

Constructive Empiricism and the Vices of Voluntarism

Paul Dicken

Abstract

Constructive empiricism – as formulated by Bas van Fraassen – makes no epistemological claims about the nature of science. Rather, it is a view about the aim of science, to be situated within van Fraassen’s broader voluntarist epistemology. Yet while this epistemically minimalist framework may have various advantages in defending the epistemic relevance of constructive empiricism, I show how it also has various disadvantages in maintaining its internal coherence.

Keywords: constructive empiricism; epistemic voluntarism

1 Introduction

Constructive empiricism – as it has been formulated and developed by its originator, Bas van Fraassen – does not make any epistemological claims about the nature of science. As van Fraassen (1980: p. 4) himself puts it in one of his earliest statements of the position, constructive empiricism is a view about the *aim* of science, and as such it is entirely neutral with respect to the epistemic attitudes that we should hold towards the consequences of our accepted scientific theories. To be sure, the constructive empiricist is committed to the claim that one does not *need* to believe that our accepted scientific theories are true, since the belief that they are merely empirically adequate is argued to suffice. But claims about what we need to believe do not determine our epistemic policy: as Ladyman, Douven, Horsten and van Fraassen (1997: pp. 318–19) point out, one could agree that the aim of science is mere empirical adequacy, and agree that we need not believe our accepted scientific theories to be more than empirically adequate in order to accommodate contemporary scientific practice, yet still maintain as a matter of epistemically well-placed fact that our accepted scientific theories are *true*; and conversely, one could deny that the aim of science is mere empirical adequacy, deny that we need only believe our accepted scientific theories to be empirically adequate in order to accommodate contemporary

scientific practice, yet still maintain a healthy degree of scepticism about the enterprise as a whole.

Moreover, it is also clear that constructive empiricism – as it has been articulated and defended by van Fraassen – *cannot* make any epistemological claims about the nature of science. This follows from the broader epistemological project within which it is to be situated. According to van Fraassen's so-called voluntarist epistemology, rationality is to be considered as a matter of permission rather than obligation, where one is rationally entitled to believe anything that one is not rationally compelled to disbelieve (1989: pp. 171–3; 2000: p. 277; 2002: pp. 92, 97); or to approach the same point from another angle, where an agent can be considered rational in holding a particular combination of beliefs just in case that combination does not sabotage its own possibility of vindication (1985: p. 248; 1989: p. 157). What this all boils down to is that once one has shown that one's set of beliefs meets the minimal standards of logical consistency and probabilistic coherence, there simply is no further work for a substantive epistemology to do.¹ Consequently, constructive empiricism cannot be construed as an epistemological claim about the nature of science – for example, about which of the consequences of our accepted scientific theories we are justified in believing – since within this voluntarist framework substantive issues about justification and warrant are simply moot.

After somewhat of a slow start, it is now generally acknowledged that van Fraassen's constructive empiricism is meant to be taken hand-in-hand with his epistemic voluntarism. The precise nature of this relationship, however, remains to be determined. Stathis Psillos (2007: p. 135) expresses what we may well take to be the consensus opinion that van Fraassen's views on rationality are quite independent of his views on constructive empiricism, since one could be both an epistemic voluntarist and a scientific realist. Of course, epistemic voluntarism does provide a particularly hospitable environment for constructive empiricism, since understanding the position as an epistemologically neutral component of a broader voluntarist package promises certain advantages in its defence: in addition to Psillos' own concerns about the status of inference to the best explanation with respect to van Fraassen's arguments for constructive empiricism (Psillos, 1996; Ladyman et al., 1997), it is also clear that any attempt to undermine the constructive empiricist's distinction between the observable and unobservable consequences of his scientific theories on the grounds that belief in the latter are just as warranted as belief in the former (or indeed *vice versa*)² will be quite irrelevant to the concerns of a voluntarist epistemology, provided of course that the constructive empiricist can show that restricting his belief to the observable consequences of our accepted scientific theories will neither generate contradiction nor guarantee losing money at the tracks. Nevertheless, for all their undoubted compatibility, epistemic voluntarism and constructive empiricism remain distinct elements of van Fraassen's overall vision.

