Is Darwin's Theory Properly Scientific?

MICHAEL KEELING

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When examining the scientific status of Darwin's theory1, it is necessary to consider both what the theory entails and, most importantly, what constitutes "proper science". A common error in thinking will lead one to use all- encompassing definitions in characterizing science, and this leads to insurmountable difficulties when considering theories such as that of Darwinian evolution. I will attempt to show how logical models such as Hempel's deductive-nomological (D-N) model2 and Popper's concept of hypothetico-deductive3 knowledge can be valuable in some instances but misleading in others when it comes to differentiating between scientific and non- or pseudo-scientific theories. The principal difficulty with these models is in their seeming inflexibility in dealing with theoretical levels, or types, a concept which I hope to explain in this paper.

In introducing the problems involved in demarcation, I would like to present classical Newtonian physics as a scientific ideal. It is falsifiable, it has exemplary formal structure, it is simple yet has widespread applications, and its structure yields either prediction or explanation according to the Hempelian D-N model, as required for the situation. However, the beauty of Newtonian mechanics is dependent upon the integrity of the atom. This atomism, which entails a reduction of systems to quantifiable units, is what best characterizes modern science, and is what makes demarcation so problematic an issue when considering non-mechanistic systems as topics of scientific enquiry.

The ideal in science, then, is perhaps best defined as that in which (in a given field of study) the observational phenomena can be expressed in formal terms as a set of atomic (by "atomic" I mean unit-like) entities, subject to relations of a law-like character. Earth can be expressed as a number. Its motion can be subject to law-like adherence to relations of quantity to quantity, and as such it may be viewed and understood in a properly scientific fashion. But what happens when we view the Earth as a system rather than as an atom? We are faced with bewildering complexity. While we can model and predict the path of Earth's orbit, we cannot adequately model or predict the path of a particle in a cup of hot coffee. Science is gradually making it possible to model the simplest of such dynamic systems, by determining the formal structure which underlies the apparent chaos. But this too is a study of atom-like units in motion, for once a system can be expressed by an equation, each momentary state has been given a formal relation to any other such state. What is important to note here is that any system which we can model in formal terms will be limited by our use of variables and correspondingly, our ability to determine initial conditions. Thus, our ideal scientific explanations are limited to formalism, mechanism, and necessary atomism, in that any observational phenomena must be considered in solid unit-like terms in order to be precisely modelled. When

using these as ideals for the studies of the multiple levels of feedback which have emerged as life on Earth, we will find that the concept of atomism breaks down and must be altered to admit this added dimension to scientific enquiry.

The fundamental problem with mechanistic thinking is its difficulty in addressing hierarchical levels of reference, or 'logical types'.4 Formal systems generally contain only two levels, the atomic units and the system as expressed in formal terms. This is true of Newtonian mechanics. The problem emerges when one attempts to provide a scientific explanation of a complex system having several levels of organization and multiple variables. This is true of Darwinian evolution. It would be possible at this point to simply say that Darwin's theory, whether in the terms he presented it, or in terms of population genetics and molecular biology, is too large a field to be called scientific because it does not -it cannot- model the phenomena it hopes to explain in the way classical physics can. But I believe Ws would be a hasty oversimplification of what science is, of what it can do, and of how we should view it.

The Difference between 'Laws' and 'Trends' is of value in demonstrating where a given field in science stands in relation to its phenomena of study. Where there are laws, there are the ideal models, and a tight formal structure. In the case of trends, there are often layers upon layers of structure which cannot be expressed in such formal terms; but science can informally identify relations between systems upon their respective levels, and can thus furnish adequate explanations of why things are the way they are.

