

## WHAT WOULD IT MEAN TO DIRECTLY OBSERVE ELECTRONS?

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### *Abstract*

*In this paper it is argued that a proper understanding of the justification of perceptual beliefs leaves open the possibility that normal humans, unaided by microscopes, could genuinely know, by direct observation, of the existence of a theoretical entity like an electron. A particular theory of justification called perceptual responsibilism is presented. If successful, this kind of view would undercut one line of argument that has been given (for example, by Bas van Fraassen) in support of scientific anti-realism. Various objections to the idea that electrons can be directly observed are also considered.*

Scientific anti-realism is, roughly, the view that we are not justified in believing in the existence of theoretical entities—of which I take electrons to be a paradigm example. Such a view obviously relies on the distinction between things that are directly observable and things that are not, where theoretical entities would fall into the latter category. In this paper I will argue against this distinction—at least in the sense in which it is required by scientific anti-realism. I will argue that (so-called) theoretical entities like electrons can be observed by normal humans.

In taking aim at scientific anti-realism, I will primarily have in mind its leading proponent, Bas van Fraassen. But it is important to keep in mind that while my narrow concern in this paper is the issue of the justification of observational beliefs, van Fraassen's constructive empiricism encompasses much more than that. Indeed, as Giere (1985, 75) points out, "van Fraassen devotes much more attention to the nature of theories than to their justification." Giere continues, "His arguments for empiricism over realism, however, turn primarily on questions of justification." And, I would add, most of van Fraassen's talk of

justification is focused on the question of what our observations justify (or don't justify) us in believing (or accepting). He says little about the justification of the observations themselves. However, an examination of the issue of the justification of ordinary observational claims will shed light on the distinction between what is and what is not knowable by direct observation. This is important to van Fraassen's project even if the primary motivation for his view is *not* to provide an account of the justification of observation beliefs but (for example) to provide a view of the aims of science which frees it from what he sees as excess metaphysical baggage. (See van Fraassen's (2002), lecture 1, "Against Analytic Metaphysics" for a recent restatement.)

One of the arguments for scientific anti-realism appeals to the underdetermination of theory by observational evidence and can be summarized like this: Some things we can know the existence of by directly observing them. Other things we can know the existence of only by inference from what we directly observe with the help of theory. For instance, I directly observe certain colored blotches on my child's face and I infer, with the help of some medical theory, that there is present a certain virus that I cannot directly observe which is causally responsible for the blotches. But there are a number of different theories that could equally well account for this observational data (the colored blotches). Some of these theories would license the inference to the existence of a virus and others would not. Thus I am not justified in believing in the virus.

If the virus were directly observable, however, this argument would be unsuccessful. Now in calling some observation 'direct' one of the main things we seem to be pointing to is the fact that the perceptual knowledge was non-inferentially produced (and non-inferentially *justified* as well, but we'll get to that a bit later.) Thus when I say that I directly observe a dog, I mean that I non-inferentially, perceptually, know that there is a dog there;<sup>1</sup> I did not come to believe that there was a dog there as the conclusion of an inference. Part of what we are saying when we say that we have observational knowledge is that we have non-inferential knowledge. Thus I will argue, contra scientific anti-realism, that electrons (and viruses, etc.) can be non-inferentially perceptually known.

Now the distinction between what is observable and what is not has come under attack from a number of quarters. To briefly name a few: There is Hacking's (1981) argument from the history of microscopy for the conclusion that observation of microscopic entities using a microscope counts as genuine seeing of said entities. (Van Fraassen (1985, 297–300) remains unconvinced.) Churchland (1985, 35–41) argues that van Fraassen cannot maintain a principled distinction between unobservables and the observables that are not in fact observed by anyone, in the sense that whatever grounds van Fraassen has for skepticism about unobservables would equally be grounds for skepticism about things that have not in fact been observed; one who remains agnostic about the existence of electrons ought to remain agnostic about the existence of Jupiter's moons as well. (Van Fraassen responds at (1985, 284–286).) More recently, Ladyman (2000) has argued that the observable-unobservable distinction must be understood in terms of counterfactuals (roughly, to say that  $x$  is observable to  $S$  is to say that if  $x$  were present to  $S$  in standard conditions of perception,  $S$  would have observed it). And, Ladyman argues, this commits van Fraassen to a kind of modal realism that is inconsistent with the latter's wish to free science from excess metaphysical baggage. (See van Fraassen and Monton (2003) for the response to Ladyman.)