What I wish to establish in this paper is that such a contention is false, on the grounds that van Fraassen's articulation and defence of constructive empiricism makes an ineliminable appeal to his voluntarist framework. In particular, I shall be concerned with the charge that the constructive empiricist cannot consistently draw his central distinction between the observable and the unobservable consequences of our scientific theories. I shall show how any satisfactory defence of constructive empiricism – again, as conceived of by van Fraassen – must appeal to a broader, voluntarist epistemology; in particular, those aspects of a voluntarist epistemology that deny that there is any higher standard for the assessment of an epistemological position than the basic constraints of consistency and coherence. Or in other words, that any satisfactory defence of constructive empiricism offered by van Fraassen depends essentially upon the background assumption that, provided one meets the basic constraints of consistency and coherence, there simply is no further question about the success or otherwise of an epistemological position. This is an important result, since there are many reasons why one may feel dissatisfied with van Fraassen's minimalist take on epistemology.³ If such objections hold, they do not merely deprive constructive empiricism of a comfortable epistemic framework; rather, they undermine the very coherence of the position.

2 Musgrave's Objection Revisited

Alan Musgrave (1985) has famously challenged the constructive empiricist's ability to maintain his own position consistently. In essence, Musgrave's objection is that in order to draw his distinction between the observable and the unobservable consequences of our accepted scientific theories, the constructive empiricist must believe what our scientific theories say about the observability or otherwise of the various entities that populate those scientific theories. Yet to believe what these scientific theories say about the *unobservability* of a particular entity is to violate the constructive empiricist's central contention about the aim of science being mere empirical adequacy. In other words, in order to defend the position that in making sense of our contemporary scientific practice we need not believe our accepted scientific theories to be more than empirically adequate, the constructive empiricist is in fact committed to the belief that they are more than empirically adequate, rendering the position untenable.

The precise respect in which van Fraassen has attempted to rebut this objection has troubled many commentators.⁴ In more recent work, however, Muller and van Fraassen (2008) have made the strategy clear. They claim that Musgrave's objection presupposes a syntactic account of theories, whereas constructive empiricism is explicitly wedded to a semantic account (2008: p. 200); and that once this is appreciated, one can see that the constructive empiricist need not violate his position with respect to the aim

of science in order to draw his distinction, since to believe that an entity is unobservable is simply to believe that his empirically adequate scientific theories fail to classify that entity as observable (2008: pp. 200–1). The first claim is false, since both Musgrave's objection and, indeed, the response offered by Muller and van Fraassen are perfectly neutral between the syntactic and semantic approaches to scientific theories.⁵ The second claim, however, is more interesting, not least because pursuing it will quickly bring us into contact with van Fraassen's epistemic voluntarism.

According to Muller and van Fraassen, to believe that (according to our accepted scientific theories) a particular entity is unobservable does not force the constructive empiricist to believe more than what his theories say about the observable phenomena, since this belief is in fact reducible to perfectly legitimate beliefs about observable entities and the (exhaustive) belief that his theory of observability is empirically adequate in this respect. To take their example, suppose that we have a scientific theory that classifies entities either as being an electron or as being observable, and suppose further that there is no model within the class of models that constitute the theory in which these two categories overlap. It follows from this that if we believe the theory to be empirically adequate – and therefore believe that all the actual, observable phenomena are represented as such in some model of that theory – then since we know that nothing that is classified as observable by any model of the theory is also classified as an electron, then we must also believe that there are no observable electrons; in other words, electrons are unobservable.

