Philosophy of Science // Fall 2015

Handout 22

Falsificationism: Sober; Laws in biology: Beatty

Popper's falsificationism. Popper seeks to find a *demarcation principle* that would separate between science and pseudo-science. A traditional approach was to say that science is supported by empirical evidence and pseudo-science is not. But the problem of induction shows that scientific theories are not conclusively supported by evidence. On the other hand, those disciplines that we would like to classify as not scientific (Marxism, astrology, psychoanalysis) also seem to be based, at least in part, on evidence.

The demarcation between science and pseudo-science is sought in the possibility of refutation. Scientific theories are sensitive to evidence in that they can be refuted on the basis of a piece of evidence. They are *falsifiable*. But pseudo-scientific theories cannot be refuted: every piece of evidence can be accommodated within them. Neither, however, are *verifiable*.

Remark 1. A corollary of his account is that the problem of induction disappears as a problem in the philosophy of science. Another corollary is that a scientific activity is distinguished by the search for falsifications. By contrast, a pseudo-scientific activity is not at all interested in them.

Is the design hypothesis unscientific? Sober lists a number of objections against Popper's views. Some of them are as follows. (1) Popper's demarcation presupposes a sharp distinction between observational and theoretical sentences. (2) It fails to deal with the tacking problem. (3) Some theoretical sentences, perfectly legitimate parts of theories, are not directly testable (see Hempel and Carnap on the structure of theories).

The evolutionary contingency thesis. Beatty splits the thesis into two parts. Biological phenomena are subject to the laws of physics and chemistry. So some generalisations about these phenomena are nomically necessary, so far as they there are laws of physics and chemistry at all. But none of these is a biological generalisation. The latter is always a product of a contingent evolutionary outcome that is caused by natural selection or random mutation.

Of course there *are* generalisations that are explained by evolutionary factors. Examples include hairlessness, Krebs cycle, and Mendel's law. That is, a particular phenomenon, uniformly (or at least widely) observed, is made sense of by citing ultimate causes. Thus hairlessness among humans is explained by evolutionary advantages conferred by sparse body hair compared to apes. Such advantages are speculated to be either more efficient heat dissipation or sexual attractiveness (though the latter is proposed by Darwin, to me it looks rather question begging).

Senses of cotingency. One of the main arguments that Beatty advances is that certain regularities due to evolutionary factors are observed at some time periods, but not at others. There is thus no necessity in a very straightforward sense. But this claim was attacked on the grounds of confusing falsity with inapplicability. We can formulate the laws in the form 'If A, then B', where the antecedent specifies the conditions under which B holds. The example given is Mendel's law. But this confirms the idea that biological laws lack sufficient generality. On the other hand, if we refine A, we might end up with a tautology, such as, to put it crudely, 'Only those organisms obeying Mendel's law should obey Mendel's law.'

If, furthermore, conditionalisation is not carried through to any great extent, we still will be able to point out exceptions (such as exceptions to Bergmann's rule). There is another sense of contingency that has to do with functional equivalence. Here we observe that many different adaptations could have been developed to confer the same, or roughly the same, evolutionary advantage. Thus descreased heat dissipation can be achieved by a smaller body surface, or by a more developed fur, or by learning novel behavioural patterns.

Biological reduction. Suppose, however, that a massive conditionalisation *is* possible without converting biological laws into tautologies. Hull gave an example: 'Any organism with the genetic makeup G in any environment ranging from E_1 to E_n undergoing biochemical reactions R_1 through R_m will come to have phenotypic characters C_1 through C_k.' We are in effect making a claim about a complete expression of genes at the level of phenotype. But, Beatty asks, even if such a formulation were provided, it would amount to specifying a chain of chemical reactions. Biology would thus disappear.

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