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Books by academics reviewed by academics

Book of the week: Scientific Representation: Paradoxes of Perspective

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An exploration of the model world impresses Steven French

What does The Haywain represent? Or Mondrian's Broadway Boogie Woogie? How about Rothko's Red on Maroon? In the case of the Constable painting, the answer seems straightforward, and we can even visit the site of the scene he sketched (more or less). Mondrian, rejecting the distinction between abstract and representational art, himself suggested that his work represented structure. But with Rothko, talk of representation seems inappropriate.

What about scientific theories? Certainly they're not easily comparable to a Rothko, but are they more like The Haywain or Broadway Boogie Woogie? The notion of representation has recently risen to prominence in the philosophy of science, with arguments and examples imported from the world of art.

Bas van Fraassen has played a leading role in these discussions, grappling with representation and its mechanism from the perspective of the empiricist stance he first took in his now-classic text, *The Scientific Image*. Densely argued, erudite and rich in examples from both art and science, his latest book expands on his John Locke Lectures, given at Oxford in 2001, to cover not just representation, but also measurement and models, structuralism and, finally, the distinction between appearance and reality.

The "venerable" question that shapes the first section concerns the role of resemblance in representation, and van Fraassen emphasises that to be successful representation may also crucially require distortion, in art just as in science. This is not, of course, to suggest that resemblance is irrelevant, but the choice of those respects in which resemblance or distortion is required is crucial and dependent on the use to which the representation is put.

Here a fundamental pragmatic element enters: we do not just represent, we represent as, and it is use, making and taking that resolve possible ambiguities. Consider Francis Bacon's portrait of Pope Innocent X, after Velazquez. Is this simply a representation of Pope Innocent X, or of Velazquez's canvas? The answer depends on how the picture is taken, pragmatically. An art critic may take it to be a subtle revisiting of Velazquez, coloured by 20th-century sensibilities. I, as a naive gallery visitor, take it to be simply a portrait of Pope Innocent X. For van Fraassen, "there is no representation except in the sense that some things are used, made, or taken, to represent some things as thus or so".

As in art, so in science. Scientists, too, are intentional agents with goals and purposes, and scientific representations also involve resemblances and distortions, in various respects and to certain degrees. Take a scientific model: to be used for the purpose intended, it must of course be similar to the object modelled; but more than this, it must be pertinently similar. Learning to "read" and to construct theories and models involves determining which features are pertinent and which are not, just as learning to paint, sculpt, even photograph, does. Of course, scientific representations do differ from the artistic - they are constrained by the empirical and related to both their predecessors and successors in ways that their artistic counterparts are not.

Van Fraassen addresses the former constraint through his analysis of measurement as itself a form of representation, with measurement outcomes also bound up with selective resemblances. To achieve these outcomes requires, of course, an appropriately designed instrumental set-up, so the outcome represents some feature of the object in the context of that set-up.

However, instruments are not just passive windows on the world, but should be seen - contentiously, perhaps - as "engines of creation". Even the optical microscope, van Fraassen argues, is productive rather than mimetic. Thus he advocates what he calls the "Clausewitz doctrine" of experimentation as "the continuation of theory construction by other means".

Of course, the journey from the raw data to something that "fills in the blanks" of theory is a complex one, involving the construction of "data models" and their smoothed-out "surface model" counterparts that are then embedded in the models presented by scientific theories. Taking this journey results in a mutual "stabilisation" of experimental and theoretical practice, and it is this that supports the realist's inference that what our theories have latched on to and what they represent is the structure of the world.

Of course, van Fraassen has no truck with realism, and his "empiricist structuralism" offers instead a view "not of what nature is like but of what science is".

However, how can an abstract entity, such as a scientific theory, represent something non-abstract? Certainly, theoretical models can be "matched" with data models - or their surface counterparts - but what is the nature of the relationship between the latter and the phenomena they model? This is a representational matter, involving use and pragmatics. There is nothing in the data model itself, as another abstract structure, that determines that it is, or is not, a representation of, say, radioactive decay, just as there is nothing in a map that makes it a map of the world, rather than a theological document. It is the user who pays selective attention to the phenomena and decides which aspects to represent, in what ways and to what extent. Just as use of a map requires a "you are here" sign, so use of a scientific graph, say, requires an indexical judgment made within the context of use. It is this judgment that establishes the above relationship.

Adopting this approach then allows us "to follow the contemporary abstract structural forms now prevalent in the advanced sciences". In quantum physics, for example, the yawning gap between definite measurement outcomes and indefinite physical states - infamously known as the "measurement problem" - can be closed by paying proper attention to the relevant representational relationships. The theoretical structures are accountable to and predictive of the appearances only (measurement outcomes again) to the extent needed in empirical applications, and this they do unproblematically.

However, this means relinquishing the age-old demand that the world of appearance must be completely explained by the attributes posited by theory. The upshot is a radical change in "the very methodology of science itself and ... the conception of what science is to be".

In a sense, however, this is a conservative conclusion: we should not try to dress up theories with some kind of "deeper" interpretation that provides the complete explanation demanded by Einstein, for example, when it came to quantum physics. Alternatively, rather than drop a demand that has served science so well, perhaps we can still follow the contemporary abstract forms science presents to us and construct new kinds of interpretation from the resources provided by structural representations themselves.

It is customary to end reviews such as this by assuring the reader that there is much more to the book than is covered in the review, but in this case it really is true. *Scientific Representation* is both provocative and subtle, and will appeal to a general readership as well as the science studies aficionado. It takes us beyond the issue of representation in science to offer one of the most well thought-out representations of science currently available.

THE AUTHOR

Bas van Fraassen, professor of philosophy at San Francisco State University, has taught at the universities of Toronto and Southern California, Princeton and Yale.

He was born in the Netherlands in 1941, and his family emigrated to Canada in 1956. He studied at the University of Alberta before moving to the US to complete a masters at the University of Pittsburgh.

An adult convert to Roman Catholicism, van Fraassen's specialist subject is the philosophy of science. He has written books on quantum mechanics, the philosophy of logic and paradox. He is also a fiction writer.

He describes cats as "the most intelligent, graceful, and insightful beings in the Universe", but he doesn't own any. A passionate rock climber, he is now learning the trapeze. He says he very much enjoys "flying with the greatest of ease, etc", but adds that "not all of that applies in my case".

Scientific Representation: Paradoxes of Perspective

By Bas C. van Fraassen

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Reviewer :

Steven French is professor of the philosophy of science and head of the department of philosophy, University of Leeds. He is author of *Science: Key Concepts in Philosophy* (2007) and editor-in-chief of the journal *Metascience*.