The Incomprehensible Nature of the Origin of Life

Melanie Davila

That theory is worthless. It isn't even wrong!
—Wolfgang Pauli

Abstract

The demarcation between science and pseudoscience is a highly debated topic in the philosophy of science. Pseudoscience threatens to not only tarnish the integrity of true science, but also to poison the mind of the everyday citizen. Although the line between science and pseudoscience is often blurred, it is crucial that the scientific community acknowledges the presence of pseudoscientific characteristics in certain theories. Moreover, the origin of life on Earth has proved to be elusive to mankind. Although humans have attempted to answer this question for thousands of years, extremely limited progress has been made regarding the matter. In this research paper, I will confirm the widely agreed upon notion that intelligent design is a pseudoscience, but I will also propose that scientific theories regarding abiogenesis might be unscientific. Ultimately, the origin of life on Earth proves to be a subject that not even science can attain a significantly firm grasp upon.

Introduction

Debates regarding the pseudoscientific nature of theories are prevalent within the intellectual community and have shown their presence in legal issues. In many cases, it is indeed difficult to determine if an idea should be considered true science. I will argue that intelligent design is pseudoscientific. I will also argue that although theories of abiogenesis possess multiple pseudoscientific characteristics, the field of abiogenesis is merely unscientific due to its young nature.

The ability to acknowledge the pseudoscientific qualities of intelligent design and abiogenesis is crucial to our ability to differentiate between scientific, pseudoscientific, and unscientific theories in other areas of exploration. My research is significant because there is a lack of public figures who have denoted theories of abiogenesis to be unscientific in nature. It is peculiar that the human race cannot provide a reasonable response to a question that has been everlastingly pondered upon. If pseudoscience continues to become widespread, uninformed humans might lose the ability to distinguish a true scientific theory from a merely plausible thought. On the other hand, if humans begin to recognize the prevalence of pseudoscience in society they may reject science and consequently, humans will cease to appreciate the purity of true science. Genuine science is the result of the pursuit of knowledge solely for the sake of intellectual pleasure. In society, the scientist is a highly respected figure. Unfortunately, humans tend to ignore the questionable nature of claims made by scientists so one must examine scientific claims before accepting them.

In *Conjectures and Refutations: The Growth of Scientific Knowledge*, Karl Popper analyzes the progression of knowledge. Karl Popper is a well-known philosopher of science and has undeniably had an impact on our ideas of scientific understanding. In his text, Popper proposes that satisfaction of the falsifiability criterion is a critical component of science. A theory does not need to be verifiable in order to be considered scientific; however, it must be able to be proved false through scientific means. He also discusses the problematic nature of vagueness in scientific theories. Furthermore, in *Progress as a Demarcation Criterion for the Sciences*, Paul Quay discusses the several modes of progress. In this article, Quay insightfully proposes that more than one demarcation criterion is needed and suggests that lack of progress is a distinguishing characteristic of pseudoscience. Analysis of these framing texts will provide multiple demarcation criteria between science and pseudoscience.

In the first section of this text, "Science vs. Pseudoscience: Demarcation Criteria", I will explore the roles of falsifiability, progress, and vagueness as demarcation criteria. Throughout second section of this text, "Intelligent Design as a Pseudoscience", I will expose the pseudoscientific characteristics of intelligent design. Afterwards, in the section entitled "The Unscientific Nature of Theories of Abiogenesis", I initiate a discussion involving the pseudoscientific characteristics of abiogenic theories (more specifically, the primordial soup hypothesis and iron-sulfur world theory), but then suggest the field of abiogenesis is currently unscientific. In the fourth section of this text, "The Implications of the Science v. Pseudoscience Debate", I discuss the extent to which demarcation is necessary.

