are singularities because they could not have happened in any other manner given the way the universe is constructed.

## Poised Pendulums

There is much in this universe that acts like a poised pendulum--the kind of rigid pendulum in a grandfather's clock which is poised (balanced) upside down. If it is not precisely poised, it falls. If these properties in the universe were not precisely the way they are, the requisite singularity would not be found.

## Compelling Attractors

It appears in many instances that certain developments or solutions "had" to occur. The conditions in the universe for these poised pendulums to exist are constrained to be very accurate. In a sense, this precise balancing act can occur only under very limited conditions. Theoretical (or real) conditions near them simply do not work or work considerably less well. Thus solutions will be found by natural selection or similar processes, whether they are approached from one direction or another.

## Ample Samples

An optimal solution may not be found immediately when a new demand or opportunity is presented to a system or organism. However the ample number of choices available and the ample number of examples of each choice, coupled with random chance, ample time, and the incalculable number of instances that subatomic particles, atoms and molecules have to react with one another in the expanding universe, ensure that cosmological evolution will eventually find it. And random chance, ample time, and the huge number of offspring produced in each population coupled with the survival of the fittest organism ensure that biological evolution will eventually find it.

## Optimal Solutions

For life to function in this universe, it must be in compliance with the physical, chemical and biological laws of this universe. This means that there will be optimal design solutions that comply with all or the maximum number of the above laws. Requisite singularities are optimal solutions, but not all optimal solutions are requisite singularities.

## Statistical Certainties

Requisite singularities will be found with statistical certainty. In other words, the variations in the ample sample around the requisite singularity will occur with enough abundance to make it certain that the mechanisms of natural selection will find it. And once found it will rapidly (geologically speaking) increase in numbers so that it becomes the basis for the development of an ample sample for the next requisite singularity.

Narrowing Options

Once a requisite singularity occurs, the future options are not as varied as they were before it was found. Natural selection is good at finding the currently optimal solution. Yet, there are only a limited number of optimal solutions and once a solution has been found, there is almost always no going back, for going back does not do anything better or differently than what is already there.

Essential Sequencing

The requisite singularities cannot occur in a random order. They must occur in a logical order, for each one proceeds to greater complexity. Included in the concept of greater complexity is the gradually increasing ability to convey greater amounts of information that is crifical to survival of offspring to reproductive age from one generation to the next.

Intricate Simplicity

The requisite solutions that can act as candidates for the next requisite solution are often extremely varied, but they can be subsumed into a reasonable number of simple categories with logical, readily comprehensible properties.

To summarize the above as briefly as possible, God created the universe in the beginning (Gen 1:1) with the Big Bang. God endowed His creation with primary laws and properties. As a result of these, short-wave length, high-energy photons (particles of light) were the simplest and the first of the fundamental entities in the Big Bang. And God said, "Let there be light." (Gen 1:3). As the universe inflated, the properties that led to the emergence of the quark-gluon plasma from the photons, also gave rise to all other fundamental particles and their properties. These fundamental particles in turn gave rise to the subatomic particles and their properties, which in turn gave rise to the atoms and their properties and so on, up the levels of complexity. This process continued for billions of years, eventually producing an intelligent being, man, from the random, evolutionary process. But this process was not one in which chance and selection operated by themselves, but one in which chance and selection operated in a universe that was established to find certain solutions (Schroeder, 2001; Morris, 2003).

This brief synopsis is an example of the ninth phenomenon. It can be called the intricate simplicity of God's creation because it is simple enough to be embodied in a few sentences, but so intricate it would require volumes to even begin to explore it thoroughly.

Perhaps a more poetic version of this concept is captured in the following fanciful consideration of Albert Einstein's famous quote which admittedly takes a great deal of liberty with Einstein's concept of God. The quote in mind has been paraphrased as "God does not play dice with the universe." if he were alive today with the knowledge we now have, he would likely revise it to, "God does play dice with the universe, but His dice are heavily loaded."

Once Enumerated Each Needs to be Elucidated with a Few Selected, Concrete Examples.

How did these phenomena effect evolution? Cosmological and biological evolution take time. Some of them are essential to ensure that the evolution of the universe would take the requisite time. Others are essential to ensure that the evolution of life would take place given the requisite time.

In 1974, Brandon Carter published some remarkable observations. No less than 12 fundamental physical constants, forces, and masses are finely tuned to a precise value. Were any of them not so tuned, the universe would not exist. This is now known as the anthropic principle. The best discussion of this principle and its implications (some of which go counter to the implications presented here) is provided by Leslie (1989), from which most of what follows is taken.

One constant is the number used in the quantum calculations that he behind cosmological science, known as the cosmological constant. It had to have been precisely tuned at the Big Bang for the universe to exist now.

A "deity wishing to bring about life-permitting conditions would seemingly need to have made two components of an expansion-driving 'cosmological constant' cancel each other with an accuracy of [10.sup.50]. ('Bare lambda', the cosmological constant as originally proposed by Einstein, has to be in almost but not quite perfect balance with 'quantum lambda'. With a balance that was perfect, Inflation would probably not occur)." (Leslie, 1989)

If it were off by one unit at this decimal place in one direction, the universe would have expanded and collapsed back on itself by now. If it were off by one unit in the other direction, the universe would have expanded so quickly that there would be little in it besides scattered hydrogen, helium and a few lithium atoms. This is an example of a requisite singularity. Further, this requisite singularity acts like a poised pendulum, if it were not just so, the universe would not exist with intelligent beings to ponder its existence.

The four fundamental forces are the weak and strong nuclear forces, electromagnetism and gravity. Looking at just two of these shows:

"Had the nuclear weak force been appreciably stronger then the Big Bang would have burned all hydrogen to helium. There could then be neither water nor long-lived stable stars. Making it appreciably weaker would again have destroyed the hydrogen: the neutrons formed at early times would not have decayed into protons....

With electromagnetism very slightly stronger, stellar luminescence would fall sharply. Main sequence stars would then all of them be red stars: stars probably too cold to encourage Life's evolution and at any rate unable to explode as the supernovae one needs for creating elements heavier than iron. Were it very slightly weaker then all main sequence stars would be very hot and short-lived blue stars." (Leslie, 1989)

This is a second and thud example of requisite singularities. Further, these requisite singularities both act like poised pendulums, if they were not just so, the universe would not exist in a form capable of supporting the evolution of life.

