Evolution and Philosophy

An Introduction

by John S. Wilkins

Evolution and philosophy have a relationship as old as the idea of evolution itself. This is partly due to the fact that science and philosophy only separated about the time evolutionary theories were being first proposed, but also because - especially in the Darwinian context - evolution was opposed to many cherished philosophical doctrines.

The first main criticisms of evolution lay in the idea that species were eternal types, and so by definition species could not change. More recently, criticisms have rested on the notion of science itself, that evolution fails to meet the standards of true science, views that also were expressed at the time of Darwin and earlier. If we are to understand these criticisms, we must understand the philosophy of science in some detail.

Many other topics of philosophical debate have been raised, and they are briefly reviewed: reductionism, progress and directionalism, teleology, naturalism, and evolutionary ethics. Not all of them are related to creationism, but all apply to antievolutionary arguments by those working from a humanities slant. Finally, the view has been put, even by philosophers like Popper who admire and accept evolutionary theory, that it is a tautology and metaphysical rather than science.

My conclusion is that evolution, especially the modern theories, is science at its best, and when it and the nature of science are considered realistically, evolution is not lacking from a philosophical perspective. This essay will deal with these philosophical questions and misunderstandings about evolution:

I apologise for the wordy and heavily-referenced nature of this essay, but the field is complex and deep, and those who would understand the issues had better be prepared for some reading. Nevertheless, I have tried to broadly summarise the main issues. The references will give those just entering the subject a starting point.

Next

Evolution and Philosophy

A Good Tautology is Hard to Find

by John S. Wilkins

***Summary**: The claim that evolutionary theory is a tautology rests on a misunderstanding of the theory. Fitness is more than just survival.*

Previous Contents Next

The simple version of the so-called 'tautology argument' is this:

> Natural selection is the survival of the fittest. The fittest are those that survive. Therefore, evolution by natural selection is a tautology (a circular definition).

The real significance of this argument is not the argument itself, but that it was taken seriously by any professional philosophers at all. 'Fitness' to Darwin meant not those that survive, but those that could be expected to survive because of their adaptations and functional efficiency, when compared to others in the population. This is not a tautology, or, if it is, then so is the Newtonian equation *F=ma* [Sober 1984, chapter 2], which is the basis for a lot of ordinary physical explanation.

The phrase 'survival of the fittest' was not even Darwin's. It was urged on him by Wallace, the codiscoverer of natural selection, who hated 'natural selection' because he thought it implied that something was doing the selecting. Darwin coined the term 'natural selection' because had made an analogy with 'artificial selection' as done by breeders, an analogy Wallace hadn't made when he developed his version of the theory. The phrase 'survival of the fittest' was originally due to Herbert Spencer some years before the *Origin* .

However, there is another, more sophisticated version, due mainly to Karl Popper [1976: sect. 37]. According to Popper, any situation where species exist is compatible with Darwinian explanation, because if those species were not adapted, they would not exist. That is, Popper says, we *define* adaptation as that which is sufficient for existence in a given environment. Therefore, since nothing is ruled out, the theory has no explanatory power, for everything is ruled in.

This is not true, as a number of critics of Popper have observed since (eg, Stamos [1996] [note 1]). Darwinian theory rules out quite a lot. It rules out the existence of inefficient organisms when more efficient organisms are about. It rules out change that is theoretically impossible (according to the laws of genetics, ontogeny, and molecular biology) to achieve in gradual and adaptive steps (see Dawkins [1996]). It rules out new species being established without ancestral species.

All of these hypotheses are more or less testable, and conform to the standards of science. The answer to this version of the argument is the same as to the simplistic version - adaptation is not just *defined* in terms of what survives. There needs to be a causal story available to make sense of adaptation (which is why mimicry in butterflies was such a focal debate in the teens and twenties). Adaptation is a functional notion, not a logical or semantic *a priori* definition, despite what Popper thought.

The current understanding of fitness is *dispositional*. That is to say, fitness is a disposition of a trait to reproduce better than competitors. It is not deterministic. If two twins are identical genetically, and therefore are equally fit, there is no guarantee that they will both survive to have equal numbers of offspring. Fitness is a statistical property. What 'owns' the fitness isn't the organism, but the genes. They will *tend* to be more often transmitted insofar as what they deliver is better 'engineered' to the needs of the organisms in the environment in which they live. And you can determine that, within limits, by 'reverse engineering' the traits to see how they work [Dennett 1995: chapter 8].

Moreover, fitness exists over and above the properties of the individual organisms themselves. There are three debated ways to construe this. Fitness can be a *relation* of genes to other genes. Fitness can be a *supervenient* property - that is, it can be a property of very different physical structures (of ants, aardvarks and artichokes) [Sober 1984]. Or fitness can be seen as an *emergent* property, a property of systems of a certain complexity and dynamics [Depew and Weber 1995]. Whether fitness is a genetic, organismic or system property is a hot topic in modern philosophy of biology. I think the system interpretation is the way to approach it [Weber and Depew 1996, Depew and Weber 1995].

Recently, there have been attacks on the very notion of adaptive explanation by some evolutionary biologists themselves (eg, Gould and Lewontin [1979]). These fall into two camps - those who think adaptation is not enough to explain diversity of form, and those who think that adaptive explanations require more information than one can obtain from either reverse engineering or the ability to generate plausible scenarios. The reason given for the former is a kind of argument from incredulity - natural selection is not thought to be a sufficient cause, and that macroevolution (evolution at or above the level of species) is a process of a different kind than selection within species. Arguments about parsimony (Ockham's Razor) abound.

Arguments for the second view - that selective explanations need supplementing - rest not on the causal efficacy of selection (which is not denied) but on the problems of historical explanation [Griffiths 1996]. In order to explain why a species exhibits *this* trait rather than *that* trait, you need to know what the null hypothesis is (otherwise you can make a selective explanation for both a case and its opposite equally well). Perhaps it has this trait because its ancestors had it and it has been maintained by selection. Perhaps it has it because it would be too disruptive of the entire genome and developmental machinery to remove it. Perhaps it has it for reasons to do with genetic drift, simple accident, or whatever. In order to make a good scientific explanation, says Griffiths, you must know a fair bit about the phylogeny of the species, its environmental distribution, and how the processes that create the trait work at the level of genes, cells and zygotes.

This leads us to the question of what a scientific explanation really is; indeed, it opens up the question of what science is, that it is so different from other intellectual pursuits like backgammon, theology or literary criticism.

Evolution and Philosophy

Is Evolution Science, and What Does 'Science' Mean?

by John S. Wilkins

***Summary**: Science is not a simple process of falsification of hypotheses. The philosophy of science is not just the views of Popper, which have some real problems. Evolution can be falsified in the usual meaning in scientific practice.*

It is often argued, by philosophers and creationists alike, that Darwinism is not falsifiable, and so is not science. This rests on the opinion that something is only science if it can be falsified, i.e., proven wrong, at least in principle. This view, which is due to Popper, is not at all universally accepted, and some history of philosophy is in order to make sense of it and the criticisms made of it.[note 1]

At the time Darwin was formulating his view of evolution, the prevailing exemplar of science was the Newtonian program. Laws were paramount, and they *determined* the outcome. Science sought generalisations. Darwin tried to make a Newtonian science, and was hurt when the leaders of the field like Whewell and Herschel, two of his acquaintances and mentors, dismissed his theory as insufficiently like their model of science.[note 2]

William Whewell was the first real philosopher of science. He was heir to the English and Scottish schools of empirical commonsense. He rejected Hume's notion that induction (proving a rule or law by reference to singular examples of data and observation) was not correct, even if he didn't deny the logical force of the argument, that you cannot prove a universalisation no matter how many pieces of evidence you have to hand. Whewell proposed what he called the 'consilience of inductions' - the more inductive cases you have based on data, the more reliable the generalisation. This is what Darwin tried to attain, and partly explains why he spent so many years gathering case after case to bolster his theory. He thought he was doing it the Right Way [Ruse 1979].