Science V. Pseudoscience: Demarcation Criteria

There are numerous distinguishing characteristics of science**,** including falsifiability, measurable progression, and the presence of theories without excessive vagueness. Falsifiability is a more reliable criterion for demarcation than verifiability. According to Popper, it is not problematic to "obtain confirmations, or verifications, for nearly every theory—if we look for confirmations" (36). A proponent of a scientific theory will have difficulty remaining unbiased in their methods of research and may produce fallacious results. Therefore, the confirmation of a theory is an unreliable method of demarcation simply due to the innocent yet detrimental tendencies of human nature. Pseudoscience is "not an impartial search for truth, but rather the validation of a claim, a fixed idea, supportable only by misuse or distortion of any relevant data" (Ecker 171). Pseudoscience aims to be verifiable and neglects the fact that humans are imperfect and

can only confirm theories through imperfect means. Pseudoscience is problematic because it provides society with a false impression of what true science is and suggests that scientific discoveries are the ultimate truth. The falsification of a theory is more reliable since the theory will most likely be examined by scientists with contradicting perspectives. The scientists attempting to falsify a theory may not be free of bias; however, a strong sense of contempt for a theory can cause a scientist to strenuously work towards a successful falsification. Moreover, falsification is also a better criterion for demarcation than verifiability since scientists do not claim to discover the truth.

It is important to note that although falsifiability is a prominent characteristic of science, it is not a sufficient lone criterion to distinguish between science and pseudoscience. For example, Rothbart cunningly suggests that an "account of an Alice in Wonderland universe purportedly describes certain specific events and therefore is falsifiable" (95). Such an absurd notion is obviously not scientific. In order to be deemed *strongly* falsifiable, a theory should be not only falsifiable in principle, but also falsifiable in practice. A theory does not necessarily have to be falsifiable at the present moment in order to be considered falsifiable. Not all theories that are only falsifiable in principle are pseudoscientific or unscientific. Nonetheless, the capability of a theory to be falsifiable in both principle and practice may indicate the presence of a stronger science than the ability of a theory to be falsified only in principle. It is simple to comprehend why falsifiability cannot be used as a lone criterion for demarcation.

The line between falsifiable and unfalsifiable theories can be difficult to clearly define under some circumstances. Albert Einstein's theory of general relativity is undoubtedly a strongly falsifiable theory. The theory of general relativity proposes the concept of spacetime curvature (Ni 914). Among the most classic attempts to falsify the theory of general relativity is the examination of the perihelion advance of Mercury (Ni 902). This test demonstrates general relativity's falsifiability since scientists are able to use the theory in order to calculate a precise measurement of the advancement of the perihelion that is attributable to the forces of general relativity. Scientists can then attempt to falsify the theory of general relativity by comparing the calculated values to the observed values. Fortunately, the value regarding the perihelion advance of Mercury that is calculated by general relativity is in agreement with the observed value. On the other hand, the philosophical theory of nihilism is not falsifiable. Nihilism suggests that life has no meaning and that "in our boredom we know ourselves as nothings" (Popper 194). According to Popper, this theory is easily classified as unfalsifiable because the

concepts involved are intangible (195).The status of falsifiability of the theory of evolution is questionable. Unlike the predictions made by the theory of general relativity, the predictions made by the theory of evolution cannot be tested in such a straightforward manner. If the fossil remains of a rabbit were found in the sediment layers of the Precambrian, the theory of evolution would essentially be falsified (Godfrey-Smith 72). Nevertheless, it would be impossible to ensure that all of the sediment layers of the Precambrian were studied and that the rocks were correctly dated in the first place. One would also have to accept the fact that some species that lived during the Precambrian may have decayed before they became fossilized. Thus, falsfiability should not be used as a lone demarcation criterion.

Progress is a defining characteristic of genuine science. Progress can occur by cumulation, complication, and refinement (Quay 156). Cumulative progress is characterized by the construction of new theories and the collection of old theories. Progress by complication necessitates the seamless integration of old theories into a newer one that encompasses their essences in an innovative manner. Basically, progress by complication ensues when new knowledge is integrated with old knowledge. Progress by refinement is the continual growth in precision of observations (Quay 156). By analyzing progress, a scientist will be able to comprehend the limitations of a theory. According to Quay, the progress of the sciences is "the increasing gap of, or the approach towards at least partial truth about and understanding of, the empirical world" (158). Therefore, a scientific theory must make testable predictions that aim to encourage the acquirement of knowledge. In order to support the gaining of new knowledge, a theory must attempt to make novel predictions that will enrich our understanding of the world. The presence of these types of progress, along with the presence of other demarcation criteria, is a strong indication that a theory is scientific.

