Philosophical assumptions in the discussion of irreducible complexity, naturalism, demarcation criterion, probability, law, and adequate explanation

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RUNNING HEAD: Irreducible complexity

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Abstract

In *Darwin's black box: The biochemical challenge to evolution*, Dr. Michael Behe evaluated the possibility of gradualism in macroevolution in the perspective of "irreducible complexity," which became a controversial topic among theologians, philosophers, and scientists. This paper argues that efforts devoting to "reasoning by analogy" regarding the "mousetrap metaphor" could not illuminate the question at all. In addition, this paper argues that the debate on creation vs. evolution related to probability and law, the meaning of adequate explanation, and many others, is tied to hidden metaphysical assumptions on both parties.

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Introduction

In *Darwin's black box: The biochemical challenge to evolution* (1996), Dr. Michael Behe evaluated the possibility of gradualism in macroevolution in the perspective of modern biochemistry. In this book he coined the term "irreducible complexity," which became a controversial topic among theologians, philosophers, and scientists. In addition, Behe is skeptical to the naturalistic view of science advocated by evolutionists. His supporters such as Phillip Johnson (2000) and William Dembski (1999) also strongly oppose using methodological naturalism as a means to exclude God as a viable explanation for the origin of life.

This paper has two objectives. First, both viewpoints supporting and rejecting "irreducible complexity" will be introduced and evaluated. Second, the epistemological and methodological aspects of the debate such as naturalism and demarcation criterion will also be discussed. At first glance, the first aspect is concerned with "factual, objective science" for its focus is biochemistry, and the second area is primarily grounded on philosophy. However, I argue that even the debate regarding irreducible complexity is philosophical in nature. In other words, the difference between both parties is based on their epistemology, methodology, as well as metaphysics. As a matter of fact, many scholars who argue for or against irreducible complexity are philosophers rather than scientists.

Darwin's Black Box

As Behe's book title implies, Behe attempted to unveil Darwin's black box. A black box is known to be mysterious. We know that a black box can perform certain functions, but we don't know how it works and how it came to be. A computer to non-engineers is a typical example. Novice computer users know that when they input some commands in the keyboard, something magical will happen to the output device (e.g. monitor, printer). They have no idea how the RAM, the bus, and the microprocessor work together to make

that happen, and how engineers design the architecture of the computer. According to Behe, at the time of Darwin, the cellular structure is a black box. Darwin was only able to make sense of biology above the level of the cell. Thus, the theory of evolution was built upon many un-examined questions. Today with the advance of biochemistry, we are able to look into the black box, and hence, based on new findings, Behe questions how this complicated structure can come to be in the first place.

It is important to note that Behe does not object microevolution, which is about changes of traits within the same species over time. But Behe has problems with macroevolution, which suggests a new species could be evolved from a different species. Contrary to the title of his book *Origins of Species*, Darwin's theory of evolution mainly dealt with microevolution rather than the origin of new species from older ones. The example of pepper moth is often cited as evidence about how species could adapt to the environment. However, this example does not show how new species are evolved.

Irreducible complexity

Based on the concept of irreducible complexity, Behe questions how a new species can evolve from another by the mean of gradualism. An irreducibly complex system is composed of many well-matched parts, and each part contributes specific functions to the entire system. This system is irreducible in the sense that when one component is removed or malfunctions, the entire system collapses. And the biological structure is an irreducibly complicated system. Behe insisted that it is impossible for such a system to add components and features bit by bit. Natural selection, the engine of Darwinian evolution, only works if there is something to select—something that is useful right now, rather than in the future.

