A primer on the epistomological frameworks of evolution and creationism for science education researchers

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Abstract

This paper defines the processes of evolution and natural selection for the non-scientist, and summarizes its history in the context of scientific racism. Types of creationism are defined , and both evolution and creationism are contextualized in the theoretical frameworks of modernism and postmodernism. The philosophical differences between scientists and creationists that lead to their conflict are discussed.

Introduction

In all levels of education in the United States, one long-standing and highly contentious debate centers on the teaching of the theory of evolution. Parents, teachers, students, and the general public have all participated in the arguments, but perhaps the loudest voices have come from religious leaders and the scientific community. The motives of all these groups, and the latter two in particular, are perhaps on the surface easy to identify. Religious leaders see the tenets of evolution and natural selection as undermining their doctrine; scientists value the data derived from observation and experimental design. Beyond these differences, what are the philosophical foundations underlying the approaches that the two camps take towards the evolution debate? What is the history of the debate itself? How do different philosophies affect public education? What philosophies are most appropriate for understanding evolution, and the nature of science itself? And finally, what does the evolution-creationism debate have to teach us about the nature and practice of science?

The evolution of the Theory of Natural Selection

The Theory of Evolution did not in fact begin as the theory of "evolution." In Darwin's time of Victorian England, the term "evolution" had a specific meaning as "progress," and for that reason he was careful not to use the term in his original Theory of Natural Selection (Gould, 1989). Simply stated, natural selection is the tendency for an organism to adapt in response to changes in the local environment. Adaptation takes the form of new species, an altered genetic structure within a species, or extinction, and is sometimes accidental, in the form of a genetic mutation (Relethford, 1997). Darwin strongly believed that such adaptations were not in the least progressive. There exists no zenith, no apotheosis, no final product for evolution (Darwin, 1859; Gould, 1989; Gould, 1993).

However, Darwin's intention has not prevented the representation of evolution as a progressive sequence, or a ladder. In terms of human evolution, many European scientists of Darwin's time articulated a progressive sequence, with apes occupying the lower rungs of the ladder, African and Asian humans being somewhere in the middle, and EuroCaucasians occupying the top, representing, of course, the acme of evolution. In fact, even in representations that leave out human ethnic variations and concentrate on the transition from ape to human, the final product is usually European in appearance (see Gould, 1989, illustrations on pages 29-34; Marks, 1995). For colonial Europe and a young America, this idea was perfectly in keeping with their very modernist notions that they were superior to non-European populations, by lending this idea spurious biological credence (Johanson and Shreeve, 1989). Biological determinism was believed to prove the innate inferiority of African, Asian, and

Indigenous races; it was science perverted into weaponry to "…enshrine existing hierarchies as proper and inevitable." (Gould, 1993, p. 84).

Of course, modern scientific thought, whether structuralist, positivist, or postmodern, rejects the objective "reality" of European superiority as the end product of evolution. Evolutionary scientists themselves reject the idea of progression or universally superior end product. To quote John Relethford (1997), a biological anthropologist, on the issue of race: "Biological variation is real; the order we impose on this variation by using the concept of race is not. Race is a product of human minds, not of nature" (p. 269). Both scientists and non-scientist postmodern philosophers would agree that variations within species of animals (including humans) are adaptations that reflect the specific reality of the local environment. Consider the example of sickle cell anemia, a condition which in the Western world is stigmatized as a "Black disease." The distribution of this hemoglobin type is concentrated in central Africa. This region also exhibits the highest occurrence of the malaria virus and its parasitic carriers. As it turns out, humans who carry the sickle cell variant enjoy an enhanced immunity to the malaria parasite as a result this blood cell variation. In a malarial environment, the reality is that sickle cell anemia enhances survival. In a nonmalarial environment, the reality is that sickle cell anemia is a deadly disease with no benefit.

What happens when these two environmental realities are compared? In one case, sickle cell anemia is an advantage; in the other, it is a liability. Which is right? Which represents the one objective view of reality? Is one reality "good" and the other "bad?" This difficulty in comparing different descriptions of reality, as well as

generating a single truth, is a fundamental theme of postmodernism (Kvale, 1995). The discard of modernist notions of one group's superiority allows us to see the true nature of the world, through our own understanding and practice of science. Although this characteristic is not unique to postmodernism, it has been advanced most enthusiastically by some thinkers (e.g., Griffin, 1988; Kvale, 1995; Orr, 1992) in recent years.

