The Primordial Seed of Life: Creation, Spontaneous Generation, and Emergence Theory

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Abstract

In this work, I examine the origin of the universe in terms of the complexity and the order exhibited in terrestrial life by analyzing the universe's design based on the "intelligent design" of creation. This paper is based on a repertoire of scientific resources and looks at whether an intelligent extraterrestrial "Creator" exists or the entire universe emanated merely from "spontaneous generation." Drawing on different examples extracted from mathematical, scientific, and philosophical resources, I hope to present a decisive argument about the gap that exists between real creation and the mere dogma of spontaneous generation. The emergence theory is discussed, and a tangible example of the failure of the emergence theory is given. The results suggest that two ostensibly very different aspects—not even acting in spaces having the same dimension—actually are equivalent. These two aspects are human perception and physics.

And the LORD God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and the man became a living being.

Genesis 2:7 NKJV

For every house is built by someone, but He who built all things is God.

Hebrews 3:4 NKJV

Introduction

The laws that govern the universe, its astronomical structure and its environment, have influenced our thoughts and actions in a subtle and unequivocal way. We are part of a cosmic environment that is vast in size. The pivoting and hard questions that come to mind are those related to the source of things: Who created the cornucopia of constellations, the complexity seen in living creatures, and the plethora of diverse species? And most of all, who created us? These questions, in their expediency and complexity, cry for an answer.

The main impetus behind this present eclectic work is to give these questions reasonable answers that are based on the repertoire of scientific resources. My paradigm will be the question of whether an intelligent, extraterrestrial "Creator" exists or whether all we have here in the universe arose merely by "spontaneous generation." Drawing on sundry examples derived from mathematical, scientific, and philosophical sources, I would like to give a decisive argument demonstrating the gap that exists between creation and spontaneous generation. In doing this, I will follow a trail ranging from the macroscopic landscape of the universe, involving structures such as galaxies and clusters of galaxies, down to the microscopic world of the tiniest living information-processing chips on a molecular level—RNA and DNA. Then, I will show that there is a hidden linkage and a delicate enterprise between the universe itself and the minutiae.

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The Physical Dictum

Complexity

We all ponder the question of our own origin. Early Greeks long debated this irksome issue, *viz*., the cause of life on earth. Creationists view the origin of life as the direct product of intelligent design by a Creator who transcends our space-time domain. This Creator pierced the veil of our three-and-a-half-dimensional universe and then applied information and biochemical "know-how" onto matter. He directly created infinitely complex "machines" such as the heart, the liver, and the central nervous system. Materialists, on the other hand, assert that life with all this complexity was caused by the interplay of natural laws and time acting on nonliving matter—the fortuitous results of accidental circumstances (spontaneous generation). Complex organs like the heart are viewed as either the result of careful design and forethought or the product of blind and haphazard interactions. When all the frills are stripped away, the fundamental question in the debate on the primordial seed of life is: Creation or spontaneous generation?

The vast universe around us is filled with a plethora of matter arranged as planets, stars, and inanimate lumps of celestial matter such as galaxies and clusters of galaxies. Even though the universe is huge, most of its volume is actually void. The mass of our universe obeys quantum laws, which dictate that mass is constant; hence, its great volume is a consequence of its expansion. The core of this is the fact that mass and size are important to our existence in very peculiar ways, which at first glance are not appreciated until we dig deeper into the universe's order and design. One might expect that our marvelous cosmic inventory would be scattered all over in a chaotic and disorderly fashion, depicting that nature explores all possibilities in a trial-and-error mode, but this is wishful thinking. By looking deeper into things, one cannot escape noticing that there is a hidden order manifesting itself in creation.

Before we proceed to examine the massive structure of our universe, let us first look at something closer to home: our planet Earth. To see design in action, let us compare our moon and Earth. The moon is arid and dead, while Earth is a life-supporting planet with intricate and colossal complexity that can support biochemistry. But why is this? The reason is that Earth has a biosphere composed of essential life-supporting compounds like oxygen, nitrogen, carbon dioxide, and water. However, the picture goes beyond this to include a hidden force that makes life possible on Earth, namely, gravity. If we were to transport our atmosphere to the moon, all the gases would escape its surface since its gravity is not strong enough to pull these gases inward. There is a delicate balance that manifests itself in the fact that if the gravitational pull of a planet is too great, then the inter- and intra-atomic molecular and chemical bonds that hold our structure will be crushed instantaneously as a result of the enormous gravitational pull. The epitome of this is the fact that life-supporting planets should fall within a critical size range. Such immense complexity cannot just be the product of randomness but rather the product of a stupendous and meticulous design.