Exactly what is life? Textbooks will attempt to give lists of the qualities of living organisms that define life. However, each quality has its exception in inanimate systems, which means that living systems must have them all together to be identified as living. In short, life is complex. Then is there an all-encompassing definition of life that does not have its example in inanimate systems? Perhaps so. Life exists when a myriad of self-sustaining and self-perpetuating chemical reactions are isolated from, but have access to, the environment around them. That external environment will be predominantly water, as will be the internal environment. How does this definition relate to Elohimian evolution, the anthropic principle and in turn to the phenomena identified above?

For the above definition of life to occur, three conditions have to be met: 1) there has to be a way to make myriads of chemical reactions possible, 2) water has to have a number of very special properties, and 3) there has to be a way to contain and concentrate these chemical reactions in a water environment, yet isolate them from the water environment surrounding them. To see how these conditions reflect the phenomena, some discussion will be required.

There Has to be a Way to Make Myriads of Chemical Reactions Possible.

Of all the 88 naturally-occurring elements, only one, carbon, has the right size, properties and number of outer orbiting electrons (four), to form four covalent bonds. Because of these four covalent bonds, it can form the plethora of different molecules so essential to life.

Taking this further, there are four different chemical bonds that readily form between elements that make up the tens of millions of molecules and compounds possible. The strongest of these bonds is the covalent bond. Covalent bonds occur when atoms share their electrons, which travel back and forth between the two atoms. This is the strongest of the four chemical bonds precisely because a great deal of energy is required to wrest an electron from this arrangement. Carbon, with its four covalent bonds is a requisite singularity.

Furthermore, its formation in large enough quantities and its sequestering in the right environment were necessary before the plethora of compounds needed for life would be possible. This is an example of essential sequencing. Carbon, like all of the naturally occurring elements heavier than lithium is formed in stars by fusion of the lighter elements in a process that occurred in the first generation of stars that formed following the Big Bang. When these stars went supernova, they flung their carbon (and the other elements formed by fusion) into the universe to be incorporated into future solar systems such as that of our sun. Furthermore, because of its mass, it would be concentrated at or near the surface of the forming protoplanets along with the other elements with similar masses in sufficient abundance for life molecules to form there with relative ease.

How does this fusion reaction occur? When two [sup.4]He (helium) nuclei fuse (the number (4) is the number of protons and neutrons in the nucleus), they form [sup.8]Be (beryllium). One of three events can now happen to this [sup.8]Be atom: 1) it can stay [sup.8]Be, but not for long, because its half life is 0.067 seconds (Heizerman, 1992) so it has to either 2) undergo fission and return to two [sup.4]He atoms or 3) fuse with another [sup.4]He atom which forms an excited (unstable) form of [sup.12]C (carbon). This excited [sup.12]C gives off a photon and decays to the stable form. The resonance of the reaction forming carbon is so precise that if it were any higher, 2), fission, would occur preferentially and there wouldn't be much carbon in the universe. If it were any lower, it would be easy for the unstable form of [sup.12]C to decay back down to [sup.8]Be and [sup.4]He and there wouldn't be much carbon in the universe (Leslie, 1989; Heeren, 1995; Hazen, 2005). In either event, people would not be here to ponder it. Instead the activation energy is JUST RIGHT for ample [sup.12]C to form. Carbon formation acts like a balanced pendulum and a compelling attractor.

Through this process, carbon was produced with sufficient regularity that it became the sixth most abundant element in the universe (Heiserman, 1992), and the fourteenth most abundant element in the earth (Mason, 1966). Thus carbon has been produced in an "ample sample." Once it is produced in sufficient abundance, it has properties that ensure it will exist as the structural backbone of a large number of compounds, many of which will exist in abundance. Thus carbon as an ample sample, becomes the basis for the next requirement for an ample sample, and as such it becomes a requisite singularity for the next requirement. Further, complex carbon compounds cannot form until carbon is formed, thus revealing an essential sequencing.

Thus the millions of compounds necessary for life will have a skeleton of carbon atoms, each with four, not two, not three, not five, nor six, covalent bonds. Carbon thus acts as a compelling attractor. The reactions behind its formation work as if carbon HAD to occur--the universe HAS to find the requisite singularity of carbon; and sooner or later (much more the former than the latter), by chance collisions, carbon WILL form and until it does form, the process cannot progress to the next requisite singularity. Carbon is the optimal solution with properties that ensure narrowing options will exist after its formation.

It should be noted that one other element, silicon, is abundant enough and has an ability to form four bonds like carbon. But its outer four electrons are too far away from the nucleus for them to react with the right binding energy to form the stable (covalent) bonds that are electronically-neutral which are necessary for the highly active molecules of life. Furthermore, many of carbon's covalent bonds are with other carbon atoms, a process called catanation, producing the long and complex and highly active molecules of life. Silicon rarely (if ever) catanates, probably because silicon is larger thus its atoms won't fit together properly or its di-silicon bonds are too readily broken to do so. In any plausible scenario you might think of, carbon and silicon will occur together and carbon will always win the competition to form long, complex and flexible molecules. In fact, here on earth where silicon is the second most abundant element in the crust (Heiserman, 1992) and carbon isn't even among the top ten most abundant, it is carbon that has won this competition. Silicon is relegated to the mostly short, simple and inflexible compounds of rocks such as quartz and emeralds (McMunay and Fay, 1995). Once again, carbon and its competitor occur in an ample sample for the optimal solution to be found.

Finally, stepping back from carbon and looking at the properties of the elements in the periodic table, they appear to be quite intricate, yet they are periodic (they have repeating patterns), and thus their relationship to one another can be simplified. Because of these simplifications, carbon, and just a few other elements (H, O, N), and to a lesser extent, sulfur (S), and phosphorus (P), are the sole elements used repeatedly in the building blocks of organic molecules. Intricate simplicity, indeed!

Finally, all of this would not be possible if the conditions that gave rise to the anthropic principle were not at work.

Water Has to Have a Number of Very Special properties

Of all the compounds, only one, water, has the dozen or so unique properties necessary for it to act as the single most important compound to life.

Water ([H.sub.2]0) is a remarkable molecule. Not only is it one of the simplest of molecules, but it bas no less than a dozen properties that are found in combination in no other molecule conceivable. These all relate to its structure, which is a molecule with an oxygen atom bonded individually to each of two hydrogen atoms. These hydrogen atoms, for reasons not necessary to delve into here, are arranged at 104.5[degrees] to one another (Fig 1). This particular combination of atoms and this resulting angle of their arrangement relative to each other are critical to the suite of unique properties found in water.

This suite of properties can be broken into four general and interdependent roles: 1) the polarity of water, 2) water and the hydrogen bond, 3) water and temperature, and 4) water and ionization.