Two points must be made briefly here. First, the concept of 'law' is not without problems. If the ideal in scientific knowledge is hypothetico- deductive, and we have a highly corroborated theory, we are not certain that its law-like character will continue to hold. And if that theory is falsified by an observation, it is not always certain that that observation is itself not a theory. For example, Kelvin's calculation of the age of the Earth seemingly refuted Darwinism, and later editions of The Origin of Species contained what Popper might call a 'conventionalist twist' 5 of Darwin's to explain how natural selection could still be the law-like mechanism of evolutionary change. Certainly, Kelvin's dating was theoretical, and it was later shown to be false due to his not knowing of radiation's earth-warming properties. But if the truth-value of a law is only probable, and the deductive character of science is to be found in the truth value of falsifying observations, does the dependence of observations upon some theoretical basis not make observations only probable truth-functions? I believe that must be the case.

Secondly, the concept of the 'trend' bears looking into, for Darwinism as it expresses trends in nature seems to cohere to some less formally-oriented conceptions of science. As Scriven rightly points out, "until the day when everything is predictable, there remains the fact that we can explain what we could not predict. 6 Much of the difficulty in prediction is due to complex initial conditions, but it is also due to the multiple levels of reference necessary to formally model the system. And it is well known that natural selection is only responsible for some, not all, changes in gene frequencies.7 It is not a law, but a trend, or a law-unless-overridden.

We cannot use modern evolutionary theory to predict future trait-distribution across a phenotypic pool of a given population, but we are well-justified in saying that whatever traits do emerge will have been influenced to a large extent by natural selection. This trend influences life at the gene level the individual, population, and species levels, and at the level of "memes", or cultural

replicators.8 All of which in turn influence and/or determine the total system, the environment, which in its turn, selects again. This may be expressed as a negative feedback loop, where maladaptation tends to mean removal from the system. But note that no matter is removed; a particular system of organization is removed, one of many similar organizations. This loop of natural selection pertains to organization of organic matter, and is at least one abstract level past the reach of pure mechanistic science. To formally cover the extent of these interrelated levels of interaction is beyond our capacity, but this does not mean that we cannot understand systems through the identification of levels or types and by recognizing such trends as natural selection.

In attempting to address whether Darwin's theory is properly scientific, I have taken care to apply the most rigid standards of scientific status as criteria. These standards themselves resemble the most rigid of sciences, classical physics. Both are expressions of a kind of wishful epistemological thinking, of a belief that certainty is attainable. While formal models are eminently useful, they are limited by the complexities we face daily in all fields including physics, as the Uncertainty Principle and quantum physics will attest. While I have not yet determined where Darwinism stands, I hope to have demonstrated that it deals with complexities which are necessarily beyond our formal capacities, due to the relations of differing levels of organic organization to feedback systems, and of the problem of determining relevant initial conditions before the fact. This by no means should indicate that Darwinism is not valuable. It has given science the paradigm within which genetics, molecular biology, evolutionary biology, ethology, taxonomy, cladistics and other fields presently find their niches. In a sense, Darwinism is testable by the degree to which it unifies other fields. It passes the test for as long as it is metaphorically relevant to knowledge. By saying this, I am speaking on the level of metaphor in that consilience is not an adequate test; but as long as natural selection fits, it fits. Our grand unifying metaphors, or "metaphysical research programs"9 either work for us or they do not, and the test is ultimately a social one. Rifkin10 is correct in thinking that Darwin was a product of his society, as was his theory. I do not see how this poses a challenge to Darwinism as a theory. If we change "competition" to "the supreme sacrifice", and "division of labour" to "diversification", and so on, we may change the tone of The Origin enough that it would have left Spencer without ammunition. But it would have said largely the same thing as a scientific document. Darwin worded nature for his society, and his society has come to accept it. I believe Darwin was more interested in barnacles than politics.

