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Review of Bas van Fraassen. Scientific representation: paradoxes of perspective

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Scientific Representation: Paradoxes of Perspective

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Scientific representation is a fast-growing topic in contemporary philosophy of science. The problem of explaining how science represents the world is an old one, deeply entangled with the issue of realism and the problems that normally come with it (from reference to mind independence). But in recent times, the topic of scientific representation has taken a life of its own, mainly because of the fashionable experimentalist quarters from which it originates. Attention to scientific practice and how scientific models represent phenomena raises specific questions about the very nature of scientific representation, and the difference between representation in science and representation in the arts.

Bas van Fraassen's book is the most up-to-date and paradigmatic expression of this new trend in philosophy of science, for at least two main reasons. Firstly, it explicitly acknowledges the *experimentalist roots* of the problem, as it arises in the contemporary literature. Measuring is a way of representing, and scientific representation is perspectival in the same sense as Dürer's 'art of measurement': drawing in perspective is itself a measurement technique.

Second, and for the first time as far as I am aware, van Fraassen's book clearly marks a distinction between the problem of representation as it appears in the sciences, and as it appears in philosophy. In particular, it marks a distinction between the problem as it originally emerged with the scientific revolution at the time of Copernicus and Galileo; and the subsequent philosophical re-elaboration of the problem with Descartes, whereby 'The problem initially faced in the sciences was thus transposed into one pertaining mind and matter' (275). And while the philosophical problem of the external world—from Descartes, to Kant, to Bradley—may well be unsolvable, philosophers of science should confine their attention to the specific problem of explaining 'how can an abstract mathematical structure represent a concrete physical entity?' (243), which leads van Fraassen back to some classical discussions about empirical adequacy and 'saving the phenomena', enriched with new important caveats and distinctions, as we shall see below.

The whole book then, as I see it, is articulated around these two main themes, and develops a sophisticated, intriguing, subtle line of argument that goes from the experimentalist roots of the problem of scientific representation, to the final diagnosis of the divide between philosophy and the sciences on this specific problem. Hence the four parts into which the book is divided, and of which I can only offer a very brief overview below, at the cost of leaving out many details. I hope at least that at the end of this overview, the subtle line of argument that goes from the first to the second aforementioned theme will become clear.

The first part, consisting of the first three chapters, is on representation itself. Going back to Nelson Goodman and most recent debates on scientific representation, van Fraassen makes the point that there is no strong argument to ban resemblance from representation. If anything, representation trades on *selective resemblances* for their usefulness, where 'use' or 'usefulness'

encompasses the intention of the creator, coding conventions in the community, and the way in which the audience takes it, among other things. The emphasis is on the *pragmatics*, more than on the syntax or semantics of representation: 'A scientific, technical, or artistic representation is an artefact … something constituted as a cultural object, through its role or function, bestowed upon it in practice' (30). Not only is representation *intentional*, in the sense of being related to the epistemic intentions of the user. It is also *perspectival*, in the same sense of Alberti's and Dürer's pictorial perspective: representing is the 'art of measuring', i.e. of using machines and engines to offer representations of phenomena *not as they are*, but *as they appear from the particular vantage point of an observer.*

The second part of the book (chapters 4–7) expands on the idea of representing as the art of measuring. This is the part of the book that fleshes out the experimentalist roots of the contemporary problem of scientific representation. The emphasis is all on scientific instruments, their three main roles (representative, imitative, and productive) and two main ways of looking at them: *either* as engines of creation *or* as windows upon the invisible world. It is in this context that we encounter some of van Fraassen's familiar discussions about electron microscopes and spectroscopes *creating 'new phenomena*, truly humanly observable phenomena' (100), as opposed to being windows into the unobservable realm. The discussion is enriched by a new emphasis on measurement, both from a historical perspective (going back to Mach on thermometers, and Poincaré and Einstein on time and length measurements—chapter 5) and from a philosophical one, whereby aspects of the notion of 'measurement outcome'—i.e. intentionality, indexicality, and perspectivity—are related to specific kinds of representation (especially imaging and picturing, 180–181).

It is in this context that van Fraassen introduces a new take on a classical distinction of his own, namely the distinction between data models and surface models: 'the data model summarizes the relative frequencies found; the surface model "smoothes"—in fact "idealizes"—this summary still further so as to replace the relative frequency counts by measures with a continuous range of values. … The abstracting is an idealising, an extrapolation to a form that *could not* be reached in actual practice' (167 and 172). This distinction turns out to be all the more relevant for the rest of the book, in particular for the discussion on structuralism that occupies Part III.