The Polarity of Water

The atoms in water are oriented in the manner described above, because the larger oxygen nucleus (containing eight, positive protons and eight neutrons) attracts the single, negative electron from each of the two hydrogen atoms so that they spend more time orbiting the oxygen nucleus. This gives it a slightly negative charge and leaves the hydrogen atoms with a slightly positive charge. Thus the water molecule has an overall polarity to it and it is said to be polarized (Fig 2) which shows the more accurate, orbital model of a water molecule.

[FIGURE 1 OMITTED]

Water and the Hydrogen Bond

As stated earlier, there are four different chemical bonds between elements that occur in the millions of different molecules and compounds possible. The hydrogen bond is one of the four. It occurs between the negatively-charged electron cloud surrounding the oxygen atom of one water molecule and one of the positively charged protons (nucleus) of the hydrogen atoms of an adjacent water molecule. This bond actually occurs between one of the four points on a water molecule and one of the four points on another. This interaction can be seen in Figure 3. Each hydrogen bond that forms is relatively weak and it forms and breaks almost instantaneously only to be formed immediately with another water molecule. In water, each bond lasts only one 100 quadrillionth of a second (Curtis, 1983), yet so many are being formed and broken at any given instant that they cause the water molecules in a drop of water to cling together with considerable strength and yet to resist clinging together further, even when pressure is applied to them. This hydrogen bonding gives water two of its life-important properties: a high liquid surface tension (only mercury has a higher liquid surface tension) and capillary action.

[FIGURE 2 OMITTED]

[FIGURE 3 OMITTED]

Water and Temperature

The amount of heat required to raise the temperature of a given volume of a liquid a given amount is called the "specific heat" of that substance. The specific heat of water is the second highest of all the common substances, due to the strength of its hydrogen bonds, which must be broken before the system can become more energetic (warmer). The "heat of fusion" (the heat that must be given off by a substance before it can change from a liquid to a solid is also very high because of the hydrogen bonds. Water's heat of fusion as it changes from O[degrees] Celsius liquid to O[degrees] Celsius solid (ice) is 80 times the amount of heat required to increase the temperature of an equivalent volume of water by 1[degrees] Celsius. This, too, is uniquely high. Similarly, the "heat of vaporization" is a critical property of water. This is the energy required to change a given volume of a liquid at its boiling point to a gas. It is 540 times the amount of heat required to increase the temperature of an equivalent volume of water by 1[degrees] Celsius. Again, this is a uniquely high value, determined by the nature of the hydrogen bond. Finally, water exhibits a property that is unlike most other liquids. When it freezes, it becomes less dense than it was just before it froze. Ice floats. This, too, is a function of the hydrogen bond and how it causes water molecules to behave as the kinetic energy of the system decreases.

Water and Ionization

The abundance of water compared to other compounds makes it the major candidate for the solvent of living systems while these other compounds become the solute. The elements bonded together in a salt crystal by ionic bonds form an important class of potential solutes. In general, ionic bonds are the second strongest of the four types of chemical bonds found in the compounds of life on Earth. The hydrogen bond is the third strongest. It would seem intuitive that the third strongest bond could not break the second strongest. Yet that is exactly what happens when water dissolves a salt crystal, a process known as ionization. The abundance of water and its polarity enables the + ends of several water molecules, which are bonded to other nearby water molecules by the hydrogen bond, to combine their weaker pulling power to wrest the negatively charged element (the anion) at the comer of the crystal away from its ionic bond and then completely surround it and keep it in solution. In a likewise manner the--ends of several water molecules gang up on the positively charged element (cation) on the corner of the crystal and pull the cation into solution. As this process is repeated, the entire salt crystal is eventually dissolved and the resulting solution is called an ionic, or more descriptively, an electrolytic solution.

What is the significance of I) the polarity of water, through 4) water and ionization, for life? Water has the right mass and is so readily formed that it is by far the most abundant liquid on the surface of the earth and will be on many other planets in the universe comparable to the earth. Its polarity makes it an ideal, incompressible liquid. Its liquidity and incompressibility impart it with turgor pressure, the ability to cause rigidity in the fluid state when it is put under pressure. Its high surface tension and adhesive and cohesive forces enable it to work against gravity to travel up tubes with tiny diameters to great heights. Its heat properties act at the freezing end of the thermometer to make it difficult to freeze, in the liquid phase to make it an ideal reservoir for energy storage, and at the vaporizing end to make it difficult to turn into a gas. Thus it serves to stabilize ambient temperatures in the range that keeps water in the liquid state. Furthermore, the consequences of its heat of vaporization on its behavior at liquid temperatures, means its evaporation will carry away a great deal of heat, thus it is an excellent cooling agent. Because as a solid it floats on top of its liquid form, life can exist in the water beneath the ice in spite of subfreezing temperatures above it. Another consequence of its liquidity and polarity is that it is the best all-around solvent, able to dissolve and transport atoms, ions and polarized and nonpolarized molecules. Electrolytic solutions are the cornerstone of many of the processes in the cell and are especially fundamental to the development of the impulse in excitatory nerve and muscle tissues. All of these properties would not be possible if the conditions captured in the anthropic principle did not exist, because it is precisely these conditions that impart to water the above properties.

So, how does water demonstrate the phenomena of Elohimian evolution? First, its ability to form one of the four common chemical bonds demonstrates intricate .simplicity. Its unique properties make it a requisite singularity. The way its two atoms, hydrogen and oxygen, were formed make it an optimal solution for the following reasons: Hydrogen is by far the most abundant element in the universe since it was the first one to emerge from the Big Bang. It made up the bulk of the first stars referred to earlier. It is the tenth most abundant element in the earth's crust. Oxygen is the third most abundant element in the universe and the most abundant element in the earth's crust (Heiserman, 1992). Thus hydrogen and oxygen are guaranteed to occur in an ample sample. Oxygen formed under the same conditions and at the same time as carbon discussed earlier. "You make [oxygen] by sticking another helium nucleus onto a carbon one. This must be possible to do, but not too readily, otherwise all your hard-won carbon will turn into oxygen and you've lost it" (Polkinghorne, 1995). And once again, the conditions captured in the anthropic principle make it this way. Thus the formation of hydrogen and oxygen behave like compelling attractors. The formation of oxygen further acts like a poised pendulum. The formation of water must occur and once it does, it is clearly the only simple compound with this suite of characteristics and the form that life assumes must fit with these characteristics (narrowing options). Lastly, water, once it is formed, must be gathered together on a protoplanet before life can evolve--essential sequencing.