Mousetrap analogy

Behe used both metaphors (e.g. mousetrap) and examples in biochemistry (e.g eyeball, cilium, and blood clotting) to support this claim. Consider first the mousetrap: A mousetrap has five parts that are necessary for the mousetrap to fully function. The absence of any one of these components will definitely disable its function. Many discussions concerning irreducible complexity focus on the metaphor of mousetrap. For example, Ussery (1998) pointed out that the mousetrap analogy works for things built by humans, but it is dangerous and misleading to extend it to molecules. Shanks and Joplin (in press) argued

that Behe's mousetrap is a technological hybrid, descended from earlier traps in a historical evolutionary process, and thus the mousetrap is not an irreducibly complicated system. Miller (1996) stated that the mousetrap analogy is invalid because there is more than one way to construct a mousetrap. Ruse (1998) also denied that a mousetrap is irreducibly complicated because one can remove the base and attach the unit directly to the floor.

It is important to note that while the mousetrap case is an example of "irreducible complexity," it is only a metaphor to "biological irreducible complexity." Analogy is a tool to clarify explanation, but it is not an explanation of a phenomenon. When a theologian uses water, ice, and steam to illustrate trinity and another theologian points out that there is much dissimilarity between the two; at most they could argue whether the analogy is appropriate, but it does not add or remove any weight of evidence toward the doctrine of trinity. Some theologians apply the dual characteristics of electrons (wave and particle) to illustrate the dual personalities of Jesus (diety and humanity) (Gould, 2002). Gould is critical to this type of mapping,

> " What am I to make of such a claim? That the status of Jesus as both God and man (a central Trinitarian concept) must be factually true because electrons, and other basic components, can be construed as either waves or particles? I don't see what such a comparison could indicate except that the human mind can embrace contradiction (an interesting point, to be sure, but not a statement about the factual character of God), and that people can construct the wildest metaphors" (p.216, bracketed phrases appear in the original text).

Consider an example in history of science: Huygens compared light to sound since they are similar in a number of aspects. One might say sound consists of wave, and by the same token, light could be composed of wave too (Thagard, 1978). However, there are also several dissimilarities between sound and light. One should not go too far to say, "Light is wave *because* sound is wave" or "light is not wave *because* light is unlike sound." The sound analogy helps to explain light, but it does not prove or disprove the nature of light. It is true that in history of science there are some successful stories of how using analogy leads to major scientific breakthroughs. For example, Newton's discovery of universal gravitational force was largely

through analogy. Rutherford also mapped the idea that in a solar system the planents revolve around the sun onto the idea that in the subatomic world the electrons revolve the nucleus. Nonethless, these examples show that using analogy is helpful to generate new ideas and formulate new hypotheses, but it is not a logic for explanation because there is no rule to determine the degree of similarities betwee two entities (Nersession, 1999; Dunbar, 1999).

In this view, similarities and difference between a mousetrap and an organism are not the main point. Neither is the issue about whether a mousetrap is considered irreducibly complicated. The focal point should be whether an organism is a structure of irreducibly complexity and how likely this system can arise from evolution. To examine this issue, we have to look at biological examples.

Blood clotting

Behe charged that many scholars who endorse macroevolution ignore details. Blood clotting is an obvious example. Dr. Russell Doolittle, who is one of the leading authorities of blood clotting, begins his research paper on this subject by asking this question: “How in the world did this complex and delicately balanced process evolve? The paradox was, if each protein depended on activation by another, how could the system ever have arisen?” (cited in Behe, 1996) After reviewing Doolittle’s paper, Behe criticized that no causative factors are cited in Doolittle’s paper. Phrases such as “appears,” “is born,” “arise,” “springs forth” are all over the paper, but there is no detail about how things could appear, spring forth, or arise.

Critics argued that gene duplication could be a key to explain this complexity. According to this idea, an organism produces a copy of the original gene. The first set of gene keeps the system running while the duplicate could work on enhancing the system. This process is repeated over and over until an advanced system is fully developed. At one time, blood clotting may use only a few genes, but the duplication process adds more and more genes into the system later (cited in DiSilvestro, 1999).

DiSilvestro (1999) rejected this argument by pointing out that the duplicated genes still had to evolve structural changes and what agent drove this change remains unanswered. Moreover, there is a high probability that additional genes would destabilize the system rather than enhancing the feature. This type of harmful mutation is well-documented in biology.

