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Constructive Empiricism and the Problem of Aboutness*

by ELLIOTT SOBER

Van Fraassen's [1980] constructive empiricism asserts that it is not for science to reach a verdict on whether a theory is true or false, if the theory is about unobservable entities; science's only interest here, says Van Fraassen, is to discover whether the theory is 'empirically adequate'. However, if a theory is solely about observables, empirical adequacy and truth are said to 'coincide'; here discovering the theory's truth value is an appropriate scientific goal. Constructive empiricism thus rests an epistemological thesis on a semantical distinction. This paper critically examines the notion of aboutness and its epistemological significance.

Although recent discussions of realism have mainly construed it as a semantical or ontological doctrine (Sober [1982]), Van Fraassen's constructive empiricism opposes realism as an epistemological thesis. The semantical view, roughly, asserts that theories are true or false independently of our capacities to confirm and disconfirm them. Van Fraassen does not challenge this, but rejects the associated epistemological claim that science is in the business of discovering which theories are true. He holds that whether this is appropriate depends on whether the theory in question is about unobservable entities. If it is, science has no interest in ascertaining truth value, but limits itself to the more modest task of assessing empirical adequacy. On the other hand, when a theory is solely about observables, the theory is true if and only if it is empirically adequate. Hence, whether it is appropriate to reach a verdict on a theory's truth depends, according to constructive empiricism, on what the theory is about.

Constructive empiricism requires a distinction between two kinds of *entities*—observable and unobservable. It does not demand that a line be drawn between observational and theoretical *terms* (Van Fraassen [1980], pp. 13–19). Like earlier realist critics of the distinction between theoretical and observational predicates, Van Fraassen holds that every descriptive predicate is 'theory laden'. There can be no theory-neutral observation language. Still, the distinction between two sorts of entities remains, and it is on this distinction that Van Fraassen's main epistemological thesis rests.

It is useful to use Dretske's [1968] ideas on epistemic and nonepistemic

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seeing (observation) to disentangle this pair of distinctions. We may begin by noticing some differences between the concept of *seeing an object* and the concept of *seeing that P*, for some proposition *P*. To see a widow, you do not need to have the concept of a widow, whereas to see that there is a widow across the room, you do.

To see that a proposition is true is basically to gain visual evidence for its truth. There is no need for the objects that the proposition is about to be visible. One can look at a meter and see that an atom emitted a pair of photons. One can look at a graph of stock market prices and see that the economy is in disarray. One can look at an equation and see that the entropy in a gas is probably on the increase. The devices that do the representing here—meters, graphs, equations—are, of course, things we can see; they themselves are observable. But the items they represent and the facts they give us access to need not be. This, after all, is a principal function of such representations—to give us information about things we cannot see.

Another fact held in common by these examples is that seeing that *P* requires background information. There is nothing about a representation that automatically reveals what its informational content is. You have to know how to do the decoding. So if an observation statement is supposed to be one you can see to be true by just looking, without knowing anything special, probably there are no observation sentences. Van Fraassen concurs in this familiar realist contention.

Consistent with all this is the fact that some objects are observable while others are unobservable. According to Van Fraassen, this difference is one that science investigates and describes. We therefore cannot expect a philosophical theory to supply all the details, but Van Fraassen's various remarks provide a substantial indication of the kind of distinction he thinks science is endeavouring to draw.

Van Fraassen counts the moons of Jupiter as observable entities, even though Earthlings may need a telescope to see them.¹ And he presumably would count genes as observable, even though microscopes are similarly indispensable. Electrons, on the other hand, he says (p. 17) are not *seen* when we look at a cloud chamber screen, although in some sense that is how we *detect* them. Another example that Van Fraassen mentions is Absolute Space. This is not an observable item. Van Fraassen does not say exactly why this is so. But his comments clearly indicate that it is no accidental and momentary fact about current technology that makes an entity unobservable (p. 63).

Van Fraassen also mentions (p. 15) numbers. These cannot be seen. And more powerful microscopes and telescopes won't help. The problem isn't that they are small or far away, but that you can't bounce light off of them.

¹ Van Fraassen (p. 16) says that 'a look through a telescope at the moons of Jupiter seems . . . a clear case of observation, since astronauts will no doubt be able to see them as well from close up'. This, I take it, may be a little misleading: even if astronauts were never able to make the trip, Van Fraassen would still want to say that the moons are observable.

