

Constructive Empiricism, Observability, and Three Kinds of Ontological Commitment*

ABSTRACT. In this paper, I argue against constructive empiricism that, as far as science is concerned, observability is not an adequate criterion as a guidance of cautious ontological commitment. My argument is in two stages. First, I argue that constructive empiricist choice of observability as a criterion for ontological commitment is based on the assumption that belief in the existence of unobservable entities is unreasonable because belief in the existence of an entity can only be vindicated by its observation. Second, I argue that the kind of ontological commitment that is under consideration when accepting a theory is commitment to what I call a theoretical kind and that observation can vindicate commitment to kinds only in exceptional cases.

1. Introduction

In the last few decades, constructive empiricism has represented one of the most significant and widely discussed alternatives to scientific realism. Constructive empiricism has revived the view that scientific theories aim to “save the phenomena”. Among the most contentious theses of constructive empiricism is that, in accepting a scientific theory, belief should be suspended with regard to the existence of unobservable entities that are postulated by the theory. Bas van Fraassen, the main advocate of constructive empiricism, argues that belief in the existence of unobservable entities ultimately relies on an unwarranted inference to the truth of the theory that postulates their existence and, therefore, it is not adequately supported. In

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this paper, I will argue that, as far as science is concerned, observability is not an adequate criterion for ontological commitment.

In an essay against van Fraassen's adoption of observability as a criterion for ontological commitment, Paul Churchland once wrote:

[...] our observational ontology is rendered *exactly as dubious* as our nonobservational ontology. This parity should not seem surprising. Our history contains real examples of mistaken ontological commitments in both domains. For example, we have had occasion to banish phlogiston, caloric and the luminiferous ether from our ontology—but we have also had occasion to banish witches and the starry sphere that turns about us daily. These latter items were observable as you please and were widely 'observed' on a daily basis. We are too often misled, I think, by our causal use of *observes* as a success verb: we tend to forget that at any stage of our history, the ontology presupposed by our observational judgements remains essentially speculative and wholly revisable, however entrenched and familiar it may have come (Churchland 1985, p. 36–37).

This paper attempts to make explicit the reasons why, as far as scientific theories are concerned, commitment to what is observable is no less dubious than commitment to what is unobservable. Even if witches are *observable* and electrons are not, I will argue, one cannot *observe that* someone is a witch more than they can *observe that* something is an electron.

My argument is in two stages. First, in Sections 3 and 4, I argue that the best explanation for constructive empiricism selective agnosticism towards the unobservable is to assume that constructive empiricists assume that belief in the existence of unobservable entities is unreasonable because it cannot be vindicated by observation of those entities. Second, in Sections 5–7, I argue that the kind of ontological commitment that is under consideration when accepting a theory is

ontological commitment to what I call a theoretical kind and that, even if we granted that only observation can vindicate ontological commitment to individual entities, it can only vindicate commitment to theoretical kinds in exceptional circumstances. I conclude that, by and large, ontological commitment to observable kinds is no safer than ontological commitment to unobservable kinds and, therefore, observability is not an adequate criterion as guidance to a risk-averse policy in matters of ontological commitment.

2. *The Observable/Unobservable Distinction*

In *The Scientific Image*, van Fraassen famously criticises logical empiricists' attempts to distinguish the terms of scientific theories into observational and theoretical. This alleged distinction, claims van Fraassen, stems from the conflation of two questions that should remain distinct and should be given opposite answers. The first question is whether it is possible to distinguish the terms of a language into theoretical and non-theoretical; the second is whether it is possible to classify entities (objects, events, properties etc.) into observable and unobservable.

According to van Fraassen, the first question should be answered negatively, for “[a]ll of our language is thoroughly theory-infected” (van Fraassen 1980, p.14). On the other hand, he believes that it is possible to answer the second question positively. Entities can be classified on the basis of their being observable by us or not:

The term ‘observable’ classifies putative entities (entities which may or may not exist). A flying horse is observable—that is why we are so sure that there aren’t any—and the number seventeen is not. There is supposed to be a correlate classification of human acts: an unaided act of perception, for instance is an observation. A calculation of the mass of a particle from the deflection of its trajectory in a known force field, is not an observation of that mass (van Fraassen 1980, p.15).

