

# Constructive Empiricism and Modal Nominalism

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## ABSTRACT

James Ladyman has argued that constructive empiricism entails modal realism, and that this renders constructive empiricism untenable. We maintain that constructive empiricism is compatible with modal nominalism. Although the central term ‘observable’ has been analyzed in terms of counterfactuals, and in general counterfactuals do not have objective truth conditions, the property of being observable is not a modal property, and hence there are objective, non-modal facts about what is observable. Both modal nominalism and constructive empiricism require clarification in the face of Ladyman’s argument. But we also argue that, even if Ladyman were right that constructive empiricism entails modal realism, this would not be a problem for constructive empiricism.

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## 1 Introduction

James Ladyman ([2000]) has criticized Bas van Fraassen’s version of scientific anti-realism, constructive empiricism, on the grounds that being a constructive empiricist requires that one recognize objective modality in nature. Ladyman himself raises no problems for modal realism,<sup>1</sup> but points out that ‘abstaining from belief in objective modal facts is central to van

<sup>1</sup> We take ‘modal realism’ to include both David Lewis’s theory of possible worlds and other theories that endorse objective modal facts.

Fraassen's conception of empiricism.' Ladyman concludes that this conception 'is untenable as a philosophy of science' ([2000], p. 855).

It does not follow that (as Ladyman writes there) 'constructive empiricism is untenable as a philosophy of science'. Constructive empiricism is the view of science that 'Science aims to give us theories which are empirically adequate; and acceptance of a theory involves only belief that it is empirically adequate' (van Fraassen [1980], p. 12). A theory is empirically adequate iff all actual observable phenomena are directly represented by certain parts (empirical substructures) of some model of the theory (*Ibid.*, p. 64). Roughly speaking, a theory is empirically adequate iff what it says about the observable things and events in this world is true. Thus characterized, constructive empiricism is neutral on the issue of modal realism—unlike, to be sure, van Fraassen's overall conception of empiricism.

It is certainly much easier for a modal realist to be a constructive empiricist than for anyone else. The reasons include:

- (A) the entire view is stated in modal discourse (even such a word as 'aim' is not easily understood without modal implications);
- (B) the central term 'observable' is on the face of it a modal term;
- (C) the assumed common ground with scientific realists includes that some scientific theories involve irreducible probability, which is a modality.

We will take up each of these reasons, and argue that modal nominalists too can be constructive empiricists. But even if Ladyman were right that constructive empiricism entails modal realism, this would not be a problem for constructive empiricism. It would only be a problem for those who want to be constructive empiricists but not modal realists.

## 2 Concerning (A) 'The entire view is stated in modal discourse'

It is not surprising that the view is stated in modal discourse since all our ordinary discourse is largely modal, or at least replete with modal locutions, and not reducible to ostensibly non-modal discourse. That is not sufficient reason to think that we are intelligible to ourselves only if we believe in the reality of other worlds or 'counterfactuals' or potentialities or the like. Nevertheless, it clearly requires any philosopher who does not take modal discourse at face value to attempt some account of just what it is to engage in modal discourse if one does not have such metaphysical beliefs.

Let us leave that rather intimidating point to the end (Sections 5 and 6), but make a beginning. How can we argue that a particular statement can be understood as being simply descriptive of what is actual? We can begin by addressing that problem for the word 'observable'. Hence we turn to the second reason.

### 3 Concerning (B) ‘The central term “observable” is a modal term’

Before delving into the issue of whether the property of being observable is a modal property, it is worth discussing *why* ‘observable’ is a central term at all. Marc Alspector-Kelly ([2001]) presents van Fraassen as maintaining that the epistemic modesty of empiricism encourages one to reject the belief that a theory is true in favor of the belief that the theory is empirically adequate. Alspector-Kelly suggests that the belief that a theory is empirically adequate goes well beyond the deliverances of experience, and hence by the epistemic modesty of empiricism that belief too should be rejected. Instead one could just believe, for example, that a theory is true in what it says about what has been actually observed, or that a theory is true in what it says about what is, has been, or will actually be observed.