Similarly, numbers cannot be heard. And the reason is not that we lack sufficiently sensitive microphones. Numbers do not *vibrate*. Perhaps we may flesh out Van Fraassen's position as follows. For an object to be observed, it must be observed through some sense modality or other. And each of the sense modalities can be impinged upon by an object only if that object is capable of certain sorts of physical interactions. There is, of course, plenty of room for philosophical perplexity about exactly how these physical interactions should be characterized. Why is it that an optical telescope allows us to see distant planets, but a gas meter in a car does not allow us to see the contents of a gas tank? Do you actually *see* the events shown on television, or only an image of them? If you *see* the concert on live television, why don't you *see* the electron by looking at the cloud chamber screen? Spelling out the sort of physical interaction an object must enter into if it is to be seen will be no simple task.

An additional wrinkle comes from the connection mentioned above between observability and the different sense modalities. It seems to be true of sight, touch, hearing, and the rest, that certain specific forms of physical interaction are required. But what of the generic notion of *observation*? Perhaps the gas meter allows us to observe (detect) the contents of the tank and the cloud chamber screen allows us to observe the electron. This may be true even though we don't see the electron or hear or smell it either. Why should an object be unobservable just because it can't be seen, tasted, smelled, *etc*? Other organisms, both actual and possible, have other sense modalities. *They* may observe without exploiting our five senses. Why can't we do the same?

It is somewhat plausible that science will tell us what makes an object visible or audible. These specific sense modalities fall within the purview of psychology. But what of the generic property of observability? I am much less confident that science will tell us very much about this. Perhaps relativity theory has already said what can be said: to observe an object it must be in your backwards light cone (tachyons excepted), since that is the only way a causal signal can go from it to you. But if this is all there is to be said, Van Fraassen's example, if not his whole position, is in trouble; electrons, for example, may be observable, according to this generous construal, even if you can't hear, see, or taste them. And if an experimental apparatus were able to measure some property of Absolute Space, would we not have observed Absolute Space, in virtue of having detected one of its properties? But perhaps when Van Fraassen says that various objects are unobservable by us, what he really has in mind is that we cannot see, hear, touch, smell, or taste them.

Van Fraassen says that observability (by us) is a dispositional property that science may investigate in the same way it looks into the nature of solubility. Scientific realists should feel perfectly at home with this approach. For one thing, the distinction, in itself, should occasion no queasiness about incipient scepticism. A realist may grant that we can have

evidence for the existence of things that cannot be seen, heard, or smelled. We postulate the existence of such things, and perhaps detect them by setting up experimental set-ups that make their effects surface in the domain of observables. But to have evidence for the existence of numbers, for instance, you don't have to bounce light off of them.

The enthusiastic rejection by realists of the observable/unobservable distinction, like other philosophical attacks on untenable dualisms, only makes sense against a background problematic. The distinction was rejected not because it could not be made sense of, but because it was associated with philosophical positions that were unacceptable. For example, the real point of Maxwell's [1962] critique of the theory/observation distinction was that the distinction cannot be drawn in such a way that it has any ontological importance. Sure, there may be differences between gravitational fields and oranges concerning the way each impinges on our senses. But this distinction makes no ontological difference; it cannot sustain a philosophical position that concludes that oranges exist but gravitational fields do not.

So the question we must ask of Van Fraassen's distinction is this: Suppose we grant that some objects can impinge on our senses in such a way that they may be observed while others are constitutionally incapable of doing this. What philosophical interest does this difference have? Van Fraassen wants to found an epistemological thesis on this distinction. It isn't that observables exist and unobservables do not. His thesis is epistemological, not ontological. According to him, the aim of science is to reach judgements about which theories are empirically adequate. Although theories that make claims about unobservable entities have truth values, it is not part of the point of science to find out whether they are true. And what does empirical adequacy mean? Our total body of beliefs is empirically adequate if all its claims about observables are true. We should be agnostic about the claims that our total belief set advances concerning entities that cannot be observed. Thus, Van Fraassen thinks that the epistemological attitude one should take towards a statement depends on what that statement is about. If it is solely about observables, the question of whether it is true is a legitimate scientific one; but if it is (at least partly) about unobservables, the question of truth is inappropriate.