As van Fraassen points out, the observable/unobservable distinction ultimately relies on the classification of some human acts as observations. According to him, a prototypical act of observation has two distinctive features: it is neither *instrumentally* nor *conceptually* mediated. Microscopes, cloud chambers, laser interferometers and other scientific instruments allow us to detect entities, but *detection* has to be carefully distinguished from *observation*. A look through a microscope does not allow us to observe directly a paramecium; only to observe *an image* of a paramecium, or to *detect* a paramecium (van Fraassen 2001). The invention of the microscope, therefore, has not extended the range of what we can observe. Rather, it has created a number of new observable phenomena to be explained: the images that we observe when we look through it. Although a few exceptional examples of instrumentally aided acts of observation (like observation through spectacles, binoculars, telescopes) can be considered clear, though perhaps not prototypical, acts of observation, the constructive empiricist regards only observations with the naked eye as prototypical acts of observation.

The second distinctive feature of a prototypical act of observation is that it is not conceptually mediated. Van Fraassen expresses this requirement by distinguishing between ‘observing’ and ‘observing that’. He remarks:

It is [...] important here not to confuse *observing* (an entity such as a thing, event, or process) and *observing that* (something or other is the case). Suppose one of the Stone Age people recently found in the Philippines is shown a tennis ball or a car crash. From his behaviour, we see that he has noticed them; for example, he picks up the ball and throws it. But he has not seen *that* it is a tennis ball, or *that* some event is a car crash, for he does not even have those concepts. He cannot get that information through perception; he would have first to learn a great deal (van Fraassen 1980, p.15).

The prototypical act of observation does not presuppose that the observer has any concept of what the observed object is. Even if the person in the example does not possess the concept of tennis ball, he can observe a tennis ball exactly as an experienced tennis player would observe it. The prototypical act of observation does not presuppose, on the part of the observer, any belief about or any knowledge of what the observed entity is.

A constructive empiricist would probably consider a few exceptional examples of conceptually mediated acts of observation clear, though perhaps not prototypical, acts of observation. For example, any observer who is presented with a tennis ball does not simply observe that there is something or other in front of her, but she also presumably observes that it is spherical, yellow and soft to touch. Nevertheless a prototypical act of observation does not require more than the mere awareness that something or other is present to the senses of the observer.

The observable/unobservable distinction plays a key role in constructive empiricism. According to van Fraassen, constructive empiricism, as opposed to scientific realism, is defined by two theses. The first thesis is that “[s]cience aims to give us theories that are empirically adequate [...]” (van Fraassen 1980, p.12) rather than true; the second is that “[...] to accept a theory is (for us) to believe that it is empirically adequate—that what the theory says *about what is observable* (by us) is true” (van Fraassen 1980, p.18; emphasis in the original).

Constructive empiricism straightforwardly equates ‘empirically adequate’ with ‘true about what is observable (by us)’. For the constructive empiricist, the range of what is observable by us coincides with the range of what is epistemically accessible to us. Hence, what is observable by us somehow determines both what we can

reasonably expect from a scientific theory and how much belief is involved in its acceptance.

A corollary to the second thesis is that, according to constructive empiricism, belief should be withheld with regard to the existence of the unobservable entities that are postulated by an accepted scientific theory. In this paper, I will focus on this corollary. The decision to withhold belief in the existence of the unobservable entities postulated by a theory, I will argue, is based on a misconception of the sort of ontological commitment that is under consideration when accepting a theory.

3. *On the Connection between Observability and Existence*

The different epistemic attitudes that constructive empiricists adopt towards the existence of observable and unobservable entities presuppose some sort of connection between the observability of an entity and its existence. However, since van Fraassen has never explicitly stated what, according to him, the connection between the two exactly is, we will need a certain amount of guesswork to determine the nature of this connection.

First of all, van Fraassen explicitly rejects the thesis that the connection between observability and existence is of an *ontological* nature. On the one hand, observability does not imply existence. Both existent and non-existent entities can be observable. Flying horses are observable (van Fraassen 1980, p.15), but this doesn't tell us anything directly about whether there are any flying horses.¹ On the other hand, existence does not imply observability. This would amount to assuming that only what is observable by us exists, a thesis that van Fraassen rejects right away as “[...] too anthropocentric [...]” (van Fraassen 1980, p.19).

The relation between the observability of an entity and its existence is rather an *epistemological* one. It is a relation between the belief in the existence of certain

entities and the possibility of observing them. But what is this relation? It is important to note that van Fraassen's constructive empiricism breaks with two prominent empiricist traditions on this issue. The first is what I shall call *naïve empiricism* whose adherents, following the example of Doubting Thomas, are sceptical towards what is *unobserved* rather than what is *unobservable*. For them, only seeing is believing. The mere possibility of seeing something is just not enough. The second, more sophisticated empiricist tradition is what I shall call *holistic empiricism* whose adherents, following Carnap (1950) and Quine (1951, pp.42–43), consider beliefs in the existence of all entities, whether observable or unobservable, on a par from an epistemological point of view. According to them, both observable and unobservable entities are ultimately posited in an attempt to account for our experiences. Since the constructive empiricist breaks with both these traditions, they need to explain on what basis it is possible to draw an epistemological distinction between ontological commitment to observable and unobservable entities.