There Has to be a Way to Contain and Concentrate These Chemical Reactions, Yet Isolate Them from the Water Environment Surrounding Them.

The two bonds between an oxygen and each of the hydrogen atoms in a water molecule are covalent bonds. However, as stated earlier, the master of the covalent bond is carbon. The four electrons in its outermost shell alluded to in "There Has to be a Way to Make Myriads of Chemical Reactions Possible" above, enable it to form covalent bonds with the five other elements critical to life also mentioned above thus giving rise to the millions of different compounds necessary for life. Place enough of these elements in a given volume of water (note that hydrogen and oxygen are already there), add the right amount and kind of energy under the right conditions and they will form covalent bonds with the carbon as they randomly encounter it, producing complex molecules, which have been dubbed organic compounds--compounds with covalently-bonded carbon.

Organic compounds come in the millions of different variations stated earlier. Despite this huge variety, organic compounds can easily be grouped into four major functional classes, each having a unique set of properties essential for life: carbohydrates, lipids, proteins and nucleic acids. One of these, lipids, has four major subclasses, and one these, the phospholipids, is vital for isolating chemical reactions.

Phospholipids have a unique ability. Because of the phenomenon like that seen in water, some of the electrons in one end of a phospholipid molecule have a tendency to spend more time in one region of this molecule than another. Like water, this causes that end of the molecule to be polarized. This polarization causes this end to behave in water somewhat like it were another water molecule. It is said to be "water-loving" (hydrophilic). On the other end of the phospholipid molecule, the situation is just the opposite. It has absolutely no polarity, and therefore it cannot react with water. In fact it avoids water and is said to be "water-fearing" (hydrophobic). These two responses to water lead to a remarkable result when a sufficient density of phospholipids occurs in water. The phospholipids spontaneously arrange themselves into two layers aligned with their water-loving ends facing outward and their water-fearing ends facing each other, an arrangement known as a lipid bilayer. Furthermore, atomic and molecular forces at work in this lipid bilayer and its interaction with the water around it cause it to form a sphere with water on both the outside and inside and the lipid bilayer in between. The water inside is contained in a compartment in which chemical reactions can occur isolated from the water outside. Furthermore, the range in the size of these compartments is perfect for the collection of a large number of complex compounds in the concentrations necessary for their reactions with each other to be enhanced (Deamer and Pashley, 1989; Dworkin et al., 2001).

How do the above demonstrate the phenomena of Elohimian evolution? The gathering of the millions of organic compounds into just four functional classes shows intricate simplicity. The ability of a subset of one of these, phospholipids, to spontaneously form lipid bilayer spheres is a requisite singularity with an optimal solution that provides an ample sample. The formation of these lipid bilayer spheres had to occur before the transition from abiotic processes to biotic processes (abiogenesis) could occur, an example of essential sequencing.

Having arrived at the stage in the evolution of complexity where abiotic phospholipid spheres occur, it is now appropriate to discuss the counterpart to natural selection in abiotic systems hinted at in the discussion of the third theme (Neodarwinian evolution assumes some important phenomena of God's creation without openly acknowledging them). Three conditions were identified that had to be met for natural selection to occur: 1) there is some mechanism for the random appearance of variability. 2) This variability is expressed as a trait on which selection can work. And 3) the surviving organism can pass on this advantageous trait to its offspring. These three conditions are necessary for natural selection to work at the abiotic stage as well, although at this stage, "organisms" have not evolved. Condition 1) is met by virtue of the random nature in which carbon atoms react with other elements and compounds and the resulting organic compounds react with each other coupled with the opportunity for this to occur in compartments, where the resulting compounds remain to react further with one another. For condition 2), the variable trait upon which selection can act is the unimaginably huge number of such spheres that may occur in the early oceans or other, appropriate habitats of an earth-like planet. Some of them will have reactions that make them self-sustaining and even capable of growth. Condition 3) occurs when those that are capable of growth reach the size that they become unstable and break into smaller spheres, sometimes two, sometimes more, a process called fission. But each of these smaller spheres will have the same mixture of compounds in them as the parent sphere, thus they will similarly undergo growth and subsequent fission.

That life appeared on earth so quickly after it provided an environment hospitable to life is quite astounding, and has given rise to the hypothesis of panspermia, the arrival of life from some other part of the universe. Although this could be, no experiment has proven that primitive life can survive the rigors and time it would take for a rock containing life buried deep within to travel from some other solar system to ours. The best that has been shown, is that life could have survived a trip from Mars to Earth (Warflash and Weiss, 2005), but that only begs the issue since the evolution of life on Mars would have started at the same time as that on earth.

The more reasonable explanation is that although the conditions for the evolution of life are quite restrictive (when compared to all the conceivable possibilities), when they do occur, the evolution of life from abiotic conditions is "preprogrammed" into the properties of the elements that make up life and the conditions created by cosmic evolution, that it will evolve in a relatively short, geological time.

Moving beyond abiogensis to the early forms of life that resulted and looking at the nature of the sun, the wavelength of light it emits, and photosynthesis, provides another example of Elohimian evolution. Life exists in two major forms: phototrophs and chemotrophs. The former capture the energy of the sun via a process known as photosynthesis and use this energy to produce organic compounds. They are the producers. The latter uses energy captured in organic compounds taken from other organisms (including the phototrophs) to make their own organic compounds. They are the consumers. A major waste product of the producers (oxygen) becomes a major requirement for the consumers (with the exception of anaerobic consumers) and a major waste product of the consumers (carbon dioxide) becomes a major requirement of the producers. In other words, for complex life to evolve, producers and consumers are mutually required. Of all the groups of wavelengths in the electromagnetic spectrum only one the visible spectrum, has just the right energy to drive photosynthetic reactions. Longer wavelengths don't have enough energy and shorter wavelengths have so much they break chemical bonds rather than energize them. It should come as no surprise, then, that the solar spectrum of the sun peaks at these wavelengths. In other words, other types of stars, from red giants to white dwarfs do not have the right solar spectrum to permit complex life to evolve on any of the planets that formed from their solar disks. It should be noted that stars like the sun, classified as moderately bright, yellow, small stars, occur with some abundance in the main sequence of stars, a graph of the brightness, spectral color and to a lesser extent, size and evolution of hydrogen-burning stars in our galaxy. (Chaisson and McMillan, 2005). Thus the visible spectrum is a requisite singularity that acts like a compelling attractor and stars with a spectrum that peaks at the visible wavelengths exist in an ample sample.

