THE NON-ENDING SEARCH FOR A PRE-DNA REPLICATOR: RICHARD DAWKINS AND THE PROBLEM OF ABIOGENESIS

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APPROVAL SHEET

THE NON-ENDING SEARCH FOR A PRE-DNA REPLICATOR:

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OF ABIOGENESIS

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To Wendy,

the love of my life

and best friend.

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PREFACE

Only through the grace of God has this dissertation been possible given the many obstacles I have experienced. To learn how to thoroughly research and critically argue through a paper of this magnitude yields perhaps the greatest challenge of all. The experience itself has truly given me a whole new perspective of the process and upon those who have accomplished it before me. They had undoubtedly earned it and I am humbled beyond measure to be even mentioned among them.

I am simply amazed that an airline pilot who had thought about enrolling in an off campus hermeneutics course a decade ago would ever arrive at this time and place. Little do we know how God will direct our paths. We must all have faith in preparing for the ride, for it is not always a smooth experience when God chooses to engage our hearts. He often demands our blood, sweat, and tears to take on the challenges presented to us. But what a joy it is in the grand scheme of it all as God alone receives praise!

Along this journey, God has afforded me many to thank. Chuck Lawless is one of the first who comes to mind when thinking back to the decision made to pursue a research doctoral track. When faced against the seemingly impossible odds of attending mid-week classes amidst an airline schedule, I was dumbfounded as to how such a conflict could ever be resolved. Unbelievably, God saw to it that the out-of-town and out-of-country flights would neither interfere nor cause me to miss but a single class during the entire time. And that class, as Mark Coppenger knows, was due to my own faulty scheduling and not a lack of God's provision.

I would be remiss if I did not recognize the godly leadership and friendship offered by Peter Gentry, Steve Wellum, Bruce Ware, and Bill Cook. These men left their mark on my heart as brothers of insight and encouragement. But where they prepared me, God supplied others to polish the skills of my chosen discipline. Jim Parker, Mark Coppenger, James Chancellor and Ted Cabal poured their efforts into further refining that which was demanded. I am forever in their debt – especially to Ted Cabal, who has not left my side since taking me on in that opening interview. He has refined the fire in my heart and channeled it in a way that would best serve God and His kingdom. I thank God for each and every one of these men.

I am also indebted to the encouragement of friends that God has brought into my life at this time. Brothers such as Brian Payne and Travis Kerns saw to it that I was steadfast to complete that which was before me. Then came men like Tawa Anderson who found a way to trudge through the process with me. In addition to these expected colleagues of the process, God has also blessed me with a few unexpected fellows who have encouraged and prayed for me along the way. A number of pilots at UPS had become aware of my work over time and offered their encouragement to get through it. Though there are too many to list here in this place, my thanks would be incomplete without mentioning Brad Clark, Mike Zawisza, Ron Karr, and Ivan Lasoi. Each has been a Barnabas to me.

Last and certainly not least, I offer my greatest appreciation and thanks to those who bore the greatest challenge of all. Only through the love and support of my ever faithful and patient wife Wendy and my two children Ciana and Luke, could this dissertation been completed. They have respected my time to research and write, and

have celebrated each and every passing chapter that had been written (and edited). They are the ones who have kept the home fires burning for a weary pilot and researcher who had come in from the cold.

All in all, my hope and prayer is that this dissertation does not simply accomplish the requirements of a degree, but that the truth about creation by the hand of God does not fall upon deaf ears. May it serve as a return volley against the challenge presented by Richard Dawkins, the New Atheist Movement, and naysayers everywhere who blindly believe in a world without cause, without hope and without purpose. As Psalm 19 declares, "The heavens declare the glory of God and the firmament shows His handiwork." May this paper serve as an argument for this truth as is evident to those of us who stand in awe of His glory. May God alone be praised.

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May 2014

CHAPTER 1

INTRODUCTION

The Gap Separating Non-Life from Life

> The most important, as well as the least studied, stage of the evolutionary process under consideration would seem to be the transition from the most complicated organic substances to the most primitive living organisms. This is the most serious gap in our knowledge.
>
> A. I. Oparin *Origin of Life on Earth*[1]

Though Oparin made this profound statement in regard to the *origin of life* in 1957, it still stands as a remarkably accurate assessment of the state of the science today. Modern efforts have continued Oparin's pursuit of this most elusive of puzzles, which asks how life first arose on our planet. It is the question which asks how inanimate matter could become living matter (i.e., or non-life to life). Though scholars have made great strides in the broader field of evolutionary studies over the past few decades, far too many have overlooked this crucial strand of the Neo-Darwinian paradigm.[2] They have tended to gloss over the lack of success in this particular area of the paradigm while

[1]Alexander I. Oparin, *The Origin of Life on the Earth* (New York: Academic Press, 1957), 101. Early versions of this text began with the original Russian edition in 1924 (translated in 1968) and a later edition in 1956 (translated in 1961). A 1936 Russian edition was also translated in 1938 by MacMillan Company. The 1957 printing referenced above is a reprint of the 1936/38 version by Academic Press.

[2]The Neo-Darwinian paradigm, in its simplest sense, is the philosophical term representing biological evolution through some means of mutation coupled with natural selection. It is the reigning paradigm in science, which envisions life as having arisen from purely inanimate, non-living matter at some point along the geological timeline. That paradigm encompasses the entire biological realm as it accounts for every known life form and expands across every known biological kingdom.

exuding an overwhelming air of confidence in its more established areas (e.g., homology, comparison of genomes, etc.).[3]

Notwithstanding such confidence, the resulting *gap* of knowledge to which Oparin had referred still exists. In fact, the accumulated wealth of scientific study over time has only enhanced our understanding of its complexity. As Karl Popper concluded nearly a half century ago, the "breakthrough[s] of molecular biology has made the problem of the origin of life a greater riddle than it was before: we have acquired new and deeper problems."[4] Unfortunately, that is still the case. Despite the hopeful ambitions of many who recognize the great strides in microbiology and related fields, the struggle persists. It has invited all new challenges across a number of disciplines. Andy Pross acknowledged the increased complexity of this issue in confessing that "the science of biology appears to have reached a conceptual impasse."[5] Indeed, in attempting to traverse the complexity of this interdisciplinary problem, science has "yet been unable to adequately bridge between the physicochemical and biological worlds."[6]

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[3]There are physiological components that are deemed by many to bolster the argument for biological evolution. Homology and genetic (DNA) similarity are two of the stronger components of this argument. While homology encompasses the macroscopic or phenotype features across differing species within comparative biology, genetic/DNA similarities represent the microscopic features in regard to the genotype. Whereas the former includes the comparison of body type, skeleton, appendages and the like, the latter includes the genetic comparison across chromosomes.

[4]Karl Popper, "Reduction and the Incompleteness of Science," *Studies in the Philosophy of Biology,* ed. Francisco Jose Ayala and Theodosius Dobzhansky (Berkley: University of California Press, 1974), 271.

[5]Andy Pross, "Toward a General Theory of Evolution: Extending Darwinian Theory to Inanimate Matter," *Journal of Systems Chemistry* 2, no. 1 (2011): 1. Andy Pross is a professor of chemistry at the Ben-Gurion University of the Negev in Israel. He is an active participant and speaker at the Gordon Research Conferences including the 2012 event on the "origin of life." This article was also presented at the following conference: idem, "Extending Darwinian Evolution to Inanimate Matter," 2012 Gordon Research Conference, Galveston, Texas (January 8-13, 2012).

[6]Ibid.

Clearly, this gap turns out to be a much wider chasm than many had presumed. To illustrate, one might envision a broad canyon – the two sides of which being of considerable distance from one another. Unfortunately, some have mistakenly pictured a much smaller gap.[7] They might envision a much narrower space like that between the two magnetic plates of a simple capacitor or perhaps the void between two sides of a multi-section bridge before the final section is added. But such an erroneous and even naïve picture stands far from the truth. The gap separating non-life from life remains immensely wide. Robert Hazen most aptly describes the problem in admitting that the "epic history of life's chemical origins is woefully incomplete. Daunting gaps exist in our knowledge, and much of what we have learned is hotly debated and subject to conflicting interpretations."[8]

More specifically, this gap separates the most complex organic molecules from the simplest living substances known to man. Researchers in the field refer to those extremes as the "bottom-up" and the "top-down," respectively.[9] Though modern science has made considerable progress in unraveling much of the detail surrounding this gap, it

[7]Jacques Loeb (1859-1924) is but one of the scholars who has envisioned a much narrower gap. He had fully expected that at any time science would triumphantly announce the creation of an artificial life form in the lab. That overconfidence back in 1912 has yet to be actualized in 2014. No one has even come close to such a feat to which Eric Collin Martin aptly calls "the gold standard of the field." See Eric Collin Martin, "Examining Life's Origins: History and Epistemic Principles in the Search for the Origins of Life," (PhD diss., University of California at San Diego, 2010), 7.

[8]Robert M. Hazen, *Genesis: The Scientific Quest for Life's Origin* (Washington, DC: Joseph Henry Press, 2005), xiv. Dr. Hazen is the Clarence Robinson Professor of Earth Science at George Mason University. He also serves as a research scientist for the Carnegie Institution of Washington.

[9]Within origin of life research, the "top-down" approach represents those methods used to ascertain the simplest of living organisms. These methods typically involve a more biologically-oriented approach that targets the minimal requirements of a life-form (i.e., while bearing in mind certain minimum criteria for what defines a life-form). Correspondingly, the "bottom-up" approach concentrates on those methods which involve the minutiae of physics, chemistry, and/or biochemistry. They research how inanimate matter could have somehow organized (and hence increased in complexity) to the point of producing those simplest of organisms. Together, these two methods work together to "bridge the gap" from opposing directions.

has not resolved how to bridge it. As was the case in Oparin's time, the origin of life is still one of the most important issues in science and, though not necessarily the least studied anymore, it remains the *least resolved* area within the reigning paradigm of all science – evolution.

But is this particular issue really that important? Has not science already uncovered enough evidence to secure the evolutionary paradigm for good? Does it really matter how life got started? More specifically, if this issue is unimportant, then individual scientists and research facilities from across the world have squandered vast amounts of time, energy, and funding for something trivial (i.e., into the billions of dollars annually). Perhaps most notably, NASA has allocated the bulk of their current budget toward resolving this very issue. Most of the U.S. space program's resources of late have been specifically designated toward finding life in our solar system and in nearby planetary systems (for this same reason).[10] In fact, this issue has attracted teams of chemists, biochemists, biologists, astrophysicists, and experts of other fields from around the globe in search of a solution. They are well aware of the implications of finding evidence for how life began, albeit from the terrestrial or extra-terrestrial realm, and how that would affect our perspective on mankind as a whole.

Why have they done so? Undoubtedly, they have sought these answers for not only the prospective technological gains but for obtaining, in hand, the ultimate evidence for securing a naturalistic explanation for life. No doubt that the ensuing worldview and

[10]Though a number of organizations from across the globe have spent a great deal of money on origin of life research, NASA has spent well into the billions. Its annual budget is estimated to exceed $17 billion for fiscal year 2012 (*U.S. Office of Management and Budget*) and though its programs are clearly multipurpose, a number of them are primarily intended to engage the origin of life. The latest project with this goal in mind is the Martian-bound *Curiosity*, which should extend the research of related missions including *Chandra's X-ray Observatory, Kepler, The Global Astrometric Interferometer for Astrophysics (GAIA), The Space Interferometry Mission (SIM),* and *DARWIN*.

philosophical implications of such a conclusion can hardly be underestimated in the world and culture around us. How might the world react to the ethical and moral backlash of such a finding? What theological implications might we need to consider? On the other hand, what alternative implications would result in the absence of a solution? In other words, if the gap remains intact, would the evolutionary paradigm lose its credibility? Moreover, how could the twin mechanisms of mutation and natural selection operate without some mechanism to have gotten them started?

Contribution of Richard Dawkins

Throughout history, a multitude of scholars have tried to determine the origin, and perhaps, cause of life. The quest reaches back to the beginning of recorded history just as it looks forward to the present age of cutting edge technology. However, few have surpassed the tenacity of Richard Dawkins, who has left an indelible mark on this most elusive issue.[11] The former Oxford scholar and Charles Simonyi Professor of the Public Understanding of Science has written some thirteen books to date in regard to evolutionary science at large. And the majority of these texts have specifically targeted the issue of origins at some point. In fully utilizing his expertise in "the public understanding of science," Dawkins has gone from promoting his worldview through his writings and Oxford classroom to more directly engaging the general populace through

[11]The *New Atheist Movement* denotes a group of contemporary scholars who have gone on more of an offensive in promoting atheism in the Western culture, especially in lieu of any faith-based worldview. Richard Dawkins, alongside his colleagues Daniel Dennett, Sam Harris, and now the late Christopher Hitchens, have acted as the recognized leaders of the movement since its inception and have cooperated with other select contributors (e.g., Victor Stenger, Anthony Grayling, and Paul Myers) who have engaged their support. In contrast to the somewhat more covert atheism of the recent past, this more aggressive approach of the New Atheists has garnered a relatively popular following as of late.

campus tours, conferences, interviews and a website.[12] There can be little doubt that Richard Dawkins is zealous about what he believes.

However, the specific solution to the origin of life appears to have changed in the mind of Dawkins over time. His writings and public stances clearly lead to that conclusion. Though relatively open to a number of naturalistic solutions, he has intentionally emphasized certain theories over others at different stages of his career. Moreover, his solutions have roughly paralleled whatever the scientific community had endorsed at the time. But why would Dawkins move from an Oparin/Haldane-based, classic solution early on to a somewhat more radical Cairns-Smith crystalline model a few years later? Such a change should invite at least some critique. But Dawkins has also publicly endorsed an extra-terrestrial source for the origin of life (i.e., panspermia), which further illustrates his dynamic and unstable stance. However, he did not stop there, for he has recently moved his position yet a fourth time. Surprisingly, when Richard Dawkins declared his support of RNA World Theory, he had changed positions in as many decades.

Evidently, Dawkins opinion on this matter has been fluid. His current position appears to somewhat follow popular opinion. But that dynamic raises the question of what to make of his previous solutions. It also calls into question the overall difficulty of the issue itself. Though Dawkins has expended considerable effort in communicating that the origin of life is almost resolved, the facts do not support this position. And this ongoing difficulty toward resolution has been the primary reason for his movement between models. Therefore, because of Dawkins's dynamic position on the matter and

[12]Richard Dawkins's website may be accessed at http:richarddawkins.net and is specifically entitled *Richard Dawkins: Foundation for Reason and Science*.

because of his opposing stance on its inherent difficulty, then it seems reasonable that a careful evaluation of his opinions on the origin of life should prove invaluable.

Focus of this Study

The significance of the origin of life and the attention it has received from an influential scholar like Richard Dawkins advocates the writing of a paper. The purpose of this dissertation, therefore, will be to address this important issue. It will begin with a brief survey of the related science at large before specifically developing a philosophical critique of Dawkins's position and contributions over time. Its thesis will demonstrate that Dawkins has not only vacillated between a number of models toward resolving the aforementioned gap (separating inanimate matter from life), but that his philosophical approach to the problem is fundamentally flawed and inconsistent.

Clearly, the potential breadth of this study must substantially limit the scope of its critique. The massive amount of material written on the subject as a whole could easily overwhelm such a study. Therefore, this paper will be confined to a historic overview of origin of life research leading up to the time of Dawkins (i.e., 1970's to the present),[13] followed by a detailed study of his personal quest toward resolving the issue. Dawkins's own ideas and the methods/models cited by him will make up the bulk of its content. Space alone will not allow for extended argumentation, not to mention the number of fields one would have to master to adequately address the wide variety of claims. Hence, this dissertation will not only approach this critique from a more philosophical perspective but will do so by accenting the historical dynamics of

[13]Richard Dawkins, *The Selfish Gene* (Oxford: Oxford University Press, 1976). The writing of the initial edition of this first book in 1976 not only helped promote the author's evolutionary views (i.e., especially in using the gene's viewpoint), but it ushered him into the ring of academic discussion on the matter of origins (which he addressed in this book).

Dawkins's thought. Such a focus will demand a thorough treatment of several philosophical issues including his assumptions, philosophical coherence, and general methodology. Moreover, the effects of worldview and bias will receive close attention.

Background of this Study

Closer to home, let us now turn to my personal interest in this study. Though coming from a predominately secular background academically, I had put my trust in the Lord Jesus Christ at the age of thirteen. It seemed to have been almost inevitable, therefore, for me to eventually gravitate toward questions involving faith and reason. Specifically, how my life of faith was to mesh with my secular background would surely draw conflict at some point in time. Nevertheless, the interface between faith and science has always intrigued me, becoming all the more acute upon my entry into college. Two science-based baccalaureate degrees gave me greater appreciation for the hard sciences, which resulted in minors in both physics and mathematics alongside a major in mechanical/aerospace engineering. It was during that time that the classic questions of existence began to encroach upon my mind: How old is the Earth? What caused the universe (that is, if there was a cause)? And how did life begin?

After teaching biblically-based studies for a number of groups over the years, I began to recognize how often I would encounter some of the selfsame questions from both students and friends alike. For instance, many had pondered the role played by evolution in the grand scheme of things – especially in light of the most straightforward rendering of the creation texts.[14] These questions propelled me to search even further for viable solutions. Though the core of my epistemology rests upon my faith in the Bible, I

[14]The biblical texts referenced above obviously include the creation account of Gen. 1-2, but also entails several related passages including Job 38-41, Ps. 8 & 19, and Col. 1.

have still resolved in my mind to engage science honestly and reasonably. This approach has become especially useful as my drive to understand the origin of life continued to stir my imagination.

After completing a master's degree in apologetics and toward the near completion of the corresponding doctoral degree, I decided to set my sights on that same interface between faith and science. Having been well aware of the plethora of pseudo-science already promoted by a number of fellow creationists (i.e., through books, articles and the internet), I recognized just how important it is to provide a true defense of the faith through respectable scholarship.[15] Though many in my field have provided many outstanding arguments in support of creationism, there are still far too many who have engendered the disrespect of poor "scholarship."

Therefore, I am admonished to carefully follow the science wherever it leads, while hoping to avoid some of the same pitfalls of bias and worldview. The dangers of such *a priori* thinking still abounds. Unfortunately, the influence of Dawkins has served to compound this problem for those very reasons. His approach fails to account for any possibility outside of his naturalistic arena. Irrespective of this view, the problem remains about as far from certain as any other *unknown* in science. It is quite literally the Achilles' heel of the evolutionary structure and thus demands answers. Meanwhile, the importance of this study is further confirmed by the rising interest of the scientific community and in the enormous consequences of its potential solution. Few studies offer

[15]The term "pseudoscience" as used above alludes to a wide variety of creationists who have posted websites or occasionally published their claims with little or no real evidence supporting them. They often depend solely upon secondary or even tertiary-level source materials that have not been adequately checked, much less peer-reviewed. Many make extraordinary claims or cite pitiful references in defense of their worldview. Unfortunately, these faulty claims often result in the side effect of rendering authentic creationist scholarship as suspect.

this degree of relevance. Therefore, the resolution of the first living organism provides the perfect platform on which to apply my research.

Finally, how does one arrive at Richard Dawkins in this study of origins? Undoubtedly, with so many prospective candidates available for such a study, Dawkins provided one of the more optimal prospects for at least three reasons. First, he exemplifies an extremely successful writer who declares a strong confidence in his evolutionary metanarrative. He has scoured the landscape through his thirteen books, numerous articles, and a multitude of discussions in detailing most everything surrounding the issue at hand. Second, his popularity and influence extend well beyond his panel discussions and best-selling texts. In many ways, he has led the academic community as a high profile, well recognized celebrity of sorts and can be readily identified with his position(s). Third, Dawkins represents a formidable opponent in regard to worldview. His allegiance to the New Atheist Movement and its aggressive approach toward students in particular has been virtually unparalleled. This overt attack on traditional faith calls for a detailed and multi-pronged response. This dissertation will serve to address at least one important aspect of that response.

Structure of this Study

The inherent nature of the science of origins and the attention given to it by Richard Dawkins provide a fairly straightforward structure for this paper. First, an overview of how things have developed historically will provide the academic foundation from which the science has progressed. That synopsis will help establish what mankind has already accomplished before moving on to where it is going. Chapter 2, therefore, will focus on the history of the science beginning with the mythological accounts of early

civilizations. It will then review the rational thought of the Greeks and the Aristotelian-influenced medieval era before building toward the relatively more recent advancements of Oparin/Haldane, Stanley/Miller, and others. The chapter will end prior to the entrance of Dawkins who came on the scene during the seventies. Chapter 3 will continue that historic theme through the life and times of Dawkins and end with his theoretical work on the science of origins. In fact, his somewhat fluid stance in regard to solutions will set the stage for the bulk of this dissertation in chapters 4 through 7.

Chapter 4, therefore, will open up the discussion on Dawkins in regard to classic prebiotic theory. Of course, the classic theory represents a fairly broad category of *organic* solutions. But because Dawkins was so confident in a naturalistic solution to origins, he focused almost exclusively on the concept of the *selfish gene* early on. The manifestation of that concept followed in his next book as he explained how genes affect their corresponding phenotype. This section will thus illustrate the many assumptions he had made to support the classic solution and naturalism in general. Chapter 5 will then shift toward Dawkins's case for Neo-Darwinism which entailed a plethora of potential defenses. Accordingly, that chapter will explore his reliance upon those models as applied to the problem of abiogenesis. Therein, he entertained one of the more intriguing solutions in Cairns-Smith's crystalline-based idea, which offered a distinct alternative to the earlier organic-based models. Chapter 6 will then take yet another turn away from the terrestrial-based models altogether. It will analyze Dawkins's interest in panspermia and the world's potential exposure to extraterrestrial life. Chapter 7 will finally end this tour of models as it returns to a terrestrial-based solution in RNA World Theory. Dawkins

hopes that this most current idea might hold the keys to the age-old "chicken or the egg" paradox that has plagued the science of origins for years.[16]

Chapter 8 will conclude this analysis in reviewing the contribution of Dawkins, while looking ahead toward further questions. Though his aggressive work and self-promotion has somewhat taken him out of mainstream academia, his growing influence has still been felt. Dawkins remains a formidable opponent to anyone outside of his own humanist circles as his discussions and popular books have risen in popularity. Nevertheless, the truth or falsity of his claims will not depend on his popularity but on the content of his case.

[16]This biochemical paradox recognizes the dual necessity of replicating nucleic acids that are dependent on proteins for their synthesis while simultaneously requiring proteins that are encoded by nucleic acids. All known cellular life today depends on this mutual arrangement to function. Detail on this paradox will be discussed later in this paper.

CHAPTER 2

HISTORY OF ABIOGENESIS

Antiquity: A Mythological Beginning

The question of origins has existed since the dawn of mankind. All major civilizations had well developed cosmologies about the origin of the world, the origin of life, and the origin of man. All three of these "origins" are arguably related to most ancient belief systems, and therefore, cannot be easily separated. Moreover, the corresponding worldviews that have often resulted from these early civilizations depended heavily on their cosmologies. The source for the origin of the world ordinarily became the solution for the origin of life and man. Hence, the developing myths of these ancient cultures not only served to explain their origins but also provided the template for their corresponding worldview(s).

All of these early civilizations,[1] including Egypt, China, the Indus Valley, and Mesopotamia depended on mythological stories to resolve their *life questions*. Most believed that the world was composed of a few foundational elements such as air, water,

[1]Mesopotamia boasts some of the earliest known civilizations including the Sumerians of the 4th millennium BC. They recorded one of the earliest known creation myths on the tablet of Nippur, which was heavily polytheistic. Old Babylon, Assyria, and Akkadia also thrived in this region between the 3rd and 1st millennia BC. In contrast, the Pre-Dynastic and Old Kingdoms of Egypt date back to roughly 3100-2700 BC and 2700-2181 BC respectively while the civilizations around China and the Indus Valley appeared somewhat later (i.e., Xia Dynasty of China dating back to about 2100 BC, while the earliest Indian groups date to between 2600 and 1900 BC).

earth, and fire.[2] Interestingly, each also envisioned a world filled with spirit beings or gods who had varying degrees of power. These foundations undoubtedly arose out of the corresponding animistic roots of each culture, which eventually evolved into a connectedness between themselves and their corresponding spirit world.

The Egyptians, like most of the other civilizations, developed a whole array of deities and/or god-like figures who dominated the different facets of life. The connection grew so strong between these gods and their earthly leaders that the status of pharaoh reached that of a virtual demi-god. Similarly, the Chinese developed an elevated status for their dead ancestors. Chinese emperors, like their Egyptian counterparts, arose to near god-like status. These leaders would literally serve as connectors between the physical and spirit worlds around them. Nevertheless, all of these early civilizations believed in a spirit world that lies somewhat beyond their physical reality. Each also envisioned some sort of overlying struggle between their respective deities. Therefore, it is common to find mythological accounts of gods competing with one another in some way that eventually culminated in the origin of life and man.

Richard Dawkins went out of his way in his latest book *The Magic of Reality* to draw sharp distinctions between these ancient beliefs and the *real* world of science. All twelve of his chapters cited examples of myths and/or fairytales to emphasize just how ignorant mankind had been over the centuries in contrast to the knowledge unveiled by modern science. For example, he rightly illustrated how brutish it was for the

[2]In recognizing the major constituents of the world around them, it appears that virtually every major civilization from antiquity adopted some form of the "four primeval elements." Though historians might be inclined to attribute the formal declaration of the classic elements of nature to the Greek philosopher Empedocles (5th century BC), several civilizations had already adopted similar beliefs much earlier. For example, the Egyptians attached a special importance to certain key elements such as earth and water (attributing gods to them) as did the Indians who wrote about "five" elements in its *Laws of Manu* (i.e., the English translation for the *Manava Dharma-Satra*). See *The Laws of Manu*, trans. by George Buhler (New York: Penguin Books, 1991).

Egyptians to believe in a sky goddess who moved the sun each day.[3] How a people could believe that a spirit actually birthed the sun at sunrise before swallowing it back up at sunset is indeed amazing.

Irrespective of such criticism, Ancient Egypt still triumphed as one of the greatest and most developed civilizations in human history.[4] Several of the earliest writings known to man come from the *Ancient Pyramid Texts* of this culture, which date back to the Early Dynastic and Old Kingdom eras.[5] These texts introduce their original god *Atum* and the ensuing drama he incited with later gods to come.[6] Despite the differing accounts of Thebes, Memphis and Heliopolis,[7] several prevailing stories have emerged in regard to the origins of life and mankind. One account reveals an early form

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[3]Richard Dawkins, *The Magic of Reality: How We Know What's Literally True* (London: Free Press, 2011), 122. In this his latest text, Dawkins juxtaposes the reality of science against a wide variety of myths, fairy tales, and other religious sources. In doing so, he is apparently not only trying to bolster his argument for the legitimacy of science but is attempting to discredit the authenticity of the biblical text in particular – a key strategy of the New Atheist Movement.

[4]Reaching back to as early as 3100 BC, Ancient Egypt represents a classic example of a mythological worldview full of polytheism and the abstract forces of nature. That culture formed an intense desire to achieve order in this world (the "maat"), which could be obtained through the efforts of civilization and the appeasement of its gods. It is thought that much of this emphasis on order originated from a combination of circumstances including the unpredictable flooding of the Nile Valley and the classic animistic tendencies of its corresponding spirit world. It was a culture that believed in a wide panorama of gods who each controlled his or her own sector of the universe.

[5]*The Ancient Pyramid Texts* are some of the oldest known religious writings in the world dating back to the 5th and 6th Dynasties of the Old Kingdom (ca. 2400 BC). Written in the Old Egyptian tongue, they were discovered on the walls and sarcophagi of the king's burial chambers. These have been especially useful in recovering that culture's cosmology, belief in gods, and concept of an afterlife.

[6]Egypt's polytheistic beliefs are well documented in a plethora of ancient sources including *The Ancient Coffin Texts* and the aforementioned *Ancient Pyramid Texts*. Several dozen Egyptian gods are described in these sources beginning with their primeval god *Atum* and include Horace (a falcon representing kingship), Osiris (god of the dead), Isis (the god of motherhood), and others. Atum was believed to have arisen through sheer will out of a heap in the waters in the Nile River. He allegedly fathered the air/dryness god *Shu* and his sister the water/wet goddess *Tefnut*. The latter, in turn, bore the earth-god *Geb* and his sky goddess sister *Nut.*

[7]The three major Ancient Egyptian cities of Thebes, Memphis, and Heliopolis had each developed their own slightly modified version of this ancient belief system. There is some difference, therefore, between how they each regard their mutual gods and ensuing cosmologies.

of spontaneous generation that described the origin of certain insects.[8] *Spontaneous generation*, which had been a common belief throughout history, described life as rising out of certain (usually organic) materials. Nevertheless, it was not the only means by which the Egyptians believed life to have originated. One myth explained how mankind arose out of the tears shed by *Atum*.[9] Another proclaimed that man had simply been fashioned by the creator god *Khnum* on a potter's wheel.[10] All of these stories fit well within the mythological genre of Egyptian cosmology.

Dawkins also contrasted modern science against some of the early myths of China and the Indus Valley. For instance, he rightly pointed out the mythological genre contained in both the Chinese primeval god Pangu and that of the Indian Lord Vishnu.[11] Michael Loewe and Edward Shaughnessy of Cambridge agree with Dawkins's depiction of Pangu as the dog-headed deity who arose out of a primeval egg.[12] Other Chinese legends portray similar animistic and mythological backgrounds including an archer who

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[8]An ordinary scarab or dung beetle rose to a heightened status in Ancient Egypt. The insect not only became a popular figure on amulets and other artifacts, but became associated with the creator god Khepri. This unusual belief was largely due to its young being observed to emerge out of a ball of dung – an event which serves as a classic example and early form of spontaneous generation. The common people began to interpret this emergence as a sign of life and origins.

[9]*Bremner-Rhind Papyrus: The Book of Overthrowing Apep*, British Museum No. 10188, trans. by Raymond O. Faulkner (ca. 310 BC). Section 27, lines 2-3 of that text contains the following: "I wept over them; that is how men came into being through the tears which came forth from my Eye." This excerpt speaks of the Egyptian god *Atum* whose all-seeing *Eye* had been in search of his two lost god-children *Shu* and *Tefnut.*

[10]Multiple resources contain the *Great Hymn to Khnum* at the Temple of Esna. It details the mythical account of the god *Khnum* who had created mankind at his potter's wheel. Numerous depictions ranging from wall carvings to other artifacts parallel these ancient writings in pictorial form.

[11]Dawkins, *The Magic of Reality*, 161-63. Chapter 8 of this text, which is entitled "When and How did Everything Begin," depicts the author's cosmological worldview in contrast to a handful of African, Indian and Chinese myths.

[12]Michael Loewe and Edward L. Shaughnessy, eds. *The Cambridge History of Ancient China: From the Origins of Civilization to 221 BC* (Cambridge: Cambridge University Press, 1999), 66-67. Loewe and Shaughnessy cite the oracle-bone inscriptions from the late Shang Dynasty period which contain the Pangu account. The Chinese used both bone and bronze as common writing materials early on.

shot all but one of the suns out of the sky (i.e., leaving our present sun). Meanwhile, in neighboring India, a wide variety of mythological accounts have been uncovered in the ancient Vedic texts. One of these texts had also depicted a cosmic egg, which served as a catalyst for life in our world. Yet another involved the slaughter and dissection of one of its primeval gods – his severed body becoming various parts of the world.[13] These cosmological accounts clearly depict a mythological genre.

However, most of the early Chinese stories also contain a strong emphasis on natural forces. Much like the pantheistic perspective of the modern Far East, Chinese folklore attributed much in how these forces had spontaneously generated our world. Michael Pruett described it as "heaven and earth simply emerg[ing] spontaneously, and their mating, which gives birth to the myriad of things, is the alignment of generation itself."[14] The resulting worldview looks remarkably like that of the *GAIA* hypothesis of today which envisions the entire world as somewhat of a giant symbiotic organism.[15]

Nevertheless, a complete overview of the most ancient creation accounts must also include the civilizations of Mesopotamia. Some of the more well-known creation myths of antiquity originated out of that particular region during the 2nd millennium BC

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[13]Hinduism's *Rig Veda* 10.90 was written during the 2nd millennia BC and contains the *Purusa-Sukta* (or Hymn of Man). In that story, the cosmic giant Purusa was dismembered into the various parts of the world (see lines 11 – 14). Later Buddhist cosmology yields its own version of this unfolding universe during the 5th century BC. See *The Digha Nigaya*, chapter 27, Agganna Sutta available in *The Long Discourses of the Buddha: A Translation of the Digha Nikaya,* trans. by Maurice Walshe (Boston: Wisdom Publications, 1995). Indian representations of a cosmic egg also describe a cosmological beginning of things and dates to roughly the 3rd – 5th century AD.

[14]Michael J. Pruett. *To Become a God: Cosmology, Sacrifice, and Self-Divinization in Early China* (Cambridge, Mass.: Harvard University Press, 2002), 145.

[15]James Lovelock, *Gaia: A New Look at Life on Earth* (Oxford: Oxford University Press, 1979). The modern theory of GAIA suggests that the earth functions somewhat like a living organism. First proposed by English chemist James Lovelock, it has attracted a fair following including geoscientist Lynn Margulis who founded the E*ndosymbiotic Theory* of living cells. See also Lynn Margulis, *Symbiotic Planet: A New Look at Evolution* (Amherst, MA: Basic Books, 1998).

including *Atra-Hasis, Enuma Elish*, and *The Epic of Gilgamesh*.[16] Much like the preceding accounts, these stories are bathed in polytheism with each of the gods posturing back and forth through a seemingly never-ending series of conflicts. Two of these myths describe the origin of mankind through the slaughter of one of their fellow gods. *The Epic of Gilgamesh*, meanwhile, tells of a somewhat more miraculous-based account similar to that of the later Hebrew text. It describes the fashioning of Enkidu who was created out of ordinary clay.

Judaism: Case of the Miraculous

Indeed, one could draw several parallels between the earlier Babylonian epic and the Jewish Old Testament. Unsurprisingly, some have categorized these parallels as decisive evidence for the latter's use of the former. Richard Dawkins agrees with this assessment as evidenced by his comparison of the two in *The Magic of Reality.*[17] Others, however, consider these parallels to be separate accountings of the same historical event. Regardless of one's position on this matter, several characteristics distinguish the biblical record from those earlier myths – particularly in regard to origins.

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[16]W. W. Hallo, ed.*, The Context of Scripture*, vol. I, Canonical Compositions from the Biblical World (Leiden: Brill Publishing, 1997). See Tablet I, lines 208 and 210 for the applicable passages of *Atra-Hasis*. These passages describe the slaughter and dismemberment of the god Aw-ilu in creating mankind. See James B. Pritchard, ed., *Ancient Near Eastern Texts: Relating to the Old Testament*, 3rd edition with supplement (Princeton: Princeton University Press, 1969) for applicable *Enuma Elish* texts. Tablets IV and V describe a similar slaughter of the god Tiamat who was "split like a shell into two parts" (Tablet IV; Line 137) to produce the universe as it is. See also *The Epic of Gilgamesh*, trans. Andrew George (St Edmunds, UK: The Penguin Press, 1999), Tablet I, lines 101-04 for the creation of the first man Enkidu out of clay by the goddess Aruru.

[17]Dawkins, *The Magic of Reality*, 140-42. As pointed out by Dawkins, *The Epic of Gilgamesh* portrays a flood account that is remarkably similar to the one found in Gen. 6-8. The creation of Adam in Gen. 2 may also have some parallel to the character Enkidu of the Gilgamesh epic. While the former was created by "the Lord God [who] formed man of dust from the ground" (Gen. 2:7), the latter was said to be fashioned with clay by the goddess Aruru (one of the many gods).

First, the overarching genre of the biblical account depends unquestionably upon the miraculous. That understanding had undoubtedly compelled Dawkins to target the subject of miracles in the final chapter of that text.[18] However, unlike the aforementioned multitude of myths that he had cited (i.e., ranging from the aborigines of Australia to the Ancient Egyptians), the biblical text speaks of the single intervening hand of an all-powerful god who performs the miraculous. Indeed, no one can walk away from the Judeo-Christian text without recognizing a complete dependency on miracles. Such a genre reads in direct contrast to the wildly imaginative myths that portray conflicts between their gods, overemphasize the elements and forces of nature, or even depict the dismemberment of a god's body to explain the formation of the world.

Secondly, the biblical account of origins describes the lives of real persons in real places. Though some biblical characters still lack validation, the historical and archaeological data supporting the text has been overwhelming.[19] Such evidence suggests something quite different from the mythological stories cited by Dawkins. Unlike the surreal characters and events found in myths, the biblical text bears the mark of real people enduring real-life circumstances. For example, how else should one interpret the way Paul and Barnabas responded to the Lystrans in the New Testament *Book of Acts*? Instead of accepting their mistaken identity as gods, they honestly

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[18]Ibid., 246-65.

[19]K. A. Kitchen, *On the Reliability of the Old Testament* (Grand Rapids: William B. Eerdman's Publishing Company, 2003). This text provides a highly respectable and thorough analysis of archaeological data. This 662 page reference contains a near exhaustive array of Old testament material with accompanying notes that attest to the reliability of the text at large. A world recognized scholar, Kitchen is also the Brunner Emeritus of Egyptology and Honorary Research Fellow at the School of Archaeology, Classics, and Oriental Studies at Liverpool, England. In regard to New Testament reliability, see also F. F. Bruce, *The New Testament Documents: Are They Reliable?* 6th edition (Downers Grove, IL: Inter-Varsity Press, 1981) and Craig Blomberg, *The Historical Reliability of the Gospels* (Downers Grove, IL: Inter-Varsity Press, 1987).

responded to them: "Men, why are you doing these things? We are also men of the same nature as you."[20] That answer reflected an ordinary response from ordinary men – a common characteristic of historical prose.

Unfortunately, Dawkins assumed that because some of the biblical accounts have an extraordinary appearance about them that they must fall into the category of myths. But that is a mistake. Setting up a straw man argument does not give credit to the massive historical and archaeological data supporting the bulk of the text.[21] Indeed, even Dawkins's hermeneutic of the creation text in Genesis 1-2 fails to take into account the *telescoping affect* that is all too common to Hebrew literature. Rather than portraying two separate accounts, Genesis 2:4ff simply amplified what the previous text (Genesis 1:1-2:3) had more generally described.[22]

Nevertheless, in addition to the creation text in Genesis, several other passages have also attracted criticism in regard to origins. Two sections, in particular, have drawn attention because of their resemblance to spontaneous generation. The first case involves Exodus 8:16 and describes how Moses grounded his staff in the presence of pharaoh to

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[20]Acts 14:12-15 records that the people of Lystra had initially thought that Paul and Barnabas were the Greek gods Hermes and Zeus (respectively). The non-mythical nature of the story is evident from the two admitting that they were ordinary men just as the Lystrans.

[21]Dawkins, *The Magic of Reality*, 34-35, 142, and 54-55.

[22]Ibid., 57. Dawkins alluded to this biblical pericope as "two different creation accounts," which is how certain, more liberal scholars interpret this text. A more conservative hermeneutic, however, takes into account the classic literary structure that was common to Hebrew literature at that time. Gleason Archer gives a straightforward explanation of this tool in the following reference: Gleason Archer, *A Survey of Old Testament Introduction* (Chicago: Moody Press, 1994), 134-35. Kenneth Kitchen offers a more focused approach to the passage in his 1966 text: K. A. Kitchen, *Ancient Orient and Old Testament* (Chicago: Intervarsity Press, 1966), 116-17. Therein he writes that "the strictly complimentary nature of the 'two' accounts is plain enough: Gen..1 mentions the creation of man as the last of a series, and without details, whereas in Gen. 2 man is the center of interest and more specific details are given about him and his setting. There is no comparable duplication here at all." Liberal scholarship often prefers to break up these "accounts" into Gen. 1:1 – 2:4a and 2:4b – 3:24. Kitchen addressed that matter in a much later and thorough archeological reference. He points out that Gen. 2:4a and 2:4b should not be separated because of a second literary structure in that text. A chiasm is used there that is also a commonly recognized literary tool of Hebrew literature. See also Kitchen, *On the Reliability of the Old Testament*, 427-28.

produce a plague of lice. The second example, found in Judges 14:6, describes Samson's discovery of bees in the carcass of a lion. Critics argue that the creation of lice from dust or the appearance of bees in the midst of dead animal flesh indicates an underlying belief in spontaneous generation.

Nevertheless, each case offers a reasonable explanation. The context of the first situation clearly implied a miracle. In this case, Moses had used his staff in a similar manner to that of a previous plague. That earlier situation had called for the miraculous when he turned the waters into blood. In both situations, God had directly commanded the use of the staff, which produced immediate changes to the substances at hand. Reports of spontaneous generation, however, usually entail somewhat more modest claims (such as the origin of small insects). None of those circumstances would have caused an *immediate* change nor produced a *miracle*. Likewise in Samson's case, there is simply too little information available in which to draw a firm conclusion. From a hermeneutical standpoint, the text makes no direct implication of spontaneous generation. For instance, it does not indicate how much time had elapsed since the animal had been killed. To assume spontaneous generation, one would have to read into the text more than what it bears. Therefore, neither of these biblical accounts should be confused with the naturalistically-based theory of spontaneous generation.

The Greeks: The Rise of Rationale

Somewhat later during the first millennia BC, the world witnessed one of the greatest contributions to the progress of human thought. Between roughly the 9th and 4th centuries, the Greek civilization arose to unparalleled heights of power and influence in the world. It was a dominant power whose belief in origins, life, and man would

influence the course of civilization. All in all, various thinkers of this era covered just about every major cosmological approach to date. Beginning with the early myths and legends of Hesiod and Homer, they would eventually move toward some of the most insightful rationale of human thought. Aristotle's cosmological insights, in particular, influenced the study of origins for nearly twenty centuries – only to be challenged from about the seventeenth century onward.

But what beliefs did they have? Why did their advancements have such a profound effect on the world to come? In looking back to the past, it is incumbent upon any serious study of origins to revisit what the Greeks achieved. For Greek scholarship surpassed every major culture up until their time with an innate desire to understand the world and its origin. By the 7th century AD, a rising class of Pre-Socratics had already begun to move toward a more rationally-based explanation of the universe. They began to envision the world as having a law-governed core with complimentary forces of nature holding all things in place.

The very thought of opposing, yet balanced forces in nature sounds remarkably similar to the Chinese and Ancient Egyptian worldviews. Like those earlier civilizations, the Greeks had developed a belief in four (or sometimes five) *essential elements* that accounted for the material composition of all things. Ironically enough, that was also the point where many of the Greeks began to diverge in opinion. While Thales believed that life had arisen out of water, both Anaxagores and Diogenes believed that it had come from air. The latter believed that the air "knew" how to keep the seasons just as it separates day from night. Therefore, it would only seem logical that it could engender

life as well.[23] Nevertheless, an underlying feeling of order in the universe seemed to undergird everything – whether at the hands of order and harmony, through mathematics, or by some divine *logos*.[24] It was that order that led some to ultimately seek a divine cause, namely Socrates, Plato and Aristotle.

Those three masters of Greek philosophy searched diligently for a link between the so-called universal harmony and the divine. To Plato, the movement from disorder to order required the intervention of a god. He envisioned a *Demiurge* (or World Soul) who formed the existing world (i.e., *ex materia*) out of a vague reflection of a more perfect one found in the heavens.[25] Following in the footsteps of his teacher Socrates, he established a philosophical reasoning for the divine.[26] This thinking would set the stage for the most dominant theory in the history of origins. Plato's most famous student, Aristotle, accepted the idea of eternal forms but concentrated more of his effort toward unraveling the fundamental causes of the world. His recognition of cause and effect formed the basis of his "Unmoved Mover." But what does that mean in regard to the origin of life and man? Aristotle dealt with this issue most specifically in his work *On Generation of Animals* for which he formally established his model based on spontaneous

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[23]David Sedley, *Creationism and Its Critics in Antiquity* (Berkley, CA: University of California Press, 2007), 77.

[24]Though ideas grounded in order and harmony arose through several of the pre-Socratics, they became more developed through Plato (424-348 BC) who envisioned a theologically-based system of morality. The foundation was largely influenced by the earlier concept of a "logos," which was first suggested by Heraclitus (535-475 BC). See Arthur F. Holmes, *Fact, Value, and God* (Grand Rapids: William B. Eerdman's Publishing Company, 1997), 6. Meanwhile, Pythagoras (570-495 BC) attributed such order to mathematics.

[25]Platonic dualism is a classic approach to understanding the world and encompasses both a material (physical) component and an immaterial (spiritual) component. Plato thought that the immaterial or perfect world of forms resided over and above the known, experiential world availed to us.

[26]Sedley, *Creationism and Its Critics in Antiquity,* 103.

generation. That model coupled neatly with the aforementioned elements of nature from which it derived its driving force(s). Aristotle explained in that text how heat, moisture and the earth combined to generate living organisms. He described how they formed "out of putrescent soil and out of residues," "in the earth and water," and "out of a certain earthy and fluid coagulation."[27] Aristotle thus credited the organization of living, complex beings to be the product of some innate energetic ability contained within these elements.

Meanwhile, an opposing view arose about that same time that employed a much more materialistic model of things. The so-called *Atomists* believed that the world was composed of tiny atoms or pieces of matter that could not be divided further. It was their materialistic worldview that would re-emerge some two thousand years later during the Enlightenment. Richard Dawkins indicated his appreciation toward the Atomist's general mindset, though he likewise displayed a bit of condescending humor against their four essential elements.[28] Both had shared a common foundational belief. They had also envisioned a system that would embrace a universe composed of natural elements and forces and nothing more. Moreover, each of them believed that everything that can be

[27]Aristotle, *On Generation of Animals*, trans. A. L. Peck (Cambridge, Mass: Harvard University Press, 1943), 715 (a25), 762 (a19), and 731 (b8) respectively. Letters and numbers in parenthesis correspond to the section and paragraph found in Aristotle's text. See also Iris Fry, *The Emergence of Life on Earth: A Historical and Scientific Overview* (New Brunswick, NJ: Rutgers University Press, 2000), 15-16. As historian Iris Fry points out, this Greek philosopher was to influence scholars for the next two millennia through his "spontaneous generation, in which organisms are formed 'automatically,' with no parents present." His was an unparalleled contribution that was only supplanted by the works of Redi and Pasteur during the 1600's and 1800's respectively. Ironically, science has come back to that theory in a sense, for some means of natural spontaneity is believed to have gotten life started. As will be shown, Thomas Huxley wrestled with this very same problem.

[28]Dawkins, *The Magic of Reality*, 77. Given that this entire book targeted a younger audience, it should come as no surprise that the author elected to enhance the text with a plethora of colorful and often humorous illustrations. The wide range of myths that he used in comparison to modern day science not only reinforced his intended contrast but does so through a brazen form of humor.

known must have been acquired through purely empirical means.[29] Perhaps the most intriguing juxtaposition between the Atomists and modern day science involves the virtually unlimited potential found in nature. Was it an improbable coincidence that Dawkins just happened to single out the Atomist Democritus (460-370 BC) as the one "a bit closer to the truth?"[30] He had engendered an idea that would become a very Darwinian concept over two thousand years later. He had envisioned the "extraordinary power wielded by [the] combination of infinity and accident."[31] How familiar does such a statement sound in light of what Dawkins wrote in *The Blind Watchmaker:* "Given infinite time, or infinite opportunities, anything is possible?"[32]

Nevertheless, despite Dawkins's criticism of these archaic worldviews, at least two things should be noted in their defense. First and foremost, Dawkins seemed all too eager to pool virtually every civilization of the ancient past under the same motif: that of a myth. Such a broad conclusion overlooks the considerable differences between the aforementioned early civilizations and either the Greek or biblical worlds. Second, even though these early cultures often misunderstood much of the world around them, they still made a few poignant observations from their less than modern perspectives. Specifically, though exceedingly off the mark in their respective mythological imagination(s), most of them at least recognized the innate "cause and effect" in the

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[29]Ibid., 12, 19. The phraseology chosen by Dawkins appeals consistently to empiricism as the sole epistemological avenue for knowledge. This is evident by comments such as "our five senses … do a pretty good job of convincing us" (12) and "it always comes back to our senses" (19). Such a narrow-minded approach not only limits other sources of knowledge but it demonstrates one of the chief obstacles in his philosophy of science.

[30]Ibid., 77.

[31]Sedley, *Creationism and Its Critics in Antiquity,* 139.

[32]Richard Dawkins*, The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design* (New York: W. W. Norton & Company, 1996), 139.

world. They observed, for example, that living things naturally thrive around air, water, earth, and the sun. Unfortunately, their fundamental lack of understanding led them to connect those elements to the organization around them.

The Medieval Era and Speculation

Most of what developed during the Medieval Era sprang from the religious ideas of Muslim and Christian scholars. Both of these groups continued to grapple with how spontaneous generation applied to the living creatures of their world. Perhaps one of the most glaring cases of this obsolete belief comes from St Basil of the fourth century:

> Let the earth bring forth the living creature. This command has continued and earth does not cease to obey the Creator. For if there are creatures which are successively produced by their predecessors, there are others that even today we see born from the earth itself. In wet weather she brings forth grasshoppers and an immense number of insects which fly in the air and have no names because they are so small; she also produces mice and frogs. In the environs of Thebes in Egypt, after abundant rain in hot weather, the country is covered with field mice. We see mud alone produce eels; they do not proceed from an egg, nor in any other manner; it is the earth alone which gives them birth. Let the earth produce a living creature.[33]

Likewise, Augustine made similar comments in *The City of God*. Therein he wrote about frogs which "sprang directly from the soil" and other animals from remote regions that simply "sprang up from the earth."[34] Clearly, these scholars believed in spontaneous generation. Correspondingly, Oparin blamed the Christian Church for how its leaders

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[33]Basil, *The Hexaemeron*, Homily IX, section 2 (ca. 370 AD). This text is available through *The Nicene and Post-Nicene Fathers, Second Series*, Vol. 8: Basil: Letters and Selected Works. Philip Schaff and Henry Wace, eds. (Peabody, Massachusetts: Hendrickson Publishers, 2004), 102ff. Basil stands as one of the most obvious examples of a church father who endorsed spontaneous generation. Unfortunately, many critics of the faith cite such commentary as biblical evidence toward that theory. It must be reiterated that neither he nor any other of the church fathers, before or after, should be considered directly inspired by God – an attribute reserved alone for the divine text itself. Therefore, Basil's comments may be errant and misleading despite his intent.

[34]Augustine, *The City of God*, trans. Gerald G. Walsh et al. (New York: Doubleday, 1958), Book XVI Chapter 7 (from the original 426 AD text).

appealed to such an understanding. He considered it a suppression of rational thought.[35] In like manner, Richard Dawkins has often criticized the medieval Church for similar distortions of the truth.[36] However, it should be noted that the biblical text itself should not be held responsible for the misinterpretations of later *uninspired* scholars. Though both Basil and Augustine attribute certain passages of the text to spontaneous generation, their comments alone do not make it so. Their commentaries on the matter make their respective opinions quite clear, whereas the biblical text does not. Though Oparin and Dawkins should know this, a relatively easy *straw man* target may be too hard to resist.

Meanwhile, Muslim scholars appear to have thought along the same lines as Basil and Augustine. Tenth century Persian polymath Avicenna not only affirmed spontaneous generation but even entertained the possibility of *human* generation. Not so for Muslim scholar Averroes a century later.[37] Though heavily influenced by Aristotle, he did not believe that such an extreme case could occur. Despite several controversial passages in the Qur'an that could be interpreted as spontaneous generation,[38] Averroes thought that such cases could only apply to simple life forms. Moreover, he suggested that the movement of the celestial bodies affected the potentiality of those earthly forms.

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[35]Alexander I. Oparin, *The Origin of Life on the Earth* (New York: Academic Press, 1957), 9ff.

[36]Dawkins, *The Blind Watchmaker*, 143.

[37]Avicenna (980-1037 AD) is the Latin form for the Persian name Abd Allah ibn Sina, while Averroes (1126-1198 AD) is the Latin form for the Arabic name Ahmad bin Rusd.

[38]Multiple accounts are mentioned in the Qur'an about the origin of mankind. Surah 25:54 indicates that man was created "from water." Surah 16:4, however, claims that man was formed "from a little germ." Moreover, two other places declare that man was formed from the dust (Surah 3:59 and 30:19). Finally, Surah 75:39 says that Allah "formed and molded" man out of "a blood clot." Both Surah 22:5 and 23:8 appear to combine these claims – perhaps to negate the apparent conflict.

Like his Greek predecessors, Averroes wrote of the "vital heat" that energized the seeds of life.[39] Clearly, little or no progress was made during the Medieval Era.

The Enlightenment: Return to Naturalism

The most pronounced paradigm shift in cosmology and the origin of life occurred during the Enlightenment. Though the prevailing consensus followed Aristotle's spontaneous generation, a plethora of philosophical advancements and scientific breakthroughs began to challenge that trust. From a scientific standpoint, the combination of advancing technology, tighter methods and controls in experimentation, and the rise of new disciplines served to erode that archaic belief gradually.

Meanwhile, and from a philosophical standpoint, Rene Descartes advanced one of the most compelling ideas in regard to origins. In *Discourse on the Method* he discussed how living organisms could be described in a mechanical sense. Their frameworks could be broken down into individual parts or even their particulate matter. He wrote that the human body breaks down like "that of a clock from the power, the situation, and the form, of its counterpoise and of its wheels" and that it might just as well be "regarded as a machine."[40] Moreover, he thought that no real difference existed between the material make up of a living organism and that of inanimate matter. Hence, Descartes established what might be considered the modern version of *reductionism*.[41]

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[39]Barry S. Kogan, *Averroes and the Metaphysics of Causation* (Albany: State University of New York Press, 1985), 177. In this text, Kogan demonstrates Averroes marked dependence on Aristotle.

[40]Rene Descartes, *Discourse on the Method and Meditations on First Philosophy*, ed. David Weissman, trans. Elizabeth S. Haldane and G. R. T. Ross (New Haven, CT: Yale University Press, 1996), 31, 34. See section V of the opening text: "Discourse on the Method of Rightly Conducting the Reason and Seeking for Truth in the Sciences."

[41]Though perhaps not the first to break down various material components into their simpler

Richard Dawkins described his appreciation for this Cartesian concept in his book *The Blind Watchmaker*.[42] His support for reductionism fits the gradual, cumulative Neo-Darwinian mindset. Both tend to presume a naturalistic basis. They further serve his "honest desire to understand how things work,"[43] which could help explain how complicated living things originally came about. Nevertheless, while breaking down the complexity of things into their more easily understandable parts, reductionism helps to identify the overall breadth of the problem that traverses several inter-related disciplines. Indeed, Dawkins describes how "the physicist's problem is the problem of ultimate origins and ultimate natural laws" while "the biologist's problem is the problem of complexity." Though that perspective serves as a ready assessment of those "upper" and "lower" boundaries of the problem, the role of the chemist/biochemist should not be overlooked. Biochemistry plays an intrinsic role in the study of abiogenesis."[44]

Nevertheless, during roughly the same timeframe as Descartes, Tuscan physician Francesco Redi began to uncover important empirical data regarding the origin of life. In 1668, he became the first man to disprove spontaneous generation through controlled experimentation. He demonstrated that flies do not arise out of rotting meat

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parts, Descartes was clearly an instrumental figure in bringing this idea to the modern forefront. As has been discussed earlier in this dissertation, a number of the Greeks had previously considered all matter to be a product of a handful of essential elements. But Descartes redefined this breakdown into a mechanically-oriented formula with the simplest of parts building up toward a more complex whole. More importantly, his comments specifically targeted the arena of physiology which, in turn, affected the argument over origins and the substance/properties of matter.

[42]Dawkins, *The Blind Watchmaker*, 13. Rather than supporting the *nonexistent* reductionist position, Dawkins is more inclined toward the more indirect *hierarchical* type. This latter arrangement helps keep him from getting too cornered when traversing each stage of complexity as he amply explains in his text.

[43]Ibid.

[44]Ibid., 15.

without the previous contamination of that meat by adult flies.[45] . Remarkably, Redi continued to believe in spontaneous generation despite these findings. This fact is evident in several of his concluding remarks that suggest how "fruit trees are produced with a secondary purpose" – involving the "generation of worms."[46] Perhaps more important than the impact of Redi's empirical contribution may be the ensuing bias reflected in his interpretation.

Regardless of the quality of virtually any experiment, science is still subject to interpretation. Moreover, parallel experiments can even produce conflicting results. Though experimenters make every attempt to perfect a given procedure, they might fail at something as simple as providing adequate quality control. That oversight caused a substantial conflict between Lazarro Spallanzani and John Needham during the 1700's. While each had determined to ascertain the validity of spontaneous generation, they did not use the same procedure.[47] Spallanzani carefully sealed his containers and sufficiently

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[45]Francesco Redi, *Esperienze Introno Alla Generatione Deal Insetti* (Experiments on the Generation of Insects) trans. by Mab Bigelow (Chicago: The Open Court Publishing Co., 1909). This text describes a wide variety of experiments performed by Redi during the late seventeenth century. In disproving spontaneous generation, he used several types of decaying meats including "the ox, the deer, the buffalo, the lion … and sometimes the flesh of ducks, geese, hens, swallows, etc." (32). Using these meats, he demonstrated that flies do not spontaneously generate out of the meat itself but are the product of maggots borne out of larvae, which had been previously deposited on that meat. He "began to believe that all worms found in meat were derived directly from the droppings of flies, and not from the putrefaction of the meat" (33).