Some Behe's opponents admitted that it is difficult to explain certain irreducibly complicated systems, but they insisted that it is only a mater of time. Dorit (1997) defended that unsolved questions are the hallmark of an exciting science. Problems that remain unsolved today may be solved in the future. In a similar tone, Miller (1999) argued that although creationists complain that natural processes cannot explain many things, given enough time, science could explain even the most difficult and complicated things. While discussing a related topic, "Did God create the universe?" Davies (1983) asserted that we can never be absolutely sure that at some distant time in the future a natural way is not discovered to explain the most astonishing and inexplicable phenomena. This optimistic prophecy may not be fulfilled since there isn't a common consent between the two parties on what the definition of explanation is. To Doolittle and many other scientists, phrases like "arise" and "spring forth" are legitimate. Discovery of self-organizing organic structures is also considered "explanation." To Behe and other creationists, terms like "automation" and "self-organization" are synonymous to "un-caused," "just happened." What is counted as explanation is a highly philosophical question.

Conceptual precursor, physical precursor, and common descent

When Behe (1997) delivered a speech in Princeton University, one audience member challenged Behe by giving the following example: Assume that a few thousands years later our current computer technology had ceased to exist. When our descendents discover a relic of a microprocessor but not other pre-microchip artifacts, they may mistakenly conclude that a microprocessor is irreducibly complex and thus it is not a product of gradual improvement. However, indeed before the invention of the microprocessor, there were integrated circuits, transistors, vacuum tubes, and so on.

In the seminar Behe didn't give a detailed response. Nevertheless, this argument could be responded by Behe's notion that there is a major difference between the conceptual precursor and physical precursor (1996). A conceptual precursor is a blue print, which is the source of inspiration of later improvements of an existing product, or the foundation (background knowledge) of later innovations. On the other hand, a physical precursor is the actual ascendant of the later improved version.

A vacuum tube is the conceptual precursor, but not the physical precursor of a microprocessor. To be specific, the engineer can design the Pentium IV chip with reference to the concepts of Pentium III, but physically, a Pentium III microchip cannot be improved bit by bit to be a Pentium IV based upon the existing physical structure. The engineer could not cramp more transistors into the older chip simply because it has a physical limit. Behe asserted that in Darwinian evolution, only physical precursors count. To validate evolution, evolutionists must explain how one species could be the physical precursor of another one.

Further, the notion of conceptual precursor fits nicely to the notion of common descent, which is accepted by Behe. Behe (1999a) emphasized that evidence of common descent is not evidence of evolution. According to common descent, similarities between species could imply that an intelligent designer created different species based upon a common conceptual architecture. Take designing microchips as an analogy again. The engineers designed Pentium, Pentium II, Pentium III, and Pentium IV using Intel's technology, and that's why similarities could be easily found among these microprocessors. However, it doesn't mean that a Pentium IV chip is physically improved from a Pentium III by adding more transistors and a higher capacity of on-chip cache.

Arguments by probability

Given that organisms are really complicated, the question is: What is the probability that such a complicated system arises from a natural cause like macroevolution? Philosopher of biology Elliot Sober (1993) criticized that creationists unfairly compared the design hypothesis with the mindless random hypothesis. Sober argued that natural selection is not a random process. If a process is random, then different options have the same probabilities. However, the principle of natural selection implies that the fittest species have the highest probability of survival. Thus, the probability that well-structured organisms could evolve is much higher than what most people perceive. Sober used the following metaphor as an illustration: Imagine that there is a combination lock. To open the lock, one must decode 19 letters in the right sequence. If the person guesses the codes randomly, the probability of opening the lock is 1/26 raises

power to 19. However, if that person can “freeze” the code when it is chosen correctly, and then proceed to the next one, the probability of decoding the lock is much higher than the first case.

Using this metaphor, Sober argued that variation is generated at random, but sele ction among variants is non-random. When a feature of an organism is functional (adaptive to the environment), this feature is “frozen” (selected) and then the subsequent evolution is built upon this foundation. In this view, the probability that well-structured species are evolved by natural selection is much higher than that of a purely random process.

