Wenceslao J. González (ed.): *Bas van Fraassen's Approach to Representation and Models in Science,* Dordrecht: Springer, Synthese Library 368, 2014, xiv + 233 pp.

A book on the work of Bas van Fraassen must always be welcome, but this is indeed a great achievement, as it contains two new papers by van Fraassen and also seven papers by different authors focused on diverse aspects of his work. After a prologue in which the editor describes the contents of the book, we find a useful overview of van Fraassen's work focusing on models and representation. This first chapter is written by the editor himself and it concludes with a complete bibliography including a list of van Fraassen's books and articles and a list of references on van Fraassen's work. González stresses the idea that, for van Fraassen, representation is a kind of activity and not just an epistemological relation. He also pays attention to the different kinds of models that have been distinguished by van Fraassen. In general, González analyzes van Fraassen's approach to models and representation as a combination of pragmatism, empiricism, a constructivist methodology, and a special emphasis on cognitive values.

In her paper "Scientific Activity as an Interpretative Practice. Empiricism, Constructivism and Pragmatism", Inmaculada Perdomo follows van Fraassen's work in order to stress the centrality of subjects in science as interpreters in construing and using scientific representations. She focuses on van Fraassen's philosophical development, but maintains that he has not really changed his positions, but rather he has emphasized the role of subjects in scientific activity. The most interesting in her paper is the way in which she relates van Fraassen's constructivism to American pragmatism. Following this pragmatist vein, scientific representation is seen as an intentional process of decision-making, whereas knowledge is viewed as a means of connecting skills with actions and purposes. As I rather tend to sympathize with this pragmatist vein, I can only salute this connection with American pragmatism, which, I think, helps to reinforce van Fraassen's ideas, but at the same time it seems to me very important to stress the fact that giving the subjects the role they have in science does not mean to remove or diminish the objective contents of scientific activity.

Valeriano Iranzo, in his "Models and Phenomena: Bas van Fraassen's Empiricst Structuralism", puts into question van Fraassen's idea that indexical constraints have the last word concerning the issue whether a scientific representation really represents what it aims to stand for. That is to say, Iranzo argues against the alleged sufficiency of the pragmatic constraint for the representation relation. Genuine representations should give us some knowledge about our targets. As he describes it, Iranzo's point "is that the truth of those descriptions [i.e. our pre-scientific descriptions of the phenomena] may be relevant after all for assessing whether the phenomenon is represented by a particular model." (p. 74). I think there are here involved two notions of representing. In the first sense, representing is understood as factive. For a model to really represent a phenomenon means that our descriptions of the phenomenon are correct and the phenomenon (at least to a certain degree of approximation) *has in fact* the properties that the model attributes to it. According to the second sense, which is non factive, representing involves just our *intention* that the model (at least approximately) corresponds to the phenomena. Both senses are perfectly valid. As I am not a realist, I tend to think that we cannot be completely sure about whether our models *really* represent the phenomena. The best we can do is getting better and better in our understanding of phenomena. I think this is what van Fraassen has in mind. But I concede to Iranzo the point that, as it stands, van Fraassen's mere intentional

notion of representation is missing something. I would say that a model does not represent a phenomenon by our mere willing or intending (even if this intending is shared by a community as a result of a certain consensus). It must be a constraint that the model allows us to extract inferences about our targets, inferences which scientists can make good use of, no matter if those inferences are correct or incorrect. Iranzo says that the model must provide us with knowledge, but again I think this is too strong if by knowledge we have the traditional notion in mind (so that we are taking it in the factive sense).

The text of Maria C. Gavalotti "On Representing Evidence" is in line with the increasing debate about the nature and the role of evidence in the process of establishing and assessing scientific hypotheses. She points out, correctly in my view, that evidence is of great importance not only from a theoretical perspective, but also in practical decision-making and risk management, and it may also involve ethical issues. According to Gavalotti, evidence is a trans-disciplinary notion that allows scientists to relate some body of information to a given hypothesis, so that the hypothesis may or may not receive support from the evidence. Different pieces of evidence may have distinct relevance for the assessing and formulation of hypotheses. This is also why she understands evidence as being context-sensitive. Gavalotti discusses examples from law and the health sciences and examines some of the problems involved. I miss in the text some kind of analysis of the relation between evidence and other related and more 'classical' concepts such as explanation and confirmation.