[46]Ibid., 92.

[47]Lazarro Spallanzani, *Tracts on the Nature of Animals and Vegetables*, trans. by Binns-House (Edinburgh, 1799). This book covers the laboratory procedures of a wide range of experiments involving, for the most part, the question of spontaneous generation. Chapter 1 of the first section, entitled "Observations and Experiments upon the Animalcula of Infusions," serves as an example of the meticulous procedures followed by Spallanzani in boiling his respective materials (1-4). Chapter 2 begins with the corresponding procedures for sealing those same materials from contamination: "I hermetically sealed vessels with the eleven kinds of seeds mentioned before" (5). Similar techniques can be observed throughout the text on like experimental procedures in all six sections of this text. See also J. Turbervill Needham, "A Summary of Some Late Observations upon the Generation, Composition, and Decomposition of Animal and Vegetable Substances," in *Philosophical Transactions of the Royal Society* 45 (1748), 615-66. English biologist John Needham describes how he used mutton gravy in the hope of spawning micro-

boiled them. But Needham did not. Unsurprisingly, Needham's experiment attracted contaminates from the surrounding air that ended up compromising his results. The ensuing dispute between the men pitted the reputation of the highly influential Needham against Spallanzani – which ultimately left the question of spontaneous generation unresolved.

But many other reasons have driven scholars to erroneous and/or conflicting results. Seventeenth century philosopher Nicolas Malebranche misled a generation of scholars in believing in the "infinite divisibility of matter," it seemed to make since that all embryos could simply be miniatures of their adult form.[48] In accordance with this so-called *Embodiment Theory*, Malebranche pictured an endless string of ever smaller embryos one inside of another infinitum, like a series of nesting dolls "produced at the creation of the world."[49] Unfortunately, the misapplication of this and fellow scholars' preconceived convictions misled research for nearly two centuries. Many experimenters began to "see" what they *expected* to see.[50]

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organisms apart from the contamination of surrounding air or external sources: "For my purpose therefore, I took a quantity of Mutton-Gravy hot from the fire, and shut it up in a Phial, clos'd up with a cork so well masticated, that my Precautions amounted to as much as if I had sealed my phial hermetically. I thus effectually excluded the exterior Air, that it might not be said my moving bodies drew their Origin from Insects, or Eggs floating in the Atmosphere" (637) – see paragraph 21 of this reference.

[48]Nicolas Malebranche, *The Search After Truth*, trans. Thomas M. Lemmon and Paul J. Ollscamp (Columbus, OH: Ohio State University Press, 1980), 26. This *Embodiment Theory* appeared to provide a reasonable compromise to both the mechanics of the science and certain religious expectations. Given that he had accepted the infinite divisibility of matter as a sort of extension of God's "infinites" (27), it seemed reasonable to assume that every descendant life was ultimately contained within its parent. Generations of apple trees, for instance, were believed to be nested within any current generation "for an infinite, or nearly infinite number of centuries." Hence, as applied to mankind, Malebranche assumed that "every man and beast born till the end of time was perhaps produced at the creation of the world." This embodiment idea was but one of the conceived "preformations," which could be further distinguished as either spermist or ovist, depending on the original source of that embodiment.

[49]Ibid., 27.

[50]Peter Bowler, "Preformationism and Preexistence in the Seventeenth Century: A Brief

False observations became especially prevalent when the microscope came into use. Although scholars were well aware of the tremendous possibilities of this new invention, many became overly aggressive in attempting to prove their respective theories. Unfortunately, that mishandling of the new tool often led to their detriment. The ability to finally peer into the micro world tempted some of these men to report all sorts of erroneous claims. Dutch anatomist Theodor Kerkringius, for example, reported a whole series of exorbitant findings. Clearly influenced by the aforementioned Embodiment Theory, he wrote that he observed "a recognizable head and body" on a human fetus a mere three or four days after conception.[51] He further claimed to have observed a "face, toes, and body parts" on a two-week old specimen.[52] Unfortunately, such a high degrees of detail in these early stages of pregnancy is not plausible. Modern embryologists would simply reject such claims given the gradual nature of how these features are known to form. But this is a classic example of the prevailing bias.

Now some might argue that these were isolated situations. But that is simply not the case. Similar cases involved noteworthy scholars such as Marcello Malpighi and

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Analysis," in *Journal of the History of Biology* 4, no. 2 (1971), 221-44. Bowler provides an excellent breakdown of preformationism, preexistence, metamorphism, and epigenetics as applied to seventeenth century scholarship. Several of these leaders contributed to variations of this distorted view of life including Malebranche, Kerkringius, Malpghi, and Leeuwenhoek.

[51]Theodor Kerkringius, "An Account of What Hath Been of Late Observed by Dr. Kerkringius Concerning Eggs to be Found in all Sorts of Females," in *Philosophical Transactions of the Royal Society* 7 (1672), 4019ff. In describing Fig. V in this reference, the author records "an Egg, which Dr. Kerkringius affirms to have opened three or four days after it had fallen into the matrix of a woman, and in which he saw that little embryon marked B, whereof he found the Head begun to be distinguished from the Body yet without a distinct perception of the organs." These alleged observations prove to be exceedingly erroneous as modern embryology can attest. The much slower development of the human fetus (that is demonstrated daily using modern techniques) renders these much earlier claims as nothing more than the product of Kerkringius' vivid imagination. Accordingly, he "saw" what he had expected to see.

[52]Ibid., 4021. In evaluating an "Embrio represented in Fig. VI, [which] was only 15 days," Dr. Kerkringius claims to have observed exceedingly fine detail including "the Eyes, Nose, Mouth, and Ears; and the Body began to have Leggs and Armes, as well distinguishable in this Figure."

Antonie van Leeuwenhoek, who each became recognized giants in the newly discovered field of microbiology. While Leeuwenhoek "claim[ed] to have seen two different types of sperm" (i.e., implying "boy" and "girl" miniatures),[53] Malpighi "claims to have seen [a] preformed chick in an egg that had not been incubated."[54] Both of these claims were eventually discarded in the course of time as mounting evidence against scientific *preformationism* came to pass. Evidently, some other theory had to account for the observed generation of parts, the complications due to heredity, the limitations of time and matter, and even the rise of cell theory.[55] But these examples illustrate, once again, how presumptions and/or bias can often distort one's judgment.

Other scholars have willingly admitted to the errant tendency of the human element – even in respect to the "objectivity" of science. For example, though Needham turned out to be wrong against Spallanzani, he still recognized his own inherent subjectivity in the course of experimentation. To this effect he wrote of being "exceedingly cautious to advance no Proposition rashly; nothing, but what seems to flow

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[53]Lois N. Magner, *A History of the Life Sciences* (New York: Marcel Dekker Inc., 1979), 189. Magner quotes the famous Dutch scientist Antonie van Leeuwenhoek in reference to his overzealous abuse of the microscope. The preformationist model eventually divided into two camps: the "spermist" and the "ovist." These opposing positions corresponded to whether the miniature person was carried via the egg or sperm. Leeuwenhoek, who was of the former opinion, claims to have actually observed boy and girl miniatures – something that was clearly driven by his worldview.

[54]Ibid., 187.

[55]One of the original founders of embryology, German physiologist Friedrich Wolff, led the critique against scientific preformationism. As alluded to above, there were a number of arguments rejecting this failed paradigm. First, the regeneration of body parts by a number of animals presented a fundamental problem for anything being completely "preformed." Crustaceans, for example, had been known to re-grow lost limbs as do certain gastropods in recovery of their lost eyes. Second, numerous heredity-related issues were raised including how the miniature could acquire all its characteristics from only the egg or sperm. How could one obtain the heredity of both parents given that the complete person would have come from just one of them? Third, matter was indeed regarded to have a limit. Trying to suggest otherwise failed to bypass the problem of "infinite nesting" which was reinforced by the conception of a young Earth. Finally, the establishment of *Cell Theory* was well demonstrated through the discovery of both cells and cell division. Clearly, none of these items could be reasonably explained through the aforementioned preformation theory.

naturally from Observation."[56] Likewise, French naturalist Georges-Louis de Buffon wrote a century later of his concern "to free myself from prejudice, I even attempted to forget what other observers pretended to have seen."[57] Despite this honorable approach, such an absence of bias is surreal. Nevertheless, the straightforward integrity of these scholars should be applauded for the standard it set for others.

Given the wide variety of problems and bias that have been documented historically, it should come as no surprise to see them recur today. Unfortunately, that is precisely what we find. For instance, in regard to the central question of how life began, Richard Dawkins has glibly suggested that the Neo-Darwinian solution is "the only game in town."[58] Obviously, he holds this position for at least two reasons. First and foremost, Dawkins has already committed to a purely naturalistic solution from the outset. He therefore limits what is acceptable to the realm of science. Secondly, he knows that no other viable solution exists from within the naturalistic arena. None, at least, have been forwarded to date. For him, therefore, it simply *must* be the only game in town for his fundamental worldview/bias requires it.

The 19th Century: Science Coming of Age

Though the Enlightenment witnessed many great strides in science, the world had to wait until the 1800's before realizing its foremost achievements. This was especially the case in regard to origins, which enjoyed a plethora of discoveries and

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[56]Needham, *A Summary of Some Late Observations upon the Generation, Composition, and Decomposition of Animal and Vegetable Substances*, 615. See paragraph 1 of this reference.

[57]Georges-Louis de Buffon, *History Natural, General and Particular,* 2nd ed., vol. 2, trans. William Smellie (London: W. Strahan and T. Cadell, 1785), 193.

[58]Richard Dawkins, *The Greatest Show on Earth: The Evidence for Evolution* (New York: Free Press, 2009), viii.

accompanying theories during that time. One of the most groundbreaking contributions came at the hands of James Hutton who set the stage for British geologist Charles Lyell a generation later. In formally publishing his ideas in 1785, Hutton had opened up the era of geological science, which entailed a very old Earth.[59] By 1830, Lyell had begun to popularize Hutton's ideas, especially in regard to the stratiform layering of rock and its uniformitarianism.[60] The presumed layering effect of such phenomena led him to the natural conclusion that the Earth had to be much older than previously thought.

The impact of Hutton and Lyell had an overwhelming effect on the way science has approached our world. Given a much older Earth, the possibilities offered by the combination of the *infinite* and *accident* began to take on a whole new meaning. And the discovery continues to provide the necessary setting for Neo-Darwinism today. In fact, Richard Dawkins portrayed the significance of this setting in an entire chapter of his 2009 text *The Greatest Show on Earth*.[61] In that text, he described some of the basic tenets of certain dating methodologies including dendrochronology and the use of radiometric dating as it specifically applies to geological data. Given the strides made by Hutton and Lyell in geologically dating the world, it is not surprising to see that particular aspect of problem move forward. The overall case for physical and geological dating remains quite formidable.[62]

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[59]James Hutton, *Theory of the Earth with Proof and Illustrations* (1795).

[60]Charles Lyell, *Principles of Geology* (New York: Wheldon & Wesley, 1830).

[61]Dawkins, *The Greatest Show on Earth,* 83-107.

[62]Ibid. Though the dating methods are overall quite strong, it is interesting how Dawkins approached this aspect of the problem. Why, for example, would he elect to use dendrochronology in this case given its limits to a few thousand years. Other comments appear to be rather optimistic in regard to the aging issue, including the "1 per cent" error in radiometric dating. Given contamination, experimental error and other factors, that figure may be somewhat less than accurate. See Jan Sloan, Christopher D.

Evolution: Darwin's Metanarrative

Without question, Darwin's theory on the evolution of all living things became the centerpiece of the developing naturalistic paradigm. A wide range of additional discoveries, however, built the superstructure from which that theory would eventually flourish – especially in the realm of origins. German chemist Friedrich Wohler accomplished the first of these discoveries in 1828 when he found a way to formulate urea out of ammonium cyanate. That experiment demonstrated for the first time how an inorganic, non-living substance (ammonium cyanate) could be used to synthesize a known organic substance (urea). Given that all living beings are organic, and therefore carbon-based, the ability to produce a known organic substance from an otherwise inorganic blend of reactants was welcomed as a step in the right direction.[63] In time, similar experiments followed Wohler's experiment a century or so later including Miller/Urey's production of amino acids (1953) and Juan Oro's synthesis of adenine (1961). Together, these findings served as hopeful pieces to the unfolding naturalistic puzzle. Despite this optimism, the limitations of these discoveries and their respective contributions have gradually become understood. Further discussion on the impact of these discoveries and the ensuing limitations therein will be covered at greater length in succeeding chapters of this dissertation.

Meanwhile, about the same time that Wohler synthesized urea, Jean-Baptiste Lamarck had begun formulating another biological idea. The latter's infamous theory

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Henry, Melanie Hopkins and Steve Ludington, "Open Report 03-236," revised ed. *U. S. Geological Survey* (2003) for further information in regard to radiometric dating and its accuracy.

[63]Friedrich Wohler used several combinations of cyanates (e.g., potassium, lead, silver, etc.) In producing his synthesis. Though all of these compounds possess a carbon atom, they were not considered "organic" at that time because they were not associated with a living organism. Today, the term organic has come to denote any chemical substance that contains at least one carbon atom. The nomenclature has clearly changed over time, and therefore, does not always mean the same thing.

(referred to as Lamarckism) is now an all-but-abandoned theory that mistakenly attributed the gradual changes of an organism's physical makeup to be something acquired at each generation (characteristics being individually passed along).[64] Interestingly, this appealing notion was suggested by the very same man who also held to the four Greek elements of nature (earth, fire, air, and water). Though modern day scholar Richard Dawkins rightly recognizes the error of such a mythical basis and defective theory,[65] he still agrees with yet another aspect of Lamarckian origin – that of the *self-organization* of matter.

As we shall see, the self-organization of matter will play a central role in the problem of abiogenesis. The unproven ability for inorganic matter to organize itself into something much more complex will be an absolutely essential element for *any* naturalistic paradigm attempting to resolve the problem – including all of those suggested by Dawkins. Along those lines, we find the parallel thought of Lamarck who wrote that "nature ... herself creates the rudiments of organization in masses where it did not previously exist."[66] Moreover, he adds the following:

> It cannot then be doubted that suitable portions of inorganic matter, occurring amidst favorable surroundings, may be the influence of nature's agents, of which heat and moisture are the chief, receive an arrangement of their parts that foreshadows cellular organization, and therefore pass to the simplest organic state and manifest the earliest movements of life.[67]

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[64]Lamarckism, often called "soft inheritance," refers to the obsolete theory that had attempted to explain physical characteristics in terms of traits being acquired during life. These were believed to be passed along from generation to generation as if they were changed through the life of the parent and then passed on directly onto the offspring. (e.g., the length of a giraffe's neck is increased from generation to generation as each one stretched toward higher branches, with longer necks resulting over time).

[65]Dawkins, *The Blind Watchmaker*, 287-94.

[66]Jean-Baptiste Lamarck, *Zoological Philosophy: An Exposition with Regard to the Natural History of Animals,* trans. Hugh Elliot (New York: Hafner Publishing Company, 1963), 236. This reference is a reprint of the original 1809 text.

[67]Ibid., 245.

Looking closely, these statements reveal Lamarck's dependence on the obsolete notion of spontaneous generation as applied to the fundamental elements of "heat and moisture." For him, that process provided the driving force for how life got started, and hence, "self-organized" the organic from something inorganic. Though Dawkins would clearly reject the classical application of spontaneous generation in and of itself, he had to presume some alternative means of self-organization because naturalism requires it.

This alternative means of self-organization still demanded explanation. Louis Pasteur had enacted the perfect experiment for burying the former archaic theory once and for all. Using a process similar to his earlier counterpart Francesco Redi, he demonstrated that microorganisms were indeed the product of contamination rather than some spontaneous activity. Thus, organic life such as molds and fungi had never originated out of a purely spontaneous process (as had been previously believed), but had always been the result of some preexisting germ(s). *Omne vivum ex vivo*.[68] Moreover, since Pasteur's corresponding experiment and public stance against spontaneous generation followed closely on the heels of Darwin's *Origin of Species*, his contribution helped pave the way for further progress by the turn of the century.[69]

Notwithstanding all of these contributors, it was Darwin who played the central role in this scientific pursuit. He had envisioned the broad metanarrative which

[68]This common Latin phrase at the time of Pasteur meant "all life is from life."

[69]Louis Pasteur, "Sorbonne Scientific Soiree," in *Revue des Cours Scientifics* ("Scientific Address at Sorbonne," in Review of Scientific Lectures) trans. Bruno Latour (1864), 257-64. This classic address by Pasteur at Sorbonne served as a culmination of several years of research – aimed primarily at dispelling spontaneous generation. After denouncing the previous "false notions" of this archaic belief (3), he demonstrated the presence of particulate matter, dust and germs and the resulting impact on decomposing materials. Following several other procedures that helped illuminate his points, he described in sufficient detail his "long-neck flask" apparatus (16). Pasteur concluded with his formal denouncement "that the spontaneous generation of microscopic beings is a mere chimera" (21).

held everything in place. However, even Darwin didn't address how evolution actually got started. As Iris Fry pointed out in *The Emergence of Life on Earth*, there was absolutely "no discussion on the origin of life in *Origin of Species*."[70] His reluctance to engage that aspect of the problem was evident in several of his personal letters to Joseph Hooker. In 1863, he wrote about how life somehow "appeared by some wholly unknown process. It is mere rubbish, thinking at present of the origin of life; one might as well think of the origin of matter."[71] However, Darwin eventually did consider a potential solution. For in 1871, he wrote a follow-up letter to Hooker that envisioned a "warm little pond" by which "a protein compound was chemically formed."[72] Most scholars would recognize this idea under the more familiar term "pre-biotic soup" (or primordial soup) – a concept forwarded by Ernst Haeckel before its further modification at the hands of Alexander Oparin and J. B. S. Haldane.[73] Most importantly, it presented a framework for the first real scientific model for the origin of life.

Chapter 4 will address this specific model as it was the first one endorsed by Dawkins. However, despite the underlying optimism undergirded by the work of Oparin/Haldane and then Miller/Urey, the path ahead was still laden with challenges. Many issues were yet to be discovered, much less resolved. Multiple obstacles would eventually turn up involving such things as the precise physical makeup of the primordial Earth, the mysterious mechanism which might drive such self-organization, and even the

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[70]Fry, *The Emergence of Life on Earth,* 4.

[71]Charles Darwin to J. D. *Hooker*, Down, March 29, 1863, in *The Life and Letters of Charles Darwin*, vol. 2, ed. Francis Darwin (New York: Basic Books, 1959), 202-3.

[72]Charles Darwin to J. D. Hooker, Down, February 1 1871, in *The Life and Letters of Charles Darwin*, vol. 2, ed. Francis Darwin (New York: Basic Books, 1959), 203. See the footnote on this page.

[73]Oparin and Haldane arrived at their respective conclusions independently.

determination of what type of molecules would be necessary from which the whole process could develop. Irrespective of these challenges, there was at least one thing to which Dawkins could feel highly confident. As Darwin had suggested nearly a century before, he also recognized that life could have happened only once. For as Darwin put it, "at the present day such matter would be instantly devoured."[74] Clearly each man was aware of the inherent savagery entailed by a world full of eukaryotes – each ready to pounce on any new organic molecule. Only at the absolute beginning of life would such a world be sufficiently benign to permit the entrance of such a fledgling organism.

The Prevailing Zeitgeist

Notwithstanding the progress of the primordial soup model, this study would be incomplete were it not to address the bias of the times. As history can attest, the influence of the prevailing *Zeitgeist* can hardly be underestimated. The nineteenth century was certainly not exempt. A few key examples should prove illustrative of that cultural climate. Gregor Mendel had fallen victim to that bias when attempting to usher in his Laws of Inheritance. How the scientific community completely overlooked this great work provides a classic case in point. The man who would eventually become known as the founder of modern genetic theory was not even taken seriously until several decades after his death. As Corcos and Monaghan described it, "Mendel's paper attracted little attention at the time he wrote it."[75] Until de Vries, Tschermak, and Correns recognized the inherent value of Mendel's work, his genetic theory would

[74]Darwin to J. D. Hooker, February 1, 1871.

[75]Alain F. Corcos and Floyd Monaghan, *Gregor Mendel's Experiments on Plant Hybrids: A Guided Study, r*eprint (New Brunswick, NJ: Rutgers University Press, 1993), xv. See also Mendel's original text: Gregor Mendel, *Experiments on Plant Hybridization* (1866).

remain overlooked. But why did the scientific community initially dismiss such genius? As in other misplaced discoveries, many scholars simply failed to recognize its relevance. But would it have made a difference if the work had not come from a friar writing a paper bound with facts and figures? It might otherwise have received an earlier hearing. But today, Mendel's genetic system provides an essential element for Neo-Darwinian theory.

As a second example, we turn to the man who became the highly charged leader of nineteenth century naturalism: Thomas Huxley. Known candidly as "Darwin's Bulldog," his allegiance to naturalism is certainly well known as was evident at his *Presidential Address to the British Association of Science for 1870*. Therein he admitted that Pasteur was absolutely right in condemning spontaneous generation – in general. However, some unique form of spontaneous generation must have occurred at some specific point in time for life to have begun.[76] Moreover, he freely admitted to the *lack* of evidence in this matter in the following statement (i.e., during that same address):

> Looking back through the prodigious vista of the past, *I find no record* of the commencement of life, and therefore *I am devoid of any means* of forming a definite conclusion as to the conditions of its appearance … to say, therefore, in the admitted *absence of evidence*, that I have any belief as to the mode in which existing forms of life have originated, would be using words in a wrong sense.[77] (italics mine).

Therefore, without any supportive evidence, Huxley concluded that spontaneous generation still must have occurred. His naturalistic bias required it. Furthermore, he confirmed that bias in a follow-up statement of that very same speech confessing, "I have no right to call my opinion anything but an act of philosophical faith."[78] Thus, we bear

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[76]Thomas H. Huxley, *Discourses: Biological and Geological Essays* (New York: Appleton and Company, 1894), 256.

[77]Ibid.

[78]Ibid., 257.

witness to a scholar who freely admits to having no data on which to rest, yet feels confident in concluding (believing) what must surely be the case.

German-born biologist and physiologist Jacques Loeb serves as a final example of this eighteenth century bias. His loyalty to materialistic reductionism followed closely with the mechanics of Descartes. He also believed that one could extrapolate the mechanics of our bodies (and of all living things) into implicit explanations for instinct, ethics, and even civilization itself. Moreover, individual will and consciousness could be swept under this same mechanistic rubric of physio-chemical composition. The following statement summarizes Loeb's total allegiance to reductionism: "all life phenomena can be unequivocally explained in physic-chemical terms."[79] In sum, Loeb viewed life as nothing more than its respective heat transfer and chemical activity. Notwithstanding this dogmatic stance, he freely admitted that science had not the "answer to the question as to how life originated on the Earth."[80] Even still, he felt exceedingly confident that it would find a resolution. So confident was Loeb that he believed that life would be artificially created in the lab during his lifetime. But that event never came to fruition. Today, many others have awaited the same achievement. And though Richard Dawkins does not commit himself to whether it will happen or not, he writes in the same speculative air that he would "not be surprised" to see some chemist "successfully midwife a new origin of life in the laboratory."[81] Perhaps that is easier said than done, for he too is still waiting.

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[79]Jacques Loeb, *The Mechanistic Conception of Life: Biological Essays* (Chicago: University of Chicago Press, 1912), 3.

[80]Ibid., 5.

[81]Richard Dawkins, *The God Delusion* (New York: Houghton Mifflin Company, 2008), 165.

The unfortunate consequence of philosophical and scientific bias continues to our present day within the academic world at large. Rarely is this bias more evident, however, than in how Richard Dawkins has portrayed the origin of life. How he came upon the scene in the seventies and how he approached the problem of origins will provide the material for the next chapter.

To his credit, Dawkins recognized what he called the "exceedingly low" probability of producing artificial life in the lab. His demeanor during the discussion, however, still affords a hopeful speculation as if it were just about to happen.

CHAPTER 3

THE CONTRIBUTION OF RICHARD DAWKINS

Introduction

Richard Dawkins has served as one of the more prolific writers and speakers of the contemporary evolutionary debate. His leadership in promoting an atheistic agenda has become well recognized throughout academia. But the influence of his underlying worldview remains wholly dependent on the success of its naturalistic foundation, which firmly rests upon a gradualist, Neo-Darwinian model for life. Because that model must have ultimately began through some assumed process of abiogenesis, that particular aspect of his case becomes exceedingly important.

Therefore, this chapter will provide an overview of Dawkins's interaction and ensuing impact on abiogenesis. It will begin with a brief synopsis of his life beginning with his upbringing in Africa, move on to his training as a young scholar, and culminate with his present success as a leader in the public understanding of science. The second section will then peruse through several of Dawkins's personal attempts at computer simulation. Two of the three models he proposed will especially demonstrate his perception and approach toward abiogenesis. Nevertheless, all three should serve to illustrate his overarching worldview and assumptions.[1] The final section of this chapter

[1]Two of the computer programs produced by Dawkins illustrate his own personal attempt to justify a naturalistic means for abiogenesis. Because they do not necessarily fit what might be considered a strict definition of professional modeling, they have been placed here in relation to his background and personal selection of models.

will then encompass the bulk of this portion of the study as it summarizes Dawkins's movement between origin of life models. This overview of his different positions will serve to introduce the succeeding chapters of this dissertation.

A Life Destined for Science

Richard Dawkins's leadership in the New Atheist Movement has combined with his writing and passion for naturalism to propel him to near celebrity status. He is not only a popular selection amongst panels, documentaries, and discussions but is a well accomplished and recognized figure in academia at large. Many a symposium and interview recognizes the former Oxford scholar as he advances his Neo-Darwinian view. Though transitioning to emeritus status in 2008, Dawkins appears to be equally if not more active now than in his previous four and a half decades of teaching. But where did he get such a passion for origins? And how was his worldview shaped to cultivate such a disdain for faith and fervor for naturalism?

Certainly, one could hardly have imagined a more perfect setting for Dawkins's upbringing as a naturalist. Being born in Nairobi, Kenya before moving to Nyasaland (now Malawi) at the age of two was sure to provide a good start for a man destined for ethology. Dawkins still recalls growing up in East Africa where he was exposed early on to a world teaming with nature.[2] His earliest recollections found him quite literally surrounded by wildlife and the outdoors.[3] Moreover, this natural habitat

[2]Richard Dawkins, *A Devil's Chaplain: Reflections on Hope, Lies, Science, and Love* (Boston: Mariner Books, 2004), 234-35. Clinton Richard Dawkins was born on March 26, 1941 in Nairobi, Kenya after his father was displaced in Nyasaland to serve the Kenyan army in WWII. The family did everything possible to stay together despite the call to service. At the conclusion of the assignment, the family returned to Nyasaland for six years before eventually moving back to England.

[3]Richard Dawkins, *An Appetite for Wonder: The Making of a Scientist* (New York: Harper Collins, 2013), 13-14.

was further enhanced by what could be considered the "family business." Several of his family members had entered professions that involve the natural sciences. Perhaps some might see this setting as more of a twist of fate.

Whatever the case, Dawkins's father went to Nyasaland to study botany and agriculture. One could hardly underestimate the impact that his father had made on his life and future studies. Dawkins formally recognized that special influence through a post-mortem article attributed to his father.[4] But John Dawkins was not the only family member attracted to the sciences. Two of his uncles pursued similar careers. One served as the chief conservator of forests in Nepal, while another worked as an ecologist in nearby Uganda (i.e., before teaching biological statistics at Oxford).[5] Clearly, Richard Dawkins "had the genetics" for science if such were possible.[6]

Nevertheless, upon his entry into boarding school at the age of thirteen, young Dawkins had already developed a voracious appetite for reading.[7] It was not long before he showed an adept understanding for science as well. This latter inclination found an immediate challenge to his Anglican upbringing.[8] Though he had initially refused to

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[4]Richard Dawkins, "Lives Remembered: John Dawkins," *The Independent* (2010), http://www.independent.co.uk/news/obituaries/lives-remembered-john-dawkins-2157459.html (accessed Mar 2, 2013).

[5]In addition to these three family members who were professionally trained in science, several others studied at Oxford. Ironically, a total nine of them attended the very same college at Oxford that Dawkins would attend as an undergraduate: Balliol College.

[6]Dawkins, *An Appetite for Wonder*, 3-25. The author aptly entitled his opening chapter "Genes and Pith Helmets" to depict the way much of his family had ended up working within the confines of science.

[7]Ibid. 15. This autobiography tells of a strong appetite for reading early on. Similar to his new home in West Oxfordshire (25 km northwest of Oxford), so his boarding school Oundle was located in nearby Northhamptonshire (80 km northeast of Oxford). Dawkins spent five years at Oundle (1954-59), which ranked as one of the three largest boarding schools in England.

[8]The Anglican Church gradually moved toward a theistic-evolutionary stance over time.

accept Darwinism at an earlier age, his faith toward God began to steadily erode.[9] Whether this denial was a precursor to his early philosophical thinking or a product of it, he was still irreversibly "drawn to [the] questions" of life early on.[10] Questions including "why are we here?" and "how did it all start?" began to encroach upon his mind.[11] To date, these questions have remained at the center of his attention.

Those life questions helped propel Dawkins into science. And there at Balliol College was the man perfectly suited to fuel his excitement for ethology, while priming his imagination for naturalism as a whole. There he met Niko Tinbergen.[12] Dawkins wrote admiringly of how this former Noble Prize winner had influenced his view of the world.[13] His influence might have only been matched by fellow scholar Mike Cullen who normally led the Tinbergen group.[14] He became the mentor who really challenged young Dawkins to develop his debate tactics and overall knowledge base. Dawkins has faithfully acknowledged his debt to both of these gentlemen. Still, they were not the only ones to carve their niche into his worldview. After completion of his studies at Oxford,

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Following closely to the position of the Catholic Church, the Anglicans affirm their general acceptance of evolution as explained in "A Catechism of Creation: Part II." Similar to the Catholic *encyclical Humani generis* proclaimed by Pope Pius XII (12 August 1950), so also went the Anglican Church.

[9]Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design* (New York: W. W. Norton & Company, 1996), 3. Though it is unclear how the edicts of the Anglican Church affected Dawkins's thinking, his overall countenance toward the faith eventually eroded to the point of total rejection.

[10]Dawkins, *An Appetite for Wonder,* 15.

[11]Ibid.

[12]Richard Dawkins, *The Greatest Show on Earth: The Evidence for Evolution* (New York: Free Press, 2009), 165.

[13]Richard Dawkins, *The Selfish Gene* (Oxford: Oxford University Press, 1976), x.

[14]Dawkins, *An Appetite for Wonder*, 171ff. Dawkins feels indebted to his graduate mentor Mike Cullen, who personally sharpened and focused his training in ethology. That "Animal Behavior Research Group" was often referred to as the Tinbergen Group for short.

Dawkins served as an assistant professor of zoology at U. C. Berkley.[15] There, during the turbulent times of the late sixties, he found himself right at the epicenter of the Anti-War movement and radical liberalism in general. Dawkins's fervent love for naturalism seems to have been well suited for this left-wing bias, which equally served in influencing his radical stance on speciesism in the long run.[16]

Dawkins spent a relatively short time at Berkley before returning to Oxford for a full professorship in 1970. He then spent the bulk of his academic life teaching in his foundational discipline of ethology. By 1974, he was offered the important post of UK editor for the prestigious journal *Animal Behavior*.[17] That experience clearly prepared him for his prolific writing to come, for in the midst of that editorial work he finished his first book *The Selfish Gene* (1976). Looking back now twelve (additional) books later, no one should doubt his thorough accomplishment as a writer. He has also written countless articles, blogs, and other contributions over these past four decades. The early preparation at boarding school, the numerous essays required at Oxford, and then his extensive journal experience had built the right foundation for this later endeavor.

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[15]Dawkins accepted his assistant professor position at The University of California at Berkley in 1967. He taught zoology there for two years before returning to Oxford in 1970. During the 1960's, U. C. Berkley became a hotbed for liberal thinking. Sparked by student activism in 1964, the university was thrust into the center of the Free Speech Movement. Anti-War demonstrations became rampant throughout that decade as clashes between the student body and university officials became frequent.

[16]Richard Dawkins, "Meet my Cousin the Chimpanzee," *New Scientist* 138, no. 1876 (1993): 36-38. This article is among several which portray Dawkins's public support of speciesism, which became a commonly held belief among animal activists. That group recognizes a number of non-humans (mostly "high-order" animals) with certain human-like rights, while eradicating the assumed position of human authority. It appears to be a logical position for a staunch believer in evolution and its ensuing relationship between all living beings. Dawkins's comments on this matter may be found in his books *The Selfish Gene* and *The Blind Watchmaker,* in addition to his involvement in "The Great Ape Project." See idem, *The Selfish Gene*, 11 and idem, *The Blind Watchmaker*, 114, 237.

[17]In 1974, Dawkins succeeded David McFarland as editor for the journal *Animal Behavior*. Papers from outside the United States and Canada (i.e., from The United Kingdom in particular) were submitted directly to him for consideration. He relinquished that post four years later in 1978.

By the time Dawkins had written his third book *The Blind Watchmaker*, he had already begun to refocus his efforts. In recognizing the cause to defend his native worldview, he gathered his available resources to formulate his attack. In addition to several chapters intended to buttress the case for naturalistic "design," Dawkins stipulated a number of specific methods that could have theoretically determined the process. He attempted to show the validity of this general process through several computer programs that he created himself.[18]

Dawkins's Computer Simulations

For Richard Dawkins, few interests have seemed to incite more imagination and zeal for biology than the computer age. Like many other biologists of his time, he quickly realized the rising potential of computer technology. Though he had to "slug it out" with the punch cards and bulky machines of the past, he could still see how computers would eventually open up a whole new venue for rapid computation and complex modeling.[19] Springing from this interest in computer programming, Dawkins became increasingly enamored with how such a tool could be specifically applied toward

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[18]Dawkins, *The Blind Watchmaker*, 47-74. See also idem, *An Appetite for Wonder*, 192-95 and 221-22. This first reference details two of Dawkins's most memorable computer programs: "Methinks it is Like a Weasel" and the "Biomorph" program. The second reference looks back to Dawkins's early days of computer programming at Oxford, wherein he "devised [his] own programming language, BEVPAL" (221).

[19]Ibid., 74. As he has stated a number of times, Dawkins believes that "the computer can be a powerful friend to the imagination." According to his autobiography, he apparently derived his interest in computers during the seventies and admits to an "addiction to machine code programming" (see Dawkins, *An Appetite for Wonder, 221)*. He appears to be naturally adept at understanding the logic as is readily apparent through his extensive discussions on strategy and the possibilities entailed in that strategy. Chapter 4 of *The Selfish Gene* entitled "The Gene Machine" serves as a good example of this understanding He had added that chapter to basically argue for the emergence of intelligence in things. Utilizing the strategy inherent in the game of chess, he invoked the plausibility of a computer to "learn." That capability is what researchers in artificial intelligence have sought for a long time – the ability for computers to think. Dawkins's interest in strategy is further evident in chapter 12 of *The Selfish Gene* (2nd edition) entitled "Nice Guys Finish First." See idem, *The Selfish Gene*, 202-33. Therein is a lengthy discussion on logic through a game called "The Prisoner's Dilemma."

evolutionary thinking. He began to imagine what many others have since discovered. The computer could model biological systems such as genetics, evolutionary growth, and even "origin of life" scenarios in ways not previously available. Having become thoroughly convinced that *chance alone* could never achieve the biological complexities of life, he instinctively contemplated some alternative path.

That alternative led him to the more developmentally-dependent concept he calls "cumulative selection." While blind chance strikes out in its purely stochastic manner, cumulative selection moves increasingly from one level of complexity to the next as it gains momentum in a more aggregate fashion. As will be demonstrated in chapter 4 of this dissertation, Dawkins utilizes the related term "simple sieving" to not only describe the inherent tendency in nature to self-organize, but in juxtaposition to the greater means of organization through cumulative selection.[20] The former might be thought of as a one-step process, while the latter is a series of steps. Though simple sieving might be demonstrated by something as simple as the sorting of pebbles on a beach (i.e., from large to small), the latter entails multiple steps requiring several layers of increase. Dawkins distinguished these two processes with the following explanation:

> In single-step selection the entities selected or sorted, pebbles or whatever they are, are sorted once and for all. In cumulative selection, on the other hand, they 'reproduce'; or in some other way the results of one sieving process are fed into a subsequent sieving, which is fed into …, and so on. The entities are subjected to selection or sorting over many 'generations' in succession. The end-product of one generation of selection is the starting point for the next generation of selection, and so on for many generations.[21]

The greatest difference, therefore, lies in the marked efficiency between the two.

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[20]The term "simple sieving" describes the natural "ordering" of certain systems and will be addressed in greater detail in chapter 4 under the subheading "Evidence of Emergence." A typical example includes the way pebbles become "ordered" (large to small) through gravity, wave action, and other factors.

[21]Dawkins, *The Blind Watchmaker*, 45.

"Methinks it is Like a Weasel" Program

Unsurprisingly, Dawkins set out to create his first computer program to prove both the capability and plausibility of cumulative selection. Moreover, he sought to establish a firm distinction between cumulative selection and blind chance. Using a familiar line from Shakespeare's *Hamlet*, "Methinks it is like a weasel," he sought to demonstrate how a computer program could effectively achieve the same sequence.[22] That now popular analogy appears to have originated with Francis Crick who calculated similar odds "of even a billion monkeys, on a billion typewriters, ever typing correctly even one sonnet of Shakespeare's during the lifetime of the universe."[23] Like Dawkins, William Dembski has also modified that original analogy to this same single phrase from *Hamlet*. Given that particular string of twenty-eight characters,[24] one might think *prima facia* that such a task would be relatively simple. However, the task is exceedingly difficult. Combining the twenty-seven possibilities of each character with the exponential component demanded of each character and one ends up with an exceedingly large number. That number represents the extremely long odds against that particular sequence occurring naturally.[25] Dawkins admitted that these remote odds equate to

[22]Ibid., 46-50. Dawkins designed this first computer program to specifically target a string of characters. He chose one of lines from Shakespeare 's play *Hamlet*: William Shakespeare, *Hamlet: Prince of Denmark*, Act III, Scene II, Line 396.

[23]Francis Crick, *Life Itself: Its Origin and Nature* (New York: Simon and Schuster, 1981), 52.

[24]The phrase "Methinks it is like a weasel" is 28 characters as it includes not only the 23 letters of the six words but also the five spaces separating those words.

[25]Stephen C. Meyer, "Word Games: DNA, Design, and Intelligence," in *Signs of Intelligence: Understanding Intelligent Design*, ed. William A. Dembski and James M. Kushiner (Grand Rapids: Brazos Press, 2001), 109-10. A number of scholars ranging from Dembski to A. G. Cairns-Smith have argued against the incredibly long odds of these kinds of sequences occurring naturally. Stephen Meyer added a laconic, yet accurate discussion on this matter as it specifically applies toward biological systems. In summary, he calculated several rough exponential estimates for the sequencing of chains of amino acids

"about 1 in 10,000 million million million million million million."[26] Correspondingly, William Dembski made a similar calculation of "$-\log_2 1/27^{28}$" or "133 bits of information."[27] These numbers represent the approximate odds that a happenstance, twenty-eight character sequence could hit its target with one hundred percent accuracy. However, the real problem for abiogenesis lies not in the sequencing of a few words, but in the real sequencing involved in the complex molecules of life.

To put this problem into perspective, the odds against life beginning through blind chance is exponentially greater than the aforementioned case of twenty-eight characters. Even the simplest components of life are still much, much longer and complex. And that higher level of complexity leads to even greater odds against the realization of such a molecule falling into place naturally. Dawkins led into this discussion on cumulative selection using an example organic molecule to put these extreme odds into perspective. Therein he describes a "haemoglobin molecule," which is illustrative of an organic macromolecule.[28] The inherent complexity of such a basic molecule of life is the reason why Dawkins was compelled to find an alternative path

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and fully functioning proteins. The calculated range entailed numbers varying between 30 to 125 zeroes. Despite such a wide variance, these numbers are virtually beyond comprehension in magnitude.

[26] Dawkins, *The Blind Watchmaker,* 47.

[27]William Dembski*, Intelligent Design: The Bridge Between Science and Theology* (Downers Grove, IL: Intervarsity Press, 1999), 174.

[28]Dawkins, *The Blind Watchmaker*, 45. Dawkins described the complexity contained in a single hemoglobin molecule: "A haemoglobin molecule consists of four chains of amino acids twisted together. Let us think about just one of these four chains. It consists of 146 amino acids. There are 20 different kinds of amino acids commonly found in living things." After crunching the numbers further, he arrived at what he called "a staggeringly large number." It entails the odds of "20 times itself 146 times." In contrast to the 28 string character from Shakespeare (having 40 zeroes), this much larger number would contain 189 zeroes (or 20^{146}).

through cumulative selection. For without some mechanism like cumulative selection, the naturalistic means for the origin of life would be defeated before it got started.[29]

So how would cumulative selection specifically help here? Theoretically, it could radically reduce the number of steps it would take to achieve a specific target sequence. Each successive level of complexity would serve as "the starting point for the next generation of selection" – thus taking advantage of the previous step.[30] Dawkins wished to demonstrate this capability through the assumed objectivity of a computer program modeling the process. If the computer could adequately reduce the number of steps toward sequencing, then perhaps the origin of life might have taken a similar path.[31] The key to the improvement lies in the ability to compare each stage to the target sequence itself by way of some mathematical means. In this case, Dawkins used a standard Hamming code system for just that purpose.[32] The Hamming system uses a converging search strategy, which by design "knows" how far any given sequence is from the target sequence. That feature enables the program to eventually achieve its goal.

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[29]Ibid., 140. Dawkins wrote about the necessity of cumulative selection to get the process of self-organization started: "Cumulative selection is the key but it had to get started, and we cannot escape the need to postulate a single-step chance event in the origin of cumulative selection itself."

[30]Ibid., 45.

[31]Dawkins's first program was designed to portray what cumulative selection is allegedly capable of from a mathematical/probability standpoint. He fully realized the near impossible odds associated with a single-step process of blind chance.

[32]The error-correcting Hamming code represents a family of codes developed in the fifties by mathematical genius Richard W. Hamming. It is an ingenious set of algorithms that have a certain capacity to self-check and/or correct errors in a linear string of symbols. A wide variance of this family of codes has found a wide variety of applications in modern telecommunications and other information-processing areas. Dawkins inserted a standard form of this algorithm into his Shakespearean program, which simply measures the Hamming distance, which is the number of incorrect characters. The built-in advantage of Dawkins's program is not only in the way in which it compares each outputted phrase to the original (i.e., yielding a target to aim at), but it also compares each of the "progeny" of each successive step. Because he designed the program to output several of these mutant, progenies (variant phrases), he is able to choose which of them is closest to the original phrase (by way of the Hamming distance). Therefore, there are two factors involved with his program that do not coincide with blind chance. In this way, the program gains information – which is how Dawkins has envisioned cumulative selection.

In this way, information and/or complexity could be added cumulatively to radically reduce the odds into something more reasonable and/or finite. That process represents what Dawkins was attempting to emulate.

Now it should be bore in mind that the individual characters of the sequence are not "locked in" as each query runs upon them. Though erroneously suggested by some critics, this is neither a characteristic of the Hamming code nor what Dawkins had assumed through his Shakespearean program.[33] Rather, the cumulative input of information builds in a certain convergence to the geometric asymptote, which tends to narrow down the focus. In Cartesian terms, that asymptote represents the solution or achieved target sequence. And though the search is essentially stochastic in each succeeding issuance of characters, the injection of even the most rudimentary form of *information* at each stage tends to produce some *asymptotically* convergent effect over time in the more productive models.

Recently, mathematician and philosopher William Dembski analyzed a number of search strategies given this very same Shakespearean sequence of characters. He aligned his goal to measure the efficiency of each model.[34] Similar to Dawkins, his team

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[33]Robert C. Newman, "Artificial Life & Cellular Automata," in *Mere Creation: Science, Faith & Intelligent Design*, ed. William A. Dembski (Downers Grove, IL: InterVarsity Press, 1998), 437. As the previous footnote explained, Dawkins did not design his program to simply "lock-in" each character as they correctly hit the corresponding character of the original or target phrase. Newman is one of the critics who had mistakenly suggested that "what Dawkins has done is that once the computer gets a particular character right, it never allows mutation to work on that character again." However, Dawkins's use of the Hamming distance still functions as an advantage. In comparing various "progeny" (or outputted phrases) at each "generation," his system obtains an unrealistic advantage versus blind chance. The comparison of each group of phrases (at each generation) does not represent a "lock-in" of any given character as Newman suggests, but is right in pointing out that the program "cheats" through its design – which entails information.

[34]Ewert Winston, et al., "Efficient Per Query Information Extraction from a Hamming Oracle," *Proceedings of the 42nd Meeting of the Southeastern Symposium on System Theory,* IEEE, University of Texas at Tyler (2010): 290-97.

used a standard Hamming distance per each query, which determined the best string of characters at each stage. Thus, only the best or closest sequence of characters would move to the succeeding stage as determined by its Hamming distance. Now it must be reiterated that the very use of the Hamming distance in the isolation of random sequences is itself an *input of information*. Moreover, various methods were considered having different "memory" components.[35] Unsurprisingly, each of the models resulted in a different rate toward achieving the target sequence. Dembski's analysis of the results indicated that the success of each competing algorithm depended on "the information available from the oracle" and "the efficiency of the search algorithm in the extraction of that information."[36] Hence, the input of information combined with the processing of that information to affect the corresponding efficiencies of the algorithms.

The design of Dawkins's Shakespearean program reveals some things about his fundamental approach to origins. He needed to design a type of program that would create some distance between simple and cumulative selection. Without some form of *cumulative selection*, his whole paradigm implodes out of sheer improbability (i.e., due to blind chance). Dawkins freely admits to the exorbitant odds entailed by blind chance, which renders his dependence on the presumed success of cumulative selection.[37] Second, like the process of Neo-Darwinism itself, each increasing level of progression requires some form of stability to retain its advance. Natural selection, then, strips away

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[35]Ibid., 296.

[36]Ibid., 297. Dembski also demonstrated that the classic evolutionary Markov process produced a lower efficiency than that of the standard Frequency of Occurrence (FOO) algorithm.

[37]Dawkins, *The Blind Watchmaker,* 139. The central concept of cumulative selection is at the core of Dawkins's solution to abiogenesis. Without some form of cumulative selection, the odds against it would be simply too great. This essential ingredient of the process is believed to supply the influx of complexity/information demanded by the given system.

any competing entity that cannot meet that progression. It awards survival to only the *fittest* member that can advance and sustain that advance. And that is essentially what the Hamming code provides for his Shakespearean program. It awards only the fittest query, then it moves on. But in applying this approach to the real world, two immediate problems come into view. Not only would it have to account for the existence of natural selection *prior* to the point of replication, but it would also have to account for how the cumulative selection itself got started.[38] As he further admitted in *The Blind Watchmaker*, "cumulative selection is the key *but* it had to get started, and we cannot escape the need to postulate a single-step chance event in the origin of cumulative selection itself" (italics mine).[39] Third, again like Neo-Darwinism, Dawkins's cumulative selection depends on an unbroken series of small, *gradual selections* or "gains" in complexity. The system must sustain this continuity while progressing ever so slowly from simple to complex. Fortunately, the very use of the Hamming code provides that unbroken series of queries. The system guarantees at least some infusion of information as it chooses only the closest query in comparison to previous queries. Hence, complexity results from the inherent dynamics of the system. Fourth, and once again like Neo-Darwinism, some sort of *mutation* is required to drive each progression forward. As Dawkins once summarized it, "natural selection may only subtract, but

[38]Richard Dawkins, *The River Out of Eden* (New York: Basic Books, 1995), 151. Dawkins refers to this challenge as "Threshold 1," which represents the first level of organic complexity. The gap that leads up to this first level corresponds to the whole problem of abiogenesis. Therefore, obtaining this level means to achieve "some kind of self-copying system in which there is at least a rudimentary form of hereditary variation, with occasional random mistakes in copying." Without some form of mutation combined with natural selection (i.e., some form of pre-biotic Neo-Darwinism), his system falls apart unless given a stroke of good luck in the form of an enormous single step or saltation.

[39]Ibid., 140

mutation can add."[40] Each new query offered to the Hamming process acts essentially like a kind of mutation that becomes evaluated in the next step.

Therefore, the success of Dawkins's program rests on its inherent capacity to receive some form of outside information (i.e., through the Hamming code process) while assuming the fundamental components of Neo-Darwinism (i.e., mutation and natural selection). Not only do Dawkins's assumptions conflict with several of his own personal axioms, but the Shakespearian program itself does little more than make an appeal to cumulative selection without sufficient reason to do so. To his credit, at least Dawkins recognized how "misleading" his program has been in regard to the "reality-based" theory of evolution.[41] As he later confessed in this same text, evolution would have had "no long-distant target" or goal in which to compare.[42]

So why did Dawkins spend so much time elaborating on the conceptual nature of this program? Because it does not reflect a real scenario, then it must fulfill some other motive. Did he produce the program to simply satisfy his naturalistic worldview? Or did he create the program to entice his audience to accept cumulative selection? If the former is true, then he has spent a lot of time portraying a fictional scenario – but if the latter, then Dawkins was right about being somewhat "misleading."[43] Referring to this program, even Nobel Prize winner Francis Crick remarked that it was "obviously oversimple."[44] Nevertheless, Dawkins pressed on with other computer simulations.

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[40]Ibid., 169.

[41]Dawkins, *The Blind Watchmaker,* 50.

[42]Ibid.

[43]Ibid.

[44]Francis Crick, *What Mad Pursuit: A Personal View of Scientific Discovery* (New York, Basic

D'Arcy Thompson's Transformations

Though not as specifically tied to his philosophy on abiogenesis, Dawkins's utilization of yet another means of computer technology helps to understand his general approach toward modeling. This second example portrays an extrapolation of the ingenious work accomplished by polymath D'Arcy Thompson in his classic text *On Growth and Form*.[45] Though Dawkins began with only a brief mention of Thompson's mathematical transformations in *The Extended Phenotype*, he more fully engaged the work in two of his later books. Dawkins admitted in that earlier text how his "imagination [was] fired" by the mathematician's ideas, though he did not elect to use it until sometime later.[46] After inserting two sections of this material in *The Oxford Book of Modern Science Writing*, Dawkins went on to more fully develop the concepts in *The Greatest Show on Earth*.

In the second of these three books, Dawkins referred to a rather innocuous chapter of Thompson's text that detailed various curvatures found in nature.[47] Specifically, it demonstrated the mathematical elegance found throughout the biological world. Dawkins sought to engage this work in showing its connection with Neo-Darwinian theory. Even a cursory look at the extraordinary biological phenomena presented by Thompson reveals a variety of exquisite designs found in many living

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Books, 1988), 29.

[45]D'Arcy Thompson, *On Growth and Form*, revised ed. (New York: MacMillan Company, 1945).

[46]Richard Dawkins, *The Extended Phenotype: The Gene as the Unit of Selection* (Oxford: Oxford University Press, 1982), 2.

[47]D'Arcy Thompson, "On Growth and Form," in *The Oxford Book of Modern Science Writing*, ed. Richard Dawkins (Oxford: Oxford University Press, 2008), 69-77. This reference is an excerpt of the text cited above.

organisms. The mollusks, for example, demonstrated how a mathematical pattern can be reflected in certain body structure(s). In this case, the familiar *Fibonacci Sequence* matched the animal's spiral.[48] Such intricacy yields strong evidence for the sheer elegance of design *via mathematica* – a quality that any reputable scholar would readily concede.

Thompson further demonstrated how various animal structures could be *graphically* compared. The two-dimensional view of the anterior side of a crustacean, for example, could be graphically juxtaposed against a similar crustacean to analyze how the dimensions were relatively "compressed" or "expanded" geometrically.[49] This method resulted in a literal bending of the Cartesian coordinate system to illustrate the mathematical core in living things. Dawkins employed the application of this tool in attempting to prove the connection between early hominids and modern man. He wrote that "it should have been possible to start with, say, an Australopithecus skull drawn on the distorted 'rubber,' and breed your way through creatures with progressively larger braincases and progressively shorter muzzles."[50] But how accurate is that assertion? Thompson freely admitted that it appeared impossible "to obtain such a series, or to pass by successive and continuous gradations through such forms as Mesopithecus, Pithecanthropus, *Homo Neanderthalensis* and the lower or higher races of modern man."[51] To his credit, Thompson realized the limitations of his tool – especially where

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[48]The Fibonacci Sequence is a well-recognized mathematical sequence that was first discovered by Leonardo Pisa in the 13th century. The series is especially significant to the biological world where many living organisms appear to follow its pattern: 1, 1, 2, 3, 5, 8, 13, and so on.

[49]Thompson, *On Growth and Form*. 1056-57.

[50]Dawkins, *The Greatest Show on Earth*, 314.

[51]Thompson, *On Growth and Form,* 1085.

samples did not transform well. He acknowledged that his tool was designed to affect only that which *could* be properly transformed. Nevertheless, the sheer value of this model lies in its ability to demonstrate the mathematical foundation inherent to many living structures.[52] In Thompson's view, it also reflects life's material composition, environment, and physical forces that surround it.

Dawkins's Biomorph Program

Dawkins's Shakespearean program was merely the first attempt of a computer-aided analog for evolution as he immediately began work on his "Biomorph" program. Equipped with these two programs, he pressed forward to their potential application in evolutionary theory. Meanwhile, he has also become a strong proponent of artificial intelligence (AI). Beyond the marvelous capacity for memory storage and processing demonstrated by today's computers, Dawkins has favored the controversial idea that computers might be *able to learn*.[53] But whether an inanimate object (such as a computer) could actually learn something remains a subject of debate.[54] Regardless, Dawkins believes that artificial intelligence has an almost unlimited potential within science. Therefore, he has drawn a strong position against the so-called "computer myth" that claims the opposite.[55] In contrast, the alternative position thinks that computers are limited to nothing more than what their human programmers have instilled in them. They

[52]Ibid., 1094. In recognizing the marked discontinuities between certain species, Thompson admitted that "this trusty guide to the affinities of animals within certain bounds or grades of kinship and propinquity, ceases in other cases to serve us, because under certain circumstances it ceases to exist. Our geometric analogies weigh heavily against Darwin's conception of endless small continuous variations."

[53]Dawkins, *The Selfish Gene*, 51-59. See also Idem, *The Extended Phenotype*, 118-19.

[54]Dawkins, *The Selfish Gene*, 51-54. See also Hubert L. Dreyfus, *What Computers Still Can't Do: A Critique of Artificial Reason* (Cambridge, Mass: The MIT Press, 1992).

[55]Dawkins, *The Selfish Gene*, 51. See also Idem, *The Extended Phenotype*, 9, 14-18.

see no possibility of them ever achieving such a capacity. Regardless, while some scholars believe computers could eventually obtain some degree of intelligence, others outright reject that claim.

Nevertheless, springing from his confidence in artificial intelligence and its promising capacity through computer programming, Dawkins set out to apply his tool toward an evolutionary scenario. After toying with the Shakespearean program, he was ready to move on to a full-blown evolutionary program aptly named "*Evolution*."[56] Using subprograms to imitate the more specialized evolutionary agents of *development* and *reproduction*, he successfully obtained two-dimensional forms.[57] Through these "biomorphs," he was intending to represent the biological organisms found in nature.

Now Dawkins began his program using simple branching techniques before adding several more elaborate parameters for increased complexity. Adjustment of the numerical value of each of these parameters could further accommodate a sense of mutation required by Neo-Darwinism. Moreover, the parameters themselves provided the means necessary to "grow" these images in a direction that would roughly reflect what one might observe in the real world (i.e., albeit in a two-dimensional fashion). Thus, a particular physical characteristic found in nature could be duplicated through a slight modification of the program. Segmentation, for example, might be included as a parameter because the repetition or segmenting of an item could be easily modeled through the adjustment of the corresponding mathematical value. And because segmentation is a common characteristic of many animals (such as arthropods), one is

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[56]Dawkins, *The Blind Watchmaker,* 55.

[57]Ibid., 53 and 55-56 respectively. Dawkins named these two-dimensional forms "biomorphs," to which the remainder of this dissertation will make reference. Similarly, the computer program used to manufacture these forms will be referred to as the "Biomorph" program.

more likely to output an animal-shaped image. Parameters can be further adjusted to accommodate the desired shape. A segmented image, then, would entail the desired *non-zero value.* On the other hand, one could alternatively produce a *non*-segmented image by simply assigning a *zero value* to that same parameter.[58] Altogether, Dawkins incorporated a total of eight parameters to infuse the "lifelike features" onto his "biomorphs."