Van Fraassen also points out two arguments from Grover Maxwell attacking this distinction. One is to the effect that it is difficult to draw a line between what is directly observed and what is observed with the aid of something else, and therefore there is no distinction between the observable and the non-observable. For instance, at what point in this continuum of cases should we say that something is not observable: "...when looking through a window, when looking through glasses, when looking through binoculars, when looking through a low-power microscope, when looking through a high-power microscope, etc.?" (See van Fraassen 1980, 15–16, and Maxwell 1962, 7.)

But, as van Fraassen correctly points out in the first chapter of *The Scientific Image*, this argument is clearly fallacious. Even if the predicate may be vague enough to admit of gray-area cases, that does not mean that it is false that some things clearly are observable and others not. One might as well argue that because it is hard to say exactly when a

man has few enough hairs to count as bald that there is therefore no distinction between being bald and not being bald.

Maxwell's other argument is that nothing can be such that it is impossible that we should ever be able to observe it (that is, to be "unobservable in principle"), for we might one day grow to have different sense organs, or to have electron-microscope eyes. If we had electron-microscope eyes, we would be able to observe electrons, therefore it is possible to observe electrons. Electrons are observable.

Again van Fraassen's response seems exactly right:

This strikes me as a trick, a change in the subject of discussion. I have a mortar and pestle made of copper and weighing about a kilo. Should I call it breakable because a giant could break it? Should I call the Empire State Building portable? Is there no distinction between a portable and a console record player? The human organism is, from the point of view of physics, a certain kind of measuring apparatus. As such it has certain limitations—which will be described in detail in the final physics and biology. It is these limitations to which the 'able' in 'observable' refers—our limitations, *qua* human beings. (Van Fraassen 1980, 17.)

Quite so. Yet I will defend the idea that *normal* human beings, the very human beings that would be described by such an ideal physics and biology, without adaptation or implantation, without any physical or supernatural changes, can directly observe electrons (and other so-called theoretical entities).

What I like about the response that van Fraassen gives is that it makes my job more difficult by making the quite plausible sounding point that what humans can observe is limited by certain biological and physiological facts about human beings and their sensory organs. Trying to argue that normal humans can directly observe electrons seems just as foolish as trying to argue that normal humans can run a mile in fewer than 10 seconds. Our physical make-up just makes it impossible. Or so it seems. I shall return to this issue once we have a theory of observation on the table.

I suspect that some of the motivation for the view that electrons are unobservable comes from the fact that people have some picture in the back of their heads about what an electron would look like. And

they've seen nothing that looks like *that*. For instance, I often catch myself thinking that electrons and other tiny particles look something like the Neils Bohr model of the atom. But of course electrons do not look like *that*.

What then do electrons look like? Must they *have* a look in order to be observable? What in any case is a look? With regard to this last question, I think there is a great tendency to suppose that a look is a configuration of shapes and colors. This view interprets the question "what does x look like?" as a request for a description of x in terms that refer only to shapes and colors. But notice that if 'x' refers to a type instead of a token (as it does in the question, "what do electrons look like"?) this request will usually be impossible to fulfill. There is, for example, no description in only color and shape vocabulary that picks out all and only the looks that chairs have. Another way of putting this point is that if someone doesn't know what chairs look like, you'll never be able to teach him or her by describing a color-shape configuration. There are an indefinite number of color-shape configurations that chairs can look to have and the only way to group them all together is to abandon the strict vocabulary of shape and color and just say that they all look like chairs. And just as chairs may have many different ways of looking, so might electrons. This is not to say, of course, that any token observation of a chair or electron will not have a look specifiable in some more restricted vocabulary. But when specifying the look of an observation *type*, we may have to be satisfied with saying "electrons look like electrons."

