Giere, Ronald, *Scientific Perspectivism*, Chicago & London: University of Chicago Press, 2006, Chapters 3 to 5.

Keywords

Scientific realism, social constructivism, contingency, robustness

Domain

Physics, science in general

Abstract

Both instrumental observation (chapter 3) and scientific theorizing (chapter 4) are shown to be perspective in character, much in the same way as color vision is. The book ends with an analysis of the concept of distributed cognition (chapter 5), a notion recently developed by cognitive scientists that can be used to provide further evidence for the claim that scientific knowledge is unavoidably perspectival.

Development

Chapter 3.

Scientific observation is often based on instruments. Historians of science have rightly argued that the use of instruments enhances objectivity. Nevertheless, this gain in objectivity should not be seen as allowing access to how things really are, for instruments produce perspectives on the world too. In order to prove it, Giere analyses some image-producing instruments used in two different fields: astrophysics (observation of very large and distant objects) and neurosciences (observation of a small object such as the brain). Consider an image of the Trifid Nebula obtained with an optical telescope: there is more than one reason to think that this kind of observation is perspectival. To start with, an optical telescope is sensitive only to a certain range of electromagnetic radiation (roughly equivalent to the visible spectrum), and, therefore, it selects a particular aspect of the observed object. Further, the technique implemented to obtain an image involves the use of a number of filters that single out even narrower radiation ranges, thus yielding different perspectives on the observed object. Finally, these perspectives are combined together in order to obtain a colored image suitable for the human eye. What is achieved in this way is by no means an observation of the nebula as it is in itself. A similar case can be made for images obtained with the Hubble space telescope. In this case the observation is even more mediated, for an extremely complex process intervenes between the external input and the final output. Moreover, the observation of very distant objects can involve the phenomenon of gravitational lensing, which renders the interpretation of the final result dependent on the General Theory of Relativity. The picture thus obtained "is the product of an interaction between light from the early universe and the Hubble telescope system" (p. 45). In this sense, the Hubble telescope is fundamentally akin to the human visual system. Another satellite observatory analyzed by Giere is the Compton Gamma Ray Observatory (CGRO) launched April 5, 1991. The four instruments contained in the CGRO are gamma ray detectors and, therefore, produce perspectives that are very different from the ones obtained by optical means. Differences exist also among the gamma ray detectors themselves. Giere compares two images of the center of the Milky Way Galaxy obtained with two such detectors respectively. One image was constructed with data restricted to gamma rays measured at 1.8 MeV, the other with a detector whose energy range was restricted to 0. 51 MeV. Moreover, the two detectors group together in different ways frequencies that are theoretically distinct but differ only by small amounts. Now, the two images thus obtained portray the very same object in two very different ways and highlight the presence of different aspects of it. "Each detector views the electromagnetic world from its own *perspective*. Every observation is perspectival in this sense." (p. 48). According to the author, this analysis shows that the result of an observation cannot be detached by the means of observation. However, this does not mean that scientists are not allowed to go beyond the *data* they obtain. Images are often more fine-grained than the actual data and can thus be seen as *data models*. Similar conclusions can be drawn by the analysis of the several existing imagining technologies for investigating the brain. In particular, it is possible to establish an important distinction between techniques such as the *Computer Assisted Tomography* (CAT) that produce perspectives only on the structure of the brain, and techniques such as the *Positron Emission Tomography* (PET) that produce perspectives on the functioning of the brain. Chapter three ends with some interesting considerations about the relation between perspectivism and multiple determination (i.e. robustness in Wimsatt's sense). Many objects can be detected by several different means. Does this imply that the object in question is real in some absolute objectivist sense? No. Coherence among different perspectives does not mean independence from perspectives altogether. Such coherence supports only the weaker claim that "there is something there" and that what is detected is not an artifact of one of the available instruments. The desire to reconcile different perspectives is based in turn on "the methodological principle of proceeding as though nature has a unique causal structure" (p. 57).

Chapter 4.

Both perception and scientific observation have been shown to be perspectival. These claims, though, can be made only if our theoretical understanding of the world is presupposed. Does this imply an objectivist understanding of scientific theorizing? On the contrary. In this chapter Giere argues that also model and theories are but perspectives on the world. To start with, it is necessary to give up the old idea that scientific knowledge is to be achieved by seeking a correspondence between sets of sentences on the one hand and the world on the other. According to this view, scientists represent the world by means of sentences and scientific theories are sets of sentences. The analysis of actual scientific practice shows that this is not the case. Indeed, the very concept of "theory" needs to be handled with care. In general, the most abstract elements used by scientists are principles, such as Newton's principle of dynamics. These abstract items do not directly represent the world, rather, in conjunction with specific conditions, they make possible the formulation of less abstract models that can be compared with empirical data or, better, with models of data. The model constructed by means of theory plus specific conditions "are the primary (though not the only) representational tools in the sciences" (p. 63). These models, also called representational models, share many features of ordinary maps: "Models too are objects, not linguistic entities such sentences." (p. 76). To be precise, they are abstract entities used to represent the world; but they are not judged to be true of the world. The only claims that can really be true or false are those about the representational adequacy of a model with respect to the relevant data. Given that models are always built on the basis of certain general theoretical presuppositions, which cannot be tested directly, models are perspectival too. They represent the world within a certain theoretical perspective. Towards the end of the chapter, Giere goes back to the contingency issue. Scientific perspectivism is compatible with the view that our theoretical perspectives may be influenced by "past knowledge and current interests and ideas" (p. 93) and that the application of scientific method cannot eliminate this influence. Scientific knowledge is therefore, to a certain extent, contingent; but it can still be interpreted in a realistic way within the framework of scientific perspectivism. In conclusion, it has to be stressed that the perspectival nature of theoretical knowledge becomes evident only when a certain theoretical perspective is replaced by a new one. Similarly, the contingent features of past perspectives are easily identified only in retrospect. For this reason, the empirical work of historians and sociologists who try to reveal the contingent elements of current perspectives is unlikely to be always successful.

Chapter 5.
The final chapter can be thought of as an appendix in which the author, by means of an analysis of distributed cognitive systems, presents further evidence to the effect that scientific knowledge is perspectival. A simple example can illustrate the concept of distributed cognition: the multiplication of two three-digit numbers is normally performed with the aid of the classic column diagrams that children learn in their early years of school. In this case, the cognitive system that performs the calculation comprises the person (mind-brain-eye-hand) plus the external physical representation (the written diagram). Thus "the cognitive process is distributed between a person and an external representation." (p. 98). Distributed cognition is a widespread phenomenon in science: scientists work with abstract models, physical models, diagrams, computers, and, of course scientific instruments requiring the cooperation of many researchers. All these material and abstract artifacts "typically incorporate a built-in perspective on the world. Beginning with an understanding of scientific knowledge as produced by distributed cognitive systems, therefore, one comes quickly to the conclusion that scientific knowledge is perspectival" (p.116).

Methodology
Naturalistic philosophical analysis based on several examples and on some recent findings in color science and cognitive sciences.

Specific contributions
The author is persuaded that a careful analysis of the actual scientific practices is sufficient to refute objective realism and establish a different version of realism called scientific perspectivism. In particular both experimental

practices involving the use of instruments and theoretical practices based on models and theories appear, when correctly understood, to produce perspectives on the world.

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