The chemotrophs also demonstrate intricate simplicity, but in another way. Figure 4 captures the essence of the metabolic pathways in an aerobic chemotroph. The arrows trace metabolic pathways. Arrows contained within the cell terminate in "cell function" and that cell function is determined predominantly by the two classes of proteins discussed earlier: those structural proteins incorporated into organelles and those making enzymes. These proteins are formed by synthesis (using DNA) which requires building blocks provided by anabolism, and energy in the form of ATP provided by cellular respiration. In turn, cellular respiration requires oxygen (the same oxygen provided by phototrophs) and fuel provided by catabolism. Nutrients (arising from phototrophs or other consumers) provide the inputs for both anabolism and catabolism. In the process of functioning, the cell gives off wastes. These are heat, carbon dioxide, miscellaneous waste metabolites mostly containing the element nitrogen, and water, which is produced by both anabolism and cellular respiration.

This figure demonstrates intricate simplicity by showing that the tens of thousands of metabolic steps in a cell can be summarized in a simplified diagram. But more importantly, it demonstrates requisite singularity because the evolution of this set of reactions was necessary to produce the amount of ATP needed for the higher energy demands that the evolution of complex structures would produce, thus this step had to evolve before multicellular life with complex structures could evolve--essential sequencing. Furthermore, this appears to be an optimal solution because it is found in almost all eukaryotic cells today. But more importantly, the implications this figure has for the problems that must be solved by the multicellular organisms that would evolve from it are clear. Since most of the cells in a multicellular organism would be far removed from the surface where these elements and compounds were readily available (especially in the Precambrian oceans, where this process occurred), this development meant that ultimately, the complex organisms that evolved from this primitive chemotroph cell had to have: 1) a "digestive system" to get water and the nutrients into the body and break the latter down to small enough molecules to move them about. 2) A "respiratory system" to get the oxygen into the body (and simultaneously get the carbon dioxide out). 3) a "urinary system" to eliminate the excess water and metabolic wastes. And 4) a "circulatory system" to move the water, small nutrient molecules and oxygen from where they entered the body to where they were needed and to move the carbon dioxide, metabolic wastes, waste heat, and water from where they were produced in the body to where they could be eliminated from the body. Finally, as the process increased in complexity with more advanced multicellular organisms, there would have to be a "nervous system" and an "endocrine system" to orchestrate all the above. Thus, the evolution of the chemotroph cell immediately narrowed the options for the future evolution of complexity.

[FIGURE 4 OMITTED]

A more advanced step in the evolution of complexity reveals another poignant example of intricate simplicity. Of all the places for the head with its unique senses to be located on the vertebrate body, only one at the forward end of the body, solves all critical design problems: 1) The information most relevant to survival lies ahead of the organism, where it is going. (Note this automatically means that consistent movement with respect to a given axis in the remainder of the body produces a "front" end and it also recognizes that all vertebrates descended from a fusiform ancestor that swam horizontally through water, a requisite

singularity in itself as the most efficient design for moving through water.) 2) This relevant information is found in the light, chemical and pressure gradients coming (most often) from ahead of the animal. 3) This information must be "captured" by sensory receptors. And 4) once captured, this information must be sent to the center where it is processed (the brain) rapidly to ensure the fastest responses to the life-or-death implications that the information may convey. All this suggests the need for the special senses: sight, smell, taste, and pressure fluctuations. Further it suggests that the receptors for these senses must be concentrated in the front of the organism with short nerve pathways to the brain, thus requiring the brain to be in the same area as the special senses. This arrangement is called the head.

Although rare exceptions are found in parts of this arrangement (e.g., in the squid and the crab, and the larger saurischian dinosaurs with a "second brain" at the base of the tail), these exceptions act to fulfill the same fundamental plan. Thus having the special senses at the front of the body, and the brain positioned close by is an optimal solution. The brain, being the central processing center for environmental information, is then the logical candidate to become the center in which further processing of information can be selected for and thus for the further evolution of intelligence. The evolution of the head is a requisite singularity necessary for essential sequencing. Furthermore, once this plan occurs, it becomes difficult if not impossible for evolution to break free from it to place the brain elsewhere, thus narrowing the options of future vertebrate plans.

Looking further into one of the special senses, sight, provides another example of intricate simplicity. Why are all extant sighted vertebrates (with the exception of the tuatara, a rare, primitive reptile from a few remote islands in New Zealand with an additional, "pineal" eye) equipped with two eyes, why not one, why not three or more? The embryonic development of structures requires energy. Energy is always a valuable commodity, thus evolution favors solutions that maximize the efficient use of energy. If two eyes will suffice to allow the organism to survive the threats to its existence in almost all situations and the existence of a third (e.g., looking backward) would give it a survival advantage in only very rare instances, evolution will not favor a third eye. If this argument is true, why not one eye? Two eyes placed near each other give absolutely essential information about the environment that one eye could not. They provide depth information. The value of depth perception can be grasped quickly by closing one eye and reaching for something on your cluttered desk. Thus two eyes become the optimal solution. Two eyes also acts as a compelling attractor since a highly complex organism with one eye or three is at a selective disadvantage to an organism with two.

This latter discussion brings up the burgeoning field of evolutionary development, or as it is more popularly known, "evo devo." In brief this is a concept that has been simmering at a low level of understanding until recently, when the findings of the Human Genome Project and its progeny, made it clear that many evolutionary changes have occurred because mutations in a given developmental pathway affected complex suites of traits. Thus, e.g., it is possible that it only took a single mutation that disturbed the chemical gradient in limb fields to break the correlation that must exist between the lengths of the long bones in the fore and hind limbs of quadrupeds so that evolution of long hind limbs could occur in bipeds without a corresponding elongation of the forelimbs. This phenomenon was suggested by Pinkham (1977) to explain the limb correlation relationships observed in the quadrupedal Mexican spiny pocket mouse (Liomys irroratus) a form that closely resembles the ancestral, fossil form of all the Heteromyidae, and its bipedal relative, the kangaroo rat (Dipodomys merriami).

The critical role of development in the evolutionary process is why "ontogeny recapitulates phylogeny," an approximate truism that recognizes that cleavage, embryonic, and fetal developmental stages of an organism contain some traits that are the developmental stages of that organism's evolutionary ancestors. How does this translate into intricate simplicity? A complex structure cannot appear evolutionarily or developmentally without antecedents (essential sequencing). This logical condition carries with it a critical narrowing of options (evolution does not proceed from an adult Australopithicus afarensis to an adult Homo sapiens) while simultaneously providing for an ample sample. Evolution acts at all stages in an organism's life (up to the loss of reproductive ability). Early developmental stages occur 10's to 10's of millions of times more frequently than the adult form. Selection eliminates most of these developmental forms, and because there are so many more of them than adults, it should not be surprising that the majority of selection occurs during development.

