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BOOK SYMPOSIUM

Bird's *Knowing Science*: on cases of scientific progress

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Abstract
In his recent book *Knowing Science*, Alexander Bird argues that scientific progress is to be understood in terms of the accumulation of knowledge (CK). To this end, he employs the method of conceptual analysis; i.e., he considers several (actual or hypothetical) cases and argues that CK does the best job in capturing our intuitions concerning the applicability of the concept 'scientific progress'. In this review, I argue that the cases which Bird considers are not fully adequate for the sake at hand, because they describe progress towards science rather than progress within science (which I take the concept of scientific progress to be all about).

Keywords Scientific progress · Knowledge · Conceptual analysis

In his book *Knowing Science*, Alexander Bird argues—as the title suggests—that knowledge is centrally important for science in several dimensions. In this review, I focus on Bird's view that scientific progress is to be understood in terms of the accumulation of knowledge (CK), which he prepares in chapter 2 and argues for more extensively in chapter 3. More specifically, I focus on the cases which Bird employs to argue for his view.

Roughly speaking, Bird gives two arguments in favor of his view of scientific progress:

(1) In chapter 2, he argues that the aim of science is knowledge. The concept of an aim is closely related to the concept of progress: progress is made insofar as an

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aim is achieved. Consequently, if the aim of science is knowledge, it follows that scientific progress consists in achieving that aim, in its simplest form, by just accumulating knowledge.[1] This way, chapter 2 does important preparatory work for the view of scientific progress which is developed and discussed in chapter 3.

(2) In chapter 3 itself, Bird mostly focuses on giving additional supporting arguments for his view: he argues that CK fares better than rival accounts in capturing our intuitions about scientific progress. The rival accounts which he considers are scientific progress as the accumulation of puzzle solutions (PS), as accumulation of true scientific beliefs (CT) or increasing verisimilitude (VS), and as increase in understanding. PS, mainly developed by Kuhn and Laudan, is the main anti-realist contender, while VS is the main realist contender. The gist of the chapter consists in discussing cases, which is complemented by discussions of aspects specific to a given account of progress (e.g., with respect to PS, Bird starts by arguing against the pessimistic meta-induction, which has been taken as a motivation for the anti-realist PS account).

Bird develops his view of scientific progress carefully, with lots of (historical) detail, some helpful illustrations, and—importantly—by contrasting it to rival accounts of scientific progress. However, I also think that the cases which he employs to argue that CK does the best job in capturing our intuitions about scientific progress are not completely uncontroversial. In what follows, I develop this argument in more detail. To this end, I examine the main cases which Bird employs to argue against PS and CT—the goat case (p. 46), the Blondlot case (p. 47), and the flukish astrology case (p. 51)—more closely.

First of all, the method here is that of conceptual analysis: several definitions of the concept of scientific progress are confronted with cases (be it actual, historical cases or purely hypothetical ones). With respect to these cases (so the idea), we have more or less robust intuitions as to whether or not the concept at hand applies, i.e., whether or not the case describes a case of scientific progress. The concept of scientific progress which captures most of our intuitions correctly is the winner concept. Bird, of course, argues that CK does the best job.

Against PS, Bird first considers the following case (see p. 46): ancient thinkers used to think that goat blood could split diamonds (when in fact, of course, it cannot). Medieval thinkers attempted to explain this alleged fact by drawing an analogy between Jesus, the "scape-goat," whose blood could soften the hardest of hearts, and goat blood, which (allegedly) could soften the hardest of substances. Later, Thomas Browne, in his *Treatise on vulgar errors*, exposed the belief that goat blood could split diamonds (along with, e.g., the belief that unicorns exist) as a myth.

Bird argues that PS must describe this episode first as progressive (the medieval thinkers made progress in solving the puzzle of goat blood splitting diamond),

[1] Bird also gives a more sophisticated version: "(CK) An episode in science makes progress precisely when it shows an accumulation of scientific knowledge in the relevant scientific community, or improves the quality of that knowledge, or gets that community closer to adding to knowledge, or promotes its acquisition of knowledge" (Bird (2022), p. 41).

but then regressive (when Browne published his treatise, that puzzle solution was lost). CK, however, describes the episode first as regressive (no knowledge has been added, since goat's blood does in fact not split diamonds), then progressive (with Browne, that knowledge was added)—in line with our intuitions.