The Grand-scale Structure of the Universe

In considering the universe, one of the greatest enigmas facing cosmologists is the evolution and structure formation in the universe. No one can deny the impressive appearance of spirals in the arms of many galaxies such as ours, the Milky Way. Galaxies are considered the sites of star formation, death, and evolution and are regarded as the fundamental structural building units of the universe. Since the beginning of modern cosmology, scientists have been involved in unraveling the mechanisms that underlie structure formation of galaxies and their prominent features and inherent properties. While many models with varying complexity have been developed to account for the origin of galaxies from their primeval seeds, there is no ample empirical evidence that supports any of the *ab initio* scenarios upon which these models have been based. Thus our understanding of galaxy formation remains elusive and rudimentary. In general, however, we know that the balances of two forces are responsible for such structures. For example, stars maintain their integrity by a balance between two opposing forces, the inward gravitational pull and the outward pressure of hydrogen gas sustained by nuclear reactions in the vicinity of their cores. Galaxies, on the other hand, display the inward gravitational pull, resulting from pulling the stars inward, and the rotation of the stars as they orbit around the center of the galaxies or the cluster of galaxies. One can see, therefore, that there is a delicate balance between such forces and a meticulous design that governs them.

All things are made of closely packed arrays of atoms, including galaxies, stars, planets, trees, human beings, insects, cells, DNA, and atoms. Hence, a single atom should have the same density as the collection of these atoms of which they are made. If two things have similar densities, then their mass (M) to volume (V) ratio must be similar (Barrow, 1995). It is also known that volume is proportional to the cube of an average linear length (r^3), regardless of the shape; hence,

$$M = k\, r^3 \qquad (1)$$

where k is an arbitrary constant.

Taking the logarithm (log) of both sides of Equation 1,

$$\log M = \log k + 3 \log r \qquad (2)$$

Equation 2 tells us that if one would measure the relative distribution of mass and size starting from the tiniest single

atom to massive galaxies, and plot M versus r on a log-log coordinate system, one should get a linear relationship with a slope of 3. Indeed, this is the case, and such a relation is depicted in Figure 1.

By examining Figure 1, it can be seen that all these solid objects lie along a straight line (dashed line). Applying the method of least squares on the data of Figure 1, the slope obtained is 2.91~ 3, and the correlation coefficient is found to be 0.93. This mathematical representation holds true from the ostensibly very different, tiniest atom (hydrogen atom) all the way to the largest solid structures of the universe, galaxies. The lesson to be learned here is that there is an orderly, hidden connection that governs our universe and extends from the smallest to the largest structures of the universe. Thus, the vicissitudes of a century of physical revelations warn us not to be dogmatic, suggesting implicitly that levels of structure are actually divisible portions of the greater picture, where everything is infinitely interconnected.

The Philosophical Dictum

Aristotle argued in the fourth century B.C. that the articulate design we encounter in living systems is evidence for a divine interlocutor. He asserted in his book *Metaphysics Part II* that causes are finite in a series of events and there must be a first cause in which the chain of explanations automatically leads to a regression, since an infinite regression is senseless (Feinberg and Shafer-Landau, 2005). This notion of first cause can be regarded as a kind of meta-cause with the preponderance to create new chains of events without requiring a predecessor. Following Aristotle's footsteps, Thomas Aquinas in the thirteenth century also corroborated this view, which he referred to as "the teleological argument," one of his four arguments for the existence of God. The assertion in modern times for the existence of God or a designer was presented by an Anglican priest and philosopher by the name of William Paley in his watchmaker argument (Paley, 1802). Paley uses the analogy that exists between machines and the structures found in living systems. He argued that if we were to find a watch in an empty field, one would logically conclude that it was designed and not the product of random formation. Likewise, since life on Earth has every appearance of contrivance or machinelike design, there must have been a designer for such life.

