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The Evolution of Darwin's Theory into an Axiomatic System

Evolutionary theory is still slowly winning its acceptance. Such is the case with any theory that opposes traditional thought long engraved in the minds of many people. And not only out of tradition do we refuse to accept new ideas. When these ideas contradict what we want to believe, they are often denied. It took over a century after Copernicus proposed the idea in 1543 before the world accepted that the Earth is not the center of the universe but revolves around the sun. This is an example of how naivete in human knowledge seems to produce a sense of egocentrism. Likewise, accepting evolutionary theory means accepting, among countless other "unsettling" things, that humans came from lowly organisms, were not created by a divine hand, and may have never even come into existence had chance led evolution in a different path. These implications were precisely the reason why Darwin was hesitant to publish the *Origin of Species*, until 1859 when inspired by Wallace. However, time has passed and neo-Darwinism, Darwin's theory in combination with growing knowledge in the genetics field, has won general acceptance as modern genetics have filled holes Darwin left on the topic of inheritance. Yet opposition to the theory has by no means disappeared. Among the most prominent is the argument from intelligent design: "Of course the world was created, how else could it be so complex?" In this argument we see the main reason why acceptance of neo-Darwinism, as well biology as a whole, as an axiomatic and pure science (like physics) is somewhat hard to swallow. In its intricacy, evolutionary theory is hard to visualize. Acceptance is therefore hampered by disbelief and sometimes fear that the complexity we see in our world today (and how we came to exist) can be broken down into many simple, mathematical steps that follow logically from one to the next. While there may be uncertainty of evolutionary biology as an axiomatic system, it remains a valid and useful science.

So what does it take to be axiomatic? There must first be accepted statements that need no justification (axioms). Next, there must be agreement on how and when one axiom follows logically from another (Greenberg). And then, by deduction, results can be proven. Darwin was indeed aiming for an axiomatic system. In the *Origin*, he provides a deductive argument for natural selection (also loosely known today as population genetics), the heart of the theory of evolution, and a term which he himself often uses interchangeably with the theory itself (Ruse, 1988). From his argument we can pull the following axioms:

Darwinian Axiom 1: There is variation among organisms.

Darwinian Axiom 2: There is a struggle for existence.

In Darwin's own words, these statements "cannot be disputed," the first because of mere observation of living things under different conditions (temporally or spatially) and the second due to a geometric increase in individuals with only an arithmetic increase in resources, an idea borrowed from Malthus (1798). Thus, there must be some variation rendering advantageous to an organism's welfare, in that the organism somehow gains a better chance of survival over another, and we can deduce a proposition:

Proposition 1 (Natural Selection): There is preservation of selected individuals

However, Darwin's theory for natural selection may not be so simple. As Dennet (1995) points out, Darwin himself described the entire *Origin of Species* as "one long argument," using two types of demonstrations. One is the "logical demonstration that a *sort* of process would necessarily have a certain sort of outcome," and the second is the "empirical demonstration that the requisite conditions for that sort of process had in fact been met in nature". The former he supports with "imaginary instances" to show how the conditions might account for the effects, and the latter with many detailed examples that the conditions have indeed been met over and over again in nature. In support of Darwin, with his long lists of evidence he was unable to find a model, or an interpretation of his system, for which his proposition of natural selection failed to hold, and therefore the theory could not be disproved. However, challengers of evolution don't find this inability to disprove sufficient for proof.

Perhaps the biggest misunderstanding of Darwin's theory, as Dennet (1995) argues, is that some forget that "algorithms" such as his don't have points or purposes, and therefore believe his theory of evolution is a procedure for producing humans. Again, egocentrism blurs the view. Considering evolution as a process with purpose turns natural selection into an absurdly complex formula, where the present state of affairs is the "solution." This simply contradicts the heart of natural selection, where the present state of affairs is the product of occurances without intention.

Even if Darwin's theory of evolution by the means of natural selection is accepted as logical and axiomatic, current evolutionary theory, the foundation of modern biology, is not so simple. Now at the core of evolutionary theory is the modernized natural selection, or "population genetics." Evolutionists have therefore developed a claim about genes in populations, the Hardy-Weinberg law, which requires the following axiom:

Neo-Darwinian Axiom 1: Genes are passed on from one individual to another by processes *derived* from basic Mendelian laws.

And from with this axiom the Hardy-Weinberg law of equilibrium can be deduced:

Proposition 2: In the absence of disruptive forces, the genetic make-up of a population is at equilibrium.