Now it should be pointed out that Dawkins claims to have "deliberately tried to avoid deploying [his] biological knowledge" in designing his program.[59] However, Ted Kaehler specifically helped him embody "an 'embryology' with some interesting biological features geared to breeding 'insects,' 'spiders,' 'centipedes' and other creatures resembling arthropods."[60] Moreover, the detailed description of his program in the first appendix of *The Blind Watchmaker* appears to have involved extensive biological knowledge and terminology.[61] In that section, Dawkins described a considerable array of biological detail for his "chromosomes" including symmetry, segmentation, branching, and mutation. Did he not intentionally wrap his subprograms "Reproduction" and "Development" into his "Evolution" program in just the right way as to avoid

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[58]The numerical value of each respective parameter provides the necessary control for the programmer to make adjustments. Using the characteristic of segmentation as an example, one can either create a number of segments on the resulting image by assigning a corresponding non-zero value (e.g., the number five for five segments) or else completely eliminate any segmentation altogether by assigning the number zero to that particular parameter's value (as noted above).

[59]Dawkins, *The Blind Watchmaker,* 352. Just as he wrote in this 1996 (2nd edition), he also discussed in an earlier article for SFI. See idem, "The Evolution of Evolvability," *Artificial Life*: *SFI Studies in the Sciences of Complexity*, ed. C. Langton (Boston: Addison-Wesley Publishing Company, 1988): 201-20. In this latter reference he wrote how he "resisted the temptation to take the easy route and build in biological details" (209). This statement applies to the writing of his program and the setting of its respective parameters. This article he wrote for The Santa Fe Institute added another layer of defense for what he had tried to clarify in the endnotes of *The Blind Watchmaker*.

[60]Dawkins, *The Greatest Show on Earth*, 41.

[61]Dawkins, *The Blind Watchmaker*, 335-49.

Lamarckism?[62] Moreover, did he not fully admit that he was "hoping to evolve animal-like shapes" in the first place?[63]

In his article "The Evolution of Evolvability," Dawkins further described how he meticulously adjusted his generic set of genes to create his animal-shaped figures using "general biological principles."[64] Though perhaps not the extensive "detailed biological knowledge" that he claims to have avoided, Dawkins's use of "general" principles was certainly enough to succeed. But knowing when to switch "on" certain symmetries or when to add segmentation appears to provide an advantage. The latter, for example, becomes instrumental in producing "phyla-vertebrates, arthropods, and annelids."[65] In summary, it appears that Dawkins utilized some of his expertise to tailor his program to reflect the biological world. But what does this program offer science?

Taken in its most positive light, Dawkins's Biomorph program may provide a kind of theoretical model that could help researchers to better visualize the *genetic distance* between species. In mapping out "related species," one can more easily traverse the imaginative landscape of resulting images. Furthermore, this type of program could help in analyzing the effects that certain genes have on genetic distance. As Dawkins concluded in *A Devil's Chaplain*, "it is convenient to imagine the set of all possible animals as arrayed in a multi-dimensional genetic landscape."[66] In this way, his program offers a kind of hypothetical model for comparative purposes. Secondly, his program

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[62]Ibid., 56. Dawkins capitalized the names of the subprograms "DEVELOPMENT" AND "REPRODUCTION" just as he did the program itself called "EVOLUTION."

[63]Ibid., 55.

[64]Dawkins, "The Evolution of Evolvability," 209.

[65]Ibid., 210.

[66]Dawkins, *A Devil's Chaplain,* 83.

provides a kind of visual aid for predicting how the assignment of certain genetic parameters might affect their corresponding phenotype. Dawkins could demonstrate this latter capacity through the careful adjustment of each parameter's value. Thus, the length or angle of a branch, the number of repeated segments, or a host of other variables could be adjusted to produce a multitude of different outcomes or "families." Overall, this type of program could potentially aid geneticists in predicting the affects felt by the modification of real genes and/or chromosomes.

From another perspective, the wide assortment of resulting "biomorphs" reveals some of the more creative venues that one can achieve through the successful integration of hardware, software, and programmer. Not surprisingly, Dawkins has displayed a whole plethora of these "evolved" designs in several of his books and articles.[67] These figures resemble anything from a "spitfire" aircraft to a "lunar lander" and from a "lamp" to a "man in a hat."[68] But how do these images help bolster Dawkins's argument for abiogenesis?

In evaluating these results, how does his program reflect the real world? What has Dawkins specifically achieved in respect to resolving abiogenesis? Unfortunately, this program has not been cited as a source material by any biochemically-related or genetically-related peer reviewed journal to date. Given the speed of technological advancement and the limitations entailed by such an older, generic program, it is unlikely that it will. Not only does his two-dimensional model insufficiently reflect what is going

[67]Dawkins, "The Evolution of Evolvability," 209-16. See figures 6, 10, and 12-15. See also Idem, *The Blind Watchmaker*, 60 and 335-58 (figure 5 and Appendices 1 and 2); and idem, *Climbing Mount Improbable* (New York: W. W. Norton & Company, 1986), 33 and 36b (figures 1.16 and 1.17).

[68]Dawkins, *The Blind Watchmaker,* 61.

on in the three dimensional world, but the mechanisms by which real organisms actually propagate are substantially different. As Dawkins freely admits, "the two-dimensional world doesn't lend itself to the physics of real life in most respects."[69] On this matter, Dembski has been critical that this type of "informational pathway need[s] to conform to biological reality, not to the virtual reality residing in a computer."[70]

Furthermore, though Dawkins has evidently gone to great lengths in illustrating abiogenesis through these computer simulations, he may have conveyed much more than he would have liked. For his non-biological examples demonstrate the near limitless ability of a programmer to create just about anything. The unbounded limits of the craft are evident in Appendix II of *The Blind Watchmaker* where Dawkins demonstrates his program's ability to spell out the names "Richard Dawkins" and "Macintosh."[71] If this program is to provide reasonable support for abiogenesis, then how does it manufacture such unrelated figures? Now given the state of computer programming, it should come as no surprise to see just about any pattern appear. Today's programmers have accomplished much, much more. But instead of portraying the origin of life, these results indicate a virtually unparalleled capacity to output just about

[69]Dawkins, *Climbing Mount Improbable*, 36.

[70]Dembski, *Intelligent Design*, 182. In this text, the author specifically challenged "Stuart Kauffman, Christopher Langton and others at the Santa Fe Institute" and Dawkins's defense of the "Biomorph" program was written for the Santa Fe Institute. See Dawkins, "The Evolution of Evolvability," 201-220. Moreover, he has been especially critical of Dawkins's Shakespearean "Methinks it is Like a Weasel" program. See also William A. Dembski and Jonathan Wells, *The Design of Life: Discovering Signs of Intelligence in Biological Systems* (Dallas: The Foundation for Thought and Ethics, 2008), 260-61.

[71]Dembski, *Intelligent Design*, 357.

anything. Manfred Eigen or Doron Lancet may offer models that more closely match the real model of abiogenesis.[72]

Dawkins's Movement Between Models

Beyond the general background, career, and contributions of Richard Dawkins, it becomes incumbent to ascertain his position on abiogenesis. Paralleling his widely varied achievements in writing, teaching and numerous other contributing roles, he has also played a significant role in conveying his opinion to the world. However, his opinion has shifted from time to time between models. Now that is not to say that he has moved in the very least from his entrenched position as a Neo-Darwinian gradualist.[73] Dawkins has made that position quite clear. But his position on abiogenesis has been a completely different matter. In that regard, he has vacillated over time.

How has Dawkins changed his mind in regard to this critical issue? What discoveries or events influenced his position? The fact that such a high profile figure of the evolutionary debate has wavered should raise concern. Abiogenesis represents a strategic link within the Neo-Darwinian paradigm because evolution could not have succeeded if it had no way of getting started. What a key proponent thinks about this issue is of utmost importance. Interestingly, Dawkins's position has roughly paralleled

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[72]Manfred Eigen and Doron Lancet are mentioned above as just two examples of authentic, peer reviewed scholarship that has earned academic consideration. Their respective models, which heavily involve origin of life research, utilize detailed, well thought out modeling techniques. See chapter 4 for further detail on Doron Lancet's computer programming and chapter 5 in regard to Manfred Eigen.

[73]Dawkins, *A Devil's Chaplain*, 187-92, 199-201 and 209-14. Dawkins's position as a Neo-Darwinian gradualist has often clashed with colleagues such as Stephen Jay Gould. The latter recognized a plethora of saltations in the fossil record for which he developed his popular theory *punctuated equilibrium*. See also idem, *Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder* (New York: Houghton Mifflin Company, 1998), 193-203. Numerous other books and articles could be included in this reference pertaining to the numerous discussions between Dawkins and Gould, but that topic is beyond the scope of this dissertation.

the prevailing consensus of the scientific community. It has become somewhat of a trend. Nevertheless, the ultimate solution is yet to be discovered.

A closer analysis of Dawkins's fluidity on this matter should shed some light on the problem as a whole. He has remained at the center of this issue since entering the discussion during the seventies. At that time, he published his first and bestselling book *The Selfish Gene*. Within a decade, however, he had already sharpened his aggressive defense of naturalism. His assault on religion came on later, which placed him in a key role for atheism. Ever since, he has become somewhat of a celebrity in promoting the twin billing of naturalism through atheistic means.

But most of his followers have apparently missed Dawkins's dubious stance toward abiogenesis. Undoubtedly, few have had the time to peruse through the full six hundred pages of a more detailed text like *The Ancestor's Tale* when it was much easier to get through a mere one hundred pages of a simpler text like *The Magic of Reality*.[74] In that latter text, Dawkins provided a series of introductory level scientific explanations to combat the straw man of historic myth. Since many of his followers have embraced his sharp banter against religion and his bold stance as an atheist, it would be easy to miss his gradual change of position. But despite this appearance of consistency, Dawkins has demonstrated an undeniable movement between models.

Dawkins's 1st Model: The Prebiotic Soup

Following on the heels of the twentieth century pioneers of abiogenesis, Dawkins naturally fell in line with the prevailing consensus as he entered the

[74]Richard Dawkins, *The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution* (Boston: Houghton Mifflin, 2004). See also idem, *The Magic of Reality: How We Know What's Really True* (New York: Free Press, 2011). This latter reference is replete with colorful illustrations, which helps target a younger audience.

conversation in the seventies. Having studied the works of Oparin and Haldane, it was all too scholarly to consider anything outside the bounds of a developing string of amino acids formed out of a rich primordial soup.[75] The prevailing theory seemed simply beyond reproach. Forty years earlier, those two scholars were considered to have finally closed in on a robust theory for life's formation. Each had arrived, quite independently, at similar solutions entailing a reducing atmosphere.[76] At that time, theirs had become the accepted theory for explaining the improbable assembly of life's first macro-molecules. Dawkins had undoubtedly agreed with that assessment as is evident from his own words that "life could not originate on any planet with free oxygen in its atmosphere."[77]

But how did this theory get established? To answer this question, we must revisit the works of the two giants of science in the 1920's: Soviet biochemist Alexander Ivanovich Oparin and England's John Burdon Sanderson (J. B. S.) Haldane. Though working on the problem independently, they each arrived at similar conclusions. Oparin

[75]The concept of a prebiotic (primordial) "soup" developed for over a century as various scholars speculated about the conditions on the early Earth. German philosopher Ernst Haeckel was the first to use this language in envisioning a sort of primeval slime called "Urschleim." He theorized this substance to be a kind of *protoplasm* which linked inanimate matter with organic life. It became further popularized through the embarrassing mistake of Thomas Huxley who claims to have discovered evidence of this unusual substance in 1868. Huxley named the foreign substance *bathybius haeckelii* after its founder Haeckel. Unfortunately, he had to eventually confess his error publicly as the idea of protoplasm began to die away. But Haeckel hoped that evidence would still be found. See further commentary and references in Hubert P. Yockey, *Information Theory, Evolution, and the Origin of Life* (Cambridge: Cambridge University Press, 2005), 114ff. British geneticist/biologist Haldane later coined the term "hot dilute soup" in a 1929 article wherein he envisaged how the chemistry of life had existed early on. See J. B. S. Haldane, "The Origin of Life," *The Rationalist Annual* (1929): 3-10. This latter term has since been coined in a number of ways by scholars who have alluded to a presumed chemical-laden sea on the early Earth. See Thomas H. Huxley*, Discourses: Biological and Geological Essays* (New York: Appleton and Company, 1894).

[76]A reducing atmosphere, which is one lacking or relatively low in oxygen content., prevents or at least limits the oxidation of materials. From an origin of life perspective, such an atmosphere would make it easier for the initial assembly of certain prebiotic molecules including blue-green algae.

[77]Dawkins. *The Ancestor's Tale,* 564.

had been working on the issue throughout the twenties, but did not formally articulate his position until 1934.[78] By that time, new astronomical data had discovered that several of the larger planets (i.e., the gas giants) might contain substantial amounts of ammonia and methane in their respective atmospheres. Therefore, he surmised that a similar condition had existed on the Earth that might have engendered a reducing atmosphere.[79] That type of environment would have more readily permitted the formation of simple organic molecules such as amino acids. Being a colloidal chemist, Oparin postulated that certain compounds might have arisen out of a dissolved solvent to coagulate in such an environment.[80] Turning to what he could demonstrate empirically, he finally succeeded in producing a number of tiny enclosed structures he called *coacervates*. Essentially, he had produced a concentrated droplet of various organic substances held together by their mutual hydrophobic forces.

Meanwhile, Haldane was working on this problem using a different approach. He concocted a theory based on the apparent abundance of hydrocarbons that he felt were central to the issue. Believing that such a high density of carbons might have tied up all of the oxygen into carbon dioxide, he likewise concluded that there had been a reducing atmosphere at an earlier time.[81] This latter condition should have allowed the first

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[78]Iris Fry, *The Emergence of Life on Earth: A Historical and Scientific Overview* (New Brunswick, NJ: Rutgers University Press, 2000), 70.

[79]As it has turned out, the four gas giants (i.e., Jupiter, Saturn, Uranus, and Neptune) are now known to have very little methane or ammonia in their dense atmospheres. All four have a mixture of hydrogen and helium in their respective atmospheres with only trace amounts of the other gases. The two outer giants (i.e., Uranus and Neptune) are believed to contain methane, ammonia and water in each of the planet's ice.

[80]Colloidal chemistry involves the study of mixtures of a dispersed substance within another substance whether gas, liquid, or solid.

[81]The astronomical data in the early thirties was obtained through the analysis of light spectra

organic molecules to have been more readily synthesized because of the presumed increase in ultraviolet radiation (i.e., due to the lack of oxygen entailed by the reducing atmosphere).[82]

Given time, the theories of Oparin and Haldane would eventually face heavy opposition. Today, most scholars have discarded Oparin's coacervates as potential intermediates on several counts. Biochemist Albert Lehninger summed it up well in concluding that Oparin's structures "were not made from biologically-formed substances and were not formed under simulated primitive-earth conditions."[83] Moreover, he notes that they "do not provide for self-replication or evolution" either.[84] Likewise, Haldane varied his approach over time but was never able to surpass that which he had achieved in 1929.[85] Today, many scholars agree that the Earth's early atmosphere was probably rich in carbon dioxide due to the enhanced volcanic activity.[86] But was it a fully reducing atmosphere? Many have come to doubt it. Moreover, the self-organizing properties required by Haldane have been slowly discarded in favor of newer ideas. But despite

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as compared to presumed planetary inertias, densities, gravitation, and other factors. Using this data, Oparin surmised that Earth may have had a reducing atmosphere. Meanwhile, Haldane believed that the large amount of carbon-based compounds today implied that much of the world's oxygen had been tied up in carbon dioxide. See David Leverington, *Babylon to Voyager and Beyond: A History of Planetary Astronomy* (Cambridge: Cambridge University Press, 2003), 311-17.

[82]Fry, *The Emergence of Life on Earth,* 66-74.

[83]Albert Lehninger, *Biochemistry* (New York: Worth Publishers, 1982), 1047.

[84]Ibid.

[85]J. B. S. Haldane, *Possible Worlds and Other Essays*, revised ed. (New Brunswick, NJ: Transaction Publishers, 2009), 16. This was a key essay of Haldane that addressed his idea of a reduced atmosphere. The original text was published in London by Chatto & Windus in 1927. The late twenties represented a high point in Haldane's work on abiogenesis.

[86]Carl Sagan and Christopher Chyba, "The Early Faint Sun Paradox: Organic Shielding of Ultraviolet-Labile Greenhouse Gases," *Science* 276 (1997): 1217. This issue will be more fully addressed in chapter 5 of this dissertation under the subheading "The early atmosphere."

these changes in the decades to come, these two men still laid the foundation for later studies. Specifically, it was their work that inspired Miller and Urey twenty years later.

Stanley Miller, working under the guidance and theoretical mind of Harold Urey, provided the long awaited resurgence of this idea. Their ingenious efforts produced a groundbreaking experiment in 1953 which not only served to confirm what those earlier pioneers had merely envisioned, but it brought about an air of confidence to virtually everyone in science. Many believed that this was the final piece of evidence that explained the origin of life. What Oparin and Haldane had accomplished theoretically, Miller and Urey had actualized empirically.

But that was not the only contribution of Oparin and Haldane. They also identified some of the difficulties that would face the construction of complex organic molecules – given a non-reducing atmosphere. They knew that an oxygen-rich mixture would prohibit the generation of certain ingredients including amino acids and nucleotides. Complex macromolecules such as proteins and nucleic acids would be exceedingly unlikely. But like his predecessors, Urey believed that oxygen had not yet become an abundant element on the primordial Earth. And that key assumption drove Miller's experiment. His simulated reducing atmosphere enabled him to produce at least two amino acids out of a mixture of methane, ammonia, water and hydrogen.[87] By the time Dawkins had begun writing some two decades later, scholars had already developed

[87]Stanley L. Miller, "A Production of Amino Acids Under Possible Primitive Earth Conditions," *Science* 117 (1953): 528-29. Working under the guidance of Harold Urey at the University of Chicago, Miller published this paper which unveiled one of the most groundbreaking experiments in origin of life theory. The experiment tested what Urey and others had suggested might have been the early Earth's atmosphere. The paper reported that his experiment had generated two of the simpler amino acids, alanine and glycine, while also noting trace indications of aspartic acid and amino-butyric acid. Many have hailed this experiment as one of the most important discoveries in abiogenesis.

similar experiments that produced the remaining amino acids found in living systems.[88] Confidence in the classic prebiotic Earth theory had reached its zenith.

In *The Selfish Gene*, Dawkins assumed that the primordial soup model was correct. He often alluded to it throughout his text, making mention of it in nearly half its chapters. In fact, he referred to the prospective ocean of chemical compounds as a "biochemical cocktail shaker,"[89] "the thickening broth,"[90] the primeval soup,"[91] "the original soup,"[92] and simply "the soup."[93] Overall, he referenced this idea in sufficient detail to clearly echo all of the key tenets of the classic theory. Two of the opening three chapters of his text argued in favor of that theory. In this his first text, Dawkins communicated quite clearly how he thought life began. Though he admitted to "a number of rival theories," he was definitely inclined to the classic model.[94] Only that model assumed a "primordial lightning" that affected the "chemical conditions of the young earth."[95] Furthermore, he described how the "influence of energy such as ultraviolet light from the sun" resulted in "larger molecules."[96] Dawkins consistently inferred a reducing atmosphere projected by Oparin, Haldane, Miller and Urey.

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[88]The twenty amino acids found in all known life include the following: alanine, arginine, asparagine, aspartic acid, cysteine, glutamic acid, glutamine, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, tryptophan, and valine.

[89]Dawkins, *The Selfish Gene*, 15.

[90]Ibid., 16.

[91]Ibid., 25, 37, 48. See also pp. 257-58 in this book's 2nd edition.

[92]Ibid., 49.

[93]Ibid., 16, 49.

[94]Ibid., 14.

[95]Ibid.

[96]Ibid., 15.

Dawkins's 2nd Model: A Crystalline Theory

By the time of his third book *The Blind Watchmaker*, Dawkins had begun to promote a very different approach. He saw an intriguing alternative in the somewhat striking model suggested by Scottish biochemist A. G. Cairns-Smith.[97] Dawkins spent the bulk of the sixth chapter of that book in describing this model. After reiterating once more about the absolute necessity for cumulative selection and the popularity of the classic model, he began to change course. He claims that he was merely "fly[ing] a kite for a somewhat less fashionable theory" that he thought had "at least a sporting chance of being right."[98] Meanwhile, the classic soup theory had begun to lose traction and a new approach was necessary. Dawkins was certainly alert to recognize this problem, but he needed an alternative. Specifically, which model offered the most reasonable solution?

Though not thoroughly convinced of any of the available options, he elected to detail the rather unusual model of Cairns-Smith.[99] Besides this crystalline-based idea, Dawkins had also entertained solutions forwarded by Leslie Orgel, Sol Siegelman and Manfred Eigen.[100] Nevertheless, he elected to take a bit of a risk in explicitly endorsing Cairns-Smith's model. That peculiar theory portrayed the organization of life through the complexity of silicates. In other words, the initial inorganic foundation might have been lain down by clays and/or crystals rather than carbon.[101] In this way, the unique

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[97]Dawkins, *The Blind Watchmaker*, 148.

[98]Ibid.

[99]Ibid., 148-65.

[100]Ibid., 131-33.

[101]This issue will be more fully addressed in chapter 5 of this dissertation under the subheading "Cairns-Smith's clay replicators."

characteristics and relative abundance of silicon-based materials could have provided somewhat of a "scaffolding" affect from which the more complex organic structures would eventually arise. Then, at some critical juncture, the organic structures must have "spun-off" from its initial foundation (i.e., the genetic takeover).[102]

Dawkins briefly mentioned Cairns-Smith's model in a single sentence of *The Selfish Gene*.[103] The crystalline-based model was undoubtedly just one of a "number of rival theories" he had alluded to in that text.[104] But the attention that it received two books later seems unusual. Dawkins had gone from a single sentence in one text to seventeen pages in his later text a decade later.[105] Moreover, why he needed to add a full explanation of this change in the 2nd edition of *The Selfish Gene* four years later (1989) raises questions. Why did he need to add an explanation to this much later version of the text? For whatever reason, he added in his new section of e*ndnotes* a full explanation in regard to that rather terse sentence from that 1st edition (i.e., the 1976 version, which briefly mentioned Cairns-Smith's model).[106]

In that 2nd edition, which was published after *The Blind Watchmaker* (1986), Dawkins had evidently felt compelled to explain himself. But it remains unclear whether he had received negative feedback from fellow scholars or had simply felt concerned

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[102]A. G. Cairns-Smith, *Seven Clues to the Origin of Life: A Scientific Detective Story* (Cambridge: Cambridge University Press, 1985), 63.

[103]Dawkins, *The Selfish Gene*, 21.

[104]Ibid., 14.

[105]Dawkins had briefly mentioned Cairns-Smith's theory in the 1st edition of *The Selfish Gene* (1976). He made no other reference to this model for the rest of the book or in the 1st edition of his second book *The Extended Phenotype* (1982). In the 1st edition to *The Blind Watchmaker* (1986), he allocated most of a chapter in describing that particular theory. Then in the 2nd edition of *The Selfish Gene* (1989), he added the explanatory end-notes (in regard to that first brief comment in 1976).

[106]Dawkins, *The Selfish Gene*, 269.

about what his readers had thought about his apparent shift in theory. Whatever the case, he had decided to explain how he did not "commit [him]self to the particular hypothesis chosen" (i.e., alluding to the support he gave to the classic soup theory in the 1st edition of *The Selfish Gene*).[107] This statement implies that he had merely taken one of several potential theories *off the shelf,* in an arbitrary sense, as he hinted toward "Manfred Eigen['s]" theory that could probably be next.[108]

Since those first three texts, Dawkins has accented his interest or support toward certain theories over others. But did Dawkins choose each model in a purely arbitrary manner? Now that is not to imply that Dawkins had not been honest about leaving his options open, but that he had deliberately accented certain models over others in a number of his works. This emphasis is well evidenced in a number of places including *The Blind Watchmaker* where he scarcely says anything about the classic "soup theory." But then again, he developed a full eighteen page explanation and informal endorsement toward Cairns-Smith's model in that same text.[109] Dawkins claimed to have only arbitrarily endorsed Cairns-Smith's theory in that text. But could such a lengthy explanation be considered arbitrary? Looking back to his earlier texts, did he ever inform his reading audience in *The Selfish Gene* or in *The Extended Phenotype* that he would be covering a number of relevant theories in the future? Had that been his original intent?

Evidently, the exceedingly long odds had caused many scholars to look for other solutions. Dawkins made that point himself in *The Greatest Show on Earth*.[110] But

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[107]Ibid.

[108]Ibid.

[109]Dawkins, *The Blind Watchmaker,* 148-66.

[110]Dawkins, *The Greatest Show on Earth*, 419.

as Cairns-Smith admitted, "'chemical evolution' looks good from a distance, and there is a common sense about it. But to my mind, like the phlogiston theory, it fails to carry through an initial promise: it fails at the more detailed explanations."[111] Moreover, Cairns-Smith had not been the only one to question the validity of the classic soup theory. Many other leading scholars have also been in search of a viable alternative whether through clay/crystals, gene-first, metabolism-first, etc. Dawkins own colleague Daniel Dennett perused through a number of potential options in his popular text *Darwin's Dangerous Idea.*[112] After paying tribute to the classic soup theory, he also devoted several pages toward Cairns-Smith's model as did Paul Davies who agreed that the "basic principle of genetic takeover is sound."[113] Whatever the case, the search for an alternative theory had become necessary to fill the void.[114]

But where does that leave Dawkins? Given his reasoning in both his texts and in his endnotes, it appears to be one of two reasons. He may have simply chosen to avoid being "pinned down" to any certain theory because he does not know which theory is correct. A second option could simply entail his movement between models. If the first case were true, then his position at any given time becomes questionable. Perhaps more

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[111]Cairns-Smith, *Seven Clues to the Origin of Life*, 34. Note the author's comparison to the ancient Phlogiston Theory, which is an obsolete theory developed by the Greeks. It attempted to explain the reason for processes such as combustion, which they attributed to a substance called phlogiston. This element turns out not to exist, but it seemed like a reasonable explanation at the time since oxidation was yet to be discovered.

[112]Daniel Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon & Schuster, 1995), 157-58.

[113]Paul Davies, *The Fifth Miracle: The Search for the Origin and Meaning of Life* (New York: Simon & Schuster, 1999), 137.

[114]The search for alternative solutions should not be interpreted as a complete abandonment of the classic approach. Many scholars have continued down that same road in search of supportive evidence. Moreover, most textbooks continued to support the classic soup theory for several years. Apart from those who are actively participating in the search, many have been simply unaware of the need for a better theory.

troubling would be the second case, which could indicate an intentional avoidance of scrutiny due to the ongoing fluidity of his position.

Dawkins's 3rd Model: Panspermia

Several books later, Dawkins appeared to be much more guarded about his position. He was certain to include a number of different theories here and there that would demonstrate to the reader that he had a variety of potential solutions at hand. By the time he wrote his eighth book *The Ancestor's Tale* (2004), he had noted contributing theories from Leslie Orgel, Manfred Eigen, Julius Rebek, Sol Spiegelman, Thomas Gold and others.[115] But he had also interspersed a few comments in regard to Cairns-Smith's model in about half those books. He reiterated that an inorganic foundation could still provide the final solution.[116]

Two years later, in *The God Delusion* (2006), yet another model piqued his interest. In considering a solution outside of the terrestrial realm, he had essentially opened up the discussion toward what space had to offer. Perhaps he had already dropped us a hint on this when he described "Threshold #10" in *River out of Eden*.[117] In that closing chapter of his fourth text, Dawkins had explained what he meant by the "ten thresholds" that evolved life would traverse. Beginning with "Threshold #1," he discussed life's foundational prerequisite to simply replicate, while "Threshold #6"

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[115]Dawkins, *The Ancestor's Tale*, 567-81.

[116]Dawkins makes mention of Cairns-Smith's clay/crystalline theory in several of his books: idem, *The Selfish Gene,* 21 (p.269 in the 2nd edition end notes); idem, *The Blind Watchmaker,* 148-65; idem, *River Out of Eden,* 150-51; idem, *The Ancestor's Tale,* 552 and 567; idem, *The God Delusion* (New York: Houghton Mifflin Company, 2006), 156; and idem, *The Greatest Show on Earth,* 419. In addition, he makes several references to clays, silicates, and crystals in regard to origin of life in his texts which are indicative of Cairns-Smith's theory.

[117]Dawkins, *River Out of Eden*, 160.

corresponded to its achievement of consciousness.[118] The last of these thresholds (i.e., Threshold #10) represented to him the culmination of life's complexity. Aptly called the "Space Travel Threshold," he described it as the stage in which advanced life would attempt to spread itself out across the universe (i.e., in deliberately "seeding" other worlds). Astrobiologists call this idea *directed panspermia*.

Dawkins concluded *River Out of Eden* with some meandering thoughts about the "wide gulf of space" and the plausibility of a "life explosion."[119] Later, in *Unweaving the Rainbow* (1998), he included a full chapter entitled the "Barcodes in the Stars" where he inserted an abbreviated argument about the possibility of life on other planets and in the general expanse of the universe.[120] Evidently, Dawkins had thought about the extraterrestrial option for some time. But despite these brief excerpts, he had not yet shown favor to either the *directed* or *natural* version of the theory. Whatever the case, he has since broadened his interest in the last decade in allocating much of chapter 4 of *The God Delusion* toward this very theory. He also included several essays on the matter in *The Oxford Book of Modern Science Writing* as well as significant portions of both *The Greatest Show on Earth* (chapter 13) and *The Magic of Reality* (chapter 9).[121]

Why did Dawkins accent this option? Perhaps he saw panspermia as a formidable solution given some of the recent organic discoveries on meteorites. Or maybe it was the steady advancement into space. However, it may have been more likely that he saw a growing potential for abiogenesis beyond Earth. For if science could

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[118]Ibid., 151 and 157 respectively.

[119]Dawkins, *River Out of Eden*, 160-61.

[120]Dawkins, *Unweaving the Rainbow*, 60-63.

[121]All four of Dawkins's most recent books endorsed panspermia at some point.

provide a second, completely independent form of life outside of the terrestrial realm, then that could more readily ensure a naturalistic solution. Moreover, with the lack of a secure terrestrial solution at hand, space offered another option. Whatever the case, his interest in panspermia adjoined him to a plethora of other interested parties. Francis Crick, who has been one of the leading scholars in the field of origins, was one of the first to be attracted to the idea. Given that he believed in a universe at least three to four times the age of the Earth, then the plausibility of life elsewhere was somewhat enhanced. Crick felt like the "uniformity of the genetic code" indicated that life had somehow perfused through a "population bottleneck."[122] Understandably, he became drawn toward an extraterrestrial solution, which he aptly described in *Life Itself.*[123]

But Crick was not the only one who looked toward the stars for life's beginnings. A number of space agencies around the globe have poured a substantial amount of time and energy toward both the directed and natural forms of panspermia.[124] While directed panspermia has received the most attention, a rising interest in natural panspermia has begun to gain ground. Astrophysicists feel certain that an innumerable cascade of meteorites have impacted billions of planets across the universe over time. Given that a substantial percentage of those impacted would have involved enough energy to have exploded rock off the respective planet's surface, then it seems plausible to consider *natural panspermia*. That process suggests that organic life had indeed existed on one or more other planets. The resulting planetary debris could have

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[122]Crick, *What Mad Pursuit*, 148.

[123]Crick, *Life Itself*, 95ff.

[124]Chapter 1 of this dissertation briefly discussed agencies across the globe and their corresponding expenditures. Several of NASA's specific missions were also noted in regard to origin of life research.

theoretically spread out toward our Solar System. If even a fraction of that debris had found its way to Earth, then perhaps some form of life could have "taken root."

Irrespective of how the seeds of life might have been spread, the plausibility of this solution has gradually encroached upon the mind of Dawkins. Though he rightly recognized the "colossal error" entailed by the *Drake Equation*, he still found it necessary to devote nearly half of a chapter toward the plausibility of life elsewhere in *The God Delusion*.[125] That is where he began to write about "the signs of water," the "so-called Goldilocks Zone," SETI, and so on.[126] He also alluded to Lee Smolin's Multi-Verse Theory in this and several of his other books.[127] Moreover, recall that Dawkins continued to write on this subject in his latest two books *The Greatest Show on Earth* (2009) and *The Magic of Reality* (2011).[128] In these texts, he became even more specific about the actual mechanics of life on other planetary systems. Following NASA's logic, he factored in the probable number of planetary systems with an accompanying list of

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[125]Dawkins, *The God Delusion*, 95-96. Though Dawkins fully acknowledged the "colossal error" involved in the multiplicity of unknown factors, he is encouraged by recent strides made in astrophysics and space exploration. Thus, at least some of the mystery has been reduced in regard to the respective factors of the Drake Equation. For example, more is known about the immediate star systems close to our solar system. Nevertheless, the equation's numbers are still far from being ascertained with any degree of accuracy. Its application offers little more than a speculative approach to the problem at hand (i.e., in assigning a number of how many alien civilizations might exist in a given volume of space).

[126]Ibid., 162, 163, and 166 respectively. All of these elements would play a substantial role on the plausibility of life beyond Earth, and hence, panspermia. As will be explained in greater detail in chapter 6 of this dissertation, water is believed to be the most essential ingredient toward the existence of life anywhere. The "Goldilocks Zone" represents the theoretical band surrounding the millions of qualifying stars which entail the right characteristics to support life. Dawkins has often referred to this factor as "not too hot or too cold" (in reference to the children's literary character Goldilocks). Finally, SETI stands for the Search for Extra-Terrestrial Intelligence and is an organization concerned with finding life beyond Earth.

[127]Ibid., 174-75. See also Lee Smolin, "The Life of the Cosmos," in *The Oxford Book on Modern Science*, 362-66. This latter idea entails a large scale speculation on the physics of the universe. Smolin suggests that there may be more than one universe.

[128]Dawkins, *The Greatest Show on Earth*, 235, 412-13, and 422-26. See also Dawkins, *The Magic of Reality*, 187-94.

specific conditions that many have deemed necessary for life to exist.[129] But he has also realized the limitation of such matters where there remains "no direct evidence."[130]

That limitation, however, did not obstruct him from being lured into conversation with Ben Stein in the 2008 documentary *Expelled: No Science Allowed*. Asked specifically about the origin of life, Dawkins indicated that he found the idea of directed panspermia to be an "intriguing possibility."[131] Nevertheless, he quickly qualified his comments, in making certain that any potential life form would still be subject to some kind of Darwinian origin in the past. Unfortunately, Dawkins was apparently unaware of the specific goal of the film, which was intended to cast doubt on the scientific community's dogmatic stance on life's origins. The film suggested a greater openness toward other theories. Together, the combined weight of these sources confirms Dawkins's interest in space as a legitimate contender in his mind in the resolution of abiogenesis.

Dawkins's 4th Model: RNA World

With every other space-related agency in the world still groping about for some real evidence of alien life, the foundation for panspermia has remained unsettled.[132] Broadly speaking, that has left an uncertainty for researchers who have searched

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[129]Dawkins, *The Magic of Reality*, 189ff. In concert with NASA, Dawkins has listed common elements that are believed to coincide with the potential for extraterrestrial life. The presence of water, similar Earth-like temperature, and a lack of poisonous gases are among those often cited. See also idem, *The Greatest Show on Earth*, 412-13; and idem, *The God Delusion*, 162-65.

[130]Dawkins, *The Magic of Reality*, 188.

[131]Richard Dawkins, "Interview with Ben Stein," in *Expelled: No Intelligence Allowed*, DVD, directed by Nathan Frankowski (Universal City, CA: Premise Media Corp., 2008). This reference entails an interview between Ben Stein and Richard Dawkins toward the end of this film.

[132]Most of the world's civilized countries have developed some level of space program and virtually all of those have made some effort in search of alien life (e.g., NASA, UK Space Agency, Indian Space Research Organization, etc.).

diligently for a legitimate solution to the origin of life. Most have sought an even newer theory that might yield more promise. As of this writing, *RNA World Theory* has become the forerunner of models in the minds of most leading scholars.[133] It has also become the current theory of choice of Richard Dawkins.

In looking at this apparent shift to yet another model, we must first determine why an alternative became necessary. Understandably, this is a problem that reflects the age old "chicken or the egg" paradox that has haunted biochemists for years. For the complexity of life demands at least some level of replicating mechanism with an accompanying band of catalysts to aid its reactions. Yet even the simplest of cells are still magnificently complex and require a certain minima to run their organic processes. One need only peruse Michael Behe's text on irreducible complexity to get the idea of what level of complexity life demands.[134] Therefore, the fundamental problem lies in achieving this minimum with the available molecules and processes of a primordial Earth.

At a bare minimum, one needs the ability to catalyze and provide replication. And these prerequisites must have existed at the "simplest" of levels. The problem comes more into view when realizing that enzymes catalyze well, while nucleic acids perform replication. Given that proteins carry a near limitless combination of structures and have the added capacity to fold three dimensionally, they also make good enzymes. Unsurprisingly, most enzymes are proteins. Their structural advantages give them the necessary properties to catalyze a multitude of cellular reactions. Likewise, the unique

[133]Dawkins, *The Greatest Show on Earth*, 419. Dawkins himself acknowledged that "a majority of biologists are moving towards the 'RNA World theory.'"

[134]Michael J. Behe, *Darwin's Black Box* (New York: Touchstone, 1996).

structure of nucleic acids gives them the perfect structure to match and/or duplicate. These represent the DNA upon which all living things depend. They pass along their information to succeeding generations. But how could nature produce such complex molecules that are aligned in just the right way to enable life? The odds are greatly stacked against a naturalistic solution explaining such precise orchestration.

RNA World Theory was borne to resolve that problem. As any biochemist knows, ribonucleic acid has at least some capacity to perform both tasks. It can perform as both a catalyst *and* a replicator – to some degree. Though not nearly as effective at duplication as DNA, it still holds some ability to replicate. Likewise, though it cannot catalyze a reaction the way a protein can, it can still function as a weak enzyme. This has led many scholars to suggest that some early form of RNA-like molecule might have been the precursor for the complexities of life. More importantly to this discussion, this is the model that has drawn the most recent support of Richard Dawkins.

Though he had fully recognized the necessity of some primitive replicator from the beginning, it took time for Dawkins to refine what that would actually entail. He aptly entitled the second chapter of his first book "The Replicators" toward that very issue.[135] But to date, he still freely admits that no one knows what that first living molecule really looked like or how it came to be. Rather, he and others have simply retreated toward what "kind of event it *must have been*" (italics mine) though no one really knows.[136] Nevertheless, Dawkins has defined what he thinks must have been the characteristics of that first replicator. By the time he wrote *Climbing Mount Improbable* (1996), he had assimilated a list of requirements: 1) life had but one beginning, 2) it was

[135]Dawkins, *The Selfish Gene*, Chapter 2.

[136]Dawkins, "Interview with Ben Stein."

a highly unlikely event, 3) it had to be simple, obeying basic physical laws, and 4) it was neither the DNA or RNA of today's organic molecules.[137] Identifying these characteristics, Dawkins hoped to narrow down his search. But not until *The Ancestor's Tale* did he really began to assert that this primitive replicator had to be accompanied by some sort of catalyst. As he aptly put it in that text, "theories of the origin of life need to account for both heredity and metabolism" – which clearly implies the ability to both replicate and catalyze at that minute level.[138] But that is what makes RNA World Theory so attractive. Theoretically, it could serve both functions.

Over the next few years, Dawkins continued to be attracted to this model as is evident from his later books. Though he made only a brief mention of it in *The God Delusion*, he elected to add biologist/physiologist Sydney Brenner's paper in his next book *The Oxford Book of Modern Science Writing*. Entitled "Theoretical Biology in the Third Millennium," the former Noble Prize winner elaborated on the renewed awareness that ribonucleic acid "display[s] catalytic functions."[139] Moreover, in direct application to abiogenesis he wrote the following:

> The discovery of catalytic functions of RNA provided a molecule that could combine catalysis and the carrying of information, and bridged the gulf posed by the present partitioned situation where information is carried by one class of molecule (nucleic acids) and proteins are the catalysts. It resolved one of the important problems in how life originated.[140]

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[137]Dawkins, *Climbing Mount Improbable*, 283. See also idem, *River out of Eden*, 136-38; and idem, *The Ancestor's Tale,* 561-67.

[138]Dawkins, *The Ancestor's Tale*, 563-64.

[139]Sydney Brenner, "Theoretical Biology in the Third Millennium," in *The Oxford Book of Modern Science Writing*. 43.

[140]Ibid.

Clearly, Dawkins has given this model his most recent support. He confessed that "a majority of biologists are moving towards the 'RNA Theory,' and for a reason that [he] find[s] quite persuasive."[141] After briefly summarizing the various theories over time, he had finally put forth his guarded endorsement. And that stance was more fully confirmed by me personally during his 2011 book tour across North America. While in attendance at Dawkins's visit to Eastern Kentucky University on October 6th, I witnessed what his thoughts were on abiogenesis. After he had responded to several random queries from the student body, one young man finally asked which theory he would endorse. After reflecting for a moment, Dawkins eventually uttered his support once again for RNA World Theory – above every other known theory today.[142]

Currently, some scholars have more recently suggested that a metabolism-first theory could offer a more thorough and convincing alternative to RNA. Despite the chance that he could move his support once again, Dawkins is still accurate in declaring that "there is no decisive evidence pointing unmistakably to any one" (theory). That understatement partially explains why there is still so much indecisiveness. Therefore, a closer look at Dawkins's position(s) over time might prove exceedingly invaluable toward understanding the topic of origins.

[141]Dawkins, *The Greatest Show on Earth*, 419.

[142]Richard Dawkins, "The Magic of Reality," US Book Tour (Eastern Kentucky University: October 6, 2011). Richard Dawkins paid a visit to Eastern Kentucky University to endorse his latest book *The Magic of Reality*. It was but one stop along a lengthy book tour that included dozens of campuses and locations across the United States. That particular engagement was staged at the Brock Auditorium of the Eastern Kentucky University campus at 7:30pm on October 6, 2011 – to which I made attendance.

CHAPTER 4

DAWKINS AND THE CLASSIC SOLUTION

Introduction

In his first book *The Selfish Gene*, Richard Dawkins set out to resolve some of the more challenging issues of animal behavior while promoting his own version of the somewhat incomplete "gene-centered" approach. It was a fully understandable move on the part of Dawkins given that he is an ethologist who had fully embraced the works of George C. Williams and W. D. Hamilton before him.[1] Moreover, in light of the state of the science in the mid-seventies, it seems reasonable why he showed little concern for the origin of life issue. Instead, he had steered his sights toward the more fascinating altruistic behavior of the animal world. Dawkins had become attracted to some of the more interesting macro level issues in ethology and how those issues might be affected by the biochemical arrangement found at the micro level. Standing on the shoulders of those earlier giants, he had sought to extend the work relating the genotype with its corresponding phenotype.

While focusing on his research, Dawkins paid little attention to philosophical issues or debate. When he entered the conversation, the scientific community had

[1]Richard Dawkins, *The Selfish Gene*, 2nd ed. (Oxford: Oxford University Press, 1989), viii. In the preface of this his revised first text, Dawkins readily acknowledged that former evolutionary biologists George C. Williams and W. D. Hamilton (alongside John Maynard Smith and others) were among the key individuals who had influenced him in his work on the selfish gene. Despite varying stances on a number of sub topics in regard to natural selection, including kin selection and group selection, these scholars paved the way toward a "gene-centered" view of biology. The 1989 or 2nd edition of this text contained no changes to the original text of 1976, but updated the preface and bibliography, added two chapters and inserted a set of endnotes.

already reached a relative point of consensus on the *origin of life*.[2] Unlike today, most scholars at that earlier time had generally accepted the prevailing view of the day. The independent models of Oparin and Haldane had already poured a foundation for what had become the *classic solution* for that vexing problem of the past.[3] Moreover, the experiments of Stanley Miller had solidified that solution with an additional layer of empirical evidence. Working under the guidance of Harold Urey, he had helped to substantiate that theoretically-based solution. Therefore, it had now become time to simply fill in the gaps for the solution while moving on to other ambitious problems.

The Prevailing View

Dawkins was trained in a time post Miller-Urey when the triumphant story of Charles Darwin had already found its way into the biological textbooks. Many of those texts of the sixties and seventies opened with the fateful story of Darwin on the *Beagle* before ending up with the excitement of Miller-Urey's chemical apparatus of 1953.[4] In the minds of most scholars, that solution offered the final resolution for the phenomenon of life. It had not only provided a model for theorizing the formation of the basic

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[2]The scientific community had reached a *relative* consensus on the origin of life at that earlier time. Few even questioned the "classic" prebiotic soup solution that had been widely accepted in most biology texts. But over time, support began to erode for this so-called "classic theory," creating a lack of consensus. This broad problem has attracted scholars from various disciplines to search for a prospective solution. To date, no consensus exists and no clear solution is in sight.

[3]Iris Fry, *The Emergence of Life on Earth: A Historical and Scientific Overview* (New Brunswick, NJ: Rutgers University Press, 2000), 82-83. As Fry notes, "Most of the studies in the 1950s followed the biochemical trend outlined by Oparin, focusing on the prebiotic synthesis of amino acids and their association to protein-like molecules."

[4]Example textbook references include popular biology books of the time. See Helena Curtis, *Biology*, 2nd ed. (New York: Worth Publishers, 1975), 1-23. The introduction and first chapter of this example text spans a considerable range of naturalistic discovery including Darwin's theory, the mechanistic view of Descartes, and Miller-Urey's experiment/apparatus. Similar references to Darwin and Miller-Urey may be found in numerous biochemistry texts as well: Donald Voet and Judith G. Voet, *Biochemistry*, 2nd ed. (New York: John Wiley & Sons, 1995), 18-24. Understandably, most of these later texts have added contemporary theories such as RNA World Theory.

chemicals of life, but it had actualized them in the laboratory as well. Therefore, most had accepted the idea that life had started through a *reducing atmosphere* on the primordial Earth. And that unique setting appears to have resulted in all the right ingredients that would have been necessary to form organic molecules over time – assuming the absence of oxygen.[5] Experiments had demonstrated that amino acids, purines, and nucleotides were all readily available given the right conditions. All that was needed was the perfect combination of chemicals, an energy source and sufficient time. Eventually, the first replicator would have surely come about – so it was thought.

However, several challenges to this classic solution caused it to diminish in lieu of several more popular models over time. Most importantly, the presence of oxygen at that earlier stage now appears more likely, which would have caused the atmosphere to be *oxidizing* rather than reducing.[6] Moreover, mechanical issues such as a faster rotational speed of that earlier Earth may have made it more difficult to provide the "warm, little pond" scenario suggested by Darwin et al.[7] These factors drove many

[5]It is a widely known fact that an oxidizing atmosphere would tend to inhibit the development of organic compounds (in contrast to a reducing or oxygen-lacking atmosphere). Alexander Oparin, to whom the basis of Urey's thesis toward a reducing atmosphere rests, was himself a biochemist who foreknew that a reducing atmosphere would be more conducive (if not utterly necessary) to abiogenesis.

[6]Though the earliest models assume a reducing atmosphere, a great many scholars in the study of origins have begun to question whether this was the case. Freeman Dyson has suggested that an oxidizing or at least partially oxidizing atmosphere appears more likely. See Freeman Dyson, *Origins of Life*, 2nd ed. (Cambridge: Cambridge University Press, 1999), 17. Whatever the case, the possibility of an oxidizing atmosphere must at least be accounted for. Francis Crick has addressed that scenario: Francis Crick, *Life Itself: Its Origin and Nature* (New York, Simon and Schuster, 1981), 79. Nonetheless, those who depend on a reducing atmosphere for their model of origins should reconsider their options. See Richard Dawkins*, The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution* (New York: Houghton Mifflin Company, 2005), 564 and idem, *The Greatest Show on Earth: The Evidence for Evolution* (New York, Free Press, 2009), 418. Also note the admonition of Stephen Meyer who concludes that "the only reason to continue assuming the existence of a chemically reducing, prebiotic atmosphere is that chemical evolutionary theory requires it." See Stephen Meyer, "Word Games," in *Signs of Intelligence: Understanding Intelligent Design,* ed. William A. Dembski and James M. Kushner (Grand Rapids: Brazos Press, 2001), 106.

[7]M. Cuk, and S. T. Stewart. "Making the Moon from a Fast Spinning Earth: a Giant Impact

scientists away from the classic theory and toward "some favored alternative."[8] As Dawkins had noted several years later, "Darwin's 'warm, little pond,' together with the witch's brew concocted by Miller that it inspired, are nowadays often rejected."[9] The chance event that a potent energy source (such as a lightning strike) would have hit at just the right place with just the right combination of chemical elements was already considered extremely rare even under the best of circumstances. Having this happen in the presence of oxygen and under tumultuous conditions would have pressed those odds back even further. However, at the time it was a *possibility* that was simply assumed.

Era of Optimism

By the sixties, few even questioned this classic solution to the origin of life. The relative success of Stanley Miller's work had naturally generated a number of follow-up experiments involving similar scenarios. It influenced Juan Oro's synthesis of adenine. In essence, these breakthroughs were interpreted as confirmation of the Neo-Darwinian paradigm. Moreover, they had ushered in an era of optimism for naturalism in general. Indeed, the synthesis of the remaining amino acids alongside several other molecular building blocks had built what appeared to be a fairly solid case for the origin

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Followed by Resonant Despinning," *Science* 338, no. 6110 (2012): 1047-52. Grossman provides a more generalized explanation: Lisa Grossman, "Fast-spinning Earth Settles Mystery of Moon's Make-up," *New Scientist* (2012). A general consensus within orbital mechanics indicates that the primordial Earth spun considerably faster than it does today. The greater angular velocity would have entailed substantial changes to the planet's early climate and geology. The faster rotation would especially affect the planet's meteorology, which would add to the tumultuous conditions caused by the heightened meteorite bombardment and surface heating. Darwin's "warm little pond" might have been more of an idealistic scenario than reality given this extreme backdrop.

[8]Dawkins, *The Greatest Show on Earth*, 419.

[9]Ibid. See also John Padgett, "Autocatalysis in Chemistry and the Origin of Life," *Working Paper Series*: Paper #2 (Chicago: University of Chicago Press, 2011): 2. Padgett agrees with Dawkins's comments on the trend away from Darwin's scenario. He suggests that "the placid and comforting image of Darwin's warm tidal pool as the physical locus for the first emergence of chemical life has been partly replaced (or at least augmented) in the current literature by violent volcanoes and thermal vents."

of life. As previously noted, many even speculated on the development of life in the lab.[10] Understandably, most scholars entrusted further research to eventually close the case given a little more time.

Meanwhile, the Catholic Church foresaw these developments in the early fifties as it began to flex a more open interpretation on the matter. In 1950, Pope Pius XII promulgated an encyclical on this particular issue. He officially declared that no conflict exists between the Catholic faith and evolutionary theory.[11] Conservative circles have interpreted this declaration as a concession of sorts that would inevitably draw a host of theological problems. Nevertheless, it was a move that would buttress the case for those who had already embraced a *theistic-evolutionary* stance toward the alleged conflict. Not surprisingly, the closely related Anglican and Episcopalian churches followed suit in declaring similar positions.[12] Ironically, that might have seemed like a welcome thing for Dawkins who had grown up Anglican. But his utter rejection of any and all religion rendered such endearment as unlikely.

The General Theory

In *The Selfish Gene*, Dawkins dedicated a full chapter on how life had allegedly begun. In setting up his more formidable discussion on altruistic behavior, he

[10]See chapter 2 of this dissertation in regard to the speculation of generating life in the lab.

[11]Pope Pius XII, *Encyclical Humani Generis: Some False Opinions Threatening to Undermine the Foundation of the Catholic Dogma,* Vatican: The Holy See (August 12, 1950). In this document, the papacy declared that no conflict exists between the Catholic faith and evolutionary theory. Obviously, that move affected both existing theology and biblical hermeneutics (especially Gen. 1-11 and the implantation of the human soul).

[12]Episcopal Church in The United States in America, Committee on Science, Technology, and Faith of the Executive Council, *A Catechism of Creation: An Episcopal Understanding* (2005). See also Anglican Church, *A Catechism of Creation: Part II* (2005). These catechisms take a similar position to that of the papacy. The compromise position of "theistic-evolution" has been supported by a number of denominations including the Anglican and Episcopalian churches. These churches have accepted the scientific argument for evolution while attempting to retain the basic tenets of their respective faiths.

offered a review of the same classic thought on the origin of life. He described the conditions on the surface of the Earth as a primeval soup, rich with the "chemical raw materials" needed for building organic molecules.[13] This abridged account of the process assumed that these building blocks had formed under "the presence of a few simple gases in the atmosphere and some volcanoes, or thundery weather."[14] Unfortunately, this scenario had been all too much a product of the times. The slow but sure development of Oparin and Haldane's respective models had combined with Miller's empirical success to promote this idea. The prevailing evidence had appeared beyond reproach. Nonetheless, the classic solution would steadily lose momentum. The immense gap separating non-life from life would not be easily traversed.

Initially, with his sights set on animal behavior, Dawkins had held close to the textbook answer on origins. But while reviewing his understanding of abiogenesis, he appears to have sidestepped the next generation of development. He explained that "under the further influence of energy such as ultraviolet light from the sun, they combined into larger molecules."[15] From this standpoint, the same source that had supplied the requisite energy in the first place was surely responsible for pressing those self-starters toward greater complexity. But that raises the question as to what explanation or process would actually account for the larger molecules. It had apparently become somewhat assumed that they "just did so" in the presence of incoming energy. However, that kind of assumption does not make for good science. Science demands solutions that are grounded on solid evidence and nothing less. As Dawkins himself had

[13]Dawkins, *The Selfish Gene,* 14.

[14]Ibid.

[15]Ibid., 15

put it (in quoting his friend Daniel Dennett), we need "some sort of cumulative ratcheting 'crane' as opposed to a 'skyhook.'"[16] In other words, science must be grounded in reality. It should never rely on dubious means. Applied to abiogenesis, science also demands substance behind the alleged process of building bigger molecules.

Meanwhile, as Dawkins finished explaining the process, much was still left undone to reach the astounding complexity of the so-called "replicators" of life.[17] Taken from the ideology developed by his esteemed predecessor W. D. Hamilton, he alluded to these little genetic powerhouses in terms of their unique ability to duplicate themselves.[18] Similar to his previous step, Dawkins had suggested that "at some point" in time, that "a particularly remarkable molecule was formed by accident."[19] Now despite the "exceedingly improbable" occurrence of such an event, it must be pointed out that he had expected that it had. Dawkins was certain of this because his naturalistic worldview required it. Nevertheless, given the brevity of his explanation, it is understandable that certain points might have been missed. However, the lingering question re-emerges as to whether there has been sufficient data available to fill in those gaps. What Dawkins had presumed in respect to this solution will be the focus of this chapter.

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[16]Richard Dawkins, *The God Delusion* (New York, Bantam Books, 2006), 99. The colloquial terms "crane" and "skyhook" were originally described by Daniel Dennett in his text *Darwin's Dangerous Idea.* See Daniel Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon and Schuster, 1995), 74-76. Along those lines, Dawkins had referred to "cranes" as a metaphor for theories based on reality, while "skyhooks" represented their imaginary counterpart for which no real basis or foundation exists.

[17]Dawkins, *The Selfish Gene*, 15. Chapter 2 of that text is entitled "The Replicators."

[18]W. D. Hamilton, "The Genetical Evolution of Social Behavior: Part II," *The Journal of Theoretical Biology* 7 (1964): 17-52.

[19]Dawkins, *The Selfish Gene,* 15.

Dawkins's Selfish Gene

In returning to his initial studies, the specifics of Dawkins's thinking should become clearer. He had selected the perfect title to his first book as it was indeed about the "selfish gene." Coming from his gene-centered approach to biology, it should be understandable why he allocated the bulk of his work toward some of the more pressing challenges of animal behavior. Ethologists have grappled for years over the various behaviors observed in the animal world ranging from symbiotic relationships to those involving pure conflict. How instinct is to be understood, how sexuality developed, and how groups survive together are but a few of the questions attracting Dawkins's attention. More specifically, many have pondered the effects of genetics in these behaviors over and against the learned behavior of life. From this standpoint, a number of additional questions have surfaced. For instance, what part does the genome play in the life of its corresponding phenotype? How would the genome actually affect its behavior? How far does that relationship extend? These are some of the more pressing issues that Dawkins attempted to address.

This gene-centered approach fits perfectly with Dawkins's worldview. It is *reductionist* in the sense that it breaks down the phenotype of any complex organism into its constituent parts.[20] The theory demands that the directing core of the system be the genome itself. But like other Cartesian systems, it is essentially just one more mechanistic system. In this case, that system is biology. From Dawkins's perspective, the phenotype is merely a materialistic product of its genes. Therefore, it can be broken down much like any other system.

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[20]Phillip Johnson, *The Wedge of Truth: Splitting the Foundations of Naturalism* (Downers Grove, IL: InterVarsity Press, 2000), 106. As Johnson points out, Dawkins not only advances reductionism, but he does so from genes to human behavior.

Daniel Dennett demonstrates his support for this type of thinking in his defense of Dawkins. Having drawn criticism from his anthropomorphic title (i.e., the "selfish" gene), Dawkins seems to have found himself under attack. Some critics had equated that title to mean more than its author had intended.[21] But in Dennett's view, terms like "selfish" could have been equally applied to just about anything that lacks real personhood (like a gene), just as these terms have been arbitrarily used in reference to complex organisms such as ourselves. As he sharply concluded, "people are made of nothing but atoms and atoms are stupid."[22] Therefore, if humans are mere hunks of flesh that could be theoretically broken down into their fleshly parts (and then further reduced to their molecular and atomic arrangement), then why would it be any more appropriate to describe them as selfish, angry, or otherwise? Why not simply extend the same set of adjectives to the genes even though they too are nothing more than the grouping of atoms/molecules?

