

CAN CONSTRUCTIVE EMPIRICISTS BELIEVE IN EXOPLANETS TOO?

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Abstract: Bas van Fraassen maintains that the actual function of optical instruments is producing images. Still, the output of a telescope is different from that of a microscope, for in the latter case it is not possible to empirically investigate the geometrical relations between the observer, the image and the detected entity, while in the former it is – at least in principle. In this paper I argue that this is a weak argument to support the belief in the existence of exoplanets that, according to van Fraassen, comes with accepting a theory that posits these entities. If a constructive empiricist asserts the empirical adequacy of such a theory, she might be relying on typical realist arguments, instead – of the very same ilk as the ones used to defend the veridicality of microscopic images. Perhaps the time has come for van Fraassen to explain his view on telescopes.

Keywords: constructive empiricism, exoplanets, observability, telescope, van Fraassen.

Resumo: Bas van Fraassen defende que a verdadeira função dos instrumentos óticos é produzir imagens. Ainda assim, o produto de um telescópio seria diferente daquele de um microscópio, pois nesse segundo caso não é possível investigar empiricamente as relações geométricas entre o observador, a imagem e a entidade detectada, enquanto no primeiro o é – pelo menos em princípio. Neste trabalho afirmo não ser esse um argumento forte o suficiente para suportar a crença na existência de exoplanetas; a qual, de acordo com van Fraassen, é acarretada pela aceitação de uma teoria que postule essas entidades. Caso um empirista construtivo sancione a adequação empírica de uma teoria como essa, ele poderia estar se utilizando de argumentos tipicamente realistas – exatamente do mesmo tipo daqueles usados para defender a veracidade das imagens microscópicas. Talvez tenha chegado a hora de van Fraassen explicar a sua visão acerca dos telescópios.

Palavras-chave: empirismo construtivo, exoplanetas, observabilidade, telescópio, van Fraassen.

Constructive empiricism is a prominent anti-realist view on science, according to which it is not irrational to maintain an agnostic stance with regard to that part of a scientific theory that describes a putative microscopic world behind the observable phenomena. This means that an image of a paramecium obtained through a microscope needs not be interpreted as veridically representing an extant entity. An image of a very distant celestial body obtained by means of a telescope, on the contrary, is considered veridical by a constructive empiricist, in case a theory positing its existence is accepted – no matter how sophisticated the detection instrument is.

Bas van Fraassen, the originator of this standpoint, has been criticized by several authors about his position on microscopes, in the last decades. This led him to explain in detail his view on these devices and on the use of instruments in science in general in some of his most recent works (see, for example, 2001 and 2008). Telescopes have not been mentioned, if not marginally, in any of these works, which means that van Fraassen's position on these apparatuses – or, at least, about the images they produce – has not changed since he published *The Scientific Image* in 1980, the book that marked the birth of constructive empiricism.

In this paper I shall try to show that perhaps the time has come for van Fraassen to reconsider – or, at least, dwell on – his view on telescopes. In the first two sections I will present his position on the use of instruments in science and explain why, according to the Dutch philosopher, telescopes and microscopes allow for a different attitude with regard to their outputs. In the next two sections I will argue that perhaps the argument according to which one can interpret an image obtained through a telescope as veridical is not that straightforward and that van Fraassen's reply to Paul Teller's 'phenomenological objection', with which he intends to block an argument in favor of a realist interpretation of the use of microscopes, can actually be used 'against' telescopes too. Realist commitments toward the output of a telescope should be based on more solid arguments. In section five it will be shown that if a constructive empiricist believes that the telescopic image of a remote celestial body is veridical, then she might actually be relying on typical realist arguments. Finally, in section six, it will be reaffirmed that exoplanets and paramecia are actually "close to being evidentially on a par" (HANSON & LEVY, 1982, p. 291) and a few comments be made on what consequences for constructive empiricism this conclusion could have.