Scottish philosopher David Hume, who lived between 1711 and 1776, attacked this long-held argument. According to Hume (1981), the weakness of the watchmaker analogy argument is the question of whether or not the similarities apply, and, if so, to what extent. He argued that the complex, machinelike structures found in living plants and animals only have the appearance of design; they were only superficially like machines but natural in essence. These "non-machines," he argued, were "natural" and therefore needed no designer or creator. In addition, he concluded that the fallacy of this argument stems

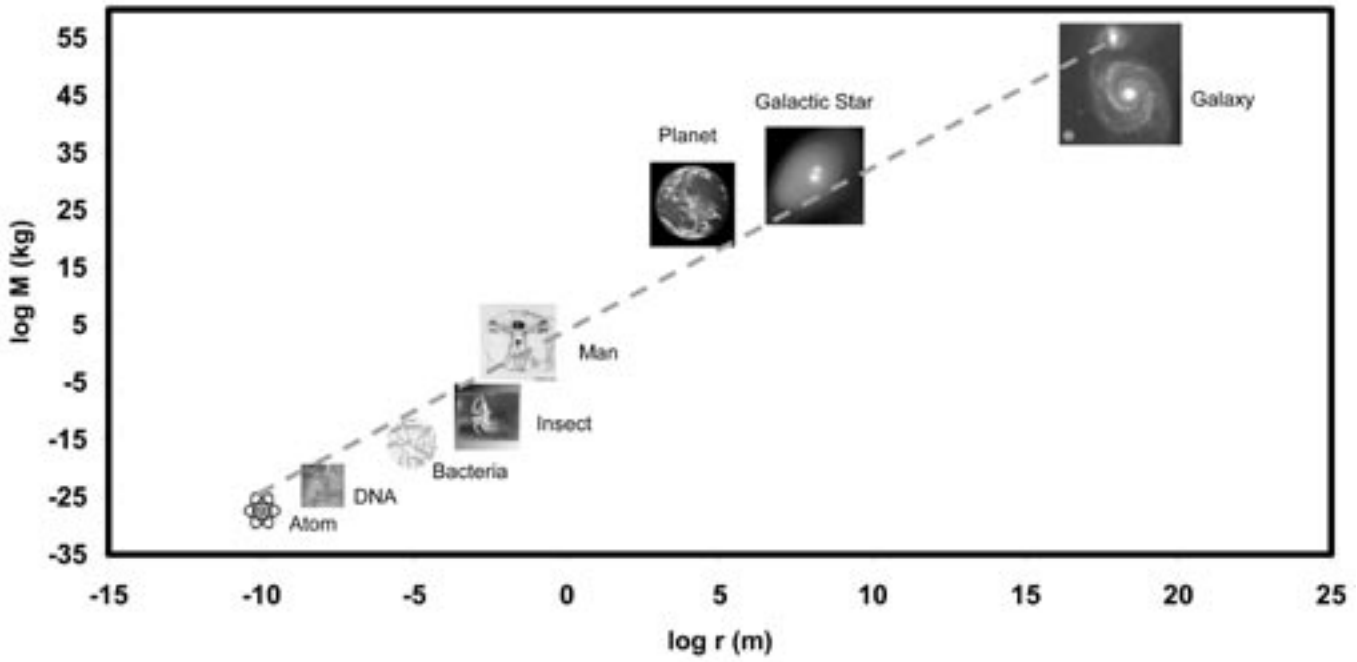

Figure 1. Logarithmic scale of variations of some of the structures found in our universe in terms of mass (M) and size (r). *See* Equation 2 in text. Despite the vast differences of mass and size between these structures, this figure demonstrates the linear correlation that exists between mass and size in the universe, implying coherence and order.

from the fact that large artifacts such as buildings are built by a group and not by an individual or a creator. He further argued that if a designer is required, then also the designer must require a higher designer and the analogy reasoning leads on *ad infinitum*. He argued that the teleological argument for God presented by Paley would hold true if, and only if, organisms were deeply analogous at the molecular level to machines (Hume, 1981).

The dearth of information about the molecular structure of living systems at the times of Hume and Paley made this an impenetrable thicket since there was no means to verify Paley's claim that living systems were, in fact, micro and/or macro machines. Accordingly, for nearly two hundred years, scientific materialists have maintained that Paley's argument is erroneous and invalid and that the God hypothesis is mundane and moot.