Although Van Fraassen never provides a characterisation of the aboutness relation, it is notorious that Fregean semantics provides little room for the development of this idea. Frege [1892] argued that sentences alike in truth must all *refer* to the same thing.¹ So reference, construed à la Frege, will hardly be the relation that Van Fraassen requires; constructive empiricism demands that the aboutness relation map different truths onto different objects. Frege's other semantic notion—sense—will serve no better. We may think of the sense of a sentence as a function from possible worlds to

¹ Frege [1892] chose the two truth-values as the referents, for reasons that are not wholly compelling.

truth values. So the relation *x has sense y* will take sentences and functions as its *relata*. Functions, I take it, are not observable; you can't bounce light off them, *etc.* Van Fraassen needs to construe aboutness as a relation that sometimes obtains between sentences and physical objects.

Frege's 'truth-value argument', clarified by Church [1956] and Gödel [1966], requires two premises. The first is that logically equivalent sentences are about exactly the same thing(s). The second is that coreferential singular terms may be substituted one for another in a sentence without affecting what the sentence is about. These two premises suffice to show that all the truths are about the same thing.¹ Van Fraassen must reject at least one of these premises.

I do not think that developing the sort of aboutness relation that Van Fraassen demands is a hopeless task. Indeed, Van Fraassen's [1969] work on facts and Barwise and Perry's [1981, 1983] on situation semantics each suggest the technical feasibility of a notion of this kind. I have argued elsewhere (Sober [1982]) that realism as a semantic or ontological thesis (as opposed to the epistemological thesis here at issue) requires such an aboutness relation. It remains to be seen what explication can be provided for the concept that Van Fraassen's antirealism demands.

However, I strongly suspect that an aboutness relation that is cut loose from these two Fregean principles will not sustain the epistemological weight that constructive empiricism places on it. For example, suppose we allow that two logically equivalent propositions may differ in what they are about. Perhaps *P* is solely about observables whereas *Q* is about at least one unobservable entity, even though *P* and *Q* are true in all the same logically possible worlds. How should this information affect our epistemic attitudes towards the two sentences? Should we treat them differently, as constructive empiricism demands, because one is solely about observables whereas the other is not? Or should we view them as being on an epistemic par, because they are guaranteed to be alike in truth value in every logically possible world? My inclination is to favour the latter approach. Never mind the difference in aboutness; it is reasonable to take a position on the truth of *P* if and only if it is reasonable to take a position on the truth of *Q*.

Some examples may help give substance to this suggestion. A food chain, I take it, is not an observable entity. You can't *see* it because it doesn't reflect light and you can't *hear* it because it doesn't vibrate. Food chains are like social classes in this respect. Very roughly, they are 'systems of relations' that obtain among observable entities—*e.g.*, groups of organisms. One describes the food chain that obtains in a given ecological community by saying how energy flows from prey populations to predators. Food webs have a certain 'topology'; they have a certain number of links, a certain 'complexity'. Ecologists debate the connection of some of these properties

¹ See Yourgrau [1984] for a clear exposition of this argument.

to others—for example, the connection of the complexity of a food web to its stability (see, *e.g.*, May [1973]).

Let's compare the following two sentences:

- (1) There is a food web in which the human population occupies a terminal position.
- (2) Human beings eat, but are not eaten by, other organisms.

These two sentences are, in some rough sense, equivalent descriptions. Yet (1) is apparently about a food web. But if food webs are unobservable, Van Fraassen's thesis implies that it is not the business of science to reach an opinion as to the truth value of (1). But where does this leave (2)? Is (2) about an unobservable entity? Arguably, it is not; perhaps (2) is solely about the population of human beings and the other populations with which it interacts.

This example brings out a general feature of the connection (or lack of connection) of issues of aboutness to issues in epistemology. The same point comes up when we consider the following two sentences:

- (1') There is a number, namely the number nine, which numbers the planets.
- (2') There are nine planets.

Perhaps (2') implies (1'); perhaps it does not. Perhaps (1') is about an unobservable entity, the number nine, whereas (2') is solely about the planets, which are observable. What I want to suggest is that these putative differences between (1') and (2') cut no epistemological ice. If science places us in a position to have rational opinions about the truth value of (2'), why should it be incapable of placing us in a position to do the same for (1')?