Another school of thought was *Positivism*. This view affirmed that the only true knowledge was scientific knowledge, and that only positively established proofs were scientific knowledge. This meant the positivists had to be able to distinguish between real science and the pseudosciences of phrenology, spiritualism and the other crank theories coming onto the scene during the nineteenth century. One influential positivist was the physicist Ernst Mach of Mach speed fame, and from him grew a school of thought in the German-speaking countries of Europe known as Logical Positivism, centering on Vienna. The Logical Positivists held that something is science when it can be verified, and they had all kinds of rules for that, based on Hume's dictum that whatever does not logically follow from matters of fact or number was metaphysics. This was equivalent to saying it was literally nonsense for the positivists. When it was observed that the Verification Principle was unverifiable, and so nonsense, the school fell apart.

However it spurred the young Karl Popper [note 3] to put forward his own way of telling apart science (of which the exemplar was the new physics) from pseudoscience (of which the exemplars were Marxism and Freudianism). Popper also accepted the legitimacy of metaphysical statements, but denied they were any part of science. Popper's view (a variety of logical empiricism) was called 'falsificationism', and in its mature versions held that something is scientific just so far as it

1. is *liable* to be falsified by data,
2. is tested by observation and experiment, and
3. makes predictions.

Real Scientists Make Predictions. This was the True Scientific Method. A minor quibble should be dealt with - Popper knew that the Falsification Principle could not be falsified. It was openly metaphysical. In this context, it makes sense why a pro-evolutionist like Popper called Darwinism a metaphysical research program. It was no more falsifiable (he thought) than the view that mathematics describes the world, and it was just as basic to modern biology [Popper 1974: sect 37].

The spanner in the works was first thrown by sociologists and historians of science, including Robert Merton, and later Thomas Kuhn. Kuhn's book [1962] in particular set the cat among the pigeons. If Popper thought that what he was doing was distilling the essence of science into a set of proscriptions, Kuhn and others observed that no science in fact looks like this model.

According to Kuhn, you can't even compare when one theory is better than another scientifically, for each global theory carries its own assessment methods. Change from one global theory to another is more akin to a religious conversion than a rational decision. Science only changes when the older theory can't cope with some arbitrary number of anomalies, and is in 'crisis'. When this happens, the scientific community acts like someone looking at those dual-aspect pictures like the famous old crone/young woman picture. They 'snap' from one view to another, what Kuhn called a 'paradigm shift'. Science undergoes revolutions, and the only way to determine if something is scientific is to see what scientists do (there is an obvious circularity here).

This was very popular in the relativistic late 1960s, but ran up against some serious problems. For a start, nobody could find these radical revolutions in the historical record. Even Galileo and Newton turned out to be revisionists rather than revolutionaries. Then, 'paradigm' started to be used for every new theory with impact on a discipline (which is all theories, in the end). Eventually, it became obvious that while Kuhn had made many interesting observations, there was no such universal cycle as he had proposed in the 'life' of a scientific theory. The very term 'paradigm' was attacked as being too vague [Masterman 1970], and Kuhn eventually dropped it in favour of more restricted terms like 'disciplinary matrix' and 'exemplar' [Kuhn 1970, 1972].

Kuhn's friend Paul Feyerabend [1970a, 1970b, 1975] stirred things even more by arguing that there was no such thing as the Scientific Method, either, something Kuhn held to exist in a more philosophical sense. Feyerabend argued that method was restricted to small subdisciplines, and that at any point any scientists could bring in anything from astrology to numerology if it helped. He even cheered on early recent creationism. This was the extreme end of the 'science is what scientists do' approach. Feyerabend wanted scientists to do anything they wanted, and call it science.

It was opposed by Imre Lakatos [1970], who argued that science was a historical series of research programs. So long as they were getting results, progressing from one problem to another, they were 'generating', otherwise they were 'degenerating'. According to Lakatos, a research program is a strongly protected core of theories that are relatively immune to revision, while ancillary theories are frequently revised or abandoned.

One thing all three of these philosophers thought in opposition to Popper - there was no point that could be ruled off as the dividing line between 'rational' science and 'non-rational' non-science. Lakatos identified what he called the Duhem-Quine Thesis - nothing can be falsified if you want to make suitable adjustments elsewhere in your theoretical commitments. Get a result that upsets your favoured theory of gravitation? Then the instrument's in error, or something is interfering with the observations, or there's another process you didn't know about, or some other background theory is wrong. And the point of this is that all these moves are actually used - they are *rational* in the sense of good scientific practice. Positivism is irretrievably dead by this stage.

So, what *is* the difference between science and non-science? There are several mutually compatible alternatives on the board. *Pragmatism*, the only philosophy to have originated in North America, holds that the truth or value of a statement like a theory or hypothesis lies in its practical outcomes. Pragmatists say that being scientific is a retroactive label given to what survives testing and makes a real practical difference, like a theory about a cancer affecting how that cancer is treated, more successfully. Progress in science is the accumulation of theories that work out [Laudan 1977].

Realists continue to say that what makes something scientific is its modelling reality successfully, and this has given rise to what is known as the Semantic Conception of Theories [Suppe 1977, 1989, see Ereshevksy 1991 for criticisms of this approach]. On this account, what science does is create effective *models*, and if a model meets Lakatos's criteria for a generating research program, those models are presumed to be adequate and true. And there is a sociological strain. This is divergent, but is either fully relativistic (science is just something that scientists construct for some social reasons of their own), or more pragmatist and realistic, and shares a strong commitment to the importance and uniqueness of science (eg, Hull [1988]).

Back to evolution. It becomes clear why the simple-minded parroting, even by scientists, that if it can't be falsified it isn't science, is not sufficient to rule out a theory. What science actually is, is a matter for extreme debate. The rediscovery post-Merton of the social nature of science has thrown eternal Scientific Methods out the window, but that doesn't mean that science is no longer distinguishable from non-science. It just isn't as easy as one would like in an ideal world. Last I looked, it wasn't an ideal world, anyway.

However, on the *ordinary* understanding of falsification, Darwinian evolution can be falsified. What's more, it can be verified in a non-deductive sort of way. Whewell was right in the sense that you can show the relative validity of a theory if it pans out enough, and Popper had a similar notion, called 'verisimilitude'. What scientists do, or even what they say they do, is in the end very little affected by *a priori* philosophical prescriptions. Darwin was right to take the approach he did.

It is significant that, although it is often claimed that Darwinism is unfalsifiable, many of the things Darwin said have in fact been falsified. Many of his assertions of fact have been revised or denied, many of his mechanisms rejected or modified even by his strongest supporters (e.g., by Mayr, Gould, Lewontin, and

Dawkins), and he would find it hard to recognise some versions of modern selection theory as his natural selection theory. This is exactly what a student of the history of science would expect. Science moves on, and if a theory doesn't, that is strong *prima facie* evidence it actually is a metaphysical belief. [note 4]

A final quote from Hull [1988: 7] is instructive:

> Yet another ambiguity constantly crops up in our discussions of scientific theories. Are they hypotheses or facts? Can they be "proved"? Do scientists have the right to say that they "know" anything? While interviewing the scientists engaged in the controversies under investigation, I asked, "Do you think that science is provisional, that scientists have to be willing to reexamine any view that they hold if necessary?" All the scientists whom I interviewed responded affirmatively. Later, I asked, "Could evolutionary theory be false?" To this question I received three different answers. Most responded quite promptly that, no, it could not be false. Several opponents of the consensus then current responded that not only could it be false but also it was false. A very few smiled and asked me to clarify my question. "Yes, any scientific theory *could* be false in the abstract, but given the current state of knowledge, the basic axioms of evolutionary theory are likely to continue to stand up to investigation."
>
> Philosophers tend to object to such conceptual plasticity. So do scientists -- when this plasticity works against them. Otherwise, they do not mind it at all. In fact, they get irritated when some pedant points it out.