But as Muller and van Fraassen (2008: pp. 201–4) themselves note, such a strategy can only get the constructive empiricist so far. To believe that one's theory of observability is empirically adequate is to believe that it correctly identifies all of the *actual*, observable phenomena; on Muller and van Fraassen's account, then, to believe that electrons are unobservable is to believe that there are no observable electrons among the *actual* observable phenomena. But the belief that electrons are unobservable presumably goes beyond this: it is to believe a certain modal claim about the unobservability of electrons; that all possible electrons are unobservable, not just the ones that might actually exist.⁶

In an attempt to bridge this residual gap, Muller and van Fraassen (2008: p. 204) propose an amendment to the constructive empiricist's epistemic policy: they stipulate that when it comes to matters of observability, exhaustive beliefs about the empirical adequacy of one's relevant scientific theory are automatically to be given the widest possible modal scope. Such a policy, however, presumably does not hold for our other classificatory categories. None of the scientific theories that I believe to be empirically adequate – that is, those theories that I believe to have classified all actual, observable phenomena correctly – classify any entity as being both a sphere with a diameter greater than 10 miles and as made entirely of gold. I therefore

believe that there are no actual golden spheres with a diameter greater than 10 miles; I don't, however, believe this combination to be *impossible* in the same way that I discount the possibility of an observable electron. Muller and van Fraassen's considered response therefore rests upon assigning a privileged status to claims about observability which, while not necessarily *ad hoc*, certainly lacks any independent motivation: observability, although obviously of enormous importance to the constructive empiricist, is in all other respects a perfectly straightforward scientific concept, to be investigated and determined by our accepted scientific theories like any other scientific concept.⁷

It is at this point that the appeal to a voluntarist epistemology becomes paramount. Musgrave's objection challenges the constructive empiricist to draw his distinction between the observable and unobservable consequences of our scientific theories, given that beliefs about the unobservability of certain entities are rendered illegitimate by the position that such a distinction is meant to establish. Muller and van Fraassen's response is to argue that such putatively problematic beliefs are in fact reducible to more legitimate beliefs, provided we are willing to grant this reduction class a privileged modal status that has no other motivation than to avoid Musgrave's objection. Within a traditional (i.e. non-voluntarist) epistemological framework, one might reasonably query how it is that the constructive empiricist can simply *stipulate* that his epistemic policy is sufficient to recover the beliefs necessary for his observable/unobservable distinction, when the objection facing him is precisely that his epistemic policy is not sufficient to recover such beliefs. That is to say, given that Musgrave has challenged the constructive empiricist's ability to maintain consistently his distinction between the observable and the unobservable consequences of our scientific theories, there is something epistemologically very unsatisfactory in being told by Muller and van Fraassen that the constructive empiricist *can* maintain such a distinction on no stronger grounds than that if he is to be a constructive empiricist, he *must* maintain such a distinction.

The only way that Muller and van Fraassen's response to Musgrave can be considered as anywhere near satisfactory is if we explicitly adopt a voluntarist framework that rejects any substantive epistemology beyond the basic constraints of consistency and coherence. For while Muller and van Fraassen's amended epistemic policy may strike us as straightforwardly begging the question against Musgrave, it must be conceded that their strategy is perfectly rational according to this more parsimonious perspective. Indeed, in this respect Muller and van Fraassen's strategy for defending the constructive empiricist's ability to draw his central distinction exactly parallels the general voluntarist strategy for defending the epistemic relevance of the constructive empiricist's distinction: in the latter case, although we may not be able to see why claims about observables are any better warranted than claims about unobservables, we must concede that

there is nothing inconsistent with maintaining such a distinction; in the former case, although we may not be able to justify Muller and van Fraassen's stipulative response to Musgrave, we must similarly concede that there is nothing incoherent in its formulation.⁸

3 Matters of Modality

Musgrave's objection was that the constructive empiricist cannot consistently maintain his central distinction between the observable and unobservable consequences of our scientific theories without violating the explicit view of science that such a distinction is meant to establish; and van Fraassen's response to this problem makes an ineliminable appeal to the minimalist framework associated with his epistemic voluntarism. The same dialectic can also be shown to underlie another important objection to the constructive empiricist's ability to draw his distinction between the observable and the unobservable, this time focussing upon the modal dimension of the distinction.