Enough thrashing about in the neighboring bushes. The only thing to do now is to sketch the theory of perceptual knowing that would allow for the possibility of observing electrons. I call the view I have in mind *perceptual responsibilism*. A full defense of this view would, alas, require more space than I have here.<sup>2</sup> If the view has absolutely no intuitive plausibility for you, I would be contented with establishing the conditional that *if* such a theory of perception could be adequately defended, then scientific anti-realism would be shown to be untenable.

Everyone party to this dispute agrees—I hope—that we can observe mid-sized objects like pineapples. As was mentioned above, part of what it means to say that S can observe pineapples (at least in the sense that would yield *knowledge*) is that S can non-inferentially know

that “there is a pineapple *here*” (in the presence of S, that is). Observational knowledge is non-inferential in two senses. The first is that the person, S, did not come to believe the proposition in question (that “there is a pineapple here”) in virtue of inferring it from some other propositions believed. This sense just concerns the mechanism by which the person is caused to believe the proposition. In observing the pineapple, the belief that there is a pineapple here is, so to speak, *wrung* from the perceiver by the pineapple itself (with the aid of her sense organs of course). The second sense of ‘non-inferential’ is that the belief in question, P, does not get its positive justificatory status in virtue of S’s believing propositions which could be premises in a good argument with P as the conclusion. P must get its positive justificatory status in some other way if it is to be non-inferentially known in this sense. Tokens of observational knowledge must be both non-inferentially *produced* and non-inferentially *justified*. Can one have a belief that “there is an electron here” that is both non-inferentially produced and non-inferentially justified?

The first part is easy. Our putative electron observer (call him Ernie) simply needs to be trained to respond to the presence of electrons with tokens of the appropriate belief type—say, “there’s an electron.” One way to do this would be to bring Ernie into a room with the “cloud chamber” apparatus and to encourage him, perhaps by using the standard behavioral reinforcement techniques, to say “there’s an electron” when there is a vapor trail in the cloud chamber. This part of the training needn’t be far removed from the process by which we get dogs to lie down whenever we produce the sound, “lie down!” Although Ernie’s *trainers* may be making inferences when they say “Ernie! There’s an electron here!”, Ernie knows nothing of the electron theory. Once he has been trained, his tokens of “there is an electron here” will not be produced as the conclusions of inferences.

One may try to claim that Ernie is indeed making quick inferences from the observable features of his environment to the existence of electrons, thus: “Here’s that cloud-chamber zip again; therefore there is an electron here.” But, as we pointed out above, there needn’t be any look, specifiable in non-electron vocabulary that invariably accompanies electrons. It might be that the various looks that electrons have are too numerous or subtle for Ernie to be conscious of. Ernie

might be like the chicken-sexers who are trained to tell male chicks from female ones, but cannot for the life of them explain what the *look* is that one has and the other does not. (In fact, studies seem to indicate that it is probably subtle olfactory differences that trigger their different classifications. But the chicken-sexers themselves are surprised to hear this—they were not consciously aware of such olfactory differences.) Thus when we ask Ernie, “why do you think there is an electron here,” he may be at a loss to say anything, except for perhaps, “it looks like there is an electron here.”

A closely related objection is that Ernie does not really observe the electron, but only its *effects*. The electron causes the vapor trail and it is only this that Ernie directly observes. But this is just to say that Ernie’s belief in the presence of the electron is the result of an inferential leap from effect to cause: all he *really* sees is the vapor trail and then he *infers* the presence of the electron. Ernie, however, made no such inferential leap, nor is he in a position to. He may know nothing about the sorts of events that electrons may cause. If he did, he could produce a belief in the presence of an electron inferentially. But he cannot. My impulse to say that this objection tacitly begs the question by assuming that Ernie cannot have observed the electron.

