Cartesian Certainty, Realism and Scientific Inference

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In the *Principles,* Descartes explains several observable phenomena showing that they are caused by special arrangements of unobservable microparticles. Despite these microparticles being unobservable, many passages suggest that he was very confident that these explanations were correct. In other passages, however, Descartes points out that these explanations merely hold the status of 'suppositions' or 'conjectures' that could be wrong. The aim of this chapter is to clarify this apparent conflict. I argue that the possibility of natural explanations being wrong should be understood as these explanations not being absolutely certain, but as being morally certain. Cartesian explanations rely on what Ernan McMullin calls *retroduction*, which is a mode of inference that justifies beliefs in concrete unobservable entities and processes. I use as a foil the debate in contemporary philosophy of science between scientific realism and instrumentalism, and argue that for Descartes we could indeed have knowledge of the unobservable world. In that sense, he was closer to being a scientific realist.

§1. Cartesian Explanations and Unobservable Particles

In contemporary philosophy of science, *instrumentalism* is the view that holds that the aim of science is empirical adequacy. The idea is that scientific theories are supposed to account only for observable phenomena, and the epistemic attitude toward claims regarding unobservable entities and processes should be agnosticism. *Scientific realism*, on the other hand, holds that the aim of science is truth. On this view, beliefs in the existence of the objects and processes posited by our best scientific theories are to some extent warranted, regardless of whether these objects and processes are observable by humans. Most versions of scientific realism restrict their commitments to the entities and processes posited by the best scientific explanations, and the criteria for classifying explanations are the so-called theoretical virtues. There is, of course, wide disagreement concerning what exactly these virtues may be, but it is generally believed that best explanations subsume their *explananda* under more general regularities (generality), while at the same time positing the fewest amount of explanatory entities or processes (unificatory power), arranged in the simplest possible way (simplicity). In turn, if an explanation gives rise to further developments of the theory, it is said to be fruitful (fertility).

This framework from contemporary philosophy of science will help me illuminate an interpretative debate concerning the nature of Cartesian explanations. In Part 4 of the *Principles*,

Descartes provides a long list of explanations of several *observable* phenomena, showing that these phenomena are effects of interactions, by physical contact, of *unobservable* micro particles (for example, he explains attraction between magnets in terms of the pulling of strings composed of screw-shaped micro particles). Appealing to these particles is not a return to medieval 'occult' qualities. Rather, they make perfect sense in Cartesian metaphysics of science. After our pure reason grasps the essential properties of matter as an extended substance, we only need to accept that matter is indefinitely divisible to conclude that there can be very small particles with exactly the same properties of concrete, observable objects, namely size, shape, and motion as described by the laws of movement outlined earlier in the *Principles* (AT VIIIA 324/CSMI 286-7). According to Descartes, the reason why these particles are unobservable by humans is simply that:

> "[the] nerves, which must be set in motion by objects in order to produce a sensation, are not themselves very minute… hence they cannot be set in motion by very minute bodies" (AT VIIIA 324/CSMI 287).

Having established the existence of these particles, Descartes explicates how their usefulness in explanations justifies claims regarding the way these particles are structured.

> "[S]ome people may be led to ask how I know what these particles are like. Mi reply is this… I took the simplest and best known principles, knowledge of which is naturally implanted in our minds; and working from these I considered, in general terms, firstly, what are the principal differences which can exist between the sizes, shapes and positions of bodies which are imperceptible by the senses merely because of their small size, and, secondly, what observable effects would result from their various interactions. Later on, when I observed just such effects in objects that can be perceived by the senses, I judged that they in fact arose from just such an interaction of bodies that cannot be perceived – especially since it seemed impossible to think up any other explanation for them… Men who are experienced in dealing with machinery can take a particular machine whose function they know and, by looking at some of its parts, easily form a conjecture about the design of the other parts, which they cannot see. In the same way I have attempted to consider the observable effects and parts of natural bodies and track down the imperceptible causes and particles which produce them." (AT VIIIA 326/CSMI 288-289).

The method consists in inferring, from the observable effects, the causes that better account for them. Here we can see that although the unobservable causal structures responsible for observable phenomena are posited as suppositions or conjectures, Descartes seems to be very confident of the correctness of these conjectures, to the point that it seems impossible to him to be mistaken about them. However, this confidence seems to be undermined by the remarks he makes in the section right after the one I just cited, where he says that:

> "… although this method may enable us to understand how all the things in nature could have arisen, it should not therefore be inferred that they were in fact made in this way. Just as the same craftsman could make two clocks which tell the time equally well and look completely alike from the outside but have completely different assemblies of wheels inside, so the supreme craftsman of the real world could have produced all that we see in several different ways. I am very happy to admit this…" (AT VIIIA 327/CSMI 289).

This passage appears in section 204, entitled:

> "With regard to the things which cannot be perceived by the senses, it is enough to explain their possible nature, even though their actual nature may be different." (AT VIIIA 327/CSMI 289).