The problem of modality, as originally raised by James Ladyman (2000), is that drawing a distinction between the observable and unobservable consequences of our accepted scientific theories immediately commits the constructive empiricist to various *counterfactual* consequences of his accepted scientific theories – what we would have observed, had the circumstances been different – of which he is fundamentally unable to provide a satisfactory analysis. For on the one hand, if the constructive empiricist maintains that these counterfactuals have objective truth-conditions, then he is admitting that in order to defend his view about the aim of science one must believe one's scientific theories to be more than empirically adequate (that is, they correctly describe certain *non-actual* phenomena); while on the other hand, if the constructive empiricist defends a non-objectivist account of his counterfactual truth-conditions, he is left with too arbitrary a distinction with which to do any philosophical heavy-lifting.

In essence, Ladyman's dilemma is a problem about the similarity ordering of possible worlds. Suppose that the constructive empiricist endorses objective truth-conditions for his counterfactuals and therefore accepts – for the sake of simplicity – something like Lewisian realism about possible worlds. At first blush, there is nothing incompatible between constructive empiricism and modal realism; after all, one is a view about the aim of science, while the other is a metaphysical thesis about the truth-conditions of modal statements.⁹ But now suppose we ask *which* possible worlds are to be used to delineate the observable, that is, to demand that the constructive empiricist give us an account of what it is that makes one possible world closer to the actual world than another. One crucial constraint here will be in keeping the laws of nature fixed – we are after all interested in what it would be *physically* possible for us to observe, since any stronger conception

of possibility would threaten to collapse the constructive empiricist's distinction altogether. But then if the constructive empiricist admits objective modal facts, he must also admit that some of the regularities posited by his accepted scientific theories correctly describe the unobservable structure of the world; in which case, constructive empiricism collapses into a form of structural realism (Ladyman, 2004: p. 764; Ladyman and Ross, 2007: p. 111).

Endorsing objective counterfactual truth-conditions in order to secure his distinction between the observable and the unobservable therefore commits the constructive empiricist to just those beliefs that he contends he need not hold in order to make sense of scientific practice. The first horn of Ladyman's dilemma can therefore be seen as an instance of the general objection raised by Musgrave. Moreover, just as Muller and van Fraassen attempted to rebut Musgrave's objection by construing their putatively problematic commitments as in fact satisfied by more parsimonious beliefs, so too do Monton and van Fraassen (2003) attempt to grasp the second horn of Ladyman's dilemma. They defend an essentially meta-linguistic account of counterfactuals, according to which a counterfactual is true iff there is a model of our accepted scientific theories in which both the antecedent and the consequent are true.¹⁰ Their basic strategy is to claim that since the counterfactuals in question just describe the logical consequences of our various scientific theories – and since the relevant scientific theory will vary from context to context – there is no sense in which such counterfactuals are made true by objective modal facts. However, since these scientific theories are believed to be empirically adequate, and thus correctly describe certain objective, non-modal facts about the actual world, using such counterfactuals to determine the distinction between observable and unobservable entities is far from arbitrary.

The crucial element in all of this, however, concerns the notion of a 'context', since the counterfactuals in which the constructive empiricist is interested will have one truth-value relative to one context, and another truth-value relative to another. Monton and van Fraassen's strategy therefore faces the general problem of *cotenability* that plagues all meta-linguistic accounts of counterfactuals, and unfortunately, Monton and van Fraassen have little further to say on the matter: they note that the context within which a counterfactual is uttered will contain 'a good deal of unformulated general opinion, but also features specific to the case' (2003: p. 410), but provide no further details. The problem can also be put in terms of the similarity ordering of models: it is not sufficient for the truth of a counterfactual that there is some model of the relevant scientific theory where the antecedent logically entails the consequent; it must also be the model *most similar to* (the model that represents) the actual world. It is simply irrelevant to the evaluation of a counterfactual to point out that there is some model of the theory that makes it true, unless that model also keeps fixed all the relevant background information about the case in question.