Behe was not convinced by Sober’s argument. According to Behe (1996), if our reproductive success depends on the probability like the one of opening a lock, we would leave no offspring. As a disk turns, who is deciding which letters to freeze and why? Behe argued that not only Sober scenario cannot support evolution, but on the contrary, it is actually an example of intelligent design. If we leave the environment to select (freeze) a feature, natural selection could lead to evolve or regress. Nature does not necessarily retain good features. Thus, there must be an agent (a lock-opener, an intelligent designer) to work through the process. Behe pointed out that seven years before Sober’s publishing Philosophy of Biology, Robert Shapiro (1986) had examined this scenario in *Origins: A Skeptic's Guide to the Creation of Life on Earth* and concluded that this type of argument is invalid in the viewpoint of chemistry.

Naturalism and demarcation criterion

Behe (1996, 1998) resented that many scientists view invoking natural cause as the only legitimate approach of conducting research. According to Behe, naturalism is not itself a scientific argument. It is philosophy. He found that in some cases, naturalistic and materialistic explanations are even harder to believe than the intelligent design argument, such as alien seed hypothesis and non-cause cosmology from the steady-state theory.

Steady-state theory, proposed by Fred Hoyle, is a cosmological model about how the universe began. Unlike what the big bang theory suggests, the steady-state theory asserts that the universe is infinite and eternal. To explain why the universe is so dense, Hoyle proposed that matter was continually coming into existence with no cause.

Alien seed theory was proposed by a Nobel Prize winner, Francis Crick. According to Crick, lives on earth might begin when aliens from another planet sent a space ship to seed the earth with spores, which are small, usually single-celled reproductive bodies that are highly resistant to desiccation and heat and are capable of growing into new organisms.

In addition, there are several other natural theories regarding the origin of the universe or lives on earth such as bubble universe, zillion anthropic universes. Behe criticized that no experiments have ever been done to support any of the preceding notions. Their use is to employ naturalism and materialism, and to avoid supernatural explanation.

In a similar vein, Dembski (1997) also criticized that some cosmological theories pursue certain approaches just because they are naturalistic. For instance, in his younger days Einstein had been committed to Spinoz's God. Spinoza had identified God with nature and assumed that this God was infinite in extent and duration. Consistent with Spinoza's conception, Einstein formulated his field equations to model such an infinite universe. In the 1930s after Edwin Hubble announced his discovery of an expanding universe, Einstein was convinced that the universe was indeed finite. But Alan Guth and his successors, much like Fred Hoyle, attempt to recapture Spinoza's lost infinity. In Dembski's view, their theories arose solely out of a need to preserve scientific naturalism.

The issue of naturalism and materialism is tied to the issue of demarcation. In the heyday of positivism and falsificationism, the demarcation criterion was often used to classify science and non-science. According to positivism, only propositions that can be testable as true or false carry cognitive meanings. Un-testable propositions are simply metaphysics. Later Popperians changed the criterion from verification to falsification. Nonetheless, both of them set a cut-off line between science and metaphysics, and the intelligent argument was classified as a non-verifiable or non-falsifiable belief.

Today, both positivism and falsificationism are no longer appealing to many philosophers (Meyer, 1999). As Behe noticed, many cosmological models proposed by scientists are resulted from neither experiments nor observation. For instance, in answering the question whether it is possible to explain the origin of the universe without the first cause (God), Davies (1983) suggested that our existing universe

might only be a disconnected fragment of space and time resulted from the Big Bang. There could be many, even infinite number of other universes, but all physically inaccessible to others. What would happen if testability and falsificability were applied to this type of theory? How could one employ any scientific method to study something that is totally inaccessible to us and the common physical laws do not apply? The only thing that still makes it "scientific" is that it offers a naturalistic explanation.