1. Telescopes as 'engines of creation'

Van Fraassen's view on instruments is notoriously controversial, especially when it comes to microscopes. Countering the quite usual perspective under which these devices are seen as 'windows on an invisible world', the Dutch philosopher prefers considering them as 'engines for the creation of new phenomena'; i.e., of new observables, that scientific theories must account for. According to van Fraassen, the same metaphor can guide our interpretation of the use of instruments in general, not only of microscopes (see 2008, p. 96-99).

Telescopes should be regarded as devices that produce images, then, on a par with microscopes, and not as instruments through which one can perform an observation. Paul Teller in fact explains that, according to van Fraassen, “instruments expand our stock of available phenomena rather than providing ‘windows’ through which we look more deeply at phenomena that exist beforehand” (TELLER, 2001, p. 130). Martin Kusch too ascribes to instruments in general van Fraassen’s view as engines of creation of new phenomena (see 2015, p. 171). This means that “what we do with a telescope does not itself count as observing (...) in the relevant sense” (TELLER, 2001, p. 126).

This actually seems to fly in the face of what van Fraassen wrote in *The Scientific Image*: “if something can be seen through a window, it can also be seen with the window raised. Similarly, the moons of Jupiter can be seen through a telescope; but they can also be seen without a telescope if you are close enough” (1980, p. 16). And in the same page: “A look through a telescope at the moons of Jupiter seems to me a clear case of observation, since astronauts will no doubt be able to see them as well from close up”.

Since there is no other explicit mention of telescopes since then in van Fraassen’s texts and ‘a look through a telescope’ is said to be ‘a clear case of observation’, one can be a little confused. Yet, considering telescopes as instruments through which it is possible to perform an observation, while retaining the same possibility for microscopes, would probably be seen as contradictory – or, at least, as an unprincipled (and perhaps irrational) discrimination. No contradiction seems to arise, on the other hand, if microscopes, telescopes and any other instrument used in science all fall under the same ‘engines of creation’ category. Had it always been van Fraassen’s opinion or has he more recently changed idea on telescopes, putting these devices under the same canopy with microscopes seems fair.

2. The difference between microscopes and telescopes, according to van Fraassen

Claiming that the actual function of optical instruments is creating images and thus denying that one can perform an observation through them is clearly an argument designed to counter the general opinion that paramecia and other microscopic entities exist. As a matter of fact, “in normal usage, ‘observes’ is a ‘success’ or ‘achievement’ word” (GREENWOOD, 1990, p. 559). That being so, considering that a detection obtained via a microscope is

an observation would imply the belief in the existence of the detected entity. If microscopes do not allow one to perform an observation, on the other hand, then perhaps it is possible to keep an agnostic attitude about the existence of the microscopic entities detected through them.

But in 2001 van Fraassen went beyond and wrote that images do not exist – perhaps to prevent any possibility of a ‘realist’ interpretation of them. This would mean that one cannot actually observe an image.¹ However, a few years later, in his last book, *Scientific Representation*, van Fraassen retreated and admitted that images are *something*, even if not ‘a thing’.² Notwithstanding their mysterious nature, images do exist then and part of them are the observables produced by microscopes, telescopes and the like. “In the case of optical instruments (...), the images produced by lenses are themselves (artificially produced) phenomena” (VAN FRAASSEN, 2008, p. 97).

Even if both microscopes and telescopes produce images, though, they allow for different interpretations. Kusch explains how van Fraassen sees it:

the reflection of a tree in water, a rainbow, and the image visible on the VDU of an electron microscope are all public hallucinations. But the reflection of the tree is a picture of something real, of something that is observable. In contrast, the rainbow is not a picture of something real. And the image visible on the VDU of the electron microscope may or may not be of something real: van Fraassen thinks that we inspect the microscopic image qua public hallucination, and that we are entitled to be agnostic about whether this image accurately reflects a microstructure (2015, p. 172).