Again, the obvious solution would be for Monton and van Fraassen to argue that we can justify privileging one model over another on the grounds that we have reason to believe that the regularities described by our accepted scientific theories describe objective features of reality, i.e. laws of nature. In other words, the reason why travelling to Jupiter would result in my observing the moons – rather than the moons disappearing, say – is that the stability of the moons is exactly the sort of substantial fact about the actual world that any sufficiently similar model must represent. But such a response is clearly unavailable to Monton and van Fraassen, as it would again commit the constructive empiricist to the view that his accepted scientific theories are more than empirically adequate. Instead, they must work with van Fraassen's (1989) own deflationary account of laws, according to which 'laws of nature' merely describe part of the implicit structure of the models of our scientific theories: they are facts about how we choose to represent the world, not facts about the world itself. To privilege one model over another, on the grounds that it is nomologically similar to the actual world, is merely to privilege one model over another on the grounds that it satisfies more of our *conventions* about how to represent the world (Ladyman, 2004: p. 762).

Ultimately, then, Monton and van Fraassen's meta-linguistic account makes the truth of a counterfactual depend upon certain conventional, pragmatic decisions of the scientific community about how to represent the world. In particular, then, counterfactual claims about what we would have observed, had the circumstances been different – and thus the constructive empiricist's distinction between observable and unobservable entities – also depends upon conventional and pragmatic decisions of the scientific community about how to represent the world. It is at this point that we can see how van Fraassen's considered response to Ladyman hinges upon what appear to be quite arbitrary considerations, just as his considered response to Musgrave ultimately depended upon quite arbitrary considerations. Similarly, it is at this point that we can see just how crucial an appeal to a voluntarist framework becomes. The only option for Monton and van Fraassen is to concede the inherently conventional status of their counterfactual statements, yet to challenge the extent to which this renders the distinction between observable and unobservable entities entirely arbitrary. The whole point of a meta-linguistic account, Monton and van Fraassen may argue, is after all to dispense with an objective notion of modality in favour of something based in everyday human practice; they might therefore, and with some justification, complain that in evaluating their deflationary account of counterfactuals against an objective standard as Ladyman does – that is, taking the standard of success for a deflationary account of counterfactuals to be to provide what is in effect an objective account of counterfactuals – he begs the question against them.¹¹ The question then is whether or not the constructive empiricist's account of

counterfactuals needs to satisfy more than just other constructive empiricists. For on the one hand, if we take Ladyman's dilemma as merely a challenge for the constructive empiricist to provide an internally coherent account of counterfactuals, then perhaps one can bite Monton and van Fraassen's deflationary bullet. Yet on the other hand, if we take Ladyman's dilemma as a challenge for the constructive empiricist to provide an internally coherent account of counterfactuals that also meets his *critics'* standards for a satisfactory account of counterfactuals, then Monton and van Fraassen's approach looks woefully inadequate. And while there may indeed be some mileage in the first approach, it clearly depends upon construing constructive empiricism as a view about the aim of science, to be situated within a minimalist epistemic framework in which broader questions of justification are redundant.

4 Conclusion

Epistemic voluntarism provides an important licence for constructive empiricism: from within such a framework, one need not show that belief beyond empirical adequacy is unwarranted, or that scientific realism is irrational, in order to endorse constructive empiricism; one merely needs to show that it is internally consistent. But epistemic voluntarism also plays a crucial foundational role for constructive empiricism, for without such a minimalist framework, van Fraassen's attempts to salvage the position from self-refutation can only be considered feeble. And while one may have some sympathy for the former attempt to resolve – or rather, dissolve – a long-running clash of intuitions within the philosophy of science, one may rightly balk at the latter attempt to finesse criticism of one's position altogether. Constructive empiricism is at heart inextricably entangled with van Fraassen's idiosyncratic epistemology; my contention is that this may well be seen as more of a vice than a virtue.