The leading philosophers of Darwin's day were forced to reject his work because it challenged their views of the nature of science, and by default, the nature of God. British philosophers of the nineteenth century perceived rigid and direct connections between God and creation (Hull, 1989). Natural selection states explicitly that species are not static; they vary through time as a response to their environment, usually in a random fashion. This amounted to a "constant tinkering" (Hull, 1989, p. 2) by God, implying that His creation was imperfect. Further, Darwin's contemporaries reasoned that "if species evolve, laws of nature evolve, and if natural laws evolve, scientific knowledge is impossible" (Hull, 1989, pp. 2-3). The Victorian scholars were advancing science by using observed natural order as a window through which to view God himself. As far as they were concerned, Darwin threw a rock at that window.

However, by rearranging the tenets of evolution and aligning them with a notion of biological determinism that favored the Caucasian British Empire, evolution-as-progress gained considerable acceptance among the Victorians and their counterparts.

Types of creationism

Creationist thinking can be categorized as Literalist, Progressive, and Theist (Alters and Alters, 2000). Literalists believe that not only does the Bible contain the word of God, it in fact *is* the word of God. They believe that the Bible is the ultimate authority on everything from morality to theology to science, and that its contents are unquestionable and infallible. Literalists accept the chronological record as presented in Genesis, and they reject the slow and random process of natural selection. They believe that the Earth is no older than ~10,000 years.

Progressives accept a much older age for the Earth, but agree that its origins, and the origins of life, are supernatural. For them, the timescale in the Book of Genesis is non-literal, but humans were created in more or less their present form rather recently. One subgroup of the Progressives allows for limited evolution in their view, postulating that it did occur but was directed by God, who also occasionally intervened, especially in the origins of humans.

Theists accept the occurrence of evolution, but argue that its randomness is and was not truly random, but was employed by God for his end purpose of creating humans. This facet gives origin to a hybrid of creationism known as Intelligent Design (ID). ID states that some supernatural (or extraterrestrial) intelligence put forth, by design, all known biological constructs. Their argument is usually that nature is "too perfect" to have been established by accident; therefore, all things were contrived by a supernatural or extraterrestrial force. ID is currently the main alternative proposed by creationists for public school science curricula, since it does not feature the word

"creation." The notion of Supreme Design as proof of God's existence is an old one, dating back at least to St. Augustine's time of ~1600 B.P. (Gilson, 1960), if not one to two thousand years earlier.

Creationism and its philosophical weaponry

In 1981, Act 590 of Arkansas state law was drafted to give creation science equal time in Arkansas classrooms, and defines creation science as:

> "…the scientific evidence for creations and inferences from these scientific evidences. Creation-science includes the scientific evidences and related inferences that indicate: 1) sudden creation of the universe, energy, and life from nothing; 2) the insufficiency of mutation and natural selection in bringing about development of all living kinds from a single organism; 3) changes only within fixed limits of originally created kinds of plants and animals; 4) separate ancestry for man and apes; 5) explanation of the Earth's geology by catastrophism, including the occurrence of a worldwide flood; and 6) a relatively recent inception of the Earth and living kinds (Montagu, 1984, p. 376-377)."

This legislation sought to provide an alternative to the tenets of natural selection and evolutionary theory in Arkansas classrooms. Offended by the ideas of evolution, fundamentalist groups positioned creationism as the alternative pedagogy for Arkansas students (Gould, 1982). The creationists reject an objective reality of evolution, and offer the explanation of "God's will" for certain difficult questions. A good example of this is the occurrence of dinosaurs in the fossil record, but the absence of living specimens. This of course is attributed to God's will in deciding that the entire superorder *Dinosauria* were to cease existing on Earth after the Noachian flood.

Some postmodernist thinkers, e.g., Griffin (1988) and Wilber (1985), argue that science is not restricted to the domain of the physical, and that whole ranges of phenomena exist beyond scientific rationalization. As a result, it is perfectly reasonable

to engage in speculation that is wholly disconnected from observation, or to deal with subjective realities, and call it science (Griffin, 1988). Let us carry the fossil example further. All geologists will agree that the deeper, or stratigraphically lower, a fossil is found, the older it is. What we observe from the fossil record over time is an increase in complexity of organisms, from older, simpler animals to more recent, complex animals. So a typical bottom-to-top order would be fish, dinosaurs, mammals. Creationists explain this order as resulting from the animal's flight from the Noachian flood. Fish were buried first, then dinosaurs ran to topographically higher locations to escape the water, and mammals ran up even higher (Relethford, 1997). Creationists don't "scientifically" test this idea, citing the Great Flood theory as being just as plausible as evolution, if not more so because of its greater simplicity. A hypothetical postmodern philosopher of science might be comfortable with this idea because she or he could argue that although science requires repeatable demonstration through experiment, it does not require one type of demonstration, such as the laboratory experiment (Griffin, 1988). Citing a desire to move beyond modernist materialism, our philosopher invokes a metaphysical notion of reality, and that each individual's construction of reality is unique and valid. She or he might conclude that since no true objective reality exists, the Great Flood theory is a perfectly acceptable explanation for whoever invokes it. Since science itself is not limited to any one type of explanation (Rescher, 1983), it is just as reasonable to invoke the actions of a god as it is to, say, develop mathematical models using complex operators to represent reality.