The Biological Dictum

In the last half of the twentieth century, profound and astonishing discoveries regarding the molecular structure and function of living systems have brought the materialistic "spontaneous generation" origin-of-life scheme into serious doubt. In the field of molecular biology, discovery after discovery has revealed that living systems contain structures that conform in every way to the modern definition of a machine. In fact, the parallel between living systems and machines has now been shown to extend all the way to the molecular level. According to Nobel Laureate Jacques Monod, machines are purposeful (teleonomic) aggregates of matter that use energy to perform work (Monod, 1971). The core of experimental science and engineering knowledge confirms that all machines are the result of purposeful design by an intelligent source. The theory of evolution asserts that inanimate matter, which possesses no concepts, knowhow, or purposefulness, developed into machines by chance! No other field in science purports that machines can arise by chance.

Hume's views of creation are also shared by Richard Dawkins (1985), who relied on probability as the criterion for the definition of complex biological entity. The major difference between Dawkins's and Paley's explanations is that Paley attributes the emergence of complex structures to a creator while Dawkins based it on trivialities and accidental events working within forces presumed to be inherent in all matter.

The primary focus on the question of the origin of life emanates from how such incredibly complex molecules can accomplish reproduction, repair, and metabolism of living things. Any feasible theory on the "spontaneous generation" origin of life should explain the origin of this chemical hardware. Similar to computers, living systems require much more than just hardware to perform functions; they also require software or coded information to direct the activities of the cellular hardware. Again, like a computer, this software needs to reside within each living system. Unlike a computer, living systems also possess the marvelous ability to reproduce and pass to the next generation both the hardware and the software or the genetic coding.

No one could fully know the nature of this coding information until 1953, when James Watson and Francis Crick unraveled the DNA structure (Watson and Crick, 1953). They revolutionized our understanding of cellular growth and metabolism. Now we know that the growth and metabolism of all life on Earth is carefully controlled by a language convention called the *genetic code*, carried by the DNA molecule, which governs the actions of the cellular hardware. The prominent questions here are, where did this code and the rules by which it is governed come from? In the last 25 years, the field of information theory has shed a great deal of light on the nature of codes and programs. Like computers, "spontaneous generation" cannot devise such hardware and/or software embedded with the necessary instructions and information needed to perform the different tasks. This fact poses a serious threat to the materialistic scenario of the origin of life. To overcome this problem and find a solution, one has to rely on a divine intervention, a "Creator." Regarding the origin of life, Francis Crick, winner of the Nobel Prize in biology, stated in 1981 (Crick, 1981):

> An honest man, armed with all the knowledge available to us now, could only state that, in some sense, the origin of life appears at the moment to be almost a miracle (p. 88).

In 1970, world-renowned British astronomer Sir Frederick Hoyle decided to calculate the mathematical odds of spontaneous generation from a primordial environmental soup to explain the origin of life (Hoyle, 1981). Applying the laws of mathematics, chemistry, and thermodynamics, he calculated the probability of the spontaneous generation of just the proteins of a single amoeba and found it to be 1 in $10^{40,000}$. Hoyle was a strong believer in the spontaneous generation dogma, but this number reversed his opinion. Hoyle (1981) stated (Missler, 1996):

> The likelihood of the formation of life from inanimate matter is one to the 40 thousand naughts (zeros) after it. It is enough to bury Darwin and the whole theory of evolution. There was no primeval soup, neither on this planet nor on any other, and if the beginnings of life were not random they must therefore have been the product of purposeful intelligence (p. 60).

The caveat behind Hoyle's work is the fact that he did not include in his calculations the chance formation of the DNA, RNA, or the cell membrane that encapsulates and holds the cell together. In essence, he did not include

the necessary parts that make this micromachine run.

A physicist from Yale University, Professor Harold Morowitz, came to the rescue by envisioning a more realistic estimate for spontaneous generation of a bacterium, which included the missing information in Hoyle's calculations (Hynek and Vallee, 1975). He concluded that the odds of a mere single bacterium reassembling by chance are one in $10^{100,000,000,000}$. Other prominent scientists, including Carl Sagan, have statistically calculated the evolution of man by chance, and the results have been staggering: one chance in $10^{2,000,000,000}$ (Sagan et al., 1973). In Mathematics, a probability of less than one in 10^{15} is equivalent to total impossibility and is regarded as "a virtual impossibility" (Eastman and Missler, 1996).