Abduction, and more concretely the logical treatment of abductive inference, is gaining increasing attention in recent times. The paper of Ángel Nepomuceno "Scientific Models of Abduction: The Role of Non Classical Logic" presents an overview of the research on abduction focusing more on the logical studies that have been developed until now. He briefly discusses the classical model of logical treatment of abduction, of which Aliseda's *Abductive Reasoning* is a good example. The classical model involves three main parameters: the background knowledge, the surprising fact that is to be explained, and the inference relation (the classical relation of logical consequence). What Nepomuceno proposes is to give up the classical model and to adopt a dynamic perspective using modal and multimodal logics. First, Nepomuceno presents a survey of Bonano's multimodal proposal, and then his own 'explanatory models' for abduction, also based on modal logic (S4) and provided with a semantics of possible logics. This allows us to work with different possible inference relations depending on the case we are trying to account for. So, Nepomuceno's explanatory models can operate with classical logical consequence as well as with a non-classical logical consequence. This must be seen as a virtue, as they can be used in cases in which the use of non-classical inference relations seems more desirable. Nepomuceno mentions the transition from classical Newtonian mechanics to quantum mechanics as an example (by the way, the case of quantum mechanics has been reconstructed by Baltag and Smets in terms of a dynamic epistemic logic). Nepomuceno's models must show their applicability to concrete cases. The possibility of treating historical scientific examples in this new framework would be the acid test for Nepomuceno's approach.

Stathis Psillos, in his "The View from Within and the View from Above: Looking at van Fraassen's Perrin", considers van Fraassen's view of Perrin's work on Brownian motion and argues against him that it is not reasonable to claim that the molecular theory was superior than any other without defending that the theory was probably true. Psillos defends a realist interpretation of Perrin's results, in fact a paradigmatic example that scientific realists tend to choose in order to favour their thesis. Psillos's point is that Perrin's aim was not

simply to prove that the atomic theory would be empirically inadequate if N (Avogadro's number) has had a different value, but to show the reality of the theoretical parameters. So, van Fraassen cannot remain neutral to the strictly theoretical part of the theory. In a very well known passage, Perrin claims quite clearly: "it becomes very difficult to deny the objective reality of molecules". I may very well admit that the realist interpretation is the position that should be attributed to Perrin himself from a historical point of view, but I am more dubious about the fact that Perrin's results should convince us of the necessity of postulating theoretical entities as the theory describes them. Bayesian arguments are not conclusive (IBE does not help either). It can be regarded as perfectly rational to say that there could be alternatives to the atom theory that could save the phenomena. Another thing is for sure whether this fact suffices for not concentrating our efforts in the theory and for abandoning our confidence in it.

Margarita Santana's contribution, "Explanation as a Pragmatic Virtue: Bas van Fraassen's Model", gives an overview of van Fraassen's pragmatic account of scientific explanation and discusses the standard criticisms by Kitcher, Salmon and Achinstein. The general idea behind these criticisms is the problematic status of the relevance relation and the fact that, strictly speaking, van Fraassen's view is not pragmatic as it includes a context, but not the subject and its audience. According to Santana, these authors depart from different premises. Van Fraassen would see explanation not as a relation between a theory and the world, but as a pragmatic virtue. As far as the relativism issue is concerned, it seems to me that van Fraassen would also want to exclude unscientific explanations, but this issue does not rely on a better characterisation of the notion of explanation. It rather depends on the context in which the explanation is produced. What is much more problematic in van Fraassen's view is the restriction of explanations to responses to why-questions.

I have left to the end the two contributions of the author who is honoured in this book. In "The Criterion of Empirical Grounding in the Sciences", van Fraassen focuses on the interplay of theory, models, and measurement, as well as on the notion of empirical grounding. From the analysis of some historical cases, van Fraassen extracts interesting considerations regarding the traditional ideas on justification, confirmation, and empirical evidence. The author puts into question the view that the scientist is engaged in confirming hypotheses and maintains that the demand is rather that of providing *empirical grounding*, understood as a contextual and normative relation involving theoretical as well as empirical tasks. Unfortunately, van Fraassen does not explore the particularities of this relation with enough dedication. He just refers to three kinds of criteria imposed by the normative demand (determinability on the basis of measurement, concordance, and refutability). Van Fraassen's second contribution, which is the last chapter of the book, focuses on "Values, Choices, and Epistemic Stances". According to the author, Quine's naturalized epistemology appeared to exclude value judgments from the rational formation (and changing) of beliefs in scientific activity. Recent naturalist positions seem to be more 'liberal', though still exclusively remain at the level of instrumental value. This is not enough, as —according to van Fraassen— value judgments lie at the center of any task in epistemology. As van Fraassen stresses, correctly in my view, judgments about values seem to be inescapable and cannot be substituted by mere factual judgments or reduced to instrumental rationality. Since Kuhn's *Structure* it has been seen as imperative to discuss the role of values in science. Van Fraassen's new paper makes a valuable contribution to this debate as it points at some difficulties, false dichotomies, and false parallels that have been generated by this debate.

In my view, this book is not a mere compilation of contributions making exegesis of an author, but a philosophical contribution in itself. Each of the papers included in this volume may contribute to the philosophical debate regarding issues such as scientific realism, the relation between theory, models, and measurement, the 'logic' of abduction, the notion of evidence, or the importance of value judgments in science. It deserves the attention of philosophers of science, not just of those interested in van Fraassen's work.

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