Dawkins on Altruistic Behavior

In writing *The Selfish Gene,* Richard Dawkins was attempting to lend support for the gene-centered model which describes how the associated genotype of an organism affects its corresponding phenotype. But in doing so, he faced several complex issues including the development of sex and the balance between conflict and the altruistic behavior among individuals and their groups. Six years later, he continued that same

[21]Alan Grafen and Mark Ridley, eds., *Richard Dawkins: How a Scientist Changed the Way We Think* (Oxford: Oxford University Press, 2006). In response to those who did not appreciate Dawkins's title, *The Selfish Gene*, several colleagues and friends offered their support. His ex-wife Marion Stamp Dawkins and fellow New Atheist Daniel Dennett, among others, each discussed the content and impact of the text as well offering a defense for its controversial title. See within this same reference text Daniel Dennett, "The Selfish Gene as a Philosophical Essay," 101-15; and Marion Stamp Dawkins, "Living with the Selfish Gene," 45-49.

[22]Dennett, "The Selfish Gene as a Philosophical Essay," 109.

theme in his second book *The Extended Phenotype* (1982).[23] Therein he attempted to demonstrate how the organism's genome affects not only the behavior and instincts of the organism but its surrounding environment as well. Dawkins had previously developed this idea of a more culturally-oriented replicator in referring to the *meme.* In short, that term describes the imitating element of human behavior as more broadly interpreted through social groups. Examples might include "the form of words, music, visual images, styles of clothes, facial and hand gestures" and so on.[24] Dawkins described the meme as the replication of behavior observed in social structures. In this way, he envisaged the control of the gene to extend well beyond the physical makeup of the associated organism and on to its behavior, instincts, and social constructs as well. These extrapolations are important, for they serve to further illustrate his worldview.

In following how this gene-centered model explained various phenomena in the animal world, Dawkins had taken his readers on a trail of replicators, genesmanship, and associated strategies. While at one end of the spectrum, he details the molecular level of physics and biochemistry (the gene), the other end engages civilization and the environment (the meme). These two extremes serve in identifying the respective realms of this worldview.

Dawkins's Position on the Study

Dawkins's approach to this relationship between genotype and phenotype comes perilously close to a form of *determinism*. Though he has openly denied this stance, he readily admits that the genes control certain behaviors in their respective

[23]Richard Dawkins, *The Extended Phenotype: The Long Reach of the Gene,* 2nd ed. (Oxford: Oxford University Press, 1999).

[24]Ibid., 109.

phenotypes.[25] This ideology is precisely what the bulk of both *The Selfish Gene* and *The Extended Phenotype* are all about. These texts portray many of the altruistic behaviors and instincts found in the animal world in terms of how their genes influence "the tendency or capacity to perform that behavior pattern."[26] But at the human level, Dawkins insists that we hold the capacity to override the gene controlling behavior of our DNA. There is a fundamental, underlying behavior therein, which he believes we can learn to overcome. As Craig notes, despite Dawkins's pessimistic attitude toward life and purpose, good and evil, "he is a patent moralist."[27] Dawkins insists that our higher development is "better equipped to escape, so that we are better equipped to use our big brains, use our conscience intelligence, to depart from the dictates of the selfish genes."[28] In other words, because we have larger brains, we now possess the judgment and reasoning (beyond tooth and claw) to enact a better world that is essentially *anti-Darwinian*. In essence, Dawkins is suggesting that the human race can rise above its natural instincts and behaviors that are riddled with Darwinian tendencies. It must, if it is ever to become a more civilized world.

Correspondingly, one might better understand why Dawkins has argued so vehemently against the alleged constraints of computer programming (e.g., computer

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[25]Public Broadcasting Service, "Interview with Richard Dawkins," *Reason and Faith*, 1996. http://www.pbs.org/faithandreason/transcript/dawk-body.html (accessed September 2, 2013). Dawkins denies that the "selfish gene" model is "fully deterministic." He further claims that this "doesn't mean we have to behave as if we are determinists" – implying that people can willfully grow beyond the Darwinian "tooth and claw" of our ancestry.

[26]Dawkins, *The Extended Phenotype*, 19.

[27]William Lane Craig, *Reasonable Faith: Christian Truth and Apologetics*, 3rd ed. (Wheaton, IL: Crossway Books, 2008), 80-81.

[28]PBS, "Interview with Richard Dawkins," 1996.

chess).[29] He insists that this same debate, which pits determinism against free agency, is somewhat analogous to the gene-centered approach to organisms.[30] The latter is simply more complex as it crosses the elusive *line of consciousness*. Should we trust that consciousness is just some arbitrary point in the intelligence of a system that propelled it to develop free will? Dawkins has alluded to that question of consciousness as one of the three most intriguing questions of biology – assuming that biology is the appropriate discipline to query.[31] Furthermore, how his reductionist position correlates to deterministic behavior remains an open question. But Dawkins had bypassed this broader argument in lieu of how the gene-centered model affects natural selection. He would rather leave most of the macro-level matters to the sociobiologists, though he has delved into that area through his concept of "the meme."

Philosophical and Scientific Assumptions

During his study of the selfish gene (and related material), Dawkins has made a number of controversial assumptions that need further explanation. For instance, he has not only challenged the limits of probability and simplicity, but the scope and constraints of information content as well. For instance, his solution and repeated public declaration of what was considered "junk DNA" in the human genome has clearly defined his stance in this still largely unknown realm. Alongside others, he had mistakenly rendered the vast majority of the human genome to be worthless material. Despite that conclusion, this "fact" has been overturned in recent times due to the cooperative effort of a large

[29]Dawkins, *The Selfish Gene*, 51-54.

[30]Ibid., 54ff.

[31]Richard Dawkins, "Richard Dawkins Answers Reddit Questions," *The Richard Dawkins Foundation: For Reason and Science* (November 14, 2010) http://old.richarddawkins.net/videos/547385-richard-dawkins-answers-reddit-questions (accessed August 12, 2013).

body of researchers. Ironically, Dawkins was correct in admitting that "nobody understands the whole picture"[32] (i.e., about the complex workings at the micro level). Moreover, he rightly acknowledged that the first replicator would have been "many orders of magnitude more improbable than most people realize."[33] But despite these astute biological conclusions, he has also made certain other assertions on questionable grounds. As Dembski has summarized it, "evolutionary biology must place a premium on rigor" and that "the just-so stories of Richard Dawkins will not do."[34]

First, consider Dawkins's train of thought in regard to *probability*. As will be demonstrated in chapter 6 of this dissertation in regard to panspermia and the probability of life elsewhere, here he appears to skirt the lines of evidence. In this case, he makes the seemingly innocuous assertion that the first replicator "only had to arise once."[35] Now, though it should be perfectly clear what he implied by this statement, would a naturalistic-based origin of life need but one chance? Would that assertion be accurate? It might be more properly expressed through the following interpretation: (1) that a *fully successful replicator* "only had to arise once" (2) *given the right conditions for it to survive* (does not go extinct), (3) *that it persists in the upward movement toward greater complexity* (and hence, channel its development toward other, more advanced replicators), and (4) *that the ensuing chain of replicators do not themselves go extinct.* In other words, even if a replicator were to defy the nearly impossible odds of coming into existence, it must necessarily traverse several formidable obstacles before the implied

[32]Dawkins, *The Greatest Show on Earth*, 250.

[33]Dawkins, *The God Delusion*, 162.

[34]William A. Dembski, *Intelligent Design: The Bridge Between Science and Technology* (Downers Grove, IL: Intervarsity Press, 1999), 182.

[35]Dawkins, *The Selfish Gene*, 15.

conditions could be considered plausible. It appears somewhat overly simplified to make such a broad, sweeping statement in light of the inherent complexities involved in the generation of that first replicator, much less the survival and ensuing progress of its offspring replicators.

Has Dawkins been consistent in his assertion? As he readily admits, the generation of the first replicator would not only defy all odds in and of itself but should be considered "particularly remarkable" in its emergence.[36] But such a statement appears to contradict several of his other comments on the origin of life. Speaking of the molecules that might produce such emergence, he claimed that it is "*easy* then to think of them joining up to form a stable chain just as the formation of the original replicator."[37] Moreover, how does such a *remarkable* event coincide with an "existence [that] need imply *only* the presence of a few simple gases" (italics mine)?[38] These comments sound contradictory. But these are the comments of Dawkins in regard to the assimilation of pre-emergent molecules. His analysis may often be more a product of worldview than the scientific rigor expected by Dembski. Correspondingly, it would appear that Dawkins's intense devotion toward a naturalistic worldview combined with his passionate zeal for communicating that worldview causes him to make certain unsubstantiated conclusions. His individual calling for the public understanding of science has often led him to promote ideas that have either not been fully addressed or are pressed beyond what has been established.

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[36]Ibid.

[37]Ibid.

[38]Ibid., 14.

Nonetheless, it is a fundamental flaw of logic to assume a certain probability without adequate support. Probabilities, percentages, and related mathematical formulations depend on *real* calculations regardless of whether their solution is to be construed as exact or approximate. Though it is conceded that certain areas of mathematics including: the digital output of a non-linear equation, a typical engineering application, or probability/statistics (to name but a few examples) moves somewhat away from a strictly, "exact" science, even these examples imply or depend on a certain "exactness" in their mathematical interpretation of reality.

Therefore, if we were to assume that a replicator arose at some point in time through a purely naturalistic process, how are we to know that it would survive for any length of time? What if this astronomically improbable event finally occurred, only to dissipate before its first replication? What if that first replication resulted in a mutation of sorts – the likes of which could not endure the harsh conditions of that primordial Earth? Whatever the case, no one knows how many of these extreme rarities would have had to occur for life to arise naturally.

Second, consider Dawkins's expectation that the first replicator had to be *simple*. He began touching on this facet of the problem in *Climbing Mount Improbable* (1996) wherein he wrote that the presumed first replicator must have been "simple enough to arise by the spontaneous accidents of chemistry."[39] In other words, a more complex replicator might have been out of the reach of the perceived physiochemical potential. He went on in that same context to distinguish the magnitude of that simplicity

[39]Richard Dawkins, *Climbing Mount Improbable* (New York: W. W. Norton and Co, 1986), 285.

as something much simpler than any life form known to date.[40] Then, eight years later, he returned to this same discussion in claiming that the first replicator "must have been a forerunner of some kind" (i.e., implying a forerunner to modern DNA).[41] Taken together, these statements help clarify the level of simplicity that he has envisioned.

In sum, Dawkins believed this entity to be simple enough to arise through the natural dynamics of physics and chemistry, be considerably simpler than any known bacterium known today, and be a forerunner to modern DNA. But this lower level of physical-chemical simplicity is more of a product of worldview than science. Undoubtedly, a simpler first replicator would improve the odds for Dawkins. It would make for an easier molecular trail of increasing complexity. In other words, the extremely rare event would suddenly become a little less extreme. But how do we really know this? Is it merely Dawkins's expectation that it turn out this way? Though it would certainly have the effect of somewhat narrowing the gap (i.e., in this case from the "top-down"), what evidence exists to support such an assumption?

The argument from simplicity has been a historic one dating back to antiquity when little was known about the complexity of life. Even Darwin had envisioned a living cell as having little more than a membrane and a nucleus. Ernst Haeckel and Max Schultze had referred to it as both "a blob" and/or globule "of protoplasm."[42] But science

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[40]Ibid., 286. Dawkins concluded that "the first replication machines – the first robot repeaters – must have been *a lot simpler than bacteria*" (italics mine).

[41]Dawkins, *The Ancestor's Tale*, 567.

[42]Max Schultze, "*Uber Muskelkorperchen und dass was Man eine Zelle zu Nennen Habe,"* im *Archiv fur Anatomie, Physiologie, und Wissenschaftliche Medicin* ("On Corpuscles and That Which Man has Called a Cell," in The Archive for Anatomy, Physiology, and Wissenschaftliche Medicine) (1861): 1-27. See also Ernst Haeckel, *Generelle Morphologie der Organismen: Allgemeine Grundzüge der Organischen Formen-Wissenschaft, Mechanisch Begründet Durch die von Charles Darwin Reformirte Descendenz-Theorie* (General Morphology of Organisms: Basic Course on Organic Forms Science,

has become much more aware of the cell's complexity through the advancement of technology. Leeuwenhoek could hardly have imaged the intricate detail of the scanning and electron microscopes of today.[43] Thus, what had appeared to be something of relative simplicity has exceeded the imagination. Darwin would have been in awe. The living cell is more likened to the complexity of a major city. "Cells are complex structures" that incorporate an amazing tapestry of highly specialized organelles, which in turn, orchestrate the transfer of information, energy, and necessary materials thousands of times each moment.[44] It is nothing less than a wonder of engineering complexity in and of itself.

Michael Behe has become well-acquainted with this particular subject. His theory of *irreducible complexity* argues that the intricate exchange(s) within the living cell requires certain pieces to be in place before it can become functional. Like a mousetrap, it requires that the organization of the individual components be in place before it can work.[45] Behe's theory has encountered strong opposition from naturalists like Dawkins who recognize the implication of design.[46] This minimum of complexity

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Mechanics Established on Charles Darwin's Theory of Descendence): 1866. Reprinted in English (Boston: Walter de Gruyter). Both of these scholars had described the living cell in terms like "protoplasm." Schultze specifically called it as a "blob of protoplasm," while Haeckel used either a "globule of protoplasm" or a "germ and protoplasm" – classic descriptions of a cell given the technology of the day.

[43]Dutch scientist Antonie van Leeuwenhoek (1632-1723) was a key leader in developing the early microscope.

[44]Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Simon & Schuster, 1996), 102.

[45]Ibid., 42-43. Behe uses the analogy of an ordinary mousetrap to illustrate how molecules and/or organic systems are irreducible when they reach a point in which the functionality is lost with any further reduction. The components of a mousetrap reflect a similar minimum in that only the essential components remain. Correspondingly, the loss of any given part renders the whole system as nonfunctional.

[46]Dawkins, *The God Delusion*, 156-9. In addition to this brief rebuttal of Michael Behe's

would naturally entail some level of infused intelligence. Notwithstanding such debate, Behe makes a strong case for the inherent complexity of this and every other living cell. The detailed examples he cites present a formidable challenge to classic gradualism.

Moreover, the simplest known living (i.e., non-viral) organisms sporting the shortest DNA are still relatively enormous in contrast to the largest of molecules yet produced from the "bottom up." Examples of these include *carsonella ruddii*, *nanoarchaeum*, and *mycoplasma gentialium*. With these *non-viral* organisms still weighing in at 160, 490, and 580 *kilo*-base pairs respectively, it is exceedingly difficult to entertain the successful bridging of such a wide gap considering the difference between their complexity and the much smaller molecules produced in the lab.[47] Despite the efforts of many within "origin-of-life research [who are] constantly lowering the bar for what may count as first life," the difference is substantial.[48] Furthermore, no evidence exists of a smaller organism in the distant past. Dennett admits that the "long period of

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work, Dawkins has launched similar challenges toward related sources/subjects through other venues. One of these targeted Hitching's *Neck of the Giraffe*. S*ee* idem, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design, 2nd ed.* (New York: W. W. Norton and Company, 1996), 86-87 and Francis Hitching, *Neck of the Giraffe* (Boston: Ticknor and Fields, 1982). Another of his rebuttals targeted Behe's *The Edge of Evolution*. See Richard Dawkins, "Inferior Design," in *The New York Times* (July 1, 2007) and Michael Behe, The *Edge of Evolution*: *The Search for the Limits of Darwinism* (New York: Free Press, 2007).

[47]J. Craig Venter Institute, "Mycoplasma Laboratorium" http://www.saylor.org/site/wp-content/uploads/2011/06/Mycoplasma-laboratorium.pdf (accessed February 3, 2014). The data available through this website depicts the three examples above alongside several neighboring species. The table provided on this site yields the corresponding *number of genes* of these exceedingly small organisms: Candidatus carsonella ruddii PV – 182 genes; Nanoarchaeum equitans Kin4-M – 540 genes; and Mycoplasma gentialium G37 – 475 genes, respectively. These correspond to the *number of base pairs* listed above. These organisms entail several hundred thousand base pairs each, which is relatively enormous in contrast to the amino acids and nucleotides developed in the lab. Even viruses, which are not normally accepted as life forms are rather large in comparison. The smallest of viruses still range from between 3 and 5 thousand (kilo) base pairs.

[48]William A. Dembski and Jonathan Wells, *The Design of Life: Discovering Signs of Intelligence in Biological Systems* (Dallas: The Foundation for Thought and Ethics, 2008), 246.

pre-cellular evolution has left no fossil traces."[49] But Dawkins has consistently argued that a simpler organism must have existed at some earlier time, for the potential for bridging the gap requires it. Though no evidence exists to indicate that this was the case, it still fits that which would support his position.

Third, Dawkins has mistakenly extrapolated DNA and its information content to fit his worldview. For the last few years, he has openly declared a connection between the alleged "junk DNA" within the human genome and the evolutionary paradigm.[50] This most recent move of Dawkins has followed a gradual sense of confidence he has projected in what science allegedly "knows" about this complex subject. In addition to several talks, debates, and writings in this area, perhaps the most telling comes from one his more recent texts. In *The Magic of Reality*, he declared the victory of science over DNA in what we now know.[51] But even Francis Crick readily admits that it is "the resulting complexity that makes biological organisms so hard to unscramble."[52] Much more so is the most complex genome known to man. With some three billion base pairs per strand of human DNA, the inherent complexity is simply overwhelming.

Notwithstanding such awesome complexity, it had been thought for decades that the vast majority of the human genome contained only *junk DNA*. More specifically, the portion of the genome that is mostly made up of *introns* (or non-coding DNA) was

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[49]Dennett, *Darwin's Dangerous Idea*, 159.

[50]Richard Dawkins, "Richard Dawkins: The Greatest Show on Earth," *Berkeley Arts and Lectures*, University of California Berkeley (October 7, 2009). See also idem, "Richard Dawkins Answers Reddit Questions," (accessed August 12, 2013); and Richard Dawkins and Howard Condor, "The Interview," *Revelation TV* (March 10, 2011).

[51]Richard Dawkins, *The Magic of Reality: How we Know What's really True* (New York: Free Press, 2011), 17. Dawkins assert that we now "know this, and *we know exactly* how DNA works, thanks to James Watson and Francis Crick, plus a lot of other scientists who came after them" (italics mine).

[52]Francis Crick, *What Mad Pursuit: A Personal View of Scientific Discovery* (New York: Basic Books, 1988), 5.

believed to have no function at all. That portion represents some ninety-eight percent of the total DNA of each human cell.[53] Dawkins compared these relatively unknown pieces of DNA to some of the old data that one might find off the "surface of an old disc."[54] Dawkins referred to this part of the code as "nonsense" (i.e., the introns) over and against the "fragments of 'sense'" which are better known as exons.[55] These latter elements of the DNA sequence are known to be vital to the life of the organism as they direct the biochemical transactions within the cell.

Where Dawkins has moved beyond observation to speculation is how he made this understanding a part of his evolutionary worldview. Dawkins has taught that the introns are either a "fossil gene" of the past or some other extraneous material that is no longer used.[56] He had rendered them as "useless" pieces of DNA that are nothing more than remnants of the evolutionary past. Rather than data that would befit the current individual, he has openly declared it as formerly used DNA from prior ancestry.

Dawkins has made this position clear in a number of his texts, lectures, and discussions. Even in his earliest text, he wrote of the "surprising" phenomenon of "DNA which does no such thing."[57] He contrasted the "meaningless introns" against the more useful exons that did all the work. He specified further that "the simplest way to explain the surplus DNA is to suppose that it is a parasite, or at best a harmless but useless

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[53]Richard Dawkins, *A Devil's Chaplain: Reflections on Hope, Lies, Science, and Love* (Boston: Houghton Mifflin, 2003), 99. "How much [DNA] is actually used" Dawkins asks? Herein he claims that "in the case of the human genome it is about 2 per cent" – leaving some 98% to the "junk DNA."

[54]Dawkins, *The Blind Watchmaker*, 174. Herein Dawkins compares the so-called junk DNA to an old computer CD/DVD that had retained much formerly used (but now useless) information. By this analogy, he is suggesting that the now useless information is evidence of the evolutionary past.

[55]Ibid.

[56]Ibid.

[57]Dawkins, *The Selfish Gene*, 45.

parasite, hitching a ride in the survival machines created by the other DNA."[58] Upon entering the discussion, Dawkins had already accepted the status quo on the matter. In his mind, it was evident that the vast majority of the genome was nothing more than "a parasite" that had no contribution or function whatsoever.

Dawkins continued along this same line of thought for the next three decades in adding remarks here and there about the worthlessness of junk DNA. He explained in *The Extended Phenotype* how a "large percentage of the DNA in eukaryotic genomes is never translated."[59] Similarly, that would imply that the bulk of the genome has no relative function. But in saying this, he was attempting to ridicule the creationists for believing in a god who would unwittingly "bother to litter [the] genome with untranslated pseudogenes and junk tandem repeat DNA."[60] As Dawkins saw it, science had already proven beyond any reasonable doubt that most of the information contained in the cell was mere clutter. And what "god" would design such a thing? In essence, he was formally challenging the existence of an intelligent designer who would riddle the very core of his own created complexity with useless "pseudo-genes."

Over the past few years, however, Dawkins had escalated this affront to an outright attack on creationism. Again, he had formally conjoined the existence of the alleged junk DNA with the evolutionary paradigm. In a series of interviews and discussions leading up to 2011, he resurrected this issue in order to project his assertion. But he had now gone from a position of accepting the "fact" of junk DNA to that of

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[58]Dawkins, *The Selfish Gene*, 45.

[59]Dawkins, *The Extended Phenotype*, 157.

[60]Dawkins, *A Devil's Chaplain*, 99.

developing his own interpretation on the matter. In doing so, he had moved from a position of relative observation to one of declaration and dogma.

In 2009 he spoke at *The Berkley Arts and Lectures* in regard to this issue and in his text *The Greatest Show on Earth*. He described this part of the genome as evidence of "a perfect hierarchy [or] perfect family tree."[61] What had been more or less implied had now become defined through his commentary. He was declaring that the alleged junk DNA was the obvious remnant of a series of former ancestries that are no longer used. He referred to them as "vestigial relics" of the past.[62] Dawkins had come full circle to the point of *knowing* that the human genome had been totally resolved and that the vast majority of it represented clear evidence of an evolutionary past. Moreover, he had also declared that this fact is the strongest evidence in support of the evolutionary paradigm – that is, the taxonomy and hierarchal structure of DNA.[63] Therein Dawkins had publically declared that the structural similarity of DNA is the most powerful evidence for his argument. He had also taught that this correlation between human DNA and evolution has been a substantiated fact. His interviews with *Reddit Questions* in 2010 and then again with *Revelation TV* in 2011 further confirm these public assertions.[64]

However, a dramatic change occurred in September of 2012 as a result of a groundbreaking study by the National Human Genome Research Institute. Working on phase II of a massive, collaborative effort intended to map out the human genome (i.e.,

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[61]Dawkins, *Berkeley Arts and Lectures*, 2009.

[62]Ibid. Dawkins claimed that this part of the genome (formerly known as junk DNA) "don't do anything but are *vestigial relics* of genes that once, that once did something" (italics mine).

[63]Ibid.

[64]Dawkins, "Richard Dawkins Answers Reddit Questions," 2013. See also Dawkins and Condor, "The Interview," 2011.

the technology developmental phase), this collective group of experts discovered that at least eighty percent of the "junk DNA" is not useless at all but plays an essential part of the overall functioning of the cell. In a work that has spanned roughly a decade, these four hundred plus scientists from thirty two institutions made tremendous strides toward unraveling the mysteries of the human genome. The massive project called ENCODE, recruited geneticists from MIT, Harvard, Stanford, and twenty-nine other organizations to unravel the complex workings of the human genome. Surprisingly, they uncovered clear evidence of widespread participation from the "vast majority" of the DNA including the "assign[ment] [of] biochemical functions for 80% of the genome."[65] In other words, the bulk of human DNA is indeed essential to the genome's functionality.

The ramifications of this study can hardly be underestimated. ENCODE's findings have rendered the former assumption about DNA as a relic itself. Alongside the rest of the scientific community, Dawkins had underestimated the information content of the human genome. Though science has had to adjust to this new discovery, it would seem Dawkins must accept the consequences of overly extrapolating the presumed data. The connection between junk DNA and evolution was relegated as an oversight.

Surprisingly, Dawkins still found a way to deflect the blame back on the creationists. In an interview at BBC's *RE: Think Festival 2012* (one week after the study), he was asked about what he thought about the new findings.[66] In discussing the matter with Chief Rabbi of UK Jonathan Sacks, he retorted that it was the "creationists

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[65]The ENCODE Project Consortium, "An Integrated Encyclopedia of DNA Elements in the Human Genome," *Nature* 489 (2012): 57-74.

[66]Richard Dawkins and Chief Rabbi of the UK Jonathan Sacks, "Rethinking the Science Versus Religion Debate," *BBC RE: Think Religion and Ethics Festival 2012,* Salford, UK (September 12, 2012).

who think it is awkward." Indeed, that is the kind of thing that every "Darwinist would hope for."[67] Dawkins continued to deflect the blame in talking about how the issue "had previously been written off" as if he himself had not done so.[68] But anyone who has kept track of Dawkins's commentary on the matter realizes that this was a side step on his part to avoid the burden of error. He had publically written off that massive part of the human genome as nothing more than "a vestigial relic."[69] Moreover, it was he who built the case for it *being evidence of the evolutionary paradigm*.

The Assumed Process for Origin of Life

Despite the aforementioned presumptions, there are several other more problematic ideas that serve as the very basis for Dawkins's argument on abiogenesis. These concepts will serve to broaden the picture of how he believes life got started. This following section, therefore, will demonstrate Dawkins's reliance upon (and declaration of) his prevailing evolutionary framework. It entails a questionable extrapolation of the second law of thermodynamics, an assumed self-organizing property in matter, an unsubstantiated accumulation of information and complexity, and a tangential sub-component of natural selection he calls "cumulative selection."

Entropy and the Second Law

One of the more foundational issues of the entire process involves the laws, transfer, and conversion of available energy. Given that no upward movement toward complexity could even be possible without some energy source, it is agreed that life's

[67]Ibid.

[68]Ibid.

[69]Dawkins, *Berkley Arts and Lectures*, 2009.

close proximity to a star would ultimately be required.[70] In the case of our own terrestrial development of life, that source would naturally be the Sun. Science has well established that the basis for that energy is the ongoing exothermic process by which a massive amount of hydrogen is being slowly converted into helium. And that process of *fusion* furnishes the requisite energy for our world.

Nevertheless, it should be equally born in mind that the Sun is not necessarily the immediate or local source of energy in every situation. Heat from the inner core of the Earth, the kinetic and/or chemical energy offered by meteorites, and deposits of nuclear material are among several alternatives. Indeed, the subsurface energy required by Thomas Gold's "deep, hot biosphere" provides a classic example of alternative energy.[71] But despite certain exceptions, the Sun has functioned as the foundational source for the Earth's energy since its onset. Dawkins rightly recognizes this exception in noting that "there has to be some kind of external source of energy, but it doesn't have to be the sun" – though he equally recognizes it as the "primary source of outside energy."[72] What really matters here is that there is some "throughput of energy" provided for the terrestrial system.[73] For any living system must necessarily be an *open system* – thermodynamically – due to implications imposed by the second law.[74]

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[70]The heat given off through the exothermic chemical reaction inside of stars has been well established as the primary source of energy for the corresponding planets of those systems. Not only does the production of helium inside of our own Sun provide the bulk of the Earth's energy, but supernovae are theorized to be behind the assimilation of larger, more complex elements to begin with.

[71]Thomas Gold, *The Deep Hot Biosphere: The Myth of Fossil Fuels* (New York: Springer-Verlag, 2001). Gold's model taps not only another form of energy, but an eventual modified alternative to the classic solution itself.

[72]Dawkins, *The Ancestor's Tale*, 558.

[73]Padgett, *Autocatalysis in Chemistry and the Origin of Life*, 5.

[74]A thermodynamically open system is absolutely essential to any prospective evolutionary

As Dawkins points out, many critics have unwittingly challenged the prospect of abiogenesis on the grounds of it potentially violating the second law of thermodynamics.[75] Unfortunately, those critics have mistakenly missed a crucial component of that law in thinking that systems must *always* move toward disorder because of the inherent nature of entropy. Though partially right, they have failed to account for *open* systems, which in contrast to *closed* systems, will actually allow the exchange of work, heat, and/or mass to cross their boundaries. Open systems can conceivably obtain certain "localized pockets" of low entropy that somewhat buck the natural trend by way of this *throughput energy*, and hence, achieve areas of "uphill" potential.[76] Now to their credit, these critics have rightly recognized the general trend found in all these systems (open or closed), as the forces of nature continue to obey the second law. The natural tendency toward disorder remains the prevailing current throughout the universe. Life, however, enjoys a kind of special case in light of the second law in that it persists in those localized pockets of *relatively low entropy*. In abiding with this energy flow, every living organism must acquire its energy from the surrounding environment.[77] Either it must receive it *directly* through photosynthesis or *indirectly* through the ingestion and ensuing breakdown of molecules from other

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model because a correspondingly closed system cannot permit a decrease in entropy. Because increased complexity entails lower entropy, the second law would forbid that latter case. Only an open system would avail the necessary throughput of energy from the Sun to engender the necessary chemical reactions on Earth. Therefore, an open system provides the only viable option for evolution because its permeable boundaries allow for the exchange of work, heat, and mass with the surrounding environment. The presumed endothermic reactions for building complex macromolecules would naturally require the acquisition of outside energy to be theoretically possible.

[75]Dawkins, *The Blind Watchmaker*, 94.

[76] Padgett, *Autocatalysis in Chemistry and the Origin of Life*, 5.

[77]Ibid.

organisms. The latter would still ultimately depend on the energy from plants, algae, and other photosynthesis-dependent organisms that had previously taken energy from the Sun. Without this throughput energy, the respective organism would eventually die and revert back "to a state of equilibrium with its environment."[78]

This seemingly reverse response to entropy is the remarkable characteristic of life that enables it to subsist. The information contained in DNA takes full advantage of the energy of this thermodynamically open system to orchestrate its chemical processes from within and from without. But recall that as we work down the chain of life, we eventually encounter the mechanism that directly enables the absorption of the Sun's energy. That process of photosynthesis "traps photons and uses them to drive 'uphill' energy-consuming reactions."[79] But this exceedingly complex process, like all of life, only thrives in a low entropy state against the second law and it only does so through the structure and instructions already present in the system. Each organism utilizes its own internal instructions to survive in this low entropy state – feeding off the energy from its surroundings and depositing (exchanging) its entropy.[80] But how did those systems get started? And how far can the natural tendency of the second law be pressed?

Going Against the Second Law

Historically, many scholars had thought that life had some unexplained ability to get around the second law. Moving beyond the archaic beliefs of spontaneous generation and the like, they could still not resolve how life could reverse the natural

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[78]Dawkins, *The Blind Watchmaker*, 9-10.

[79]Ibid., 94. See also Dawkins, *The Greatest Show on Earth*, 375-77.

[80]Padgett, *Autocatalysis in Chemistry and the Origin of Life*, 5.

inclination toward disorder. As Paul Davies points out, several prominent scholars even thought that life might be unaffected by entropy. Physicist Hermann von Helmholtz was one of those who thought that "life somehow circumvent[ed] the second law."[81] Had there been some unknown aspect of the law yet to be realized? Even Erwin Schrodinger struggled with how the living cell could "produce events which are a paragon of orderliness."[82] He thought that there was some underlying "physical law prevailing in it."[83] Davies suggests that Schrodinger did not think that "the second law [applied] to living matter."[84] Whatever the case, the inherent bias of these statements is obvious. Somehow the concept of abiogenesis was believed to continue regardless of the effects incurred by the second law. But there is also no *perpetual motion machine* in the universe.[85] All systems must eventually pay the price demanded by the second law in the form of heat, friction, disorder, and chaos. Like the ever present challenge of accelerating upward in a gravitational field, so must any movement toward complexity face the ubiquitous propensity toward disorder.[86] In *Genesis: The Quest for Life's*

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[81]Paul Davies, *The 5th Miracle: The Search for the Origin and Meaning of Life* (New York: Simon & Schuster Paperbacks, 1999), 52.

[82]Erwin Schrodinger, *What is Life?* (Cambridge: Cambridge University Press, 1967), 79.

[83]Ibid., 80.

[84]Davies, *The 5th Miracle*, 52.

[85]A perpetual motion machine is a fictional mechanism that assumes perfect efficiency. Such a mechanism would theoretically incur no loss due to heat or friction. It is limited to an ideal because it can never be achieved in real practice due to the demands of the first and second laws of thermodynamics (i.e., the conservation of energy and the entropic nature of the exchange of energy within a system). The comparison above implies the inherent difficulty in moving against the natural course of entropy – especially to the degree demanded by certain models.

[86]The above comparison of entropy and gravity is provided as an analogy. Like gravitation, there exists a consistent "pull" (or tendency) in a system, thermodynamically, toward greater entropy or disorder. Any attempt to defy gravitational forces is impossible as it must be accounted for. Likewise, entropy must be accounted for as it is ever present in the form of inefficiencies: heat, friction, etc.

Origin, geophysicist Robert Hazen entitled his first chapter "Against the Tide" for that very reason.[87] In reference to the alleged emergence of life, he suggested that there simply must be some physical law tied to the special case of life that he calls "the missing 'law of emergence.'"[88]

Richard Dawkins is correct in saying that the second law of thermodynamics has neither been violated nor circumvented in regard to the naturalistic explanation of abiogenesis. That process would depend on a thermodynamically open system. He has rather embraced the fact that this counter against increased entropy "is the only viable explanation of [the] facts."[89] Moreover, Dawkins fully acknowledges that without some capillary-like (upward) movement against the natural course of energy (downward), than life would not be possible. Therefore, he believes that the upward trend against entropy must in exist some way. In quoting Peter Atkins, Matt Ridley, and Erwin Schrodinger, Dawkins appealed to the idea that life had risen through the insertion of some outside energy working against the disordering effects of the second law.[90] But how far does Dawkins feel that this injection of energy can consistently press the limits of entropy when he freely admits that it is but a "trickle upstream, temporarily and locally, against the thermodynamic torrent?"[91] The demands of abiogenesis would likely require more than just a trickle. But like Paul Davies, he is right in recognizing that the law "does not

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[87]Robert M. Hazen, *Genesis: The Scientific Quest for Life's Origin* (Washington, DC: Joseph Henry Press, 2005), 11-23.

[88]Ibid., 15.

[89]Dawkins, *A Devil's Chaplain*, 84.

[90]Peter Atkins, "Creation Revisited," in *The Oxford Book of Modern Science Writing* (Oxford: Oxford University Press, 2008): 11-16. See also excerpts from this same reference text of Matt Ridley, "Genome," 35-40; and Erwin Schrodinger, "What is Life?" 249-55.

[91]Dawkins*, The Greatest Show on Earth*, 412.

absolutely forbid physical systems from going 'the wrong way.'"[92] Hence, the question becomes: How far might such an extrapolation be drawn?

To date, the degree to which the second law of thermodynamics is supposedly stretched has not been adequately addressed. Time and again, Dawkins has cited how each entity has had to drive "uphill" against the grain. Though it may be feasible to do so, to what degree can it go against the grain? He admits that such a concept "coax[s] and stretch[es] the laws of physics and chemistry to evolve prodigious feats of complexity."[93] But he never entertains the question as to how far those laws should be stretched. Though it is also true that plants utilize the Sun's radiant energy to produce their chemical potential through the endothermic process of photosynthesis, it is yet to be demonstrated how inanimate matter or a simple molecule could achieve the same. We are reminded that plants contain the necessary instructions in their respective DNA. Likewise, animals utilize the chemical energy stored in foodstuffs by way of their internal instructions. But these things are observed in a world that already reflects such complexity. The problem remains in how to extrapolate that complexity back to the point of abiogenesis.

Thus, despite the marvelous structures of life that now populate the Earth, we are still faced with the problem of how this complexity first came about. Though work in the form of sunlight may have been available from the start, the means by which simple molecules could develop into anything even approaching productivity remains a mystery. In response, many point back to the Miller-Urey Experiment. But then again, how can the formation of a few simple amino acids extrapolate to the much greater achievement of

[92]Davies, *The 5th Miracle*, 90.

[93]Dawkins, *The Greatest Show on Earth*, 415.

massive macromolecules required by even the most elementary systems of life? Davies clarifies this point in admitting that: "Whereas the spontaneous formation of amino acids from an inorganic chemical mixture is an allowed *downhill* process, coupling amino acids together to form peptides is an *uphill* process" (italics mine).[94] Indeed, the downhill process should be expected. But how can Dawkins simply assume such a steep uphill process without the aid of a chemical apparatus and/or instructions to guide it?

Therefore, it is argued that Dawkins has taken an acceptable aspect of the second law of thermodynamics beyond that which should be reasonably expected. Not only does the whole process of building complex macromolecules face astronomical odds on its own, but it must do so against the natural inclination of nature itself – and that without any structure to guide it along. From an empirical standpoint, Dawkins seems to have little to go on beyond the present wonder of life, which already has its guidance and structure in place. Correspondingly, from a theoretical standpoint, he still stands on chance teamed with an uphill battle against the laws of nature. Only the absolute necessity of the process sustains its plausibility.

Self-Organization and Selection

Beyond the grip of entropy and the second law lies the real heart of the model that explains how inanimate matter spontaneously turns into biological complexity. More specifically, it is that crucial component of Dawkins's *modus operandi* which affords self-organization – and that, quite independently and without agency. In other words, it is the reasoning behind how the simple became complex. Self-organization is central to abiogenesis because it remains the only means by which matter could theoretically

[94]Davies, *The 5th Miracle*, 89.

achieve complexity apart from some form of agency. As Per Bak asserts, "self-organized criticality is so far the only known general mechanism to generate complexity."[95] That encompasses the classic naturalistic position and speaks volumes of the mind of Dawkins. He included it in one of the key sections of *The Oxford Book of Modern Science*. Alongside Crick, Atkins, Ridley and a handful of others, Dawkins included Bak in the attempt to buttress his case for how complexity allegedly arose.

Moreover as Padgett notes, self-organization is an essential aspect of the "minimal chemistry" demanded by life.[96] Using the related term *autocatalysis*, he indicates that the capacity to become complex, and then reproduce, are foundational properties that define life.[97] Some mechanism like autocatalysis would become necessary in the absence of agency. From what other source would complexity come? Whether described as information that comes out of simplicity, spatial patterns amidst chaos, or order from noise, it is the element of *emergence* that is fundamentally important.[98] Hence, self-organization becomes not only an essential element of the process but the very basis from which the origin of life must be obtained.

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[95]Per Bak, "How Nature Works," in *The Oxford Book of Modern Science* (Oxford: Oxford University Press, 2008), 273.

[96]Padgett, *Autocatalysis of Chemistry and the Origin of Life*, 6.

[97]Ibid., 4. Autocatalysis is a special kind of chemical reaction in which the product (or products) of that reaction also serve as the catalyst(s) for that same reaction. As an essential element of life, Padgett includes it in his list of four key properties (of life): 1) a thermodynamic throughput of energy, 2) autocatalysis or other self-reproduction, 3) cellular enclosure, and 4) evolution. Though the exact list of essential properties is still highly debatable, the inherent ability to self-organize is consistent to virtually any such list.

[98]Francis Heylighen, "The Science of Self-Organization and Adaptivity," in The Encyclopedia of Life Support Systems (Oxford: Eolss Publishers, 2001): 3. See also Christof K. Biebricher, Gregoire Nicolis, and Peter Schuster, "Self-Organization in the Physico-Chemical and Life Sciences," in *The European Commission of the Directorate General XII for Science, Research & Development*, Report no. 16546 (1995): 1-21.

Meanwhile, Dawkins has personally commented on the crucial nature of self-organization. In theorizing the existence of macromolecules (beyond the achievement of Miller/Urey), he writes that "these same ingredients, at least in some rudimentary form, must have arisen spontaneously on the early Earth, otherwise cumulative selection, and therefore life, would have never got started in the first place."[99] Those complex molecules, which are believed to have arisen out of the more modest sized building blocks resulting from reactions described by Miller-Urey et al., must have "arisen spontaneously" for life and even natural selection to subsist.[100] But what is even more challenging than whether such macromolecules arose is how one might explain the phenomenon of emergence in general. Similar to the much later emergence of consciousness, Dawkins has always been fascinated with how these things spontaneously arose out of the mire of inanimate matter on the one hand (abiogenesis) and complexity without intelligence in the other (consciousness). These, he admits, are two of the greatest questions of biology.[101]

Evidence of emergence. By the time he wrote *The Blind Watchmaker*, Dawkins had already begun to describe a number of commonly used evidences to further his argument for self-organization. Perhaps the most illustrative of these cases involves the assortment of pebbles on a beach. It is common to observe the natural ordering of

[99]Dawkins, *The Blind Watchmaker*, 128.

[100]Ibid.

[101]Dawkins, "Richard Dawkins Answers Reddit Questions," 2010. Asked what are the three most pressing questions in biology, Dawkins replied, how consciousness evolved and what is consciousness, how life began from non-life, and why sex evolved.

pebbles in this setting as they become sorted over time. The resultant ordering from large to small represents what he calls *simple sieving*.[102]

Others have made similar comments on this phenomena including Roger White who categorized this type of sorting into three broad categories. These divisions correspond with his descriptive examples: 1) "scattered in a disorderly fashion," 2) found "in descending order of size," or 3) "arranged to form a stick figure."[103] As White points out, while both the second and third patterns indicate order, only the latter entails agency. This is because the second pattern could have been ordered quite easily through natural forces acting in "lawful correlation between physical properties such as volume, mass, and inertia."[104] The third pattern, however, "arranges" the sticks in a specified order. A more accurate rendering of this case might further entail the beach's slope, wind and wave action, the viscosity of the water, and other variables. But the basic concept remains clear. The physical properties of matter combined with the surrounding environment can and do affect the assortment of ordinary beach pebbles.

Nevertheless, while the above example clearly distinguishes the case for agency over and against the work of natural forces, it does not establish the limits of "simple sieving." Fortunately, Dawkins helped to clarify this point in admitting that it "is obviously nowhere near capable of generating the amount of order in a living thing."[105] Simple sieving does not engender that level of order. His comments on the previous page

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[102]Dawkins, *The Blind Watchmaker,* 43.

[103]Roger White, "Does Origin of Life Research Rest on a Mistake?" *NOUS* 41, no. 3 (2007): 454-55. White serves as a philosophy professor at MIT. He specializes in the philosophy of science and epistemology.

[104]Ibid., 455.

[105]Dawkins, *The Blind Watchmaker*, 45.

further define those limits. "Sieving," he wrote, cannot "account for the massive amounts of nonrandom order that we see in living things."[106] Why then would Dawkins use such an example to further his case? He clearly recognizes a distinction between the common place ordering of pebbles and the awesome complexity demanded by even the most rudimentary molecules of life. Perhaps it was the most communicable way for him to illustrate the self-ordering principle of natural objects despite the misconception it could breed in respect to abiogenesis.

But in addition to this simpler case, another more complex example has often been discussed. The symmetrical pattern known as the *Bernard Roll* has been one of the more easily recognized examples of a naturally organized system. This phenomenon, which can occur under the right conditions when a liquid is heated from below, produces "a convective honeycomb pattern or [as] parallel convection rolls."[107] The influx of heat affects the natural properties of the liquid to produce the corresponding pattern. But one could likewise observe an organized arrangement of water molecules when in the process of changing states (e.g., from liquid water to ice).[108] Furthermore, several other unique examples in nature might include the majestic swirl patterns observed in many galaxies or the artistic patterns of what chemists call "well-stirred systems."[109] These examples

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[106]Ibid., 44.

[107]Leonard J. Soltzberg, "Self-Organization in Chemistry – The Larger Context," *Journal of Chemical Education* 66, no. 3 (1989): 187.

[108]Water moves from its liquid state to a solid when the temperature is decreased to below 32 degrees F (i.e., given otherwise standard conditions including sea level pressure, etc.). During this transition, the water molecules in the fluid (liquid water) "line up" to form the more structured lines of a solid (ice) – a common example of self-organization in nature. Meanwhile, the entropy of the system drops (because of the greater order) and a substantial amount of heat is exchanged with the environment (i.e., the latent heat of fusion).

[109]Biebricher, Nicolis and Schuster, "Self-Organization in the Physico-Chemical and Life

demonstrate that matter does indeed produce a kind of organized pattern under the right conditions.

Whatever the case, the various patterns observed at the micro level may be even more intriguing – especially those involving crystalline or magnetized materials.[110] In terms of stability, Dawkins used the example of "salt crystals [which] tend to be cubes because this is a stable way of packing sodium and chloride ions together."[111] Other interesting geometries may also be found throughout chemistry in the molecular arrangements of various elements and compounds. But all of these are based on the basic laws of physics as interpreted through chemistry. How these natural processes could achieve the complexity of life remains a whole other problem. What law, principle, or process would enable such a possibility? Moreover, how do these relatively simple patterns of nature coincide with the awesome property in life we call complexity?

Complexity through gradualism. Dawkins argues that the increase of complexity is a result of *gradualism*. Like the "limit" taken in elementary calculus, so also might the upward movement toward complexity use the smallest of incremental steps. As he later justified it, if those steps were "sufficiently small, [then] the necessary mutations are almost bound to be forthcoming."[112] Such thinking echoes back to the

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Sciences," 13-22. This article portrays a number of physico-chemical reactions that display complex patterns (see especially figures 3.3 and 3.6). This section offers an abundance of information on well-stirred systems in particular, which as it says, has become "a prototype of complex behavior" (15).

[110]A. G. Cairns-Smith, *Genetic Takeover and the Mineral Origins of Life* (Cambridge: Cambridge University Press, 1982), 4. The natural order found in crystals forms the very basis of Cairns-Smith's theory. Magnetic materials offer yet another form of natural alignment and ordering.

[111]Dawkins, *The Selfish Gene*, 12.

[112]Dawkins, *The Blind Watchmaker*, 79.

Democritean reasoning involving *infinity* and *accident.*[113] Applied here, it is essentially the repeated movement (infinity) from one point of relative stability to another more complex point of stability through some perturbation (accident). Beyond that, Dawkins is somewhat ambiguous about the exact means by which the upward movement toward complexity takes place.

In *The Selfish Gene,* Dawkins extrapolated the concept of the salt crystal's stability to a template for which basic organic molecules could also combine. He wrote that they might "link up together in chemical reaction to form molecules, which may be more or less stable."[114] Surprisingly, he claims that "it is easy to think of them joining up to form a stable chain just as the formation of the original replicators."[115] Although the profound complexity inherent in the "original replicators" would seem anything but "easy," the appeal toward stability seems at least viable. Nonetheless, Dawkins claims that the differences between the resultant variant molecules would incite a competition

[113]D. N. Sedley, *Creationism and its Critics in Antiquity* (Berkeley: University of California Press, 2007), 138-39. A classic case of Democritean reasoning involves his philosophy of the nature of our complex world, which entails the accident and infinite. Sedley writes that "it should be clear enough how Democritus means to capitalize on this principle in explaining the nature of our own world. Without an intelligent creator, the formation of a world like our own would seem vanishingly unlikely. Even so, for the atoms to come together in this particular arrangement as a result of random motions was still intrinsically possible, and the more worlds there are in the universe the less unlikely that chance result is. Granted, then, the infinity of the universe, and the consequent infinity of worlds, it was in fact inevitable that precisely this fluke should occur. Democritus's calculation that every individual world-type must recur repeatedly at suitably vast distances throughout space is his way of demonstrating that the providential-seeming features of our world need be no such thing. Worlds exactly like ours necessarily occur in any case. And even if worlds altogether indistinguishable from ours will occur only at mind-bogglingly vast intervals across the universe, worlds sufficiently similar to ours to support intelligent life will no doubt occur with much greater frequency. How satisfying is *this mode of explanation by appeal to accident on an infinite scale*?" (italics mine). Colleagues of Dawkins have made similar assertions including Daniel Dennett who wrote that "the power of the Darwinian idea comes from the way it distributes the huge task of Design through vast amounts of space and time." See Dennett, *Darwin's Dangerous Idea*, 151.

[114]Dawkins, *The Selfish Gene*, 13.

[115]Ibid., 15.

that would promote "the earliest form of natural selection."[116] He believes that the process would provide a "selection of stable forms and a rejection of unstable forms."[117] He further claims that the projected upward movement would entail ever-increasing levels of stability. Macromolecules would eventually form pre-DNA molecules in the gradual climb to replicator-like complexity. The system would essentially step along the path of increasing complexity, moving from one stable platform to the next. But these statements appear to contradict Dawkins's own stance toward cumulative selection that he says "had to get started."[118] Indeed, he had made it clear that "cumulative selection cannot work unless there is some minimal machinery of replication and replicator power."[119] It therefore remains unclear how that early form of "selection" could occur.

Furthermore, Dawkins's gradualism is met with a number of problems that demand explanation. First, Dawkins needs to establish what mechanism is actually responsible for the linking of those molecules. But he does not offer such detail. In his earlier texts, he appears to presume that such matters would inevitably be resolved. Again, he suggested that it is just "easy to see" how the simpler molecules would "link up" to form bigger molecules.[120] Then, once all the parts are in place, it would become easier to construct the pieces required by the macromolecules. But this process only becomes feasible with the instructions and enzymes at hand.[121] These elements are

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[116]Ibid., 13.

[117]Ibid.

[118]Dawkins, *The Blind Watchmaker*, 140.

[119]Ibid., 141.

[120]Dawkins, *The Selfish Gene,* 15.

[121]Dawkins*, The Ancestor's Tale*, 568, 574. See also idem, *The Greatest Show on Earth*, 241.

absolutely essential to the basic functionality of any living system. But these essentials would not have been available. As Dawkins said himself, "we cannot suppose that there were enzymes around to help them to replicate."[122] Therefore, in attempting to track upward against the natural tendency of the second law, the system would have to do so without the aid of instructions or catalysts. And that is assuming that the developing molecules can overcome the ensuing molecular breakdown of that same environment. Indeed, as Davies points out, there is a destructive side effect of "the same energy that generates organic molecules [that may] also serve to destroy them."[123] Together, these obstacles present a formidable impasse which any model would have to traverse.

Second, Dawkins needs to establish what he means by "stability" and how cumulative selection factors into the model's progressive movement toward higher, more stable molecules. Indeed, he uses the former term or a derivative of it nearly a dozen times in chapter 2 of *The Selfish Gene* in describing the genesis of the first replicator. He writes of the "survival of the stable," both "increasing" and "decreasing" stability, stable "packing," "forms," "patterns," "chains," and even "stable configurations."[124] Clearly this is an important component of Dawkins's model. But what does he specifically mean by it? Ilya Prigogine has been one of the key leaders in origin of life research who uses similar language. Davies described his idea of "a sequence of self-organizing transitions, where matter [is] driven by an energy flow [that] jumps to higher and higher levels of

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To his credit, Dawkins fully recognizes the essential need for enzymes to be present in the operation of any living cell. Moreover, he describes them as not only absolutely necessary, but perfectly suited in shape for their particular task.

[122]Dawkins, *The Blind Watchmaker*, 133.

[123]Davies, *The 5th Miracle*, 89.

[124]Dawkins, *The Selfish Gene*, 12-18.

organized complexity."[125] This latter idea appears to resemble what Dawkins implies by the "selection of stable forms" and ultimately what he expects from *cumulative selection.* But what evidence exists in regard to these increasingly more stable platforms? What process does Dawkins suggest can bridge the gulf between the more modest-sized molecules of Oro/Miller-Urey and the replicator-level macro-molecules of life? It is incumbent upon Dawkins to ascertain the specific detail of how this upward movement is to take place given his system of stable platforms.

Finally, as briefly pointed out above, it is unusual that Dawkins would appeal to such an early timing for natural selection (i.e., a point of relatively low complexity) when he himself referred to its much later arrival.[126] In fact, he returns to this point later on in *The Blind Watchmaker* where he more fully acknowledged the fact that "cumulative selection is the key, but *it had to get started*" (italics mine).[127] He even followed this statement with the profound admission that "we cannot escape the need to postulate a single-step chance event in the origin of cumulative selection itself." In essence, Dawkins is admitting that cumulative selection (his version of natural selection at this juncture) would itself need to be born.[128] French chemist Jean-Marie Lehn agrees in promoting his three step process of self-organization. Only during the final, *emergent phase* does Lehn believe that selection would have even been plausible.[129] But Dawkins has yet to address this apparent contradiction.

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[125]Davies, *The 5th Miracle*, 139.

[126]Dawkins, *The Blind Watchmaker*, 128.

[127]Ibid., 140.

[128]Ibid.

[129]Jean-Marie Lehn, "Toward Complex Matter: Supramolecular Chemistry and Self-

Dawkins has been fully committed to what he believes is the innate ability in matter to organize itself under the auspices of a process he calls cumulative selection. It is, as he puts it, "the key to all our modern explanations of life."[130] Clearly, cumulative selection is the essential ingredient to Dawkins's model for obtaining life's complexity. In describing it, he writes of the "slow and gradual" process that took a multitude of incremental steps to evolve over time.[131] But how would cumulative selection specifically function? Unlike the alternative "single-step" or punctuated solution(s) to greater complexity, Dawkins believes that only the *gradual accumulation* of much smaller steps could ever succeed.[132] Specifically, cumulative selection speaks of a term used to describe the union of natural selection and gradualism. The combination of these two concepts appears to imply the activity of natural selection over an extended period of time. It entails that upward movement of complexity from stable pattern to slightly more complex stable pattern – with the end goal of life.

But again, cumulative selection itself is said to depend on a certain level of complexity. Dawkins admitted that it requires "some minimal machinery of replication and replicator power" in place.[133] Therefore, even if this process could feasibly move upward against the thermodynamic current, how could it achieve the minimal machinery that Dawkins himself suggests it needs – that is, without retreating to pure chance? In

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Organization," *Proceedings of the National Academy of Science* 99, no. 8 (2002): 4763.

[130]Dawkins, *The Blind Watchmaker*, 139.

[131]Dawkins, *The Magic of Reality*, 31.

[132]Dawkins, *A Devils' Chaplain*, 187-92 and 209-12. The contrasting views of classic gradualism and ideas such as punctuated equilibrium (e.g., Gould) have incited debate amongst scholars that have resulted in a new round of questions including how long a "punctuated step" in complexity could be. Is the latter just another form of gradualism or is it a real stasis with punctuation? Dawkins found himself commonly sparring with Stephen Jay Gould on this particular issue.

[133]Dawkins, *The Blind Watchmaker*, 141.

light of his own admission that the probability of achieving even a single phrase of a Shakespearean play by chance is astronomically difficult, then how could nature have achieved the level of complexity required for cumulative selection – assuming that cumulative selection actually works?

In sum, what had gone unaddressed in Dawkins's earlier books is still left unanswered now. His explanation of one stable platform pressing forward toward an increasingly complex stable platform remains incomplete. Dawkins needs to establish the type of process that would achieve the "in-place machinery" required by cumulative selection. Instead, he has moved past these finer points in lieu of his overall proclamation that natural forces were responsible for the first replicator – and that, through a process that had been accepted as the long standing classic solution for the origin of life. Dawkins's gradualism struggles in working out the details.

Information and Complexity

This final section will address one of the more difficult and controversial issues that Dawkins has faced. In light of the ongoing debate over what is biological "complexity," how information is to be measured, and what Peter Medawar and William Dembski call the "conservation of information" – much of the subject is still left to interpretation.[134] Moreover, how mechanical and/or thermodynamic terms such as *chaos, order*, and *entropy* relate to information and complexity is yet to be fully determined. Nowhere is this understanding more limited than in how natural selection should be applied to the process leading to replication. Information specialist Hubert Yockey

[134]Ibid.

points out how entropy alone has garnered considerable debate between the descriptions offered by Shannon and those of Maxwell, Boltzmann and Gibbs.[135]

Nevertheless, the twin concepts of *information* and *complexity* continue to be stalwart elements of the Neo-Darwinian paradigm as they depend upon the sifting of chance through some form of "selectionism." However difficult it may be to establish rationally that which separates inanimate matter from organic life, it is mutually agreed that the achievement of replication (followed by DNA) entails that which *must* be considered an absolute and unswerving *increase* in information and/or complexity. Dawkins clearly acknowledges this fact as well as the "digital format" through which it was communicated.[136] He further concurs that the resulting "flow of information" functions as the very lifeblood of every living cell which makes it absolutely essential to the prevailing model.[137]

By the time he had written his first book, Dawkins appeared to be unconcerned with how the information and/or complexity worked out. But the acquisition of the first replicator's instructions presents a formidable problem. Dawkins admits that those instructions "must have been assembled by natural selection."[138] But as in every other piece of the puzzle, Dawkins must return to the power of natural selection. It is now his

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[135]Hubert P. Yockey, *Information Theory, Evolution, and the Origin of Life* (Cambridge: Cambridge University Press, 2005), 32. Yockey makes an excellent point in this text in regard to the prevailing confusion over the concept of entropy. Now this confusion is not in regard to the more common error of those who misunderstand the difference between open and close thermodynamic systems, but is in the difference between how scholars have attempted to define the elusive term "entropy." The more classic approach to entropy (i.e., statistical mechanics) was more specifically defined by Ludwig Boltzmann and James Maxwell early on during the 1870's, followed by J. Willard Gibbs a few decades later. Their definitions contrast with Shannon's version of entropy which entails a more information-laden approach.