Most scientists are not philosophically inclined and will make use of whatever is a help in their work, but not in the way Feyerabend thought. Reflective scientists know that it's all how you *ask* the question that counts. Most physicists would not immediately think that atomic theory could be false, either. They are answering the question "is it likely to be dropped later on?" not the philosophical "could it in theory be dropped?" which is a different issue. Philosophers do conceptual tidying up, among other things, but scientists are the ones making all the sawdust in the workshop, and they need not be so tidy. And no cleaner should tell any professional (other than cleaners) how it ought to be done. Creationists who say, "evolution is not like what Popper said science should be, so it isn't science" are like the janitor who says that teachers don't keep their classrooms clean enough, so they aren't teachers.

Evolution and Philosophy

Predictions and Explanations

by John S. Wilkins

Evolution is sometimes criticised for not being a predictive science, and for not having natural laws. This relates to the issue of whether science should be like physics (see the section on the nature of science), but the two issues raise a more general matter.

It goes to the question whether explanations have to make use of natural laws, and just what are explanations anyway?

One theory about explanation is called the *nomological deductive* (ND) theory, or less pretentiously, the *hypothetical deductive* theory. Due to philosophers Karl Popper and GC Hempel [cf Dray 1966, especially the essay by A Donagan], it has the form:

Premises

Universal Law

Thing to be explained

The idea is that if the thing to be explained is a logical, deductive, consequence of the premises and the universal laws, then you have explained it. Once you have a theory of this form, then you can predict that a phenomenon will occur if the initial conditions are right, based on the universal laws of physics, chemistry, etc:

Initial Condition

Universal Law

Observed phenomenon

There is a version that uses statistical assumptions and permits inductive argument rather than restricting explanation to deductive argument, called the *statistical inductive model* (SI), but we can safely ignore it here.

The prediction is a deductive consequence of a true theory and proper measurements. Since evolution cannot make predictions of this kind, and in fact any outcome is compatible with the theory, its critics say that evolution is not a complete science (see the section on the tautology of fitness).

However, there are problems with this highly idealised view of scientific explanation, and anyway, I will argue it doesn't affect evolution.

Any set of laws are ideal simplifications. In order to predict where a planet is going to be in 10,000 years, you have to ignore may things, such as the very small bodies, the influence of distant stars and galaxies, friction due to solar wind, and so forth. And it works, to a degree. But that degree is still real. You may only be off a few meters, but you will be off, due to these ignored complications. Physical systems of this kind are *stable*, in that the initial conditions do not greatly affect the outcome.

Evolution is not like these systems. It is highly sensitive to the initial conditions and the boundary conditions that arise during the course of evolution. You cannot predict with any reasonable degree of accuracy what mutations will arise, which genotypes will recombine, and what other events will perturb the way species develop over time. Moreover, the so-called 'laws' of genetics and other biological rules are not laws. They are exceptional. Literally. For every law, right down to the so-called 'central dogma' of molecular genetics, there is at least one exception.

And yet, we know the properties of many biological processes and systems well enough to predict what they will do *in the absence of any other influences*. This is proven in the lab daily. So, in this way, we have in biology the extreme end of the continuum of what we have in physics at the other end. The difference is one of degree, not kind. And more and more, physicists are uncovering systems that are similarly unstable and sensitive. You cannot predict in physics what any small number of molecules will do in a flame, or in a large gas volume, for example. And while the weather cannot be predicted at all in fine detail for very long, you can explain last week's weather through the initial conditions and the laws of thermodynamics, etc, *after* it has happened.

If you take the standard form of biological explanation, it has the same structure as a physical explanation. It just differs in two ways. First, you cannot isolate 'extraneous' influences ahead of time for wild populations. Second, you cannot make a prediction much beyond the immediate short term (hence, nobody can predict the future of evolution of a species). Although a number of experiments have been conducted to test selectionist hypotheses through prediction, such as the studies on finches in the Galápagos Islands by the Grants, mostly, explanations in evolution take the following format:

Initial Conditions at t-n

Properties of biological systems

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Observed phenomenon at t

In other words, they are *retrodictions*, not predictions. The only formal difference between this and the same form in physics is that the tense is different. This use of the nomological-deductive model in historical cases is called a *covering law* model [Dray 1957, 1966].

So, physics is not really a different kind of science to evolutionary biology, except in some matters of convenience with experimentation, and the degree of the stability of the systems it sometimes explains, and not always then.

Covering law explanations can be used to retrodict the initial conditions, under certain circumstances. If you know what is now in evidence, and you have laws that generate these outcomes, you can sometimes predict what *will* be found:

Predicted initial conditions

Universal Laws

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Observed phenomena

For example - you know that certain features of ants are derived (not in the primitive ancestor). You have general laws of evolution that account for the phenomena you observe (actual ants today, and in the fossil record). So, you predict that a certain transitional form will be found. When it is, you have made a bona fide prediction.

What special conditions can this be done under? Well, for a start, if you have a deductive argument if A then B, you cannot immediately infer from the existence or truth of B, that A. It might have been something else. B might have a virtual infinity of possible causes. Before you can make a retrodiction like this, you have to narrow down the field. That is, you have to assume the validity of some theoretical models before you can make the retrodiction/prediction. On the other hand, if you make such a claim, and it pans out, you have certainly strengthened your model.

Finally, note that the ND model is not sophisticated enough to capture everything important about scientific explanations. A good many scientific explanations rest not on laws but *propensities*, that is, likelihood to behave in a certain way. And many perfectly useful accepted scientific explanations are not *deductive*, they are *inductive*. That is, the likely outcome of the initial conditions and the laws is not a rigourous deduction but an induction with all the problems that brings. Still, that's what science does, whether philosophers like it or not (cf Franklin 1997).

Evolution and Philosophy

Why are natural kinds supposed to stay fixed?

by John S. Wilkins

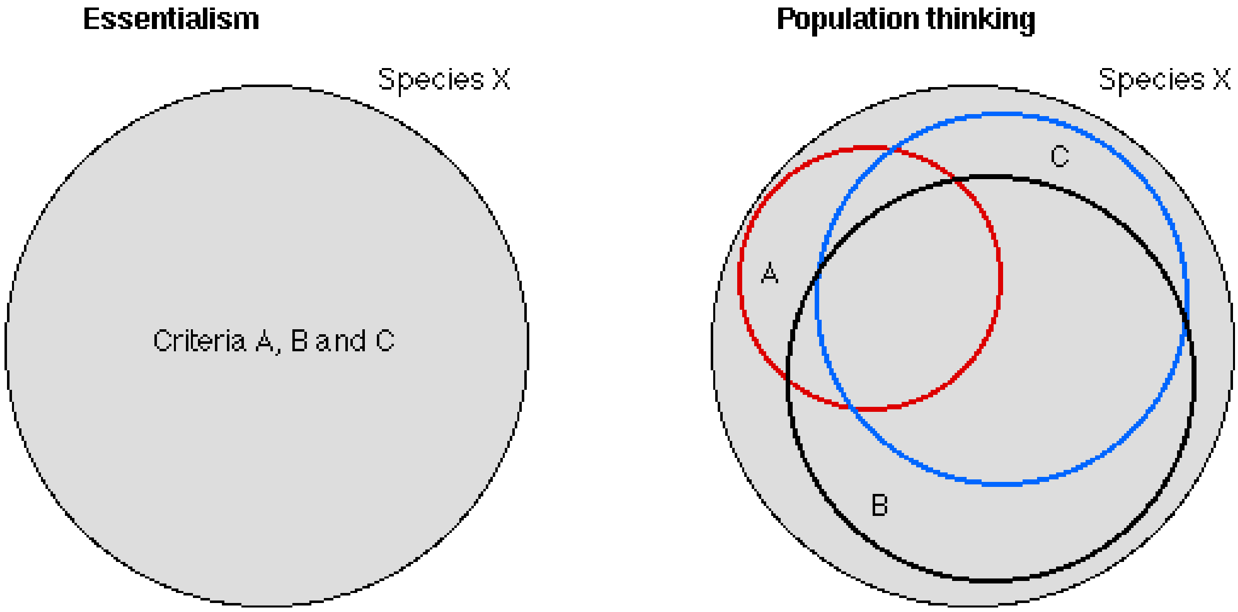
Summary: *Species are not eternal types, even though they are natural kinds.*