Returning to the idea of the evolution of intelligence and transitioning into ecological evolution, consider from which trophic group (level in the food chain) advanced intelligence would arise. Producers, as stated earlier, are plants and since their energy source is the light that surrounds them, they can be stationary (sessile). Stationary organisms require only a minimum of information processing. Consumers, moving about for their food, do require a fair amount of information processing (intelligence), but they do not need to be very intelligent. Their food source, plants, the producers, are normally in great abundance and plants are not mobile, thus finding them is little more demanding than scanning the local environment and often lowering or raising the head slightly to eat. The appellation "dumb sheep" although relative, is justified. Secondary consumers have to be able to process information somewhat more extensively. Their prey can move and are not totally without wits. Top carnivores have to be the most intelligent in all these trophic levels. Their prey is a hunter themselves. But perhaps the most demanding niche at this trophic level is the omnivore, because not only does an omnivore need to know how to hunt, how to hunt the hunter, but it also needs to know how to find. It is not surprising, then, that paleontological evidence indicates that the ancestor of modern man was an omnivore. This is an example of an optimal solution and a requisite singularity on the way to advanced intelligence.

Continuing with the ecological focus, life, including single-celled and multicellular organisms, has exploited the niche of the water column, the ice surface, the rock surface, rock interstices, the land surface, the soil column, especially the upper horizons, and the air column, especially the lower altitudes. It, has not exploited the niche of the lava surface or column, the rock column, nor the ice column, with the exception of unique, simple organisms (archaea) which can exploit interstices in these columns. Why is this? The simplest answer is that the conditions that allow life to occur do not coincide with the conditions found in these "dead zones." (Ward and Brownlee, 2003)

The final two examples of Elohimian evolution presented relate to speciation: isolation and mass extinctions. Speciation is the process whereby one species gives rise to another. At the heart of speciation is the concept that a species is a population of interbreeding individuals producing fertile offspring. Thus, speciation occurs when one subpopulation derived from a parent population cannot breed with another subpopulation derived from that same parent population, or if it can, the union does not produce fertile offspring. A subtle condition inherent in this definition is the opportunity to breed. The loss of opportunity is the starting point of speciation. There are many ways this can happen, but they fall into three general categories. Loss of opportunity occurs when physical, reproductive, or chronological barriers arise to isolate two or more subpopulations.

Physical barriers to interbreeding isolate the two, formerly united subpopulations, such as would happen with the orogeny (development) of a mountain range in their midst, or the drifting of a raft of organisms to an oceanic island, where they can no longer interbreed with their relatives left behind on the mainland. Reproductive barriers isolate the two when the behavior or structure of one does not allow it to participate in the mating of the other, so that mating cannot or does not occur. Chronological barriers isolate the two when the older, parent population has no survivors that are capable of interbreeding with the younger, descendent population.

During the period of isolation, natural selection acting on the genome of individuals in the isolated subpopulation (the founder principle), or random drift, if the subpopulation is small enough, produces genetic changes that prevent the two subpopulations from successfully interbreeding should they ever be united. Physical or behavioral isolation produce two (or theoretically in very rare instances, more) species from a parent population. Chronological isolation occurs when one species evolves into another over time (phyletic evolution). Since the test of interbreeding cannot occur with chronological isolation, a secondary test is applied that seeks to find sufficient structural differences between individuals of the parent and descendent population. An excellent example of phyletic evolution is proposed by White, et al. (2006), as they document the evolution of the early hominid, Australopithicus anamensis into A. afarensis in the same area of the Afar rift valley in eastern Africa.. These two mechanisms respectively account for the branching and the long, uninterrupted limbs seen in phylogenetic trees. Speciation, then, is a process that requires time, is a continuum (species B does not spontaneously arise intact from species A, or does so only when a very unique mutation has occurred) and operates such that all forms of life are ultimately related to each other.

For speciation and thus evolution to occur, then, there must be ample opportunities for isolation. Until the 1960s, the mechanism for this isolation was poorly understood. At that time, a group of English geophysicists expanded upon the idea of continental drift proposed by Alfred Wegener in 1912, to provide hard evidence that the lighter continental masses float like ice cubes on a heavier mantle material. Although the suggestion that continents are not fixed in place was radical at the time, the evidence for it now is so compelling that it is known as plate tectonics. Since the Cambrian, these plates have converged into a giant continent (Pangaea), separated into two continents (Lamasia and Gondwanaland), and further separated into the seven continents we now know. During this time smaller pieces would split off of the larger plates and "drift" away from them only to collide with another plate, producing highly folded mountain ranges, similar to what occurs in miniature when two napkins are forced together and one eventually slips below the other. Although the time scale for major merging and splitting of continents is I Os to 100s of millions of years, the time scale for lesser isolating events, such as mountain building, river formation, island birth and growth, and regional climate change are on a shorter time scale and produce adequate opportunities for isolation around the globe.

But, isolation is only one part of the process of speciation, another can be the eventual merging of the isolated populations with the resulting competition (if the nascent species are still occupying the same niches) and natural selection that acts on these competing populations that either drives them further apart or causes one to thrive and the other to perish. Clearly, plate tectonics provides for this process as well.

There is one other device in evolution's tool kit, only this time it is more like a sledge hammer: mass extinctions. Five times since the Cambrian (Kardong, 2005) there have been geologically instantaneous extinctions of up to 100 percent of all the organisms living in a given environment or of a particular taxon (group). Often this mass extinction occurs across many environments and taxa simultaneously. The most famous of these is the extinction of the dinosaurs at the Cretaceous-Tertiary boundary, 65 million years ago, now unquestionably caused by the impact of a large asteroid off the peninsula of Yucatan, leaving the huge, Chicxulub crater mostly buried beneath the Caribbean Sea. As in all these mass extinctions, the causative event did not wipe the slate clean, causing evolution to start all over again, but it did wipe out prominent groups, cleaning out many niches so that they were totally devoid of occupants. Immediately after these extinctions, an episode of explosive evolution occurred as the descendents of the survivors evolved to fill these now-vacant niches. These extinctions have occurred somewhat regularly, with an average periodicity of nearly 62 million years (Rhode and Muller, 2005). This has led to the speculation that they may be linked to the periodicity with which the solar system passes through one of the great spiral arms in our galaxy (Gonzales et at., 2001) or more recently, by the periodicity to which our solar system oscillates to the edge of the galactic plane and thus becomes exposed to more intense intergalactic cosmic rays coming from the direction of the Virgo constellation (Medvedev and Melon, in press). Whatever the explanation, the regularity of these extinctions suggests the phenomenon is likely to happen elsewhere in the universe, causing periodic, mass extinctions of life evolving on other planets as well.