[136]Richard Dawkins, *The River Out of Eden: A Darwinian View of Life* (New York: Basic Books, 1995), 19.

[137]Ibid., 4.

[138]Dawkins, *The Selfish Gene*, 23.

solution to both information acquisition and processing. Nevertheless, such an extraordinary achievement would have placed an enormous demand on some yet to be determined pre-replicator process that was responsible for producing instructions out of mere chance, increasingly stable platforms, and some earlier means of selection.

Dawkins has joined others in thinking that the laws of physics must have caused the "atoms and molecules to join up together."[139] This statement strikes a familiar chord to those who have previously suggested some "missing law" or innate self-organizing property in matter itself.[140] But such speculative ideas have little to offer beyond their fit within the model(s) themselves. It should be understandable, then, why some have considered the intricate, organized state of *crystals* as a possible lead. Dawkins has alluded to this possibility in not only its potential for self-assembly but in the origin of life model founded by A. G. Cairns-Smith.[141] But as Yockey points out, crystals simply "repeat [their] pattern indefinitely."[142] Indeed, snowflakes serve as an excellent example of how the physical properties of a material can affect its shape – creating all kinds of designs. But like the natural ordering of liquid water molecules that must realign when changing into ice, they "have nothing to do with [the] origin of

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[139]Dawkins, *The Blind Watchmaker*, 128.

[140]Hazen, *Genesis,* 15.

[141]Cairns-Smith, *Genetic Takeover,* 164. Cairns-Smith offers the most commonly accepted theory in regard to crystalline or silicate-based life. This text boasts the more detailed version of his theory alongside *The Life Puzzle.* See idem, *The Life Puzzle* (Edinburgh: Oliver and Boyd, 1971). In his much simpler rendition, *Seven Clues to the Origin of Life,* Cairns-Smith offers a layman's path toward this same theory. See idem, *Seven Clues to the Origin of Life* (Cambridge: Cambridge University Press, 1985). A number of scholars have cited Cairns-Smith's model for its unusual potential including Dawkins. See Dawkins, *The Blind Watchmaker*, 149; idem*, A Devils' Chaplain*, 45; and idem, *The Greatest Show on Earth*, 223; Daniel Dennett, Michael Ruse and others.

[142]Yockey, *Information Theory, Evolution, and the Origin of Life*, 166.

life."[143] In fact, a multitude of other crystalline structures exhibit similar chemically-based patterns including silicates, sulfates, carbonates and a host of other materials (incorporating thousands of geometric designs). But despite their intricate beauty and complexity, crystals are not known for information. Unlike Dawkins, who extracts a kind of "template for self-organization" from salt crystals,[144] Stephen Meyer adamantly disagrees in pointing to the ordinary chemical attraction between the sodium and chloride ions.[145] Crystals, like any other exotic-looking example, are still limited in information content.[146]

Moreover, the extent to which that "information" can obtain might be compared to the original gap that separates the largest of natural molecules from the simplest of replicators. Time and again, Dawkins has acknowledged this monumental problem while simultaneously promoting the potential for bridging it. Why the ambiguity? Perhaps, the Neo-Darwinian model demands it. Despite his admission to exceedingly "low odds," "odds [that are] too great," and the incredible complexity that he himself describes as accompanying even the simplest of proteins, Dawkins remains thoroughly convinced that it simply *must* have occurred.[147]

Meanwhile, Yockey has commented on the extraordinary complexity of the commonly cited and well-documented protein called *iso-1-cytochrome C*. This molecule

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[143]Ibid.

[144]Dawkins, *River Out of Eden*, 140.

[145]Meyer, "Word Games," 114.

[146]Ibid.

[147]Richard Dawkins, *Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder* (Boston: Houghton Mifflin, 1998), 4. See also idem, *River Out of Eden*, 83 and idem, *The Blind Watchmaker*, 121. This number entails one hundred and forty-seven zeroes.

serves as an excellent example of organic information content. In regard to its complexity, Yockey arrived at a staggering number that represented the odds against it ever being realized. Specifically, his calculation in respect to the *sequencing* of that single protein came to "1.03845927171 X 10 E 147."[148] Now, despite the somewhat exaggerated accuracy of this and similar estimates, the order of magnitude should be respected.[149] Many others have calculated similar numbers ranging from Smith and Szathmary, Cairns-Smith, Daniel Dennett, and even Dawkins himself. In each case, they all agree that the resultant odds far exceed such an accident.[150] Chance could simply not make it happen and no scientific discovery to date can support such long odds. Applied more specifically, Meyer adds that "amino acids alone do not make proteins, any more than letters alone make words, sentences, or poetry."[151] Most of the organic building blocks including amino acids, nucleotides, and the rest are short enough to almost be expected given the right conditions. Oparin and Haldane foresaw that likelihood nearly a century ago. But as Dembski concludes, if neither "chance or [natural] law left to themselves" nor any "joint action" of the two could achieve the necessary complexity of

[148]Yockey, *Information Theory, Evolution, and the Origin of Life*, 84.

[149]The number of "significant digits" presented by Yockey in the above case is 12 and cannot possibly be accepted as exact given the astronomically large exponential of 147. The very fact that this number represents an already rough calculation against the probability of sequencing does not in any way discredit the approximate value of the corresponding exponential. The margin for error in such an estimate should make this clear. Nevertheless, it is the size of the approximate number or order of magnitude that is really important here. Thus, the somewhat exaggerated trail of excess digits should be ignored in lieu of the size of the number at hand – which represents a number so staggering in size that it is virtually zero against any framework.

[150]A wide variety of exceedingly large numbers have been calculated in respect to the odds against the chance sequencing of a first replicator (or some related advancement in the origin of life). See John Maynard Smith and Eors Szathmary, *The Major Transitions in Evolution* (Oxford: Oxford University Press, 1995), 67; Cairns-Smith, *Seven Clues to the Origin of Life*, 19; Dennett, *Darwin's Dangerous Idea*, 152, and Dawkins, *The Blind Watchmaker*, 47ff.

[151]Meyer, "Word Games," 107.

the greater, more massive macromolecules of life, then what other means is available?[152] Dembski has concluded that his patent CSI (i.e., complex, specified information) could only be gained through inheritance with *modification, selection*, or *infusion*.[153]

Now Dawkins has faithfully followed the Neo-Darwinian explanation of chance mutation conjoined with natural selection from the beginning. Using Dembski's system above, then the process of *mutation* would fit closest to inheritance with modification, while *natural selection* would correspond to "selection." It might then be argued that the corresponding phenotype would have utilized the element of infusion during the course of its life, which in affect might influence its selection. Nevertheless, genetics indicates that the infusion (e.g., of knowledge, strength, weakness) accrued over a lifetime cannot be passed along (i.e., Lamarckism). But as Dembski points out, the steep path toward complexity combined with irreducible complexity, only partial functionality, and a lack of teleological guidance renders such an effort as untenable.[154] Again, as Dawkins pointed out, even natural selection would have had to evolve.[155] So how could a "blind watchmaker" traverse such impossible odds? Dawkins has attempted to answer that question with a text bearing that very title. Nevertheless, no plan has been

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[152]Dembski, *Intelligent Design*, 169.

[153]Ibid., 175. By "inheritance with modification," Dembski implies the complex, specified information of "the parents" combined with "any modifications … by chance." Selection corresponds to the "environmental pressure that selects some organisms to reproduce," while infusion depicts the "direct introduction of novel information from outside the organism."

[154]Ibid., 177-78.

[155]Dawkins, *The God Delusion*, 168. As has been referenced in several of his texts, Dawkins believes that natural selection could only occur post-abiogenesis. In this text, he again alludes to Dennett's "crane" that metaphorically represents a scientifically tenable process. In this case, he has cited natural selection in two cases – pre and post origin of life. In regard to the latter he wrote that "The origin of life, by contrast, lies outside the reach of the crane, because natural selection cannot proceed without it." According to Dawkins, natural selection can only work *ex post facto* to the origin of life – making it a useless function prior to that time.

forwarded to date that offers the kind of evidential support and comprehensive theory that is required by the rigors of academic inquiry. The weight placed on selection alone has yet to be proven to the degree demanded by its adherents.

Finally, perhaps the most fascinating yet perplexing component of Dawkins's model toward increased complexity involves the acquisition and development of information. This issue has been one of the most elusive problems for Neo-Darwinism because information is said to emerge where it once was not. But even with the required throughput of energy, how can information be said to emerge suddenly? Was there some mysterious exchange between energy and information (i.e., as if information was considered a form of energy)? Dawkins has rested his entire case on the influx of energy from the Sun conjoined with the selection process. That idea becomes the sole assumed process by which energy would have been channeled toward complexity. From his perspective, the information contained in every living organism must have been ultimately derived from the throughput of outside energy.

Interestingly, Dawkins included several scholars in *The Oxford Book of Modern Science Writing* who had previously encountered this issue. Therein he offered excerpts from Matt Ridley, Sydney Brenner, Erwin Schrodinger and Per Bak.[156] Though all of these men offered detailed discussions on various aspects of information, entropy, and energy, Ridley may have provided the most applicable. In his book *Genome*, Ridley had specifically addressed the relationship of information, entropy *and DNA*. Commenting in the first of two excerpts, Dawkins focused on Ridley's "allusion to

[156]Dawkins, *The Oxford Book of Modern Science Writing*, 35-40, 40-48, 249-54, and 273-76. Dawkins incorporated two of Ridley's excerpts in this text, but only the first applied to the issue at hand (from *Genome*). In order of appearance, Dawkins added excerpts from Ridley (35-40), Brenner (40-48), Schrodinger (249-54) and Bak (273-76) for which he added a brief commentary on each.

information's mathematical affinity to the 'entropy' of the thermodynamicists."[157] More specifically, Ridley had pointed out how mathematician Claude Shannon had analogously placed "information and entropy [on] opposite faces of the same coin" in assuming that "both have an intimate link with energy."[158] Such speculation fits neatly with Dawkins's perspective on how the complexity of life arose.

Conclusion

As is evident from his earliest works, Dawkins has consistently embraced Neo-Darwinism as the explanation for the origin and evolution of life. When he embarked upon his mission to further the gene-centered model of ethology, there had been little or no challenge to the most popular theory regarding the origin of life. That classic solution of Oparin, Haldane and Miller-Urey had already been fully etched upon the mind of the scientific community at large. Dawkins focused instead on what he thought were the more troubling ethological problems including the development of altruism in the animal world. He hoped to utilize this gene-centered approach to more forcefully explain such phenomena. It should be fully understandable, then, why the "control" of the gene and its manifestation in the body and/or phenotype became the central theme of his first two books: *The Selfish Gene* (1976) and *The Extended Phenotype* (1982).

Though his handling of this project became a huge success from a popular standpoint, it also indirectly propelled him into the broader discussion of origins and evolutionary theory. As is evident in his next book *The Blind Watchmaker*, Dawkins undoubtedly felt it necessary to fall back to a defense of that greater problem. Having

[157]Ridley, "Genome," 36.

[158]Ibid., 40.

made a number of general assumptions in the course of his initial text, he went on to modify his stance moving forward. The bulk of this chapter was devoted to those assumptions and the ensuing analysis of his depiction of entropy and the second law, self-organization and selection, and information and complexity. A careful look at these areas has revealed several assumptions that go beyond proven discovery – especially in regard to the interface separating energy and information.[159] Evidently, these areas deserve further exploration.[160] Nevertheless, this dissertation argues that Dawkins's perspective on abiogenesis rests heavily upon his worldview, which adversely affects his interpretation of the matter. How he began to develop a more formal defense of his position will be the subject of the next chapter.

[159]Though the First Law of Thermodynamics may be technically satisfied in this process of conversion (i.e., from energy to information) through the conservation of energy, can we expect information to be extracted from an energy source? Clearly, such an idea crosses the line of how even potential (chemical) energy might be described seeing that it is, in essence, an increased ordering of individual molecules. But *can information be reduced* to the physical breakdown of chemical bonds? For example, does the potential energy gained by one additional covalent bond represent an advancement of information? Somewhat paralleling the ongoing problem of defining that other elusive term "entropy," so also does this relationship between energy and information need to be understood. These two issues are much closer than one might think *prima facie.* For in the case of entropy, many have mistaken the more classic, thermodynamically-related form with the contemporary statistically-related form. The first is generally considered a macroscopic version of entropy that had evolved through the works of Boltzmann, Maxwell, and Gibbs. The latter, however, details the microscopically-related form as defined by Shannon. Though both have attempted to define related terms such as *order* and *chaos*, they have not yet been fully established. The complex issue of how energy and information might relate lies beyond the scope of this dissertation. But despite the ongoing challenge of this question, it cannot be simply assumed by a scientific model today. The relationship, if there indeed is one, must first be established. Otherwise, nothing should be assumed about the potential exchange of energy for information. Though the process of changing the incoming energy of the Sun could certainly charge the metabolism of a living system, caution must be exercised in any extrapolation moving forward. Further discovery in the realm of quantum mechanics would undoubtedly lead this discussion on chemical energy and the potential exchange between energy and information/complexity. Such a relationship could have particular importance as applied to the issue of origins.

[160]The interface between energy information and complexity fall beyond the scope of this dissertation.

CHAPTER 5

A MOVE TOWARD ALTERNATIVE SOLUTIONS

Introduction

Ten years after writing his first two books, Richard Dawkins redirected his focus away from his native ethology and toward a more formidable problem. He elected to take on the defense of naturalism itself. As has been noted, both *The Selfish Gene* and *The Extended Phenotype* had engaged the controversial though respected "gene-centered" model which relates the world of DNA to that of the organism (or phenotype).[1] Though Dawkins had spent the bulk of his time in the late seventies and early eighties working on this project, he began to realize a greater need at hand. By 1986, he had accepted the broader challenge of defending the entire paradigm on which all of his studies rested: Neo-Darwinism itself. He began this challenge through his third book (and bestseller) *The Blind Watchmaker*, which functioned as a rejoinder to William Paley's classic work *Natural Theology*.[2] Through this text, Dawkins set out to promote his purely naturalistic

[1]Richard Dawkins, *The Selfish Gene*, 2nd ed. (Oxford: Oxford University Press, 1989). See also idem, *The Extended Phenotype: The Long Reach of the Gene*, 2nd ed. (Oxford: Oxford University Press, 1999). The first editions of these texts were 1976 and 1982, respectively.

[2]Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design, 2nd ed.* (New York: W. W. Norton and Company, 1996). The first edition of this text was written in 1986 by the same publisher. For the contrasting text, see William Paley, *Natural Theology: Or Evidences of the Existence and Attributes of the Deity Collected from the Appearances of Nature* (New York: Sheldon & Company, 1854). Paley's text took the reader on a guided tour across the biological spectrum. Its teleological approach argued for the inherent design found in nature, which clearly implied a designer. Its numerous examples range from plants and animals to complex parts of the body.

explanation that views life as a mere "illusion of design."[3] He aptly entitled his new work to contrast Paley's well-known analogy of a *watch* being found "upon the ground."[4] To Paley, such a discovery would obviously imply a "watchmaker."[5] Dawkins's riposte to this analogy, in contrast, assumed a naturalistic alternative which he calls the *blind* watchmaker. From this standpoint, natural selection had provided no more than the mere *appearance of design*.[6] Armed with this idea, Dawkins pressed on to show how naturalistic processes lie at the root of all life.

Chapter 4 of this dissertation discussed Dawkins strong advocacy for the classic soup scenario, which he had made perfectly clear in *The Selfish Gene*.[7] Though he allowed some latitude for a potential alternative, his allegiance toward the Oparin/Haldane (or Miller/Urey) "model" remained steadfast. That well known solution required the gradual development of complexity from an early primeval soup. Specific compounds combined with the familiar lightning strike (or similar energy source) to produce the required amino acids, which in turn, combined to form proteins, macromolecules, and so forth. Dawkins allocated an entire chapter to this very subject. At this point, he had simply assumed that the classic solution explained the origin of life.

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[3]Dawkins, *The Blind Watchmaker*, 21. Dawkins describes life as a mere "appearance" or "illusion of design." See also idem, *A Devil's Chaplain: Reflections on Hope, Lies, Science, and Love* (Boston: Houghton Mifflin, 2003), 79 and idem, *The God Delusion* (New York, Houghton Mifflin Company, 2006), 168.

[4]Paley, *Natural Theology*, 5.

[5]Ibid., 6. Paley's analogy favors a free agent's intervention over and above natural causation. It involves a watch being found "upon the ground" and the ensuing question that arises over its origin. Paley's solution implied that the "watch must have had a maker" who had at some time designed the watch, and therefore, infused its complexity. In extrapolating this same simple logic to the biological world, some free agent would have also been responsible for the apparent design found in all living things.

[6]Dawkins, *The Blind Watchmaker*, 21.

[7]Dawkins, *The Selfish Gene*, 12-20. The author aptly entitled that chapter "Replicators."

However, by the time he wrote *The Blind Watchmaker*, Dawkins had made a marked shift toward an alternative solution. What he presumed in 1976 had become questionable by 1986.[8] His emphasis on the primordial soup scenario had diminished in lieu of some favored alternative. But while his focus on ethology had shifted toward the defense of evolution, he had simultaneously allowed some distance to grow between him and the classic solution. Dawkins had not only redirected most of his energy toward the origin of life, but to plausible theories that could help explain it.

While *The Blind Watchmaker* (1986) was the first of his texts to defend naturalism and formally counter design, it would certainly not be the last. Dawkins not only added a second addition to *The Selfish Gene* three years later but would go on to publish a plethora of books and articles on the subject through the nineties. Articles following this theme included *Evolutionary Chemistry: Life in a Test Tube* (1992) and *Evolutionary Biology: The Eye in a Twinkling* (1994).[9] Notwithstanding the impact of these papers, it was his third book that made the boldest impression. In fact, *The Blind Watchmaker* served as a real turning point for Dawkins in setting the tone for his upcoming assault on faith, God, and religion in general.[10] Arguing on a number of fronts, he used it to present his hardened case against any and all theologically-based solutions.

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[8]The first date (1976) corresponds to the publishing of Dawkins's first book, *The Selfish Gene,* while the second relates to the 1st edition to his third book *The Blind Watchmaker* (1986). Dawkins's second book *The Extended Phenotype* (1982), revealed no change in position.

[9]Richard Dawkins, "Evolutionary Chemistry: Life in a Test Tube," *Nature* 357 (1992): 198-99. See also idem, "The Eye in a Twinkling," *Nature* 368 (1994), 690-91. These were among Dawkins's classic papers that challenged the design arguments and promoted naturalism. The first article played a significant role in introducing his interest in Julius Rebek's self-replicating hybrids, while the second demonstrated how he believed the eye could evolve over time.

[10]*The Blind Watchmaker* was not necessarily Dawkins's first assault on faith and religion, but it was indeed the broadest in scope. It served as his only published book between 1983 and 1994, but wrought a significant following in support of the evolutionary debate. Moreover, though Dawkins has become well-known for the comments he makes against religion, these became much more prevalent in this

Setting Aside the Gene-Centered Studies

Dawkins broke onto the academic scene through his studies on animal behavior. Naturally, he had trained under Niko Tinbergen and Mike Cullen at Oxford in that particular discipline.[11] His unique ability to communicate a relatively difficult concept such as gene-centered biology had catapulted him into the limelight early on. In fact, *The Selfish Gene* attracted international attention. However, that first text represented just one of Dawkins's many contributions between 1969 and 1986. During that same timeframe, he also completed his second text *The Extended Phenotype* (1982). In addition, he wrote a number of related articles shortly thereafter. Whether describing the social network of bees or kin selection in the animal kingdom, Dawkins remained close to his area of expertise. All the while, he had apparently determined that the origin of life offered little debate. That was evident by his heavy dependence on the classic solution, which permeated those early texts.

Meanwhile, after completing his first book, Dawkins published a number of other articles meant to fan the flames for his gene-centered ideology. Titles along this line included *Replicator Selection and Extended Phenotype* (1978), *Good Strategy or Evolutionarily Stable Strategy* (1980), and *In Defense of Selfish Genes* (1981).[12]

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text. This book also served as a springboard for his ensuing attacks against faith and religion over the years. These attacks have culminated in not only an alliance with The New Atheist Movement in around 2004, but with numerous associations of humanist and atheist-based groups on both sides of the Atlantic.

[11]See chapter 3 of this dissertation for specific commentary on Oxford ethologists Niko Tinbergen and Mike Cullen. Each of these men made a significant impact on the life of Richard Dawkins.

[12]Dawkins wrote several articles on ethologically-related issues between 1969 (seven years prior to *The Selfish Gene*) and 1986 (the year he wrote *The Blind Watchmaker*). These included Richard Dawkins, "Bees are Easily Distracted," *Science* 165, no. 3895 (1969): 751; idem, "Parental Investment, Mate Desertion and a Fallacy," *Nature* 262 (1976): 131-32; idem, "Replicator Selection and the Extended Phenotype," *Z Tierpsychol* 47, no. 1 (1978): 61-76; idem, "Twelve Misunderstandings of Kin Selection" *Z Tierpsychol* 51 (1979): 184-200; idem, "Good Strategy or Evolutionary Stable Strategy," in *Sociobiology:*

Dawkins remained ever consistent to this staple of his naturalistic worldview. Later articles continued along those same lines including *Extended Phenotype* (2004), *Genes Still Central* (2007), and *Evolution of Altruism* (2008).[13] These articles would usher in his ideas well into the twenty-first century.[14] But while maintaining his gene-centered approach to biology, Dawkins began to show signs of divergence from the classic solution. While the selfish gene continued to surface in his writings, alternative solutions began to eclipse the latter. Several moves on his part helped confirm this retreat from his original position.

First, Dawkins made little mention of the classic solution in *The Blind Watchmaker*. Such a downplaying of his favored solution should pique one's curiosity. After all, it had been his answer to the origin of life for well over a decade. Why would he discard a solution that he had promoted at length in *The Selfish Gene*?[15] Ironically, the problem of origins became the central theme of *The Blind Watchmaker*, which afforded its title. Nevertheless, despite the reasons why Dawkins refocused his efforts toward the greater issue at hand, it proves somewhat interesting how he went about it. For unlike the

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Beyond Nature/Nurture? ed. George W. Barlow and James Silverberg (Boulder, CO: Westview Press, 1981): 331-37; idem, "In Defense of Selfish Genes," *Philosophy* 56, no. 218 (1981): 556-73; idem, "Universal Darwinism," in *Evolution From Molecules to Men*, 403-25, ed. D. S. Bendall (Cambridge: Cambridge University Press, 1983) and a co-authored article, Richard Dawkins and J. R. Krebs, "Arms Races Between and Within Species," *Proceedings of the Royal Society of London B* 205 (1979): 489-511. The three articles mentioned above addressed the gene-centered ideology and associated strategies.

[13]Richard Dawkins, "The Extended Phenotype – But Not *Too* Extended. A Reply to Laland, Turner and Jablonka," *Biology and Philosophy* 19 (2004): 377-96. See also idem, "Genes Still Central," *New Scientist* 196, no. 2634 (2007): 18 and idem, "The Evolution of Altruism," *New Scientist* 197, no. 2638 (2008). The first two of these references relate to Dawkins's response/rebuttal to others who had questioned his second text *The Extended Phenotype*. The third reference addressed his view on how the altruistic behavior in animals evolved.

[14]Other articles pertaining to Dawkins's gene-centered model include Dawkins, "Extended Phenotype," 377-96; idem, "Genes Still Central," 18; idem, "The Group Delusion," *New Scientist* 197, no. 2638 (2008): 17; and idem, "The Evolution of Altruism," *New Scientist* 197, no. 2638 (2008).

[15]Dawkins, *The Selfish Gene*, 14ff.

relatively in-depth explanation he gave to the classic solution in his first text, Dawkins spent little time addressing that same solution going forward. Instead, he devoted lengthy stretches of material on a widespread field of options.

Second, he avoided any such model that would fall anywhere near the classic solution. While perusing a plethora of options, note how Dawkins handled that model or anything approaching its basis. Nowhere is this more evident than in how he ignored the *protein-based* model. Given that the classic formula should have neatly explained the first amino acids, it would seem well suited to a protein-based scenario. Why would Dawkins spend so much time describing the rise of amino acids out of that primordial soup? Every protein molecule known to man is composed of amino acids. They function as "the chemical workhorses of life."[16] Therefore, it would only seem logical that if lightning had struck that "soup" and produced amino acids, then the next step toward life would have likely run down the path of proteins. And amino acids do not combine to form nucleic acids, sugars, or the like. Indeed, they form proteins. Whatever the case, Dawkins apparently discounted the advantages instilled in a protein-based system. Even though the model in his first book (and evidently presumed in the second) was of this genre, he elected to discard it moving forward.

Third, Dawkins went out of his way to dismiss not only one of the key ingredients of the Miller-Urey scenario but proteins in general. In *River Out of Eden* (1995), Dawkins evidently found it necessary to clarify these points. There he wrote that "the DNA/protein system wouldn't work in a world of chilled liquid ammonia, but

[16]Robert Hazen, *Genesis: The Scientific Quest for Life's Origin* (Washington, DC: Joseph Henry Press, 2005), 135.

perhaps some other system of heredity and embryology would."[17] Now in all fairness, Dawkins had been specifically addressing a potential extraterrestrial solution. Nonetheless, Miller's landmark experiment had entailed that very same compound – *ammonia* – which had served as one of the four main ingredients of that early Earth concoction.[18] Dawkins's confidence in that experiment seems to be waning. Moreover, in *The Greatest Show on Earth* Dawkins formally denounced the plausibility of a protein-dependent scenario in lieu of RNA World Theory. In recognizing the near impossibility of a protein replicating, he concluded that "the key step in the origin of life cannot have been the spontaneous arising of a protein."[19]

Fourth, he completely overlooked the contributions of Sydney Fox. In this case, it may prove more interesting what Dawkins did *not* say rather than what he did. Specifically, why would he exclude biochemist Sydney Fox from his commentary on origins? He appears to have included virtually every other viable theory to date. Why would he overlook one of the subject's leading authorities? Fox had led the field of protein-based modeling for some thirty years. His *proteinoid microspheres* drew much interest through the late eighties.[20] Why would he ignore the achievements of a man who

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[17]Richard Dawkins, *River Out of Eden: A Darwinian View of Life* (New York: Basic Books, 1995), 151.

[18]Stanley L. Miller, "A Production of Amino Acids Under Possible Primitive Earth Conditions," *Science* 117 (1953): 528-29. As noted in chapter 3 of this dissertation, Miller's experiment presumed an early Earth atmosphere composed of methane, ammonia, water, and hydrogen.

[19]Richard Dawkins, *The Greatest Show on Earth: The Evidence for Evolution* (New York: Free Press, 2009), 420. It is well established that proteins are incapable of replication. Dawkins affirms this fact in pointing out how "they are hopeless at replication."

[20]Sydney W. Fox and Kaoru Harada, "Thermal Copolymerization of Amino Acids to a Product Resembling Protein," *Science* 128, no. 3333 (1958): 1214. Though first publishing his findings while at Florida State University in 1958, Fox continued to promote them until 1988. See Sydney W. Fox, *The Emergence of Life: Darwinian Evolution from the Inside* (New York: Basic Books, 1988). Later, at

most closely embraced the work of Oparin/Haldane and Miller/Urey? Regardless, this evidence suggests that Dawkins's support for the classic solution had gradually diminished over time.

In Defense of Evolution

Dawkins began his new endeavor by developing a multi-pronged effort in defense of Neo-Darwinism. He intentionally wrote *The Blind Watchmaker* with this vision in mind, while specifically targeting that which had become the more porous problem of origins. In the opening chapter, he set out to establish the depth of that problem before returning to it later on.[21] In recognizing the obvious, he had to develop a comprehensive, robust approach that could explain the origin of life. The odds against it were staggering.[22] Because his model lacked original evidence (i.e., dating back to the time of life's alleged origin), he was forced to find an alternative means from which to ground his argument. That plan resulted in a combination of techniques that he has called upon to build a case for how the first replicator arose. These techniques divide into two broad categories: *empirically-based* modeling and *theoretically-based* modeling. The bulk of this chapter will serve to describe the nature and status of these various ideas.

The University of Miami, Fox worked on his protein-first models in addition to analyzing some of the first lunar rocks for the Apollo program.

[21]Dawkins, *The Blind Watchmaker*, 1-18. This opening chapter, appropriately entitled "Explaining the very improbable," sets the tone for this book as did a statement made toward the end of it: "But another question is how the complicated thing came into existence in the first place. This is the question that this whole book is particularly concerned with" (13-14). The title of this chapter and the theme mentioned herein depict what Dawkins set out to explain.

[22]Ibid. To his credit, Dawkins not only acknowledges, but he further elaborates on just how difficult this problem really is. He wrote of "the sheer hugeness of biological complexity" (15) and "the astronomically long odds against the spontaneous arising of order, complexity, and design" (317). Moreover, he specifically addressed both the size and complexity of the cell in addition to the proteins associated with it (120).

Empirical Evidence

After drawing upon evidence that was becoming outdated, Dawkins was forced to scour the horizon for alternatives. The era of optimism had passed as unforeseen obstacles encroached upon earlier solutions. For one, though many had believed that life would have surfaced in the lab at some point, it never came to fruition. Nor did it appear that it would. Several years beyond the sesquicentennial of Darwin's treatise of 1859 and the world had not yet witnessed this feat. Though rather reserved on this particular aspect of the matter, Dawkins had quietly inclined towards its hopeful success.[23] More problematic had been his dependence on the classic solution. His position on this second matter appears to have left him exposed. Nonetheless, Dawkins needed a new solution. Correspondingly, this section will address the solutions he has embraced that most closely entail empirical support. Others, such as Manfred Eigen's *hypercycle,* will be covered in the following section under "theoretical modeling." Though these scholars had engaged in some degree of empirical work, theirs had been primarily theoretical.

What evidence did Dawkins utilize? He readily admits that it would be "difficult to do experiments" regarding origins because "we are talking about the evolutionary timescale here."[24] Three and a half billion years removed from the natural event(s) render such experimentation exceedingly difficult. Moreover, the conditions surrounding any given process or reaction under analysis would beget only an estimate at

[23]Dawkins, *The God Delusion*, 166. See also idem, *The Greatest Show on Earth*, 421. In the latter reference he wrote that "I think it quite likely that chemists will, within the next few decades, simulate in the laboratory a full reconstruction of the events that launched natural selection on its momentous way four billion years ago."

[24]Dawkins, *The Blind Watchmaker*, 210.

best. Such estimates are not only highly debatable but are susceptible to error. Despite these difficulties, Dawkins began to peruse several current empirically-based models.

These later models have helped fill the void caused by the classic solution. More importantly, new data had begun to call into question the validity of the presumed geological and meteorological conditions on the primeval Earth. Experts had to revisit the question of whether a reducing atmosphere was still tenable. At that earlier time, did the Earth have a reducing atmosphere or not? If so, then Miller's experiment may have helped confirm Oparin and Haldane by explaining the first amino acids. But if oxidizing, then Miller's experiment (and the first three quarters of the twentieth century's work on origins) would essentially have been in vain.[25] Oxygen would have almost certainly squelched the assembly of those first organic building blocks. The following section will address this issue prior to looking at the contemporary models supported by Dawkins.

The early atmosphere. As chapter 3 pointed out, the classic solution depended strongly on a reducing atmosphere. Oparin and Haldane had each theorized that prerequisite, though from differing angles.[26] Stanley Miller, then, actualized their joint vision through his 1953 experiment. The entire structure of that "model" depended on that preconceived condition. But debate over the composition of the Earth's early atmosphere has substantially changed over the past few decades. Current findings indicate that the primordial atmosphere may not have been reducing at all. Rather, they

[25]Hazen, *Genesis*, 92-93. At the end of his chapter on Stanley Miller's work, the author acknowledged how some of the more current geological data reveal a very different atmosphere than Miller had assumed. In this text, he wrote that "new geochemical calculations along with data from ancient rocks pointed to a much less reactive early atmosphere of nitrogen and carbon dioxide, two gases that do almost nothing of interest in a Miller-Urey apparatus."

[26]See chapter 2 of this dissertation in regard to the detail of these earlier models.

warrant a neutral atmosphere at best.[27] This updated data, if correct, would render Miller's groundbreaking experiment as virtually obsolete – at least in how it would relate to the terrestrial model. Therefore, those who have heavily invested in the classic approach have been forced to reevaluate their positions.

In light of this new data, a reducing atmosphere now appears less likely. As Joel Levine points out, "early ideas about the composition of the pre-biological atmosphere were strongly influenced by several factors, including spectroscopic studies of the chemical composition of Jupiter."[28] Compared to the earth, the Jovian world boasts an exceedingly heavy atmosphere. But even its thick atmosphere contains only small amounts of methane and ammonia.[29] Nevertheless, the most current data still suggests that the terrestrial planets lie in sharp contrast to the gas giant. The Earth's atmosphere, like several of its terrestrial cousins, appears to have contained substantial levels of carbon dioxide at that earlier time.[30] Carl Sagan and Christopher Chyba write

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[27]Carl Sagan and Christopher Chyba, "The Early Faint Sun Paradox: Organic Shielding of Ultraviolet-Labile Greenhouse Gases," *Science* 276 (1997): 1217-21. The radical shift toward a neutral atmosphere in recent years has generated a whole new set of theoretical and empirical challenges. The scholarly consensus finds that such an atmosphere would severely limit the production of most of the essential organic compounds including amino acids. In this article, Sagan and Chyba admitted that the difference between a reducing and neutral atmosphere would entail "some three orders of magnitude" of these organic products. However, other means by which the effects of the oxygen might have been diminished have also been explored. One study suggests that the addition of an oxidizing inhibitor such as calcium carbonate could substantially improve the amino acid yield. See H. James Cleaves, et al., "A Reassessment of Prebiotic Organic Synthesis in Neutral Planetary Atmospheres," *Origins of Life and Evolution of Biospheres* 38, no. 2 (2008): 105-15. Note, however, that potential scenarios such as these tend to decrease their odds due to further restrictions.

[28]Joel S. Levine, ed., *The Photochemistry of Atmospheres: Earth, the Other Planets, and Comets* (New York: Academic Press, 1985), 12.

[29]S. K. Atreya, et al., "Composition and Origin of the Atmosphere of Jupiter – an Update, and Implications for the Extrasolar Giant Planets," *Planetary and Space Science* 51, no. 2 (2003): 105-12. Table 1 depicts the team's results which indicate relatively low levels of methane (CH_4) and ammonia (NH_3) as compared to hydrogen and helium (107). Other secondary compounds include water, hydrogen sulfide, phosphine, and a lengthy list of trace elements.

[30]The atmospheres of the nearest terrestrial planets, Venus and Mars, boast high percentages

that "a vast reservoir of carbon dioxide is present in [the] Earth's sediments … and in the atmosphere of Venus."[31] Such a high level of carbon dioxide in the rock coincides with the later (non-reducing) models. James Kasting admits that methane and ammonia "may not have been present in the atmosphere of the early Earth."[32] Yet those were the primary ingredients of Miller's experiment.

The older models regarding Earth's accretion (during the prebiotic Hadean period) assumed that it had taken more time for the iron to sink to its present state.[33] As Iris Fry notes, such a case favors the newer "hot heterogeneous accretion model," which has gained ground in recent debate.[34] This latter scenario entails a more rapid accretion of the Earth's layers that would have almost certainly resulted in "an oxidized mantle."[35] Therefore, rather than an abundance of methane and ammonia at that earlier time, these studies suggest that the Earth's atmosphere had been "dominated by carbon and nitrogen compounds, primarily carbon dioxide, carbon monoxide, and nitrogen."[36]

Perhaps even more compelling, recent evidence involving zircon crystals strengthens the case for an oxidizing atmosphere. Known universally for their extreme

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of carbon dioxide – 96.5% and 96.0% respectively. Mercury has a few trace gases in an atmosphere that is virtually inexistent (approximately 1 nPa, which is some 14 orders of magnitude less than Earth).

[31]Sagan and Chyba, "The Early Faint Sun Paradox," 1217.

[32]James F. Kasting, "Earth's Early Atmosphere," *Science* 259 (1993): 921.

[33]The Hadean Eon, which is believed to have lasted between 4.6 and 4.0 billion years ago, describes an extremely dynamic time in the Earth's history consisting of a hellish-like environment (hence the name) and major tectonic activity. The accretion of the Earth's various layers, from core to crust, took time to settle into their present states. How rapidly that accretion took place remains a question of substantial debate.

[34]Iris Fry, *The Emergence of Life on Earth: A Historical and Scientific Overview* (New Bruswick, NJ: Rutgers University Press, 2000), 114.

[35]Ibid.

[36]Kasting, "Earth's Early Atmosphere," 921.

durability, some zircons date back to 4.4 billion years. That places some of the older specimens into the Hadean period as "the sole mineral survivors" of that most ancient past. Dustin Trail and his team from the University of Rochester detected "an oxygen state" in some of these zircons that approaches "present-day conditions."[37] The significance of such a discovery can hardly be underestimated. As Bruno Scaillet and Fabrice Gaillard wrote, the amount of oxygen recorded in these zircons lead the authors "to conclude that Hadean volcanic gases were as highly oxidized as those emitted today."[38] Again, that would imply an oxidizing atmosphere, which would further impede the classic solution.

Not only would this finding help confirm more recent models, but it would buttress the case for oxygen at that earlier time. That would place the oxidation event several hundred million years prior to the earliest known life form.[39] Now given that this discovery is relatively recent, it demands further peer review. But the ramifications of such a finding would agree with other recent data to limit the plausibility of Miller's presumed atmospheric conditions. Moreover, they would substantially affect origin of life research.

Spiegelman's "Little Monster." For his first empirical model, Dawkins turned to Sol Spiegelman's work on the *Q-beta virus*. This particular bacteriophage inhabits the bacterium *E. coli*, which has attracted a great deal of study because of

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[37]Dustin Trail, E. Bruce Watson, and Nicholas D. Tailby, "The Oxidation State of Hadean Magmas and Implications for Early Earth's Atmosphere," *Nature* 480 (2011): 79-82.

[38]Bruno Scaillet and Fabrice Gaillard, "Redox State of Early Magmas," *Nature* 480 (2011): 48-49.

[39]Ibid., 49.

illnesses associated with food handling.[40] The much smaller virus (Q-beta) acts a parasite to the host bacterium where it resides. Former molecular biologist Spiegelman made quite a stir in 1965 with a variant molecule of this virus, which many began to call "Spiegelman's Little Monster." Colleagues had coined that colloquial term to describe the replicating viral RNA of his ingenious experiment as they recognized the significance of the landmark discovery.[41] The procedure called for a combination of the virus's Q-beta replicase (enzyme) and template RNA with a copious amount of RNA-producing material. The ensuing reaction produced new copies of the template RNA.[42] Given that the replication occurred outside of its host bacterium, it had clearly broken new ground. Moreover, the variants (or mutations) between succeeding generations caused what some have interpreted as a low level form of molecular competition.[43]

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[40]*Escherichia coli* is a relatively common bacterium that occurs all too frequently in food manufacturing and handling. Most have come to know it by its more familiar name *E. coli*. Because it has attracted much study, it has serendipitously afforded an opportune specimen for Spiegelman and others to study. The corresponding bacteriophage (or "phage" for short) refers to the parasitic nature of the virus which normally inhabits that bacterium. In this case, that bacteriophage is the Q-beta virus.

[41]Sol Spiegelman, who taught at the University of Illinois at Urbana-Champaign, attracted considerable attention in the sixties when he produced a replicating RNA molecule in the lab. After some fifteen generations of "breeding," he reduced this non-living molecule from 3600 nucleotides to a mere 550. The combination of the experiment's success with its relatively small size resulted in its name: "Spiegelman's Little Monster." After serving at The University of Illinois at Urbana-Champaign for twenty years (1949-69), Spiegelman returned to his alma mater at Columbia University where he led cancer research until 1983.

[42]Sol Spiegelman, et al., "The Synthesis of a Self-Propagating and Infectious Nucleic Acid with a Purified Enzyme, "*Proceedings of the National Academy of Sciences of the United States of America* 54, no. 3 (1965): 919-27.

[43]Reuben Levisohn and Sol Spiegelman, "Further Extracellular Darwinian Experiments with Replicating RNA Molecules: Diverse Variants Isolated Under Different Selective Conditions," *Proceedings of the National Academy of Sciences of the United States of America* 63, no. 3 (1969): 805-11. Dawkins briefly mentioned some of the follow-up research done by Leslie Orgel, et al., who furthered the work performed with these selection pressures. First, in *The Blind Watchmaker* and then later in *The Ancestor's Tale*, he referenced how the addition of ethidium bromide (a poison) would cause certain variants to react differently from others. See Dawkins, *The Blind Watchmaker*, 132-33 and idem, *The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution* (Boston: Houghton Mifflin, 2004), 578. Orgel and his team published the results of this experiment in 1970. See Leslie Orgel, et al., "In Vitro Selection of

Dawkins first alluded to this experiment in *The Blind Watchmaker* as evidence of near replication "from scratch." However, such an extrapolation of the results is still problematic. Though Spiegelman's work on the Q-beta virus represents a remarkable discovery in its own right, we must bear in mind what he actually achieved. Without the existing instructions present in the RNA, this experiment could have yielded nothing approaching true replication. Rather, it demonstrated the ingenious production of a previously existent RNA (and replicase) toward the generation of itself outside the host. In referring to this enzyme and its raw materials, Dawkins freely admitted, that "all they need [now] is to be fed the right blueprints."[44] Indeed, all that they *ever* needed were the complex "blueprints" contained in the associated nucleic acid, which in this case was the original RNA.

But Dawkins wished to convey that something more had occurred. He speculated that this experiment had brought us much closer to resolving the problem of replication. But is that the case? Though a number of newspapers had made a series of similar mistakes in overly extrapolating the results, Spiegelman himself had utterly rejected those claims. Quoted by his alma mater's journal, he clarified the achievement by releasing the following statement: "when you say you 'create' a living object, the presumption is that the object didn't exist before. This we did not do. Working with simple chemical compounds, we take a primer of a living object and generate many living objects from it."[45]

Bacteriophage Q-beta Ribonucleic Acid Variants Resistant to Ethidium Bromide," *Journal of Molecular Biology* 51, no. 3 (1970): 531-39.

[44]Dawkins, *The Blind Watchmaker*, 131.

[45]Roger Signor, "Breakthrough in Biology," *Washington University Magazine* 36, no. 2

Spiegelman did not create some new complexity. Rather, he had taken the *existing* complexity of the Q-beta's RNA and replicase to produce his results. Though the discovery itself still stands as a monumental achievement, it did not resolve the problem of replication. As Dawkins summarized it, we were still left with a "cheat."[46] But did he recognize how much of a "cheat" it really was? Surprisingly, Dawkins only referenced the "Q-beta replicase being present throughout."[47] But was that the only "cheat?" Did he not forget to acknowledge a much greater shortcut as the experiment drew upon the RNA's existing complexity? Meanwhile, Spiegelman himself had done nothing wrong as he openly and professionally acknowledged the limitations of his discovery. The product still required the inherent complexity of the Q-beta RNA to provide the template for replication. Without that critical component, nothing would ever have been achieved. Dawkins appears to have overlooked this finer point. He only recognized the "cheat" of the somewhat *lesser loan* of the enzyme/replicase.

Rebek's autocatalytic system. Six years after writing *The Blind Watchmaker*, Dawkins recognized another potential solution in Julius Rebek's work on self-replicating hybrids. He co-authored an article on this idea with the assistance of biologist Laurence Hurst of The University of Bath.[48] Entitled *Evolutionary Chemistry: Life in a Test Tube* (1992), the two produced what became essentially a layman's abstract of how Rebek's

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(1966): 28-32. Spiegelman's quote in this article helped to clarify his achievements with the Q-beta virus. To his credit, he fully recognized the limitations of his discovery. At no time did he claim to develop the complexity of the RNA or the capacity of its achieving replication without that inherent complexity.

[46]Dawkins, *The Ancestor's Tale*, 576-78.

[47]Ibid., 578.

[48]Dawkins and Hurst, "Evolutionary Chemistry: Life in a Test Tube," 198-99.

autocatalytic system worked. Moreover, they extrapolated the potential of that model in an effort to explain the first replicator.

MIT chemist Rebek had already written a fair amount on this and other related issues. This groundbreaking discovery, however, demonstrated the plausibility of a self-catalyzing system using real materials. He accomplished this goal using the ensuing reaction of amino adenosine (molecule A) with pentafluorophenyl ester (molecule B) to produce a third molecule called amino adenosine triacid ester (molecule C or AATE for short).[49] Most importantly, the resultant C molecule acted as its own catalyst for the original reaction between A and B.[50] Thus, Rebek's team achieved a real autocatalytic reaction using organic materials.

Two years later, Rebek discussed the fine tuning of his discovery in a 1992 article he co-authored with Qing Fang and Tao Kyo Park.[51] In reference to this and a second article published for the American Chemical Society, Dawkins cited Rebek's work as an achievement of both replication and natural selection.[52] He then incorporated a rather generic explanation of this work in *River Out of Eden* (1995) three years later.[53] But not until *The Ancestor's Tale* (2004) did Dawkins provide any relevant detail of

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[49]T. Tjivikua, P. Ballester, and J. Rebek, Jr. "A Self-Replicating System," *Journal of the American Chemical Society* 112, no. 3 (1990): 1249-50.

[50]When a reaction between two molecules A and B produces a third molecule C that is itself a catalyst for that same reaction, then that describes an autocatalytic reaction. In fact, that sort of reaction functions as the textbook example for autocatalysis.

[51]Qing Feng, Tao Kwo Park, and Julius Rebek, Jr. "Crossover Reactions Between Synthetic Replicators Yield Active and Inactive Recombinants," *Science* 256, no. 5060 (1992): 1179-80.

[52]Dawkins, "Evolutionary Chemistry: Life in a Test Tube," 198-99. Herein Dawkins cited both the previously footnoted article in *Science* (1992) and a related article published by the American Chemical Society. See Tae Kwo Park, Qing Feng, and Julius Rebek, Jr. "Synthetic Replicators and Extrabiotic Chemistry," *The Journal of the American Chemical Society* 114, no.12 (1992): 4529-32.

[53]Dawkins, *River Out of Eden*, 143-44.

Rebek's achievements (since the 1992 article).[54] Nonetheless, he did acknowledge its success in obtaining a certain level of autocatalysis, while demonstrating a rudimentary form of pseudo-selection between competing entities.

For whatever reason, Dawkins elected not to follow Rebek's work toward the *encapsulation* of related molecules. That seemingly promising area of the study still plays a substantial part of the overarching argument for abiogenesis. Most notably, Rebek recognized this crucial step in enabling the control of necessary chemical reactions within the presumed replicator. Encapsulation of these prospective molecules vaulted this secondary work into one of the leading examples of a synthetic proto-cell.[55] Through a variety of atomic forces, including hydrogen bonding, van der Waal's interactions, and aromatic stacking, Rebek's team demonstrated how such a three-dimensional molecule might have developed.

Nonetheless, Rebek recognized the limit of his own contribution against the overarching problem of abiogenesis. Like Spiegelman before him, he also professionally acknowledged both the achievement as well as the limitations of his work. In relation to these encapsulating molecules, he freely confessed that his "system's limitations make it a stepping stone on the path toward more sophisticated self-replicating reactions rather than an end unto itself."[56] Likewise, his discovery of the self-catalyzing AATE molecule

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[54]Dawkins, *The Ancestor's Tale*, 571-72.

[55]M. Morgan Conn and Julius Rebek, Jr. "Self-Assembling Capsules," *Chemical Reviews* 97, no. 5 (1997): 1647-68.

[56]I. Amato, "Making Molecules that Copy Themselves," *Science News* 137, no. 5 (1990): 69. See also Julius Rebek, "Synthetic Self-Replicating Molecules," *Understanding Cloning: Science Made Accessible* (New York: Warner Books, 2002). Rebek explained in this latter source what he had achieved in the progress of encapsulation. He referred to it as "small, initial steps toward this goal." That goal refers to the ultimate end goal of complete encapsulation (i.e., of the proto-cell) – a huge step toward obtaining a minima for a life-like self-replicator.

stands as an example of autocatalysis though fully dependent on existing information. Unfortunately, it tends to cling too tightly to its original framework which severely limits any "new reactant [from] com[ing] in."[57] Thus, despite its enormous contribution, he still readily acknowledges the overwhelming challenge at hand. Dawkins acknowledged the "highly artificial" nature of Rebek's chemistry, but appears reluctant to embrace the inherent limitations of this most intriguing work against the backdrop of the problem.[58]

Current Theoretical Modeling.

On a somewhat different front, Dawkins surveyed the field of options for a viable theoretically-based model. In looking to this more abstract type of model, a number of additional considerations come into play. Theoretical models, by their very nature, entail a broad range of assumptions. Should the model depend more on self-replication or incline toward a more network-based strategy? What type of molecular arrangement should one expect? To what degree can a mathematical or computer algorithm aid the process? These are but a few of the key questions that one might consider when attempting to model the origin of life theoretically.

Dawkins centered his attention on four very different kinds of theoretical models, each yielding its own unique strategy. In addition to the computer modeling techniques that were addressed in chapter 3 of this dissertation, he also considered methods forwarded by A. G. Cairns-Smith, Manfred Eigen, and Thomas Gold. By the time Dawkins wrote *The Blind Watchmaker*, he had already made mention of all of these

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[57]Amato, "Making Molecules that Copy Themselves," 69. William Dembski also notes this largely synthetic problem of what he referred to as the ability to "reproduce to accurately." See William A. Dembski and Jonathan Wells, *The Design of Life: Discovering Signs of Intelligence in Biological Systems* (Dallas: The Foundation for Thought and Ethics, 2008), 247.

[58]Dawkins*, The Ancestor's Tale*, 572.

except for Gold, who did not enter the conversation until the publishing of his book *The Deep, Hot Biosphere* (1992). Nonetheless, Dawkins paid the closest attention to Cairns-Smith who developed one of the more unusual models of the three. Similar to the others, his model also faced the greater challenge of having little or no evidence upon which to go on. Nevertheless, Dawkins utilized the bulk of an entire section (chapter 6) on that particular model.

Cairns-Smith's clay replicators. University of Glasgow chemist Cairns-Smith conceived his crystalline model for the origin of life barely a decade after Miller had published his famous experiment on amino acids. In a 1966 paper written for The Journal of Theoretical Biology, he forwarded an idea he appropriately called *genetic metamorphosis*.[59] In essence, that means the transfer of some replicating capacity from one material to another. Cairns-Smith began to use that term to describe the potential transition from a clay or crystalline-based replicator to the common DNA-based replicators of today. In other words, he envisaged the transfer of complexity from something inert and inorganic to something organic. He referred to this transfer as a kind of "scaffolding" that entailed a coordinated structure. The structure would eventually disappear – leaving the built up system behind.[60] Cairns-Smith developed this alternative solution in the wake of what he believed was a less than convincing argument of the classic model. In all three of his books pertaining to this subject, he continued to echo his

[59]A. G. Cairns-Smith, "The Origin of Life and the Nature of the Primitive Gene," *Journal of Theoretical Biology* 10, no. 1 (1966): 53-88. See also idem, *The Life Puzzle* (Edinburgh: Oliver and Boyd, 1971), 115 and 137ff.

[60]A. G. Cairns-Smith, *Seven Clues to the Origin of Life* (Cambridge: Cambridge University Press, 1985), 59ff. Cairns-Smith used the idea of a scaffold as an analogy to what he believed happened from a molecular standpoint. Like a scaffold erected around a wall being built, the scaffolding would eventually be removed, leaving the constructed wall in place. He saw the scaffolding as a means to produce the resulting structure.

marked distrust for that reigning though popular explanation. Cairns-Smith boldly suggested that Miller's "experimental results may be misleading."[61] In accordance with that position, he listed nineteen "difficulties" in rebuttal to that theory. His conclusion, which he declared in *Genetic Takeover*, states that "it is really naïve simply to assert that the previtral simulation experiments confirm the doctrine of chemical evolution."[62]

From Cairns-Smith's point of view, the classic solution had fallen well short of what it allegedly affirmed. Some other approach had become necessary. That need set the stage for his crystalline-based model, which he claimed could provide the kind of template necessary for the ensuing complexity. Given that clays and silicates are ubiquitous materials, they would have been readily available. And their stunning portrayals of complexity rank among the most ornate structures found in nature. These facts further attracted his interest. They afforded him an idea for how nature could theoretically achieve complexity on its own. But how could an inert lump of clay produce and direct information? Cairns-Smith speculated that the *defects* found within the crystalline structures themselves might provide a form of information. Along those lines, he mentioned several kinds of physical defects that might function in this way. He discussed "point, line, and plane defects,"[63] which could be further broken down into subcategories having "vacancies, substitutions and dislocations."[64] Whether these defects can actually store and transfer information remains a subject of debate. That

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[61]Cairns-Smith, *The Life Puzzle*, 110ff.

[62]A. G. Cairns-Smith, *Genetic Takeover and the Mineral Origins of Life* (Cambridge: Cambridge University Press, 1982), 64. The author also lists nineteen "difficulties" or problems he finds against the classic theory in this text (56-58).

[63]Cairns-Smith, *The Life Puzzle,* 16.

[64]Cairns-Smith, *Genetic Takeover*, 267.

"information" may not satisfy the specifications for how the rest of science defines information. Would the message carried within the defective areas of crystals fulfill the criteria of Dembski's complex, specified information (CSI)? It would likely fail at least two of the three criteria: contingency and specification.[65] Perhaps one could argue that it carries some other form of information.

Irrespective of such debate, for any model to successfully portray Neo-Darwinism it would have to account for both replication and the increase of complexity. Can Cairns-Smith's solution account for such increase? Moreover, can it provide an authentic form of replication?[66] Dawkins appears to think that it can for he has repeatedly demonstrated his interest in the model. In *The Blind Watchmaker*, Dawkins claims that it shows "some properties of replication, multiplication, heredity and mutation."[67] In this model, Dawkins sees a system which could theoretically furnish all of those ingredients "for a form of cumulative selection to get started."[68]

Looking at the mechanics of the model, Cairns-Smith explained how these crystals could theoretically replicate. He notes how the type of material, its orientation and geometry, and manner of growth could all combine to affect its replicating

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[65]William Dembski, *Intelligent Design: The Bridge Between Science and Technology* (Downers Grove: Inter Varsity Press, 1999), 128.

[66]Hazen, *Genesis*, 164-65. In a brief critique of the potential testing available for Cairns-Smith's crystals, Robert Hazen recognizes the limits of current technology. He points out how ordinary DNA-based testing has enjoyed decades of investigation. But "an adequate clay-particle population survey, is beyond any current technology."

[67]Dawkins, *The Blind Watchmaker*, 153.

[68]Ibid. Dawkins saw in Cairns-Smith's model more than just a crystalline theory. The two not only find common ground in their classic gradualist mentality, but in their gene-centered approach to biology as well. See Cairns-Smith, *Seven Clues to the Origin of Life*, 3 and idem, *The Life Puzzle*, 71. The first reference mentions the latter's agreement with "gradualism," while the second describes his "gene-centered approach" to biochemistry.

capacity.[69] Furthermore, he speculated on their selection ability in *The Life Puzzle*. The seventh chapter of that text describes the potential for clays to be "Sloppy," "Sticky," and/or "Lumpy."[70] Each "variant," he claimed, could theoretically compete in the sense of staying intact or decomposing due to the inherent "survival" conditions of the environment such as weathering (e.g., rain washing "weaker" clays away). Dawkins further expounded on this idea using a series of genetically-packed terms including "instructions," "family tree," "genes," and "successful."[71] But are these terms applicable? Regardless of whether they are or not, Dawkins sees potential in this unique model. He referred to the alleged mutation/selection of these clays as potential evidence of Neo-Darwinian behavior – before acknowledging that his illustrations had been "little flights of fancy, embellishments of Cairns-Smith's own."[72]

In summary, Cairns-Smith went against the conventional mindset in not only promoting a rather extraordinary idea, but in willingly challenging the status quo and its seemingly indisputable solution. But whether his model will ever become a viable option in the eyes of the scientific community remains questionable. More than anything else, his model lacks concrete evidence.[73] And without at least some level of empirical support, it will undoubtedly continue to struggle in acquiring the support of fellow

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[69]Cairns-Smith, *Genetic Takeover*, 273ff.

[70]Cairns-Smith, *The Life Puzzle*, 131-33.

[71]Dawkins, *The Blind Watchmaker*, 153-55.

[72]Ibid., 155.