If Alspector-Kelly is right, then the central term ‘observable’ could be replaced with ‘observed’, and Ladyman’s objection could be evaded. But Alspector-Kelly is not right. He pays insufficient attention to the fact that constructive empiricism is a doctrine about the aim of science. The doctrine that science aims to give us theories which match what we actually observe is incompatible with what it is virtually universally agreed about scientific practice. Following Railton ([1990]) and Rosen ([1994], p. 161), *manifestationalism* is the doctrine that science aims to give us theories which match what we actually observe. According to manifestationalism, it has been argued, there would be no scientific reason for someone to do an experiment which would generate a phenomenon that had never been observed before. But one of the hallmarks of good scientists is that they perform experiments pushing beyond the limits of what has been observed so far. Manifestationalism fails to capture our idea of what it is to do good science.

Consider a range of possibilities, with ‘science aims to give us true theories’ on the far right side, and ‘science aims to give us theories which are true in what they say about what is being observed right now’ on the far left side. Realists submit that attention to the practice of good science, where bold conjectures and audacious theorizing have been rewarded with much predictive success, moves us toward the right. Empiricists, who would wish for epistemic modesty in their paradigms of rational inquiry, would tend toward the left. Constructive empiricism finds an equilibrium point between the two extremes, thus respecting both desiderata. (To be precise, we should add that the equilibrium point is in the view of science. It is not part of constructive empiricism to dictate a particular epistemic position, though in elaborating its view of science, it identifies that *acceptance* of a theory as successful involves belief only in its empirical adequacy, rather than in its

truth overall. Someone who accepts a theory may of course have beliefs that go beyond that, or not. A particular constructive empiricist need not be what Peter Forrest ([1994]) calls a scientific agnostic, any more than a scientific realist needs to be a scientific gnostic, as far as logical consistency goes.)

Ladyman ([2000], p. 853) seems to recognize this:

It seems as if constructive empiricism incorporates a prior commitment to the rationality of science, and that van Fraassen advocates belief in empirical adequacy because it is the minimum epistemic state that someone who has such a commitment can advocate.

But Ladyman makes this point in the context of a criticism of constructive empiricism which we think is misguided. Ladyman (following Rosen [1994], p. 177) considers a thought experiment where scientists have it in their power to create conditions in a laboratory that had never obtained before and could never obtain again. Ladyman says that if these scientists are constructive empiricists, their goal is just to have a theory adequate to actual observable phenomena, so there would be no reason for them to do the experiment. He considers the reply that constructive empiricists want theories that are ‘empirically strong’, but says ‘the extra strength of modalized theories can only consist in their description of possible but non-actual states of affairs which [...] should be of no interest to an empiricist.’

But there are three problems with this contention. The first is that in the thought experiment in question, the scientists have the choice to do the experiment, and if they choose to do so then they will be making a phenomenon actual. So the extra empirical strength will arise from making a correct prediction about a new actual phenomenon; there is no reason the constructive empiricist cannot be interested in empirical strength of this sort. The second is that it ignores the social dynamic of science, where competition is one of the keys to success. To challenge a competing theory, what better tactic than to create a new phenomenon (under the guidance of one’s own theory) which the competitor has difficulty accommodating? Thirdly, it is unrealistic to think that this creation of new phenomena throws no light on the phenomena naturally occurring outside the laboratory. Those newly created phenomena will eliminate a range of hypotheses about how certain sorts of phenomena can come about or can be, and this new knowledge can be expected to have many indirect consequences for how things happen in nature. Even if we wish only for empirically adequate theories, we may simultaneously wish, with good reason, to extend our knowledge of what the worldwide natural observable phenomena are like; and those two desires are jointly satisfiable.

### 3.1 A devastating argument?

Van Fraassen does not give a definition of ‘observable’, but offers the following rough guide:

X is observable if there are circumstances such that, if X is present to us under those circumstances, then we observe it. (van Fraassen [1980], p. 16)

One reason this is just a rough guide is that what is observable is not a determination to be made by philosophy: limits to observation ‘are a subject for empirical science, and not for philosophical analysis’. Since different theories could give different accounts of what is observable, the limits to observation cannot ‘be described once and for all’ (*Ibid.*, p. 57).