Despite the more practical concern of which reality to, for example, codify into the Common Core Standards, a far more dangerous precedent is set by this incidental alignment of creationism and postmodernism. Postmodernist science claims that because humans conduct science, no neutral truth or point of view exists because no human point of view is truly neutral (Griffin, 1988). As a result, any scientific proposal should be subjected to "ongoing public discussion among those with diverse viewpoints" (Griffin, 1988). Using this very argument as a rallying cry, the Kansas State Board of Education (NCSE, 1999) removed biological evolution from the State Science Standards at their August 10, 1999 meeting.

Creationists have a purpose beyond merely presenting *alternative viewpoints*; they seek to install *their* viewpoint as the truth, in the guise of public discourse on alternatives to evolution. By removing evolution, they strategize, creationism is the inevitable pedagogical truth that will be installed (Relethford, 1997). Creationists work to debunk evolution not through experiment, observation, or open discussion among those with "diverse world views," but instead via a one-way teleological argument:

> "We need to be equipped to teach young people (and adults) to see and draw connections between the Bible and the world around us. This means educating ourselves in the basics of biology, geology, and astronomy—as founded in Scripture." (AiG, 2018
>
> And:
> "…the Bible serves as an essential foundation for understanding science in the past and present."(AiG, 2018)

Far from a discussion favoring diversity!

The real danger, however, is the confusion of freedom from modernism with the preaching of creationism. Creationists seek to explain the world "scientifically" through

faith, stopping the teaching of evolution in public schools (Eldredge, 2000). They do this in the guise of "freeing" us from the "tyranny of Darwinism." Evolution, they say, is "only a theory[1]," so therefore it should not be taught. This amounts to a systematic censure of education. The fundamentals of evolution have been derived from our observations of both living and fossil organisms. Rejecting the observable in favor of the "metaphysical" disenfranchises individuals as learners, and disconnects them from their physical world. If people are actively discouraged from using their own skills at observation, they become disempowered. As a result, the powerful heads of churches remain unchallenged by the masses who are kept ignorant. Creationism is a modernist movement that seeks to relegate the understandable to the realm of the supernatural, asking all of us to close our eyes in the process.

Corollary to this argument is the notion that many creationists take when attempting to debunk evolution. Large-scale evolution, say the development of a new flying species from an ancestral non-flying one, is not a process observable in human time scales. Therefore, according to creationists it is not "…real science…[b]ut since we cannot see it functioning, it is not any more scientific than creation." (Morris and Morris, 1996, p. 14). This argument contradicts the more postmodern one advanced by creationists discussed earlier. It also serves as an open admission that creation science is in fact not science (Alters and Alters, 2000).

[1] The scientific meaning of the word "theory" is an explanation of a phenomenon that has an overwhelming amount of data supporting it, which is repeatable and repeated. One can say, "I have a theory that the Sun will rise in the east." So far, no contradictory data or evidence have surfaced to the contrary, and the Earth has been observed to rotate on its axis such that a diurnal cycle results. A layperson might say that an eastern sunrise is a "fact," which is perfectly appropriate vernacular—but not the language of science.

Why the conflict?

Creationist leaders contend that the mechanisms of evolution are in direct contradiction with biblical history (Alters and Alters, 2000; Morris, 1990). They contend that God created humanity in more or less the form we are in today. Biologists and anthropologists report evidence that we originated from an ancestral hominid over the last 8-5 million years. Creationists perceive a moral decay attendant to embracing natural selection (Alters and Alters, 2000). The argument goes that if we agree that humans came from animals, then nothing will stop us from behaving like animals, and the morality dictated in the Bible will be discarded.

Finally, some people attack evolution on the grounds that it is counter to postmodernism. Eugenie Scott reported this issue in 1998 by writing "there exists an anti-science movement among postmodernists that views science as negative and even 'corrosive'" (p. 25). An example of this is found among the works of select feminist scholars and scientists, particularly those working in the field of ecofeminism, which has some roots in the Gaia hypothesis.