The use of excessive vagueness and ambiguity is a distinguishing characteristic of pseudoscience. The presence of vague language in a notion is an indication that its proponents are trying to validate the concept. By making a theory vague, scientists are able to minimize the risk of their theory being refuted. Simply put, in order to "escape falsification they [destroy] the testability of their theory" (Popper 37). When vague jargon is used in a potential theory, its proponents are able to stifle opposition with ease. For instance, the excessive amount of ambiguity in astrology, an obvious pseudoscience, facilitates the manner by which its proponents can defend its notions. According to Popper, astrologers typically "predict things so vaguely that the predictions can hardly

fail: that they become irrefutable" (37). Simply put, astrologers use vague descriptions in order to escape falsification. Experiments conducted in order to test vague theories provide little value to the scientific community because the results of these experiments cannot be deeply understood. Ultimately, vague terminology weakens not only the testability of theory, but also the value of the tests conducted upon it.

Intelligent Design as a Pseudoscience

Intelligent design is a theory regarding the origin of life on Earth. According to intelligent design, an omniscient creator is responsible for all of the intricacies of life. The notion has several conclusions regarding nature, but the most prominent is "the concept of 'irreducible complexity'" (Collins 182). This theory avoids specifying a specific creator; however, an abundance of its proponents believe the creator to be the God of Christianity.

During his lifetime, Henry Morris was a young earth creationist and one of the founders of the Institute for Creation Research. In their text, Harrold and Eve oppose the view of Morris regarding integration of intelligent design into the public educational curriculum. Morris believes that science is a pursuit of the truth and since intelligent design seeks to uncover the truth regarding the origin of life, it is science. However, Harrold and Eve refute this idea by indicating that "science is not a search for 'truth' but the proposal and testing of hypotheses that seem in accordance with empirical observations" (13). Throughout his argument, Morris neglects the fact that scientists never claim to discover the truth, but instead propose hypotheses that can be readily tested. Scientific realists, who believe that scientists do aim to discover the truth, would still have objections to Morris' claims. Not everything that seeks to uncover the truth is scientific. For example, philosophy strives to discover the truth, but it is most definitely not science. Popper suggests that the "criterion of the scientific status of a theory is its falsifiability, or refutability, or testability" (37). Intelligent design exhibits the pseudoscientific quality of being unfalsifiable because we cannot falsify the concept of irreducible complexity.

In the fairly recent Kitzmiller v. Dover Area School District case, the court ruled that intelligent design is "a 'mere relabeling of creationism', and not a scientific theory" (Lee 583). The court case was sparked when a group of parents argued that a statement required to be read to students in a ninth grade biology class was unconstitutional. The statement regarded "gaps in evolution theory with specific reference to ID as an 'explanation of the origin of life that differs from Darwin's view'" (Lee 582). Intelligent

design, undeniably parallel to religious creationism, cannot be falsified and is therefore, a pseudoscience. Throughout the history of human existence, numerous gods have been fabricated in order to enlighten humans with knowledge regarding unexplored territories. When religious leaders provide a perpetually changing "God of the gaps," or omniscient being, that serves only to answer what science cannot answer, they run a "huge risk of simply discrediting faith" (Collins 193). In some cases, members of the religious community manipulate their beliefs in order to avoid adopting ideas that are not in agreement with scientific knowledge. For instance, when common events such as the sun rising became demystified, the popularity of religions that involved "sun gods" began to slowly decline. Science does indeed change, but it adjusts in order to answer more questions than it did before and in order to account for new evidence. Religion, on the other hand, often adjusts in order to answer different questions and disregards new evidence.

Unlike genuine science, intelligent design is based solely on faith. Faith in religion, and intelligent design, is by no means a horrendous concept since it shows the wondrous capability for undying devotion that humans can possess. However, it does not provide a scientific foundation because skepticism is encouraged in science. This fundamental difference between true science and religion (arguably the foundation of intelligent design) allows for the independent progression of knowledge in genuine science.