The second conditional claim in van Fraassen’s rough guide is clearly not a material conditional, otherwise all entities which are not present to us are observable. The natural way to read it is as a counterfactual. Yet van Fraassen has denied that counterfactual statements are objectively true or false (*Ibid.*, p. 13). How, then, are we to understand what is observable? Consider the following argument:<sup>2</sup>

1. Counterfactual conditionals have no objective truth value
2. ‘X is observable’ implies ‘if we encounter X in suitable circumstances and under suitable conditions then we observe X’
3. ‘X is observable’ has an objective truth value
4. Implication preserves truth and also preserves the property of having an objective truth value
5. ‘If we encounter X in suitable circumstances and under suitable conditions then we observe X’ has an objective truth value
6. All of the above holds whatever X be, hence also when the antecedent of that conditional is false
7. Some counterfactual conditionals have an objective truth value.

This explicates a major part of Ladyman’s argument, in terms of statements that Ladyman quotes. As the argument stands, it displays a clear inconsistency between constructive empiricism and a modal anti-realist view at least of counterfactual conditionals.

### 3.2 Critique of the argument

But the argument suffers from an ambiguity in premise 2, given the sense in which 1 is asserted in *The Scientific Image*. First of all, it is clear that 1 cannot be held about all counterfactuals in the first place; just consider ‘if it were the

<sup>2</sup> With thanks to Stephan Leuenberger.

case that A, then it would be the case that A' for any false statement A. In fact, many counterfactual conditionals are straightforwardly implied by strict logical implications, or by logical implications relative to theories or even simple statements the speakers take for granted. An example would be 'If you had looked in that drawer you would have seen the letter', which the speaker would justify with 'Because the letter is in that drawer', fully confident of various generalities about vision, light, and the like. Even if the drawer is never opened the facts about its contents plus certain well-selected generalizations about the circumstances suffice to determine anything about what would happen if the drawer were opened.

The sense in which counterfactuals are here held not to have an objective truth value is that they are in general context-dependent. The context in which they are asserted is one in which the speaker is holding something fixed, which together with the antecedent implies the consequent. What is held fixed tends to include a good deal of unformulated general opinion, but also some features specific to the case. The conditional has a truth value, relative to such a context; but that value will vary with context. When it is true it is because a certain conditional in this contextual background is logically true.

Sometimes what is held fixed is a bit surprising or even perverse. The interlocutor may hold fixed, and refuse to bracket, some fact incompatible with the antecedent for example. In that case a question like 'Would you forgive your brother if he tortured a suspected terrorist?' would be steadfastly rejected with 'My brother would not do that!', and the interlocutor may simply refuse to go further. To give a less extreme example, 'Would this bomb have exploded if you had pulled the pin?' might be answered with 'No, because I would not have pulled the pin without first disarming the bomb.' In that case the questioner was most probably holding something fixed (the fact that the bomb had not been disarmed) which the interlocutor does not hold fixed. These points clearly belong to the dynamics of dialogue, hence (as context dependence does) to the pragmatics rather than semantics of this discourse.

Notice that on this construal there is no need to believe in or even hold intelligible any views concerning 'counterfactuals' or other possible worlds. What it does introduce is an ambiguity in the word 'imply', and hence in premise 2. In one sense of 'imply', a sentence which is not context-dependent will generally be incapable of logically implying one that is, since (being invariant with respect to contexts) it includes no information peculiar to the context of utterance, which the context-dependent one relies on for its truth value. But the former can *contextually imply* the latter (van Fraassen [1989], p. 35; see further van Fraassen [1981]). Thus one could say (with a bow to Robert Stalnaker) 'Science implies that your health is threatened by tobacco

smoke.’ This assertion is not meant to indicate that science includes information about what you specifically are like, or even that you are human. But in this context the speaker keeps that much fixed, and simply instantiates the very general context-independent statements that science is here taken to include.

Hence the verdict on premise 2 is that ‘imply’ should be read as ‘contextually implies’, and will be true only in such contexts as we encounter at the point in *The Scientific Image* where Ladyman finds the source for such premises. A good example would be ‘Phobos is observable because if we were close enough we would see it’—the conditional after ‘because’ is true in a context where the antecedent plus certain factual information about us, kept fixed there, together logically imply the consequent. (In the case of the central core of the sun, imagined to exist separately, the ‘close enough to’ would of course have to be replaced by ‘far enough away from’!)

Contextual implication obviously does not preserve the property of context-independence. Hence in the relevant sense, premise 4 is false.