According to the constructive empiricist, unobservable entities, *unlike observable ones*, are beyond our direct epistemic grasp and belief in their existence can only be indirectly based on a form of inference, abduction, whose very validity is dubious.² Philosophers usually maintain that, if someone arrives at a belief by means of a fallacious reasoning or holds it for the wrong reasons, their belief cannot be considered rational (see, for instance, Audi 1993). This could lead one to suppose that constructive empiricism stigmatises belief in the existence of unobservable entities as irrational.

In fact, van Fraassen explicitly acquits those who believe in the existence of unobservable entities from the charge of irrationality:

Is it rational to believe in angels or electrons? I construe the term *rational*, as applied to opinion here, as a term of *permission*, rather than of *obligation*. To say that you are rational in your opinions does not mean that your opinions are rationally compelled—that any rational person with the same experiences as yourself would have to agree. It is not irrational to ‘go beyond the evidence,’ and belief in angels or electrons [...] does not *ipso facto* make one irrational. The constraints or bounds of rationality leave much undetermined—*rationality is bridled irrationality* (van Fraassen 1985, p.248; emphasis in the original).

In his most irenic moments, van Fraassen seems to suggest that the divergence between constructive empiricists and their critics is ultimately a divergence in the epistemic stances accepted by the two sides of the dispute and that the acceptance of a specific stance is only a matter of personal inclination insofar as the stance does not lead to beliefs that are logically inconsistent or probabilistically incoherent (van Fraassen 2002). Scientific realists are simply less averse towards ontological risk than constructive empiricists. If this was the case, however, van Fraassen’s arguments against scientific realism would be no more than exercises of rhetoric. Unless proven inconsistent or incoherent, scientific realism and constructive empiricism would be on equal philosophical footing.³

However, there seems to be a way to reconcile van Fraassen’s claim that ontological commitment to unobservable entities is rational with his agnosticism towards unobservable entities. Van Fraassen frequently distinguishes between the *rationality* and the *reasonableness* of an act or a decision:

Any act or decision can be evaluated in two ways. If we evaluate it beforehand, we ask how *reasonable* it is, and afterward, we ask to what extent it was *vindicated*. The two cannot be the same since the agent cannot have knowledge beforehand of the exact outcome and consequences of his action—vindication or the lack thereof lies as yet beyond his ken. But there must be a connection, since the point of deciding or

acting lies in the outcome (broadly construed). Therefore a minimal criterion for reasonableness is that you should not sabotage your possibilities of vindication beforehand. (van Fraassen 1989, p.157)

Van Fraassen also states that “[a] *commitment* is [...] not true or false: The confidence exhibited is that it will be *vindicated*” (van Fraassen 1980, p.13; *emphasis added*). We could thus suppose that ontological commitment to unobservable entities, though not irrational, is nevertheless unreasonable. In other words, those who decide to believe in the existence unobservable entities “sabotage their possibilities of vindication beforehand,” to use van Fraassen’s phrase.

But why would the decision to believe in unobservable entities be unreasonable? If only we assume that belief in the existence of an entity can only be vindicated by the observation of the entity in question, it is easy to understand why. If the belief in the existence of an entity can only be vindicated by its observation, then the decision to believe in the existence of an unobservable entity is unreasonable. In fact, since, *ex hypothesis*, it will never be possible to observe unobservable entities, it will never be possible to vindicate belief in their existence.

4. *Observability, Observation, and Vindication*

Van Fraassen never explicitly claims that belief in the existence of an entity can only be vindicated by its observation, even if there is some textual evidence that this is the case.⁴ However, the assumption that constructive empiricists consider belief in the existence the unobservable entities unreasonable would account for many aspects of constructive empiricism. In particular, it would account for the choice of *observability* rather than *actual observation* as guidance to ontological commitment. Constructive empiricism’s scepticism towards the *unobservable* is not to be confounded with the naïve empiricist’s scepticism towards the *unobserved*. For the constructive empiricist,

it is not unreasonable to believe in the existence of unobserved entities as long as the entities in question are observable.

According to the interpretation defended here, this is because belief in the existence of an observable and yet unobserved entity can be either true or false, but can be in principle vindicated by the observation of the entity and, according to van Fraassen, lack of vindication does not impugn the reasonableness of a belief. So it was not unreasonable to believe in the existence of the planets Uranus or Vulcanus before their observation because they were observable (remember that observation through the telescope amounts to observation according to van Fraassen). However, since Vulcanus was never observed, belief in the existence of Vulcanus was never vindicated.

