Science is more than knowing

Abstract

Bird's new book, *Knowing Science*, provides an exemplar of how to do epistemology and philosophy of science together. While I wholeheartedly appreciate his attempt to bridge the gap between epistemology and philosophy of science and find his project promising, I am not convinced by the central thesis of the book that knowledge plays a central role in science. In this article, I focus on Bird's epistemic account of scientific progress, which is the view that the nature of scientific progress is the accumulation of scientific knowledge. Contra Bird, I argue that scientific progress cannot be fully characterised as the accumulation of scientific knowledge.

Key words

science; knowledge; scientific progress; exemplary practice; usefulness; X-rays

Twenty-first century analytic philosophy has become a highly specialised enterprise. It is not unusual for an epistemologist to get lost in a philosophy of science conference. Nor is it surprising for a philosopher of science to get bored, or even confused, with a discussion full of Gettierian examples. That being said, this is very unfortunate. Good philosophy of science will ultimately contribute to answering general epistemological questions, while good epistemology will shed light on how science is and should be practised. Philosophy of science and epistemology should have been much closer to each other than actually are. It has been over 50 years since the publication of W. V. Quine's 'Epistemology Naturalized' (1969), but there is still so few serious or systematic attempts to develop a naturalistic, or science-informed, approach to epistemology.[1] On the other hand, the current discussion in epistemology seems to have little impact on the philosophy of science. However, Alexander Bird's recent book, *Knowing Science* (2022a), is an extraordinary exception by providing an exemplar of how to do epistemology and philosophy of science together. Bird develops a knowledge-based, or epistemic, approach to the nature and development of science. He summarises some central theses of the book as follows.

> The key concept we need in order to understand science is knowledge. For example: science aims at knowledge; scientific progress is the accumulation of knowledge; evidence is that which can lead to knowledge, and therefore is itself knowledge. (Bird 2022a, 11)

I agree with Bird on the point that science is about knowledge to a great extent, but I am not convinced by that knowledge plays a central role in science. In this article, I focus on Bird's epistemic account of scientific progress, which is the view that the nature of scientific progress is the accumulation of scientific knowledge. Contra Bird, I shall argue that scientific progress cannot be fully characterised as the accumulation of scientific knowledge.

[1] By 'science', I mean empirical science rather than exact or mathematical science. In addition, by mentioning Quine's paper, I do not attempt to defend Quine's strong naturalist proposal that epistemology should be a chapter of psychology, which in fact I find wrong.

Bird employs two arguments to support his epistemic account of scientific progress: the argument from teleology and the argument from superiority, which can be formulated as follows.

Argument from Teleology

> P1. The aim of science is knowledge.
>
> P2. If an activity A aims at goal X, then A makes progress insofar as it achieves X, achieves more of X, achieves X better, gets closer to achieving X, or promotes the achievement of X (depending on what X is and how it is specified).
>
> C. 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.

Argument from Superiority

> P3. There are four main accounts of scientific progress: the epistemic, the semantic, the functional, and the noetic accounts.
>
> P4. The epistemic account is better than the semantic, the functional, and the noetic accounts.
>
> C'. The epistemic account of scientific progress is correct in the sense that 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.

At first glance, the argument from teleology not only offers a defence of the epistemic account of scientific progress, but also a coherent and systematic picture of the nature and development of science. Here Bird employs a popular strategy: in order to examine the nature of progress of X, one ought to clarify the aim of X first. Such a strategy has been widely adopted by philosophers in their examination of scientific progress and philosophical progress. However, I am highly sceptical of it. I argued in a recent essay (Shan 2022a) that the aim of philosophy and philosophical progress should be better construed as two separate issues. A given account of the aim of philosophy does imply a particular account of philosophical progress, but not vice versa. And there can be an account of philosophical progress that is not defined in a teleological way. For example, one may argue that philosophy progresses if philosophy solves more problems, while it regards the aim of philosophy as an open question. In a similar vein, I argue that the aim of science and scientific progress should be better construed as two separate issues. A given account of the aim of science does imply a particular account of scientific progress, but not vice versa. Furthermore, a good account of scientific progress does not have to be defined in a teleological way. It makes perfect sense for one to defend a particular account of scientific progress while being open to the nature of the aim of science. One example is my new functional account of scientific progress (2019). I define scientific progress as the increase of the usefulness of exemplary practices without committing to any particular account of the aim of science.

Moreover, the argument from teleology is a double-edged sword. It does provide a coherent and systematic account of the aim and progress of science. By doing so, it is too risky (in a Popperian sense): it tries to show too much, contains too many falsifiable contents, and is thus more vulnerable to objections. The epistemic account of scientific progress will be simply undermined if the epistemic account of the aim of science is shown to be problematic. It is clear that the aim of science is at least as controversial as the nature of scientific progress, so I doubt that it is a good strategy to defend the epistemic account of scientific progress based on the epistemic account of the aim of science, which itself is under debate. In other words, C is true if P1 and P2 are both true. However, P1 is controversial itself. It is in this sense that arguing for C by appealing to P1 is risky. Thus, the argument from teleology is not very promising.