One may argue that testability and empirical content are not overly stringent in terms of determining scientific status, and that I have been hasty in simply noting the complexity of evolutionary systems and going on to show that formal models of proper science cannot do them justice. To some extent this criticism is justifiable. Natural selection is testable, but only on its own terms.11 (It is interesting to note that our acceptance of ideas follow a selection-based pattern, and thus selection has selected itself as the mechanism of adaptive change.) I might counter this by claiming that God has spoken to me, that I can now predict that the Earth will start spinning in the opposite direction on March 14, 2021. My theory is testable and has empirical content. The criteria of testability of predictions and empirical content is an empty category, unless we stress the logical relation entailed by laws or trends. But as a trend, natural selection is difficult to pin down. The character of chance events in the world and of the dynamic between environment and its subsystems is such that initial conditions are unknowable. We can thus only presume natural selection to be at work, because all available evidence points to it, along with mutation, as the primary mechanism of evolutionary change. Dawkins argues that it is the only logical non-creationist theory available, and that no other

theory is even logically possible.l2 If natural selection were not at work, then, there would not be any life to discover it. I believe that these are grounds for testing, in the form of retrodiction. The world seems to be the way we see it, and if such is the case, there is natural selection. We can base our assertion only on the way the world is. This paradox is either self-affirming or self-refuting as infinite regress. Nonetheless, testability can be viewed in terms of accordance with ideas about the world. As such it is at best a probabilistic procedure.

One may also criticize my seeming willingness to open up the demarcation issue to include potentially unscientific theories within science, by making a claim to amnesty on grounds of confusing subject matter. My view may be defended on the following grounds. It seems that the scientific community is quick to denounce theories as unscientific when they are controversial and/or use alternative methodologies. Rather than allowing a theory to be ignored due to categorization, it would be preferable to see theories accepted or rejected on merit. If we cannot refute Lysenko's or Velikovsky's theories by reasonable arguments, by showing how the premises are untenable or simply unlikely, or that there is no connection to the conclusions, or that they have no relation to the world, then perhaps they should be taken seriously. In these days of overemphasis on "scientific" knowledge, it is unsurprising that demarcation would be taken so seriously, for it represents credibility. The criteria involved are highly formalized tests of merit. But it seems that scientists use the boundaries of science to refute forms of knowledge as untenable by lack of hard or formal content. Ultimately, we have to recognize that the best story is the one which the most people accept. This doesn't always mean it is the story which is the most true, but rather the one which best fits society's need for a story at the time. For that reason, we can be certain that natural selection is at work.

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Notes:

1. When speaking of Darwin's theory, I will separate two parts: the first stating that evolution has occurred; and the second stating the mechanism of evolution as natural selection upon variations, coupled with competition for survival and the transmission of inherited variations into the offspring. I will focus my attention on the second part of the theory.

2. Hempel, C. (1966), *The Philosophy of Natural Science*. Englewood Cliffs: Prentice-Hall.

3. Popper, K. (1965), "Science: Conjectures and Refutations", in *Scientific Knowledge*, by J. Kourany (ed.). Belmont: Wadsworth, 1987.

4. 'Logical types' was Russell's term, but I read of the concept in Bateson, G. (1988), *Mind and Nature*, ch 4. New York Bantam Books.

5. 'Conventionalist twist' is Popper's term: see note 3.

6. Scriven, M. (1959), "Explanation and Prediction in Evolutionary Theory", in *Science 130*, no. 3374, pp 480.

7. If we consider a tornado wiping out half of a population, and yet wish to call this gene- frequency change an effect of natural selection, we empty the concept of meaning. Scriven makes a similar point in his article (see note 6., pp478).

8. 'Memes' is Richard Dawkins' term, from (1978), *The Selfish Gene*, ch. 11.

9. See Karl Popper's "Darwinism as a Metaphysical Research Program", in Ruse, M.(ed.) (1988), *But is it Science?* Buffalo: Prometheus Books.

10. Rifkin, J. (1984), "Darwin's Vision", from *Algeny*. Harmondsworth: Penguin

11. "but only on its own terms." When we think of tests for natural selection as the mechanism of evolutionary change, we can think of tests around selection, via Darwinian evolution. For example, Darwin's theory 'predicted' variation (Mendelian genetics) and the two came to be considered together. Certain items which must not exist in the geological strata would refute his theory. His theory also entails an old earth, and gradual, slow change. But the point which I am trying to make is that selection eludes these predictions. It cannot be tested except retrospectively as the most reasonable mechanism.

12. Dawkins, R. (1991), *The Blind Watchmaker*, ch 11.

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