The difference in interpretation is the result of whether it is possible to empirically study the geometrical relations between the elements involved or not. In the reflection case, there exist geometrical relations between the eyes of the observer, the reflection and the tree that can be studied empirically (see

¹ “We never see images, because images do not exist. (...) Since we can’t see things that don’t exist, the phrase ‘seeing an image’ is code for something we are describing metaphorically or analogically. It is similar to ‘Macbeth saw a dagger’ in the scene where he reports that sort of experience although there is no dagger there” (2001, p. 158). Of course this does not apply to images which are actually material objects, such as paintings and photos (see 2001, p. 159).

² “When you see the reflection of a tree in water you are not seeing a thing; a reflection is not nothing, it is something, but it is not a *thing*, not a material object” (2008, p. 105). According to van Fraassen, reflections in water and microscope images fall under the same sub-category of images that he calls ‘public hallucinations’ (see 2008, p. 104).

KUSCH, 2015, p. 172). “The invariances in those relations are precisely what warrant the assertion that the reflection is a picture of the tree” (VAN FRAASSEN, 2001, p. 160). The same is not true of the images produced by microscopes. In this case, “the geometrical relations are not all open to empirical study: we cannot empirically investigate the geometrical relations between the eye and the microscopic image on the one side, and the postulated unobservable entity on the other side” (KUSCH, 2015, p. 172). This is the reason why van Fraassen feels one is entitled to suspend the belief and to maintain an agnostic stance about the reality of the entity detected through a microscope.³

It is immediately clear that van Fraassen’s (and Kusch’s) use of ‘empirical’ is pretty narrow. As Teller puts it, “van Fraassen has a quite specific criterion: something counts as empirical if it can be observed, without the use of instruments, by oneself or by any in one’s epistemic community” (2001, p. 129). As is well known, ‘empirical’ means ‘originating in or based on observation or experience’ and references to experience trace back to the etymology of the word. Moreover, according to van Fraassen, experience can give us information only about what is observable (see VAN FRAASSEN, 1985, p. 253), which means that, at the end of the day, ‘empirical’ and ‘observable’ amount to the same thing – to him (and Kusch), at least.⁴

What do we do with a telescope, then, once for it too it is denied that it is an instrument designed to perform observations? We can detect Jupiter’s moons and obtain an image of them, for example. That allows us to gather information about these celestial bodies. As a matter of fact, “our present information about the moons of Jupiter come to us courtesy of our use of telescopes” (TELLER, 2001, p. 126). The same happens with a microscope: keeping neutrality about the existence of the entity allegedly represented by a microscopic image “does not prevent us from gathering empirically attestable information by means of the microscope” (VAN FRAASSEN, 2008, p. 109).

³ According to van Fraassen, *to detect* is to be distinguished from *to observe*: “Microscopes, cloud chambers, laser interferometers and other scientific instruments allow us to detect entities, but *detection* has to be carefully distinguished from *observation*. A look through a microscope does not allow us to observe directly a paramecium; only to observe *an image* of a paramecium, or to *detect* a paramecium” (CONTESSA, 2006, p. 456). See also VAN FRAASSEN (2008, p. 93).

⁴ Nothing about the use of instruments is implicit in the concepts of experience and of observation, nor in their etymology, however. This allows Sara Vollmer, among many others, to critic van Fraassen’s position and remark that “instrument-assisted observation can give experiential information, too” (VOLLMER, 2000, p. 362). Then perhaps ‘observation’ is not necessarily equivalent to ‘unaided detection’.

Right, but what should be our attitude with respect to the existence of the entity detected with the use of a telescope?

The reason why, according to van Fraassen, one is entitled to suspend the belief in the existence of the entity allegedly represented by a microscopic image is that we do not have empirical (unaided and independent) access to it. In the case of a moon of Jupiter, conversely, the geometrical relations can be studied empirically, “since astronauts will no doubt be able to see [the moons of Jupiter] as well from close up” (VAN FRAASSEN, 1980, p. 16). It might very well be that Teller is right and van Fraassen never really meant that one can perform an observation through a telescope, but he surely considers that in this case the situation is analogous to that of the reflection of a tree in a pond – or else what would ‘a clear case of observation’ mean? Hence, the belief that an image of Lysithea obtained through a telescope represents an extant entity is apparently grounded. But is it?