Now let us to turn to the argument from superiority. I am sympathetic to Bird's objections to the semantic account of scientific progress (Bird 2022a, 50–62). I also agree with Bird on his judgment that the noetic account is not promising (Bird 2022a, 62–68), though for different reasons.[2] That being said, I find Bird's criticism on the functional account (Bird 2022a, 45–50) too hasty. Bird focusses on criticising a particular variant of the functional account, namely, the Kuhn-Laudan account. Although he realises that there are other variants of the functional account, such as the Popper-Lakatos account (Popper 1963; Lakatos 1978) and my new functional account (Shan 2019; 2020; 2022b), he dismisses these quickly.

> Much of what I have to say [about the problem solving views of Kuhn and Laudan] will apply to Lakatos's methodology of scientific research programmes also. (Bird 2022a, 45)

> Yafeng Shan (2019) has recently offered a version of the functional-internalist approach that seems to me to be an improvement on the Kuhn–Laudan version. Nonetheless, I think it still fails on the point [raised] in this paragraph, that not all progress involves solving a problem. (Bird 2022a, 45f2)

I doubt that Bird's objections to the Kuhn-Laudan account can be simply applied to the Popper-Lakatos account and my account. As I argued, there are crucial differences between the Kuhn-Laudan account and the Popper-Lakatos account and the latter does not succumb to all of Bird's objections to the Kuhn-Laudan account (Shan 2022b).[3]

In addition, as I highlighted, problem-solving success is not central to my new functional account (Shan 2022b, 57–58). Unlike the Kuhn-Laudan account, my functional account does not maintain that scientific progress necessarily 'involves solving a problem'. In other words, Bird's argument that problem-solving success does not sufficiently account for the nature of scientific progress poses no challenge to my account.

Bird (2022b) develops a more sophisticated argument against my account. He argues that the proposal of a new useful exemplary practice is not necessary for scientific progress by referring to a historical case, Wilhelm Röntgen's work on X-rays. Bird argues that Röntgen's work on X-rays is a good example of scientific progress and it can only be well characterised by his epistemic account.

[2] For Bird, the noetic account is either reducible to the epistemic account or too demanding. For me, Dellsen's early formulation of the noetic account (2016) by defining scientific progress in terms of predictive and explanatory power reads more like a variant of the functional account, while his recent formulation (2022) is too close to the semantic account.

[3] For more discussion on the Popper-Lakatos account, see Shan (2022b).

> Roentgen's discovery of X-rays was a celebrated contribution to scientific progress because after 1895 scientists knew that these interesting and important rays existed, whereas before then they were ignorant of their existence. Progress here was made by the addition of knowledge and nothing more. (Bird 2022b, 17)

Moreover, he argues that '[t]he discovery of X-rays was not itself a useful exemplary practice' (Bird 2022b, 17). In other words, Bird contends that Röntgen's work on X-rays is a counterexample to my new functional account.

However, Bird's argument is too quick for my tastes. The significance of Röntgen's work on X-rays was not a clear case of 'the addition of knowledge'. From a historical point of view, it is inappropriate to regard Röntgen's work on X-rays as the discovery of X-rays: it is not correct that only after Röntgen's work (1895) 'scientists knew that these interesting and important rays existed, whereas before then they were ignorant of their existence'. As A. A. C. Swinton (1896, 276) put it, 'The discovery does not appear, however, to be entirely novel, as it was noted by Hertz that metallic films are transparent to the kathode rays from a Crookes or Hittorf tube, and in Lenard's researches, published about two years ago, it is distinctly pointed out that such rays will produce photographic impressions'. In other words, scientists were aware of the existence of these rays before Röntgen's work. Moreover, it cannot be argued that Röntgen's work on X-rays provided new knowledge of the nature of X-rays. Although Röntgen suggested that X-rays were longitudinal waves, his contemporaries merely regarded it as a 'speculation' with inconclusive evidence (Bottomley 1896, 268). Even Röntgen's himself was 'quite conscious that the hypothesis [that X-rays are longitudinal waves] advanced still requires a more solid foundation' (Röntgen 1896, 276). Thus, Röntgen's work on X-rays is not a clear case of the accumulation of scientific knowledge.

What is more, it is unclear why Röntgen's work on X-rays 'was not itself a useful exemplary practice'. Contra Bird, I argue that Röntgen's work on X-rays is better characterised as a useful exemplary practice. By definition, a useful exemplary practice is a particular way of problem-defining and problem-solving which is repeatable and provides a framework for further investigation, typically by means of conceptualisation, hypothesisation, experimentation, and reasoning, to solve unsolved problems and define novel research problems across different disciplines (Shan 2020).