Before Lamarck, species were thought to be eternal kinds, and any single organism to have all the necessary and sufficient conditions of being a member of that species. Think of it like this: To be a member of the supporters of a football team, you must have certain characteristics. For argument's sake, suppose they are:

1. paid up membership in the fan club,
2. a personal interest bordering on the obsessive in the fortunes of your team, and
3. ownership of certain items of team identity (caps, flags or books).

Anyone who has one, or even two, of these criteria filled may still not be a supporter. You might get your membership from a corporate sponsorship deal in which you have no interest. You might be obsessively fixated due to a pyschological disorder. You might collect things in the hope they become valuable. Each condition is *necessary* , but only all conditions are *sufficient* for you to qualify. An organism was thought to need identifying characters - all of them - in order to be a member of the species. And these conditions never changed. 'Football supporter' was an idea that would remain the same even if nobody filled the conditions, or even played football. If something was a species, it *could* not change, and if it changed, it could not *be* a species.[note 5]

Figure: The difference between essentialist and populational notions of species. Not all members of a species may have all the diagnostic traits that tells it apart from similar species. Species which all share all the same diagnostic traits (like Species X) are called 'monotypic' species and are rare. Species usually share only some diagnostic traits among all members (Species Y, a 'polytypic' species).



This is the kind of view expressed implicitly when a creationist says that such and such a change represents "devolution": a movement away from "pure type". The great evolutionary theorist Ernst Mayr has, following the philosopher Karl Popper, called this "typological essentialism", the opinion that species have essences in some Aristotelian fashion [Mayr 1988]. While the "kinds" mentioned in the Bible (*Genesis* 1:21-23) are merely observations that progeny resemble parents, that is, that some principle of heredity is active in reproduction, Aristotle held rather that living things are generated in an approximation to a "form" of that species. There is something that represents the perfect dog, for example. [note 6] This view found its way into Christian theology through the rediscovery of Aristotle from the Islamic tradition in the middle ages, primarily through Thomas Aquinas, and was enshrined in biology by Carl von Linne in the 18th century in what is now called the Linnean system of classification.

After the work of the mid-nineteenth century explorers and naturalists, scientists were no longer able to view species in this way. They were much more diverse than that. Not only were species sometimes more different internally than some members were to other species, but it became clear that what was actually common between members of a species was the ability to interbreed (at least, in sexual species).

Actually, this view (now called the *biological species concept*) predated evolution by some fifty years, deriving from Buffon, who attacked the Linnean system. It meant that seeing species as *morphological* kinds (that is, as groups of characters of organisms) was no longer scientifically possible. Some, including Darwin, thought on occasions that this meant that species were conventional names given to record observations, but nothing more, and that 'species' were artificial constructions. Others held to the older view that there was something in virtue of which things were members of a species, but that this had nothing to do with their morphology, but with their relations of descent. Of course, if this is all that makes an organism a member of a species, and the variation that is observed is real, then there is nothing in being a species that can prevent a species - or at any rate a part of a species - becoming something different and new. Nothing else makes scientific sense.

In this century, the systematist Ernst Mayr (eg, [1970]) has championed the view that what he calls 'typological thinking' has been abandoned by modern biologists in favour of what he calls 'population thinking'. Typology is the view that there are 'types' - unchanging forms that are what makes a species what it is. It derives from the philosophy of Plato, who claimed that true knowledge is knowledge of the Idea (Greek *eidos*). Population thinking is a recent development in Western thought - it is the view that aggregates of individuals, groups, have a profile that shows a distribution of characteristics. The well-known 'bell curve' of statistics illustrates this - for almost any trait of a population you will find a bell curve distribution. Some organisms will be longer or shorter, heavier or lighter, and there will be a mean around which most individuals cluster. Variation is a universal fact about all species. Some parts are located in different environments, and natural selection, genetic drift and happenstance all work to make them different if they are isolated for long enough. Thus are new species created.

Enter Michael Ghiselin [1975] and David Hull [1976, 1988]: a biologist and philosopher respectively. They proposed that species are *not* universal types, or classes, but are historical individuals (which is what 'species' *meant* to Aristotle anyway). The name of a species, according to Ghiselin and Hull, is a proper noun, the name of a single and unique individual that has a beginning, a history, and an extinction, and which also has a distribution in space. *Homo sapiens* is not, on this view, the name of a 'type' of rational animal as Aristotle had it, but the name of a particular lineage of hominoids that happened to develop language and ratiocination. If all humans were extinguished next year, they could never arise again. This view is also hotly debated by philosophers and biologists (cf Gayon [1996]). Mayr [1970] for example thinks that some taxa (eg, families or even orders) are 'grades' which can be arrived at more than once, which the individuality thesis rules out.

This is related to the complex and difficult area of the taxonomic methods collectively called *cladistics* (from the Greek word *klados* , meaning branch). Cladistics attempts to 'reconstruct the past' [Sober 1988] - recreate phylogeny - using as few theoretical assumptions as possible, on the basis of the present distributions of organismic traits [Panchen 1992]. This deserves an essay on its own, but not by me.

Whatever the triumphant view in philosophy, evolutionary notions of species do preclude eternal types, in favour of what the philosophers Hilary Putnam [1975] and Saul Kripke [1972], following the great American philosopher WVO Quine [1969], call 'natural kinds' - things that exist naturally at certain times and places. Like Hobbes's example of the ship of Theseus, which over the course of a voyage was completely rebuilt, species can be changed so much that they are not the same individuals they once were, but this change can happen imperceptibly (at varying rates), as Darwin expected it would. Species are biological entities that change.

Evolution and Philosophy

Reductionism and Evolution

by John S. Wilkins

Summary*: Biology cannot be reduced to physics, even though all biological entities are physical entities, and nothing more. Group selection is not an accepted evolutionary theory, but group sorting is.*

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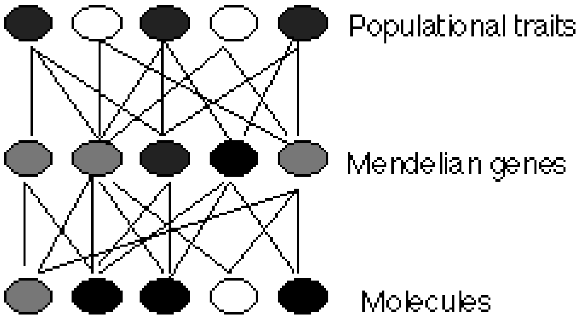
Previous Contents Next

The philosophy of science, and criticisms of evolutionary theory in particular, has been driven by the view that physics, or perhaps mathematics, is the very model of a modern scientific discipline. If it ain't like physics in some way, then it ain't science.