Is ‘observable’ context-dependent? Yes, it is; it is short or elliptical for ‘observable by us’, where ‘us’ refers to our epistemic community—a community which may not remain the same during social or biological evolution, upon contact with extra-terrestrial beings, or even discovering a way to communicate with such animals as dolphins, cats, or some of the great apes. But as with all context-dependent terms, the reference is definite in specific contexts that fix the relevant parameters. In this case we maintain that the reference, the property of being observable, is neither theory-relative nor modal, but simply factual.

#### 4 The objectivity of ‘observable’

It is our contention that the property of being observable is not a modal property. That flies in the face of the term’s ending in ‘-able’, so that it is at once classified as a modal term; that is, a term that belongs to the class of modal locutions in our language. So before we see how we could support that contention, we should ask whether modal predicate terms have to stand for modal properties.

We are immediately faced with a second difficulty here. How can we argue the matter without taking for granted a distinction between modal and non-modal properties? That is a difficulty for us since this distinction might after all only make sense to a modal realist. However, even a modal anti-realist may be able to classify parts of our language as modal or not modal. Quine tried to do so with hallmarks like ‘referential opacity’. There are simple criteria of failures of extensionality which can be applied without buying into the metaphysics. So for example we can think of the suffix ‘-able’ as turning

predicates into predicates: ‘X breaks’ is turned into ‘X is breakable’, and so forth. This operator is not extensional. For example, it is not inconsistent to contemplate a world in which all and only the things that break also catch flame, and the ones that catch flame also break. But it is consistent to add to this that even there the set of breakables is not identical with the set of flammables. So we can see a violation of extensionality even before we take into account the logical connection (in a certain part of our discourse) between that ending and such words as ‘can’, ‘may’, ‘possibly’, and the like.

But these linguistic features may accompany notions that can easily be explained without modal realism. For example, every daughter is a woman and every woman is a daughter, so the set of women = the set of daughters. But the difference between being a woman and being a daughter is well-founded in features that even the most diehard modal irrealist has no difficulty explaining. We can make the same point about ‘-able’, with various examples. There are certainly cases where philosophical differences matter. Is the property of being computable well-founded on non-modal features of the world? An intuitionist would not see it that way. But a classical mathematician would simply equate that property with the existence of a certain kind of function.<sup>3</sup> In the case of such less abstruse examples as ‘marriageable’, there would not seem to be such worries about philosophical controversy.

Admittedly the case of ‘observable’ is not as straightforward. The very first obstacle is that for a philosopher to identify the contingent factors in general that constitute observability in general would run precisely counter to van Fraassen’s contention that what is observable is an empirical question. Given this view, any such philosophical enterprise must end up as either armchair science—worst in the empiricist’s catalog of philosophical sins, next to psychologism—or as metaphysics of the same ilk as modal realism.

But if we are to stay within the dialectic, two approaches may still seem open to us here. The first is to adopt a modal realist point of view, for the sake of argument, and try to show that within that view, the property of observability is non-modal. That would require settling on some criterion to define that distinction, a criterion which the extant modal realist literature

<sup>3</sup> Rosen, among others (including e.g. Otavio Bueno and Joel Friedman), has attributed another tension to constructive empiricism, between van Fraassen’s disbelief in the reality of abstract entities and his use of mathematics to describe theories, models, and such features as empirical adequacy. This attribution presupposes that the practice and use of mathematics is intelligible only given realism or platonism in the philosophy of mathematics. That is in effect the supposition that mathematics is intelligible only if we can view it as a true story about certain kinds of things—not, for example, a supposition shared in intuitionism. Without offering a rival philosophy of mathematics, we may proceed in philosophy of science in the conviction that any satisfactory philosophical account of mathematics must imply that the sorts of applications of mathematics needed in philosophy of science are acceptable, correct, and intelligible.

does not clearly provide—and hence to do this (difficult!) job for them. The second approach is to exhibit intuitive patterns of reasoning that both sides could take as telling in favor of a status for observability that is not different from that of, say, ‘made of brick’ or ‘75 feet long’.

#### 4.1 A specific empirical question

We will make a stab at the latter here. At one point, one of us (BvF) had a neighbor whose research was being funded by the Canadian armed forces—he was trying to determine the properties of gun flashes that determined whether they were visible at night within the distance of an effective rifle shot. The duration and intensity of the flash were the most obvious factors to measure. If successful his result would presumably come in the conclusion that certain ranges of values for certain measurable parameters pertaining to the flash would be jointly necessary and sufficient for visibility under the given range of conditions. His results would not, we think, have been greeted with much enthusiasm if they had involved reference to other possible worlds or to parameters depending functionally on conditions incompatible with the conditions under which the guns were fired. Thus while visibility is on the face of it a modal property, he was to determine the class of visible gun flashes in terms of ‘occurrent’ properties of those flashes. Note well that this was not simply an inquiry into what is actually observed rather than observable: “visible but not seen” is consistent, and the inquiry was into conditions of visibility.