[73]Leslie E. Orgel, "The Origin of Life – A Review of Facts and Speculations," *Trends in Biochemical Sciences* 23 (1998): 493. In this review of origin of life theory, Orgel sharply criticizes Cairns-Smith's model for its lack of empirical evidence. He concludes that "Cairns-Smith's postulate of an inorganic life form has failed to gather any experimental support. The idea lives on in the limbo of uninvestigated hypotheses."

scholars. Despite this fault, Dawkins has continued to allude to this model as a favored option in several of his later books.[74] It would seem that his interest goes beyond simply flying "a kite for a somewhat less-fashionable theory."[75]

Manfred Eigen's hypercycle. Dawkins discussed the potential of a second theoretical model that has attracted attention since its introduction some thirty years ago. Though only mentioning the work of Manfred Eigen in *The Blind Watchmaker*, Dawkins more fully engaged his contribution later on.[76] The German biochemist had broken onto the scene through his follow-up work on what Spiegelman and Orgel had begun through RNA. Dawkins cited that advanced work on autocatalysis at that earlier time before engaging Eigen's greater contribution two decades later.[77] Through this latter achievement, Eigen had blended the advantages of a self-organizing mechanism with an interactive network – resulting in an ingenious theoretical system known as the *hypercycle*.[78]

With the necessity of some form of autocatalysis in mind, Eigen intended to take a step further toward increasing the overall information capacity of a given system.

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[74]Dawkins, *River Out of Eden*, 151. See also idem, *A Devil's Chaplain*, 45 (in regard to crystals) and idem, *The Ancestor's Tale*, 552, 567.

[75]Dawkins, *The Blind Watchmaker*, 148.

[76]Ibid., 133. In this initial text in defense of Neo-Darwinism, Dawkins alluded to Eigen's experimentation following Sol Spiegelman and Leslie Orgel. After the great strides made by these early pioneers (regarding the autocatalysis of Q-beta virus RNA and its reaction to ethidium bromide), Eigen had taken things one step further. He had worked a similar experiment without the template RNA. See M. Eigen, et al., "The Origin of Genetic Information," *Scientific American* 244, no. 4 (1981): 88-118.

[77]Dawkins, *The Ancestor's Tale*, 572-74.

[78]Manfred Eigen, "The Hypercycle: A Principal of Natural Self-Organization – Part A: Emergence of the Hypercycle," *Die Naturwissenschaften* 64, no. 11 (1977): 543. Eigen cited two well-known cycles found in nature that led him to envision a similar arrangement of cooperating reactions. Both the Krebs or "citric acid" cycle (cellular respiration) and the Bethe-Weizsacker or "carbon" cycle (of larger stellar systems) function through a cyclical ring of reactions.

Scholars in the field of abiogenesis had come to the consensus that autocatalysis played an essential part of the origins process. Each model was virtually expected to include it. But Eigen planned to modify that prerequisite in his new model. Though he thought that a single reaction could obtain a certain level of complexity, perhaps a series of cooperating reactions might "raise the system to a new [and higher] level of organization."[79] Certainly, the limited complexity of previous systems had not come anywhere near that which life demands. The resulting complexities from experimentation had fallen many magnitudes short of real systems. While forging ahead to press the envelope further, Eigen still recognized the inherent need for simplicity (or achievability). The system needed to remain within the realistic range of probability. Yet without sufficient complexity, all hope of achieving real-life replication would remain out of reach. Eigen envisaged a sustainable set of progressing, yet interactive reactions to ever achieve this goal. And those reactions would have to entail an autocatalytic-like property to be self-sustaining. So in keeping in mind the "sufficiently simple," he also stretched ahead toward greater complexity.[80]

In planning this model, Eigen organized a list of prerequisites. First, he realized that the model would need a series of "steps." Again, no single step could bridge the enormous gap toward true replication.[81] In fact, his entire project of the hypercycle itself would probably fulfill but one of the steps in the overall process.[82] Therefore, it had

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[79]Ibid., 541.

[80]Ibid.

[81]Ibid, 542.

[82]Ibid. Eigen envisaged rather "a sequence of reactions." And not just the immediate ring or chain of reactions implied by a single hypercycle arrangement, but multiple cycles. He admitted "that catalytic hypercycles are a minimum requirement for a molecular organization that is capable to

to remain simple enough "to admit an origination of finite probability."[83] Though a theorist, Eigen sought that which is real and tangible. Second, the resulting molecular arrangement had to obtain the level of "quasi-species."[84] That was the term he used to suggest a macromolecule that demonstrated the minimum properties of metabolism, self-reproduction, and mutability. Eigen believed that those minimum attributes would enable at least some degree of Darwinian selection. And that would imply a rudimentary form of competition between variants. Third, the model would have to involve "highly evolved enzymic replication machinery."[85] In that way, one could achieve a certain level of complexity, while sustaining its stability. As he noted in the ensuing discussion, "at least one, but possibly all of the intermediates themselves [would need to be] catalysts."[86] Therefore, the individual components of the hypercycle itself would require a whole series of cooperating enzymes to assure the self-sustaining cycle. Finally, it must reflect "the present genetic code" of real systems and the minimal requirements of information content. Otherwise, it would not model the organized properties of the real system.[87]

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accumulate, preserve, and process genetic information (542). He explained that these could provide "hierarchies of reaction cycles" (543), but "their role in molecular self-organization is limited." This last statement reflects part of Eigen's conclusion to Part B of his paper. See Manfred Eigen, "The Hypercycle: A Principal of Natural Self-Organization – Part B: The Abstract Hypercycle," *Die Naturwissenschaften* 65 (1978): 41.

[83]Eigen, "The Hypercycle: Part A," 541.

[84]Ibid., 549. Interestingly, Eigen and Dawkins part ways somewhat in regard to natural selection. Though Dawkins considers natural selection to be a post-replicating mechanism, Eigen argues that it could have existed to some degree prior to replication. See Dawkins, *The Blind Watchmaker*, 140-41 and Eigen, "The Hypercycle: Part A," 547ff on this latter point.

[85]Eigen, "The Hypercycle: Part B," 7.

[86]Eigen, "The Hypercycle: Part A," 544.

[87]Ibid., 541.

In detailing Eigen's model, one would begin with a ring of cooperating reactions moving in complexity like a kind of upwardly directed helix. Each point along the resulting chain of reactions would then function as a catalyst for the succeeding reaction until the round of reactions made full circle. In this way, the system would function as a symbiotic set of cooperating autocatalytic reactions. Interestingly, Eigen's depiction and illustration of the model reflects a symmetrical appearance.[88] Several other scholars have envisioned similar sets of reactions though in an asymmetric fashion. Wim Hordijk and his team at Oxford suggested a set of reactions that formed an exceedingly irregular pattern.[89] Biebricher and Schuster forwarded a similar idea to the European Commission on Science Research Development in 1995.[90] But Eigen's model has remained center stage in attracting attention. Moreover, his mathematical support and detailed explanation has been second to none. He discussed the mathematical portion of his model at length in the second part (Part B) of this three-part series.

However impressive Eigen's model appears, it has still struggled without empirical support. Although he has fully acknowledged this inherent weakness in his model's realization, he would like to achieve at least some degree of proof in its defense. Despite Dawkins's confidence in this model's potential to resolve the "catch-22 riddle of life," it still struggles in moving beyond pure theory.[91] Eigen needs to address several

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[88]Ibid, 543-46.

[89]Wim Hordijk, Jotun Hein and Mike Steel, "Autocatalytic Sets and the Origin of Life," *Entropy* 12 (2010): 1736.

[90]Christof K. Biebricher, Gregoire Nicolis, and Peter Schuster, "Self-Organization in the Physico-Chemical and Life Sciences," *The European Commission of the Directorate General XII for Science, Research & Development*, Report no. 16546 (1995): 10.

[91]Dawkins, *The Ancestor's Tale*, 574.

issues that plague this model.[92] For example, Rauchfuss asks "how did the first hypercycle emerge in the first place?"[93] Indeed, how does one account for the self-assembly of such a large number of mutually cooperating reactions? Moreover, how can Eigen's system explain how the ensuing ring of reactions can sustain its composition in moving upward in complexity? How can an entire set of reactions remain stable during the complex interplay of so many reactions? These challenges face exactly what Michael Behe views as irreducible complexity. The problem of molecular complexity has not gone away. Nonetheless, Eigen's model is a brilliant idea that has held its place among competing models.

Thomas Gold's deep, hot biosphere. On the heels of the classic model's eroding support, many researchers began to search out very different ways for resolving the origin of life. A neutral or oxidizing atmosphere would have undoubtedly obstructed the synthesis of the more common organic molecules. But that environment might not have played as much of a factor given certain isolated conditions. The model proposed by Thomas Gold actually thrives in the more unique, "out-of-the-ordinary" environment. His model depends on a type of microbial life known as an *extremophile,* which only survives under the most pressing conditions. Many of these organisms prefer the boiling

[92]Freeman Dyson, *Origins of Life*, 2nd ed. (Cambridge: Cambridge University Press, 1999), 78. In this text, Dyson references "Ursula Niesert's computer simulations" which he claims "exposed several serious weaknesses of that model." Likewise, Horst Rauchfuss of the University of Dortmund in Varberg, Sweden indicates similar reservations having to do with *error catastrophe*. In this text he details several "doubts about the problem of error catastrophe" similar to the concerns of Niesert and Dyson. See Horst Rauchfuss, *Chemical Evolution and the Origin of Life*, trans. Terence N. Mitchell (Berlin: Springer-Verlag, 2008): 226-27. Both of these sources also reference works by Ursula Niesert. See also Ursula Niesert, "How Many Genes to Start With? A Computer Simulation About the Origin of Life," *Origin of Life and Evolution of the Biosphere* 17, no. 2 (1987): 155-69 and U. Niesert, D. Harnasch, and C. Bresch, "Origin of Life Between Scylla and Charybdis," *Journal of Molecular Evolution* 17 (1981): 348-53. Eigen also recognized this problem concerning error catastrophe. See Eigen, "The Hypercycle: Part A," 550-53.

[93]Rauchfuss, *Chemical Evolution and the Origin of Life*, 226.

temperatures of a subterranean ocean vent. Others survive within the frozen ice sheets beneath Antarctica. Nonetheless, they each persist under conditions that would ordinarily eliminate any common form of life.[94] But such extreme conditions can often provide the scenario for these extremophiles. And some of these fit Gold's model.

Gold's idea offers an ingenious option for how life could have circumvented a *non-reducing* atmosphere. He simply discarded the poor surface conditions for what he called "another domain."[95] That domain, which centers about "ocean vents," effectively removes the likelihood of an otherwise chemically antagonistic atmosphere.[96] Moreover, it also sidesteps the most common source of energy, which is sunlight. Whereas most origin of life models match that ultimate energy source with the immediate demands of the organism, Gold sees potential in a more local alternative. The deep regions of the Earth contain a wide array of chemical materials and a virtually unlimited source of both heat and chemical energy. These provisions form the basis for Gold's unique approach to abiogenesis.

His multifaceted theory suggests that tectonic and early accretion forces were responsible for the origin of petroleum – an idea that runs in direct conflict with conventional theory (which presumes the gradual degradation of ancient fossil life). Nevertheless, Gold thinks that a combination of chemical energy and material in that subterranean environment might have afforded the right conditions for certain extreme forms of life. He further speculates that these extremophiles could have fed off of the

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[94]Science has uncovered a wide spectrum of extremophiles under varying conditions. They persist in not only the extreme temperatures of Artic cold or volcanic vents (heat), but in the highly acidic and alkaline conditions as well.

[95]Thomas Gold, "The Deep, Hot Biosphere," *Proceedings of the National Academy of Science* 89 (1992): 6045.

[96]Ibid.

petroleum, which would have risen up from those lower regions. Hence, the extremophiles could have birthed the abundance of life found on Earth. Therefore, he envisions a joint theory that explains both the origin of petroleum and the origin of life simultaneously.[97]

Richard Dawkins saw merit in this rather unusual explanation for life's origin which he described in *The Ancestor's Tale* (2004). After all, he had already succumbed to the idea that the ultimate explanation for life would elude the obvious. He readily conceded that it would "positively *not* be a plausible theory" (italics mine). Otherwise, he wrote, "life should be common."[98] Therefore, this philosophical side road toward virtually any other model has opened up a whole new venue for eccentric models. Unfortunately, that describes how much of the scientific community has perceived Gold. Dawkins even referred to him as yet "another maverick," for he had indeed walked a fine line between genius and the enigmatic.[99] On one hand, Dawkins notes that Gold has things right on a number of fronts. For example, Gold recognizes that the extreme heat and pressures existing in these deep sea vents resemble the conditions projected of the Hadean period. On the other hand, some of his fundamental premises in regard to the origin of petroleum run completely against the scientific establishment. However one

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[97]Thomas Gold, *The Deep Hot Biosphere: The Myth of Fossil Fuels* (New York: Springer-Verlag, 1999). The author spent the bulk of this text in supporting a fairly old theory that he has revived. It suggests an alternative origin for the petroleum of the world. Generally speaking, the model contrasts with conventional thought, which suggests a biological origin for petroleum. Massive forces acted on decaying material to form the world's oil resources. Gold's theory, however, believes that petroleum came from vast resources well beneath the Earth's crust and formed during the Earth's accretion. Cracks within that crust gradually admit portions of that petroleum to ooze forth into the reservoirs of today. Gold suggested a follow-up corollary to this theory, which projects a rather unique theory to the origin of life. According to Gold, the earliest life might have fed off those petroleum deposits to extract their chemical energy.

[98]Dawkins, *The Greatest Show on Earth,* 422.

[99]Dawkins, *The Ancestor's Tale*, 579.

reacts to Gold's ideas, Dawkins openly confessed that his deep, rock theory was "especially appealing."[100]

But what drove Gold to conceive of such a divergent model? What was his background leading up to these ideas? Thomas Gold portrayed the modern day "general scientist," who had intrepidly dabbled about in a number of disciplines.[101] Formally trained as an astrophysicist, he had begun his work alongside Hermann Bondi and Fred Hoyle during World War II. In providing some of the foundational research on radars, he had inadvertently prepared himself for the eventual design of radio telescopes later in life. In time, he found himself teaching astronomy at Cornell while pondering the concepts of background radiation and steady-state theory.[102]

Returning to the sixties, Gold had already made his mark in astrophysics. The space program had gradually gained momentum in that virtually untapped field of research where Gold served as a consultant. In probing through a number of research areas, one exceptional idea attracted his attention. He saw potential in extremophiles. Astrobiologists had previously considered the idea of an alien bacterium that had latched onto a stray meteorite and seeded life on Earth. Whether through the sheer accident of some ejected piece off another world or the direct intervention of some alien race, the idea that a bacterium could have survived through the extreme conditions of space came to the forefront. Gold took special interest in this unfolding field of astrobiology. These

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[100]Ibid., 580.

[101]Ibid., 579.

[102]H. Bondi and T. Gold, "The Steady-State Theory of the Expanding Universe," *Monthly Notices of the Royal Astronomical Society* 108 (1948), 252-70. See also Stephen Hawking, "Sixty Years in a Nutshell," *The Future of Theoretical Physics and Cosmology*, G. W. Gibbons, E. P. S. Shellard, and S. J. Rankin, eds. (Cambridge: Cambridge University Press, 2003), 109.

factors not only influenced his offshoot theory on "accidental panspermia," but toward his controversial *deep, hot biosphere theory* regarding the origin of life.

Unfortunately for Gold, most of his ideas encountered heavy resistance. His relationship with NASA eroded over time and his "deep rock theory" never gained support. Though making formidable contributions to radio telescope research and astrophysics in general, his later theories gained him an eccentric reputation. His ensuing theory on the origin of petroleum, which was deeply connected to the "deep, hot biosphere," collapsed in the face of ongoing geophysical research.[103] Nevertheless, his gross achievements across a number of fronts have made an impact on science.

Though recognizing the sheer ingenuity of some of Gold's work, how much weight should Dawkins place on his unconventional theory? Should he follow a virtually unsupported and untested idea in lieu of the massive amount of research that has already been poured into the geophysical industry? Dawkins's interest in Gold's model seems to put him on unsteady ground. Despite his retreat from the classic theory, should he embrace such a theory that would defy all odds? Without question, some form of concrete evidence would be necessary for the scientific community to reconsider this theory. But it has much to prove as it hinges upon a complete revision of the origin of petroleum while revisiting the unsubstantiated existence of primordial extremophiles – which allegedly arose out of the "volcanic vents on the floors of deep oceans."[104]

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[103]Gold's unique approach to the origin of petroleum has attracted a host of criticisms, particularly from within the geoscience community. For further discussion on these rebuttals to Gold, see Geoffrey P. Glasby, "Abiogenic Origin of Hydrocarbons: An Historic Overview," *Resource Geology* 56, no. 1 (2006), 85-98; Jean Laherre, "No Free Lunch, Part 1: A Critique of Thomas Gold's Claims for Abiotic Oil," *The Wilderness Publications* (2004); and Alton Brown, "Up-Dwelling of Hot Gas," *American Scientist* 87, no. 4 (1999).

[104]Dawkins, *The Ancestor's Tale*, 579.

Computer modeling. Over the past few decades, many have turned toward computer-based modeling to help determine the means by which the first replicator arose.[105] These methods have surfaced in part to help guide empirical discovery while filling in the void where the science lacks data. In essence, computer modeling can explore avenues where empirical science has not yet been. To date, these programs have played an increasingly large role in origin of life research.

As was established in chapter 3 of this dissertation, Dawkins wrote several of these programs in buttressing his case for evolution and the origin of life.[106] In addition to his own programming, he has often turned to professional programmers who have addressed these and related issues.[107] Dawkins has especially welcomed the visual imagery that accompanies this type of tool. As he admits, "the computer can be a powerful friend to the imagination" and to a limited degree he may be right.[108] The technological advancement of tools ranging from computer-aided design (CAD) to computer-aided modeling (CAM) has barely scratched the surface of what these systems

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[105]Daniel Segre, Doron Lancet, Ora Kedem and Yitzhak Pilpel, "Graded Autocatalysis Replication Domain (GARD): Kinetic Analysis of Self-Replication in Mutually Catalytic Sets," *Origins of Life and Evolution of the Biosphere* 28 (1998): 501-14. See also Suzan Mazur, "The Origin and Synthesis of Life: An Interview with Doron Lancet," *Counterpunch* (2012). This first reference provides a detailed (technical) description of one of the more recognized computer models designed for abiogenesis. The second reference entails a related interview with one of the key researchers of that model.

[106]See chapter 3 of this dissertation under the heading "Richard Dawkins's Computer Simulations."

[107]Dawkins, *River Out of Eden*, 79-83. See also idem, *Climbing Mount Improbable* (New York: W. W. Norton & Company, 1986), 58ff and idem, *Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder* (Boston: Houghton Mifflin Company, 1998), 293. In the first reference, Dawkins detailed a set of computer models written by Dan Nilsson and Susanne Pelger that targeted the unfolding evolution of the eye. The second reference alludes to a program written by Fritz Vollrath in regard to the evolution of spider behavior. The final text references a quote from a representative from Microsoft who briefly described the increasing power of computer programming. Dawkins has always been enamored with the enormous potential offered by computers as he has argued from the beginning. Several of the models he has referenced herein have directly or indirectly involved some level of computer modeling (e.g., Manfred Eigen's hypercycle). See Eigen, "The Hypercycle: Part A," 555ff.

[108]Dawkins, *The Blind Watchmaker*, 74.

are ultimately capable of. But despite the near exhaustive capacity for computers to "crunch numbers" and add visualization, they can also potentially go too far in venturing beyond that which empiricism can validate.[109]

[109]As befitting any usable theoretical model, computer models hinge upon the same basic inputs including: the assumptions of the programmer, the parameters (and values) he or she assigns, and the general approach by which reality is artificially presented. Therein lays its most formidable obstacle. How does the model reflect the real world? That question becomes all the more acute in respect to conditions in the past. But in modeling something more familiar or tested, such as an aircraft or bridge, the inputs can reasonably be ascertained. Hence, the corresponding program or model becomes virtually unlimited. Only time, effort and technology (and perhaps finances) stand in the way. The forces acting on that bridge or the characteristics of the corresponding flight can usually be physically measured and tested. But in the case of origins, one can only speculate as to the specific conditions of the past. Clearly, the programmer requires a certain degree of empirical support to function as his reference. Without sufficient empirical support as a guide, any given model would essentially operate "in the blind." It would have nothing to go on in which to model. Therefore, regardless of the ingenuity of the programmer, the success of the program is inherently limited to the corresponding depth of the evidence at hand. Beyond that, the programmer is left to his own ideas and presumptions.

CHAPTER 6

DAWKINS'S INTEREST IN PANSPERMIA

Introduction

Toward the ultimate goal of resolving the origin of life, Richard Dawkins has eventually gone the way of many scholars who have considered the heavens as an option. However, after explaining in the endnotes of *The Selfish Gene* what appeared to be a change of theoretical allegiance, he has become much more guarded in how he has couched his position.[1] Nevertheless, he has still expressed his interest in terms that sufficiently establish that position. Before describing the classic soup theory in relative detail, Dawkins tacitly declared that the "simplified account [that he] shall give is probably not too far from the truth."[2] However, several books later he admitted to his more recent support of RNA in saying that "a majority of biologists are moving towards the 'RNA World Theory,' *and for reason that I find quite persuasive*" (italics mine).[3] But during the years between these admissions, Dawkins afforded similar interest to the multifaceted idea of *panspermia*. As he had freely offered in his now infamous interview

[1]Richard Dawkins, *The Selfish Gene*, 2nd ed. (Oxford: Oxford University Press, 1989), 269. This section of endnotes was absent in the first edition of this text. Adding it to his second edition allowed Dawkins to explain a number of assertions from his earlier edition. Otherwise, the second edition made no changes to the original except to add a preface, two new chapters, and a section of endnotes.

[2]Ibid., 14.

[3]Richard Dawkins, *The Greatest Show on Earth: The Evidence for Evolution* (New York: Free Press, 2009), 419.

with Ben Stein, Dawkins described the theory as having "intriguing possibility."[4] Nonetheless, that statement sounds like an understatement from a veteran scholar who does not wish to overplay his position.

As has been alluded to earlier in this paper, some of the leading minds in science have poured copious amounts of both time and energy into the exploration of space. Its virtually unlimited expanse has intrigued mankind since antiquity and has only been thrust further into the forefront through the recent achievements of our times. Space is a virtually untapped realm that not only offers science the opportunity to prove life elsewhere but entertains the aforementioned theoretical oddity that could possibly explain the origin of life on Earth – that is, through panspermia.

History of Panspermia

Looking back to the history of the concept, panspermia has been around for centuries though through a variety of manifestations. As previously established, even the early Egyptians had well developed mythological explanations about the surrounding cosmos. Several of their stories included some form of *proto-panspermic* episode which usually centered about the reigning pharaohs and their interaction with the gods who held the power to create and destroy.[5] For them, the origin of the sun and the stars, all of life,

[4]Richard Dawkins, "Interview with Ben Stein," in *Expelled: No Intelligence Allowed*, DVD, directed by Nathan Frankowski (Universal City, CA: Premise Media Corp., 2008). At The 2009 American Atheists Convention in Atlanta, Dawkins declared that there had been a massive abuse of his comments in a manner he called "quote mining." He referred to his comments in the above film along those lines. He was essentially criticizing those who had taken his quotes out of context. Understandably, that kind of mistake constitutes a serious matter that any conscientious scholar would hope to avoid. Nevertheless, Dawkins would certainly welcome the honest peer review of his works much the same as anyone else in academia. Abuse of this review process, however, should not obtain special treatment for anyone. See idem, "Ludicrous, Ridiculous, Impossible," *2009 American Atheists National Convention,* Atlanta (April 9-12, 2009).

[5]Similar to those who refer to proto-life or proto-cell, Robert Temple used the term "proto-panspermic" to explain the ancient beliefs that proceeded, yet were similar to, the later idea of panspermia.

and even the Earth itself were a mere product of these creator gods. As Robert Temple described it, the creator god became "the source for everything," seeding anything and everything that would come into existence.[6]

In a similar fashion, the Indus Valley was also enamored with the same kind of storytelling. The *Golden Egg* mentioned earlier in this dissertation was but one example of how fertility lay at the base of their belief system.[7] It also serves as an example of this culture developing an early form of panspermia that explained life and the cosmos. Centuries later, it was the Greek philosopher Anaxagoras who propelled the theory into the modern era as he took the idea one crucial step further. He envisioned the actual connection between the composition of the seed (Greek *spermata*) and its corresponding phenotype.[8] In moving away from myth and magic, he had begun to see the relationship between the two.

Since the Enlightenment, a number of scholars have considered variants of this ancient "seed-based" theory. In 1821, Sales-Gyon de Montivault suggested that life on Earth came from spores originating on the Moon. A generation later, others had entertained similar versions of this theory ranging from Jons Jacob Berzelius to H. E. Richter and from Lord Kelvin to Hermann von Helmholtz. Each of these theorists believed that the seeding had occurred on Earth through some combination of comets, meteorites, and/or transplanted Martian rock. In their time, these ideas seemed logical

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[6]Robert Temple, "The Prehistory of Panspermia: Astrophysical or Metaphysical?" *International Journal of Astrobiology* 6, no.2 (2007):171. Temple is an American writer who is steeped in Oriental history.

[7]See chapter 2 of this dissertation for a detailed history of abiogenesis.

[8]P. V. Grujic, "The Concept of Fractal Cosmos: I. Anaxagoras' Cosmology," *Serbian Astronomical Journal* 163 (2001): 28. Though the works of Anaxagoras survive through mere fragments, the general framework of his cosmology is still evident in the portrayal of life and the cosmos. His connection of the micro "seed" with the "macro" phenotype is especially noteworthy.

given that Pasteur had disproved spontaneous generation. Understandably, many scholars were satisfied to simply "'postpone' the riddle of the origin of life from planet to planet *ad infinitum*."[9]

Panspermia offered a reasonable alternative to the seemingly contradictory position of men like Thomas Huxley who readily accepted the condemnation of spontaneous generation while holding fast to a particular facet of it.[10] Science still required that archaic theory to explain the beginning of life at some point in time. For Huxley, spontaneous generation was an outrageous concept – except for that one time it became necessary.[11] In contrast, panspermia offered scholars a non-contradictory option with even more time to work with.[12] Moreover, it presented no real challenge to the exchange of inanimate matter and life. As Fry points out, "all the versions of panspermia were based on the dualistic conception that life could not have arisen from inanimate

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[9]Iris Fry, *The Emergence of Life on Earth: A Historical and Scientific Overview* (New Brunswick, NJ: Rutgers University Press, 2000), 60.

[10]Thomas Huxley, *Discourses: Biological and Geological Essays* (New York: Appleton and Company, 1894): 256-57. While in total agreement with the achievements of Redi and Pasteur, Thomas Huxley still felt inclined to entertain a special exception to spontaneous generation when it was demanded by the generation of life itself. In claiming that this scientific "expectation [was] permissible where [his] belief [was] not," he was decidedly speculating from his worldview. In essence, his backward projection into geological time permitted him to speculate about how the forces of nature could have somehow engendered the first protoplasm out of inanimate matter. In the end, he at least acknowledged that his opinion had been "an act of philosophical faith."

[11]Ibid., 255-56. Huxley admitted during the Presidential Address to the British Association of Science in 1870 (see chapter 2 of this dissertation) that he "must carefully guard [him]self against the supposition that [he] intends to suggest that no such thing as Abiogenesis ever has taken place in the past, or ever will take place in the future." Huxley realized that spontaneous generation must have occurred at some point in history for life to have ascended from inanimate matter *through natural processes*.

[12]Francis Crick, *Life Itself: Its Origin and Nature* (New York: Simon & Schuster, 1981), 116. In consideration of life evolving elsewhere in the universe, Crick pointed out the much greater time element that would have been available. Given that the universe is estimated to be several times older than the Earth (and Solar System), then it makes sense that more time would have been available for evolution outside of the Earth. He writes that "there is enough time for life to have evolved not just once*, but two times in succession*."

matter because life and matter belong[ed] to two distinct categories."[13] Panspermia had rendered spontaneous generation unnecessary – at least in an immediate sense. But as Crick points out, it "merely transfers the problem elsewhere."[14] Nevertheless, it provided an alternative that fit the time – *omne vivum ex vivo*.[15]

By the 1900's, Swedish physicist Arrhenius made one of the more remarkable contributions of his era in conceiving an idea based on life *spores*. Like J. B. S. Haldane after him (who forwarded a similar effort in 1954), he envisioned an exchange of these spores between planets. However, not until a particular paper was published in 1972 did the theory gain any real traction. In that year, Nobel laureates Francis Crick and Leslie Orgel described their potential solution as *directed panspermia*.[16] Since that time, NASA and a host of other space agencies have explored this new avenue, albeit through the alternative version of the theory known as *natural panspermia*.

Explanation of the Theory

Panspermia is a fairly straightforward theory despite its many variants. However, it neatly divides into two main categories*:* *natural* and *directed*. Natural panspermia encompasses the various means by which life could have been transported naturally – or without agency. Meanwhile, directed panspermia involves some form of agency, which necessitates alien involvement. While the natural version of this theory has inherited a variety of terms ranging from *lithopanspermia* to *ballistic panspermia*, all entail the physical impact of some planetary-like body by another body and the ensuing

[13]Ibid., 59.

[14]Ibid., 142.

[15]This is a common Latin phrase in abiogenesis meaning "all life comes from life."

[16]Francis Crick and Leslie Orgel, "Directed Panspermia," *Icarus* 19 (1973): 341-46.

ejection of material from the original body's surface.[17] Given that even the smallest "parcel" of life could have remained hidden amidst that ejected rock and found its way to Earth, it becomes at least feasible that it could have "seeded" life onto this world.

In contrast, directed panspermia requires some sort of alien intervention. This latter version of the theory provided the material for Crick and Orgel's paper and follow-up book.[18] It describes the deliberate attempt by an alien race to seed life from elsewhere in the universe. However, despite the potential that this idea offers, a number of additional problems begin to surface in challenging its plausibility. For at the very least it would require the existence of a highly evolved form of life and the probability of that life specifically targeting Earth. One would also need to factor in a number of logistical problems, not to mention the kind of motive involved and so forth.

An offshoot variant of this assumed intentionality involves aliens but *without* motive or reason. Thomas Gold forwarded this slightly modified version of directed panspermia in what he calls *accidental panspermia*. He believes that science should account for the possibility that some alien race could have contaminated the Earth "accidentally." In other words, the origin of life on Earth may have come as the result of "alien garbage" being left behind.[19]

Dawkins's Move toward Panspermia

Meanwhile, Richard Dawkins has expressed at least some degree of interest in space throughout much of his published career. Now and again he has speculated about

[17]Scholars have generally agreed on the delineation of natural panspermia into two main sub-categories. Material coming from "within" the immediate Solar System has usually been referred to as *ballistic panspermia*, while material coming from "without" has been called *lithopanpermia*.

[18]Crick and Orgel, "Directed Panspermia." Crick wrote *Life Itself* in 1981.

[19]Thomas Gold, "Cosmic Garbage," *Air Force and Space Digest* 65 (1960), 65.

the possibilities of life elsewhere in concert with his strong affinity toward a Darwinian solution. In 1983, he began to trek down that path in a contributing chapter to Bendall's book *Evolution from Molecules to Man*. Aptly entitled "Universal Darwinism," his article began to develop a case for why Darwinism should be considered "as universal as the great laws of physics."[20] Moreover, he suggested that it remains the only "working diagnostic characteristic of all life, anywhere in the universe."[21] Dawkins had made it clear that any and all life throughout the universe must have ultimately arisen by some Darwinian means.[22]

Despite this position, the existence of alien life in the universe had not yet become a central theme in his public work(s). Now and then Dawkins had alluded to the plausibility of life in the universe, but never to the point of becoming a primary issue. For instance, during *The Royal Institution's Annual Christmas Lectures* (1981), he engaged the idea of life on other planets, but never pressed it to any real length.[23] In 1995, he suggested that advanced life would pass through a progressive series of evolved stages he called the "Ten Thresholds of Life." He thought that this evolved series would

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[20]Richard Dawkins, "Universal Darwinism," *Evolution from Molecules to Man*, ed. D. S. Bendall (Cambridge: Cambridge University Press, 1983), 423.

[21]Ibid., 405.

[22]Dawkins has emphasized the above position many times throughout his career. Without exception, he has consistently asserted that any form of life, no matter how advanced, would have ultimately come by way of some Darwinian-like process from inanimate matter.

[23]Richard Dawkins, "Growing up in the Universe: Waking up in the Universe," *The Royal Institution's 162nd Christmas Lectures*, episode 1 of 5 (1991). During this prestigious lecture, Dawkins spoke of the amazing good fortune that the human race has enjoyed at this specific time and place. He speculated that most of the worlds (i.e., planets) beyond our solar system are deserts though an untold number are teeming with life (bacterial or otherwise). Moreover, he speculated on the unlikelihood that any advanced form of life would ever find our world. Though not specifically mentioning panspermia, Dawkins began this section of his lecture with a question: Where did life come from? The ensuing commentary on life elsewhere was designed to help answer that question.

probably culminate in a final threshold that would entail space travel. Nevertheless, until re-engaging this subject in 1998, that is essentially where he left it.[24]

By his sixth book *Unweaving the Rainbow*, Dawkins had allocated a greater amount of material toward the exploration of space and the plausibility of life elsewhere. Therein he openly engaged the subject, admitting that "the urge to know more about the universe seems to me irresistible."[25] From that point on, he has gradually added more elements along this vein in an appeal toward space in general. He covered a number of prospective features in several of his later books including *The God Delusion* (2006), *The Greatest Show on Earth* (2009), and *The Magic of Reality* (2011).[26] These texts helped him address a number of specific aspects regarding life on other planets. He discussed the planet's spin and tilt, the distance between a particular planet and its respective star (or star system), its atmospheric composition, evidence regarding water and so on. Dawkins had clearly demonstrated a speculative, yet unabated interest in this alternative approach to the origin of life.

Interview with Ben Stein

In regard to abiogenesis, perhaps the most startling admission by Dawkins to date occurred during his interview with Ben Stein in 2007. That event marked the first time he had spoken openly about his interest in *directed* panspermia. However, what is most confusing about this matter is how Dawkins appeared to change his stance shortly

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[24]Richard Dawkins, *River Out of Eden: A Darwinian View of Life* (New York: Basic Books, 1995), 160.

[25]Richard Dawkins, *Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder* (Boston: Houghton Mifflin, 1998), 63.

[26]Richard Dawkins, *The God Delusion* (New York: Houghton Mifflin, 2006). See also idem, *The Greatest Show on Earth*, 2009; and idem, *The Magic of Reality: How We Know What's Really True* (New York: Free Press, 2011).

thereafter. For within a few short months, he had already rejected that very same theory. What did Dawkins specifically say in regard to this idea? Was he taken out of context at any time?[27] Clearly, a careful review at what he said, and how he said it, should prove instrumental to the discussion moving forward.

Did Stein in some way misrepresent or otherwise trap Dawkins during the interview? Was Dawkins somehow caught off guard in regard to his questions? Candidly, there appears to be no evidence of such mistreatment in any way as the following review will demonstrate. Moreover, the interview appears to be quite benign despite Dawkins's complaints against it. Even the transcript reveals that Stein seemed considerably forthcoming in all that he asked.[28] He was neither "leading" in his questions nor overly aggressive in his demeanor toward Dawkins. Stein appeared both courteous and respectful throughout the interview.

Whatever the case, the addition of that now infamous interview to the 2008 film *Expelled: No Intelligence Allowed* has produced a firestorm in its wake. The resulting controversy should not come as a surprise because a high-powered opinion like

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[27]Dinesh D'Souza, "Ben Stein Exposes Richard Dawkins," *The Discovery Institute* (2008). Dawkins has commonly been taken out of context in regard to intelligent design. In addition to Ben Stein's initial misinterpretation of Dawkins's comments during their interview, others have also failed to understand his explanation. D'Souza is one of the more recognizable figures who has misinterpreted Dawkins on this matter. He writes how "Stein brilliantly responds that he had no idea Richard Dawkins believes in intelligent design!" He further contended in that same article that "Dawkins [had] surrender[ed] on the claim that evolution can account for the origins of life." To be fair, Dawkins did not imply "intelligent design" in any way beyond an advanced alien life form as he would certainly not forfeit his classic evolutionary formula under any circumstance. These statements, like Stein's initial impulse during their interview, take Dawkins out of context.

[28]Dawkins, "Ludicrous, Ridiculous, Impossible." Dawkins cited this interview/transcript in a lecture to The American Atheists Convention in 2009. Interestingly, he elected to mute the accompanying audio much the way he did not roll the film. Instead, he opted to flash a series of slides in a presentation that portrayed only certain areas of the transcript. Whether this method was meant to downplay the way he sounded on tape or the way that he might have sounded on camera is uncertain. Whatever the reason, the associated fallout from this interview has prompted him to defend himself repeatedly.

Dawkins holds considerable weight when discussing the origin of life.[29] After rejecting that which he had recently supported (just a few short months before), it seems difficult to follow his train of thought. Therefore, his apparent change of heart warrants further examination. An overview of the preparation and specific communication prior to and during the interview, a survey of the unedited transcript itself, and an analysis of the follow-up commentary should prove invaluable toward evaluating Dawkins's position.

Dawkins has claimed alongside others that he was deceived by the entire interview process and that he had only been speaking "tongue in cheek" in regard to panspermia all along.[30] Notwithstanding some of the details leading up to this and some of the other controversial interviews, what did Dawkins specifically say during the interview? To answer this question, it is best to follow Dawkins's exact words as they were recorded. He has since lodged numerous complaints against just about everyone and everything involved with that interview. He has been especially harsh toward his host Ben Stein who he has described as "irritating," without "logical reasoning," and "stupid."[31] Despite this retaliation, the transcript reflects a rather congenial interview between the two men. Stein even commented more than once that he was just simply trying to "get things right."[32]

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[29]Dawkins's interview was not the only interaction that resulted in conflict. Several other of the interviewees (whose opinions carried similar weight) felt deceived during the process including Michael Ruse and Eugenie Scott.

[30]Richard Dawkins, "Lying for Jesus?" Blog (2008). See also idem, "Interview with Paula Kirby," *Edinburgh International Book Festival* (2008). Dawkins attempted to retract his original comments in a manner that suggests that he had merely been speaking "tongue in cheek."

[31]Dawkins, "Lying for Jesus?"

[32]Dawkins, "Interview with Ben Stein."

True to Dawkins's allegations, Stein had been the one who introduced intelligent design (ID) into the discussion after the two had covered some of the more rudimentary points on origin of life theory. But it was Dawkins who volunteered the details. Upon establishing Dawkins's position in regard to classic Neo-Darwinian gradualism, Stein went on to ask the most important question of the interview which entailed intelligent design. Dawkins's response clearly implied some form of directed panspermia.[33] Specifically, his reference to "a civilization" that has developed "a very, very high level of technology" that was used to "seed … this planet" serves as evidence for that conclusion.[34] Dawkins's interest in this particular version of the theory seems evident given his own words. Not only had he issued forth his admission that such a theory is "a possibility," but he had referred to it as "an intriguing possibility" at that. Given this language, it is hard to understand how these comments could be construed as merely "tongue in cheek" as contended by Dawkins.[35]

Moreover, how does he explain his own remarks about "a signature" found in biochemistry and/or molecular biology?[36] These do not appear to be the comments of a

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[33]Ibid. An analysis of the transcript reveals how Dawkins responded to Ben Stein's question on intelligent design (ID). The following excerpt from that interview demonstrates that response:

Stein: "What do you think is the possibility that *intelligent design* might turn out to be, uh, the answer to some issues in genetics or end up in evolution?"

Dawkins: "It could have come about in the following way, it could be that, uh, at some earlier time – somewhere in the universe, a civilization evolved by probably some kind of Darwinian means to a very, very high level of technology and designed a form of life that they seeded onto, perhaps, this planet. Umh, *now that is a possibility and an intriguing possibility*.

Dawkins: "And I suppose it's possible that you might find evidence for that if you look at the, umh, at the details of biochemistry, molecular biology – *you might find a signature of some sort of designer*."

[34]Ibid.

[35]Dawkins, "Interview with Paul Kirby." See also idem, "Lying for Jesus?" During this interview at the Edinburgh International Book Festival, Dawkins continued to claim that he had only been speaking "tongue in cheek" in his dialogue with Ben Stein.

[36]Dawkins, "Interview with Ben Stein."

scientist giving "ID its best shot" nor the result of his being "magnanimous" that particular day.[37] Furthermore, these comments do not reflect the demeanor of an expert being humorous or half-hearted. Dawkins even claimed that Francis Crick and Leslie Orgel had originally proposed directed panspermia in that same "tongue in cheek" manner.[38] But neither of these two Nobel laureates nor any of their peers has revealed such a light hearted attitude toward their papers or in Crick's lengthy book which followed.[39] Rather, each of their books and papers conveyed a professional honesty toward that potential theory. In Dawkins's case, his interest in panspermia found him *intrigued* enough to support it.

Meanwhile, it has been established that if extraterrestrial life indeed exists, then Dawkins would expect it to be grounded in a Darwinian solution. He has made that point clear on a number of occasions and in a variety of formats.[40] To his credit, that stance not only concurs with the recorded interview but with everything that he has written to date. The issue at stake, therefore, involves his admission to supporting directed panspermia and his statements that followed.

But before revisiting the transcript with Stein, a few things need to be clarified in regard to the purpose, genre, and production of the film itself. These things need to be established in light of the ensuing complaints, interviews, and rebuttals that had been issued by several participants in the film. Almost immediately the film attracted a heated

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[37]Dawkins, "Lying for Jesus?"

[38]Ibid. See also Richard Dawkins, "God and Earthlings," (2008), http:old.richarddawkins.net/articles/2480-gods-and-earthlings (accessed October 14, 2013).

[39]Crick and Orgel, "Directed Panspermia." See also Crick's text *Life Itself*.

[40]Dawkins, "Interview with Ben Stein." Just as he qualified his response to Ben Stein, so Dawkins has made it clear in a multitude of venues that he assumes a fundamental evolutionary scenario regardless of when and where life began. Dawkins has yet to waver on this point.

debate because of its focus on origins. Moreover, the filmmakers themselves may have been less than forthcoming in their stated purpose as they had planned from the beginning to challenge this controversial topic. Envisioned as a kind of documentary film, they had sought to engage key figures over the intelligent design issue. Therefore, it should be understandable why this film has attracted attention given its sharp contrast in worldview.[41]

Many of the experts that were interviewed for the film have vocalized their joint opposition against what this film set out to portray. They claim to have been deceptively recruited by a producer who had allegedly concealed the film's name and intent. A *New York Times* article came out on September 27, 2007 that addressed this problem, citing a number of these complaints. Given the subject at hand, most of them came from scientists who felt deceitfully solicited for a film that even received a title change.[42] Dawkins followed up these claims with his own article in March 2008 entitled "Lying for Jesus?" That personal rebuttal represents, perhaps, the sharpest counterattack against the film to date.[43]

Regardless of the questionable intent of the filmmaker and the ensuing controversy that it spurred, what the interviews communicated should remain of utmost importance. The interviewees were still asked the kind of questions that they had

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[41]This hot topic of origins has provoked substantial debate in education and in multiple levels of the government over time. Ben Stein and the makers of the *Expelled* film had intended to bring a candid reaction from its participants to explore what the scientists might really think behind the camera.

[42]Cornelia Dean, "Scientists Feel Miscast in Film on Life's Origin," in *The New York Times* (September 27, 2007). Many of the interviewees claim that they were asked to interview for a documentary film called "Crossroads" rather than a creationist-based film in support of intelligent design.

[43]Dawkins, "Lying for Jesus?" As has been previously noted, Dawkins has been highly critical of the film's leading actor Ben Stein. This edgy reprisal placed additional blame on the associate producer Mark Mathis who Dawkins described as "deceitful," "bungling incompetent," and a distributor of "shoddy" work.

anticipated. The general nature and content of the questions had been previously communicated to them well in advance. Specifically, the filmmakers claimed to have sent a series of e-mails that had provided them with this information.[44] Therefore, though the interviewees may not have known the ultimate intent of the film, they had ample time to prepare in advance for their questions.

Despite the controversy that resulted from this exchange, the real focus should fall on Dawkins who appears to have downplayed his change of position. An interview with Paula Kirby the following year serves as a prime example of that apparent change. Therein he denied any support for panspermia.[45] Although it is perfectly acceptable for Dawkins to rest his confidence in a terrestrial solution, it is hard to understand his ensuing explanation(s) on the matter. How can an expert assert in one moment his "intrigue" with a theory that he could so quickly call "outlandish" in the next?

Evidently, Dawkins and the other interviewees had been caught off guard with the way that they were recruited for the film. They may have said some things that they would have liked to have left "behind the scenes." To their credit, none of the others appeared to convey anything that did not correspond with their otherwise stated positions. Eugenie Scott, for example, conveyed the same thoughts that one would find in her book

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[44]John-Henry Westen, ed. "Atheist Scientists in Uproar over Movie Showing Intolerance of Evidence for Intelligent Design," Lifesitenews.com (October 5, 2007). http://www.lifesitenews.com/news/archive//ldn/2007/oct/07100505 (accessed August 11, 2013). E-mails were claimed to have been exchanged in the spring of 2007 between the filmmakers and their interviewees. The related material and potential questions for the upcoming interviews were claimed to be relayed at that time and were said to pertain to science, religion, and intelligent design. This article quoted associate producer Mark Mathis in saying the following: "I went over all of these questions with these folks before the interviews and I e-mailed the questions to many of them days in advance."

[45]Dawkins, "Interview with Paul Kirby." During this interview, Dawkins claimed that he didn't "need to resort to *such a[n] outlandish hypothesis* as directed panspermia" (italics mine). Though this statement contradicts his prior commentary with Stein, he has now taken the position of virtually ruling out directed panspermia. Because he has made no mention of natural panspermia in the past, it can be concluded that he expects a terrestrial model to explain the origin of life. Moreover, what Dawkins has now called "outlandish" had been a viable theory in the minds of both Francis Crick and Leslie Orgel.

Evolution vs. Creationism.[46] Though clearly irritated with the deception by which she claims to have been recruited, she still held close to everything that she had written – especially in regard to her efforts at *The National Center for Science Education*.[47] Likewise, Michael Ruse and William Provine provided opinions that seemed consistent with their public positions. Ruse had previously commented on the plausibility of life bounding "off the backs of crystals," while William Provine's nihilistic comments fell well in line with what he has previously written and debated.[48]

In contrast, why would Dawkins need to revoke his commentary? Rather than appearing to divert the attention away from one's stated remarks, why not simply acknowledge what had been recorded? To further trivialize those comments, Dawkins said that he had "ben[t] over backwards to accommodate the IDiots." In doing so, he claims to have constructed "a science fiction scenario."[49] Dawkins publically stated during his 2008 Kirby interview that he had intended to extend "an olive branch" to the *Intelligent Design Movement*.[50] But was that the real motive behind his commentary? Why would an esteemed celebrity like Dawkins need to indulge his enemy? Perhaps he had divulged some things during the interview that he would like to have taken back.

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[46]Eugenie C. Scott, *Evolution and Creationism: An Introduction* (Berkley: University of California Press, 2004). This text reflects much of what Scott accomplished in her fight for evolution at the legal and academic levels. It was also well communicated in her interview with Stein.

[47]Dean, "Scientists Feel Miscast in Film on Life's Origin." Quoting Eugenie Scott, Dean wrote "I have certainly been taped by people and appeared in productions where people's views are different than mine, and that's fine … I just expect people to be honest with me, and they weren't."

[48]Michael Ruse, *Darwinism and its Discontents* (Cambridge: Cambridge University Press, 2008), 65. In this text, Ruse discussed Cairns-Smith's model for the origin of life writing that "organic molecules piggybacked on crystals." That explanation agrees closely with his interview with Ben Stein. Cornell professor William Provine also holds closely to that which he projected in the film. His strong opinion in support of atheism is well known throughout his writings and debates.

[49]Dawkins, "Lying for Jesus?"

[50]Dawkins, "Interview with Paul Kirby."

Dawkins's Reasoning toward Panspermia

As has been demonstrated thus far, Richard Dawkins has spent the bulk of his life marveling over how life has manifested itself in the world and how that life first came to be. His career has been a balanced reflection of a faith in naturalism and a channeling of that faith through ethology. Just as he acknowledged in his first book (*The Selfish Gene*), so he has still struggled to find the answers to life in one of his last (*The Magic of Reality*).[51] What is the meaning of life? And why is there evil? Dawkins's naturalistic worldview depends most prominently on a concept that was cast over two thousand years ago by Democritus. It lies in the potential between *infinity and accident*. Others have found the boundless frontier of space intriguing. Science has discovered a seemingly infinite number of planets scattered across billions of star systems. And those star systems are a mere subset of the billions of galaxies. Understandably, many have imagined the possibility of life beyond our world.

Nevertheless, Dawkins has found a way to work out this potential using this same philosophical reasoning found between infinity and accident. At a 2005 lecture entitled "Why the Universe Seems So Strange," he alluded to "the vastness of astronomical space and geological time."[52] He declared during that lecture how "that which seems impossible … might turn out to be inevitable."[53] A few years later, his friend and colleague Neil de Grasse Tyson asserted much the same thing in his dialogue with Dawkins. Tyson claimed that "rare phenomena happen" if you factor in enough

[51]Dawkins, *The Selfish Gene*, 1. See also idem, *The Magic of Reality*, 8-9.

[52]Richard Dawkins, "Why the Universe Seems So Strange," a lecture at TEDGlobal 2005, Oxford (July 12-15, 2005). See also Crick, *Life Itself*, 92.

[53]Dawkins, "Why the Universe Seems So Strange."

time and space.[54] Given the estimated billions of years before the time of our relatively young solar system, one is further steeped in this ultimate game of probability.

The Drake Equation was developed for the very purpose of putting a "number" on how many planets in the universe support life (i.e., specifically targeting the Milky Way Galaxy).[55] Theoretically, one could insert a certain percentage into the half dozen variables of that equation to output a reasonable estimate of that figure. Unfortunately, the variables required for this equation provide little more than *estimated probabilities* at best. Hence, they result in a considerably inaccurate and unsubstantiated solution. Dawkins has recognized the inherent error of this formula in treating it as a theoretical novelty. As he noted in *The God Delusion*, the individual probabilities "are all unknown, or [are] estimated with enormous margins of error" which thus produce a product of "colossal error."[56]

Nonetheless, Dawkins has appeared to gloss over his own astute conclusion on this matter in attempting to forward his own "gut feeling" about how many worlds may contain life.[57] In doing so, he has had to rely once again on that same potential intersecting infinity and accident. From his perspective, given enough galaxies and enough star systems in those galaxies and one should have no doubt that a great number of civilizations must exist. But is that a reasonable assertion?

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[54]Richard Dawkins, "The Poetry of Science: Dialogue with Neil de Grasse Tyson," Howard University (September 28, 2010).

[55]Written in its mathematical form: $N = R_* f_{p*} n_{e*} f_{l*} f_{i*} f_{c*} L$, the Drake Equation represents a theoretical estimation of the number of advanced civilizations in the Milky Way Galaxy. The corresponding variables on the right side of the equations represent (in the order above) the rate of star formation in the Milky Way, the percentage of the stars which have planets, and a number of other fractions accounting for probabilities associated with potential life in those star systems. The last variable represents the time interval between signal propagation and its receipt.

[56]Dawkins, *The God Delusion*, 95.

[57]Dawkins, *The Magic of Reality*, 182-203.

Tyson offered a similar argument during his discussion with Dawkins in 2010.[58] He called those naïve who would deny the probability that life exists beyond our world. Tyson likens such logic to someone "taking a cup of water scooped up from the ocean and concluding that whales don't exist."[59] However, Tyson's extrapolation cuts both ways. Though his theoretical sample cannot discount the existence of whales, it cannot prove them either. Dawkins's estimations befit the same logic. They too appear to depend more on speculation than scientific evidence. Properly understood, naturalism extends well beyond the beginnings of life on Earth and toward the potential of life across the universe.

In summary, Dawkins has been intrigued with the possibility of finding extraterrestrial life for much of his career. Like Francis Crick, he has found good reason to keep an open mind toward the subject. Certainly, one could hardly underestimate the consequences involved in finding life beyond Earth. As Crick saw it, there are at least two good reasons why panspermia may remain a viable option for explaining the origin of life. It would explain the uniform "bottleneck" found in biochemistry, while yielding twice as much time for life to have developed.[60] Though somewhat indirectly, Dawkins has endorsed these very same reasons. He appreciates this same explanatory power of Crick's "bottleneck" as it applies toward every strand of DNA. Because all DNA come with the same four letter code (i.e., A, C, G, and T), it seems logical to him that all living things depend on the same origin. Moreover, Dawkins has also mentioned the time

[58]Dawkins, "The Poetry of Science."

[59]Ibid.

[60]Francis Crick, *What Mad Pursuit: A Personal View of Scientific Discovery* (New York: Basic Books, 1988), 148.

element.[61] He agrees that much of the universe has had more time than Earth, which could have allowed the requisite time for an advanced civilization to evolve first. These issues will be discussed at greater length in the following sections of this chapter.

Dawkins's Ambiguous Solution

As should be abundantly evident throughout this chapter, Richard Dawkins has spent a fair portion of his time contemplating the potential of space. However, he has remained quite ambiguous as to his specific position(s) relating to that potential. Time and again he has speculated about how many planets may exist in our own galaxy and in the universe as a whole. He has further speculated about the number of planets that might have the right conditions for life as he extrapolates the conditions found on Earth.[62] For instance, he has asked whether any of these planets have water. Do they possess the right kind of "Earth-friendly orbit?" Are the eccentricities of their orbits too high as to afford life?[63] Do they exhibit the kind of rotational pattern and distance from their central star to maintain the right temperature? As Dawkins puts it, are any of them in the so-called "Goldilocks Zone" that is neither too hot nor too cold?[64] Dawkins has elaborated on these and other related issues that are deemed essential for life.

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[61]Dawkins, "Why the Universe Seems so Strange."

[62]Dawkins, *The Magic of Reality*, 183ff. See also idem, *The Greatest Show on Earth*, 412-13; and idem, *The God Delusion*, 162ff.

[63]Given that the eccentricity of any ellipse ranges from zero (near circular) to one (near a parabola), it is important to abiogenesis that the resulting orbit be low (close to a circle). High eccentricities result in exceedingly elongated orbits that would generate much greater extremes in temperature (hot when nearing the star and cold when venturing outward from it). Hence, a relatively low eccentricity (like that of the Earth) is thought to be more favorable for the natural generation of life.

[64]Dawkins, *The Magic of Reality*, 194.

But what is Dawkins's point in attempting to stress these possibilities? Is he contemplating the idea that life arose in one of these more "Earth-like" environments only to be transferred to Earth? Or is he considering the potential that one of these worlds has become so advanced that it might have developed a superior race of beings capable of *seeding* the Earth? Perhaps he is hopeful for that which NASA has sought from the beginning – that one piece of evidence that hints to an independent life form. Such a finding would at least improve the fleeting odds of this extraterrestrial scenario.

Dawkins on Directed Panspermia

As has been already established, Richard Dawkins clearly admitted in 2007 that directed panspermia is a viable theory. Despite any appearance of misdirection, that was his stated position. Shortly thereafter, however, he renounced his support. He denied that he had even made that assertion. Given the circumstances, he could claim that there had been some sort of ploy that forced his admission or deceived him in some way. But neither the taped interview nor its transcript reveals any sense of misunderstanding or coercion. His host Ben Stein conveyed anything but coerciveness. And Dawkins did not appear to be coerced in any way. Such an approach would be the exact antithesis of Ben Stein who appeared laid back and unassuming.[65] Moreover, neither could Stein's repetitious approach be difficult to understand. The sheer repetition itself would be hard to miss, especially for a scholar like Dawkins. And none of his complaints said anything about misunderstanding the questions.[66] Rather, he said that he

[65]Actor, lawyer and comedian Ben Stein is well known as for his stoic persona on and off the camera. His innocuous, gentile approach is typically anything but aggressive or coercive.

[66]Dawkins, "Lying for Jesus?" See also idem, "Interview with Paul Kirby." and idem, "Ludicrous, Ridiculous, Impossible."

simply felt "conned" into doing the interview in the first place, which is somewhat understandable in light of the sharp contrast separating his worldview from that of the filmmakers.[67] But none of this should have affected his interview. More than anything, it was the annoying demeanor of Stein's repetition that became Dawkins's key complaint following the interview.[68] Therefore, it should be safe to conclude that neither coercion nor misunderstanding were at issue that day.

Meanwhile, as has also been pointed out, Dawkins offered supportive evidence to his own comments on panspermia. He said at that time that science might eventually uncover "a signature of some sort of designer."[69] Unfortunately, that comment has been used to distort his position. A host of follow-up bloggers have misinterpreted those comments to imply Dawkins's support for intelligent design.[70] That interpretation is not completely accurate. Dawkins has made that point clear many times. His "designer" should not be construed as anything but an advanced alien life form. It would not coincide with the intelligent designer assumed by Stephen Meyer or Phillip Johnson.[71]

In defending his remarks at the American Atheists Conference in 2009, Dawkins said that he had been seeking some means of compromise with William Dembski who he believed had detached himself from the "supernatural" element of

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[67]Ibid.

[68]Ibid.

[69]Dawkins, "Interview with Ben Stein."

[70]Ibid. Ben Stein quickly corrected his initial conclusion that Dawkins had conceded intelligent design as a "legitimate pursuit." Stein had said that "professor Dawkins was not against intelligent design, just certain types of designers – such as God." That second statement appears to be much closer to what Dawkins actually meant.