On the other hand, belief in the existence of an unobservable entity can happen to be either true or false, but, whatever the case may be, it can never be reasonable, for it can never be vindicated by the observation of the entity. Unless we assume that constructive empiricists accept the above thesis, it is not clear how they can justify their different epistemic attitudes towards unobservable and observable but unobserved entities, which differentiate constructive empiricism from much traditional empiricism.

Since van Fraassen has never explicitly subscribed this view, it may be argued all this is very speculative. In fact, I may well be wrong about the rationale underlying the constructive empiricist's agnosticism towards the unobservable and I cannot rule out that the motivation that underlies the constructive empiricist agnosticism towards the unobservable is not the one I am proposing. Nevertheless, though speculative, my interpretation is not only plausible but, to my knowledge, also consistent with both the letter and the spirit of constructive empiricism.

Moreover, most of the alternative motivations that may underlie agnosticism toward the unobservable I can think of do not seem to cut to the heart of the problem. For example, as an anonymous referee for this journal has pointed out to me, the rationale behind the agnosticism may be that the postulation of the unobservable entities is superfluous to account for scientific practice or the success of science. This seems to be what van Fraassen thinks (the old story of the sheep and the lamb), but, it does not cut to the heart of the problem. In fact, if this was what motivates their agnosticism towards the unobservable, constructive empiricist would still have explain what justifies the constructive empiricist's departure from the views of empiricists such as Carnap or Quine, according to whom all entities, whether observable or unobservable, are ultimately posited to account for our experiences. In other words, constructive empiricists would still have to explain why commitment to observables and unobservable are on a different epistemic footing, if it is not because, unlike holistic empiricist and like naïve empiricists, constructive empiricist think that actual observation grants us direct epistemic access to observable entities.

If I am right, the rationale that underlies the constructive empiricist agnosticism towards unobservable entities is their belief in the unreasonableness of belief in the unobservable entities. In the rest of this paper, however, I will argue that, even if we conceded that belief in the existence of an entity can only be vindicated by the observation of that entity, the observation of an entity cannot vindicate the sort of ontological commitment that is under consideration when accepting a scientific theory.

5. Three Kinds of Ontological Commitment

The debate between van Fraassen and his critics has been based on the unchallenged assumption that the sort of ontological commitment that is under consideration when

accepting a scientific theory is belief in the existence of individual entities. In this and the next sections, I will argue that to close scrutiny this assumption appears to be wrong. For the present purposes, it is important to distinguish between three main kinds of ontological commitment: ontological commitment to an individual entity, ontological commitment to a natural kind, and ontological commitment to a theoretical kind. *Ontological commitment to a (bare) individual entity* amounts to belief in the existence of some specific entity or other. In the language of first order logic, belief in the existence of an individual can be expressed as ' $\exists x(a = x)$,' where ' a ' is the name of the individual in question. One's belief in the existence of the Sun could be an example of this sort of commitment. Ontological commitment to the Sun as an individual entity is belief that there is something rather than nothing before our eyes when we look at the Sun and, as such, it does not imply any belief as to what kind of entity the Sun is, nor does it imply any belief about what properties the Sun has (except, possibly, for the most basic ones). For the sake of the argument, we can assume that this sort of commitment is thus largely independent from the theories about what the Sun is and that it was shared by Ptolemaic and Copernican astronomers as well as by the contemporary astronomers.⁵

Ontological commitment to a natural kind amounts to the belief that certain entities are entities "of the same kind". If we are to follow Kripke and Putnam's influential account, membership to a natural kind is conditional on the possession of some essential properties (*cf.* Putnam 1973 and Kripke 1980). Ontological commitment to a natural kind would therefore amount to the belief that the entities in question (and possibly other entities) share some "essential" properties. This sort of commitment, however, does not imply any specific belief about what the essential properties are (Putnam 1975 p.225), it only implies that the entities in question share some essential

properties. In the language of second order logic, this sort of belief could thus be expressed as $\exists X (Xa \wedge Xb \wedge Xc \wedge \dots \neg Xm \wedge \neg Xn \wedge \dots)$, where ‘*a*’, ‘*b*’, and ‘*c*’ are the names of individuals that one believes to be members of the kind and ‘*m*’ and ‘*n*’ names of individuals that one believes not to be members of the kind.