Henceforth, the demarcation criterion has changed its emphasis: theories that involve natural laws are considered science while theories using supernatural explanations are not science (Ruse, 2000). In a similar vein, Pennock (1999) promoted "methodological naturalism," in which lawful regularity provides a ground for inductive evidential inference. To defend scientific naturalism, Grinnell (1997) argued that inter-subjectivity within the scientific community necessitates the demarcation criterion. According to Grinnell, discovery is only the first part of the scholarly inquiry and credibility is the second step. Individual scientists make discoveries and the scientific community verifies whether those discoveries are credible. Inter-subjectivity refers to the recognition of others as people who are like the scientist, whose basic experience of reality complements each other. Since the naturalistic world shared by everyone is the only world accessible to scientists, naturalism should be adopted. If a theory cannot be empirically measured with referenced to the accessible world, then it can't be science.

At first glance, the demarcation criterion has shifted the focus from testability and falsibility to natural laws. Indeed, the fundamental principles of the demarcation criterion are not a lot different from positivism and falsificationism. Promoting "natural laws" or "lawful regularity" is another way of endorsing the covering law model. The inter-subjectivity among scientists and accessibility to a common reality is the same thing as basing judgment on empirical or logical means. To some certain extent, naturalism and demarcation criterion are defensive rather then offensive. To be specific, it does not declare that the intelligent design argument is false; it just says theology and metaphysics should not step inside the arena of science, which is self-sufficient in inquiry. As Morrow (1997) said, a naturalistic and scientific inquiry of the origin of life does not argue that God doesn't exist, but simply that it is unnecessary to propose a divine purpose to explain how things came to be. However, while naturalists such as Morrow devoted efforts to

stop metaphysics at the front door, many people are not aware that metaphysical assumptions have been stepped inside naturalism through the backdoor.

As mentioned before, Behe found the naturalistic criterion unacceptable. Meyer (1997, 1999), Dembski and Meyer (1999) also firmly refuted the demarcation criterion. In response to Ruse's natural law criterion, they argued that the covering law model has several difficulties. First, many laws are descriptive but not explanatory. A typical example was Newton's Universal law of gravitation, which Newton himself admitted that it did not explain, but instead merely described, gravitational motion. Second, covering laws could not explain a single past event. Many things do not come into existence via a series of events that regularly recur. The origin of the universe and the origin of life belong to this category. In Meyer's view, historical events could employ neither empirically-oriented induction nor logically-based covering law models. Instead, historical theories depend on what C. S. Peirce (1934/1960) called "abductive inferences." In abduction, various plausible explanations of a phenomenon are explored and the best explanation is accepted when alternate hypotheses do not give a satisfactory explanation. Thus, this mode of inquiry is also termed as "inference to the best explanation."

Further, when inter-disciplinary inquiries have been gaining popularity, it is not a progressive move to revert to the demarcation criterion. For example, historians and psychologists have been collaborating in exploring psychohistory. Computer scientists, mathematicians, social scientists, and philosophers have been exchanging ideas on causality in structural equation modeling (Yu, 2001). Within social science, more and more researchers employ mixed methodologies such as quantitative and qualitative methods. Rejecting other views just because of non-compliance of "house rules" would hinder researchers from fruitful dialogues and collaboration.

Philosophical conflict

There is a popular myth that the debate between evolutionists and creationists is a conflict between science and religion. Phillip Johnson (1991, 1996) highlighted that this conflict is indeed philosophical: If evolution is viewed as improvement of organisms over a long period of time, evolution and creationism do not necessarily conflict with each other. This is the philosophy derived from Darwinism going against

Christianity, such as the naturalistic and materialistic approach of inquiry, the implications that life is accidental and without a purpose, and morality has no objective and ultimate foundation.

It is not difficult to see that the debate regarding naturalism and demarcation criterion is philosophical because the discussion is centered on epistemology and methodology (What is cognitively meaningful knowledge? What is science? How can we conduct research on unobservable, single events?) At first glance, it seems that the arguments pertaining to irreducible complexity are based upon biochemistry and probability, which is less philosophical in nature. Nevertheless, in my view, this discussion is also directed by philosophical beliefs, especially metaphysical assumptions.