[71]Though these scholars have at one time or another admitted their respective belief(s) in God, they have normally left the question "open" in regard to what the specific intelligence is behind intelligent design (ID). With this approach, the concept has been able to more adequately address the related scientific issues at hand without being encumbering with religious assertions.

intelligent design.[72] In offering what he called an "olive branch," he claimed to be extending himself toward a more moderate position that could still be tenable. But does that explanation fit his candid performance during the interview? Would such a concession warrant his calling directed panspermia "an intriguing possibility" or move him to buttress that position? Perhaps the seemingly amiable atmosphere of the interview enticed him to speak more freely. Whatever the case, Dawkins has spent a fair amount of time and energy in defending that commentary.

Since his interview with Stein, Dawkins has denounced any and all support for directed panspermia. He has also criticized just about everything in relation to that infamous interview including the filmmakers who arranged it. Undoubtedly, he would have preferred to have never gotten involved with that project to begin with.[73] Since that interview, Dawkins has repeatedly renounced that position in the form of blogs, interviews, and public lectures several times over. He has made every attempt to fortify what he now claims to be his true position. Through what could be considered "damage control," Dawkins has used a variety of euphemistic terms and phrases ranging from offering an "olive branch" to giving "intelligent design its best shot."[74] That seems like an unusual gesture coming from a man who is utterly deposed to intelligent design.[75]

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[72]Dawkins, "Ludicrous, Ridiculous, Impossible."

[73]Dean, "Scientists Feel Miscast in Film on Life's Origin." Dean claims that she received an e-mail from Richard Dawkins that communicated his regret in agreeing to the film. In short, "if he had known the film's premise," then "he would never have appeared in it."

[74]Dawkins, "Interview with Paul Kirby."

[75]Dawkins, *The God Delusion*, 150-61. In addition to the number of interviews, blogs and articles in which Richard Dawkins has argued strongly against the main tenets of intelligent design, perhaps no voice has been more lucid than his own in *The God Delusion*. Though William Dembski has often found himself as a favored target, Dawkins renegotiated his sights toward Michael Behe and his concept of *irreducible complexity*. See Michael Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Touchstone, 1996).

Despite his denial of that earlier admission (and irrespective of its intent), what should be made of Dawkins's comments in regard to advanced life beyond Earth? Through his public platform, he has discussed at length the plausibility, the barriers, and the potential interaction with advanced, technological life. He has also suggested that these potential beings might even appear "god-like" from man's perspective.[76] Therefore, regardless of Dawkins's *ex post facto* retraction of his own words, he has still demonstrated intrigue toward the existence of highly evolved beings beyond our world. Whether contact with these beings has resulted in the origin of life on Earth is where he has apparently drawn his line between what is "plausible" and what is "outlandish."[77]

Dawkins on the Probability of Alien Life

Dawkins has dropped comments here and there about the possibilities of extraterrestrial life and has thus maintained something between genuine intrigue and simply not ruling it out. Nevertheless, he has attended a number of interviews with Lawrence Krauss, Neil Tyson, and others in addressing the plausibility of advanced life in the universe. He has formally suggested that "god-like beings" probably exist.[78] Moreover, he has also discussed the potential biochemical signature that may be present

[76]Richard Dawkins, "Something from Nothing: A Discussion with Lawrence Krauss," Arizona State University (2012). During this conversation, Dawkins spoke about the likelihood of "god-like beings" in the universe. He projected these beings to be so far beyond us (in complexity) that "we would fall down on our knees and worship them." Dawkins went into much more depth on this subject in an earlier article "God and Earthlings." Therein he argued that despite how complex these beings might appear, that they too would be a product of a Darwinian mechanism that arose from inanimate matter. As Dawkins puts it, a god "would have to have designed the universe … and therein lies [the] fundamental contradiction. Entities capable of designing anything … [are] statistically improbable." Dawkins cannot get past his naturalistic presumptions. See idem, "God and Earthlings," 2008.

[77]Dawkins, "Interview with Paul Kirby."

[78]Dawkins, "Something from Nothing."

in all of life – here and abroad. Dawkins had somewhat described that signature as a common formula that points to one source or beginning.[79]

Meanwhile, he has also written an article that criticized Paul Davies for thinking that a second genetic code may exist on Earth. From Dawkins's perspective, if a second code were to have arisen on Earth, it would have likely "been eaten by our kind."[80] And if that second code had originated in space, then it would have been probably covered up by the dynamic processes here on Earth. Therefore, he thinks that Davies should establish his search outside of the terrestrial environment beginning with an uncontaminated meteorite of lunar rock.[81] According to Dawkins, those sources would provide a better chance given the much greater time available from the past (i.e., because the inert lunar landscape more readily preserves the past).[82] Nonetheless, though somewhat skeptical of Davies's approach, Dawkins respects the probability of extraterrestrial life as a viable option.

Now one of the more challenging and decisive issues that faces directed panspermia involves the so-called *Fermi Paradox*. That term describes the dilemma faced by those who have maintained high expectations for finding advanced alien life but

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[79]Dawkins, *River Out of Eden*, 11-12. Here Dawkins is referring to the same basic DNA structure found in all known living things. In essence, that structure acts as a *biochemical signature* that relates all life together. As he described in that text, the structure entails four bases of DNA including two purines, adenine (A) and Guanine (G), and two pyrimidines including thymine (T), cytosine (C) (a third pyrimidine uracil replaces the thymine in the case of RNA). They are specifically paired purine to pyrimidine and thus, A-T and C-G. Sixty-four codons or combinations result from these pairings – a specific basis from which all life extends.

[80]Richard Dawkins, "Searching Under the Lamp-Post," (2011), http://old.richarddawkins.net/articles/644352-searching-under-the-lamp-post (accessed July 10, 2013)

[81]In the above statement, Dawkins was referring to the dynamic forces on Earth including tectonic activity, weathering, vegetation, and so on. These processes would not have recently played a factor in most extraterrestrial scenarios such as the Moon or Mars, which still reflect cratering over time.

[82]Dawkins, "Searching Under the Lamp-Post."

have not yet found it. Described by its founders Enrico Fermi and Michael Hart, the concept throws somewhat of a damper on those who have held an optimistic outlook toward finding alien life. Closely related to that paradox is the so-called "radio bubble" that communicates our existence outward into space. That spherical waveform is caused by the electromagnetic transmissions from Earth spreading outward over time. Needless to say, that waveform continually attenuates because the strength of the signal(s) reduces by the square of the distance.[83] That translates to a relatively weak signal by the time it reaches even the nearest of star systems.

Nevertheless, in that same interview with Dawkins in 2010, Tyson explained how the ensuing radio bubble from Earth has broadcast our existence to a relatively limited distance. With barely seventy years of radio technology, the corresponding signal would encompass only the local star systems. Now given the fortuitous prospect that an advanced civilization was to receive that transmission, it would still take the equivalent amount of time for their response to return to Earth. Therefore, an advancing sphere of some thirty-five light-years may be more accurate to account for both the initial signal(s) from Earth and the prospective inbound signal from that alien world. That would entail a considerably smaller volume of only some four to five hundred stars respectively.[84] A

[83]The physical attenuation of virtually any waveform diminishes with the square of the respective distance. Therefore, even a neighboring star system would present a challenge for virtually any Earth-borne radio signal. Moreover, the relatively large numbers associated with the enormous distances between stars would be reduced by several orders of magnitude (because of the attenuation of the signal three dimensionally).

[84]Given that radio waves travel at the speed of light, it becomes a relatively simple computation to resolve how far our radio transmissions have traveled since broadcasting on Earth began. Factoring in roughly seventy light-years, that spread would reach some two or three thousand of the nearest star systems. In addition, the outward waveform would roughly entail a spherical shape. This is an extremely simplified shape given that the true waveform would factor in the direction of the signal(s), the rotation of the Earth, the blockage of the signal due to the Earth itself, and so on. Nevertheless, these factors are assumed to be more or less negligible given the primary goal of the approximation itself, which is to simply estimate how far out the radio transmissions from Earth have traveled. Moreover, the much

much greater opportunity would undoubtedly result if the signal had originated from the alien source rather than being a response from Earth. Unfortunately, SETI (i.e., Search for Extraterrestrial Intelligence) has never received a confirmed signal from outside the Earth. Despite a formidable array of radio telescopes, they have still received nothing but silence.[85]

Dawkins on "Advanced" Alien Life

Over the past two decades, Dawkins has not only discussed the probability of alien life but that of "advanced" alien life as well. In the aforementioned American Atheists Conference of 2009, he described four "barriers to our being visited." In a presentation entitled *Ludicrous, Ridiculous, Impossible*, Dawkins speculated on the various obstacles that might prevent a real encounter with advanced alien life.[86] He suggests that the first obstacle corresponds to the same first threshold he had mentioned in *River Out of Eden* – the extreme difficulty of the origin of life itself.[87] Dawkins had arbitrarily assigned a "one in a billion calculation" toward surpassing that initial barrier.[88] But he humbly dismissed even that estimate with the understanding that such a

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smaller (relatively speaking) thirty-five light-year spherical waveform yields the minimum time for a return signal to be sent back to Earth – assuming that the corresponding signal was also limited to the speed of light. Each of these respective solutions entail a differing number of associated star systems – increasing cubically, at least until the signal reaching the sides of our galaxy which is elliptical and flat.

[85]Twice in the past four decades, observers have detected signals in a band closely resembling the resonation frequency of hydrogen (i.e., approximately 1420 MHz). SETI rejects this lone detection (the second of these) as indicating an alien source. They believe that it is more likely the result of some natural causation, equipment malfunction, or cosmic noise. With a huge accompaniment of telescopes operating worldwide, SETI has provided a formidable attempt toward apprehending an alien signal from space. But to date, it has yet to receive anything of that nature.

[86]Dawkins, "Ludicrous, Ridiculous, Impossible."

[87]Dawkins, *River Out of Eden*, 151-60.

[88]Dawkins, *The God Delusion*, 165.

"probability statement is made in the context of a certain level of ignorance."[89] However, he still went on to accept his own estimate as it applied toward the challenge of design. Despite his admission to dismiss that speculation, he evidently accepted it to some degree in claiming that it "completely demolishes any suggestion that we should postulate design to fill the gap."[90] But such a conclusion appears to be more the product of speculation and worldview than concrete evidence.

Furthermore, Dawkins entitled his lecture *Ludicrous, Ridiculous, Impossible* to communicate how unlikely it would be for life to have arisen *only* on Earth. In other words, the very idea that life was unique to Earth would drive the inherent probability for life to the edge of being ludicrous, ridiculous, and so on. That position speaks volumes about Dawkins's stance on the issue, for in a game of Poker that would be analogous to an "all or nothing bet." Evidently, Dawkins's confidence rests on the fact that life is *not* unique at all.[91] Rather, it is his belief that life *must* exist somewhere in the universe or else he would be left to explain why science should be satisfied with a seemingly impossible solution to the origin of life.

On the other end of the spectrum, life could be considered quite common in the universe. Again, that is Dawkins's position. Speaking at TEDGlobal 2005, he stated that he "suspect[s] that life is quite common in the universe."[92] His second barrier picks up at this point to explain why the Fermi Paradox should not interfere with his assertion. If it is true that "technological life [is] very hard to arise," then *advanced* life may be so far

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[89]Ibid., 166.

[90]Ibid.

[91]Dawkins, "Why the Universe Seems so Strange."

[92]Ibid.

apart as to ever discover one another.[93] Therefore, the blending of these statements fits his presumption that "most worlds out there are deserts."[94] Despite perhaps many billions of isolated "islands of life," they are still too far apart.[95] And that would further coincide with why no meteorite, lunar rock, or Martian rock has yet to be found accompanying life. The few traces of amino acids and other organic elements fall well short of that prospect.

Nevertheless, to round out his four barriers to "being visited by aliens," Dawkins suggests two probable reasons. The technologically advanced life would be either "too short-lived" due to the probability of internal conflict or be "too advanced to even bother with us."[96] How he arrived at this conclusion is still speculation on his part. But what remains important is Dawkins's opinion on the plausibility of life and that of advanced life beyond our world. Though there are billions of galaxies containing billions of star systems, it would still be nothing short of pure conjecture to assume that the planets within those systems contain any form of life.[97] That is simply the scientific reality before us. So what does that indicate? Once again, it appears that Dawkins's position rests more on his philosophical worldview than his scientific methodology.

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[93]Dawkins, "Ludicrous, Ridiculous, Impossible."

[94]Dawkins, *The Royal Institution's 162nd Christmas Lectures.*

[95]Dawkins, "Searching Under the Lamp-Post."

[96]Dawkins, "Ludicrous, Ridiculous, Impossible."

[97]Though planets undoubtedly exist around most of the surrounding stars of the Milky Way and among the multitude of star systems in the billions of other galaxies, the most current data indicates that only a few hundred extra-solar planets have been found and catalogued. Nevertheless, it is perfectly reasonable to conclude that planets do exist beyond our immediate star systems.

The Characteristics of Alien Life

Assuming for a moment that Crick and Orgel were correct in that some advanced alien race had intentionally seeded the Earth, then what form of life might they have sent? For that matter, what form of life could the aliens themselves have been? These are some of the questions that Richard Dawkins has pondered. In an article he wrote entitled "God and Earthlings," he speculated on how an advanced alien life form might be received as a god.[98]

Ever consistent to his naturalistic worldview, Dawkins contends that certain alien life forms might be construed as "god-like" from our limited (human) perspective. Along this same train of thought, what appear to be miracles might simply be the fruit of a more advanced technological system. In other words, the human confrontation of such an advanced race might leave the impression that we have encountered a god-like figure. According to Dawkins, any such being would still have ultimately arisen through some Darwinian-like mechanism in the distant past.

So how does this worldview apply toward God in general? From Dawkins's standpoint, the mere suggestion of a god-like being (of which there was no beginning) is utterly foreign to his thinking. He would view such an idea as little more than ignorance and superstition. Though it is argued by conservative theologians that the very concept of the biblical God denotes an eternal being without origin, it is a definition that Dawkins cannot accept. He wrote that "a creator god who had always existed would be far more improbable still."[99] He believes that such a god is far less likely than even the complex

[98]Dawkins, "God and Earthlings."

[99]Ibid.

"gods" that might exist elsewhere in the universe. His worldview demands that everything simply *must* have a beginning except for the universe itself.

But that assumption ushers in a whole new line of thinking. Perhaps the universe could be considered eternal if there were some outlet in which to extend time indefinitely.[100] Perhaps the multi-verse theory provides him with that tool. Dawkins has entertained Lee Smolin's *multiverse* idea for that very reason.[101] It offers yet another tangential argument into a still greater infinite. In other words, a multiverse arrangement could conceivably extend the problem of *infinite regress* to an innumerable set of alternate (or even parental) universes. But such a theory is without any real substance to support it. Rather, it is a speculative idea on the part of those who would find such a possibility stimulating. But if it were true, the existence of our own "successful" universe would become more of a mathematical anomaly rather than impossibility. It could be argued that the "right" universe would have surely come along given enough time and an infinite number of universes to "choose" from. Moreover, the precision of the anthropic principle would find its answer in obtaining the right *chance* universe sooner or later.

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[100]Given the fact that the universe has been determined to be much older than the immediate Solar System, than it is clear that much more time would have been available in that much larger theatre. Hence, time would be somewhat extended. But even with those staggering numbers reaching 15-20 billion years, the total amount of time is still limited and finite. That is but one of the advantages that the multiverse theory might try to resolve. Not only does it engender the possibility of alternative universes having different sets of constants for the forces of nature, but it extends the time almost indefinitely as the number of potential universes grows. The imagination can only stretch the potential consequences of such a reality. Whereas the ultimate finiteness of it all becomes somewhat lost in the growing numbers that were already beyond comprehension. The multiverse theory fits neatly with the idea of infinity and accident.

[101]Richard Dawkins, *The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution* (Boston: Houghton Mifflin, 2004), 3-4. In addition to this text, Dawkins has alluded to Smolin's multiverse theories in several other books: idem, *The God Delusion*, 174-75; and idem, *The Oxford Book of Modern Scientific Writing* (Oxford: Oxford University Press, 2008), 362-66. Smolin is a theoretical physicist who specializes in quantum theory and has written extensively on the cosmos and quantum theory.

Again, it would undoubtedly occur given enough time and space – if for no other reason than because we are here to talk about it.[102]

Given that the multiverse theory could have somewhat resolved infinite regress, science would still need to explain the generation of advanced life prior to ours. If such an advanced civilization did arise and was to find our world, it would still need to make the decision to "seed it." Moreover, unless the complexity of life had somehow "transferred" that life from a previous universe, then the conditions to produce the advanced life would have needed to have already been in place. The development of higher elements might have served as another obstacle toward achieving that goal.[103]

Furthermore, it would be important to know what kind of life that might have been sent (or survived within an expelled rock in the case of natural panspermia). The scenario could be narrowed down to a life form that was able to *survive* the trip and one that *matches* the kind of life found on Earth. Science has gone to great lengths to understand what kind of life might have endured such a daunting journey.[104] But its

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[102]Dawkins, *The Royal Institution's 162nd Christmas Lectures.* The speculative idea of a multiverse entails a wide variety of unusual ramifications . It is a purely theoretical idea that can be manipulated to help resolve theoretical problems such as infinite regress, eternal matter, and the like. In the above discussion, it could theoretically extend the limits of both time and space because an untold number of universes might be behind the one universe that we observe and exist in. Because Dawkins has already mentioned the elements of time and space on a number of occasions, it is evident that any explanation pertaining to the origin of life faces daunting odds as to be probable. But the addition of a multi-universe might serve to ease those odds. More specifically, the "right" universe might be more likely to achieve life because it has all the right values assigned to the necessary constants including gravity, weak and strong atomic forces, and so forth. Perhaps, it is surmised, that other universes might have different values for these constants and thus do not obtain life. Moreover, having these *right* values in our universe helps to explain why the so-called anthropic principle seems so unique. According to Dawkins, we might simply be the lucky ones who live at the right time and in the right universe.

[103]Stephen W. Hawking, *A Brief History of Time: From the Big Bang to Black Holes* (New York: Bantam Books, 1988), 120. Hawking briefly explained in this text how the "heavier" elements were believed to have come into existence through *supernova nucleosynthesis.*

[104]Mauri Valtonen, et al., "Natural Transfer of Viable Microbes in Space from Planets in Extra-Solar Systems to a Planet in our Solar System and Vice Versa," *The Astrophysical Journal* 690 (2009): 210-15. This article addresses the primary issues facing natural panspermia.

research has focused primarily on natural panspermia rather than through an engineered excursion (i.e., directed panspermia). Crick and Orgel entertained that latter idea as they wrote of a spaceship that would be equipped with all the necessary provisions to maximize the payload's survival. Radiation, the lengthy duration of the flight and similar logistical concerns were some of the more pressing issues they addressed.[105]

But if some alien race had surpassed these obstacles, what form of life might they have sent? To match the life on Earth might entail some form of *prokaryote* because that is the oldest form of life known to man.[106] Using a combination of dating techniques including geological superposition and radiometric dating (i.e., with longer half-lives), geophysicists have been able to assign an approximate date of 3.5 billion years or so for the rocks that surround the corresponding fossils.[107] That would affix an upper limit to the potential seeding. Otherwise, life would have already had to exist.

Given the latter scenario (that life already existed), it would seem very unlikely that the origin of life afforded two successful "origins." Not only would this unlikely event have had to occur, but no *second* form of life has yet been discovered. Thus, assuming that this less likely scenario did not occur, then only one origin occurred and 3.5 billion years could be assigned to the "upper limit." Meanwhile, a corresponding lower limit could also be estimated given the overall age of the Earth. Now in this case, one would need to account for the time required for the hot, primordial Earth to

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[105]Crick and Orgel, "Directed Panspermia," 343.

[106]Though biologists debate what the first life would probably have been, they generally agree with the contention that it must have been some form of early prokaryote because that is the earliest and simplest form of life known to man. Because it has no real nucleus, it represents an even simpler single-celled organism than the more complex eukaryote that is believed to have come later.

[107]Crick, *Life Itself*, 122ff. The author discussed the advantages and disadvantages between the selection of a prokaryote versus a eukaryote. If the latter could have been equally protected from an engineering standpoint, then why send the simpler organism?

sufficiently cool before life would have a chance. With the Earth estimated to be roughly 4.5 billion years of age and an additional 200 million years or so were required to reach a feasible temperature, then that would place the bottom limit at close to 4.3 billion years.[108] Therefore, for directed panspermia to remain a plausible explanation for the origin of life on Earth, then an alien race would have needed to deposit some form of prokaryote onto our world between 4.3 and 3.5 billion years ago.

But then one might ask why an alien race would go to the trouble to shower the Earth with such a simple organism that might never achieve anything beyond what it is? What would have been the motive? Recall that Dawkins has already commented on each level of life and how difficult the barriers would have been going forward.[109] Moreover, he has suggested that much greater odds hinder a simpler life from advancing beyond its relative simplicity. So even if it were possible to advance toward a more complex form of life, would it have been worth the effort to wait billions of years for it to happen?[110] In

[108]4.5 billion years appears to be a relatively safe estimate for the age of the Earth, from a scientific viewpoint, given the large database that points to that approximate age and the number of simultaneous dating methods used to calculate it. First, it is logical to suggest that the age of the Earth would almost certainly be about the same age as nearby planets and the Moon. The dating of rocks both from corresponding meteorites and from these other entities suggests a similar range of about 4.5 billion years. The direct collection of rocks from numerous sites on these extraterrestrial bodies bears similar numbers. Hence, the solar system appears to befit an age of about 4.5 by. Second, the dating methods used are numerous and the samples plentiful in number and type. Though these ages fall well beyond chemical and biological methods, some of the methods available through radioactive decay still fall within that range. Specifically, the Potassium-Argon, Rubidium-Strontium, and the Uranium series techniques provide a superposition of data that leads to greater accuracy. Combined with astronomical measurements of light and distance and the geological sequencing through stratification (and the laws of superposition) and one can achieve a solid estimate for the corresponding age of the Earth. Zircon crystals appear to be among the oldest known rocks available to us from the Earth and have also been dated to approximately 4.3 by.

[109]Dawkins, *River Out of Eden*, 151-60.

[110]Richard Dawkins has made it abundantly clear that numerous obstacles obstruct the progression from simple to complex living systems. Though the gap that separates non-life from life may represent the greatest gap in his view, other succeeding gaps make for less overall probability toward maximum complexity. If true, then advanced technological life would be increasingly rare as compared to simple life forms.

summary, the odds against directed panspermia are staggering, the limitations great, and a reasonable motive lacking. The theory appears to be of low probability.[111]

Minimal Life Elsewhere

Today, the more popular form of this theory is natural panspermia. NASA has led the way in exploring this second version of the theory. Interestingly, Dawkins does not make mention of natural panspermia *per se* in any of his works. That omission is surprising considering how many times he has written about the multitude of planets having Earth-like atmospheres, the consequences of orbital mechanics and similar issues. Like Carl Sagan, Crick and Orgel, or Paul Davies, Dawkins has shown great interest in the physical makeup of planets beyond our world because of their alleged potential to generate life.[112] To date, he has commented on this area of the study in seven of his last ten books.[113] His interest has generated a number of articles, blogs, and interviews where he has addressed this subject matter in relative detail.

Specifically, Dawkins has shown the greatest interest in the search for life among our neighboring planets and moons. Science has already acquired a plethora of data from that realm. The knowledge quickly diminishes, however, as one moves away from the areas where man has directly explored to those distant areas that he has barely

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[111]Crick, *Life Itself*, 153. Crick himself somberly realized that "too much speculation" about directed panspermia was "running after too few facts." Though he retains the idea as a "viable scientific theory," he equally notes that the data to support it "is premature."

[112]The men listed above represent some of the more well-known scholars who have demonstrated great interest in astrophysics and cosmology. Each of their disciplines requires significant research in regard to the physical makeup of other planets including many features discussed by Dawkins.

[113]Dawkins has cited interest in the cosmos and in potential life-bearing planets in several books: Dawkins, *River Out of Eden,* 1995; idem, *Unweaving the Rainbow,* 1998; idem, *The Ancestor's Tale,* 2004; idem, *The God Delusion,* 2006; idem, *The Oxford Book of Modern Science,* 2008; idem, *The Greatest Show on Earth,* 2009; and idem, *The Magic of Reality* , 2011.

detected. Several programs including the Viking, Apollo and Pioneer programs have explored the more immediate neighbors. But the growing list of extra-solar planets outside that area still relies on highly specialized methods that often bear little more than the mere existence of those planets.[114] Thus, while classic scientific observation has served well in analyzing the planetary bodies of our vicinity, it has had little to go on in moving beyond the Solar System.

Furthermore, while most every space agency in the world has sought to find life elsewhere in the universe, so Dawkins has maintained a keen ear to that which they uncover. However, though he and these organizations share that common interest, they differ somewhat on what they expect to recover. For though the various space agencies (e.g., NASA, CNSA, RFSA)[115] are interested in finding life beyond Earth, they are looking for a source of life that might have been transferred by the natural exchange of material.[116] In contrast, Dawkins has shown interest in only the former idea and has stated that position more than once. In expressing his opinion to Neil Tyson, he asserted

[114]L. J. Richardson and S. Seager, "The Atmospheres of Extrasolar Planets," *NASA Technical Reports* (2007). Using a technique that tracks the slightest change in the corresponding star's luminosity to a known planet, one can determine several basic physical properties and orbital parameters of that particular planet. Of the hundreds of currently catalogued extrasolar planets, only about ten have been tracked to that level. These ten unique planets have enabled this level of tracking by way of their edge-on geometry in relation to the star, the planet's circumstances, and the observing platform. Though certain atmospheric parameters are also available through related methods, this still represents a small fraction of the known planets.

[115]The familiar acronym NASA denotes the U. S. based space agency known as The National Aeronautics and Space Administration. Though this government agency remains the undisputed leader in space exploration, nearly eighty other nations have developed their own programs or have entered into joint programs with cooperating nations. The European Space Agency (ESA) is a classic example of this latter type of program. Behind NASA, the Chinese National Space Agency (CNSA) and the Russian Federal Space Agency (RFSA) have made great strides in developing similar programs to that of the United States.

[116]The natural exchange of rock between planets is the essence of natural panspermia. The latest data suggests that the exchange of material between neighboring planets of the same star system was common in relation to geological time.

that what they need "is a second sample of life."[117] In other words, what Dawkins needs to help close his case for naturalism is a second, completely independent source of life. Despite the unlikely chance that such a sample would have originally come from Earth, it would send the message that life had indeed originated on its own and without the direct intervention of a cosmic designer.[118]

Search for Life in the Solar System

In either case, he and others are searching for life beyond our world. And that is what Dawkins is especially hoping for – that second form of life which would reflect something foreign to the DNA present in every organism on Earth. It would not matter how simple or complex that form of life turned out to be as long as it was founded on a different basis. Science is looking for a difference in complexity, however slight, as to how that organism had originally developed. That difference could involve an alternative set of nucleotides, a molecule based on ammonia rather than water, silicon rather than carbon-based, or anything else that would render it *alien* to the life yet known to man.

Scholars such as Dawkins feel that the most likely candidates lie within our own Solar System. Potential sites include our own moon, the innermost terrestrial-like planets and the gas giants and their respective moons.[119] These are not only the places

[117]Dawkins, "The Poetry of Science."

[118]Despite the classic theistic argument for a relational, creator God, the lack of direct intervention by God could still conceivably fit either a deistic or theistic evolutionary paradigm. These alternative models entail a less than direct or "hands-off" relationship between God and creation.

[119]Dawkins has steadily increased his discussion in matters pertaining to life beyond the Earth as this chapter has demonstrated. During the course of his personal investigation, his primary focus has remained on the real data that has been largely acquired by NASA. Correspondingly, NASA has accomplished much toward understanding our immediate neighbors including the Moon, the other planets of our Solar System, and so forth. Though efforts continue to reach out to extra-solar systems, the bulk of their efforts have remained on the neighboring planetary systems.

where direct exploration has already begun (i.e., given the state of technology), but where the natural exchange of rock has been established. Moreover, both manned and unmanned missions have explored our Moon and its four closest neighbors (i.e., Venus, Mars, Jupiter, and Saturn). They have also ventured out to some of the more isolated bodies.[120] The combination of all this data has provided a more complete picture of the Solar System in general. Extraterrestrial missions, the existing knowledge of Earth, and the cataloging of meteorites have all contributed to this understanding.

Unfortunately, those looking to find life within that closer arena (near Earth) would be disappointed given the fact that no life has been discovered there. Despite a multitude of extraterrestrial missions launched to date, NASA has yet to uncover the most modest sign of life. Other space agencies have faced similar results during their explorations. The physical data and extensive photographic imagery acquired from both the lunar and Martian missions reveal barren, lifeless landscapes with only a handful of amino acids and associated molecules. Meanwhile, the sorting and analysis of over forty thousand meteorites bear similar results. After surviving the blistering heat of the Earth's atmosphere, these remnants of the Asteroid Belt and nearby planets have yielded little more than the same basic molecules as those obtained from exploratory missions.[121]

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[120]The Moon has received the greatest attention given the space race between the Soviets and the U. S. in the 1960's and because of its close proximity to the Earth (i.e., roughly 239,000 miles). With over 40 lunar-related missions between these and various nations, only a half dozen have ever been manned. The Moon also represents the only extraterrestrial body on which man has ever set foot. Meanwhile, roughly a dozen or so missions have been sent to Venus despite the ragingly hot conditions. Greater effort has been afforded to Mars which offers a similar challenge as the Moon but at a much greater distance (twelve missions to date). Two other missions have reached Jupiter. But only a few missions have taken on the more extreme challenge of reaching one of the moons of Mars or Saturn, of hitting a comet (Deep Impact, 2005), or reaching an asteroid. Other endeavors offer such a great challenge or distance before them that only a sophisticated technology (not yet developed) or a deep space probe could overcome such obstacles in a given lifetime.

[121]The bulk of the meteorites found on Earth appear to have originated in the Asteroid Belt that

Furthermore, the remaining planets, their moons, and a few miscellaneous SSSB are not expected to provide much more of an opportunity. Only a slender optimism is retained for a few of the larger moons orbiting the gas giants.[122] Most exobiologists consider Enceladus and Europa, two of the larger moons of Saturn and Jupiter respectively, to be the current longshots for finding life. Each is considerably smaller than the Earth, contain at least some atmosphere and fall on the fringe of the so-called "Goldilocks Zone." As Dawkins has pointed out, the only reliable candidates for supporting life are believed to reside in that particular zone that avails what is believed to be the required habitat and range of temperature(s). But even these two moons are soberly recognized as unlikely candidates for life. Meanwhile, the remaining planetary bodies entail far too many obstacles for consideration. Mercury has the same problem as Venus in being too hot for even the most durable extremophile.[123] These planets are too close to the Sun for life to have any real chance. On the other hand, the outermost planets

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lies between Mars and Jupiter. The majority of the remaining meteorites have been relegated to Martian or lunar origins as is evident in their respective compositions. Though most are unrecoverable due to the challenging areas in which they had fallen (i.e., uninhabited areas, the arctic region, or the ocean), about a half dozen or so find their way into the hands of astrophysicists and geologists annually. One particular meteorite has drawn considerable attention since its discovery in the Allan Hills region of Antarctica in 1984. Known as ALH84001, it bears certain trace amounts of organic molecules including a few amino acids and PAH's (polycyclic aromatic hydrocarbons). Though Bada thinks that these amino acids are largely of terrestrial origin, some might be contained within the rock. See J. L. Bada et al., "A Search for Endogenous Amino Acids in Martian Meteorite ALH84001," *Science* 279, no. 5349 (1998): 362-65. In that article, his team points out how "the radiocarbon measurements of EETA79001 and ALH84001 indicate that the bulk organic carbon, of only a few percent or less, is terrestrial in origin. These studies coupled with the amino acid results presented here indicate that major and minor organic constituents in these Martian meteorites are contaminants" (365). Furthermore, David McKay and his team have verified minute amounts of PAH's in this rock and bacteria-looking formations that had excited the scientific world for their potential evidence for life. However, the PAH's offer nothing that even remotely approaches the scale required for any known life form and may be likened to the Miller-Urey discovery of 1953(that produced small amounts of organic materials). Craig Hazen adds that PAH's are a ubiquitous commodity in the cosmos much like carbonate minerals. See Robert M. Hazen, *Genesis: The Scientific Quest for Life's Origin* (Washington DC: Joseph Henry Press, 2005), 36. Moreover, the morphology of these tiny formations is far too subjective to afford such a conclusion.

[122]SSSB is an acronym for "Solar System Small Bodies" and includes the comets, asteroids, elements of the Kuiper Belt, and all other "smaller" debris orbiting within the Solar System.

[123]See chapter 5 of this dissertation for a description of extremophiles.

and their respective moons are likewise too cold to enable life. Water, which is thought to be one of the essential ingredients to life, would likely be bound up in ice. Such a bleak frozen landscape does not afford the kind of place to find life.[124]

Moreover, the large numbers of SSSB are equally if not worse candidates to engender life given that they are so small. In this much wider category, which includes a multitude of asteroids, comets, and other chunks of rock, lie a wide spectrum of eccentricities ranging from near circular to exceedingly elongated elliptical orbits. Not only do the vast majority of these bodies have no atmosphere, but they lack any real diurnal pattern from which to maintain a consistent temperature. The lack of atmosphere alone would make it virtually impossible to achieve the right kind of chemical composition much less the capacity to overcome the extreme temperatures involved. Most of them would be blazing hot on the one side (facing the sun), while blistering cold on the other (facing away). They do not possess the necessary conditions for life.[125]

Dawkins appears to be perfectly willing to accept the fact that life on Earth may be unique within the confines of our own Solar System. But like SETI, he has also been waiting for that one shred of data that might indicate otherwise. In the meantime, he has attempted to explain this troubling status in terms that still make for a hopeful solution. He writes that scientists are "happy without the knowledge" and are therefore perfectly content with not knowing the answers.[126] He claims that they are rather

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[124]Dawkins, *The God Delusion*, 164. As Dawkins notes, most planets "are not in the Goldilocks Zone." In the case of the inner most terrestrial planets, they are simply too hot.

[125]Such extremities in temperature alone render the potential for life as exceedingly small. Even the most durable of extremophiles yet known to man still contain limits and normally inhabit but one those extremes. Perhaps the greatest challenge would entail one of these robust *organisms to survive both extreme heat and cold* – something that is yet to be demonstrated.

[126]Dawkins, *The Magic of Reality*, 188. Dawkins claims that "one of the great virtues of

energized by the challenge itself as they humbly recognize what they do not know. In addition, he also seems to justify that the lack of evidence really befits what he has said all along – that if a given solution "were too easy, then life would be everywhere."[127]

Dawkins appears to be overly optimistic in the face of these obstacles. In regard to the difficulties facing abiogenesis, he wrote that whatever "theory that we seek," it should "positively not be a plausible theory."[128] Such a statement implies that the theory on which we must hang the entire origin of life must be an "implausible" one at that. Despite this euphemistic attitude in the face of a prevailing lack of evidence, he fully realizes that life has not been discovered beyond Earth. For all the optimism and certainty he might retain within his own worldview, it does not make it so. Though one can appreciate Dawkins's hope as he imagines the manifestation of alien life, the reality of the evidence must eventually set in.[129] Thus far, the scientific evidence is simply found wanting in regard to alien life within our Solar System.

Search for Life outside the Solar System

Meanwhile, what evidence indicates that life exists outside of our Solar System? To date, there is none. But despite this lack of evidence, Dawkins believes that life exists throughout the universe. He has repeatedly spoken about this expectation that

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science is that scientists know when they don't know the answer to something" and that "they cheerfully admit [when] they don't know." These statements appear to be an overly optimistic approach to science that is probably more ideal than Dawkins would like to admit. Thomas Kuhn would undoubtedly challenge the confidence in scientists always knowing (i.e., given his work regarding scientific revolutions) while the idealism of scientists being happy "without knowing" seems stereotypical at best. Competition, budgets, and other pressures alone would render such statements as suspect in their sweeping generalities.

[127]Dawkins, *The Greatest Show on Earth*, 422.

[128]Ibid.

[129]Richard Dawkins, *A Devil's Chaplain: Reflections on Hope, Lies, Science, and Love* (Boston: Houghton Mifflin, 2003), 95.

envisions a billion "islands of life" scattered across the universe.[130] And though he is specifically interested in the evidence of that second form of life in and of itself, one must ask if that life could have been responsible for the life present on Earth? In light of the previous section, these questions become much more pressing given the inherent lack of data. Currently, there are about a thousand *known* planets outside of our Solar System that extend outward to several hundred light-years away. But to put it in Dawkins's own terms, what do we *really* know about them?[131] Could a single microorganism have somehow channeled life toward Earth in the distant past?

Looking closely at what we know about these extra-solar planets, it is striking what little data there is. The discovery of just about all of these planets has been rather recent since the design of the more accurate telescopes, techniques and platforms operating outside of the Earth's atmosphere. Though a number of space observatories have been used at one time or another, the introduction of *The Hubble Telescope* in the nineties produced that true quantum leap in the science of space. Since its inception, it has yielded an unparalleled view of the universe in virtually eliminating the adverse effects of background light and atmospheric distortion. Through this unique tool, hundreds of additional planets have been detected and catalogued.

What does science know about these planets? Given that the larger masses are more easily detected, the planets discovered thus far are mostly of the "gas giant" category. But the shortage of detailed information about the vast majority of these planets limits any real chance of accurately estimating their odds. Science has returned to

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[130]Dawkins, "The Poetry of Science."

[131]Dawkins, *The Magic of Reality*, 38, 58, 100, 124, 164, 188, 214, and 232. Using some of Dawkins's own words, it would do this study justice to evaluate where the evidence *really* points. Dawkins used that phrase "really" a number of times to delineate the difference between myth and scientific reality.

the same problem encountered with the Drake Equation. How does one assign a probability for that which is unknown? Thus, the hope of Dawkins and others is left in obscurity outside of a few limited and somewhat speculative discoveries of a handful of planets.[132] Unfortunately, the likelihood that any hard evidence will surface in the present generation is doubtful at best due to the staggering distances involved.

More specifically, NASA and other space agencies have looked closely at the chance that natural panspermia had seeded the Earth. Could one of those extrasolar planets have developed life early enough for it to somehow make its way to Earth? Several papers have been written on this issue including Hawkes, et al., who addressed the possibility of meteoroids coming from outside the Solar System. Using a combination of imaging techniques ranging from multi-station photography, radar, and even television, they compiled a data set that revealed a relatively low percentage of extrasolar meteoroids.[133] These rocks, which had likely originated outside of the immediate Solar System, usually entail hyperbolic orbits because of their high energy/ highly eccentric paths. Elliptical orbits are typically lower in velocity, and hence, lower in energy. The latter orbits have already been captured by the Solar System. In contrast, hyperbolic orbits normally entail extrasolar debris. Hawkes and his colleagues calculated that the percentages approach *one percent* of those falling into the hyperbolic category, which is an extremely low figure. In other words, there are few rocks that have originated from outside of our Solar System to render any chance of seeding the Earth

[132]Richardson and Seager, "The Atmospheres of Extrasolar Planets."

[133]Robert Hawkes, Tricia Close and Sean Woodworth, "Meteoroids from Outside the Solar System," *Meteoroids* (1998).

from abroad. Even more sobering, however, is the exceedingly rare chance of this extrasolar debris ever reaching Earth.

H. J. Melosh, who is a recognized expert on impact cratering and the associated orbital mechanics of such debris, contributed a paper that paralleled and somewhat extended these calculations. Though fully recognizing the active nature of the material exchange between intra-solar bodies, he produced a substantial study of extra-solar exchange using a Monte Carlo simulation.[134] Factoring in the exceedingly low probability that a given rock would reach a neighboring star system, and then adding the even greater rarity of its hitting a small cross section and/or gravitational field of the Earth (i.e., as compared to the much larger cross sections of Saturn or Jupiter), and the probability becomes essentially nil. In conclusion, Melosh admits that it is "unlikely that any rock ejected from a terrestrial planet in our Solar System *has ever reached* a terrestrial planet in another solar system" (italics mine).[135] Factoring in the "spaces between stars [which is] immense," and he concludes that "the prospect that life hopped from star to star by any natural agency becomes vanishingly small."[136] The "origin of life on Earth," he writes, "must be sought within the confines of the Solar System itself, not abroad in the galaxy."[137]

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[134]H. J. Melosh, "Exchange of Meteorites (and Life?) Between Stellar Systems," *Astrobiology* 3, no.1 (2003): 208.

[135]Ibid., 214.

[136]Ibid.

[137]Ibid.

Conclusion

Despite Dawkins's confident attitude, the evidence for life beyond Earth is unfavorable thus far. Though he has made it clear that the greatest promise resides in the hope of finding a second form of life beyond Earth so far that hope has gone without evidence. The chances of realizing that hope seem somewhat diminished with each sample of extraterrestrial rock recovered from abroad. That is not to say that the knowledge of mankind is failing to advance, for that is certainly not the case. Rather our lack of success in finding even the most rudimentary sample of life beyond Earth combines with the steady exhaustion of available places to steadily diminish its long term prospectus. Like the lengthy catalog of meteorites recorded to date, the expanding database of extraterrestrial samples has yielded nothing more than a few simple organic molecules. That data falls well short (by many magnitudes) of that required by life.

That lack of success has forced science to press deeper into the geology of Mars while simultaneously moving outward toward a few of the remaining possibilities that encompass the Goldilocks Zone. A few of the larger moons bring the greatest possibility for life though they too remain "long shots." Unfortunately, that is where the state of the evidence rests. Despite the hopes of Dawkins and others, nothing acquired thus far has indicated the existence of any extraterrestrial life form to date. Likewise, no source has been identified to offer the natural transfer of that life either. Moreover, the possibility of finding life beyond our solar system does not look much better given that the distances involved are staggering – making direct exploration still many generations away (if then).

Meanwhile, this chapter has sought to address the confusing position that Dawkins has conveyed toward panspermia. Not only has it demonstrated that his statements between 2007 and 2008 were anything but consistent, but that he has found himself in defense of his position ever since. Though it appears unlikely that he would publically admit to any support for directed panspermia, it is still important to note that the theory lacks sufficient foundation. Aside from the complete lack of evidence, it is a theory which faces extremely longs odds. Given the need for an alien civilization to simply exist, it must have also found our world. The likelihood of natural panspermia does not look much better. The probabilities are astronomically low for debris from outside the Solar System and no evidence exists among the thousands of meteorites already catalogued. Thus the combined evidence against either form of panspermia to have seeded Earth appears to be essentially nil at this point. Though maintaining the slightest openness toward the theory, Dawkins was left to find another source from which the beginning of life could be explained.

CHAPTER 7

DAWKINS AND RNA WORLD THEORY

Introduction

Richard Dawkins has most recently embraced RNA World Theory as the most viable model for the origin of life. He reiterated that position in response to a student's question at a book tour in 2011. Initially, he had hesitated before telling the audience that "it really didn't matter."[1] Then after referring to "the available theories at the moment," he talked about the ongoing effort in search of that "just right" theory that could identify the solution.[2] Dawkins carefully qualified his response before admitting his position. He eventually confessed that RNA World "seems to be the most promising" of the theories yet forwarded to date.[3] But why did he seem reluctant to simply state his position? Why did Dawkins need to qualify his answer? Evidently, the ongoing fluidity of his position has undoubtedly begun to weigh on him. Though popular among his followers, surely many have noticed his movement between models over time.

As early as 1995, Dawkins began to consider RNA as a potential pre-replicating molecule. Despite the brevity of his comments, he had clearly demonstrated

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[1]Richard Dawkins, "The Magic of Reality," US Book Tour, Eastern Kentucky University (October 6, 2011). Dawkins offered his support for RNA World Theory during the Question and Answer session after his book review (2011 book *The Magic of Reality*). Dawkins elected to qualify his position in saying that it was the best "*available* theory at that moment." See Richard Dawkins, *The Magic of Reality: How We Know What's Really True* (New York: Houghton Mifflin, 2006).

[2]Dawkins, US Book Tour 2011.

[3]Ibid.

an interest in its capability and versatility.[4] Its corresponding model afforded much promise over competing theories. Unsurprisingly, Dawkins had brought up the idea amidst his commentary on the models provided by Cairns-Smith and Julius Rebek. He inserted it in what appeared to be a subtle interest alongside these endorsements. Moreover, he had only allocated a single sentence to its mention. Nevertheless, he indicated that one of those theories might have served as a "forerunner" of the DNA-based system known today.[5] Perhaps RNA had something to offer. But Dawkins would not return to RNA (or RNA World) for nearly a decade. Instead, he wrote four other books, produced two new editions (of previous books), and published a plethora of articles on other issues. At that earlier point in time, he had refrained from pursuing RNA as a leading option.

After concentrating his attention on other matters, including a more focused attack on Christianity (and God in general), Dawkins returned to RNA during his more detailed and formidable work on evolution: *The Ancestor's Tale*. In that text and then again in *The Greatest Show on Earth*, he revisited the possibilities of RNA World Theory in more detail.[6] He also offered his guarded support for the theory after a brief recapitulation of past solutions.[7] Given that he has not forwarded any other position

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[4]Richard Dawkins, *River Out of Eden: A Darwinian View of Life* (New York: Basic Books, 1995), 151. Having declared that a full DNA-based system is far too "sophisticated [and] high tech," he began to allude to several alternative theories that had been proposed. He said that "the forerunner might have been RNA," though specifically referencing Cairns-Smith and Julius Rebek.

[5]Ibid.

[6]Richard Dawkins, *The Greatest Show on Earth: The Evidence for Evolution* (New York: Free Press, 2009), 419-21. See also idem, *The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution* (Boston: Houghton Mifflin, 2004), 574-76; and idem, *The God Delusion* (New York: Houghton Mifflin, 2006), 164.

[7]Dawkins, *The Greatest Show on Earth*, 419. This brief summary of Dawkins's own past commentaries reveals a lack of consensus among scholars in search of a theory that best explains the origin of life. Herein Dawkins admitted that the classic model (represented by Miller) had fallen away against an

since that time (2009)[8] and has not rejected that support since his book tour in 2011, it seems safe to conclude that RNA World Theory remains his favored option.

History of RNA World

As was previously established in this dissertation, the gradual shift away from the classic theory created a void in explaining abiogenesis. Though Dawkins had surveyed a relatively wide range of options, three scholars had already begun to consider RNA. Francis Crick, Leslie Orgel and Carl Woese had all thought about the same general concept during the late sixties. Could RNA have played a role in developing the first replicating molecule? Woese had written a full text on that possible link between RNA and abiogenesis in 1967.[9] Crick and Orgel then followed with related papers shortly thereafter.[10] All three of these scholars had recognized the near universal

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eclectic field of options (represented by Cairns-Smith and various theories pertaining to thermophiles). Dawkins summarized his own search through the following brief recapitulation: "Darwin's 'warm little pond,' together with the witch's brew concocted by Miller that it inspired, are nowadays often rejected as a preamble to advancing some favoured alternative. The truth is that there is no overwhelming consensus. Several promising ideas have been suggested, but there is no decisive evidence pointing unmistakably to any one. In previous books I have attended to various interesting possibilities, including the inorganic clay crystals theory of Graham Cairns-Smith, and the more recently fashionable view that the conditions under which life first arose were akin to the Hadean habitat of today's 'thermophilous' bacteria and archaea, some of which thrive and reproduce in hot springs that are literally boiling. Today, a majority of biologists are moving towards the 'RNA World theory,' and for a reason that I find quite persuasive."

[8]Dawkins wrote *The Greatest Show on Earth* in 2009.

[9]C. R. Woese, *The Genetic Code* (New York: Harper & Row, 1967).

[10]F. H. C. Crick, "The Origin of the Genetic Code," *Journal of Molecular Biology* 38 (1968): 367-79. See also Leslie Orgel, "Evolution of the Genetic Apparatus," *Journal of Molecular Biology* 38 (1968): 381-93. Both of these articles appeared in the same edition of the same journal. Following closely behind Woese, they also began to think of RNA in terms of a pre-DNA structure. Crick asserted in that early paper that different RNA molecules (specifically tRNA and rRNA) were probably "*part of the primitive machinery* for protein synthesis" (371). Similarly, Orgel accented the Principle of Continuity in thinking that whatever molecule or sequence of molecules led to the recent system, that it would entail structure(s) that would match the current system. Therefore, he found it "very difficult to see how a totally different biological organization could have undergone a continuous transition to the nucleic acid-protein system with which we are familiar" (381). RNA would naturally fit the precursor to which he was alluding to given its current role in organisms. The above article by Crick should not be confused with another

presence of RNA and the variety of ways that it contributed to the workings of life. But not until Thomas Cech had demonstrated the enhanced versatility of RNA did the modern version of the theory really progress. His team discovered that RNA displayed a certain catalytic property, similar to, though much less effective than ordinary enzymes.[11] Nevertheless, this groundbreaking discovery opened the door for further research in this area. Together, the twin functions of catalysis and replication could potentially resolve the lingering problem of the "chicken or the egg."[12] Correspondingly, Cech obtained his Nobel Prize in 1989 pertaining to this finding.

By the mid-eighties, Cech's research on RNA had gradually developed into a defined theory. A decade later and even Crick and Orgel were surprised with its relative success. In a 1993 article, they confessed that they had "not anticipate[d]" the attention RNA would attract over time, for twenty-five years earlier "a system based on polypeptide replication seemed to be the only reasonable alternative."[13] Nonetheless, each had engaged in searching out alternatives since that time (including RNA). In

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article bearing a similar title. He had previously written on a related issue in 1967: idem, "Origin of the Genetic Code," *Nature* 119 (1967): 119.

[11]Thomas Cech, et al., "Self-Splicing RNA: Autoexcision and Autocyclization of the Ribosomal RNA Intervening Sequence of Tetrahymena," *Cell* 31 (1982): 147-57. See also idem, "A Model for the RNA-catalyzed Replication of RNA," *Proceedings of the National Academy of Sciences* 83 (1986): 4360-63.

[12]William A. Dembski and Jonathan Wells, *The Design of Life: Discovering Signs of Intelligence in Biological Systems* (Dallas: The Foundation for Thought and Ethics, 2008), 235. What Dembski and Wells called the "chicken or the egg" paradox, Dawkins calls the "Catch-22 of the origin of life." See Dawkins, *The Ancestor's Tale*, 573; and idem, *The Greatest Show on Earth*, 420. Dawkins described this paradox in this latter reference: "a gene big enough to specify an enzyme would be too big to replicate accurately without the aid of an enzyme of the very kind that it is trying to specify" (420). In other words, the enzyme is required to reduce the error rate, which enhances the replication. But the gene itself must be complex enough to specify the enzyme.

[13]Leslie E. Orgel and Francis H. C. Crick, "Anticipating an RNA World – Some Past Speculations on the Origin of Life: Where Are They Today?" *The Journal of the Federation of American Societies for Experimental Biology* 7 (1993): 238-39. Polypeptide replication suggests the stringing of amino acids into a replicating entity – a "sub"-protein-based system (akin to the classic model).

addition, Crick became a leading proponent for *directed panspermia* (as noted in chapter 6 of this dissertation), having not been overly satisfied with the progress of terrestrial solutions.[14] Moreover, he was cautious to extend too much confidence in computer modeling techniques.[15] Meanwhile, Crick's associate Leslie Orgel remained somewhat more confident in RNA's viability referring to it as "the watershed event in the development of life."[16] He has thus followed the progress of RNA World Theory since its inception. But he has equally recognized the extensive obstacles facing the molecule's initial formation given the absence of enzymes.[17] Unsurprisingly, he has concluded that RNA "was not the first self-replicating molecule."[18] From Orgel's perspective, it would have taken additional steps to achieve RNA's high level of complexity. Nevertheless, RNA World Theory has become one of the leading candidates for explaining the origin of life and has attracted many adherents.[19]

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[14]Francis Crick, *Life Itself: Its Origin and Nature* (New York: Simon & Schuster, 1981). The entirety of this text developed a case for directed panspermia including the probability of advanced civilizations (chapter 9), what they would specifically send (chapter 11) and how they would send it (chapter 12). Though appearing somewhat ambivalent about his own idea, Crick elected to look for options in lieu of current theory.

[15]Francis Crick, *What Mad Pursuit: A Personal View of Scientific Discovery* (New York: Basic Books, 1988), 115. In this text, Crick wrote about the way "authors love playing with computers and writing computer programs and are simply carried away when a program produces a pretty result." At the time, he was alluding to "'models' of the brain" in particular.

[16]Leslie Orgel, "The Origin of Life on the Earth," *Scientific American* 274, no. 4 (1994): 83.

[17]Ibid., 82

[18]Ibid. Orgel admits that "because synthesizing nucleotides and achieving replication of RNA under plausible prebiotic conditions have proved so challenging, chemists are increasingly considering the possibility that RNA was not the first self-replicating molecule on the primitive earth – that a simpler replicating system came first." Though this article was written by Orgel nearly twenty years ago, the status of this problem does not appear to have changed much. Additional or alternative steps have become the focus of current research (as will be demonstrated later in this chapter).

[19]Walter Gilbert, "The RNA World," *Nature* 319, no. 6055 (1986): 618. Nobel laureate Gilbert was the first to coin the phrase "RNA World," which gave the theory its name. Some scholars refer to this same idea as the "RNA World Hypothesis."

Challenges to RNA World Theory

The long standing problem that demands both replication and catalyzation – simultaneously – has left an enormous challenge for origin of life research. Without the necessary enzymes in place, how does a molecule achieve replication? And without the nucleic acids, how would the proteins become synthesized?[20] If DNA is far and away too complex, then RNA becomes the likely choice. With its minimal enzymatic capacity now demonstrated, perhaps it could have performed both roles. Thomas Cech agrees, concluding that it would be easier to "conceive of a single type of molecule [that] replicat[es] itself than to posit that two different molecules (such as a nucleic acid and a protein capable of replicating that nucleic acid) were synthesized by random chemical reactions in the same place at the same time."[21] He further described a number of advantages to the theory including certain features that would suggest chemical continuity.[22] Nevertheless, the idea is not without problems.

As Dawkins himself confessed, RNA enzymes "are not as efficient as protein enzymes."[23] Biochemist H. S. Bernhardt concurs, noting that RNA is simply "too limited."[24] More specifically, he points out how "the probable metabolic requirements of

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[20]Dawkins, *The Greatest Show on Earth,* 420. See also idem, *The Ancestor's Tale*, 574.

[21]Thomas Cech, "The RNA Worlds in Context," *Cold Spring Harbor Perspectives in Biology* 4, no. 7 (2011): 1.

[22]Ibid. Cech describes six "persuasive arguments in favor of RNA World" despite its numerous problems. In summary, these arguments include the joint capacity to replicate and catalyze (though to a lesser degree), the more simplistic means of achieving replication through a single molecule rather than two, its use of RNA catalysts which suggests their comparable early chemistry, RNA components that are "already present," indications that it preceded DNA, and the continuity of an earlier system that would fit well with the current system (i.e., with RNA involved heavily in both).

[23]Dawkins, *The Greatest Show on Earth*, 421.

[24]Harold S. Bernhardt, "The RNA World Hypothesis: The Worst Theory of the Early

an RNA World would have exceeded the catalytic capacity of RNA."[25] Unlike the exceedingly malleable properties of regular protein enzymes, RNA can achieve only a limited degree of *folding*. And this three-dimensional capacity to fold in a near limitless manner provides the key to its enzymatic properties.[26] Meanwhile, the replicating properties of RNA are likewise limited. RNA does not lend itself to the equivalent replicating power of DNA. As Dawkins readily admits, RNA's flexibility somewhat hinders its ability to replicate. "RNA does not easily form a long double helix," he notes, "which means that it is somewhat inferior to DNA as a replicator."[27] Because of this inherent structural flaw (though somewhat beneficial to its pseudo-catalytic properties), RNA lacks the "kind of proofreading" that benefits DNA. Its diminished capacity to proofread causes "*mutation rates that are thousands of times greater than DNA*" (italics mine).[28] That heightened susceptibility to error would drastically limit the size of organism that RNA could potentially serve without DNA. He further concedes that, "only simple organisms" and "some viruses can use RNA as their primary replicator."[29]

Those theorists in support of RNA World hope that those limitations would not have obstructed the initial steps of life. But even if RNA could somehow circumnavigate

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Evolution of Life," *Biology Direct* 7, no. 23 (2012). Bernhardt teaches in the department of biochemistry at the University of Otago, New Zealand.

[25]Ibid.

[26]Dawkins, *The Ancestor's Tale*, 574. Herein Dawkins discusses the remarkable capacity of proteins to essentially take on a desired shape. As he describes it: "Proteins are good at being enzymes because they can assume almost any shape you want in three dimensions, as an automatic consequence of their amino acid sequence in one dimension. It is the chemical affinities of amino acids for other amino acids in different parts of the chain that determine the particular knot into which the protein chain ties itself …. It is this protein talent that qualifies proteins to act as enzymes."

[27]Ibid., 575.

[28]Ibid.