The Emergence Theory Dictum

Recently, there has been renewed interest among scientists in the discussion of the behavior of complex systems and the reconcilability of mental causation, or consciousness with physicalism in terms of emergence theory (Laughlin and Pines, 2000; Laughlin et al., 2000; Bar-Yam, 2004). Emergence theory is based on the dictum that the whole is greater than the sum of the parts; that is, when complex systems supervene upon their lower-level parts, there is a birth of and an inexorable rise to universal complexity. In general, the theory of emergence depends on two main notions: (1) the epistemological, which is concerned with the role of the observer during the act of the observation in terms of limits on human knowledge of complex systems, where emergent properties could not be predicted; and (2) the ontological, which is concerned with the metaphysical assumptions of the observer prior to the act of the observation, where the physical world is layered as composite structures, a ladder, based on increasing complexity in which each step or strata is a consequence of the lower one, resulting in novel qualities.

Many philosophers have adopted the epistemological approach in describing complex systems. The first serious attempt was by George Henry Lewes, who made a clear distinction between resultants in which the sequence of steps that produces a certain phenomenon is traceable, while in emergence it is not (Lewes, 1875). This paradigm might be interpreted as identifying emergence with the epistemological limitations of the observer. Others have followed Lewes's approach (Smuts, 1926; Nagel, 1961; Fodor, 1974; Popper and Eccles, 1977; Teller, 1986; Bedau, 1997; Clark, 1996, 2001; Batterman, 2001).

The early exponent of ontological emergentism was John Stuart Mill, who argued that the mechanical and chemical modes are different in that the total effect of several causes acting in concerted fashion is identical to the sum of each of the causes acting alone in the mechanical, but not in the chemical (Mill, 1843). He coined the term "composition of causes" to describe the mechanical mode. For him, the law of vector addition of forces, such as the parallelogram law, is the "composition of causes," or the mechanical mode. Chemical reactions on the other hand are in violation of the "composition of causes" since the addition of an acid and a base to produce a salt and water is not the sum of effects of the causes had they been acting separately. Many others have adopted the notion of "composition of causes" (Morgan, 1923; Broad, 1925; McLaughlin, 1977). Other emergentists have adopted different definitions for emergent theory, such as Samuel Alexander, who combined both definitions of emergentism (Alexander, 1920). Timothy O'Connor on the other hand adopted a non-supervening, dynamical approach to emergence theory (O'Connor 2000a, 2000b). Paul Humphreys favored a metaphysical relation he coined "fusion," in which emergent properties result from a fusion of their constituent properties that are nomologically necessary for the appearance of the emergent property (Humphreys, 1997).

Proponents of the nonmaterialist or nonreductionist theories of emergence are rejected *a priori* on the basis that emergence is considered a part of spiritual creation that is governed by a Designer. Stephen Pepper (1926) rejects the idea of emergence based on the argument that such emergent properties are epiphenomenal and that the alleged emergent change is predictable and not cumulative. Jaegwon Kim (1999) argues that both upward and same-level causations necessitate downward causation, and therefore it is epiphenomenal. On the other hand, Ali-Sayed and Zimmer (2005) have argued against the theory of emergence by employing a relativistic interpretation through the inclusion of both the role of the observer during the act of the observation and the metaphysical state of the observer prior to the act of observation.

Accordingly, there is as yet no sound scientific theory of emergence. It can therefore be considered one of the paradoxes of modern science that in spite of our knowledge about the cosmos and its laws, there is no clear general definition of emergence. There are also numerous speculations, edifices, and arguments associated with its validity, axioms, and applicability. It is of special interest to note that not all complex systems can be attributed to emergence. Since emergent properties are not entirely free to make things up as they proceed, they are therefore subjected to constraints, such as the conservational laws, which dictate that matter cannot be destroyed; they can proceed by creating new patterns of relationship by employing preexisting conditions. Within this context, genetic coding, for example, is not entirely confined to this definition since genetic coding can be considered as the lower-

level laws, where other phenomena can be attributed. In retrospect, laws cannot emerge; what emerge are not laws but what the laws describe. What is of significance is the fact that in emergence, one is not discussing the possibility of chance but a thorough regularity in nature, which can be considered a part of the design and order that is described by this work.