Unsurprisingly, many biologists weren't happy with this view of what they do as some kind of 'stamp collecting' [note 7]. Ernst Mayr [1970, 1982] attacked this philosophical presumption, especially the idea that biology is just a form of physics, or perhaps chemistry. Philosophers, too, started to make similar attacks [Hull 1974, see Sterelny 1995 for a review].

The view of science of philosophy in the early 60s was generally reductionist [Nagel 1961]. This meant that in principle the objects and processes of one level of science were made out of the objects of the next level down, ending with subatomic physics. Thus, biology reduced to chemistry, and chemistry reduced to physics. This sort of reduction is called *ontological reduction*. Those who accept this form of reductionism are called 'physicalists'.

Another type of reduction - often confused with the ontological - is *explanatory* or *epistemic reduction*. This is the view that the properties of one level must be ideally explained as the effects of processes at the next level down. This is roundly denied by many philosophers and biologists, and asserted by many others [eg, Dennett 1995]. Hull [1974] argued that it is in principle impossible to reduce, for instance, population genetics to Mendelian genetics, and Mendelian genetics to molecular genetics, because each level is the result of many entities interacting at the lower level, and many entities at the higher level result from a single entity at the lower level:



Hull's problem is sometimes called the *Problem of the Many to Many*, in homage to an old philosophical problem, the *Problem of the One and the Many*. Many Mendelian genes are made from many DNA molecules, and many populational traits are coded for by many Mendelian genes. Simple reduction will not work. What Williams [1966] called an 'evolutionary gene' is just a unit of heredity that is 'visible' to selection, and it could be an entity at any level - a molecule, a Mendelian gene or even a populational trait.

Reduction enters the evolutionary debate in the form of the issue of *group selection*. In 1962, Wynne-Edwards proposed that some bird populations regulate their clutch size (the number of eggs laid) in hard times to benefit the population as a whole, even though it was detrimental to the 'Darwinian fitness' of the individual birds. Williams [1966] responded with an argument that selection of individuals could not account for this and other forms of supposed group selection, and that if group selection occurred at all, it was not very important.[note 8] A decade later, Dawkins [1976] hardened this view into the claim that genes, and genes alone, are the 'units of selection', and that all biological effects in evolution are the result of these 'lower-level' entities.

Gene-centrism is not the view that only genes exist, or even that only genes have effects, but that only genes are selected (that is, are evolutionarily important). The way Dawkins put it, as evidenced by the title *The Selfish Gene*, was wrongly interpreted to mean that organisms are irrelevant. More informed analysis developed the view that if evolution-by-selection is generalised, then using Dawkins's own distinction between replicators and vehicles (or Hull's refinement, interactors), then selection can occur at levels above the gene, or even above the organism.

This puts the lie to simplistic notions that evolution is *defined* as a change in allele frequencies. That is what has been called by Wimsatt the 'bookkeeping' definition of evolution, and it is true as far as it goes, but it is not all that is interesting about evolution. Few biologists are still simple reductionists, although Williams did write a limited defence of reductionism as a methodological ploy [1985], in which he argued that reduction was the 'null hypothesis' and it was onerous to abandon it. Dennett [1995] claimed that reduction had yet to fail, especially in evolutionary explanations using selection.

If evolutionary levels above the gene can be selected, are they adapted? Several have followed Wynne-Edwards on this. Recent versions, though, have moved from the notion that groups are *selected*, though, in favour of the view that they are *sorted*, because selection requires that the entity in question replicates, and does so differentially relative to other contenders. This is OK for genes, and arguably for organisms, but species? Even phyla? Groups do not reproduce, they split. Recent work by Gould, Eldredge and Vrba [refs in Sterelny 1995] amends this from species *selection* to species *sorting*, what Vrba calls the 'effect hypothesis'. This is a view that now has wide acceptance amongst biologists, including Williams [1992]. Groups are thought to survive extinction events differentially, based on adaptations of their component organisms, so the organisms are adapted, not the groups.

Evolution and Philosophy

Is There Progress and Direction in Evolution?

by John S. Wilkins

Summary: *Evolution has no goal, but there are directional trends of a lesser kind. Teleological explanations are more complex than one might think.*

- Previous - Contents - Next

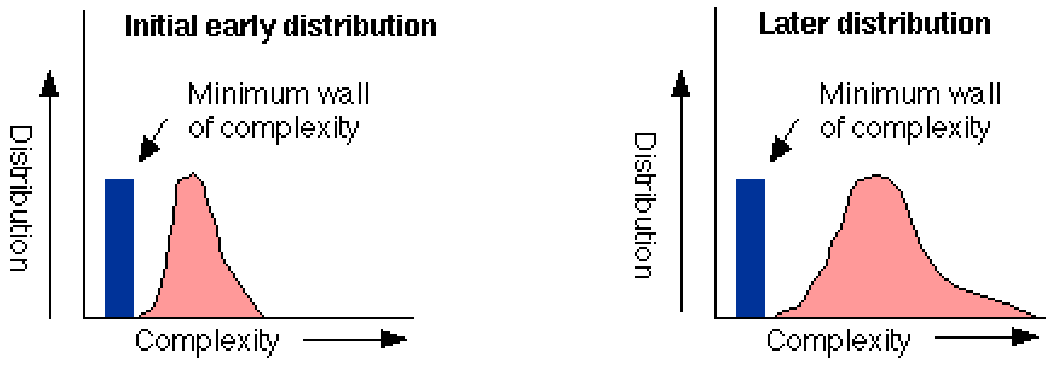
One of the more common misconceptions, with a history long before Darwin, is that evolution is progressive; that things get more complex and perfect in some way. In fact, this view is attributed more to social and religious attitudes of 18th and 19th century European culture than to any evidence. It was a given that things are getting better and better, every way, every day. This persisted until long after Darwinism, until the middle of this century (e.g., Teilhard de Chardin). Even Darwin was ambiguous about it, talking on occasion about 'perfection' as a result of selection.

At the time of the 'modern synthesis' [note 9] in the 1940s, the notion of progress was quietly dropped, with a few exceptions like Dobzhansky and Huxley within the synthesis, and Schindewolf and Goldschmidt outside it. Of course, heterodox writers (usually not biologists) like Teilhard and Koestler remained progressionists long after this. But by the 1970s, progress had been abandoned by working biologists.

Recently, the issue has resurfaced, shorn of the mysticism of earlier debates. Biologist J.T. Bonner argued that there was a rise in complexity of organisms over the long term [1988], and others were arguing for a form of local progress under the terms 'arms race' [Dawkins and Krebs 1979] and 'escalation' [Vermeij 1987]. Gould [1989] felt so strongly about it he was moved to deny that, at least since the Cambrian explosion, there has been any progress at all.

Much of the modern debate centres on what counts as 'progress'. Gould [1996] thinks that the apparent trend to complexity is just a matter of random evolution that started at a minimal 'wall' of complexity:

Apparent progress due to a 'wall' restricting
where random change can take things.
Adapted from Gould 1996.



Others [cf Nitecki 1988] claim that there is only progress because any increase over zero is a net increase, and that different measures will give different results. The traditional notion of progress as an increase in perfection or optimality has been abandoned, for it rested on a view that goes back to the late neo-Platonists - the idea that all of reality is arranged in a heirarchy of increasing perfection. This is called the *scala naturae*, and is often referred to the Ladder of Perfection. Modern evolutionary science does not think that the path of evolution is a ladder, although Lamarck did. The current view is best summed up by a phrase of Gould's - evolution is a bush, not a tree.

The idea of progress itself was a late medieval notion, taken from the secularisation of theology, especially from the doctrines called 'eschatology' (literally, the 'study of the Last Things') [Ruse 1997]. The 'discovery' of history led to the realisation that biological organisms are historical entities. The view that history was progressive led to the notion that so was the history of life, especially since it led to Man.[note 10] In the nineteenth century, progressivism was rampant, and curiously it always seemed that the ultimate stage was that of the writer, whether it was Marx for the (European) working class, Spencer for the (mostly English) British, or Wagner for the (mostly Prussian) Germans. The first world war came as quite a shock to many, and progress gradually lost its appeal.