Pseudoscientific notions are often presented as valid scientific claims; however, pseudoscience does not always have cruel intentions. Admittedly, some pseudosciences such as astrology and parapsychology serve to exploit humans for financial gains. Nonetheless, most pseudoscience is merely the result of presenting information in an insufficient manner. Proponents of intelligent design often argue that it is science because it is plausible. Intelligent design is by all means plausible, but "a statement may be pseudoscientific even if it is eminently 'plausible' and everybody believes in it" (Lakatos 1). Enthusiasts of intelligent design often ignore that probability is of greater significance than plausibility in the realm of science.

Direct empirical observation is undeniably a useful tool of scientific study, but it is not thoroughly necessary in order to develop a scientific theory. In *Scientific Creationism*, Henry Morris acknowledges some of the difficulties of studying the origin of life scientifically. For instance, he claims, "Creation is not taking place now, so far as can be observed. Therefore, it was accomplished sometime in the past, if at all, and thus is inaccessible to the scientific method" (5). By making such an assertion, Morris is

committing a fundamental error. He is unintelligibly adapting the beliefs of radical empiricists such as John Locke, George Berkley, and David Hume. However, Morris' claim is more poorly constructed than the views of the radical empiricists because he does not allow for abductive or inductive reasoning (which will be discussed shortly). According to Willer, the empiricists have asserted that "man gains all knowledge through sensory experience" (7). However, this notion neglects the fact that not all empirical evidence is currently observable. Ecker suggests that although "direct observation is a scientific ideal, in practical terms science must often depend on indirect observation or inference" (172). For example, we cannot physically observe gravity; however, we can undoubtedly observe its effects. Therefore, the presence of gravity is empirically supported even though it is not observable. The absence of empirical observations does not indicate the presence of a pseudoscience.

Scientific theories are often formulated based upon their agreeability with prior scientific knowledge and the ability to seamlessly integrate the new knowledge with prior knowledge. Inductive reasoning results in the production of general rules from a collection of specific instances (Garcez 26). Therefore, laws can be formulated from recurring patterns. Moreover, abductive reasoning allows scientists to use inferences in order to affirm a result (Garcez 26). Both inductive and abductive reasoning promote assumptions and harsh generalizations. Although inductive reasoning and abductive reasoning are not flawless methods, their presence in the scientific method is undeniable. It is fairly alarming that scientific progress depends upon the ability to integrate new knowledge with previous knowledge. According to Rothbart, many scientists attempt to ward off refutations by proposing "vague or unintelligible hypotheses, but at the cost of producing hypotheses that are trivially true in relation to accepted background knowledge" (Rothbart 100). The fact that integration with prior scientific knowledge is a significant aspect of the scientific method is distressing to scientists attempting to advance the status of a theory. There is a high probability that the gaining of scientific knowledge has been hindered due to the fact that some scientists are proposing vague theories.

The Unscientific Nature of Theories of Abiogenesis

There are a significant number of theories of abiogenesis, but two of the multitudes are prominent. The primordial soup hypothesis and iron sulfur world theory both have a few aspects in common. According to both theories, the early earth was extremely hot and had a reducing environment with little or no free oxygen. Lightening and volcanic

activity provided the ambience with a multitude of energy (Folsome 48). The main gases in the atmosphere were "nitrogen, carbon monoxide, hydrogen, and water vapor" (Folsome 56). In the primordial soup hypothesis, these molecules accumulated on rock or clay surfaces that contained enzymes necessary for catalysis (Ponnamperuma 25). On the other hand, the iron sulfur world theory proposes that life originated in hydrothermal vents in the ocean floor that protected the early life from potentially dangerous meteorites (Stein 998). Notably, both theories fail to explicitly discuss how these non-living chemical precursors aided in the origin of life.

Although the theories of abiogenesis may seem wholly scientific, they possess pseudoscientific qualities since there is a high presence of vagueness in the theories. The theories do indeed suggest that amino acids and proteins originated from nonliving chemicals.