[29]Ibid.

those limitations and/or obstacles, it would still have to face the monumental task of achieving its initial complexity. Robert Shapiro asked that precise question in his criticism of RNA World: "How did that first self-replicating RNA arise?"[30] Bernhardt added his own concern after calculating the enormous odds facing such an event. In discussing "the best ribozyme replicase created so far," he writes that the associated "length [is] far too long a sequence to have arisen through any conceivable process of random assembly."[31] Meanwhile, even longstanding proponent and leader of this theory Leslie Orgel agreed that those extremely long odds force RNA World to require "perhaps a simpler polymer"[32] or "replicating system"[33] (i.e., an additional step). This conclusion has recently attracted a number of other ideas that entail additional steps or similar means by which RNA itself could have been derived.

Dawkins and RNA World Theory

Dawkins first demonstrated his interest in RNA in *River Out of Eden*. In light of its "self-copying" capability, it seemed to him like a reasonable candidate as a pre-DNA replicator.[34] Because of the increased awareness of life's complexity, a true "DNA-like molecule" seemed even less likely to arise naturally. For several years, researchers had begun to look for some "pre-DNA" type replicator that required less

[30]Robert Shapiro, "A Simpler Origin of Life," *Scientific American* 296, no. 6 (2007).

[31]Bernhardt, "The RNA World Hypothesis."

[32]Leslie E. Orgel, "The Implausibility of Metabolic Cycles on the Prebiotic Earth," *Public Library of Science: Biology* 6, no. 1 (2008).

[33]Orgel, "The Origin of Life on the Earth," 82.

[34]Dawkins, *River Out of Eden*, 144. The self-catalyzing property of RNA had also been recently demonstrated three years before. See Cech, et al., "Self-Splicing RNA."

biological machinery.[35] As chapter 3 of this dissertation has made clear, RNA offered a unique solution because of its dual capacity to function as both a pseudo-catalyst and pseudo-replicator at the same time. That twin capacity to accomplish both roles (however effective) brought it to the forefront. Understandably, Dawkins has also considered this molecule to be a possible "forerunner" of DNA.[36]

After making that cursory mention of RNA in 1995, Dawkins would bypass the idea for nearly ten years before returning to it as a potential candidate for abiogenesis. Upon his more lengthy explanation in *The Ancestor's Tale* in 2004, he began to unfold the basic tenets of its associated theory.[37] Therein he reviewed the advantages of RNA in being able to perform the dual roles. Though only touching on the idea again in *The God Delusion* (2006), he returned to it somewhat more thoroughly three years later in *The Greatest Show on Earth* (2009).[38] After recapitulating much of the same basic material covered in his earlier text, Dawkins went on to say that it was not only "plausible," but that he found the theory to be "quite persuasive."[39]

By the time Dawkins had paid a visit to Eastern Kentucky University (EKU) in 2011, he had already settled on RNA World Theory. Given that he has not mentioned any other theory nor suggested a replacement since, it would appear that he still holds to

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[35]In regard to RNA alone, numerous scholars have pursued a pre-DNA replicator including Carl Woese, Francis Crick, Leslie Orgel, Walter Gilbert and Thomas Cech. These leaders paved the way for RNA World Theory. But a multitude of others have supplemented that which they started (a list of these contributors would prove exhaustive).

[36]Dawkins, *River Out of Eden*, 151.

[37]Dawkins, *The Ancestor's Tale*, 574-76.

[38]Dawkins, *The Greatest Show on Earth*, 419-21. See also idem, *The God Delusion*, 164. After a brief mention of RNA as a potential pre-DNA replicator in *The God Delusion,* Dawkins spent three pages in both explaining and endorsing the theory in his later text *The Greatest Show on Earth*.

[39]Ibid., 421 and 419 respectively.

that position. But his limited commentary suggests that he might be somewhat reluctant to offer his full commitment. Though his comments in *The Greatest Show on Earth* clearly illustrate his confidence in this, the best theory to date, he remains substantially more guarded as to a formal position. When prompted by the student's question in that 2011 book tour, he implied that the question itself was irrelevant.[40] Rather than concern himself with that particular aspect of the paradigm, he elected to steer the conversation toward the relative strengths of his argument. To Dawkins, that somewhat less established part of his position had more of a tendency to expose its weaknesses. Understandable, for the question of abiogenesis had not yet been resolved. Naturally, he would have rather discussed other aspects of the paradigm that would have helped develop his case.

To his credit, Dawkins eventually did answer the student's question. He said that "of all the available theories at the moment, [that] the RNA World is the one that seems to be the most promising."[41] That answer also coincided with the position he had offered in his more recent text.[42] Nevertheless, the manner in which Dawkins addressed that student's question appears somewhat more telling. He appeared to be uneasy about how to respond – preferring to dismiss or perhaps diminish the relevance of the question rather than address it. Evidently, he would have rather answered a question pertaining to homology, the fossil record or some other more established position. However, at the

[40]Dawkins, US Book Tour 2011.

[41]Ibid.

[42]Dawkins, *The Greatest Show on Earth*, 419.

moment he appeared ostensibly uncomfortable as he informed his audience that "*it really doesn't matter*" (italics mine).[43] But is that statement consistent with his record?

Chapter 4 of this dissertation briefly described Dawkins's 2010 response to a group called *Reddit Questions*. That organization, which manages a website for its patrons, asked an intriguing question about *the most pressing problems in biology*.[44] In a video-taped interview, Dawkins responded that one of those most important questions involved the problem of abiogenesis. Specifically, he answered with two interrelated questions: "How did life itself begin from non-life? And what was the origin of the first replicating molecule?"[45] Indeed, Dawkins had just stated that how life began from non-life – or what was the first replicator – *remains one of the most pressing questions in all of biology*. Certainly many scholars would agree. Chapter 1 of this dissertation briefly discussed the global participation, multiple programs, and overall expenditure in regard to the origin of life in the space programs alone.[46] The question of abiogenesis is a central issue. Why then would Dawkins dismiss that crucial question at the book tour as

[43]Dawkins, US Book Tour 2011.

[44]*Reddit Questions* operates a website for the general public. The organization provides the service of finding answers to a virtually unlimited range of questions. Its primary web address is at http://www.reddit.com/r/questions/.

[45]Richard Dawkins, "Richard Dawkins Answers Reddit Questions," http://www.youtube.com/watch?v=v5FxjPq5V9k, provided by the Richard Dawkins Foundation (accessed August 12, 2013). The two questions mentioned above were essentially asking the same thing, but from a slightly different perspective. The first question utilized a more generalized format about how life arose from non-life, while the second asked the more specific and localized question about the first replicator.

[46]Chapter 1 of this dissertation briefly addressed NASA's 2012 expenditures and several of the programs related to origin of life research. Chapter 3 also noted a few of the nationalized space agencies that have participated in this research. The organizations mentioned in these chapters are searching for the origin of life outside of the terrestrial realm. A much broader search continues toward a terrestrial solution among a host of agencies.

if it didn't matter?[47] How consistent had he been between his taped interview for Reddit Questions in 2010 and his public appearance at Eastern Kentucky University in 2011?

Impact of Dawkins's Worldview

What part did Dawkins's worldview play in the above assertions? Did the student's question that evening at the book tour really matter or not? How could the issue go from being one of the most pressing problems in an entire discipline at one point, to becoming a mere side issue in the second? Did the audience that night influence him in some way? Looking back to past commentaries, it would seem that Dawkins's fervor for naturalism has sometimes clouded his interpretation. His acceptance to lead in the "public understanding of science" may have pressed him to become somewhat presumptuous in favor of naturalism.[48]

Numerous examples expose this apparent bias including Dawkins's critique of a one scholar's biblically-based worldview. He strongly criticized Kurt Wise for admitting that "if all the evidence in the universe turn[ed] against creationism … [that he] would still be a creationist."[49] Dawkins's rebuttal could not imagine such "doublethink" from a fellow scientist.[50] At a Berkeley lecture, he even referred to Wise as "a disgrace

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[47]Dawkins, US Book Tour 2011.

[48]As previously mentioned in chapter 1 of this dissertation, Richard Dawkins was the first to be awarded the title of chair to the Charles Simonyi Professor for the Public Understanding of Science in 1995 and held that prestigious position until 2008. As the title suggests, the purpose of the position is the promotion of science to the public without losing the essence of its meaning.

[49]Kurt Wise, "Geology," in *In Six Days* (Green Forest, AR: Master Books, Inc., 2000), 351-55. The assertion in this question came from Wise who publicly declared that "if all the evidence in the universe turns against creationism, I would be the first to admit it, but I would still be a creationist because that is what the Word of God seems to indicate. Here I must stand."

[50]Richard Dawkins, "Sadly, and Honest Creationist," in *Free Inquiry Magazine* 21, no. 4 (2001): 2. In this article, Dawkins sharply criticized Wise for such "doublethink" – meaning the ability to understand a certain level of data available through science, but has elected to discount it due to his

to the human species."[51] But the bias of his worldview was only matched by Dawkins's own admission in *The Blind Watchmaker* (1986) wherein he wrote:

> My argument will be that Darwinism is the only known theory that is in principle *capable* of explaining certain aspects of life. If I am right it means that, *even if there were no actual evidence* in favour of the Darwinian theory (there is, of course) *we should still be justified* in preferring it over all rival theories. (italics mine).[52]

That statement appears remarkably similar to the one he condemned Wise for uttering.

Numerous other examples demonstrate how Dawkins's comments often *yield the impression* that certain circumstances within science are better than they actually are. Regarding the ongoing struggle of abiogenesis, Dawkins claims that scientists are "satisfied with not understanding."[53] Accordingly, "they cheerfully admit that they don't know the answer to something."[54] But such a view seems to be more of a caricature. Realistically, are scientists really satisfied with not knowing that which they seek? Given the demand for grants, tenure, fame and other factors, are they not also stressed or unsatisfied with not knowing or failing to obtain their goal? Phillip Johnson points out how "people base their careers and their personal lives" on the progress that accompanies their work. More often than not, their "professional reputation is at stake."[55]

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worldview. Incidentally, in comparing the career/education of Dawkins and Wise, one acquired his doctorate from Oxford while the other came from Harvard. Both studied the hard sciences and both performed exceptionally well in their respective studies (Dawkins under Niko Tinbergen; Wise under Stephen Jay Gould).

[51]Richard Dawkins, "Richard Dawkins: The Greatest Show on Earth," *Berkeley Arts and Lectures*, University of California Berkeley (October 7, 2009).

[52]Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design,* 2nd ed. (New York: W. W. Norton & Company, 1996), 287.

[53]Dawkins, *The God Delusion*, 152.

[54]Dawkins*, The Magic of Reality*, 188.

[55]Phillip E. Johnson, *Darwin on Trial*, 2nd ed. (Downers Grove, IL: InterVarsity Press, 1993),

Yet in following Dawkins's commentary on abiogenesis, he appears to find an optimistic resolution to just about any situation. For example, in discussing RNA World Theory, he confessed to finding the "theory plausible."[56] But after asserting that air of confidence, he also admonished his readers to be unconcerned with how plausible a theory actually appears. For two paragraphs later, he admitted that "the theory that we seek, of the origin of life on this planet, should therefore positively *not be a plausible theory!*" (italics mine).[57] So in addition to whether the theory should actually be realistic (or not), he has also inserted an *all-encompassing default* that would allow for the most unlikely of explanations.

Current Status of RNA World

Having led the movement toward RNA for some forty years, perhaps Leslie Orgel understands the molecule and its associated theory as well as anyone. Not only was he one of the three originators of the concept during the sixties, but he has supported its potential throughout his life. But even Orgel has recognized substantial limitations to RNA World Theory. Just as he indicated in his 1994 article alluded to earlier, so he revisited it through a later article published post-mortem in 2008. He fully admitted that some earlier "pre-RNA" molecule had become necessary. At that time he wrote that "perhaps a simpler polymer preceded RNA as the genetic material."[58] And though acknowledging this obstacle toward the end of his life in 2007, he had fully recognized it

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149. Johnson points out in his text how many factors tend to influence the perception and interpretation of scientific inquiry.

[56]Dawkins, *The Greatest Show on Earth*, 421.

[57]Ibid., 422.

[58]Orgel, "The Implausibility of Metabolic Cycles on the Prebiotic Earth."

well in advance (as early as 1994). It seems that Crick and Orgel were consistently ahead of their time. Orgel concluded that "a simpler replicator came first."[59] If true, then it raises the question as to what molecule might have filled that gap.

Over the past decade, a wide variety of ideas has surfaced to fill this void toward a *pre-RNA replicator*. Along those lines, Carole Anastasi and her team at The University of Manchester have acknowledged "that RNA might have been preceded by a 'simpler' informational macromolecule."[60] Likewise, Robertson and Joyce have recognized much the same. In addition to noting that "the problem of the origin of the RNA World is far from being resolved," they further concede the need for something else. They suggest that science should "consider the alternative possibility that RNA was preceded by some other replicating, evolving molecule, just as DNA and proteins were preceded by RNA."[61] Together, these assertions imply a virtual *chain of molecules* that allegedly linked inanimate matter to the *first true replicating molecule* of life. It appears that RNA World is possibly becoming a mere link in that chain (i.e., assuming the validity of RNA World).

Anastasi has adjusted her efforts to resolve this more foundational molecular solution. She notes that a "large number of potential chemical routes to RNA" need to be explored that could enable the RNA World scenario.[62] She alluded to threose nucleic acid (TNA) and glycol nucleic acid (GNA) as two of the more promising pre-RNA

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[59]Orgel, "The Origin of Life on the Earth," 82.

[60]Carole Anastasi, et al., "RNA: Prebiotic Product, or Biotic Invention?" *Chemistry & Biodiversity* 4, no. 4 (2007):721.

[61]Michael P. Robertson and Gerald Joyce, "The Origins of the RNA World," *Cold Spring Harbor Perspectives in Biology* 4 (2010).

[62]Anastasi, et al., "RNA: Prebiotic Product, or Biotic Invention?" 722.

molecules to date.[63] Perhaps one of those paths could have resulted in RNA World, which would provide the necessary *replicating catalyst* that many have hoped for. Nelson, Levy and Miller had forwarded a similar idea several years earlier. In recognizing this same problem, they suggested that "peptide nucleic acids" (PNA) might have provided an even more efficient path toward RNA World.[64] Meanwhile, Peter Nielson has pursued his own version of this idea more recently.[65] Working on a project alongside Leslie Orgel as early as 1995, he has explored what has become one of the more attractive options.[66]

But what do these most current studies indicate about RNA World Theory? Does it remain a viable option? Clearly, a shift toward an even *simpler* molecule has drawn increased attention over the past few years. Some theorists continue to pursue alternative methods based on "metabolism-first," mathematical or computer modeling. Leading scholars such as Cech recognize the overall potential of the idea, yet equally note its obstacles. Much still stands in the way of RNA World Theory as the ultimate solution. But whether a pre-RNA molecule will eventually resolve these additional problems is anyone's guess. Research in this new area is still rather recent. Whatever the case, the path toward RNA World remains unclear. Given the increased need for additional "support" molecules seems to imply a *chain of molecules* reaching toward that

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[63]Ibid.

[64]Kevin E. Nelson, Matthew Levy, and Staley L. Miller, "Peptide Nucleic Acids Rather than RNA may have been the First Genetic Molecule," *Proceedings of the National Academy of Sciences* 97, no. 8 (2000): 3868.

[65]Peter E. Nielson, "A New Molecule of Life?" *Scientific American* 299 (2008): 64-71.

[66]Christof Bohler, Peter E. Nielson, and Leslie E. Orgel, "Template Switching Between PNA and RNA Oligonucleotides," *Nature* 376 (1995): 578-81.

first replicator. That seems to imply a more comprehensive solution that entails several necessary stages.

Nonetheless, as this dissertation has demonstrated, numerous scholars have suggested that some form of additional staging was probably necessary to achieve replication. Manfred Eigen recognized the need for a series of "steps" or "sequence of reactions" in regard to his hypercycle.[67] Julius Rebek also concluded that his self-replicating molecules made his system "a stepping stone on the path toward more sophisticated self-replicating reactions rather than an end unto itself."[68] And even Cairns-Smith's crystalline-based model presumed a series of steps not the least of which entailed the inorganic stage.[69] Independently, each of these scholars recognized the obvious. They recognize the immensity of the gap separating inanimate matter from the simplest replicator and that no single method has been forwarded to date to traverse it.

Where does that leave Dawkins? Certainly he must be aware of the shortcomings that face RNA World Theory. Though still quite plausible in the minds of many, it too demands additional support. Will Dawkins make a move toward a more comprehensive scenario? Will he agree with Orgel and others that a pre-RNA path would have been necessary to usher in RNA World – if the latter remains viable? Whatever the case, there is no clear-cut solution. As Dawkins had concluded in 2009,

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[67]Manfred Eigen, "The Hypercycle: A Principal of Natural Self-Organization – Part A: Emergence of the Hypercycle," *Die Naturwissenschaften* 64, no. 11 (1977): 542. See chapter 5 of this dissertation for more detail on this model.

[68]Julius Rebek, "Synthetic Self-Replicating Molecules," *Understanding Cloning: Science Made Accessible* (New York: Warner Books, 2002).

[69]A. G. Cairns-Smith, *Genetic Takeover and the Mineral Origins of Life* (Cambridge: Cambridge University Press, 1982). See also idem, *Seven Clues to the Origin of Life* (Cambridge: Cambridge University Press, 1985); and idem, *The Life Puzzle* (Edinburgh: Oliver and Boyd, 1971).

there is still "no overwhelming consensus."[70] But will he stay with RNA World Theory? Or had he already hinted to some other "just right" theory to come along in time?[71] Perhaps Dawkins will keep his options open as these new theories progress. But the non-ending search for a pre-DNA replicator continues.

[70]Dawkins, *The Greatest Show on Earth*, 419.

[71]Dawkins, US Book Tour 2011.

CHAPTER 8

CONCLUSION

Alongside several of the more salient points that constitute this study, these closing remarks will address a few potential issues and/or rebuttals. These latter comments intend to qualify the reasoning behind the strong scientific emphasis that drove the bulk of this study, while maintaining the broader perspective of God's sovereignty. They will briefly describe why this dissertation does not endorse methodological naturalism in the exploration of our world or the metaphysical naturalism that assumes His absence. Moreover, they will address the likely rebuttal that might charge this dissertation with a "god-of-the-gaps" fallacy. Given that the problem itself represents a *gap* that science has failed to resolve, then it seems reasonable that such a complaint might be lodged against this study. In response, this dissertation appeals to the "best explanation" given the state of the evidence, which appears to point far and away above any naturalistic explanation and toward intelligent design. It is the opinion of this author that the gap will never be filled. Nevertheless, further research has been suggested that should enhance our understanding of the nature of this gap.

Initial Remarks: Dawkins and Abiogenesis

The problem of abiogenesis has continued to elude the greatest minds of our time. From the earliest myths of antiquity to the technological advancements of today, man has sought the answers for how life began. As of this writing, no acceptable solution

has been forwarded to date that demonstrates any real chance of explaining the origin of life. Moreover, no reasonable consensus has been obtained that has found agreement amongst scholars. The gap separating non-life from life remains a formidable challenge yet to be resolved. Given the unresolved status of the problem, it proved all the more helpful to revisit how man has grappled with this problem historically. Chapter 2 of this discussion served that very purpose. In reflecting back to the imaginative thought throughout history, it is evident that the contrasting solutions reflect the corresponding variance of each worldview.

Recent studies since the time of Darwin have remained closely tied to his metanarrative. The resulting variants of Darwinism (and Neo-Darwinism) have strengthened over time to the point that methodological naturalism (i.e., through some evolutionary means) holds the dominant position within academic thought. Thomas Huxley, who was arguably the greatest defender of Darwinism from its beginning, perhaps summarized it best. In attempting to resolve the origin of life in the "absence of evidence," he admitted that he had "no right to call [his] opinion anything but an act of philosophical faith."[1] Such brutal honesty in the face of an unswerving allegiance to methodological naturalism, serves well to establish the underlying reason for Huxley's dogmatic stance. Apart from evidence itself (which quite literally supplies the grounding for any empirical method), he was still going to adhere to his pre-determined worldview. Upon his own admission, that was his *philosophical* stance.

Moreover, Huxley's stated position toward the archaic and utterly rejected notion of *spontaneous generation* conflicted with that which had been deemed necessary

[1]Thomas H. Huxley, *Discourses: Biological and Geological Essays* (New York: Appleton and Company, 1894), 256.

for life to arise. Again, his honesty toward this issue should be applauded as he fully acknowledged that the same archaic idea (that he had personally rejected) must have somehow accounted for life as we know it. Despite his own rejection, spontaneous generation still provided the "expectation to which [his] analogical reasoning leads."[2] Unless directed by an agent, some form of that process *must have occurred* at some point in time. Though equally rejected today, something akin to that antiquated idea necessarily provides the naturalist's lone position by default – albeit through a much slower process entailing numerous stages.[3]

Richard Dawkins demonstrated his own thoughts on abiogenesis during the writing of his first book in the seventies. Since that time, he has gradually expressed greater interest in the problem in declaring whatever his most recent opinion had become. This dissertation has followed how Dawkins has engaged this problem over the past four decades. It has offered evidence that he has vacillated between a number of models over that time – suggesting more fluidity than certainty in regard to this issue. Moreover, his philosophical approach to the matter has often been questionable and inconsistent. His ideas in regard to emergence and self-organization, for example, have employed little or no evidence. Moreover, much of his commentary has resorted to a more polemical argument in favor of naturalism rather than the straightforward dissemination of information. This bias should call into question his opinions and overall position on abiogenesis in the ongoing conversation.

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[2]Ibid., 257.

[3]Though some have described spontaneous generation as the rise of certain living organisms out of decaying matter (i.e., from a formerly living organism), many accounts suggest that the same process could sometimes occur through inanimate matter.

Dawkins's Search for a Solution

The analysis provided by this dissertation has demonstrated that the perception Dawkins has often conveyed suggests a lack of concern toward the problem as a whole.[4] From his perspective, there is already sufficient evidence along various other points of the paradigm to assure the world of its naturalistic basis. Nevertheless, Dawkins has equally confessed in other venues that the problem of origins is indeed important. He has candidly admitted that it remains one of the most important issues in all of biology.[5]

How should the above positions be taken? The resulting ambiguity reveals that the perception Dawkins promotes does not always coincide with the reality that he understands. But an analysis of his explanations reveals a number of additional concerns. For example, he has written his own computer programs in the hope of demonstrating a naturalistic path toward biological complexity. But these programs entail the infusion of information that would not have been available through evolution. They appear to inject far too much imagination into a problem that demands reality. Dawkins's reliance on imagination has driven much of what he has communicated to date. Whether describing what he imagines to be the conditions on the primordial Earth, how the molecules of life initially came together, or what aliens might physically look like, Dawkins has consistently appealed to the imagination. Nonetheless, science depends on the reliable interpretation of the empirical.

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[4]Richard Dawkins, "The Magic of Reality," US Book Tour, Eastern Kentucky University (October 6, 2011).

[5]Richard Dawkins, "Richard Dawkins Answers Reddit Questions," *The Richard Dawkins Foundation: For Reason and Science* (November 14, 2010) http://old.richarddawkins.net/videos/547385-richard-dawkins-answers-reddit-questions (accessed August 12, 2013).

From a scientific perspective, Dawkins has sometimes struggled in his treatment of material. Though producing a number of formidable arguments, he has all too often resorted to unsubstantiated ideas. His ultimate dependence on a *thermodynamically open system*, for instance, has led him to press the limits of the second law beyond that which has been demonstrated in science.[6] Moreover, the underlying and unproven junction between energy and complexity should not be assumed in providing a case for "cumulative selection." To date, science has neither proven nor accepted an exchange between these two entities.

Meanwhile, this dissertation has also followed the movement of Dawkins between various models. His thoughts on the origin of life have clearly changed over time. He has entertained ideas that range from the terrestrial to the extraterrestrial, from carbon-based to silicon-based, and from empirical to theoretical modeling. Though currently in support of RNA World Theory, he may very well follow those who have already begun to abandon that idea for a metabolism-first scenario or some other more comprehensive solution.

Nevertheless, Dawkins has effectively communicated his position over several decades. In addition to writing thirteen books and a host of articles, he has also participated in countless debates, lectures and public interviews throughout his career. Three of his books have become bestsellers and a few others appear to be on the verge of that status.[7] Moreover, his position as Chair to the Charles Simonyi Professor of the

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[6]Though the second law of thermodynamics may be observed in the exchange of energy in a closed system or "control volume," the problem of abiogenesis requires a *thermodynamically open system*. This general restriction of the law will not permit a decrease of entropy in the former case, but will allow for a *localized* decrease in entropy in the latter case due to the exchange of heat and work across its open boundaries – though the "net" change of entropy (system and surroundings) must necessarily increase.

[7]At least three of Dawkins's thirteen books have been called bestsellers by the New York

Public Understanding of Science has further propelled him into the public square.[8] These achievements have provided Dawkins with the requisite platform for engaging his worldview and for promoting his opinions from within. But again, the perception he has exhibited toward the general public draws a sharp contrast against the reality of the problem itself. Despite his confidence in resolving abiogenesis, the issue remains far from settled. The general lack of evidence combines with the sheer magnitude of the problem to provide one of the greatest problems of science.

Applying Theistic Science to Abiogenesis

In embarking upon this challenge, which many scholars regard as one of the most important questions in all of science, this study has followed one of its more recognized leaders in Richard Dawkins who offers a localized perspective on the enduring problem at hand. In resisting the pressure to restrict this endeavor to *methodological naturalism* from the outset, this dissertation has opted for the broader approach afforded by *theistic science*. Though the bulk of this analysis has opted to follow Dawkins's work from within his own world (i.e., through empirical discussion), it has remained within the confines of theistic science. However, only in the defense of a handful of passages has this empiricism even been pressed (i.e., chapter 2), so as to avoid the additional burden of casting any further distraction upon the analysis. Using this approach, Dawkins's handling of abiogenesis has remained the focal point of the discussion – which is essentially the centerpiece of this dissertation's thesis.

Times including *The Selfish Gene, The Blind Watchmaker* and *The God Delusion*. See Richard Dawkins, *The Selfish Gene*, 2nd ed. (Oxford: Oxford University Press, 1989); idem, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design*, 2nd ed. (New York: W. W. Norton & Company, 1996); and idem, *The God Delusion* (New York: Houghton Mifflin Company, 2006).

[8]Richard Dawkins was selected as the inaugural Chair to the Charles Simonyi Professor for The Public Understanding of Science at Oxford University where he served from 1995 to 2008.

Nevertheless, this latter approach has sustained the efficacy of the scientific method albeit through a theological lens. Meanwhile, its philosophical sensitivity has provided a means for detecting bias and worldview throughout the discussion. Though this dissertation has allocated the bulk of its research in the realm of scientific discovery, it has not restricted its scope to the narrower subset of strict empiricism that would neglect certain philosophical obligations. For apart from the more obligatory concern for the *philosophy of science* itself, such an approach would have been left unchecked and unbridled to the prevailing *zeitgeist* of the day.

Therefore, this dissertation makes no apology in utilizing this broader approach which has afforded a more grounded foundation through the general and special revelation of God. As He so richly proclaimed it in the nineteenth Psalm, "the heavens declare the glory of God and the firmament shows His handiwork. Day unto day utters speech, and night after night reveals knowledge. There is no speech nor language where their voice is not heard. Their line goes out through all the Earth and their words to the end of the world."[9] This commitment *a priori* – first to the revelation of God through His Word and second through the evidence found in creation – is offered herein unabashedly and without apology. Even the engineering marvel observed at the microscopic level (that has been discussed at length in this study) points to a biochemistry instilled by the hand of God. Such design echoes the work of a creator and not the blind forces of chance and energy. Nonetheless, this dissertation has made every attempt to heed the evidences offered by science through their selection and citation of Dawkins. This process has followed the career and personal quest of this key leader, who somewhat reflects that which has been observed about the scientific community at large. Moreover, each has

[9]Ps. 19: 1-4a.

continued to sift through the latest discoveries in search of a solution. This dissertation has provided an overview of those evidences *at this junction in history* through the general commentary of those who have offered those views (alongside their peers).

Undoubtedly, this approach will draw critique as some will categorize it as yet another diluted effort to render that which has not been discovered to a supernatural explanation. Dawkins upbraided that sort of strategy in a section of *The God Delusion* he entitled "The Worship of Gaps."[10] He is quite right that such an errant move would have taken advantage of the fact that science has failed to achieve a reasonable consensus or solution at this point in time – leaving a gap wide open for God to fill. But that common *argument from ignorance* cannot justifiably provide a truth just because it has not yet been proven false.[11] It is that classic "god-of-the-gaps" defense that erroneously depends on insufficient investigation (before further exploration has been affected). In light of this inevitable riposte, I offer two levels of response in defense of this dissertation – one from a more general standpoint and the other from a specific perspective.

God-of-the-Gaps: A General Response

First, as has been alluded to by the approach of this dissertation, a theistic science has been assumed throughout. That approach exposes the most important and conflicting assumption between competing worldviews (i.e., theism and naturalism). While one side recognizes the existence and activity of God in creation, the other

[10]Dawkins, *The God Delusion*, 151-61. Dawkins classic criticism asserts that "creationists eagerly seek a gap to present-day knowledge" so that it can be "assumed that God, by default, must fill it" (151). He suggests that this faulty methodology is a "ploy [which] undermines the scientist's natural – indeed necessary – rejoicing in (temporary) uncertainty" (152). Though he is right in criticizing those who would rely on such gaps to simply insert God, he is also exposing his metaphysical intolerance for the supernatural (i.e., apart from its potential use as a psychological crutch for the "unenlightened").

[11]Also known as an "appeal to ignorance" or *argumentum ad ignorantiam*.

discounts His existence. But the broader approach (of theistic science) recognizes that God cannot be limited. His sovereignty reigns despite anyone's recognition or approval of that fact. Therefore, the natural dividing line separating these worldviews defines the differing perspectives in regard to this or any other gap as His sovereignty resides both inside and out that gap.

Though His direct intervention in the world (i.e., through primary causation) could be described as occasional at best, it is clearly not His normative *modus operandi* over time. Secondary causation, therefore, depicts the ordinary means by which He sustains the world. That regularity provides a universe that is openly available to responsible scientific study and interpretation.[12] But just as any such study should not be limited to a naturalistic bias, so also God cannot be limited to only that which has not been discovered or explained (e.g., the gap separating non-life from life). He does not reside in the mere gaps that the progress of science has yet to unfold (i.e., if able), but remains sovereign throughout the course of nature. More specifically, God cannot be restricted by anyone's feeble attempts to dismiss Him nor can He be swept into the gaps to affect a solution.

Second, this particular critique has a tendency to cater to methodological naturalism. In the overly zealous attempt to avoid being guilty of alluding to the supernatural, it has become all too easy to cite a violation of the "god-of-the-gaps" in just about any case where naturalism is challenged. Though this complaint has correctly unmasked a number of ill-supported cases that have not performed the due diligence of

[12]Such regularity tends to eliminate the other common objection in regard to epistemic virtue. Does God's intervention tend to distort the work of science in discovering the world? No, theistic science recognizes that the vast bulk of the world presents a consistent framework in which to affect discovery.

responsible scholarship, it cannot and should not become the *default defense* against any approach that does not pay tribute to an unbounded empiricism. Theistic science, properly understood, does not look for the unfilled gaps of science to look for God. It evaluates the whole of the universe through a lens that simply recognizes His design.

Third, despite the misnomer that many hold against *intelligent design* (ID), it is a specialized field of study that utilizes the very same tools that are demanded by the scientific method except that it does not allow naturalism to restrict certain possibilities *a priori*. Even pressing beyond the inclination toward biblical truth as my primary epistemic foundation, intelligent design remains especially steadfast to avoid such bias. As Stephen Meyer states it, "intelligent design is not 'religion,'"[13] but it "makes theism more plausible or more likely to be true than it would have been otherwise in the absence of [certain] evidence[s]."[14] In properly accepting ID as yet another means of scientific inquiry, its adherents should also be afforded the same rights of critique that are available to any other scholar within science. Given that such a right is deemed reasonable, then no area of scientific discovery should be "off limits" to peer review – and that would necessarily include areas of study that hinge on some gap. Of course, those kinds of gaps (short of scientific explanation) account for the bulk of scientific discovery. Limiting the peer review of a particular group of scientists because of their conflicting approach or worldview represents a bias that would restrict the progress of science wherever it leads.

Finally, a gradual shrinkage of just about any gap (in knowledge) is expected over time. In essence, such a physical depiction represents not only the progress of

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[13]Stephen C. Meyer, *Signature in the Cell: DNA and the Evidence for Intelligent Design* (New York: Harper Collins, 2009), 441.

[14]Ibid., 444.

science but of knowledge itself. Despite the corresponding discovery of ever newer gaps (that simultaneously arise over the course of time), knowledge is expected to forge ahead in cementing those gaps of knowledge. And either version of science, theistic or otherwise, would acknowledge that fact. Nevertheless, that accompanying progress of science *does not guarantee* that any particular gap will ever be filled (i.e., in strict scientific terms or methodology) as if it were inevitable. Such an overconfident attitude toward science not only assumes a strong form of scientism but an unfounded efficacy of methodological naturalism in general. Further discussion on these matters is provided in the latter sections of this conclusion.

God-of-the-Gaps: A Specific Response

Looking more specifically at the criticism that may be directed toward this dissertation, it is likely that this same fallacy may be lodged against it. Not only has this study challenged one of its more celebrated and recognized scholars of science, but it has deliberately addressed a "gap" in scientific knowledge. But as previously established, unless the prevailing studies in abiogenesis are immune to critique, then they should also be available for review herein. The basis of this study, though viewed under the lens of theistic science, has honestly looked at the state of the evidence as cited by Dawkins and as depicted by its scholars. Therefore, this study has not appealed to a "god-in-the-gaps" solution but has affected a rather straightforward critique of one particular scholar's attempt toward resolving the problem.

In any case, what really matters is the acceptance and/or recognition of the *best explanation*. If intelligent design can explain the complexity of DNA over and above any current (i.e., naturalistic) solution, then why should it be ignored as a viable model? That

is not to suggest that one necessarily accept the supernatural, but that some form of agency might be entertained as a rational solution. Dawkins had admitted that possibility in his interview with Ben Stein.[15] Regardless, if a better model eventually surfaced having greater *explanatory power*, then the former should be discarded much like any other superseded theory.[16] The progress of science has always afforded that form of competition in search of the truth. In regard to the origin of life, this dissertation does not argue that God is a "filler" of this gap. It merely reveals the state of the problem through the perspective of Richard Dawkins.

The critique provided herein should also not be limited to a *positive argument*. Despite the overarching pressure felt by those of the ID movement, honest critique of any other scientific study should be "fair game." The exchange of criticism between scholars is a necessary ingredient of the academic process. Every scholar mentioned in this dissertation has accepted and/or extended criticism at some point in time. It is part of the very fabric of science to search for truth and expect accountability. Honest critique is not only welcomed by science but functions as a foundational part of its inherent structure. For how else can *falsifiability* be assured? Unfortunately, equality in this matter has not necessarily marked the practice of science today. Proponents of ID must be exceedingly cautious in criticizing any naturalistically-based position. Given that just about any negative argument may be rendered as a retreat to the "god-of-the-gaps," one must be especially careful in how their argument is communicated. Again, such bias against

[15]Richard Dawkins, "Interview with Ben Stein," in *Expelled: No Intelligence Allowed*, DVD, directed by Nathan Frankowski (Universal City, CA: Premise Media Corp., 2008).

[16]J. P. Moreland and William Lane Craig, *Philosophical Foundations for a Christian Worldview* (Downers Grove, IL: InterVarsity Press, 2003), 62. In addition to the greater explanatory power of a given solution, these authors factor in the range or scope of a given solution, the support and/or resistance it has toward other established truths, and the straightforward (less *ad hoc*) means by which that solution stands in juxtaposition to other solutions.

honest critique is an unreasonable burden that should not be forced upon those of a different worldview. Otherwise, every other critique would also have to be condemned, which is an absurd and unreasonable alternative. This dissertation was never intended to produce a positive argument for some position. Rather, it has served in exercising the right to critique another position.

Finally, it must be pointed out that abiogenesis as a whole rests upon the potential for its getting started. Rather than perceiving it as a mere gap within the Neo-Darwinian paradigm, the problem of abiogenesis is *problematic in its entirety*. It is a serious issue having enormous implications. Therefore, it is only reasonable that the state of the problem be returned to the forefront of academic discussion. Looking closely at the models cited by Dawkins, all are substantially limited in one way or another. Upon the admission of just about all of his contributors, each has recognized their own corresponding limitations. Most of these scholars have honestly admitted to the minimal gains in light of the prevailing gap. Neither Spiegelman's Q-beta virus, Rebek's autocatalysis, Eigen's hypercycle nor Gold's extremophiles can provide an answer within several orders of magnitude of that required by even the simplest of replicators. Moreover, the mathematical odds against the success of any of these processes are simply beyond the technology of the day. Whether resulting in insufficient evidence or the over dependency on existing information, none have come close to explaining the process for the origin of life. This problem is far more than a mere "gap." It is a crucial problem that must be resolved within the reigning paradigm of all of science.

Admonition against Methodological Naturalism

Dawkins's approach to the origin of life exhibits a methodological naturalism that may be recapitulated in the following sequence of processes. Simply put, despite the prevailing lack of empirical evidence, he proclaims that some *undetermined physical process* converts energy into biological information. And that process incorporates some *unknown self-organizing mechanism* which is believed to channel that incoming energy into this other "format." This latter mechanism performs its exchange against the natural *disordering property* of the second law (of thermodynamics) that would entail staggering odds against its natural occurrence. Specifically, that number is so large that it would far exceed the total number of atoms in the entire universe by several orders of magnitude. Nonetheless, it is this sequence of presumed processes that provides the desperately sought after "implausible" solution which Dawkins finds plausible.

This dissertation has demonstrated that Dawkins has not adequately supported his own string of assertions (summarized above) about how life began. In limiting his search to strict empiricism, he has ignored *a priori* what might be the "best" solution. But rather than retreat to a god-of-the-gaps explanation, which "argues from ignorance," it is suggested herein to seek an "'Inference to the Best Explanation,' [which] argues from knowledge."[17] In moving beyond the stifling and premature assignment of intelligent design to a non-science (i.e., religion), the following will review the methodological naturalism demanded by Dawkins. This section will argue that a better explanation resides in the broader approach provided by theistic science. Moreover, the reasons which follow should encourage the believer in God to trust theistic science as

[17]Ken Peterson, "Signature in the Cell," *Spectrum* (2009). See also Meyer, *Signature of the Cell,* 324-48. The former reference is a book review of the latter.

their preferred approach over and above methodological naturalism – both from within science itself and from the standpoint of philosophical reasoning.

From a scientific perspective, the exceedingly complex instructions common to any organism are well established. Every modern scholar cited in this dissertation recognizes this problem and the limited degree by which any conceivable process could achieve such complexity. As briefly summarized above, Dawkins has described a number of processes that have attempted to resolve this issue. However, from the standpoint of physics, he has assumed a connection that has not been shown to exist between solar energy and biological information. Unlike the well-established absorption of energy through photosynthesis (that absorbs that energy for the plant), his conjecture suggests the complete *exchange of energy into information*. Such an unknown and unproven process has never been established though it represents a fundamental cog within his solution. Moreover, he trusts that some *self-organizing property* exists that ushers along this transmission of energy into information. Because no such property has been established to date, it is difficult to accept such conjecture toward a solution.

From a chemical standpoint, the movement toward greater complexity demands an *"uphill"* chemistry rather than the "downhill" chemistry demonstrated by Miller-Urey. These endothermic reactions are naturally less likely and not as spontaneous as their exothermic counterparts, and hence, go against the natural grain of that which would spontaneously occur. Though the second law of thermodynamics permits some degree of decreased entropy given an open system, the massive degree required by the alleged series of processes becomes much less probable. Dawkins himself recognized the enormous odds against this self-assembly given even the most

rudimentary molecules – much less the macromolecules required by biochemistry. Those odds render such an occurrence as virtually zero. Intelligent design, however, offers a much better and more likely explanation that should be considered.

Meanwhile, methodological naturalism entails a number of philosophical problems and limitations. First, the presuppositions demanded by this approach limit the explanatory power of other areas in the system. In addition to the immediate effects felt by the problem at hand, such an approach results in broader implications. In this case, the methodology used to resolve the origin of life leads to the additional *problem of consciousness*. Dawkins has not only recognized the crucial importance of resolving consciousness biologically but lists it as one of the major thresholds in the progress of life.[18] This related problem explains why Dawkins argued his case for the potential intelligence of computers. Despite his denouncement of what he calls the "computer myth," no proof for his position has been offered to date. Therefore, the burden of proof on this matter remains with Dawkins. Nevertheless, because any purely naturalistic approach depends on the self-organization of matter, how would it account for the consciousness of man? Moreover, given the presence of *mind and intelligence* that are observed in life, why would one discard each of these components while in search for its origin? Abiogenesis, which entails the origin of life from non-life, would seem to represent more of an anomaly or discontinuity than the uninterrupted, continuous relationship of existing mind/intelligence. Unfortunately, methodological naturalism disregards the likelihood of such agency *a priori*.

Similarly, why not consider *life from life*? Much like the preceding point that argued for the continuity gained by matching the nature of life to its prospective source

[18]Dawkins, "Richard Dawkins Answers Reddit Questions."

(i.e., mind derived from mind or intelligence from intelligence), why not consider that life ultimately came from life? As Pasteur had demonstrated in the 1860's, *omne vivum ex vivo*. Life might actually be the sole source of *any* life. Unless life can find a better explanation here on Earth or was somehow transferred by natural panspermia, then such a solution would necessarily imply intelligent design. But when conjoining the data provided by Hawkes, et al. and Melosh (chapter 6) with that obtained through exploration and the direct observation of space, natural panspermia appears to be exceedingly unlikely. Moreover, as Crick pointed out, if that intelligence came from some alien source (advanced or not), then the problem of origins would merely be extended to another time and place. The *ultimate* source for the origin of life would remain unresolved.

Second, methodological naturalism tends to *restrict the conversation*. When it comes to the reigning paradigm within science (i.e., evolution), Dawkins has referred to it as "the only game in town." From his perspective, naturalism provides the only source for a solution because that is what his worldview demands. But as Plantiga points out, science is not the sole epistemic source for knowledge. Despite the strong scientism position that would argue otherwise, science cannot reasonably be considered the only source of knowledge *a posteriori*. That position would rely upon a number of philosophical presuppositions which could not be provided given its own limitations (e.g., that all truths must be scientific truths). Therefore, its own reasonability becomes absurd. Hence, there must be other sources of knowledge for which methodological naturalism does not account for. Such a restricted approach restricts the conversation.

Third, the effectiveness of methodological naturalism becomes questionable when the empirical method cannot be directly applied. As classic empiricism relies on some sort of repeatable experimentation, problems that are *historic* in nature are commonly more difficult to resolve much less prove. This latter type of problem often represents a non-repeatable single event. Because it requires some form of extrapolation from repeatable experimentation, the corresponding accuracy of the solution using this process is also less likely to be true. And nowhere is this condition more evident than in attempting to resolve the origin of life.

Dawkins's vacillating movement between models provides a classic case in point. He has been attempting to resolve a historical problem using the empirical methodologies at hand. But if any one of his solutions had been accurate, then why would he have needed to change positions? This type of problem tends to magnify the innate inexactness found in much of science. After all, it is already inductive in many respects in its basic formulation. Belief in spontaneous generation, a reducing atmosphere, and Haeckel's *Urschleim* represent but a few of the mistaken ideas that have become obsolete in time. Though uniformitarianism may be true in establishing a general consistency of physical law, it cannot make up for unfounded extrapolation or attempts beyond what empiricism can reach. Methodological naturalism is substantially and especially limited in the realm of origins.

Finally, the acceptance of methodological naturalism as the exclusive tool for doing science may cause metaphysical naturalism to appear normative. As this dissertation has pointed out, such thinking parallels what Dawkins has sought to achieve all along. As he has confessed in more than one venue, his goal to "exceed the critical

mass" is his central ambition.[19] In this statement, he essentially means to change the prevailing worldview "to a tipping point" that would substitute atheism as the prevailing worldview in the West.[20] That possibility should admonish believers against the capitulation to methodological naturalism. A shift in worldview, whether at the cultural of individual level, usually occurs through some gradual means. The use of an empirical method that discounts God *a priori* would function as a catalyst for that shift – whether recognized or not. Eugenie Scott, who has fought on the political frontlines for atheism, agrees in persuading other scientists to "defuse some of the opposition to evolution" by allowing "individuals [to] retain their religious beliefs and still accept evolution as science."[21] She claims that "scientists should avoid confusing the methodological materialism of science with metaphysical materialism."[22] Acceptance of methodological naturalism would add yet one more step in the gradual shift of worldview.

Failure of Metaphysical Naturalism

Throughout the breadth of this dissertation, it has been hoped that the ensuing analysis would provide a reasonable hearing for how Dawkins addressed the problem of abiogenesis despite its thesis to expose his inconsistencies. Little or no allusion toward a supernatural explanation has been mentioned within the body of this work to prevent any distraction, while allowing this hearing to be recapitulated upon its own grounds. Nevertheless, the latitude afforded by this methodology was never intended to suggest in

[19]Ibid.

[20]Ibid.

[21]Eugenie Scott, "Creationism, Ideology, and Science," *Annals of the New York Academy for Sciences* 775 (1995): 505-22.

[22]Ibid.

any way that Dawkins's metaphysical approach to abiogenesis (or toward any related argument) has been condoned or recognized as reasonable. Moreover, despite this license it is argued that Dawkins's reliance on *metaphysical naturalism* is in fact problematic and irrational. Several of the more salient points in support of this assertion have been articulated below.

First, and perhaps most importantly, the reasonability of metaphysical naturalism must be evaluated for what it is. Though easily confused with its methodological cousin, which appears *prima facie* to offer a reasonable means for observing the world (though merely extending the metaphysical worldview which assumes naturalism in the first place), it is still a parochial framework in the sense that it discounts *a priori* what might extend beyond that framework. Despite the underlying attempt to formulate their reasoning otherwise, supporters of metaphysical naturalism cannot help but attach their own philosophical reasoning upon the means by which science is established.

Neil de Grasse Tyson and Richard Dawkins provide a classic case for this position. During their dialog at Howard University in 2010, these two scholars publically denounced philosophy as having little or no status as juxtaposed against "the reality" of science. Ironically, they were applying their own philosophy of science in considering the place of those disciplines in relation to each other and toward the world at large. This classic case of *scientism* by two of the more influential scholars within science fulfill what Francis Schaeffer and Nancy Pearcey had forewarned about the two-tiered structure of certain present-day worldview(s).[23] In addition to dismissing religion as nothing more

[23]Nancy Pearcey, *Total Truth: Liberating Christianity from its Cultural Captivity* (Wheaton, IL: Crossway Books, 2004), 20-21.

than a study of human ignorance in its historical context, they had also relegated philosophy to a much lower sphere of academia.

Regardless of how Tyson and Dawkins taut their respective views on science, religion and philosophy, several leading scholars have provided challenging arguments for why metaphysical naturalism fails on its own philosophical merit. C. S. Lewis and Alvin Plantiga are among those who have recounted why the naturalistic paradigm cannot sufficiently ground its own reasonability for truth. To summarize the gist of their arguments, how can one be confident that propositional truths could result from a purely evolutionary-based source? Such would be the case for mankind's intellectual capacity given a Neo-Darwinian explanation. That portrayal of mankind's origin would entail all the necessary parts coming together at the end of a lengthy trail of increasing biological complexity that would have been capped off with an extraordinary mind that portends to think and to reason.

But if the evolutionary trail had been the source of this observed complexity, then naturalists would be right in describing the human mind in the reductionist terms of biological science. Rather than mind, the human brain is merely a highly developed organ that breaks down to an innumerable bundle of neurons firing billions of times per second. That organ would equip its corresponding body to react as the dangers of life that fell upon it. And that complex biochemistry is believed to have developed over time as it produced whatever had become necessary to ensure survival. But can the chemical activity within a brain account for a single propositional truth containing any real content? If not, then how could metaphysical naturalism be trusted to provide epistemic virtue? In essence, the argument leads to agnosticism at best because the probability for

producing a propositional truth appears to be quite low under any given scenario by which evolutionary processes were responsible for the complexity. Because a belief entails content as well as the biochemical activity within the brain, then how could one justify a given belief? If the natural processes within the brain developed by means of survival, then what source or mechanism could produce real content? Plantiga analyzed every potential naturalistic scenario by which "learned" behavior (due to survival) could instill beliefs and none appear to ensure what might be considered a justifiable truth.[24] A paradigm that recognizes only strict naturalism fails under its own restrictions, and thus, must be considered an irrational approach to reality. Therefore, metaphysical naturalism cannot justify its own validity. But a wider approach that entails agency would provide the necessary source for propositional truth.

Second, despite the criticisms that have been commonly lodged against the Church and toward faith and religion in general, the *history of science* has told a very different tale. For instance, regardless of the errors that science has blamed on the Church, it had to depend on Louis Pasteur to finally put to rest the two thousand year old archaic theory of spontaneous generation. Pasteur firmly believed in God. Likewise, science relied upon some of its greatest scholars to overturn the geocentric view of the solar system for the more favorable heliocentric model of today. Copernicus, Galileo and Newton were also men of faith. Each of these scholars had incorporated his own theistic belief within the broader scope of their respective interpretations of science. All of these men succeeded. Moreover, Francis Bacon, Johannes Kepler and Blaise Pascal represent a small sampling of a host of other mathematicians, philosophers and scientists who had

[24]Alvin Plantiga, *Where the Conflict Really Lies: Science, Religion, and Naturalism* (Oxford: Oxford University Press, 2011), 334-35.

collectively contributed toward affecting the most significant discoveries of all time – and each them working within the open integration of their respective faiths with science.

Third, for metaphysical naturalism to be valid, one must eventually address the problem of *infinite regress*. For how does one account for a purely naturalistically-based universe in terms of the expanse of time and space? When contemplating the furthest possible material object in the universe – what lies just beyond that? Can such an extension continue onward toward infinity? Craig and Moreland argue that an *actual infinite* cannot be realized in the universe.[25] If that is so, then metaphysical naturalism cannot justify such infinitudes. And this same argument should also apply to time. Can a naturalistically-based universe support an infinite past? Did time exist prior to the "earliest point" imaginable? Is it feasible for an actual infinite to exist in time/space?

Both of these cases illustrate the contingency of the world around us. Each occurrence (in time) and each point (in space) are really contingent elements in the universe that may only be explained by other contingent references – given metaphysical naturalism as its basis. But how does this system account for that which lies beyond them? It appears that Aquinas had recognized this problem eight centuries ago with at least four of his *Five Ways.* There is a *cosmological problem* here that may only be satisfied with something inherently outside of that which is contingent – a necessary being. Metaphysical naturalism is not equipped to account for such a being nor does it satisfy the problem at hand. In his attempt to extend the material envelope that this problem exposes, Dawkins resorted to the *multi-verse theory* of Lee Smolin. Without any evidence on which to rest this speculation and in recognizing the finitude of

[25]Craig and Moreland, *Philosophical Foundations for a Christian Worldview*, 473.

additional universes (i.e., if they were to exist), he continues to defer the problem down the road. Unfortunately, one will eventually run out of appeals.

Fourth, naturalism struggles to account for the broad range of what appears to be design in the universe. Even Dawkins recognizes and admits to this fact though he sees it as the organization of matter caused by the physical forces of nature. Mankind has recognized the beauty in nature from the earliest times, but has quantified that beauty in the form of the *simplicity of science* and the *elegance of mathematics* somewhat more recently. It seems serendipitous that the human mind can even comprehend and appreciate that beauty, simplicity and elegance for that would not necessarily follow a mind bred for "survival of the fittest." But these cognitive reactions fit perfectly well within a created world designed by an intelligent mind. Undoubtedly this latter explanation fulfills Occam's razor rather than the "complicated, gerrymandered theories" of metaphysical naturalism.[26]

Finally, metaphysical naturalism fails to account for several of the most important points specifically pertaining to abiogenesis. Most importantly, nothing suggested by Dawkins can account for the necessary *instructions* indicative of life. Despite his mention of a wide variety of potential solutions, none can achieve nor even come within the same order of magnitude of the complexity demanded by those instructions. Each model either admits to being a mere "step" within a much broader process or "a cheat" that had been factored in to enable the success of that particular process or strategy (which even then represents a mere step).

[26]Plantiga, *Where the Conflict Really Lies*, 298.

Looking more closely at the models discussed in this dissertation, Dawkins freely acknowledged the artificial nature or "cheat" that was involved.[27] Sol Spiegelman's Q-beta virus had not only required the RNA replicase to reproduce, but the RNA template as well. Dawkins had even admitted that they needed "the right blueprints" to succeed.[28] Likewise, he noted that Julius Rebek's autocatalysis was "highly artificial."[29] Even Dawkins own computer programs incorporated some form of either a "target sequence" (the Shakespearean program) or preset parameters (the Biomorph program). All of these methods utilized some form of inputted *instructions* to accomplish their feats. Simply stated, metaphysical naturalism offers no reasonable solution for the complex instructions of life.

Current State of the Problem

While searching for a scientific solution to the origin of life, all are bound by the inherent limitations imposed by physical law. How far, we might ask, can a thermodynamically open system defy entropy? Similarly, whatever solution comes forward, it must agree with established laws to be tenable. Otherwise, the laws themselves must be re-examined. This problem suggests that the interface between physics and biochemistry demands further exploration. How energy might relate to information and complexity should prove to be a crucial relationship to both thermodynamics and abiogenesis (if such a relationship exists). To date, no connection has been demonstrated to convert energy into information. But these complex things

[27]Richard Dawkins, *The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution* (Boston: Houghton Mifflin, 2004), 576-78.

[28]Dawkins, *The Blind Watchmaker*, 131.

[29]Ibid., 572.

must be better understood to decipher the mechanics of the problem. Moreover, several terms need more accurate definitions including "biological complexity," "information," and even what is "life." Schrodinger had posed these questions half a century ago.[30]

Ultimately, this problem demands a *source for the instructions* inherent to that first replicator. Regardless of how those instructions are perceived, scholars jointly recognize the tremendous level of complexity involved. As is evident from the models covered in this study, none have provided a suitable answer to this problem. In summarizing the challenges faced by a number of scientists, one can immediately understand the precipice that this gap presents. The physics of the problem alone provide perhaps the greatest of obstacles. For every one of the models forwarded to date, whether empirical or theoretical, each requires some sort of self-organizing property within matter. And no one has adequately demonstrated that matter acquiesces toward complexity beyond the simple patterns produced by natural law. The so-called "missing law" appears to be more of an *ad hoc* solution than that which indeed exists.[31]

Further Research

Wherever the research leads from here, science will do well to recognize the place of philosophy. Daniel Dennett readily admitted that "there is no such thing as philosophy-free science."[32] But will the empiricists of today heed this admonition? Will intelligent design be given a fair hearing in time or will it remain suppressed by those demanding a naturalistic explanation at all costs? Will agency eventually be recognized

[30]Erwin Schrodinger, *What is Life?* (Cambridge: Cambridge University Press, 1944).

[31]Robert M. Hazen, *Genesis: The Scientific Quest for Life's Origin* (Washington, DC: Joseph Henry Press, 2005), 15.

[32]Daniel Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon & Schuster, 1995), 21.

as a viable option? Undoubtedly, the answers to these questions will affect how the philosophy of science is construed and how the science is interpreted – especially in the case regarding the ongoing search for a pre-DNA replicator.

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ABSTRACT

THE NON-ENDING SEARCH FOR A PRE-DNA REPLICATOR:
RICHARD DAWKINS AND THE PROBLEM
OF ABIOGENESIS

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Chair: Dr. Theodore J. Cabal

Throughout history, the origin of life has served as one of the greatest and most vexing problems of mankind. This dissertation was written as a rebuttal to one of the more popular and influential figures who has addressed this topic: Richard Dawkins. Its thesis will demonstrate that he has not only vacillated in his position but has done so amidst a series of philosophical errors. Chapter 1 opens the discussion by laying out the thesis, structure and methodology of the argument.

Chapter 2 traces the historic path of man's attempt to grapple with the origin of life. It revisits the various beliefs across time ranging from the myths of ancient Egypt to the technology of twentieth century science. Chapter 3 picks up with the life of Dawkins and the impact that he has made. It addresses his more popular attempts at computer programming before introducing his movement between models. Chapter 4 demonstrates Dawkins's decisive shift from ethology to his impassioned defense of Neo-Darwinism. It provides an in-depth look at his many assumptions ranging from self-organization to information theory. Chapter 5 details his efforts to defend those positions in retreating to a number of theories in search of answers.

Chapter 6 follows Dawkins's consideration of panspermia, which opened the door to the extraterrestrial realm. This effort became a controversial move for Dawkins who had offered an ambiguous allegiance to the theory midstream. Chapter 7 changes course, yet again, to another solution that attracted his attention. The rapidly rising RNA World Theory has hoped to resolve the age old paradox that requires the functionality of both proteins and nucleic acids. As of late, Dawkins has publically declared his support for this RNA-based solution as his favored alternative.

Chapter 8 draws the discussion to a close in pulling together the multifaceted areas that define this analysis. The movement between models over time combines with a number of faulty assumptions to reveal the errancy of Dawkins's approach – a vacillation which has roughly paralleled that of the prevailing scientific community.

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