Two people can be committed to the same individual entities and yet be committed to completely different natural kinds, if they do not group those entities in natural kinds in the same manner. For example, unlike contemporary astronomers, Ptolemaic and Copernican astronomers did not believe that the Sun and the “fixed” stars belonged to the same natural kind. They would thus be committed to different natural kinds from the ones to which contemporary astronomers are committed, even if we assumed that they all believed in the existence of the same individual entities.

Finally, *ontological commitment to a theoretical kind* is the belief that there are entities that have the properties directly or indirectly attributed to them by a certain theory. In the language of first-order logic, this sort of belief would be expressed as $\exists x (Px \wedge Rx \wedge Qx \wedge \dots)$, where ‘*P*’, ‘*Q*’, and ‘*R*’ denote the properties and relations that the theory implicitly or explicitly attributes to the members of the kind. Ontological commitment to one of the various theoretical kinds star implies that there are entities that have the properties a certain theory (implicitly or explicitly) ascribes to the stars. If two people accept different theories about what properties the members of the kind are, they may be both committed to the same individual entities and to the same natural kinds and yet be committed to different theoretical kinds.

Although crucial, the distinction between natural and theoretical kinds is not always easy to draw. This is particularly true when the same kind term is used to refer to both a natural kind and to a number of corresponding theoretical kinds, as in the case of ‘electron’ and ‘star’. However, the two kinds of commitment are crucially

different. To believe in the existence of the natural kind electron is to believe that, say, the entities that make up cathode rays, those that are diffracted in the Low-Energy Electron Diffraction (LEED) and those that go through electric wires are the same kind of entities. To believe in the existence of some theoretical kind electron is to believe that there are entities that have the properties that one of the theories about the nature of electrons attribute to the electrons.

6. *Ontological Commitment and Theory Acceptance*

Of the three kinds of ontological commitment that I have considered in the previous section, ontological commitment to individual entities is completely independent of the acceptance of any theory. This sort of commitment is the belief that there is something rather than nothing before the eyes of the observer and, for the sake of the argument, I will assume that this sort of commitment is completely independent from the acceptance of any theory and that it can be vindicated by a non-conceptually mediated act of observation of the kind discussed in Section 2. For example, since this box rattles when I shake it, I believe that there is something rather than nothing in it. If I open the box and I see that there is something inside, my belief that there is something in the box is vindicated even if I have no idea about what the object in the box is. Analogously, my belief that there is a colourless liquid in the glass can be vindicated by the observation of the glass. However, this belief amounts to little more than the belief that there is something rather than nothing in the glass, if I do not know whether the colourless liquid is water or gin.

Ontological commitment to individual entities is clearly not the kind of commitment that is under consideration when accepting a scientific theory. Theories rarely postulate the existence of individual objects. Even when they do, they postulate the existence of objects that have certain properties. For examples, something could

qualify as the aether postulated by some versions of classical electromagnetic theory only if it was, among other things, a massless, incompressible, and non-viscous fluid that transmits transverse electromagnetic waves. To believe in the existence of the aether postulated by the theory is to believe that, in the world, there is something with certain properties—it is to believe in the existence of a certain theoretical kind.

The situation is more complicated when it comes to ontological commitment to a natural kind. On the one hand, ontological commitment to a natural kind often precedes the acceptance of any theory about the nature of that kind. On the other hand, it is not entirely independent from the acceptance of those theories. The acceptance of a certain theory about the nature of a certain kind may lead one to revise their beliefs about which entities belong to the kind and which do not. When we accept a theory according to which what we call ‘water’ is dihydrogen oxide, for example, we might no longer be willing to consider water a sample of liquid that has all the observable characteristics of water if it is not a sample of dihydrogen oxide. People who accept different theories about the nature of the entities that belong to a certain natural kind, however, are still committed to the same natural kind insofar as they agree about which entities belong to that kind and which ones do not. However, they do not completely agree on what there is in the world if they are committed to different theoretical kinds.

Ontological commitment to a natural kind is the kind of commitment of convergent realists *a lá* Putnam (1982). Convergent realists maintain that terms like ‘electron’ are natural kind terms and, as such, they continue to refer to the same entities in spite of the change in our theories about electron. The convergent realist’s commitment to electrons therefore does not depend on the acceptance of a certain theory about the nature of the electron but on the assumption that the term refers and the entities to

which it refers are entities “of the same kind”. This is why, according to the convergent realist, we would be able to claim that the 19th-century physicists were committed to the natural kind electron in exactly the same way as 21st-century physicists are, despite their different views about the nature of electrons.