This is a very specific case of course. But we submit that what goes here for the visibility of gun flashes—observability in one perceptual mode of a specific sort of event—goes equally for observability in general of any sort of object, event, or process. We note that the specific investigated question was empirical—not linguistic, and not at the level of the theoretical foundations of science—and we submit that the general question is equally empirical. (That is not to say that detours through theoretical physics and physiology might not be instrumental and perhaps indispensable for such empirical research!)

A different sort of example, though much more fanciful, may also help to focus the question for us. Let us imagine various societies with different ways of talking about fire. One has our phrase ‘rapid oxidation’ and the theory of combustion that we accept. Another has the phrase ‘rapid phlogiston escape’, with the phlogiston theory accepted. The third has a short word that means ‘kind of event whose name begins with M’; they subscribe to a rather complicated theory which has not unified the 2500 varieties of fire that they can distinguish, but those are the only kinds of events which in their language have names beginning with M. The fourth has a short word that means for

them ‘kind of event which exists not only in our world but also in one in which there are bountiful gods’—you may fill in the rest. When detecting what we would classify as a fire the members of these societies respond verbally in very different ways. But they could all have been conditioned so as to respond in these stable and recognizable ways to fires and only fires (modulo their human fallibility) and we would have no great reason when reflecting on these societies to conclude that being a fire is a theory-dependent, linguistic, or modal property.

For his report on the conditions of visibility our Canadian physiologist has to list occurrent properties of the gun flash (duration, intensity) plotted against other occurrent properties (humidity, ambient light). As pointed out above, it would be entirely out of keeping with the constructive empiricist point of view to ask for an unrestrictedly general characterization of observability: the physiologist gathers data about actual observation under a specific range of conditions and proposes an empirical hypothesis that generalizes on those data.

#### 4.2 Viewing ourselves as our own measuring instruments

It is worthwhile to link the above discussion back to *The Scientific Image*. Here is the crucial passage:

To accept a theory involves no more belief, therefore, than that what it says about observable phenomena is correct. To delineate what is observable, however, we must look to science—and possibly to that same theory—for that is also an empirical question. This might produce a vicious circle if what is observable were itself not simply a fact disclosed by theory, but rather theory-relative or theory-dependent. It will already be quite clear that I deny this; I regard what is observable as a theory-independent question. (van Fraassen [1980], p. 57)

As van Fraassen says on the very same page, though, different theories give different answers to the question ‘What is observable?’. So in practice, we must rely on our current best theories to answer that question. But in principle, once the epistemic community is specified, the answer to the question is implied by facts about the world. (‘Facts’ should be understood to be empirical, non-modal, and theory-independent.) As argued by van Fraassen ([1993], Section 3), this is enough to ensure that constructive empiricism is not viciously circular.

Given that in practice we have to rely on theories we accept to determine what is observable, why does van Fraassen say that what is observable is a fact *disclosed* by theory? A partial answer is that the theories which do the disclosure are theories we don’t have yet:

The human organism is, from the point of view of physics, a certain kind of measuring apparatus. As such it has certain inherent limitations—which will be described in detail in the final physics and biology. It is these limitations to which the ‘able’ in ‘observable’ refers. ([1980], p. 17)

But hearing anyone, let alone van Fraassen, talk about ‘the final physics and biology’ should raise red flags. For example, why should we think that scientific inquiry, even ideally rational scientific inquiry, will someday end? Van Fraassen is clearly aware of such issues. But the point that he is making does not depend on there actually being ‘the final physics and biology’. That the human organism has limitations is a fact. What those limitations are is also a fact. Those facts would be entailed by final physics and biology, were final physics and biology to exist.