But it brings up an interesting issue: given that there are a myriad of different ways of describing what is in front of Ernie, how should we decide what he *really* saw? Should we say that he really saw an electron? Or that what he really saw was a zip in a cloud chamber? Or perhaps what he really saw was only a light blue line moving from left to right within a semi-transparent rectangle. Or maybe what he really saw was just electromagnetic radiation bouncing off various objects and into his eyes. Someone with a better imagination than mine could undoubtedly think of even more variations. How shall we decide among them?<sup>3</sup>

Here’s a more innocuous case. Ben the bird watcher looks up at what happens to be a magpie in a nearby tree, and says, “look at that! A magpie!” Should we say that he what he directly sees is a magpie? Or should we say that what he really sees is a bird with such and such markings (and he then infers that it is a magpie)? Or should we say that what he really sees is a configuration of shapes and colors (and he

then infers that it is a bird with such and such markings and is therefore a magpie)?<sup>4</sup>

Different people can be standing in front of the same thing and yet see different things. Clearly the *belief* that the person forms when standing there ought to help determine which we should say that they *see*.<sup>5</sup> Ben the bird-watcher spontaneously and immediately forms the belief that *that is a magpie*. Unlike novice birdwatchers, he did not first form the belief that *that is a bird with such and such markings* and then conclude that it is a magpie. Similarly, Ernie did not form the belief that there was a zip in the cloud chamber, or that there was a blue line in a rectangle, or that there was electromagnetic radiation in front of him. The belief he spontaneously formed was that that is an electron. Therefore what the observation is *of* is an electron. The question we really need to settle is this: is he justified in believing it, and if so, why?

If we've trained Ernie well, his tokening of "there is an electron here" will be reliably correlated with the presence of electrons. Now if I were a reliabilist about epistemic justification, my job would be pretty much done. For according to the reliabilist, a belief token will get its positive justificatory status in virtue of being produced by a mechanism that turns out a high percentage of true beliefs; and if we've done our training well, Ernie's tokenings will be the result of just such a mechanism.<sup>6</sup> Reliabilists therefore should not be scientific anti-realists.

But I am one of those people who think (due in part to the influence of Wilfrid Sellars and some of his disciples) that justification is an irreducibly normative notion.<sup>7</sup> People like us will never be satisfied by an account that makes justification a descriptive matter of a reliable hook up between a believer (seen as a cognitive mechanism) and the world. So my job is not yet done.

Some people may worry that since Ernie is no scientist, and is not in a position to inferentially justify his tokenings of "there is an electron here," he is at the mercy of his trainers in a worrisome way. It might be, for all Ernie can tell, that the scientists who trained him were mistaken, or they were tricking him, playing a joke on him, so that his tokenings of "there is an electron here" do not track the presence of electrons at all. The suggestion then is that the fact that Ernie is not in a position to make sure that he has been trained correctly im-



plies that his tokenings, the upshot of such training, cannot have positive justificatory status.

But this cannot be right. For our reliance on our trainers is widespread. If the mere possibility of our having been mis-trained is enough to impugn the justificatory status of our tokenings, then none of our so-called observations would be justified. Take for example a child's learning to identify pineapples. Her parents put pineapples in front of her, saying, "that's a pineapple," and encourage her to say likewise. Soon her tokenings of "that's a pineapple" track, with a high degree of accuracy, the presence of pineapples. But it could have been, for all the child can tell, that her parents were malicious pranksters and have trained their child to token "that's a pineapple" in the presence of pomegranates, and have paid everyone who might ever come in contact with her not to correct her about it. The trouble is we are all in the position of that child, with respect to a myriad of observational concepts; we could have been mis-trained as well. If the child's tokenings of "that's a pineapple" fail to be justified just because of the possibility that she has been mis-trained, then none of our putative observational tokenings are justified either. That kind of skepticism seems too difficult to swallow.

On the other hand, as I indicated above, I do *not* think that the mere fact that one has been trained to be a reliable token of "there is an X here" in the presence of Xs suffices for the tokening's being an instance of observational knowledge. So what more is needed? Where does the token's non-inferential positive justificatory status come from?