Biological systems are historical in two ways: they are the result of irreversible processes (i.e., they grow and die), and they are contingent. the second point is important if you are thinking about what is science in biology. You can't often repeat an event in biology like speciation (some hybrids can be reformed repeatedly in the lab) and get the same results. What's more, the view called *teleology* has been dropped by biologists: explanations of what something is *for* don't say that they are there *in order to* achieve an end result. It is enough that they are the result of selection.

Or is it? Teleology, too, is making a minor comeback. In science, teleology is a way of modelling a system's behaviour by referring to its end-state, or goal. It is an answer to a question about function and purpose. Why do vertebrates have hearts? In order to pump blood around the body to distribute oxygen and nutrients, etc. This is a *functional* explanation. The function of hearts is to pump blood. In evolution, the question 'why do organisms exhibit adaptation?' is not answered teleologically with 'in order to survive', but historically - 'because those that were less adaptive didn't survive'. However, some forms of teleology are still used, on the understanding that they reduce to historical explanations.

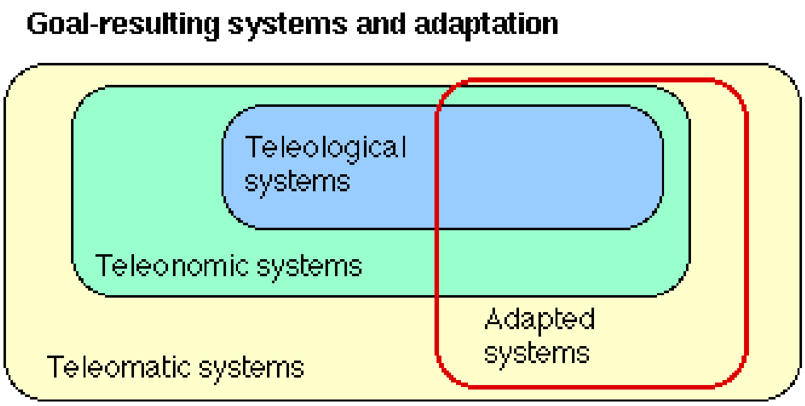
It may help to think of a social analogy. We can explain the behaviour of a stock broker teleologically, for a stock broker seeks a goal (the best profit). We cannot explain the behaviour of a stock *market*, for stock markets have no goals, just outcomes. When Dawkins talks about genes maximising their representation in the gene pool, this is a metaphor not an explanation. Genes just replicate. It happens that those that out-replicate others end up out-surviving them. There is no 'goal' to genetic behaviour.

There are two forms of teleological explanation (Lennox 1992). *External* teleological explanation derives from Plato - a goal is imposed by an agent, a mind, which has intentions and purpose. *Internal* teleological explanation derives from Aristotle, and is a functional notion. Aristotle divided causes up into four kinds - *material* (the stuff of which a thing is made), *formal* (its form or structure), *efficient* (the powers of the causes to achieve the things they achieve) and *final* (the purpose or end for which a thing exists). Internal teleology is really a kind of causal explanation in terms of the *value* of the thing being explained. This sort of teleology doesn't impact on explanations in terms of efficient causes. You can, according to Aristotle, use both.

Evolutionary explanations are most nearly like Aristotle's formal and efficient causes. Any functional explanation begs the further question - what is the reason why that function is important to that organism? - and that begs the even further question - why should that organism exist at all? The answers to these questions depend on the history of the lineage leading to the organism.

External teleology is dead in biology, but there is a further important distinction to be made. Mayr [1982: 47-51] distinguished four kinds of explanations that are sometimes called teleology: *telenomic* (goal-seeking, Aristotle's final causes, 'for-the-sake-of-which' explanations); *teleomatic* (lawlike behaviour that is not goal-seeking); *adapted systems* (which are not goal seeking at all, but exist just because they survived); and *cosmic teleology* (end-directed systems) [cf O'Grady and Brooks 1988]. Only systems that are actively directed by a goal are truly teleological. Most are just teleomatic, and some (e.g., genetic programs) are teleonomic (internal teleology), because they seek an end.

How the four forms of apparent teleology relate.



Many criticisms of Darwinism rest on a misunderstanding of the nature of teleology. Systems of biology that are end-seeking are thought to be end-directed, something that Darwinism makes no use of in its models. Outside biology - indeed, outside science - you can use external teleology all you like, but it does not work as an explanation of any phenomena other than those that are in fact the outcomes of agents like stock brokers. And even there, teleology is not always useful, for which stock brokers (or cabal of stockbrokers) desired the goal of the 1987 crash, or the 1930 depression? External teleology is useless in science, and any science that attempts to be teleological will shortly become mysticism.

Evolution and Philosophy

Naturalism: Is it necessary?

by John S. Wilkins

Summary: *Science must assume that everything can be investigated empirically, but this doesn't force the abandonment of the supernatural, for those who want it.*

In philosophy, 'naturalism' is the view that an explanation is justified just so far as it rests on evidence of an empirical kind. It has been very active in the philosophy of mind and moral philosophy, and recently as a tool for the 'conceptual hegemony' of science in opposition to the views of some sociologists and historians of science who would relativise worldviews [Rosenberg 1994]. In the creationist-evolution debate, it tends to mean something else - the view that explanations must not take into account the supernatural or spiritual. These two senses overlap to a degree (because evidence of the supernatural is not empirical, but revelatory).

Notice, though, that the second sense is a view about what exists, while the former is a view about what can be known in science. If there is a spiritual realm which is not open to observation, then science cannot use it in explanation, for science is about explaining things that *are* observed.

If science cannot be used to explain things in terms of what it cannot see and test, this doesn't rule out other disciplines using non-natural explanations (like theology). It just means that science cannot use it as it undercuts the very notion of science. There are two ways science cannot be non-naturalistic. It cannot make the assumption that phenomena are themselves non-natural - it has to assume that everything observed is amenable to a naturalistic investigation. Call this *methodological* naturalism.

Science must also avoid non-natural explanations. This is *explanatory* naturalism. Any explanation that uses a non-natural explanans (thing doing the explaining) fails to be testable. I could propose that some process is the result of an Invisible Pink Unicorn's powers. You can neither falsify nor verify this (in the ordinary senses). The hallmark of science, perhaps the only hallmark, is that explanations are testable. The reason for this lies in what philosophy calls *epistemology* (from the Greek word for belief, *epistemé*, but used in the sense of knowledge - hence, 'the study of knowing').

Epistemologies from Plato to Kant were infalliblistic - a belief was not knowledge if there was any chance it was mistaken. Science, on the other hand, is often wrong, and is constantly revised. Nevertheless, what science delivers is by far the most successful form of knowledge gathering humans have ever developed. The epistemology demanded by science is therefore a falliblistic view of knowing. The basis for this lies in testing. A scientific explanation must be open to any competent investigator to test and evaluate. Revelatory experiences are not universally open to all, and intuitions about the universe are wildly different for different people and cultures, so non-naturalistic explanations are ruled out of the domain of science.

A useful way to approach this is to ask what a non-naturalistic explanation would look like. Explanations are equations, of a kind. You explain X by saying it is a Y (and a Z, etc). If a non-natural explanation is to work, it has to put something that is neither empty nor circular on the other side of the equation. What counts as a non-natural explanans? 'Something is non-natural if it isn't natural' is entirely empty until we know how to distinguish between the two.