Entity realists such as Hacking (1983) or Cartwright (1983) are also primarily committed to the *natural* kind electron rather than any specific *theoretical* kind electron (this is what Hacking has sometimes called their “debt to Hillary Putnam”). They accept that there are electrons in the sense that they accept that the entities that we manipulate in a number of different circumstances are entities of the same kind. However, they do not necessarily believe that there are entities that have all the properties that any of our current theories attribute to electrons—i.e. they are not committed to any specific theoretical kind electron. Their belief in the existence of the natural kind of electrons does not depend on their belief in the truth of any of the theories that postulate the existence of electrons, it depends on their belief that the entities with which we interact in a number of different contexts are entities of the same kind. As such, their ontological commitment to electrons can survive theory change.

Even if we were to assume that commitment to a natural kind depends to some extent on the acceptance of a certain theory, however, this kind of commitment cannot be vindicated by an act of observation, let alone a non-conceptually mediated one, as it is not observable that something is a member of a certain natural kind. As Kripke and Putnam have repeatedly argued, on the one hand, something can have all the observable properties that characterise a certain kind and not be a member of the kind and, on the other hand, something can be a member of the kind and have none of the observable properties that characterise the kind. If they are right, then, whether the

alleged members of the kind are observable or not, one's ontological commitment to a certain kind cannot be vindicated by the observation of its alleged member as it is not *observable that* the alleged members are actually members of the kind. The observation of samples of colourless, odourless, and tasteless liquid cannot vindicate our belief in the theoretical kind water, as the samples could be actually samples of different substances (say, H₂O and Putnam's XYZ).

If the first two kinds of commitment are largely independent of the acceptance of a theory, then, what is under consideration when accepting a scientific theory is, thus, mainly the third kind of ontological commitment—i.e. ontological commitment to a theoretical kind. Sometimes, as in the case of water and dihydrogen oxide, a theory postulates that a certain natural kind to which one is already committed is identical with a certain theoretical kind—i.e. that all the members of the natural kind have certain properties. Other times, as in the case of dark matter, the theory postulates the existence of a kind that does not correspond to any natural kind to which we are already committed. Whatever the case may be, in accepting that theory we have to decide whether to commit ourselves to the theoretical kinds of the theory and, if so, to what extent.

In the previous section, I have loosely characterised ontological commitment to a natural kind as the belief that there are entities that have the characteristics attributed to them by the theory. However, it is worth distinguishing between unqualified and qualified ontological commitment to a theoretical kind. *Unqualified* ontological commitment to a theoretical kind is the belief that there are entities that have *all* the characteristics that the theory attributes to the kind. Today, most scientific realists, rendered cautious by the pessimistic meta-induction, would probably be reluctant to declare their unqualified committed to a theoretical kind. When they are committed to

a certain theoretical kind rather than a natural kind, their commitment is usually qualified. *Qualified* ontological commitment to a theoretical kind is the belief that there are entities that have the “core” properties attributed to them by the theory. Realists of different stripes disagree as to which of the properties attributed to the kind by a theory one need to be realist about, however it seems that, in order to count as commitment to a certain theoretical kind, one has to believe that there are entities that have the most important properties that are attributed to the kind. Minimally, this seems to involve that the members of the kind have causally relevant properties attributed to them by the theory, which is the extent to which most entity realists are committed to theoretical kinds. Anything less than this can hardly be considered commitment to a certain theoretical kind.

Now, constructive empiricism urges its followers to avoid commitment to a certain theoretical kind if the kind is a kind of unobservable entities. If my interpretation of in Sections 3 and 4 is correct, this is because commitment to the unobservable theoretical kinds is unreasonable, as it cannot be vindicated by the observation of the entities that belong to the kind. The problem however is that the observation of a certain entity cannot vindicate unqualified ontological commitment to a theoretical kind either, unless all of the properties that the theory attributes to the kind are themselves observable. In other words, observation of an entity can vindicate unqualified belief in the existence of a theoretical kind of entities, whether observable or unobservable, only if it is observable that the entity belongs to that kind.

Let me illustrate this point with one of Chuchland’s examples in the above quotation. Suppose that we are back in the 17th century when demonology was considered a scientific theory and many scientists accepted it as such.⁶ Demonology postulated the existence of witches: people, mostly women, who, among other things,

were endowed by the devil with magical powers. Since witches are observable, a constructive empiricist who accepted demonology would not seem to have any reservations in believing in the existence of witches.⁷

The obvious problem is that the alleged observation of (someone who the observer believes to be) a witch does not and cannot vindicate the observer's unqualified ontological commitment to the theoretical kind witch. In fact, whereas a witch is *observable*, it is not *observable that* someone is a witch. To be a member of the theoretical kind witch, someone would have to exemplify all the properties that demonology attributes to witches, which include having magical powers and having received them from the devil. However, since some of these properties are not observable, whether or not someone is a witch is not observable either.