Consider the claim ‘if the moons of Jupiter were present to us (in the right kind of circumstances) then we would observe them’. Ladyman ([2000], p. 851) thinks van Fraassen would analyse the claim in terms of possible worlds. As we will discuss in the next section, such an analysis is not fruitful. The way to understand the claim is to note that, even though it is a counterfactual, it is entailed by facts about the world: facts that the moons of Jupiter are constituted in a certain way, and facts that we are constituted in a certain way. These facts can be disclosed by empirical research. In practice, not all the empirical research has been done, so we have to rely on our current best theories to determine what these facts are.

Isn’t this viciously circular, for members of our epistemic community to use themselves as measuring instruments to discover facts about the limitations of the members of our epistemic community, considered as measuring instruments? But this is not just a criticism of van Fraassen; this potential problem is inherent in the project of doing epistemology in a fully general fashion. Here we are simply encountering the realization that there are no perfectly secure foundations for our beliefs.

The point is perhaps by now a familiar one. For example, Paul Feyerabend’s ([1970]) argument against classical empiricism can be construed as a general argument against foundationalist epistemology. Van Fraassen ([1997]) builds on Feyerabend, arguing that anti-foundationalism does not lead to a debilitating or self-destructive form of relativism: ‘Rationality will consist not in having a specially good starting point, but in how well we criticise, amend, and update our given condition’ ([1997], p. S391). Barry Stroud has made a closely related point: he rejects the familiar epistemological question of how perception gives us knowledge of anything at all in the physical world; he suggests that what is demanded by this question is not achievable. If that is the case, then ‘We could still ask how we know one sort of thing about the physical world, given that we know certain other things about it, but there would be no philosophical problem about all of our

knowledge of the world in general' (Stroud [1994], p. 303). It would perhaps be nice if we could escape from any appearance of circularity by establishing perfectly secure foundations for our empirical investigation into the perceptual abilities of the members of our epistemic community, but such an ability to escape is not part of the human condition.

### 5 Concerning (C) 'Scientific theories involve irreducible modality'

Ladyman might have more advantageously raised his challenge for modality in general rather than for counterfactuals. (He seems to recognize as much in his footnote 16.) For it was admitted from the beginning that in characterizing theories the elements of a state-space represent possible states and possible trajectories, and moreover that when probabilities are introduced in certain recent theories these are irreducible. Hence the question of what it is to accept a theory in which modality—and especially probability—is involved is crucial for constructive empiricism. Moreover, van Fraassen rejected *The Scientific Image's* account of acceptance of probabilistic theories in the later *Laws and Symmetry*. (Acceptance of probabilistic theories is there newly construed, utilizing the notion of input from 'expert functions' in the theory of subjective probability. This is explicitly presented as finessing the apparent requirement of believing in an objective modality in nature when accepting irreducible probabilities in a theory.)

Ladyman ([2000], p. 845) claims that 'sometimes van Fraassen seems to say conflicting things' about the nature of modality. We will show how the apparently conflicting statements Ladyman cites are actually all compatible.

Ladyman asks three questions about the nature of van Fraassen's modal nominalism:

- (i) Does van Fraassen think that modal statements have truth conditions?
- (ii) If so, does he think that these truth conditions are objective [...]?
- (iii) Does he believe any modal statements? (*Ibid.*, p. 846)

Van Fraassen's view is closest to what Ladyman calls 'modal non-objectivism': modal statements have non-objective truth conditions. Modal statements can be considered true or false, but only relative to a context (analogously to the situation with counterfactuals, discussed in Section 3.2). In its rough slogan formulation, van Fraassen's view is: 'causal and modal discourse describes features of our models, not features of the world' ([1989], p. 214).

Does van Fraassen ever contradict this view in his writings? Ladyman thinks that he does; Ladyman's argument begins with the following quote:

From an empiricist point of view, there are besides relations among actual matters of fact, only relations among words and ideas. Yet causal and modal locutions appear to introduce relations among possibilities, relations of the actual to the possible. (van Fraassen [1989], p. 213)

Ladyman suggests that this makes van Fraassen a ‘modal atheist’; one who believes that modal statements quantify over something like abstracta or concrete possible worlds, and hence are false (because nothing like abstracta or possible worlds exists). But contra Ladyman, this quote need not be read as endorsing the view that ‘modal statements quantify over possibilia’ (Ladyman [2000], p. 847). Van Fraassen just says that modal locutions *appear* to introduce such relations, and while contemporary metaphysicians have done their best to reify such appearances, constructive empiricists need not follow in their footsteps.

