What the History of Science Cannot Teach Us

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The 1960s marked a turning point for the scientific realism debate. Thomas Kuhn and others undermined the orthodox positivist tradition by showing that a careful study of the historical record speaks against the linear accumulation of scientific knowledge. But, as is so often the case, reaction to the admittedly naïve positivist view was disproportionate and resulted in an equally naïve and diametrically opposite view, namely that there is no significant accumulation whatsoever. Realist philosophers like Richard Boyd and Hilary Putnam were quick to reply that not everything is lost in the wake of a scientific revolution. Successive scientific theories, they claimed, preserve the theoretical relations and referents of earlier theories so long as both belong to a mature science.

This attempt to rescue realism did not last long, for in the late seventies and early eighties a more sophisticated anti-realist argument appeared. The pessimistic induction argument, most often associated with Larry Laudan, is now widely considered to be one of the two main obstacles for realism (see, for example, Kitcher (1993: 136), Leplin (1997: 136) and Worrall (1982: 216); the other being the underdetermination of theories by evidence.[1] Put simply, the argument holds that since past predictively successful scientific theories have eventually been discarded, we have inductive evidence that our current theories will also be discarded one day. This landmark attack has stimulated a realist counter-strategy (see, for example, Clyde Hardin and Alexander Rosenberg (1982), Philip Kitcher (1993), Jarrett Leplin (1997), Stathis Psillos (1994) and John Worrall (1989)) that is primarily concerned to show that the historical record provides grounds for optimism. More precisely, it is argued that some theoretical components survive theory change, and that only those are responsible for any success enjoyed by the rejected theories. This strategy is now the mainstream approach for scientific realists.

[1] The pessimistic induction argument can be viewed as a constructive demonstration of underdetermination since the new theory, despite being incompatible with the old theory, entails its correct empirical consequences.

In effect, historical arguments have come to dominate the scientific realism debate these last four decades. In one corner, anti-realists argue that no theoretical preservation takes place. That, they claim, should be indicative of the falsity of theories past, and the likely falsity of theories present and future. In the opposite corner, many realists argue that at least some theoretical components get preserved, a detail that, they claim, should be indicative of their approximate truth. Both sides thus agree that the historical record is essential in settling the debate.

Without doubt, the realist needs to provide a rejoinder to the anti-realist's historical arguments. Yet, the expected returns from a realist-friendly interpretation of the history of science have been overestimated. Realists seem to behave as though realism will defeat its foes on the basis of establishing historical continuity. Yet, on a strict reading, that would require belief in the view that the preservation of a component *X* is a necessary and sufficient condition of *X*'s approximate truth/truth. No realist, I hope, would be happy to adopt such a strong claim. Indeed, it can easily be shown that the preservation of a theoretical component through theory change is neither a *necessary* nor a *sufficient* condition for its truth or approximate truth.[2] Realists should not even adopt the weaker, though still strong, claim that preservation is either a necessary *or* a sufficient condition for the approximate truth/truth of what gets preserved.

It is *not a necessary condition* because even though a component may be true/approximately true, its preservation is not guaranteed. Suppose a scientist postulates a law that is actually true or approximately true in its domain of phenomena. Many reasons, quite a few of which are social/cultural, could transpire to make the general scientific community cast the law aside. For example, if the law seems incompatible with well-established theories, there will be no guarantee it gets adopted. This will especially be the case when the predictive accuracy of the law cannot yet be fully tested – as when the instruments to perform such measurements are inexistent, unreliable or inaccurate. An example of, at least temporary, unreliability/inaccuracy taken from the historical period when the caloric theory of heat reigned supreme is the Irvinist equation for the determination of the absolute zero

[2] That it is not a sufficient condition is a point that has also been made by Chang (2003).

point of temperature, $c_i x + L = c_w x$, where c_i is the heat capacity of ice, c_w the heat capacity of water, L the latent heat of fusion, and x the absolute temperature of ice/water at the melting point. The equation was contested at first but the issue could not be settled due to a lack of reliable and accurate measurements. Eventually, the accuracy and reliability of the measurements improved sufficiently to tell against the equation. This fact notwithstanding, the point here is that there is no guarantee that we will always be able to construct instruments that can assess the predictive power of theories. Moreover, even if we do acquire the required instruments, the theory may already have been shelved. For this and other reasons, there is no guarantee that true/approximately true theoretical components will be preserved.

A potential realist reply may take the following form: Had the scientific community tested the law, they would have discovered its wonderful predictive powers, making its rejection difficult, if not completely out of the question. In other words, the predictive success enjoyed by the law should guarantee that scientists, following the canons of rationality, would preserve it for posterity. Though this may largely be true, notice that now it is the predictive success of the law that takes centre stage, not its preservation. In fact, the issue of preservation becomes parasitic on the issue of predictive success.

It is *not a sufficient condition* because the mere survival of a given theoretical component does not guarantee that it has latched onto the world. Various reasons may be responsible for a component's survival. It may be a convenient feature of scientific practice, or it may be a useful tool that has no power of representation. Plenty of examples can be drawn from the history of science to make plain that the preservation of a theoretical component is an insufficient condition to its truth/approximate truth. One such example is the hypothesis of the materiality of heat, which survived for at least two millennia until its wholesale rejection in the middle of the 19th century. Its long preservation guaranteed neither its survival nor its truth/approximate truth.

In the recent history of science, there has been a substantial correlation between preservation and (presumed) approximate truth. This correlation, however, can be explained by the fact that scientists are more likely to preserve those components that have predictive success and independent confirmation. Since one of science's chief

aims is to procure accurate predictions, any preserved elements are likely to have predictive merits. Indeed, as the demands for predictive accuracy increase, it will be reasonable to assume that so does the preservation of predictively powerful, as opposed to merely convenient, elements.

To be fair, very few realists would take preservation as a necessary or sufficient condition for a theory's truth/approximate truth.[3] But then, what role exactly does preservation play in the scientific realism debate? I am not claiming here that we should completely dismiss the importance of history in the scientific realism debate. Given that the pessimistic meta-induction argument is a real threat to the realist, one can employ cases of genuine preservation to *defuse* anti-realist objections stemming from the history of science. That, however, is as far as the preservation strategy will take the realist. The most telling, though admittedly not conclusive, test for which components have latched onto the world is whether they have predictive success and are independently confirmed. The test for this can be done independently of any historical considerations, and, therefore, makes the requirement that a component be preserved superfluous. Realists should thus focus more on elaborating such prediction-based criteria. Of course, if radical underdetermination holds not even prediction-based criteria can save realism.

[3] Exceptions can always be found. Worrall, for example, takes preservation to be a necessary condition for a theory's truth/approximate truth.

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