So how do plate tectonics and mass extinctions fit into Elohimian evolution? The first ensures that an "ample sample" of variability will arise for evolution to find the "optimal solution." And once it is found, even if it arose in isolation, for it eventually to prove itself as it is reunited with larger populations. Mass extinctions also work to find the optimal solution by eliminating the "dead ends" and providing an opportunity for evolution to find the next step in the "essential sequencing" from the group of survivors, which now have an opportunity to evolve new innovations to fill the newly opened niches. The prime example of this is provided by the extinction of the dinosaurs. As the dominant form, with the best "ample sample" available at the time, they had over 200 million years to evolve the capability to reason. Yet they did not. In contrast, the mammals, which were finally freed to fill these vacated niches evolved it a mere 65 million years later, in part, because they included a major group, the placentals, that not only invested more time and resources in protecting the offspring before it was physically separated from its mother (birth), but continued this process that enabled the passage of new information from one generation to the next in a much faster way than waiting for advantageous mutations: teaching. This latter is a "requisite singularity" for the evolution of advanced intelligence.

A large number of additional examples of Elohimian evolution could be cited, but enough have been presented here to make the point that these nine phenomena are encountered repeatedly in cosmological and biological evolution.

The requisite singularities are "found" by the universe using natural selection working through a combination of precisely poised pendulums that act as compelling attractors that work through the ample sample to find the optimum solution. Once a requisite singularity occurs, its variations also increase to an ample sample from which natural selection can find the next optimum solution, and it narrows the options that evolution has left open to it. Finally, this process ensures that requisite singularities are "found" in the right order. It seems suspiciously as if the universe were organized to produce intelligent beings and perhaps even more specifically, intelligent beings similar to man, through evolution.

It is the presence of these repeating phenomena of Elohimian evolution that work unobtrusively through the mechanisms of neodarwinian evolution that gives the appearance of randomly produced intelligence.

Although it is true an infinite number of monkeys typing furiously, would type out the Bible (or any other text) given sufficient time, they would do so most readily by typing a useful word or two here and a year later another word or two. There would have to be some mechanism to put their useful output together and what's more, put it together only when it came out in the right order. In other words there has to be a filterer, an organizer and a GOAL for this to happen. (Of course infinity is so large, that one of these infinite monkeys could type out all the keys in the proper sequence to type out the Bible perfectly. The problem is coming up with the infinity of monkeys and time.) Neodarwinian evolution provides a filterer only. It can only explain (and does so absolutely correctly and convincingly) how the survival of the fittest will bring about change in a population over time and observe (again, correctly and convincingly) that over longer periods of time that this process, has lead to ever-increasing complexity of the individuals in these populations and that this process culminated (at least up to now) in the evolution of the intelligent species, Homo sapiens. Neodarwinian evolution correctly ascribes this fascinating process to natural selection acting on random mutations, yet it is mostly descriptive in nature, its ability to predict specific outcomes is limited. Elohimian evolution recognizes neodarwinian evolution as the filterer, but the phenomena of intricate simplicity become the organizer and intelligent beings, predictably, the goal.

In truth, evolution cannot have goals beyond those of continuing the species and improving its fitness in either a stable or changing environment. However, the laws and principles of the universe do have a goal and that goal is to use evolution to produce man (for certain) and possibly other, anatomically similar forms of intelligent beings.

These Examples Need to be Expanded Further.

Perhaps the first scientist to begin to recognize the possibility put forth in this paper was the scientific humanist, Julian Huxley (1948), who, in less than 22 pages of text, laid out a more detailed version of some of what is presented here, the essence of which is summarized in the following, "Evolution is thus seen as an enormous number of blind alleys, with a very occasional path of progress. It is like a maze in which almost all turnings are wrong turnings. The goal of the evolutionary maze, however, is not a central chamber, but a road which will lead definitely onwards." In this work, Huxley, on the basis of one or more shortcomings (some of which are identified above), systematically eliminated every major taxonomic group that ever existed from being capable of evolving intelligence except one, the hominids. In doing so, Huxley knowingly violated one of the most sacred tenets of evolutionary discussion, the avoidance of teleological thinking--the idea that evolution has a goal.

This taboo has been a valuable and necessary condition for the studies of the mechanisms of evolution because it freed the investigators to discover what the facts told them without a biasing objective in mind. The time has come as evidenced by the recently burgeoning literature on both sides of the issue, to openly suspend this ban with our eyes wide open to see where that suspension will take us.

"Cosmology and evolution are the closest scientific cousins to theology. We cannot experiment on God, we cannot recreate the big bang or evolution on a grand scale, we have to look at the evidence and deduce the truth" (Polkinghorne, 1995).

Although Polkinghorne is correct, all three can be subjected to less grandiose tests of their truth. As alluded to earlier, the examples presented above are a small sample of those that could have been described. If this thesis is true, then undoubtedly there are many more waiting to be discovered. Their discovery is a monumental task that no one person can tackle. The complex nature of many of the examples will require the cooperation of specialists in different disciplines to discover them and fully flesh them out.

**Conclusion**

Both cosmological and biological evolution follow an identical pattern and that pattern is strongly suggestive of a Creator. Information contained in properties dependent upon the laws, constants, and forces of the universe make it not only possible, but certain, for intelligence to arise. Natural selection is nothing more nor nothing less than the mechanism that ferrets out that information, producing the cosmological and biological evolution we see.

Thus the evolution of life elsewhere in the universe is possible. However, the conditions for abiogenesis are so numerous and narrow (only a few of the many requisite singularities are mentioned in this paper), that the chance that they will occur together is remote. It is also possible that this life can evolve into complex forms, but once again, the odds are against it. Finally, it is possible that this complex life, once it evolves can evolve intelligent beings. Again, it is not likely, but it is at least equal to once in the universe. However, the evidence favors God's creating the universe such that random processes, following carefully-designed and tuned laws and principles, would "find" the optimal solutions that lead to the evolution of life, and if all the requisite singularities were met, intelligent life, not at all unlike ourselves.