Notes

This paper was originally given to the Philosophy Workshop at the Department of History and Philosophy of Science, University of Cambridge; my thanks to those who gave comments and suggestions, especially Alex Broadbent, Elly Kingma, Steve John and Mark Sprevak. I would also like to thank the Master and Fellows of Churchill College, Cambridge, where I completed this work as a Research Fellow.

- 1 It should be noted, of course, that van Fraassen's epistemic voluntarism consists of more than the justificatory negative elements sketched above; it also consists of a positive element concerning the role of values and pragmatics within our epistemic judgments, and the sort of commitments one undertakes in making such judgments – these are particularly well illustrated in the context of van Fraassen's defence of the Reflection Principle (van Fraassen, 1984; 1995) and in his articulation of an epistemic stance (van Fraassen, 2002). However, since these

positive elements will have no bearing on my subsequent argument – which concerns the internal coherence of the constructive empiricist’s position – I shall be concerned exclusively with the negative elements of the position in what follows.

- 2 See, for example, Hacking, 1985 and Churchland, 1985 respectively.
- 3 For recent discussion of the pros and cons of van Fraassen’s epistemology, see Monton, 2007: in particular, Ladyman, 2007 argues that such a minimalist epistemic framework collapses any distinction between realism, empiricism and scepticism; Chakravartty, 2007 argues that such a framework leads to some unfortunate forms of relativism; and Psillos, 2007 raises some doubts as to whether such a framework captures any intuitive notion of rationality. See also van Fraassen’s (2007) response in the same volume.
- 4 For van Fraassen’s original response to Musgrave, see van Fraassen, 1985: p. 256. For various interpretations of van Fraassen’s response, see Kukla, 1998: pp. 138–9), Muller, 2004 and Dicken and Lipton, 2006.
- 5 See Dicken, 2009.
- 6 An anonymous referee for this journal has suggested to me that the constructive empiricist could simply ignore this difficulty, arguing instead that science itself only licenses beliefs about the unobservability of actual phenomena, and that therefore it is not required of the constructive empiricist to make up this alleged doxastic deficit. Such a response has some merit, although I think it’s fair to say that this would be both a descriptively implausible account of scientific practice, and straightforwardly at odds with van Fraassen’s own understanding of constructive empiricism (it would after all lead to the unattractive position of having an epistemic policy that forbade belief in the consequences of our scientific theories that were about actual electrons, but which could manage no opinion whatsoever about what we should believe about an additional electron, had it existed!). In any case, in order to defend such a view – which simply states that the constructive empiricist need not accommodate a range of beliefs usually considered as a basic desideratum of a philosophical theory – the constructive empiricist would be forced to appeal to the minimal epistemic constraints licensed by a voluntarist epistemology, avoidance of which (as we shall see) is the primary motivation for such a move.
- 7 The point, of course, is that while ‘being a sphere with a diameter greater than 10 miles’ is clearly not a modal property in the same way that ‘being observable’ is, Muller and van Fraassen appear to have no grounds upon which to make this distinction. The constructive empiricist must show how he can accommodate the range of beliefs necessary for the internal coherence of his position, given that such beliefs are not entailed by his belief in the empirical adequacy of his scientific theories – and if that challenge requires him to stipulate the modal scope of his beliefs, he must justify why it is that this stipulation only covers some beliefs and not others. To claim that some properties are modal and others not is merely to *state* the problem, not to solve it.
- 8 An anonymous referee for this journal has suggested to me that the constructive empiricist could justify his amended epistemic policy on the grounds that since constructive empiricism aims to capture scientific practice, and since scientists themselves infer their beliefs to be about more than the actual observable phenomena, such an amendment simply offers a more accurate description of science and its standards. However, the issue of course is not about the *accuracy* of the constructive empiricist’s description so much as it is about the *internal coherence* of the constructive empiricist’s position – with how he can be entitled