3. The need of a better argument

The only reason van Fraassen adduces in favor of the belief that an image of a satellite of Jupiter obtained through a telescope represents an extant entity is the possibility of directly perceiving the same entity (with no mediation of instruments). No mention to the reliability of the telescope, to how it works or to the possibility of comparing the image just obtained with other ones (or other ‘evidence’).

Let us consider other possible examples. *Beta Pictoris b* is an exoplanet 63 light-years away from Earth. A quite famous photograph of it, taken four years ago in Chile, is available on the internet. M32 is a dwarf elliptical galaxy, satellite of the famous and much larger Andromeda (M31, visible to the naked eye). First detected in 1749 by the French astronomer Guillaume Le Gentil, Messier 32 can be easily detected with a pair of binoculars; but unlike Andromeda, is not visible to the naked eye (from Earth). Are we entitled to believe in the existence of M32 and *Beta Pictoris b*?

Since both these celestial bodies are quite big, astronauts will no doubt be able to see them as well from close up. But will a human being actually be able to do it in the future? Is this really the reason why one is entitled to believe that the images we have of them are veridical (and therefore *Beta Pictoris b* and M32 do exist)? An amateur astronomer would probably find this a bizarre reason to believe in the existence of M32 and would rather cite her confidence in the reliability of the binoculars she uses, together with all the

other available evidence. A professional one would probably use similar arguments to support her belief in the existence of *Beta Pictoris b*, or better, her belief that the image obtained by the Gemini Planet Imager in 2014 represents a huge extant planet (first detected by a team of French astronomers using ESO's Very Large Telescope in 2008). Could van Fraassen use similar arguments instead of appealing to the (naked-eye) observability of the entity allegedly represented by a telescopic image?

Probably not. Or else he would end up admitting that microscopic images of paramecia too represent extant entities, too small to be seen with the naked eye, on pain of contradiction. For the very same kind of arguments one can use in favor of a realist (?) interpretation of the use of telescopes can also support the conclusion that at least some microscopic images faithfully represent real (microscopic) structures and entities. Now, despite being apparently ready to admit that the optical microscope actually allows us to detect observable entities – i.e., that some microscopic images can be taken as veridically representing extant invisible-to-the-naked-eye entities –, van Fraassen would certainly not do the same for the electronic microscope (see 2001, p. 163 and 2008, p. 110). It seems that he must stick to the (naked-eye) observability of the detected entity, then.

That being so, it would be interesting to know how he thinks one should interpret an image obtained by an infrared telescope. Beautiful ones can easily be found on the NASA website. Three of them, taken in October 2013, represent Comet ISON and were taken by SOFIA's FORCAST camera (SOFIA means Stratospheric Observatory for Infrared Astronomy). As one learns accessing NASA website, "SOFIA is optimized for observations at infrared wavelengths that cannot be accessed by any telescope on the ground or currently in space" (CALZADA, 2017). Still, astronauts will no doubt be able to see Comet ISON as well from close up. Are we entitled to assert that the picture NASA made available on the internet represents a real celestial body? If so, which is the argument one can adduce in support of this belief?⁵

⁵ The same goes for terrestrial entities, of course. "For example: do we or do we not observe foxes in pitch darkness using an infra-red camera? One might answer 'Clearly, yes' (denying that there is any vagueness), on the grounds that if there were adequate illumination we could see the foxes with unaided vision. But since the illumination is not actually adequate, it can only be our confidence in the camera which backs our belief in this counterfactual, and, if it is a vague matter how far instruments can expand the domain of the genuinely observable, it will be an equally vague matter when this confidence is justified" (MENUGE, 1995, p. 61).