A Robust Example of the Failure of Emergence

I have recently shown that the perception of Moiré patterns (when a random-dots pattern is superimposed on itself and rotated by a small angle, creating a circular pattern, see Figure 2) is dependent on the total energy of the system being minimum and can be described by employing classical Newtonian mechanics (Batarseh, 2005, 2007). Calculations of the total energy of the system have revealed that the minimum energy levels correspond to the angle at which humans can perceive the Moiré patterns (Batarseh, 2005). The minimum energy requirement was found to directly correlate with the impoverishment of the Moiré effect. The outcome of this modeling effort is that it appears that the brain detects parallelism at low energy levels. Therefore, for the perception of these patterns, it can be concluded that filters that respond only to low-energy-level signals govern information processing in the human brain. Hence, the human visual system is making direct relations between the master pattern and its copy, which are strong functions of the total mechanical energy, and once this minimum energy *threshold* is reached, there is no new information that can be deduced, independent of the stimulus code. For a detailed discussion, the reader is referred to Batarseh (2005, 2007).

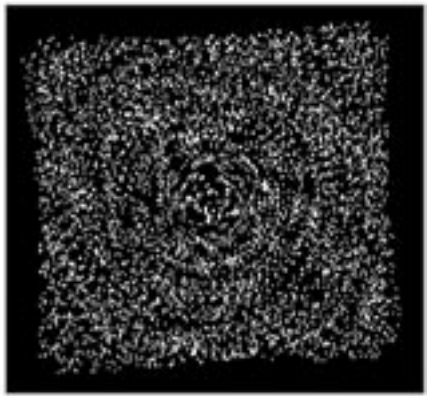

Figure 2. Circular Moiré pattern generated by a computer algorithm through superimposition of two identical copies of 4000 dots distributed homogenously with one copy rotated by θ= 6°. This angle of rotation corresponds to the total energy of the system being minimum where the Moiré effect is perceived by humans.

In retrospect, the neurobiological emergence phenomenon underlying the perception of the Moiré effect is actually reducible to lower physical laws (Newtonian mechanics), which is a clear and obvious violation of the emergence theory, since it explicitly dictates that such complicated neurobiological process are in fact effectual and can be reduced to basic physical laws. This is in clear agreement with the proposition suggested by Stephen Pepper (1926): "That is to say, if the laws of behavior enter into the physical system at any point they must constitute either primitive laws in that system or be deducible from the primitive laws. There is no other way out of it."

Interestingly enough, the phenomenon of Moiré patterns actually can be used to infer information about the grand-scale structure of the universe. In fact, the Moiré demonstration can give a plausible cosmological theory for structure formation in the universe regarding the rotation velocity curves of spiral galaxies, as well as observational evidence related to the structures of ionized hydrogen and positions of giant molecular clouds and dust lanes observed in spiral galaxies (Batarseh, submitted). Since detailed derivations of the theory are available elsewhere (Batarseh, submitted), only a brief discussion will be given here.

Optical measurements of spiral galaxies' rotation velocity curves as a function of radial distances from the center have shown that the shape of the rotational velocity curve does not follow Keplerian falloff, where the circular velocity should drop as the radius is increased. Specifically, it was observed that the rotation velocities of stars and gas/dust in the center increases with radius while those at the outer skirts of the arms showed higher and nearly flat rotation velocity profiles, extending out to the radial limit of the data (Rubin et al., 1985). This unusual and counter-intuitive behavior of spiral galaxies is extremely common, and most known spiral galaxies behave in this fashion.

In an attempt to reconcile this perplexing phenomenological discrepancy, physicists have invoked invisible dark matter (DM) halos in the peripheries of spiral galaxies so as to force the flattening of the circular velocity profiles, thereby suggesting that galaxies are composed of ~ 90% invisible dark matter (the standard cosmological principle). This peculiar assumption has resulted in complicated cold dark matter models (Λ-CDM) with many adjustable parameters (Ostriker and Steinhardt, 1995). Despite the continuous efforts to find dark matter, to date none has been found.

An alternative theory to the DM hypothesis is the "modified Newtonian dynamics" model, or MOND, developed and advocated by Milgrom (1983). Milgrom's approach relies on adding terms to the gravitational potential of the Newtonian dynamical equation to account for the astronomical mass discrepancy and forcefully making it fit the observed rotation velocity data (Milgrom, 1983). Notwithstanding its empirical success, MOND remains an *ad hoc* modification of Newtonian dynamics because it was designed to fit rotational

velocity curves without a foundation in deeper theory (Sanders, 2003).