It is evident that Röntgen's work on X-rays was such a useful exemplary practice. Röntgen introduced a new way to investigate the nature of X-rays by proposing new way of experimentation, introducing new problems and testing hypotheses. By 'his carefully conducted experiments' (Schuster 1896, 278), Röntgen disconfirmed that hypothesis that X-rays are ultra-violet light. He also showed that 'the X-rays are capable of transformation' experimentally (Röntgen 1896, 275). Note that his experiments were successfully repeated by his contemporaries (Swinton 1896). Although his hypothesis concerning the nature of X-rays was not accepted immediately, Röntgen's work on X-rays provided a foundation for further investigation with a prospect to 'materially affect our views concerning the relation between the ether and matter' (Schuster 1896, 268). It opened up a new line of enquiry, which eventually led to fruitful and remarkable results across different disciplines, 'both within and outside science', as Bird (2022b, 17) notes. Therefore, I argue that Röntgen's work on X-rays is a perfect example of a useful exemplary practice.

Of course Bird might still argue that Röntgen's work on X-rays did provide some knowledge such as that bone is so much less transparent to X-rays than flesh and muscle. However, the

addition of such piecemeal knowledge cannot fully characterise the significance and contribution of Röntgen's work on X-rays in the history of science. Röntgen's work on X-rays not only provided us knowledge, but also offered us new and useful ways of doing science. As I emphasised, not all the ways of doing science can be reduced to knowledge, no matter how broadly knowledge is construed (Shan 2019; 2022b). Science is more than knowing.

Despite my objections to the epistemic account of scientific progress, I wholeheartedly find Bird's project promising and pursuitworthy. I do think that Bird is walking in the right direction, but not far enough. A science-informed epistemology ought to pay more careful attention to the multifaceted and nuanced aspects of scientific practice within its historical context.

Acknowledgements

I would like to thank Michael Wilde and an anonymous referee for their helpful comments.

References

Bird, Alexander. 2022a. *Knowing Science*. Oxford: Oxford University Press.

———. 2022b. "The Epistemic Approach: Scientific Progress as the Accumulation of Knowledge." In *New Philosophical Perspectives on Scientific Progress*, edited by Yafeng Shan, 13–26. New York and London: Routledge.

Bottomley, J. T. 1896. "On Röntgen's Rays." *Nature* 53 (1369): 268–69.

Dellsén, Finnur. 2016. "Scientific Progress: Knowledge versus Understanding." *Studies in History and Philosophy of Science* 56: 72–83.

———. 2022. "The Noetic Approach: Scientific Progress as Enabling Understanding." In *New Philosophical Perspectives on Scientific Progress*, edited by Yafeng Shan, 62–81. New York and London: Routledge.

Lakatos, Imre. 1978. "Falsification and the Methodology of Scientific Research Programmes." In *The Methodology of Scientific Research Programme*, edited by John Worrall and Gregory Currie, 8–101. Cambridge: Cambridge University Press.

Popper, Karl. 1963. "Truth, Rationality, and the Growth of Scientific Knowledge." In *Conjectures and Refutations: The Growth of Scientific Knowledge*, 215–50. London: Routledge and Kegan Paul.

Quine, Willard V. 1969. "Epistemology Naturalized." In *Ontological Relativity and Other Essays*, 69–90. New York: Columbia University Press.

Röntgen, Wilhelm C. 1895. "Eine Neue Art von Strahlen." *Sitzungsberichten Der Würzburger Physik.-Medic. Gesellschaft 1895*, 1–10.

———. 1896. "On a New Kind of Rays." Translated by Arthur Stanton. *Nature* 53 (1369): 274–76.

Schuster, Arthur. 1896. "On Röntgen's Rays." *Nature* 53 (1369): 268.

Shan, Yafeng. 2019. "A New Functional Approach to Scientific Progress." *Philosophy of*

Science 86 (4): 739–58. https://doi.org/10.1086/704980.

———. 2020. *Doing Integrated History and Philosophy of Science: A Case Study of the Origin of Genetics*. 1st ed. Boston Studies in the Philosophy and History of Science. Cham: Springer. https://doi.org/10.1007/978-3-030-50617-9.

———. 2022a. "Philosophy Doesn't Need a Concept of Progress." *Metaphilosophy* 53 (2–3): 176–84. https://doi.org/10.1111/meta.12526.

———. 2022b. "The Functional Approach: Scientific Progress as Increased Usefulness." In *New Philosophical Perspectives on Scientific Progress*, edited by Yafeng Shan, 46–61. New York: Routledge. https://doi.org/10.4324/9781003165859-5.

Swinton, A. A. C. 1896. "Professor Röntgen's Discovery." *Nature* 53 (1369): 276–77.