Here is Ladyman’s second van Fraassen quote:

I reiterate that to assert a theory is to assert that the actual, whatever it be, shall fit (to a significant degree) the possibilities delimited by that theory. And I perceive no valid inference from this type of assertion to any form of realism with respect to possibilities or propensities. (van Fraassen [1979], p. 412)

This passage isn’t really trying to address any of Ladyman’s three questions. Van Fraassen is simply making the claim that asserting a theory is asserting that the actual should match one of the possibilities delimited by the theory. But to speak of possibilities delimited by a theory does not necessarily imply an ontological commitment to the reality of non-actual possibilities. A good deal of modal discourse is innocuous, and need not be construed along realist lines. Specifically, if a theory offers a family of models as candidate representations of e.g. spontaneous combustion, then we can say that it rules out as impossible any process of spontaneous combustion which fits none of those models, and implies the possibility of any that does. Only from a modal realist point of view does it follow from this that the theory implies the reality of objective modality in nature. Van Fraassen thus points out that realism about possibilities *cannot* be derived from his claim about what it is to assert a theory; this is of course what one would expect a modal non-objectivist to say.

Ladyman then quotes:

if [...] a model has parts corresponding to alternative courses of events (alternative in the sense of mutually incompatible), then there can be a complete correspondence between the model and reality only if alternative possible courses of events are real. (van Fraassen [1980], p. 197)

Ladyman suggests that this makes modal entities like unobservable entities, and says that perhaps van Fraassen wants to be a ‘modal agnostic’: one who believes that modal statements quantify over something like abstracta or concrete possible worlds, but doesn’t know whether modal statements are true or false, since he doesn’t know whether things like abstracta or possible worlds exist. But Ladyman misunderstands the role this passage plays in van Fraassen’s discussion. Van Fraassen’s claim is a conditional one, and the antecedent is true for only some models. The antecedent would be true for a model of Everett ([1957])/deWitt ([1971]) quantum mechanics, for example. A single model of that theory would consist of multiple incompatible courses of events, corresponding to the different ‘worlds’ of the many-worlds interpretation. The consequent of van Fraassen’s claim is then unproblematic: for such a model to fully correspond to reality, all the alternative possible courses of events need to be real. In the case of this example one could consistently add that quantum mechanics under the Everett/deWitt interpretation is empirically adequate—but not that it is true—without granting the reality of the many worlds that do not include our actual history.

For models of many other theories, however, the antecedent of van Fraassen’s claim is false. For example, in Newtonian particle physics on one obvious construal a model capable of representing an actual system would consist of a state-space with a trajectory through the state-space representing the positions of the particles at each time. This model represents just one alternative course of events for the world. (Different models would have different trajectories and hence would represent different possible courses of events.) In sum, this third van Fraassen passage should be taken as *just* a conditional claim; it should not be taken as giving his theory of how modality is represented in physical theories.

Ladyman next points out that van Fraassen makes claims about modality which suggest a modal non-objectivist view, which is roughly the view that van Fraassen actually endorses. For example:

The supposed objective modal distinctions drawn are but projected reifications of radically context-dependent features of our language. (van Fraassen [1981], p. 190)

By itself this quote is hard to interpret, but van Fraassen spells out the idea in some detail in Chapter Six, Section 5 of *The Scientific Image*. The idea is that we do draw modal distinctions, in that we do make use of modal locutions in our language. But we only do so under a supposition that some theory is accepted: ‘Once the theory is accepted [...] it guides our language use in a certain way’ (van Fraassen [1980], p. 199). Thus, the modal locutions that we use are guided by the scientific theories we accept. Modal statements taken by

themselves are not true, but there are nevertheless pragmatic circumstances where it is correct to assert a modal statement.

This does not fully explain van Fraassen's modal nominalism, we admit.<sup>4</sup> Perhaps our discussion of counterfactuals and the word 'observable' can serve as a concrete illustration of how the position can be implemented in particular cases. The general issues belong in part to philosophy of language, and as van Fraassen (*Ibid.*, p. 199) writes, 'I cannot pretend that we have a theory of language which is satisfactory' to be utilized in his theory of modality. Nevertheless, we hope to have dissipated such confusions as Ladyman expresses regarding van Fraassen's position.