The usual way to define non-natural is that it is not explicable in terms of natural laws; that is, it breaks the causal chain. If we abandon the methodological assumption of naturalism - that everything is open to empirical investigation - we can say that anything not presently explained by scientific laws is non-natural, but that's not what is meant. We can distinguish between our present ignorance and something that's in-principle not scientifically explicable, surely. We want something that is completely outside the course of physical events [some proponents of the term 'supernatural' use it to mean 'uncaused' - what *that* actually means is really unclear].

But if we had it, could we incorporate it into a scientific explanation? We could obviously not use empirical observations - they depend on the ordinary course of physical processes. So what else is there? The answer is, nothing. Non-natural explanations are not scientific.

A final form of naturalism is *ontological* naturalism. This is the opinion that all that exists (Classical Greek: *on-* , root form of 'to be', from which 'ontology' is derived, hence, 'the study of that which exists') is natural. Many scientists are also physicalists. They argue that if we do not need to postulate the reality of non-physical processes for science, then we can conclude that there are no such things. This argument is too quick. The claim that 'if A then B' explains B may be true, but there may also be a C that explains B. Moreover, many things in the physical world are caused by many things together rather than just a few. So, we might say that a physical event is caused both by God *and* by the physical causes, without being logically inconsistent.

Your resolution depends on what you are using as basic assumptions. In science, Ockham's Razor ('do not unnecessarily multiply entities in explanation') - also known as parsimony [cf. Sober 1988] - is used to trim as much away as possible in order to achieve the leanest explanation. Extending this outside science is a risky proposition, unless you are willing to make the methodological assumption also work on metaphysics as well as physics. Many are (including myself), but it is not a *necessary* conclusion from any form of science.

In the philosophical doctrine known as moral naturalism, moral systems are explained in terms of the social or biological properties of humans. This is often a Darwinian approach. The point I want to make is that not only *explaining* but *proposing* a moral system in this way commits what GE Moore famously called the "Naturalistic Fallacy". You can give a naturalistic explanation of morals without either justifying *or* invalidating those moral principles. Explanation and justification are two different activities. So, too, with ontology. You can accept the methodological assumption of naturalism in science without invalidating non-naturalistic ontologies. They just aren't scientific. In my view, ontologies outside science are a matter of personal choice. And as Cicero once said, in matters of taste there is no dispute. In science, there is (legitimate) dispute. Therefore, science is more than a matter of taste.

Evolution and Philosophy

Does evolution make might right?

by John S. Wilkins

***Summary**: Evolution does not have moral consequences, and does not make cosmic purpose impossible.*

- Previous - Contents - Next

A number of critics see the use of selection theory in other than biological contexts as forcing malign political and moral commitments. A prime example of this is sociobiology, which is supposed to result in such things as eugenics, racism, and the death of the welfare state. Sociobiology, and the more recent evolutionary psychology movement, seeks to explain human behaviour in terms of the adaptations of human evolution. Gould especially has been vitriolic in his attacks on sociobiological explanations. It is thought by some to result in a completely selfish ethic known as rational egoism.

Another such view is "Social Darwinism", which holds that social policy should allow the weak and unfit to fail and die, and that this is not only good policy but morally right. The only real connection between Darwinism and Social Darwinism is the name. The real source of Social Darwinism is Herbert Spencer and the tradition going back to Hobbes via Malthus, not Darwin's own writings, though Darwin gained some inspiration on the effects of population growth from Malthus.

The claims made by Social Darwinists and their heirs suffer from the ethical fallacy known as "the naturalistic fallacy" (no connection to naturalism in explanations and the study of knowledge mentioned above). This is the inference from what may be the case to the conclusion that it is therefore right. However, while it is certainly true that, for example, some families are prone to suffer diabetes, as mine is, there is no licence to conclude that they should not be treated, any more than the *fact* that a child has a broken arm from a bicycle accident implies that the child *should* have a broken arm. David Hume long ago showed that "is" does not imply "ought".

In fact, diverse political and religious opinions characterise social musings based upon evolutionary biology. For example, the 19th century Russian anarchist aristocrat Pyotr Kropotkin wrote a book called *Mutual Aid* [1902, cf Gould 1992] in which he argued that evolution results more in cooperation than it does in harsh competition. His views are echoed in recent use of games theory to show that, in some cases at least, cooperation is a stable strategy for certain populations to adopt [Axelrod 1984].

Evolutionary theory doesn't exclude Purpose from Life, although it does remove the need for purposive design from a lot of the living realm (ie, all but the genetically engineered bit of the living realm). This apparent confusion is resolved if we ask of evolutionary theory two questions: one, is there a design evident in the structure of living organisms? Two, is there a universal purpose to life in general? Science answers No to the first question. Design is not directly evident in living things, although there is a marvellous complexity and adaptivity of life to its environment. To the second question, science of any kind answers: Insufficient Information. *That* kind of answer you get elsewhere - from a personal commitment or religious belief in some revelation.

- Previous - Contents - Next

Evolution and Philosophy

Is evolution just another religion?

by John S. Wilkins

Summary: *Evolutionary theory is a scientific theory dealing with scientific data, not a system of metaphysical beliefs or a religion. It does, however, set the sorts of general problems biology deals with, and also acts as a philosophical attitude in dealing with complex change.*

Previous Contents Next

Some claim that evolution is a metaphysic equivalent to a religion. To attack evolution, these critics feel the need to present it not as just a scientific theory, but as a world view that competes with the world views of the objectors. For example:

> "When we discuss creation/evolution, we are talking about beliefs: i.e. religion. The controversy is not religion versus science, it is religion versus religion, and the science of one religion versus the science of another." [Ham, K: 1983. The relevance of creation. Casebook II, *Ex Nihilo* 6(2):2, cited in Selkirk and Burrows 1987:3]

> "It is crucial for creationists that they convince their audience that evolution is not scientific, because both sides agree that creationism is not." [Miller 1982: 4, cited in Selkirk and Burrows 1987: 103]

Metaphysics is the name given to a branch of philosophical thought that deals with issues of the fundamental nature of reality and what is beyond experience. It literally means "after the physics", so-named because Aristotle's book on the subject followed his Physics, which dealing with the nature of the ordinary world, which in Classical Greek is *physike* . It is defined in the 1994 *Webster's Dictionary* (Brittanica CD edition) as

> "a division of philosophy that is concerned with the fundamental nature of reality and being and that includes ontology, cosmology, and often epistemology: ontology: abstract philosophical studies: a study of what is outside objective experience".

Metaphysical systems come in three main flavors: *philosophical systems* (overall systems such as Kant's or Hegel's, or more recently Whitehead's or Collingwood's); *ideologies* , which are usually political, moral or other practical philosophical systems; and *religions* which in their theologies attempt to create comprehensive philosophical structures.

A metaphysic is often derived from first principles by logical analysis. Aristotle, for example, started with an analysis of "being" and "becoming" (ie, what is and how it changes); Kant, with an analysis of knowledge of the external world; Hegel, from an analysis of historical change. Religious metaphysics often attempt to marry a philosophical system with basic theses about the nature and purpose of God, derived from an authoritative scripture or revelation.

In some traditions, metaphysics is seen to be a Bad Thing, especially in those views sometimes called "modernisms". The great 18th century Scottish philosopher Hume once wrote that any book not containing reasoning by number or matters of fact was mere sophistry and should be consigned to the flames (he exempted his own philosophical writings, apparently). This distaste stems from the excesses of the medieval Scholastics, whose often empty formalism was applied to Aquinas' theology based on Aristotle's metaphysics. Early science arose in part from the rejection of this vapid quibbling.

No-one can deny that views such as Luther's and Marx's rely upon metaphysical assumptions and methods. If views like these come into conflict with science, then there are four options: change the science to suit the metaphysics; change the metaphysics to suit the science; change both to fit each other; or find a place for the metaphysics in a "gap" where science hasn't yet gone. The last option is called the "God of the Gaps" approach [Flew and McIntyre 1955], and of course it has the disadvantage that if (when) science does explain that phenomenon, the religion is diminished.