However, beyond this point the details become quite imprecise and arguably nonexistent. As Collins contemplates, "How could a self-replicating information-carrying molecule assemble spontaneously from these compounds?" (90). Theories of abiogenesis fail to propose a solution to the main question of interest. Neither the primordial soup hypothesis nor the iron-sulfur world theory explicitly discusses how nonliving materials became living, and essentially, how life originated on Earth. Slightly vague explanations in a theory are reasonable since science does not seek to discover the truth; however, vagueness should be used minimally. Vagueness exposes the incompleteness of a theory. Yet, a theory being incomplete does not always signify the presence of a pseudoscience. Factors such as the age of the theory and the presence of other pseudoscientific characteristics must be taken into account when demarcating. Nonetheless, there is currently an absence of a "comprehensive abiogenic hypothesis" (Stein 996). When a theory fails to propose a comprehensible solution to the question it seeks to explore, the theory is too vague. The fundamentally unclear nature of theories of abiogenesis undeniably poses an elementary quandary.

Compared to genuinely scientific theories, such as the theory of general relativity, theories of abiogenesis are not strongly falsifiable since they are only falsifiable in principle and not in practice. When a theory makes a sufficient amount of valuable predictions, it increases its ability to become falsified. Therefore, genuinely scientific theories should attempt to make explicit predictions in order to satisfy the falsifiability criterion. For instance, the theory of general relativity predicted the phenomenon of red shift. This phenomenon proposes that light coming from an object will shift towards an

increased electromagnetic wavelength. Basically, the light will appear redder to an observer. Pound and Rebka confirmed the red shift phenomenon through the use of the M*ö*ssbauer effect (Ni 906). Theories of abiogenesis are weakly falsifiable because they do not make explicit predictions. They only predict that life on Earth arose from nonliving molecules such as nitrogen, carbon monoxide, and hydrogen (Folsome 56). Testing this vague hypothesis merely allowed scientists to create nonliving proteins. Variations of the experimental conditions have allowed scientists to generate differing nonliving proteins. Essentially, abiogenesis has indeed made predictions; however, these predictions are not explicit enough and the testing of these predictions does not provide results as promising as the results from the testing of the red shift phenomenon. There is no counterpart in abiogenesis to general relativity, where we are able to empirically demonstrate the strength of the theory. Theories of abiogenesis are only weakly falsifiable due to the lack of explicit predictions proposed; however, one must frankly consider the fact that this field of study may not be in the position to make such predictions at the current moment.

Since multiple ambiguities still exist regarding the environment of the early Earth as well as the chemicals present in its atmosphere, it is not possible to construct a valuable experiment regarding abiogenesis. Folsome insightfully asks, “How can we conduct meaningful simulation experiments if we are unsure of the composition of the starting atmosphere” (59)? Since theories of abiogenesis are immensely vague, experiments performed regarding the subject will not provide the scientific community with valuable knowledge. There is indeed a possibility that humans will acquire the means to disprove intelligent design and abiogenesis in the future, but we do not currently possess these means. One must consider that although falsifiability is a reliable demarcation criterion, when used as a sole criterion, it is insufficient for distinguishing mature sciences from protosciences (Quay 154). Therefore, even though abiogenesis is only weakly falsifiable, it cannot be labeled pseudoscientific nor unscientific by the mere use of one criterion.

Abiogenesis shows a significant lack of progress in comparison to genuine sciences. Since the theories surrounding abiogenesis are exceedingly vague and incomplete, there has been little precision in the observations provided by experiments. Collins remarks, “No current hypothesis comes close to explaining how in the space of a mere 150 million years, the prebiotic environment that existed on planet Earth gave rise to life” (90). He further clarifies that multiple hypotheses have been proposed, but “their statistical probability of accounting for the development of life still seems remote” (90). Since little

is known of the conditions of the early Earth, experiments regarding abiogenesis rely more on plausibility than probability.