- to this amendment to his epistemic policy when it clearly goes beyond that which is entailed by the constructive empiricist's belief in the empirical adequacy of his scientific theories.
- 9 Monton and van Fraassen, 2003: p. 406; Ladyman, 2004: pp. 763–4. As Ladyman points out, however, there may well be something incompatible between modal realism and van Fraassen's conception of empiricism, of which his constructive empiricism is an integral component: not only does van Fraassen (2002) characterize empiricism as a sceptical stance towards metaphysics, but in some cases he even seems to suggest that the denial of objective modality is a definitive component of empiricism (e.g. van Fraassen, 1977).
 - 10 This of course raises another worry, this time concerning the status of these models, which according to van Fraassen (1980: pp. 64–9; 1989: pp. 217–32) are abstract, mathematical objects. Indeed, one can raise here an analogous problem about mathematics for the constructive empiricist to those Musgrave and Ladyman raise for unobservables and counterfactuals respectively. For the objection that the constructive empiricist must adopt an attitude towards abstract, mathematical objects that is inconsistent with his view concerning the aim of science, see Rosen, 1994; for an attempt to secure the constructive empiricist's commitments along more parsimonious (mathematical fictionalist) lines, see Bueno, 1999; for the argument that such a strategy falls short of satisfying the constructive empiricist's (meta-logical) needs, see Dicken, 2006.
 - 11 Moreover, there may be something of an *ad hominem* lurking here, since Ladyman (Ladyman and Ross, 2007) pursues his philosophy of science against the backdrop of a highly naturalized metaphysics. There is thus a methodological tension to be found between his view that we should essentially allow contemporary physics to settle our metaphysical disputes, and the metaphysically loaded criteria he brings to bear in his criticism of Monton and van Fraassen's deflationary account of counterfactuals. The extent to which one finds the meta-linguistic approach unsatisfactory will be determined by the sorts of pre-scientific cost-benefit analysis of ontological commitment that one brings to the debate, the sort of thing championed by David Lewis and supposedly renounced by the naturalistic metaphysician. Indeed, a purely philosophical debate over the attractive features of a theory of modality is something that floats quite freely of any naturalistic constraint; and no debate over the appropriate semantics for counterfactuals is going to make any headway in a unified, naturalistic metaphysics. For more, see Dicken, 2008.

References

- Bueno, O. (1999) 'Empiricism, Conservativeness and Quasi-Truth', *Philosophy of Science* 66: S474–85.
- Chakravartty, A. (2007) 'Six Degrees of Speculation: Metaphysics in Empirical Contexts', in B. Monton (ed.) *Images of Empiricism: Essays on Science and Stances with a Reply by Bas C. van Fraassen*, Oxford: Oxford University Press, pp. 183–208.
- Churchland, P. M. (1985) 'The Ontological Status of Observables: In Praise of the Superempirical Virtues', in P. M. Churchland and C. A. Hooker (eds) *Images of Science: Essays on Realism and Empiricism with a Reply by Bas C. van Fraassen*, Chicago: University of Chicago Press, pp. 35–47.
- Churchlands P. M. and Hooker, C. A. (eds) (1985) *Images of Science: Essays on Realism and Empiricism with a Reply by Bas van Fraassen*, Chicago: University of Chicago Press.