The second case (see p. 47) features French physicist Blondlot, who believed he had discovered a new kind of ray ("N-rays"). For a while, interest in N-rays was high, especially within France—until American physicist Wood, who has been sent to check on Blondlot's results, manipulated Blondlot's experimental setup; Blondlot, however, still reported to obverse the rays. After this, belief in the existence of N-rays was largely abandoned.

Bird argues again that PS must count this episode as progressive, since within the (short) era of N-ray research, problems have been solved. Abandonment of the belief in the existence of N-rays counts as regressive, accordingly, because puzzle solutions were lost. CK, by contrast, counts this episode first as regressive (since N-rays do not exist, no knowledge about them has been added to the stock of scientific belief), then progressive (knowledge about the non-existence of N-rays has been added). CK is, as Bird argues, in line with our intuitions, while PS is not.

Against CT, Bird considers 'flukish astrology' (see p. 51): a community forms its beliefs by an unreliable method, such as astrology. By fluke, however, these beliefs are all true. Nevertheless, when the unreliability of astrology is convincingly demonstrated by a member of said community, the method along with the beliefs it has generated is abandoned.

Bird argues that CT must count this episode first as progressive (true beliefs have been added to the community's stock of belief), then regressive (those true beliefs have been abandoned). CK, by contrast, counts this episode as first regressive (since the method was unreliable, the beliefs were not justified and therefore did not count as knowledge), then progressive (knowledge about the unreliability of the method has been added). Bird argues that CK is in line with our intuitions, while CT is not.

While I think the method of conceptual analysis is fine in general, I also think there might be some particularities when it comes to analyzing the concept of 'scientific progress'. First of all, intuitions about the applicability of the concept 'scientific progress' are complex in the sense that they are combinations of intuitions about science, i.e., what sorts of activities count as scientific, and progress, i.e., under what circumstances activities count as progressive. Consequently, if our verdict about a given case is that, e.g., there is no scientific progress, that could either be because the scientific activities described do not count as progressive, or because the activities described do not count as scientific to begin with. If, on the other hand, we judge that a given case is a case of scientific progress, we need to be extra careful that the activities described do not only count as progressive, but also as scientific.

To see this, consider typical cases usually discussed in debates about scientific progress, such as phlogiston theory or ether theory. In both cases, it is clear that the proponents of phlogiston theory and ether theory were engaged in activities which count as scientific. It is also clear that the proponents of the respective successor theories—oxygen theory and relativity theory—were engaged in scientific activities. What exactly constitutes the progressive part is then, of course,

a matter of debate. However, I take the following to be uncontroversial: typical cases in the debate about scientific progress describe progress *within* science.

I think here lies a crucial difference to the cases which Bird employs. Take the goat case: ancient thinkers who thought that goat blood could split diamonds, and medieval thinkers who tried to explain that by biblical analogies, would both not count as engaged in scientific activities (at least, not according to my intuition). When Thomas Browne exposed the belief as a myth by appealing to empirical evidence, that was indeed progress—but not progress within science. Rather, I would describe the case as progress from non-science to proto-science, i.e., progress *towards* science.

The same can be said about the flukish astrology case: the members of the community which Bird describes were not engaged in activities which count as scientific, exactly because the method they used (astrology) was unreliable. As Bird himself acknowledges at another point:

> Good science requires not just that our theories be true but that we have adequate grounds for believing them, that our methods are reliable, and that they do not rest on self-deception or other irrational causes. The best explanation for those additional conditions is that they are required for science to be knowledge (Bird (2022), p. 20).

In a similar vein, Niiniluoto (2014) has already commented on the flukish astrology case in Bird (2007):

> Irrational beliefs and beliefs without any justification simply do not belong to the scope of *scientific* progress (Niiniluoto (2014), p. 76).

Furthermore, astrology is a standard example of a pseudo-science (although, of course, there is no unique opinion of why exactly that is). So, again, when the community abandoned the unreliable method, that was indeed progress—but not within science. Rather, the progress was from pseudo-science or non-science towards scientifically inclined insights (i.e., that astrology is an unreliable method).

