Philosophy of Science // Fall 2015

Handout 19

Scientific revolutions, Darwinism: Kuhn, Kitcher

Kuhn's programme. The basic picture of scientific change that Kuhn defends can be summarised as follows:

(1) Normal science dominated by the paradigm X.
(2) Anomalies.
(3) Crisis.
(4) Revolution: paradigm Y replaces X.
(5) Normal science dominated by the paradigm Y.

But what is a paradigm? There is no one single meaning attached to the term:

(1) It is an achievement accepted by a given community.
(2) It is likely to be codified in a classical book (*Physica*, *Almagest*, *Principia Mathematica*).
(3) It is unprecedented attracting many followers.
(4) It leaves sufficient space for further research: poses problems, rather than just solves them.
(5) It is a 'tradition of research'.

Most importantly for our present selection, a paradigm, through education and exposure to textbooks, grants a researcher a place in the community: the researcher works within a paradigm since the completion of his doctoral studies. He is unlikely to subsequently challenge the paradigm. It represents the commitment is to the same rules and standards.

Example 1 (Optics). The current paradigm (wave-particle duality) is relatively young. Its predecessors are no longer mentioned in textbooks. No paradigm before optics became mature. Without a paradigm in place, research tended to go back to the basics. Shared rules and standards are a prerequisite for turning 'philosophy' into science.

Paradigm change. The 'insecurity' in the belief in a paradigm is created by the repeated failure of the normal science to resolve the puzzles 'adequately'. We have to explain 'inadequacy' further, since the paradigm is never refuted.

Example 2 (Astronomy). Ptolemaic astronomy was as successful as Copernican astronomy in predicting the movement of stars, and almost as successful in predicting planetary movement. However: with the multiplication of epicycles the theory was getting more and more cumbersome.

What are the conditions for the alternative? Not the greater accuracy of the alternative. Not the greater simplicity. But the crisis and the long history of the anomalies.

Incommensurability. Kuhn emphasizes the drastic changes of perspective occurring in the change from one paradigm to another. His argument can be summarized as follows:

(1) Scientists never confront nature in its purity.
(2) They have to use concepts and tools to formulate theoretical problems.
(3) These problems suggest which evidence should be collected.
(4) But concepts and tools are determined by the reigning paradigm.
(5) Thus paradigms affect the way scientists 'perceive' reality.

Invisibility of revolutions. Textbooks, as Kuhn stresses, present exclusively the victorious paradigm in the given discipline. They hide, therefore, its historical development. They use the standards, language, and problems of the dominant paradigm. Sometimes they can create a false sense of historicity. But they never show any real connection with the history of the given discipline.

Darwin's innovation. Kitcher begins with the following problem: every major claim in Darwin's theory, as presented in page 19, could have been endorsed by his opponents. Thus we have to understand where precisely the crucial disagreements lay. Preliminary answer: Darwin attached different theoretical significance to these claims. That is, he was able to see their explanatory power and to create novel explanatory techniques based on those claims.

In other words, Kitcher suggests that we view Darwin's contribution in terms of articulating the explanatory links between the history of the given organism and its extant properties. As I understand it, Darwin was unique among his contemporaries to insist that these histories  alone can provide the required explanations. That contrasts his approach with, e.g., de Candolle's and Forbes' (page 22).

Example 3 (Analogy and homology in comparative anatomy). Evolution of wings in different species (insects, birds etc.) represent an analogy. Wings evolved as a response to similar environmental pressures. By contrast, forelimbs in different mammals are explained as originating in the same organism. In both cases the crucial difference between Darwin and his contemporaries (Owen) is Darwin's appeal to a historical 'explanation'.

Example 4 (Biogeography). Question: why do we find so many marsupials in Australia? This is a quest for explanation, roughly in accordance with the pragmatic model of explanation. We have to fix the comparative class: why so few elsewhere outside Australia? Then we outline a Darwinian history. We show that marsupials reached Australia before the evolution of the placentals. We also claim that, elsewhere, the placentals were able to outsmart the marsupials and push them out. And that the placentals were not able to reach Australia (after the continental breakup).

Darwinian histories. We can reconstruct Darwin's explanations further by focussing on the notion of Darwinian histories. Begin with *minimal* Darwinian histories (pages 26–27). Here we do not pretend to identify the causes of evolutionary change. But this pattern may invite the objection that it merely 'lists' changes, without properly explaining them. Hence Darwin, on many occasions, turned more ambitious: evolutionary change was said to be caused by natural selection. That is, the occurring change allowed for a better reproductive success of its possessor.

How Darwin changed biology. The creation of a new *first* paradigm: before Darwin, there was no one acceptable way for biologists (as *we* would call them now) to practice their craft. Teleologists, for example, had little in common with practising naturalists. The language has changed: even though reference to theoretical entities (such as species) was preserved, ways of fixing this reference have changed. Similarly, Darwinism set new questions the biologists were supposed to ask. It set the criteria for acceptable answers. In all these regards it resembles scientific paradigms, as we saw in Kuhn.

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