Sellars' answer is that the tokener must have *some* kind of weak awareness of the fact that she is reliable (Sellars 1956, § 35). How plausible this is will depend in part on how weak this awareness requirement is, since surely there are many people (especially children) who do not have any strong kind of awareness of their reliability but who we would still count as knowers. There is also the worry that the awareness of one's reliability, if thick enough, will be able to serve as an inferential justification of the tokening, impugning its status as non-inferentially justified (and thus impugning its status as a direct observation.)

My perceptual responsibilist alternative (which I believe is congenial to the spirit of the Sellarsian framework, even if it jettisons some of Sellars's stringent internalist requirements on observational knowledge) is simply that the tokener must be held epistemically *responsible* for her observational dispositions. This is an (epistemically) *normative* sense of responsibility. A large part of this responsibility consists in the fact that she would alter or jettison her disposition to token "there is an x here" if she were to come to find that the disposition is not reliable. (Compare Ryle 1949, 28.) For example, part of my epistemic responsibility with respect to my dispositions to token "this is blue" consists in the fact that if I were to discover that I sometimes token this in the presence of dark purple, I would alter the disposition so that I no longer make this mistake—I would retrain myself. (This epistemic responsibility will also often manifest itself in a tendency to correct the mistakes of others' perceptual dispositions—or at least to have a "something aint right" feeling when they make such mistakes.) It is the fact that one can recognize one's errors and change one's erroneous dispositions which allows one to be held responsible (in the normative sense) for having dispositions that one had no part in cultivating. The point is a general one: a child who is clever enough to blame his parents for his bad upbringing only demonstrates that he is old enough to take responsibility for it himself. It is only when he can recognize his errors and has the capacity to correct them that we can really call the errors his own. This goes for all kinds of trained dispositions, from states of character to dispositions to token "there is an electron here" in the presence of electrons.

According to the theory of perceptual responsibilism an agent must be normatively responsible for her perceptual tokening dispositions if their exercise is to count as observational knowledge. It is this fact that prevents parrots trained to squawk "that's red" in the presence of red things from having observational knowledge. We still hold the trainer responsible for the parrot's mistakes (and successes). But if the parrot could recognize her mistakes and correct them, we might begin to think otherwise.

It is important to notice that being able to recognize your erroneous perceptual dispositions will require having other knowledge, sometimes other perceptual knowledge. For me to recognize that my disposition to

token “this is blue” is sometimes mistaken, I have to be able to discover that I sometimes token “this is blue” in the presence of dark purple things, and I have to know that something which is purple is not blue. Thus this theory of perceptual knowledge is holistic: one cannot have one bit of perceptual knowledge without having lots of other knowledge (some of it perceptual) as well. Presumably this will go for Ernie too. He’ll have to know *something* about electrons, even if it is mostly knowledge about what electrons are *not*, so that when he discovers that he has mistakenly identified something as an electron which is not an electron, he will take back his claim to have seen an electron and try to do what is necessary to prevent further errors of the same kind. But this extra knowledge will not necessarily be sufficient for his being able to inferentially justify his “electron here” beliefs.

In the core of my account of observational knowledge is the notion of epistemic responsibility. Since this is a normative notion, it accords well my epistemology-as-normative leanings. We are now in a good position to see what was misleading about van Fraassen’s position. Remember he said that:

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

But now we see that observation—at least in the sense pertinent to knowledge—is not a physiological or biological affair, but a normative one. And the normative is not held hostage, at least in any simple and straightforward way, to the physiological or biological. That is why it is not absurd to say that it is possible for normal humans to observe electrons, while it is absurd to say that it is possible for normal humans to run a mile in less than ten seconds. Running speed is just a physiological matter, and observation is not. Another way of putting this point is that neither “theoretical entities” nor “observable entities” are natural kinds. (In particular, they are not physiological or biological kinds.)