A third example may be instructive. What are the following two sentences about?

- (1'') Temporal simultaneity is a transitive relation.
- (2'') For any events x , y , and z , if x occurs at the same time as y , and y occurs at the same time as z , then x occurs at the same time as z .

(1''), I take it, is about an unobservable entity—the relation of temporal simultaneity. Whether or not (2'') is about the same thing, it seems plausible that (1'') and (2'') have the same epistemological status.

In these examples I have assumed that we have some rough and ready ideas concerning what the three pairs of sentences are about. However, it is important not to lose sight of the fact that our intuitions about aboutness are highly inchoate and conjectural. This is perhaps clearest when we consider simple universal generalisations. What is the sentence 'all swans are white' about? One natural, though by no means inevitable, proposal is that it is about everything in the universe (Quine [1970]). However, if the universe contains at least one unobservable entity, then Van Fraassen's view implies that science should take no position on the truth value of this generalisation,

but should only decide whether it is empirically adequate. Another suggestion is that the generalisation (assuming for the sake of argument that it is a law of nature) is about the property of being a swan and the property of whiteness (Dretske [1977], Tooley [1977], Armstrong [1983]). Since properties and theoretical magnitudes are not observable, this suggestion also leads to the paradoxical conclusion that science ought to take no position on whether the generalisation is true. A third possibility is that the generalisation is about swans and things that are white. This alternative, unlike the first two, delivers the verdict that the generalisation is solely about observables. But the same idea, applied to the conditional's contrapositive—'all nonwhite things are nonswans'—implies that this generalisation is about the nonwhite things and the nonswans. If one or more of these is unobservable, then the contrapositive is about an unobservable. Perhaps this conclusion is tolerable; if one abandons the Fregean principle concerning logical equivalence, perhaps a conditional and its contrapositive may be about different items. My point, again, is that even if this were true, it is hard to see why this difference should permit one to take a position on the truth value of the conditional but not on the truth value of the contrapositive. After all, knowing that two propositions are logically equivalent is just the sort of knowledge that tells us that the propositions stand or fall together.

Van Fraassen says several times that in the case of claims solely about observables 'empirical adequacy coincides with truth'. This just means that if a sentence is solely about observables and if everything it says about observables is true, then the sentence must itself be true. Aside from the problem of understanding 'aboutness', I see no objection to this idea. I bring it up here only to point out that it doesn't solve the 'all swans are white' problem. Granted, if the generalisation were solely about observables, Van Fraassen would then be able to say that science may take a position on its truth value. The problem I am raising is an antecedent one: why think that this claim is solely about observables?

It may be objected that my questions about aboutness are misplaced, since Van Fraassen demands that we understand theories in terms of their models, not 'syntactically'. One can, of course, give a model in which 'all swans are white' comes out true such that the objects in the model are all observables—namely, swans. Does this suffice to show that the generalisation is solely about observables, after all? No, it does not. We can give such a model for lots of true sentences, regardless of whether they 'really are solely about observables'. We could, for example, interpret the sentence 'there are two primes in the integers between 10 and 14' in a model in which the five relevant numerals denote some cities on a highway, and 'being prime' means having an opera house. The sentence, thus interpreted, would be solely about observables. Looking at a model is likely to give you the right answer concerning what a theory is about only if the model is the 'intended one'. But here we are back to the question of aboutness. What objects must occur in a model of a universal generalisation for that model to

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be the intended one? The model-theoretic approach presupposes a solution of this problem rather than providing one.

The examples I have discussed, besides indicating how very unclear and theoretically ungrounded our judgments about aboutness are, also support a more positive thesis. It is quite common, I think, for scientists to move happily back and forth between different theoretical formulations that may strike the careful semanticist as ontologically quite different. It isn't that the semanticist is wrong about these differences. Rather, the point is that these semantical differences are often epistemologically inconsequential. They do not affect experimental strategy or judgments about confirmation. Were it not for this kind of interchangeability, we really would be cut off from investigating food webs, numbers, and magnitudes and relations like temporal simultaneity. Happily, semantical distinctions about aboutness do not seem to coincide with the epistemological distinction that constructive empiricism attempts to draw.

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