Probability and law

Shanks and Joplins (1999) argued that typical biochemical systems exhibit considerate redundancy and overlap of function. They proposed that "redundant complexity" is a more accurate description of biochemical structures than "irreducible complexity." Further, they argued that this type of redundant complicated system could be developed and maintained by a self-organizing process. Thus, it is *possible* to explain the origin of life in a naturalistic, evolutionary fashion. However, the argument of self-organizing process introduced by Shanks and Joplins, to Behe (2000), still does not answer the question of the origin of life. Behe asserted that saying a process is self-organizing and automatic is a description of the phenomenon; the mathematical modeling does not call the automated system into being.

Ussery (1998) asserted that a biochemical process is complex yet it carries room for mutation. For instance, one out of every thousand males has an extra X chromosome, and a similar number (one out of a thousand) of males have an extra Y chromosome. About one out of every thousand females only has one X-chromosome, instead of two. With this error rate, while DNA is replicated via various processes, it is *highly possible* that new species could arise from mutations.

Regardless whether a biochemical system is irreducibly complicated, redundantly complicated, or error-prone, the description of a biochemical system does not lead to a firm conclusion of either evolution or creation. It is important to note that when Ussery, Shanks and Joplins drew their conclusion, they said it is "possible" to give a naturalistic explanation. Behe (1999b) employed the same logic from the opposite

side: the odds against finding a new functional protein structure are astronomical. Dembski (1998), who is also vocal in promoting the intelligent design theory, used mathematical probability to develop criteria for detecting intelligent design. Inferences from description to explanation are probabilistic inferences, and probability itself is philosophical (Hacking, 1975; Salmon, 1967; Weatherford, 1982; von Mises, 1957).

As far as the universe is an open system, no event has a probability of zero. No matter how small the probability is (e.g. $p = .000001$), it does not mean that it would never happen. Rather it means that the occurrence of such event is extremely rare. Traditionally, the Fisherian hypothesis testing is employed to determine whether the *p* value is significant or not. However, since the origin of the universe and the origin of life are considered single events in history. It doesn't make sense to compute the probability based upon the relative frequency in the long run. In this context, phrases like "possible" and "high probable" reflect the subjective view of probability.

Besides the subjective view of probability, the propensity account of probability is another way to address the problem of non-repeatable events. According to the propensity school, the realization of probabilities, which may be random, depends on the total situation within which the possibilities are being actualized. In the frequentist view, all members of a set have equal chances to be draw. In the propensity view, all members are equal but some are "more equal." In other words, there are "weighted" probabilities rather than mere probabilities. These weighted probabilities lead to a tendency or a disposition. Peacocke (2000) suggested that the evolutionary process is characterized by propensity.

Indeed, there is no generally agreed procedure for computing probabilities regarding the origin of life and the origin of universe. In the Sober's scenario mentioned earlier, Sober insisted that the probability that organisms evolve naturally is much higher than that of purely random process, because evolution involves both random mutation (the law of probability) and purposive selection (the law of biology). Similar arguments were also adopted by Johnson (1997) and Ruse (1998). Fred Hoyle, the aforementioned scientist who proposed the stead-state theory, found that the odds against DNA assembling by chance are $10^{40,000}$ to one. Nonetheless, Hoyle still favored a naturalistic approach to explain the origin of the universe. Defenders of evolution argued that DNA did not assemble purely by chance. Instead, it assembled by a combination of

chance and the laws of physics. Without the laws of physics as we know them, life on earth would not have evolved in the short span of six billion years (Stenger, 1997).

Behe did not agree that "laws" could increase the probability that the emergence of life is natural. In reviewing Davies's *The Fifth Miracle: The search for the origin and meaning of life*, Behe (1998) pointed out that Davies contradicted himself by using the law argument. Davies said that laws couldn't contain the recipe for life because laws are "information poor" while life is "information-rich." In facing the challenge that a deterministic, mechanical, law-like process, like a primordial soup left to the mercy of familiar laws of physics and chemistry, could hardly achieve the complexity of life, Davies admitted that indeed no known law of nature could achieve this.