Indeed, in the following Part III of the book (chapters 8–11), the focus of the discussion shifts from measurement as representation to the contention that scientific representation is about structure only. Through a historical *excursus* via Hertz's and Boltzmann's *Bildtheorie* to Russell's structuralism, and from Carnap's *Aufbau* to Putnam's model-theoretic argument against metaphysical realism, van Fraassen returns to another familiar topic of his own, namely the defence of an empiricist version of structuralism. Hertz's problem of explaining '*just how do those "pictures", those mathematical constructions, represent what they represent?*' (208) is the same problem that Newman raised against Russell's structuralism; and the very same problem that also empiricist structuralism ought to address, whereby:

> Essential to an *empiricist structuralism* is the following core construal of the slogan
> that *all we know is structure*:
>
> I. Science represents the empirical phenomena as embeddable in certain *abstract structures* (theoretical models).
>
> II. Those abstract structures are describable only up to structural isomorphism. …

Empiricist structuralism is a view not of what nature is like but of what science is. (238)

Van Fraassen uses Putnam's model-theoretic argument to fight the metaphysical realist view (associated with the correspondence theory of truth) claiming that 'there is an essentially unique *privileged* way of representing: "carving nature at the joints"' (244). At the same time, he uses Putnam's argument also against non-empiricist versions of structuralism that tend to forget that '*We have an interpretation* for the given language *only if we can define or identify such a function.* To do that we must be able to describe both the function's domain and its range … . As long as we are not given an independent description of both the domain and the range of the interpretation, we do not *have* any such interpretation, nor any way to identify one' (233–234).

But while Putnam, led by the model-theoretic argument, landed in Kantian internal realism (until the pragmatic turn of the late 1980s), van Fraassen, led by the same argument, opts for a self-declared Wittgensteinian move with an emphasis on the *use* of theories and representation (see 235), in continuity with the *pragmatics* of scientific representation discussed in Part I. But how can such a Wittgensteinian move help us address the problem of explaining '*how, or in what sense, can such an abstract entity as a model "save" or fail to "save" this concrete phenomenon?*' (245). Moreover, if 'saving the phenomena' implies embedding data models into theoretical models, both of which are abstract structures, then 'doesn't a reflection that focuses on the data model for assessing empirical adequacy, lose contact with reality altogether?' (246).

We reach here what in my view is the most interesting part of the book, where the previous discussion on the pragmatics of representation and on measurement as representation come together and some classical tenets of van Fraassen's constructive empiricism are revisited. The self-declared 'Wittgensteinian move' (254) consists then in the following: 'the *theory to phenomena relation* displayed here is an embedding of one mathematical structure in another one. For the data model—or, more accurately, the surface model—which represents the appearances, is itself a mathematical structure … . Construction of a data model is precisely the selective relevant depiction of the phenomena *by the user of the theory* required for the possibility of representation of the phenomenon … . *There is nothing in an abstract structure itself that can determine that it is the relevant data model, to be matched by the theory*' (252–253).

By shifting attention to the user-dependent notion of scientific representation, van Fraassen can maintain:

> For us *the claims*
>
> (A) that the theory is adequate to the phenomena and the claim
>
> (B) that it is adequate to the phenomena as represented, i.e. as *represented by us*
>
> are indeed the same*! That (A) and (B) are the same for us is a pragmatic tautology.* (259)

And again: 'in a context in which a given model is *someone's* representation of a phenomenon, there is *for that person* no difference between the question *whether the theory fits that representation* and the question *whether that theory fits the phenomena*' (260).

Having taken this crucial pragmatic step, in the final Part IV, van Fraassen finally returns to the issue of realism. As anticipated above, in this final part of the book he explores the parting of the

way in the problem of representation as it emerged in the sciences with Galileo, and as it was later reinterpreted by Descartes and other philosophers as the 'problem of the external world'. By building up on the previous *user-dependent,* perspectival analysis of scientific representation, van Fraassen now introduces a new distinction between appearances and phenomena: 'Phenomena are observable, but their appearance, that is to say, *what they look like in given measurement or observation set-ups* is to be distinguished from them as much as any person's appearance is to be distinguished from that person' (284). Appearances are simply the contents of measurement outcomes, and should not be confused with what philosophers sometimes calls 'appearances', namely subjectively experienced impressions (see 276).

On the other hand, phenomena are observable things and events in the world: they are the 'smelly, colourful, noisy things' which are real (276). A paradigmatic example is how Copernicus's theory saved the 'phenomenon' of Mercury's motion, by showing how the 'appearance' of its retrograde motion could be derived (via kinematics and optics) from what Copernicus postulated about Mercury's motion. One may also be tempted to equate van Fraassen's distinction between appearances and phenomena to the previous distinction between data models and surface models, although van Fraassen does not do this explicitly. The bottom line is that reality consists of smelly, colourful, noisy (observable) phenomena (not Kantian things-in-themselves, nor a Cartesian external world), while appearances are the way phenomena 'look like' in a given measurement set-up, and hence from a particular vantage point (as in Dürer's pictorial perspective). We 'save phenomena' by embedding perspectival appearances (as given by a certain instrument, measurement set-up, or frequencies in a data model) into another abstract structure, the surface model, which 'smoothes' and 'idealises' the measurement outcomes, and eventually embed the surface model into theoretical models, such as for example Copernicus's geometric models in astronomy.

This brief overview of the book does not do justice to the complexity, details, and nuances of it. But I hope it suffices to give an idea of the fascinating journey that goes from a serious re-appraisal of the role of scientific instruments in artistic and scientific representation, to the more general issue of how science represents nature, and how its modalities and operations should not be conflated with the philosopher's problem of the external world, according to van Fraassen. This is a book with an important and intricate story to tell, and it does it with so much attention to historical, philosophical, scientific, and even artistic details that makes it an occasion for a thousand wider meditations.