- Dicken, P. (2006) 'Can the Constructive Empiricist Be a Nominalist? Quasi-Truth, Commitment and Consistency', *Studies in History and Philosophy of Science* 37: 191–209.
- Dicken, P. (2008) 'Conditions May Apply: Essay Review of Ladyman, J. & Ross, D. *Every Thing Must Go: Metaphysics Naturalised*', *Studies in History and Philosophy of Science* 39: 290–3.
- Dicken, P. (2009) 'On the Syntax and Semantics of Observability: A Reply to Muller and van Fraassen', *Analysis* 69: 38–42.
- Dicken, P. and Lipton, P. (2006) 'What Can Bas Believe? Musgrave and van Fraassen on Observability', *Analysis* 66: 226–33.
- Hacking, I. (1985) 'Do We See Through a Microscope?', in P. M. Churchland and C. A. Hooker (eds) *Images of Science: Essays on Realism and Empiricism with a Reply by Bas C. van Fraassen*, Chicago: University of Chicago Press, pp. 132–52.
- Kukla, A. (1998) *Studies in Scientific Realism*, (Oxford: Oxford University Press).
- Ladyman, J. (2000) 'What's Really Wrong with Constructive Empiricism? Van Fraassen and the Metaphysics of Modality', *British Journal for the Philosophy of Science* 51: 837–56.
- Ladyman, J. (2004) 'Constructive Empiricism and Modal Metaphysics: A Reply to Monton and van Fraassen', *British Journal for the Philosophy of Science* 55: 755–65.
- Ladyman, J. (2007) 'The Epistemology of Constructive Empiricism', in B. Monton (ed.) *Images of Empiricism: Essays on Science and Stances with a Reply by Bas C. van Fraassen*, Oxford: Oxford University Press, pp. 46–61.
- Ladyman, J., Douven, I., Horsten, L. and van Fraassen, B. C. (1997) 'A Defence of van Fraassen's Critique of Abductive Inference: Reply to Psillos', *Philosophical Quarterly* 47: 305–21.
- Ladyman, J. and Ross, D. (2007) *Every Thing Must Go: Metaphysics Naturalised*, Oxford: Oxford University Press.
- Monton, B. (ed.) (2007) *Images of Empiricism: Essays on Science and Stances with a Reply by Bas C. van Fraassen*, Oxford: Oxford University Press.
- Monton, B. and van Fraassen, B. C. (2003) 'Constructive Empiricism and Modal Nominalism', *British Journal for the Philosophy of Science* 54: 405–22.
- Muller, F. A. (2004) 'Can a Constructive Empiricist Adopt the Concept of Observability?', *Philosophy of Science* 71: 80–97.
- Muller, F. A. and van Fraassen, B. C. (2008) 'How to Talk About Unobservables', *Analysis* 68: 197–205.
- Musgrave, A. (1985) 'Realism Versus Constructive Empiricism', in P. M. Churchland and C. A. Hooker (eds) *Images of Science: Essays on Realism and Empiricism with a Reply by Bas C. van Fraassen*, Chicago: University of Chicago Press, pp. 197–221.
- Psillos, S. (1996) 'On van Fraassen's Critique of Abductive Reasoning', *Philosophical Quarterly* 46: 31–47.
- Psillos, S. (2007) 'Putting a Bridle on Irrationality: An Appraisal of van Fraassen's New Epistemology', in B. Monton (ed.) *Images of Empiricism: Essays on Science and Stances with a Reply by Bas C. van Fraassen*, Oxford: Oxford University Press, pp. 134–64.
- Rosen, G. (1994) 'What is Constructive Empiricism?', *Philosophical Studies* 74: 143–78.
- van Fraassen, B. C. (1977) 'The Only Necessity is Verbal Necessity', *Journal of Philosophy* 74: 71–85.
- van Fraassen, B. C. (1980) *The Scientific Image*, Oxford: Oxford University Press.
- van Fraassen, B. C. (1984) 'Belief and the Will', *Journal of Philosophy* 81: 235–56.

CONSTRUCTIVE EMPIRICISM AND VOLUNTARISM

- van Fraassen, B. C. (1985) 'Empiricism in the Philosophy of Science', in P. M. Churchland and C. A. Hooker (eds) *Images of Science: Essays on Realism and Empiricism with a Reply by Bas C. van Fraassen*, Chicago: Chicago University Press, pp. 245–308.
- van Fraassen, B. C. (1989) *Laws and Symmetry*, Oxford: Oxford University Press.
- van Fraassen, B. C. (1995) 'The Problem of Ulysses and the Sirens', *Philosophical Studies* 77: 7–37.
- van Fraassen, B. C. (2000) 'The False Hopes of Traditional Epistemology', *Philosophy and Phenomenological Research* 60: 253–80.
- van Fraassen, B. C. (2002) *The Empirical Stance*, New Haven: Yale University Press.