Such forces of disruption include selection and sampling effects due to finite numbers (Ruse 1988). At first consideration, such a proposition may seem restrictive. What good is a theory that can only predict the genetic make-up of a population "in the absence of disruptive forces"? How is this applicable to real life? This is where the complexity comes in. Such a theory is used by evolutionary biologists, not to know that when they do find that magical population free from any environmental pressure that the population is at equilibrium. Rather, the theories are used as foundations to build from in order to determine the forces at hand. This point can be further exemplified with the optimal foraging theory, an ecological theory that considers an organisms adaptation to its environment through an analysis of energy cost and benefit (Dodson 1998). In consideration of natural selection, we have the axiom:

Optimal Foraging Axiom 1: The organism with the highest rate of energy intake will have the highest fitness.

Proposition (Optimal Foraging): An organism behaves to maximize energy gain.

Cost is the energy expended to obtain food, often measured in units of time, and benefit the energy acquired from a food source, usually measured in calories or by size. Dodson (1998) gives the example of a bee foraging for nectar moving from flower to flower. The bee should theoretically remain at the same flower until nectar levels are depleted enough that it would benefit the bee to move to another flower with a fresh supply of nectar. Thus, there should be an optimal time spent at each flower.

In actuality, the bee might not spend the "optimal" amount of time spent at the flower as predicted by measurement. What would be the reason? There are a number of different possibilities. Perhaps the measurement of costs and benefits are simply incorrect. Maybe the influence made by of other members of an organism's species need consideration, as they may add an element of competition or change the distribution and/or abundance of a particular resource. There may be predation risks involved that would make acquiring a resource more "expensive" than previously thought. The optimal foraging theory serves as a starting point, which, after observation, needs modification. If the theory doesn't work, the behavior ecologist must revise the parameters, make new predictions, and retest. Thus, the new optimization model works for a certain species or perhaps a subset of a species, rather than serving as a universal model for all foraging organisms.

As Dodson (1998) points out, optimality is not what is being tested. Rather, the goal of the theory is to test hypotheses on the adaptiveness of a certain behavior. And according to Ruse (1988), any model, including population genetic models using natural selection, is true until it is applied to reality, where it becomes empirically true or false.

With evolutionary theory, scientists are able to construct real, empirical processes, for example that of sickle-cell anemia, where, despite the fatality of homozygousity, when an indivdual has two sickle-cell alleles for a gene, the disease stays in the population because heterozygotes, those individuals with one sickle-cell allele and one normal allele, benefit with the accompanying malarial resistance. Thus, evolutionists work on a case-by-case basis.

Thus the question of evolutionary theory as an axiomatic system depends on the degree of specificity. Maybe evolutionary theory can be axiomatized at a universal level, but this requires that the axioms remain general. Mary Williams, who attempted an axiomatization of evolutionary theory has been critiqued for being too general (Ruse 1988). Is generality good or bad? Some argue that it adds strength to a system, others argue that nothing of specific interest could be deduced with such generality. When claims become very specific, they become applicable to only so many real-life instances. Maybe the claim that coniferous trees outnumber deciduous trees, as they are more adapted to the environmental conditions is true in the Pacific Northwest, but it is a false statement in South America.

Thus comes the argument that evolutionists, rather than building a grand axiomatic system, often use restricted models. It seems that what evolutionists do is what they can do, and that is build a general axiomatic system from which they can derive more specific information once applied to nature. The route that evolution will take in a certain case is dependent on the situation. Using past evidence that has as few differences from that which you are trying to prove as possible will provide more predictive power. When claims become more specific in evolutionary theory, as they must to explain many biological processes, they lose their predictive power at the universal level. Is evolutionary theory then more descriptive than prescriptive? As Wolters (1993) points out, maybe evolutionary theory is a collection of "descriptive narratives" that merely explain evolution. It is a science that deals with events "after the fact" with "no scope for prediction" (Ruse 1988). But, as the world is not regular, it seems that the world is too complex, with too many variables, to have much predictive power at a universal level. Surely many ecologists would argue that, given enough specificity, there is predictive power in evolutionary theory.

It should make sense that biology doesn't always act according to overall general rules. It is itself a very encompassing science, which uses many of the other "pure" physical sciences to help explain natural processes. The elements of probability and chance are a result of such complexity. The reason they play such a big role is that there are so many factors to deal with in nature. Rules change over time and between environments. Maybe evolutionary theory in biology is too wide ranging to be condensed into a reasonably sized axiomatic system. An evolutionary axiomatic system without modification of theory in specific cases would be composed of too many if-then statements to count, and therefore not practical. This does not undermine the validity of evolutionary theory or biology as science. Any field of science cannot be 100% predictive once placed in reality.

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