Finally, the era of N-ray research is sometimes described as an example of "pathological science," exactly because Blondlot and his fellow French physicists believed in having discovered a new kind of ray due to psychological inadequacies. When belief in N-rays was finally abandoned, that was not progress within science, but progress from pathological science back to "healthy" science.

Consequently, I think that the cases which Bird employs against PS and CT would (although diachronic) fit better as cases in the debate about the demarcation criterion, i.e., as cases which trigger our intuitions about science versus pseudo-science or non-science: with respect to all three cases we can ask ourselves which element is responsible for triggering our intuition that the activities employed towards the end of each episode are more scientific than the activities employed at the beginning of each episode. Take the goat case: in tracking the history of the goat blood myth, we can ask ourselves why we think that Thomas Browne has acted more in the vein of modern science than ancient and medieval

thinkers (because of his appeal to empirical evidence, probably). Or, as Bird would have it, because ancient and medieval thinkers did not possess knowledge with respect to the goat-blood-diamond issue. So, what the goat case shows is that knowledge is an important constituent of science (and potentially the element which distinguishes it from non-science). Similarly, the Blondlot episode shows that psychological factors can interfere with the scientificity of our activities. Lastly, as Bird himself acknowledges (see the quotation above), flukish astrology shows that science (not scientific progress) needs to rest on reliable methods.[2]

In the debate about scientific progress, we might want to stick to cases where the activities described uncontroversially count as scientific throughout the whole episode (such as Laudan's examples, listed by Bird on p. 44)—otherwise, our intuitions might yield false positives because intuitions about progress within science get conflated with intuitions about progress toward science.

Note, however, that Bird's cases would not be completely conclusive if utilized in the context of the demarcation criterion either: arguably, there are cases which show that justification (and thereby knowledge) is not necessary for scientific progress (and thereby science). Dellsén (2016) cites Einstein's derivation of Brownian motion as a case in point. He argues that in 1905 (when Einstein published his respective famous paper), Einstein neither knew the kinetic theory of heat, nor did he know that the hypothetical motion he derived from that theory is indeed identical to the already observed phenomenon of Brownian motion, both for lack of justification. Dellsén points out that nevertheless, Einstein's derivation uncontroversially counts as a case of scientific progress (and thereby science). As I see it, besides being a counterexample to Bird's CK, Dellsén's case emphasizes that the debate about science versus non-science is itself complex and open-ended. Therefore, it seems reasonable to sidestep this (complex and inconclusive) debate when discussing scientific progress by sticking to cases in which the activities described uncontroversially count as scientific, whatever the exact criterion for qualifying as scientific might be.

To sum up, I think that the cases which Bird employs in his arguments against PS and CT are cases which describe progress towards science, not progress within science. Therefore, they might not be the best sort of case when it comes to analyzing the concept of scientific progress—which, as I understand it, concerns progress within science only. Therefore, the typical cases which describe progress within science, such as the replacement of phlogiston theory by oxygen theory, or ether theory by relativity theory, might be better suited for that enterprise. However, to be fair,

[2] Interestingly, I think that the goat case and the Blondlot case might still be problematic for PS—not because PS yields wrong judgements about scientific progress, but rather wrong judgements about science. That is because PS, at least Kuhn's version, comes with an integrated view of what counts as science, and what distinguishes science from non-science, pseudo-science, and proto-science: According to Kuhn, the hallmark of normal science is puzzle-solving. Consequently, if it can be argued that PS would have to count the activities of ancient and medieval thinkers, and Blondlot's activities, as scientific because they were engaged in puzzle-solving, that would indeed be strongly counter-intuitive. However, I also think that Bird's considerations are a bit too quick here: for example, it is questionable whether the short era of N-ray research would count as normal science according to Kuhn's standards—the French community was probably too isolated from the rest of the scientific community to count as having established a research paradigm.

that might not be a problem which is specific to Bird's account—the cases which he discusses have been around for quite a while and have been accepted and discussed as valid cases for the sake at hand by other authors.

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