When we deny that witches have been observed, we do not necessarily deny that some person or other was in front of the observer (even if sometimes we may even deny that much). What we deny is that the person in front of the observer is actually a witch—i.e. had the properties that the theory attributes to witches. In other words, in order for an act of observation to vindicate unqualified ontological commitment to witches, the observer should be able to *observe that* someone is a witch, but whereas witches are *observable* we cannot *observe that* someone is a witch.

In general, unqualified ontological commitment to a theoretical kind can be vindicated by the observation of a member of the kind only if all the properties that characterise the kind. But this is not usually possible, because the overwhelming majority of the theoretical kinds postulated by modern scientific theories are characterised by properties that are not observable (in the constructive empiricist construal of the term). Unqualified ontological commitment to an observable theoretical kind is not necessarily more reasonable than ontological commitment to an

unobservable theoretical kind, since in a vast majority of cases neither can be vindicated by an act of observation.

7. *Four Possible Ways Out?*

There seems to be four different strategies to avoid the above difficulty:

- (1) Constructive empiricists should only believe in the existence of entities that have only the observable properties attributed from the theory to the kind.
- (2) Constructive empiricists should only believe in the existence of observable theoretical kinds whose only properties are observable properties.
- (3) Constructive empiricists should only be ontologically committed to observable natural kinds.
- (4) Constructive empiricists should only be committed to observable individual entities.

According to (1), a constructive empiricist's belief in the existence of witches would amount to the belief that there are entities that have all and only the *observable* properties that demonology attributes to witches. Commitment to the observable kind witch would thus be reasonable, as it could be vindicated by an act of observation. The problem, however, is that to believe in the existence of a theoretical kind is, at least, to believe that there are entities that have at least the "core" properties that the theory attributes to the kind, whether observable or unobservable. In the case of the theoretical kind witch, for example, these properties seem to include at least the property of having magical powers. It does not seem possible to be committed to the theoretical kind witch postulated by demonology without being committed to the existence of people who have magical powers.

People who believe in the existence of entities that have only the observable properties that demonology attributes to witches simply do not believe in witches. For

example, historians today usually believe that people who were accused of witchcraft actually had the observable properties that demonology attributed to witches, but this does not mean that they are qualifiedly committed to the theoretical kind witch. For example, suppose that an old woman was accused of having caused the death of her neighbour by cursing him (as it often used to happen). Usually, the historian would neither doubt that the woman did not direct cursing words at her neighbour; nor would they deny that the neighbour actually died. What the historian would usually question is that there is the curse caused the death of the neighbour in virtue of the magic powers that the woman received from the devil.

Even if it is possible to be committed to a theoretical kind in a qualified manner, it seems that constructive empiricist's commitment to the theoretical kind witch is way too thin to count as commitment to the kind witch at all. To replicate the structure of one of van Fraassen's arguments in defence of the observable/unobservable distinction, though the difference between the belief that there are entities that have most of the properties attributed to witches by demonology and the belief that there are entities that have only the observable properties the properties attributed to witches by demonology is only a matter of degree, the former is a case of commitment to the kind witch; the latter is not.

Consider now (2). By adopting this strategy, the constructive empiricist can actually avoid being committed to witches. As I have already noted, whereas witches are observable, not all properties demonology attributes to witches are. The problem with this strategy is that modern scientific theories rarely postulate the existence of kinds that are exclusively attributed properties that are observable in the constructive empiricist's strict construal of 'observable'. Planets, for example, are attributed among other properties, that of orbiting in elliptical orbits around a central star. This

property, which, in the ordinary sense of ‘observable’, would seem to be an observable property, does not count as observable in the constructive empiricist sense. In fact, the shape of the orbit of a planet is not observable in the constructive empiricist sense. Not only it takes numerous observations of the relative position of the planet in the sky at different times to discover that the orbit of the planet is elliptical, but those observations, by themselves, are compatible with different kinds of orbits (such as those in the geocentric systems of epicycles and deferents of Ptolemaic astronomy).

This strategy succeeds in avoiding commitment to non-existent kinds only at the price of avoiding commitment to almost any theoretical kind postulated by modern scientific theories. If they were to adopt this strategy, constructive empiricists cannot be even ontologically committed to the theoretical kind planet, which would seem to be above suspicion. I would think that even someone as averse to ontological risk as the constructive empiricist is likely to concede that blind fear of ontological commitment to most theoretical kinds including seemingly innocuous theoretical kinds such as planet is excessive.