The notion that biological laws lead to a high probability of the occurrence of life is called "biological determinism." In attempt to rectify the problem of biological determinism, Davies (1999, 2000) proposed a new type of law that is not derived from physical laws: the law of complexity. According to Davies, this law is derived from the logical structure of the system. Artificial life generated by computer models is an example. Lifelike qualities could be found in computer-generated characters maintained by self-organizing algorithms. Using the artificial life analogy, Davies argued that universal logical laws might provide a key to unlock the mystery of life. However, Behe (1998) asserted that this idea has met with considerable skepticism; organic life is actually not an example of self-organization.

Assume that the preceding arguments are valid; the law of biology, the law of physics, or the law of logic do increase the probability of naturally emerged lives. But how do those laws arise in the first place? Then, the question on the origin of life and universe became the question on the origin of laws, which is closely tied to metaphysical assumptions.

The nature of reality

Johnson (1991) draws a distinction between "methodological naturalism," the attitude that scientists should explain as far as possible in terms of natural laws, and metaphysical naturalism," the belief that the ultimate existence in the universe is just material and nothing is beyond that. No doubt there is a big gap

between description and explanation. To fill the gap, the debate has been escalated from methodology to metaphysics. Indeed, subtle metaphysical assumptions are hidden in both sides.

While Behe (1996) argued that evolutionists are unable to give the detail about how simple biochemical systems could evolve into advanced systems, Shanks and Joplin (in press) also charged that no proponent of intelligent design has ever offered the slightest clue about how supernatural creation could be done. To explain the unexplained, both parties develop their own philosophical interpretations. To some creationists, the ultimate reality is supernatural, and thus there is no need to give the detail of how the creation process happened. The premise is that supernatural is beyond our comprehension. To some evolutionists, their ontology is naturalistic. Not surprisingly, they have no problem in using phrases like "appear," "arise," "spring forth" without giving the detail of how things arise or appear. To both parties, their metaphysics tell them what are considered "self-evident axioms" and nothing could ever go beyond that ultimate point.

The next question is: what is an epistemologically adequate explanation? Again, both parties criticized that explanations given by the other side are inadequate. In *Darwin's black box*, Behe expressed his disapproval of alien seed theory as an explanation of the origin of life. His question is: If humans are descended from aliens' spores, who created those outer space aliens? Interestingly enough, when Behe (1997) held a seminar in Princeton University, one audience member also complained that the intelligent design theory is not satisfactory. His challenge is: If God created the world, who created God? Stenger (1997) also asserted that the problem of *creation ex nihilo* could be applied to theism: You cannot get something out of nothing. The Creator is something. How did God exist out of nothing? Again, this different view of "what is adequate explanation" is due to different approaches in metaphysics. To Christians, God is ultimate and there is no need to ask the question "who created God?" But the natural realm, including outer space aliens, is not ultimate and thus it is legitimate not to accept "alien seed theory" as an adequate explanation. On the other hand, people who embrace naturalism regard material are the primary reality and thus alien seed is considered an adequate explanation. They might answer, "In their home plants, aliens have their own evolutionary process." In short, as what is considered adequate explanation is undefined, this type of debate will not be fruitful.

Conclusion

This paper argues that the debate on creation vs. evolution in the context of irreducible complexity is not necessarily a conflict between religion and science. Not only it is a philosophical debate regarding naturalism and demarcation criterion, but also the discussion related to probability and law, the meaning of adequate explanation, and many others, are tied to hidden metaphysical assumptions on both parties. Although it seems that the demarcation criterion has shifted the focus from testability and falsificability to naturalism, the new criterion is not much different from the old one, and I found it detrimental to inter-disciplinary inquiry. In short, the debate on irreducible complexity could never be settled by biochemistry alone, and philosophy would continue to play an important role in this "proxy war" between religion and science.

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