At this point one may begin to wonder just what kind of limitations, if any, there are on what normal humans are able to observe. I

do not mean to imply that there are *no* limitations on what may be observed, or even that certain physiological facts could not partly determine what was observable. (For example, there may be truths that are too complicated for us to entertain, given our brain's limitations, and so *a fortiori*, we could not observe that they are true.) But I will say this: anything that is knowable by inference is potentially knowable by observation. That is to say, if *O* is an observable fact, and there is a good inference from *O* to *T*, then it is possible to observe that *T*. Anything that is inferentially knowable is potentially non-inferentially knowable. For if the inference from *O* to *T* is a good one, then a person could be trained to token *T* in just the perceptual conditions in which it would be appropriate to token *O*. This is essentially what we did with Ernie. The scientists were inferring, relying on their theories, from some observable facts, to the presence of electrons. They trained Ernie to skip the inference and just token "there's an electron here" in just those conditions in which they would have been justified in inferring that there is an electron present.

Of course, we now see that Ernie's observations of electrons are "theory-laden" in the sense that they presuppose the goodness of inferences involving theories (in this case, electron theories). But van Fraassen concedes the theory-ladenness of our language. He simply thinks that this has no bearing on the observable-unobservable distinction. (van Fraassen 1980, 14.) So there should be no objection from the anti-realist on that score.

But is the perceptual responsibilist account of perceptual justification one that would be acceptable to an anti-realist with the sort of empiricist scruples that van Fraassen has? As I pointed out above, one of the main motivations for van Fraassen's project (or "stance" as he now calls it) is to provide a picture of science and its aims that is free from excess metaphysical baggage. But my perceptual responsibilist account does not bring any such baggage. It does, of course, bring with it a commitment to there being genuine normative facts—facts about whether someone is epistemically responsible, for example. But if this is a kind of "Normative Realism," it is not the sort that brings with it any queer entities of the kind that would raise the eyebrows of van Fraassen. Epistemic responsibility is way of cashing out the epistemic ration-

ality operative in observational belief, and epistemic rationality is not a concept that van Fraassen has any problem with.

Of course van Fraassen thinks that the question of what is or is not observable is not one that can be answered by arm-chair philosophy, but is itself an empirical question for science. He provides an example (Monton and van Fraassen, 2003, p. 413) in which a researcher (a neighbor of van Fraassen's, apparently) was hired by the Canadian armed forces to do some research on the observability gun flashes at night. They wanted to know over what distances and in what conditions the flashes from a gun were visible. One can imagine the sort of empirical experiments that might be set up to find out such things. Does my view make the question of what can be observed into a non-empirical matter in a way that would be objectionable to van Fraassen?

I do not think so. Of course, I cannot say that I came up with perceptual responsibilism as a result of doing scientific experiments (any more than van Fraassen's constructive empiricism is the result of scientific experiments). So there is an element of arm-chair philosophizing there.<sup>8</sup> Part of what this account of perceptual justification has shown us is that observational justification is not primarily a biological or physiological matter. However there is still an important empirical component involved in what can and cannot be observed. If we grant that observing<sup>9</sup> gun flashes is a matter of being an epistemically responsible non-inferential reporter of gun flashes, there is still the empirical question: In what circumstances are normal humans epistemically responsible non-inferential reporters of gun flashes? Thus there is still a need for van Fraassen's neighbor's empirical study. Likewise, it is still an empirical question whether there is anyone out there like Ernie who is an epistemically responsible non-inferential reporter of electrons. Perhaps training someone to be like Ernie would prove to be too difficult for us.

In short I see nothing about perceptual responsibilism that would be at odds with van Fraassen's empirical stance.