According to (3), the constructive empiricist should only be committed to observable natural kinds. This would allow the constructive empiricist to remain non-committal as to the properties that are common to the kind. The problem is that ontological commitment to the natural kind witch does not seem to be more reasonable than ontological commitment to the theoretical kind witch. As I have already argued above, ontological commitment to a natural kind cannot be usually vindicated by an act of observation, as the “essential” properties are (usually?) not observable properties.

According to (4), constructive empiricist should avoid ontological commitment to kinds altogether and only believe in the existence of individual entities. Constructive empiricist would therefore believe in the existence of observable objects, such the tree in front of my window, the mouse in the wainscoting, Venus and the moons of Jupiter, but they would not believe that there are stars or planets more than they believe that there are electrons or neutrinos. If this was the case, in accepting a theory, constructive empiricists would simply avoid any sort of ontological commitment at all. As I have argued above, theories rarely postulate the existence of individual entities and, even when they do, the belief in the existence of these entities cannot be vindicated by a non-conceptually mediated act of observation.

8. *Conclusions*

In conflating commitment to individual entities and commitment to kinds, constructive empiricists fail to see how commitment to observable kinds can be unreasonable even if the entities that allegedly belong to the kind are observable as in the case of witches. The fact that belief in the existence of witches is not vindicated by the numerous reported “observations” of witches does not depend on the fact that no entity was actually observed, but on the fact that it is not possible to *observe that* someone is a witch.

Ontological commitment to kinds is more complicated than brute ontological commitment to individuals. In order to vindicate, one’s ontological commitment to a kind by means of an act of observation, one should be able to observe that a certain entity belongs to the kind and, in the case of unqualified commitment to a theoretical kind, this can only happen when all the properties that are attributed to the kind are observable, which in modern science seems rarely, if ever, the case. Contrary to what

constructive empiricists seem to assume, belief in observable kinds does not seem to be necessarily more reasonable than belief in unobservable ones.

Notes

¹ It is worth noting that defending the thesis that flying horses are observable might be a problem for constructive empiricists. As James Ladyman (2000) has pointed out, van Fraassen's use of the notion of observability seems to be incompatible with his modal antirealism (see also (Monton and van Fraassen 2003) and (Ladyman 2004)). How can one determine whether unicorns are observable, if no unicorns have been actually observed and counterfactual statements have no objective truth-value? I believe this to be a substantive problem for constructive empiricism but it is beyond the scope of this paper to discuss it. Here I am not concerned with the internal consistency of van Fraassen's philosophy. I am only concerned with the tenability of his agnosticism towards the unobservable.

² According to van Fraassen (1980, 1989), belief in the existence of unobservable entities can only be ultimately based on a form of inference to the best explanation from the explanatory success of the theory that postulates those entities to the truth of the theory. Van Fraassen argues that inference to the best explanation is an unwarranted form of inference and, therefore, belief in the existence of unobservable entities is always unwarranted (see in particular (van Fraassen 1989)). Apologists of inference to the best explanation have repeatedly tried to defuse van Fraassen's arguments against this form of inference (e.g.: (Psillos 1996)). It is far beyond the scope of this paper to determine whether inference to the best explanation is an allowable form of inference or not. For the sake of the argument, I will grant van Fraassen that the inference from the explanatory power of a theory to its truth is unwarranted.

³ Moreover, van Fraassen would seem to deny that constructive empiricism and scientific realism are stances (van Fraassen 2004, p.171).(I would like to thank an anonymous referee for this journal for bringing this passage to my attention.)

⁴ For example, van Fraassen states: "A flying horse is observable – *this is why we are so sure that there aren't any [...]*" (van Fraassen 1980, p.15; *emphasis added*). This claim is unexplainable unless we assume that the lack of observation of flying horses vindicates the belief in their non-existence.

⁵ It is worth noting, however, that this assumption is far from uncontroversial among empiricists. As I have already noted, "holistic" empiricists such as Carnap and Quine would deny this and claim that the existence of an observable individual entities is no less posited than the existence of unobservable ones.

⁶ On the scientific status of demonology, see, for example, (Clark 1984). Those who accepted demonology and believed in the existence of witches in the second half of the 17th century included Robert Boyle as well as many members of the Royal Society of London. From the point of view of the present discussion, it is interesting to note these scientists believed that it was a matter of empirical inquiry to discover whether or not witches existed (Olsson 1992).

⁷ Of course, witches are observable in the same sense in which unicorns are observable and van Fraassen himself says that unicorns are observable (van Fraassen 1980, p.15).

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