4. Van Fraassen's reply to Teller's phenomenological objection to the 'engine of creation' metaphor – and its consequences for telescopes

A well-known argument against van Fraassen's application of his 'engine of creation' metaphor to all the instruments used in science is Teller's phenomenological objection (see TELLER, 2001). Van Fraassen's metaphor might very well work for devices such as the oscilloscope, says Teller, but not for the stethoscope or the microscope. In the latter case, a direct observation is performed, when one uses these instruments. As Marc Alspector-Kelly puts it, "the sense that one really is looking at something real when one looks through the microscope at a cell remains phenomenologically irresistible" (2004, p. 336).⁶

Van Fraassen does not answer to the stethoscope case, probably thinking that the reply to the microscope case is enough (it would have been interesting to hear what he has to say in the stethoscope case too, though). Now, it is certainly true that the output of a microscope can be sent into a scanner which transmits to a computer or projector so that we can see the image on a monitor or on a screen, as the originator of constructive empiricism maintains (see VAN FRAASSEN, 2008, p. 106) – and the conviction that we are seeing the microstructure of the object on the slide (rather than an image) evaporates the moment we scan and project the image on a screen, as Kusch says (see 2015, p. 176) –, but the same is true of telescopes as well.⁷

Does this mean that one could keep neutrality with regard to the existence of the entities allegedly represented by an image obtained through a telescope? Are realist commitments optional in this case as well? Of course they are, or at least no less optional than the commitments one can assume in the case of a microscopic image.⁸ True, in the case of the telescope, it is in

⁶ In his seminal works on microscopes, Ian Hacking too speaks of the 'dramatic sense of the reality' of what one (apparently) sees when one looks through such a device (see ALSPECTOR-KELLY, 2004, p. 332).

⁷ It would be contradictory to maintain that one can observe through a telescope but cannot do the same with a microscope then. It is here worth adding that van Fraassen's reply to Teller can be read as an answer also to William Seager, who in his 1995 paper on the debate between Hacking and the Dutch philosopher invites the latter to provide an alternative description to the former's 'manipulability argument': "The anti-realist owes us an alternative understanding of our micro-practices which can dissolve our sense of conviction or at least explain it in terms which do not presuppose the reality of microstructure" (SEAGER, 1995, p. 461).

⁸ And of course keeping neutrality in the telescope case would not prevent us from gathering empirically attestable information by means of this device either, as was said before.

principle possible to empirically (here meaning with no instrumental assistance) investigate the relations between the eye and the telescopic image on the one side, and the postulated observable entity on the other side – while this is not possible for microscopes. But it seems more a logical possibility than a physical possibility, in most cases. Think of *Beta Pictoris b* again. Will a human being ever be capable of directly observing a planet which is 63 light-years away from Earth? Very unlikely – and it is hard to imagine that one can be convinced that an image of the exoplanet is veridical by this line of argument.

Other considerations, however, can support a realist interpretation of the image of *Beta Pictoris b*, such as the reliability of the instrument through which it has been obtained and the possibility of relying on other evidence. The point is that this seems to be the case of the microscope too (or of more than one kind of microscopes, at least) and van Fraassen would surely not be willing to rely on such arguments. Not to mention that, at least in the case of microscopes, he would consider this an appeal to an inference to the best explanation, a typically realist argument that he notoriously rejects.

Sticking to the observability in principle of the detected entity as the only criterium to warrant the veridicality of the output of an optical instrument was criticized right after *The Scientific Image* was published. In a 1982 review of the book, Philip Hanson and Edwin Levy compared two putative theories, one that posits the existence of natural satellites of Jupiter and one that posits the existence of bacteria.

A comparison of these two cases reveals a peculiar result: neither the moons of Jupiter nor bacteria have been directly observed by humans, yet a proponent of [CE]⁹ regards *s* [the statement “Jupiter has (at least) four moons”] as true and remains agnostic about *b* [the statement “The human gut contains bacteria, e.g., *E. coli*”]. In contrast we believe that statements like *s* and *b* are close to being evidentially on a par; we do not see how the fact that we could in principle observe some objects directly gives greater evidential warrant to statements about such objects (HANSON & LEVY, 1982, p. 291).