## 6 Serious tension at the motivational level?

Must the constructive empiricist be a modal nominalist? Modal nominalism does not follow from constructive empiricist claims about the aim of science and about what it is to accept a scientific theory. In *The Scientific Image*, van Fraassen takes the doctrine of *empiricism* to include modal nominalism (though as Ladyman notes, van Fraassen has subsequently argued that empiricism is a stance which cannot be captured in terms of any specific doctrine).<sup>5</sup> But one is perfectly free to take a constructive empiricist view of science without being an empiricist.

Nevertheless, one could argue that, at the motivational level, there is a serious tension between constructive empiricism and modal realism. This is perhaps how we should read Ladyman's ([2000], p. 855) claim that, since constructive empiricism entails modal realism, 'constructive empiricism is untenable as a philosophy of science'. Ladyman suggests that, if one were to adopt modal realism, this would vitiate the arguments that make constructive empiricism plausible:

It would be bizarre to suggest that we do not know about electrons merely because they are unobservable, but that we do know about non-actual possibilities. If we were to believe what our best theories say about modal matters, then why not believe what they say about unobservables, too? (*Ibid.*)

The first sentence is formulated in a way that begs the question against constructive empiricism, and we believe that this is the reason that the suggestion of the first sentence seems bizarre. Constructive empiricism is not

<sup>4</sup> His view may be compared with Wilfrid Sellars' that in accepting a theory we 'talk ourselves into' the intention or commitment to infer consequences of any premises relative to that theory, and that this commitment is signaled by the use of modal locutions. In a more formal vein, it may be compared with H. B. Curry's construction of modal logic.

<sup>5</sup> While this conception of empiricism as stance was introduced in earlier publications, it is developed most fully in van Fraassen ([2002]).

a doctrine about epistemology, but about the aim of science.<sup>6</sup> Nevertheless, a natural epistemic attitude for a constructive empiricist to have is that we should believe what quantum mechanics, say, tells us about observable entities while remaining agnostic regarding what it tells us about unobservable entities. Such a ‘scientific agnostic’ (Forrest [1994]; Hájek [1998]; Monton [1998]; van Fraassen [1998]) would never say that ‘we do not know about electrons merely because they are unobservable’; instead she would say that she is agnostic about the very existence of electrons.

The general point that Ladyman is getting at is expressed in the second part of the passage quoted above. We simply do not feel the force of Ladyman’s rhetorical question. One can be a modal realist without believing *everything* that our best theories say about modal matters. Specifically, one can believe what our best theories say about observable entities (whether actual or non-actual), but not what our best theories say about unobservable entities (whether actual or non-actual). This is perfectly compatible with van Fraassen’s account of observability:

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. (van Fraassen [1980], p. 15)

It would thus be natural for a person who is a constructive empiricist and modal realist to believe what our best theories tell us about flying horses, but to be agnostic regarding what they tell us about the number seventeen.

In addition to Ladyman’s blanket rejection of the conjunction of constructive empiricism and modal realism, he makes a more specific claim about the plausibility of holding both doctrines. He writes:

perhaps the main motivation for constructive empiricism [...] is that it allows us to avoid engaging in the metaphysics of modality. (Ladyman [2000], p. 855)

If this were true, then a constructive empiricist who comes to believe modal realism would lose the main motivation for being a constructive empiricist, and perhaps this would be enough to make constructive empiricism untenable. But in fact some of van Fraassen’s central arguments for constructive empiricism do not depend on modal metaphysics. Consider for example the argument that reasons for acceptance are not reasons for belief (van Fraassen [1980], p. 88), and the argument that realism is not needed to explain the success of science (*Ibid.*, pp. 34–40).

It is true that one of the arguments van Fraassen gives for constructive empiricism is weakened if one rejects modal nominalism. Van Fraassen

<sup>6</sup> We know from other contexts that Ladyman himself is quite clear on this; but his text at this point could invite a misunderstanding.

maintains that one of the benefits of constructive empiricism is that ‘it makes better sense of science, and of scientific activity, than realism does and does so without inflationary metaphysics’ (*Ibid.*, p. 73). Even if some constructive empiricist were to embrace modal realism—and therefore at least one bit of what van Fraassen counts as inflationary metaphysics—she could still argue that constructive empiricism makes better sense of science than realism does. It is here—regarding how to best make sense of science—that one finds a central motivation, arguably the main motivation, for constructive empiricism.

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