Before I finish there is one more issue I want to take up. One might worry whether there is something troubling, in light of standard interpretations of quantum mechanics, about Ernie's being able to perceptually know that there is an electron *here*. On the standard interpretation, an electron does not have any independent definite position, so

perhaps there is no *here* for the electron to definitely be at. What I want to say in response is that it is true that apart from the electron's being observed it has no definite position (but only a probability of having a definite position were it to be observed). But on the standard interpretation, once it is observed (say, by Ernie), then it *does* have a definite position. Of course, when Ernie says "there is an electron *here*," he is not being terribly specific about the electron's location other than "in front of me, in that cloud chamber." So we won't want to commit to the electron's having a definite position more fine-grained than that. But there should be no problem about the electron's being definitely in front of Ernie and inside the cloud chamber, at least once it has been observed.<sup>10</sup>

The epistemologically important sense in which something is observable is that it is non-inferentially knowable. But what is now merely *inferentially* knowable may become, with the proper training and a person's being an epistemically responsible agent with respect tokens of that type, *non-inferentially* knowable. Thus what is now unobservable (in the epistemically important sense) may become—and without the help of electron microscope eyes—observable. Thus it is not impossible for normal humans to directly (non-inferentially) observe electrons (or other theoretical entities), and a crucial argument for scientific anti-realism is undermined.<sup>11</sup>

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### Resumo

*Neste artigo, argumenta-se que uma compreensão adequada da justificação das crenças perceptuais deixa em aberto a possibilidade de que seres humanos normais, sem ajuda de microscópios, possam saber genuinamente, por observação direta, da existência de entidades teóricas como electrons. É apresentada uma teoria da justificação em especial, denominada responsabilidade perceptual. Se bem sucedida, esse tipo de concepção bloquearia uma linha de argumentação que foi apresentada (por exemplo, por van Fraassen) em favor do anti-realismo científico. Também são consideradas aqui diversas outras objeções à idéia de que os elétrons podem ser diretamente observados.*

### Palavras-chave

*Percepção, justificação, anti-realismo científico, entidades teóricas.*

### Notes

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<sup>1</sup> I'm going to restrict my attention to propositional, or conceptual observings where strictly speaking one observes *that* something is the case. These are the only kinds of observations that could help to justify anyone in believing anything. Thus when I say, "Jones observed the dog", I will usually take this to be equivalent to "Jones observed that the dog was there" or something in this neighborhood. Although I am highly inclined to think that all real observation (as opposed to stimulus-response) involves observation *that*, nothing on my argument will turn on it, since it is only observation *that* that plays a role in the scientific anti-realist's arguments. Van Fraassen acknowledges this important distinction at (1980, 15).

<sup>2</sup> I more fully articulate and defend perceptual responsibilism in Nixon (2004).

<sup>3</sup> See Haugeland's (1996) similar way of answering this question. Much (but perhaps not all) of what he says there would be in line with my perceptual responsibilist account.

<sup>4</sup> Van Fraassen of course wants to say that what is observable is a matter of empirical study. We will return to this point below. See van Fraassen and Monton (2003) for a reiteration of that idea.

<sup>5</sup> I do not here need to deny that there might a sense in which humans non-conceptually see things—a sort of perception that we would have in common with lower animals perhaps—but this kind of perception is irrelevant to the question at hand. Van Fraassen (1980, 15) is quite right to distinguish between seeing and seeing *that*. However, it is the latter which is relevant to what we are or are not justified in believing on the basis of observation.

<sup>6</sup> The *locus classicus* of reliabilism is Goldman's (1979) "What is Justified Belief?". See also Plantinga (1993) and Swain (1981).

<sup>7</sup> See Sellars (1956), §5, and (for example) Jay Rosenberg: "At the heart of Sellars's critique of 'the entire framework of givenness' is his articulate recognition of the irreducibly normative character of epistemic discourse." (From Rosenberg's entry on Sellars in Dancy and Sosa (1992), p. 470.) See also Brandom (1994), chapter 1.

<sup>8</sup> However, I certainly do not deny that empirical questions can have a bearing on the acceptability of perceptual responsibilism (and other philosophical theories). This is not First Philosophy in any sense that van Fraassen would object to.

<sup>9</sup> ...in the sense of 'observing' that would be relevant to the question of whether someone *knows* by observation that a gun flash has occurred.

<sup>10</sup> Thanks to an anonymous reviewer at *Principia* for urging me to consider this question, and to Marc Lange for helping me answer it.

<sup>11</sup>I am grateful for the comments and suggestions provided by two anonymous referees for this journal.