To counteract these deficiencies in the previous theories, I have recently developed a theory referred to as Virialized Astrophysical Moiré Patterns, or VAMP, based solely on Newtonian dynamics. It was found that VAMP's predictions are consistent with observational evidence, lending support to its foundations. In particular, VAMP correctly accounts for the rotation velocity profiles as a function of radial distance, the total mass of spiral galaxies, and many other features associated with spiral galaxies without taking the so-called DM or MOND into account. For a thorough review of VAMP and its predictions, the reader is referred to the literature (Batarseh, submitted).

Collectively, the above unequivocally ascertain the fact that there is seemingly a collapse of higher-level entities to lower-level entities that are predictable and can be described by elementary physical laws, clearly violating the underlying premise of emergence. Thus, it appears that in a universe of colossal complexity, everything at first glance seems to be discrete; but a closer look reveals that things are essentially infinitely interconnected and eventually can be described by basic primitive laws that were implemented and standardized by a Designer or a Creator.

Summary

The monotheistic religions, Judaism, Christianity, and Islam, have asserted for thousands of years the doctrine that there is a transcendent Deity, a Creator who produced our space-time domain, pierced this veil, and inserted information and know-how onto matter to form life out of nothing. The result was the birth of an ordered, energized universe filled with information and every appearance of contrivance and design.

The above leads us to conclude that the absence of a supernatural cause, or Creator, for the origin of life is ridiculous. So we invoke a transcendent Creator who fashioned, ordered, and established the laws that govern life. To invoke the god called "spontaneous generation," however, is to believe in "virtual impossibilities."

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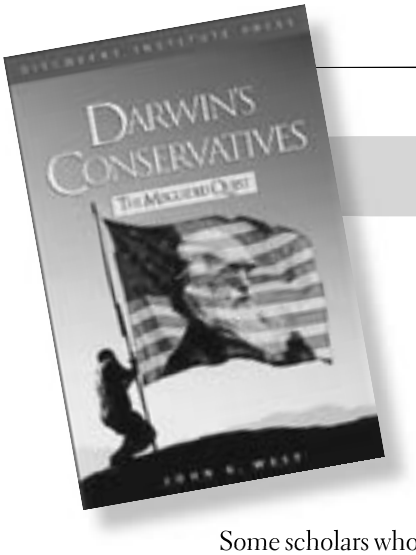

Book Review

Darwin's Conservatives: The Misguided Quest

by John G. West

Discovery Institute Press, Seattle, 2006, 157 pages, $15.00.

Some scholars who are otherwise conservative (traditional family, morality, etc.) support Darwinism. These individuals are Darwin's conservative champions, and Larry Arnhart at Northern Illinois University is one of these articulate advocates. His argument is that Darwinism supports traditional morality, family life, sexuality, economic liberty, and non-utopian limited government and is compatible with free will, personal responsibility, and religion. Also, he believes that "Darwinism has not been refuted by intelligent design" (pp. 10-11).

The author of *Darwin's Conservatives,* John West, strongly disagrees with the above contentions. West declares that "among the elites," Charles Darwin "retains his prestige" to the extent that he is recognized "as a secular saint" (p. 93). In seven chapters and a conclusion, West mounts a convincing refutation of Arnhart's views, while showing that Darwinian biology is seriously flawed and even corrosive. Intelligent design clearly is supported by data. West, who is strongly opposed to belief in the idea of theistic evolution, says, "Such religious believers either reject full-blown 'Darwinian' (i.e., unguided) evolution or they jettison traditional theism in order to uphold a consistent Darwinism" (p. 66).

It is of considerable interest that the Discovery Institute, of which West is a Senior Fellow, "does not advocate forcing intelligent design into classrooms. Instead, the group favors the more limited policy of encouraging mainstream scientific criticisms of neo-Darwinism to be presented alongside the best evidences favoring Darwin's theory" (p. 74).

Darwin's Conservatives ends with an appendix containing information about the Cobb County, Georgia case, which started in 2002. There are also an impressive 303 notes with references and comments, along with a seven-page index. I consider West's book worthy of wide distribution and serious attention.

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