In 1877, the Italian astronomer Giovanni Schiaparelli announced the presence of ‘canals’ on Mars, that he allegedly observed (with a telescope) during a close approach of Mars to Earth. Percival Lowell built an observatory in Arizona a few years later, with the intention of, among other things,

⁹ [CE] clearly stands for ‘constructive empiricism’.

continuing Schiaparelli's work. He produced several sketches of the 'canals', as a result of 'observations' through his telescope. Between the late 19th and the early 20th centuries, various astronomers believed they had seen – and sketched – a network of channels on the surface of planet Mars. It soon became clear that the 'canals' were actually an optical illusion (see, for example, DOUGLASS, 1907), but the belief that there actually were channel on the surface of Mars was widespread at the beginning of last century.

Now, suppose a certain theory T entailed statement c : "There is a network of channels on the surface of Mars". How would an *avant-la-lettre* constructive empiricist have regarded it, a century ago? Should she have regarded c as true, once it is a statement about an observable entity and T was compatible with the available evidence, i.e., with several images produced by telescopes? Or could she remain agnostic about statement c ?

We now know that c is not true and that therefore theory T is not empirically adequate, but what about a theory that posits the existence of *Beta Pictoris b*? The latter is an entity that van Fraassen classifies as observable. Should a constructive empiricist regard the statement "*Beta Pictoris b* is an extant planet very far from Earth" as true, once the theory is compatible with the available evidence, i.e., with the image produced by a telescope?¹⁰ Or could she remain agnostic about the existence of this exoplanet?

5. What attitude toward a theory? And toward the image of an exoplanet?

As van Fraassen explains, there exist two different epistemic attitudes one can take up toward a scientific theory.

We can assert it to be true (i.e. to have a model which is a faithful replica, in all detail, of our world), and call for belief; or we can simply assert its empirical adequacy, calling for acceptance as such. In either case we stick our necks out: empirical adequacy goes far beyond what we can know at any given time. (All the results of measurement are not in; they will never all be in; and in any case,

¹⁰ One might reply that this is a way of talking about theories that van Fraassen does not share, for it reminds the so-called 'syntactic view', according to which scientific theories are, roughly speaking, sets of sentences, while van Fraassen favors the 'semantic view', that considers scientific theories as sets of mathematical models. This does not undermine the above argument, however, since one might talk of a theory which posit channels on Mars in (at least) one of its models instead of saying that it entails sentence c and the situation would be the same. Not to mention that van Fraassen actually admits that a certain theory can entail a specific sentence (see, for example, his 1985, p. 256).

we won't measure everything that can be measured.) Nevertheless there is a difference: the assertion of empirical adequacy is a great deal weaker than the assertion of truth, and the restraint to acceptance delivers us from metaphysics (VAN FRAASSEN, 1980, p. 68-69).

Then again, if 'merely accepting' a theory implies, according to van Fraassen, in asserting its empirical adequacy, this sure requires a wholesale leap of faith, for it means believing in facts we will never know.¹¹

[A] theory is empirically adequate exactly if what it says about the observable things and events in this world, is true – exactly if it 'saves the phenomena'. A little more precisely: such a theory has at least one model that all the actual phenomena fit inside. I must emphasize that this refers to *all* the phenomena; these are not exhausted by those actually observed, nor even by those observed at some time, whether past, present, or future (VAN FRAASSEN, 1980, p. 12).

That being so, how can one assert the empirical adequacy of any theory? What one can actually do is 'testing' theories and see whether they are empirically inadequate; if not, then they might be said to be empirically adequate – even if we will never know whether they really are or not.¹² Now, a theory asserting the existence of *Beta Pictoris b* does not seem to be empirically inadequate, at present, for it is compatible with several detections obtained through telescopes, which can be interpreted as empirical consequences of the theory. Accordingly, it is reasonable to think that some constructive empiricist might already be keen to accept such a theory.¹³ Which means, among other things, believing in the existence of the abovementioned exoplanet.