Gaia and feminism

In 1972, James Lovelock proposed the Gaia hypothesis, which he named after the ancient Greek Earth goddess. The idea behind Gaia is that the biosphere on the Earth exerts a strong influence on the nonliving processes operating on the surface (Lovelock, 1972). It remains a controversial hypothesis in that it suggests that life itself is the dominant influence on the Earth's oceans and atmosphere, impacting their temperature, chemistry, and circulation. In truth, interconnections between the Earth's systems are

well documented (Tarbuck and Lutgens, 2000). A few billion years ago, the circulation of heat in the Earth's mantle broke the rigid surface into many plates, which today continue to drift about on top of the denser rocks of the mantle, colliding, diverging, and sliding past each other. The collision of plates forms mountains, which expose rocks to the atmosphere for erosion into sediment. The sediment is transported to the oceans, continuously increasing the salinity of the oceans. Corals, foraminifers, and other shelled animals in the ocean uptake the various salts into their bodies, keeping the ocean water from becoming too saline. Algae in the ocean produce the bulk of Earth's free oxygen, maintaining an oxidizing environment. This promotes chemical weathering, helping to tear down the mountains.

Modern geologists and biologists agree with this basic notion of interconnectedness of Earth's systems. What they often reject is the more teleological aspect of Gaia—the notion that the Earth is an organism, that it is alive and self-regulating, that the biosphere controls the environment with the purpose of ensuring continued life on Earth. It animates nature, they say, personifies it; turns nature into Nature. Maybe even Mother Nature.

While some scientists blanched at this idea, many (other) feminists ran with it (Christ, 1979; Gadon, 1989; Ruether, 1992). Gaia is a central theme of ecofeminism, which combines environmental concern with feminist analysis of the power of the patriarchy. In ecofeminism, Earth and nature are not passive entities that exist for the benefit of [Man], but rather Nature is cast as benevolent mother, caretaker, and holds the ultimate power over the planet, in contrast to human dominion and exploitation.

Gaia, then, is the perfect answer to the modernist notion that nature is exploitable, and the attendant devaluing of women as a result of this human disconnection with nature (Ruether, 1992).

Some postmodern thinkers, e.g., Alaimo (2000), categorize natural selection and other contemporaneous works of Darwin's contemporaries as patriarchal and contributing to the oppression of particular groups. Others, e.g., Griffin (1988) and Orr (1992) see natural selection and evolution as ways of thinking which unnecessarily limit scientific thought; that is, making it overly materialistic and singular to one viewpoint.

Postmodernism and science are both inherently self-critical and self-questioning. Indeed this is how science grows and discoveries are made. These behaviors, when focused on evolution and natural selection, are often construed by creationists as casting doubt on the core validity of these theories. This is because 1) scientists are seen as not presenting a "united front," and 2) the scientific context of the term "theory" is often misunderstood, usually interpreted as "guess" or "hunch." This latter problem can be addressed by educating people on the proper meanings of the terms hypothesis, theory, and law. The former problem is not so easily addressed. To ask scientists to stop questioning themselves and each other is akin to asking them to stop practicing science. Discussion, exchange, and, to a degree, conflict are all a part of the process of science. Ceasing this activity might well present the united front that creationists often point out as missing. But at what cost? The exchange and criticism of ideas? The suppression of alternative and conflicting viewpoints? This would cripple science, yet it would not slow the momentum and veracity of creationist attacks on science. Indeed,

even after the reversal of the Kansas Board of Education's decision to remove biological evolution as a standard, creationists have stayed their course. This reversal represented a major blow to their agenda, when scientists and laypersons throughout the country rallied in support of science. Today, the battle continues.

Conclusions

Darwin's original theory of natural selection was metamorphosed into the theory of (progressive) evolution by other scientists of his time. Modern science rejects the notion of a superior end product of evolution, and the attendant oppression such a notion generates. The philosophers of Darwin's time rejected the notion of natural processes as random and long term, because it conflicted with their view of nature as a window to God. Today, the conflict between science and religion manifests as an ideological battle between creationists and the scientific community, waged on the battleground of public schools. Creationists take issue with the disparity between biblical chronology and evidence from the fossil record, and they believe that teaching the theory of evolution will lead to moral decay. Scientists and other educated citizens reject the notion of supernatural explanations for observed natural processes, and also oppose the introduction of religious doctrine in public school settings. To implement their agenda, creationists employ tactics akin to postmodern philosophy on the surface, which quickly breaks down under close scrutiny. In order to minimize the conflict, scientists could cease to debate the many sub-facets of evolution and present a united

front; however, this would not be science. The conflict continues, and is likely to continue indefinitely in our nations public schools.

The solution to this conflict lies in education; not the policy of education, but the access to information about the scientific method, the theory of evolution, and the nature of science and scientific terms like hypothesis, theory, and discussion. Only through this process will the real truth, the one that is observable, recordable, and repeatable by everybody, be revealed.

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