Thus, we may soon find that life exists or existed elsewhere in our solar system, but we will not find complex life in the solar system anywhere else but on earth. And we will definitely not find intelligent life anywhere else but on earth. In fact the odds against the evolution of life forms capable of intelligence are so high (so many requisite singularities are involved) that it is likely intelligence will evolve no more frequently than once in a galaxy or even more likely, less often. But that still leaves a lot of opportunities for our distant offspring to assess the thesis put forth here.

In the meantime, do the facts and phenomena presented in this paper prove the existence of a Designer God? No, but they do imply One because they are the kinds of phenomena and facts a Designer could weave into an algorithm designed to bring about a desired outcome. Besides, God cannot and should not be proved. If He could be, where would that leave choice? Even if this thesis is supported by further evidence, there will always be skeptics, who for their own reasons, choose to find the alternative explanations God has placed in His creation to provide choice. But these phenomena and their further study by Christians should have two important outcomes. They should dislodge those fractions of Christianity who ignorantly criticize evolution, and put all Christians in the place they belong as the children of the Supreme Scientist--the center of science rather than its periphery.

If God is real and desirous of our choosing Him, He is both the Supreme Scientist and the Supreme Defender of Choice. We will have to tread very carefully as we attempt to find the best way to address this issue, a way that does not trample God's plan for us all to have the freedom and the choice to choose. It would be unwise to propose Elohimian evolution as a curriculum in the public, primary, and secondary schools where evolution alone should be taught. There is a great deal of value in the separation of Church and State. But it is a potential subject for higher education and for education in religious settings such as, retreats, and special sessions. The evidence for God in cosmological and biological evolution, in the Bible, in the life, death and resurrection of Jesus, in the conviction of the early witnesses, or in the changed life of believers is not enough to be convincing in isolation, but taken as a whole, they are circumstances that cry out for understanding, for explanation. They can be understood as being unrelated, with disparate explanations, or they can be understood as being unified with a single, efficient explanation, God.

**References**

Scripture taken from the Holy Bible, new international version. 1984. Colorado Springs, Colorado: International Bible Society.

Behe, Michael. 1996. Darwin's black box, the biochemical challenge to evolution. New York: The Free Press (Simon & Schuster). 307 pp.

Carter, Brandon. 1974. "Large number coincidences and the anthropic principle in cosmology." in M. S. Longair, ed., Confrontation of cosmological theory with astronomical data. Dordrecht: Reidel, 291-298.

Chaisson, Eric and Steve McMillan. 2005. Astronomy today, 5" Ed. Upper Saddle River, NJ: Pearson Prentice Hall. 761 pp.

Chalmers, Matthew. 2002. Second law of thermodynamics broken. NewScientist.com (http:///www.newscientist.com /article.ns.?id=dn2389, accessed 8 January 2005.

Curtis, Helena. 1983. Biology, 4th Ed. New York: Worth Publishers, Inc. 1159 pp.

Deamer, D. W. and R. M. Pashley. 1989. Amphiphilic components of the Murchison carbonaceous chrondrite: surface properties and membrane formation. Origins of life, and evolution of biaspheres 19: 21-38.

Dworkin, Jason. P., David W. Deamer, Scott A. Sandford, and Louis J. Ailamandola. 2001. Self-assembling amphiphilic molecules: Synthesis in simulated interstellar/precometary ices. Proceedings of the National Academy of Sciences, USA 98:815-819.

Hazen, Robert M. 2005. Genesis, the scientific quest for life's origins. Washington, DC: Joseph Henry Press. 339 pp.

Heeren, Fred. 1995. Show Me God. What the message from space is telling us about God. Wheeling, IL: Search Light Publications. 336 pp.

Heizerman, David L. 1992. Exploring chemical elements and their compounds. Blue Ridge Summit, PA: McGrawHill, Inc. 376 pp.

Holt, Jim. 2005. Unintelligent design. The New York Times Magazine. Feb 20, p 15.

Huxley, Julian. 1948. Man in the modern world. New York: Mentor Books. 191 pp.

Kardong, Kenneth V. 2005. An introduction to biological evolution. Boston, MA: McGraw-Hill Higher Education. 322 pp.

Leslie, John. 1989. Universes. London: Routledge. 228 pp.

Mason, Brian. 1966. Principles of geochemistry, 3rd Ed. New York, NY: John Wiley and Sons. 329 pp.

McMurray, John, and Robert C. Fay. 1995. Chemistry. Upper Saddle River, New Jersey: Prentice Hall. 1069 pp.

Medvedev, Mikhail and Adrian L. Melon. In Press. Do extragalactic cosmic rays induce cycles in fossil diversity? Astrophysical Journal.

Morris, Simon Conway. 2003. Life's solution, inevitable humans in a lonely universe. Cambridge, UK: Cambridge University Press. 464 pp.

Pinkham, C.F.A. 1977. A biomechanical analysis of leaping in the kangaroo rat and the spiny pocket mouse. Proceedings, Utah Acad. of Sciences, Arts and Letters 53(2):1-15.

Polkinghorne, John. 1995. Quarks, chaos & Christianity, questions to science and religion. New York: Crossroad. 102 pp. (originally published in 1994, by Triangle Society for Promoting Christian Knowledge, London, England.

Rees, Martin. 1999. Exploring our universe and others. Scientific American 281: 78-83.

Rennie, John. 2002. 15 answers to creationist nonsense. Scientific American 287: 78-85.

Rhode, Robert A. and Richard A. Muller. 2005. Cycles in fossil diversity. Nature 434: 208-210.
Schroeder, Gerald L. 2001. The hidden face of God, science reveals the ultimate truth. New York: Touchstone. 224pp.

Ward, Peter D. and Donald Brownlee. 2003. Rare earth, why complex life is uncommon in the universe. New York: Copernicus Books. 335 pp.

Watson, J. D, and F. H. Crick. 1953. Molecular structure of nucleic acids, a structure for deoxyribose nucleic acid. Nature 171: 737.

White, Tim D, Giday WoldeGabriel, Berhane Asfaw, Stan Amrose, Yonas Beyene, Raymond L. Berner, Jean-Renaud Beisserie, Brian Currie, Henry Gilbert, Yohannes Haile-Selassie, William K. Hart, Lesles J. Hlusko, F. Clark Howell, Reko T. Kono, Thomas Lehmann, Antoine Louchart, C. Owen Lovejoy, Paul R. Renne, Harms Ssegusa, Elisabeth S. Vrba, Hank Wesselman, & Gen Suwa.2006. Asa Issie, Aramis and the origin of Auaralopithicas. Science 440: 883-889.

Carlos Frank Amory Pinkham, Visiting Associate Professor of Biology, Norwich University