Historically, evolutionary science grew out partly from natural theology such as Paley's and Chambers' arguments from design, which defined the problems of biology in the early 19th century [Ruse 1979: chapter 3]. These writers sought evidence of God in the appearance of design in the natural world, yet, only a century later, when the evolutionary biologist JBS Haldane was asked what biology taught of the nature of God, he is reported to have replied "He has an inordinate fondness for beetles", since there were so many species of beetle. Other than that, he couldn't really say. Evolutionary science removed the ground from underneath natural theology. Arguments from design for the existence of God were no longer the only conclusion that could be drawn from the adaption of living things [Dennett 1995].

All the furore generated about the nature of chance in evolution is based not upon challenges to the scientific nature of the theory, but upon the need to find purpose in every facet of reality [cf Dennett 1995]. Often, this derives from religious conviction, but sometimes it arises from a more considered philosophical view.

Metaphysical theories tend to fall into two kinds: those that view everything in nature as the result of Mind (idealisms) and those that view Mind as the result of mechanisms of Nature (naturalisms). One may take a naturalistic approach to some things, and still be an idealist in other domains; for example, one may accept with equanimity that minds are the result of certain sorts of physical brains and still consider, say, society or morality to be the result of the workings of Mind. Typically, though, idealism and naturalism are held as distinct and separate philosophical doctrines.

Idealists, including creationists, cannot accept the view that reality cares little for the aspirations, goals, moral principles, pain or pleasure of organisms, especially humans [cf. Dawkins 1995:132f]. There has to be a Purpose, they say and Evolution implies there is no Purpose. Therefore, they say that evolution is a metaphysical doctrine of the same type as, but opposed to, the sort of religious or philosophical position taken by the idealist. Worse, not only is it not science (because it's a metaphysic, you see), it's a pernicious doctrine because it denies Mind.

Christian creationism may rely upon a literal interpretation of Christian scripture, but its foundation is the view that God's Mind (Will) lies directly behind *all* physical phenomena. Anything that occurs must take place because it is immediately part of God's plan; they believe that the physical world should, and does, provide proof of God's existence and goodness (extreme providentialism). Evolution, which shows the appearance of design does not imply design, is seen to undercut this eternal truth, and hence they argue that it must be false. In the particular (actual) demonology of fundamentalism, it follows as a corollary that evolution is the work of the devil and his minions. [note 11]

It should be noted that many evolutionists think that the mere fact and scientific theory of evolution in no way prohibits further moral or spiritual meaning, and many do not think that any particular purpose to the universe is implied just by evolution, but requires some religious or philosophical commitment.

Philosophers of science mostly conclude that science is metaphysics neutral, following the Catholic physicist Pierre Duhem [1914]. Science functions the same way for Hindus as for Catholics, for Frenchmen as for Americans, for communists as for democrats, allowing for localised variations that are ironed out after a while. However, science does indeed rule out various religious *etiological* myths (origin stories), and often forces the revision of historical and medical stories used in the mythology of a religion. And when cosmologies are given in ancient scriptures that involve solid heavens, elephants and scarab beetles, science shows them to be unqualifiedly false as descriptions of the physical world as it is observed.

Science *can* rule out a metaphysical claim, then. Is evolutionary science therefore a metaphysical *Weltanschauung* (a nice pretentious German word meaning world-view)? I don't think so. Many things claimed by metaphysical views such as fundamentalist Christian biblical literalism are not themselves metaphysical claims. For example, the claim that the world is flat (if made by a religious text) is a matter of experiment and research, not first principles and revelation. If "by their fruits shall ye know them", false factual claims are evidence of bad science, not good religion.

Many of those who do hold religious views take the approach that they get their religion from their scriptures and their science from the scientific literature and community. They therefore treat the factual claims made in those scriptures the same way they treat the metaphysical views of scientists: as not germane to the function of that source of knowledge [Berry 1988]. Does the fact that Stephen Jay Gould admits to learning Marxism at his father's knee or Richard Dawkins to being an atheist mean that evolution is either Marxist or atheistic (as so many immediately and fallaciously conclude)? Of course not.[note 12]

If it were the case that personal views of scientists *defined* the results of scientific work, then the broad range of metaphysical views of practising scientists would mean that -- at the same time -- science was Christian, Hindu, Marxist and probably even animist, as well as agnostic or atheist. While some extreme cultural relativists do try to claim that science is no more than the sum of its cultural environments, this view fails to explain how it is that science gets such consistent results and acquires such broad agreement on matters of fact. Nevertheless, this does not stop idealists from sometimes disingenuously claiming that science is what you want (or "will") to make of it (see the section on the nature of science).

There is a tradition in modern Western philosophy, dating at least from the Romantic philosophers of the 18th century, that treats overall theories of the natural world as self-contained and self-validating systems of belief that are beyond criticism from other such systems. Many Christian and some Jewish philosophers and theologians have claimed that Christianity (or any religion) is indeed a self-contained *Weltanschauung*, and that it is immune from attacks upon its claims by scientific research. This takes several forms. One theologian, Rudolph Bultmann, once said that even if Jesus' physical remains were found, Christianity (as he interpreted it) would still be true. Others hold that all of science is just a religion, in the sense that it is a self-contained belief system, and therefore it cannot objectively disprove or challenge the claims made by another system (ie, Christianity). This is the approach often taken by creationists.

In the final analysis, this boils down to an "anti-science" prejudice, for science is not, in this sense, a metaphysical system. Since science is not a system of thought deduced from first principles (as are traditional metaphysical systems), and that it deals precisely with objective experience, science is not, nor is any theory of science, a true metaphysical system.

However, the claim is sometimes, and more plausibly, made that evolutionary theory, along with some other scientific theories, functions as a kind of *attitudinal* metaphysical system [Ruse 1989]. It is (in my opinion, rightly) thought to influence the kinds of problems and solutions dealt with by science. There is no problem with this, since in order for a discipline to make any progress, the field of possible problems (essentially infinite, to use a malapropism) must be restricted to some set of plausible and viable research options. The theory of evolution as now consensually held acts to narrow the range and limit the duplication required. This is harmless, and is true of any field of science.

Ruse also describes what he calls "metaphysical Darwinism" [Ruse 1992] (as opposed to "scientific Darwinism") which is indeed a metaphysical system akin to a worldview, and which has expressed itself in numerous extra-scientific philosophies, including Spencer's, Teilhard's, and Haeckel's, or even the quasi-mystical views of Julian Huxley. These must be considered separate to the scientific theory, and are often in contradiction to the actual scientific models.

Other than this, the "metaphysic" of evolution by selection is primarily a research-guiding mindset that has been extraordinarily fruitful where no others have been [Hull 1989]. However, *as a metaphysic*, evolutionary theory is fairly poverty-stricken. This is what *should* be true of a scientific theory; for the number of conclusions beyond the empirical evidence that can be conjectured is unlimited. Any theory that committed itself to a metaphysical conclusion as a logical inference would be almost certainly false.

Those who need Cosmic Meaning need not fear that any version of evolutionary theory prohibits it; although neither does nor can it support it. Those evolutionists who have either argued in favour of Cosmic Meaning on the basis of evolutionary theory, or have argued that there can be no Cosmic Meaning because things evolve, are both wrong. The conclusions do not follow from the premises, simply *because* 'is' does not imply 'ought'.

Evolution and Philosophy

Acknowledgements and Bibliography

by John S. Wilkins

Previous Contents

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Bibliography

> *This is intended to be a reading list. Introductory and review items are marked with an asterisk. The bibliographies in these will get you into the meat of the modern debate very quickly. Access to the journal Biology and Philosophy will help, too.*

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