It also means believing in the veridicality of Gemini Planet Imager's first light image of *Beta Pictoris b*, that can be found on NASA's website. Then again, where does this belief come from? In a 2009 letter to the editor of *Astronomy and Astrophysics*, one of the premier journals for astronomy in the

¹¹ As van Fraassen states, "the belief involved in accepting a scientific theory is only that it 'saves the phenomena', that is, correctly describes what is observable" (1980, p. 4). Observable are also dinosaurs, a stone on a planet outside our galaxy, an earthquake that will take place in California after human extinction, etc. Accepting a theory that posits all these phenomena means believing they are real (be it in the past, present or future). Hence believing in facts we will never know.

¹² Which means that if the concept of empirical adequacy delivers us from metaphysics, then perhaps the assertion of it does not.

¹³ It is worth reminding that van Fraassen admits that both belief and acceptance can come in degree (see 1980, p. 9).

world, a team of French scientists announced they might have taken a picture of a giant planet in the system surrounding the star *Beta Pictoris*. The title of the paper is “A probable giant planet imaged in the β Pictoris disk”, which clearly indicates how cautious they were at first. At the time, they suspended judgment about the existence of an exoplanet orbiting *Beta Pictoris*.

Reading the proceedings of the conference *Thirty years of beta Pic and debris disks studies*, held in Paris in 2014, however, one can easily perceive that only five years after the abovementioned letter was published, scientists had no doubt about the existence of *Beta Pictoris b* anymore. Mickaël Bonnefoy, for example, presented the talk “The properties of the planet(s) around Beta Pictoris”. In the abstract he wrote: “Since the discovery of the *Beta Pictoris* dust system in the 80s, the detailed study of the disk and the discovery of the falling evaporating bodies phenomenon around this star provided a growing evidence that the system was hosting, at least, one gas giant planet”. And again: “In this talk, I will review the past and ongoing efforts to characterize the properties of *Beta Pictoris b*, and to find additional planets in the system”.

As a result of the growing confidence in the existence of the exoplanet, that nowadays no one seems to question or doubt, scientists retrospectively looked at the picture that was mentioned in the 2009 letter to the editor of *Astronomy and Astrophysics* as veridical. What about a constructive empiricist?

As said before, it is reasonable to think that some constructive empiricist might already be keen to believe in the existence of the abovementioned exoplanet, which goes hand in hand with believing that the pictures of *Beta Pictoris b* we now have are veridical. Since we are talking about an observable celestial body, one might very well think that in this case the constructive empiricist’s attitude should have been the same as the scientists’. Cautious at first, ten years ago a supporter of van Fraassen’s view could have shared the scientists’ opinion that a giant exoplanet might have been imaged. No theory positing *Beta Pictoris b* were available at the time, however, allowing for a realist interpretation of the image obtained by the team of French astronomers in 2008.¹⁴ Then again, even if there were one, could it suffice to believe in the veridicality of the picture?

¹⁴ Since no theory positing a planet orbiting around *Beta Pictoris* were available at the time, no one could say: “A look through a telescope at *Beta Pictoris b* seems to me a clear case of observation, since astronauts will no doubt be able to see it as well from close up”. Nor defend that, in this case, there exist geometrical relations that can be studied empirically – even ignoring that the detection of an exoplanet is a far more complicated affair than ‘observing’ a moon of Jupiter through a common optical telescope (see MOSTERIN, 1998). The same goes for the initial interpretation of the picture of *Beta Pictoris b*, of course.

On the other hand, no one can accuse a constructive empiricist of being irrational in case she believes that the abovementioned image faithfully depicts a giant exoplanet, nowadays. But this seems more the result of the still growing evidence of the (putative?) existence of this celestial body than of we now having at disposal a theory that posits *Beta Pictoris b* as an extant entity. Not to mention that such a theory might very well be, on its turn, the result of the large evidence in favor of the thesis of the existence of this celestial body.¹⁵ And of the scientists' confidence in the reliability of the instruments and of the techniques they use.