Researchers of abiogenesis undoubtedly put much effort into researching the topic; however, they have been unsuccessful in creating a truly useful theory. Scientists have not been able to create life by manipulating the essential chemicals of the primordial soup in an environment plausibly similar to that of the ancient world. By experimenting with chemical compounds such as carbon dioxide, methane, and ammonia in an environment with no free oxygen and a high amount of energy, scientists have merely been able to generate amino acids (Ponnamperuma 78). Many of the amino acids formed "do not occur naturally in biological material" (Ponnamperuma 78). Since such peculiar amino acids were formed, the scientific community has failed to understand the nature of the amino acids they have indeed generated. Therefore, theories of abiogensis have not undergone progress by refinement because there has been no growth in the precision of the observations. Researchers of abiogenesis may claim that their field of study is making progress because the observations made in the laboratory have been repetitive. However, repetition fails altogether as a criterion for science (Quay 163). This is due to the fact that the repetition of a scientific event would imply "neither self-contradiction nor falsification of anything known to be true" (Quay 163). Theories of abiogenesis cause scientists to believe they are making progress on one foot when in reality they have failed to "remove the other foot from the cave" (Harrold 146). The field of abiogenesis exhibits the same lack of progress that many pseudosciences demonstrate.

Scientific accounts of the origin of life, including theories of abiogenesis, are fairly recent. According to Cyril Ponnamperuma, "The study of the origin of life, until recently, has been relegated to the realm of metaphysics and philosophy" (12). Science is inexperienced in dealing with the matter of the origin of life. People are thoroughly correct when they claim that life has not been created in a laboratory, but one should consider that research in abiogenesis is young and nature "has had a four-billion-year head start" (Ecker 14). The most sophisticated experiment done regarding abiogenesis was the Miller-Urey experiment which occurred a little over half a century ago. Since the study of abiogenesis has only been present for fifty seven years, we cannot judge its lack of progress in such a harsh manner. Furthermore, we cannot be exceedingly critical about the presence of other pseudoscientific aspects that it possesses. Therefore, abiogenesis is not currently pseudoscientific, but instead unscientific. Unscientific notions are distinguishable from incomplete science because they exhibit a greater multitude of

pseudoscientific traits compared to merely incomplete science. Science is a function of time only to an extent. Therefore, a new field of study can indeed be scientific if it does not exhibit multiple demarcation criteria of a pseudoscience. It is difficult to provide a time limit for the progress of a theory. However, it would be reasonable to propose that if abiogenesis continues to provide the scientific community with such little value for another five hundred ears and continues to exhibit multiple criteria of pseudoscience, it will become pseudoscientific.

The Implications of the Science V. Pseudoscience Debate

Theories of abiogenesis are often regarded as science without hesitation. On the other hand, it is widely acceptable that intelligent design is a pseudoscience. When carefully considered, both of these accounts for the origin of life have pseudoscientific features. Many people believe that the pseudoscience should not be alarming since pseudoscientific arguments are only effective when directed to the scientifically illiterate. However, the presence pseudoscience is unfortunate because there is an enormous amount of scientifically illiterate beings in society (Ecker 59). Scientific illiteracy facilitates the ability for pseudoscience to become widespread. If pseudoscience continues to become widespread, society may begin to stop appreciating the rich value of true science. Consequently, scientists may find it difficult to obtain the funding necessary to pursue a legitimate scientific experiment. Scientists are arguably one of the last remaining figures that society trusts without much hesitation. If pseudoscientific beliefs continue to plague society in an excessive manner, humans will begin to associate science with a negative connotation. An intellectual catastrophe would arise if the pursuit of scientific knowledge ceased due to a thoroughly preventable mistrust.

Demarcation between science and pseudoscience is essential, but demarcation between scientific and unscientific theories has the potential to become slightly superfluous. Science is perpetually changing as our knowledge of the world continues to expand and the capability to research more areas continues to grow. Therefore, the scientific community should inform society of blindingly obvious pseudosciences such as astrology while continuing to explore all realms of interest, whether they seem scientific or unscientific. No idea should be completely extinguished because the unscientific notions of today may become some of the most elegant and fruitful scientific theories of the future. The beauty of science is that it is an everlasting quest for knowledge that asks more questions than it answers.

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