6. Conclusion: what about constructive empiricism then?

In the introduction of his last book, van Fraassen writes: "I try to be an empiricist, and as I understand that tradition (what it is, and what it could be in days to come) it involves a common sense realism in which reference to observable phenomena is unproblematic: rocks, seas, stars, persons, bicycles..." (2008, p. 3).¹⁶ Being realist about the entities he mentions is one thing, however, since we all can easily see persons, rocks, bicycles, etc. around us right now, while maintaining the same attitude toward other observables, such as the exoplanet *Beta Pictoris b*, is another. Right, we now have theories postulating its existence, but, for all we know, we might also be in the same situation as Lowell was, when he believed in the existence of the observable Martian channels.

Moreover, as said in the previous section, a theory positing the abovementioned exoplanet is probably the result of the scientists' effort to 'save the phenomena' produced by telescopes, while the degree of conviction reached about the theory not being empirically inadequate (with regard to *Beta Pictoris b*, at least) probably comes from the growing evidence about the existence of the exoplanet, part of which depends on the confidence in the reliability of the instruments and the techniques used in its detection – as when the possibility of the image of the planet actually being the result of an artifact has been discarded.

¹⁵ According to van Fraassen, the devices used in science create new phenomena, to be accounted for by our theories: "Their importance too lies in our use in the systematic creation of new phenomena that must also be saved by our theories, and suffice to refute theories to be discarded. (...) The instruments used in science can be understood as not revealing what exists behind the observable phenomena, but as creating new observable phenomena to be saved" (2001, p. 154-155)

¹⁶ For an interesting study on the kind of ontological commitment that is under consideration when accepting a theory in the perspective of constructive empiricist, see CONTESSA (2006).

This means that if a constructive empiricist decides to accept the theory and thus believes that *Beta Pictoris b* exists and that the image in the NASA webpage veridically represents it, at the end of the day she is actually relying on the confidence the scientists have in their instruments, on the compatibility of this postulation with other knowledge we have and on other evidence.¹⁷ What she cannot – and perhaps no one will ever be able to – do is empirically investigate the relations between the eye and the telescopic image on the one side, and the postulated observable entity on the other side. Is there a difference with a paramecium? (Well, perhaps in the latter case the degree of belief in its existence is already, with a very few exceptions, 100%...).

That being so, what a constructive empiricist might do is acknowledge that exoplanets and paramecia “are close to being evidentially on a par” (HANSON & LEVY, 1982, p. 291) and admit that some unobservable (to the naked eye) entities do nevertheless exist. Or in alternative – and for the same reason – allow for agnosticism with regard to some observable entities, even when the theory that posits them is accepted.¹⁸

But there are other alternatives, such as extending the scope of the adjective ‘observable’ and admitting that paramecia and the like are observable too; or, on the contrary, restrict it in order to leave *Beta Pictoris b* out of the set of the observable entities – which would imply in reviewing the general limits of observability (see VAN FRAASSEN, 1985).¹⁹

Be that as it may, perhaps the time has come for van Fraassen to explain his view on telescopes, as he has already done with the microscopes. This might lead to a revision of his concept of observability *e*, as a consequence, to *his* anti-realism.

¹⁷ Would she also be relying on someone else's inference to the best explanation then?

¹⁸ As said before, van Fraassen admits that both belief and acceptance can come in degree. Nothing prevents one to think that a not-100% acceptance can be the result of a non-uniform belief in the posited observables.

¹⁹ As van Fraassen explains in “Empiricism in the Philosophy of Science” (1985), observability presents *special limits*, due to the physiology of the human species (our epistemic community), and *general limits*: the latter are spatial and temporal limits determined by Einstein's relativity theory. Interplanetary travels fit within these limits and so there should be no problem in imagining contexts (models) in which astronauts are in the vicinity of an exoplanet. But is that right?

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