So, on the one hand, Descartes says that it seems impossible for these causal explanations to be wrong, and on the other, he says that one must not infer that things in fact occur in that way. How are we to understand the seemed impossibility that warrants Descartes' confidence in the correctness of the explanations against his admission that it is possible for these explanations to be mistaken? In what follows I argue that, contrary to some instrumentalist readings, the possibility of these explanations being wrong should be understood merely in a metaphysical sense (from the perspective of God, it is possible for these explanations to be wrong), but in no way this warrants instrumentalist readings that advocate for skepticism towards unobservable structures. By making reference to God's power, Descartes is drawing a distinction between the metaphysical or absolute certainty we can achieve in some domains, namely, the existence of God, humans being thinking things, and matter being an extended substance (what he calls *Scientia*), and the weaker certainty that is the goal of the natural sciences.

§2. Descartes as an Instrumentalist

2.1. Garber and Empirical Adequacy

The remarks in section 204 have led some authors to believe that, for Descartes, whether or not claims about unobservables are true is not important in explanation. For example, according to Daniel Garber:

> "it simply does not matter if the conjectures [i.e. the explanations] are false, as long as they agree with the phenomena of experiment and observation. What is important for Descartes is now simply that the consequences of his conjectured particular natures agree with experience. For if they do, then whether true or false, they can be used to predict future experience, and in that way serve as reliable guides to life. In this way we can say that for Descartes, experience doesn't confirm the truth of conjectures about the corpuscular sub-structure, but their reliability as predictors of future experience." (Garber 2001, 127).

On Garber's view Descartes' goal is merely to account for the observable phenomena, regardless of whether both the unobservable structures and the causal histories described in the explanations actually exist. Beyond the fundamental properties of matter and the laws of movement, Descartes would be giving up the quest for knowledge about the unobservable physical world.

The instrumentalist undertones of Garber's reading are clear. Instrumentalism is an empiricist view. It gives primacy to the evidence directly gathered by the senses or systematic organizations of disparate accounts of observable phenomena over the speculations concerning unobservable reality. Garber attributes this asymmetry to Descartes. He quotes the *Meditations* as evidence that, for Descartes, despite the fact that the senses can deceive us, they can also be truth-conducive:

> "I know that in matters regarding the well-being of the body, all my senses report the truth much more frequently than not." (ATVII 89/CSMII 61).

But, Garber argues, this is not the case of the unobservable reality:

> "[W]e can't even say this about our conjectures about hidden natures; for all we know they may be genuinely false" (Garber 2001, 128).

Garber then concludes that, for Descartes:

> "[T]he hidden mechanism, the corpuscular substructure, the real nature of a body has become a mere calculating device for predicting future phenomena, and lost the status of even being a candidate for knowledge or ignorance; all that really seems to count are the phenomena" (Garber 2001, 128).

2.2. Dellsén and How-Possibly Explanations

A more recent instrumentalist reading is that of Finnur Dellsén, who argues that:

> "on [Descartes'] conception there is no conflict at all between appealing to a hypothesis in an explanation and simultaneously recognizing that it is not true" (Dellsén 2017, 316).

On Dellsén's view, Descartes' goal in the *Principles* is to present plausible mechanical explanations, that is, explanations that align with Cartesian general principles of nature, but these explanations do not necessarily correspond to the way things are. In that sense, Dellsén argues, for Descartes "theories can explain even if they are not true" (Dellsén 2017, 315).

In order to explicate his view, Dellsén appeals to a distinction by William Dray (1957) between *how-possibly* and *why-actually* explanations (see also Salmon 1992, and Cuffaro 2015). *How-possibly* explanations show how things could have happened, given some basic principles of nature, but without asserting that they actually happened that way. *Why-actually* explanations, on the other hand, do intend to track down the actual causal history of the phenomenon to be explained. To Dellsén's mind, Cartesian explanations are better described as *how-possibly* explanations (Dellsén 2017, 318). Dellsén quickly points out that this does not mean that for Descartes that "any explanation will do, as long as it is mechanical" (2017, 317). Rather:

> "an adequate explanation must also be the clearest and most distinct of the available explanations. And of course, the mechanical explanations must also be consistent with the observations they explain and be deducible from the laws of motion. However… the explanantia in such explanations need not be regarded as true" (2017, 317).

In Dellsén's reading, Descartes never thought to make the extra step of inferring, from the clearest and most distinct of the available explanations, to its truth. In that sense, Dellsén's is an instrumentalist reading because, according to it, Descartes' goal was merely to account for the observed phenomena, regardless of whether both the unobservable structures and the causal histories described in the explanations actually existed. Beyond the principles of movement:

> "the theories appealed to in Cartesian explanations… do not fall within the scope of Descartes' requirement of certainty" (2017, 326).

Thus, for Dellsén the ultimate epistemic value of Cartesian explanations is to be "indicative of the explanatory power of the first principles" (2017, 321), but these explanations do not justify any commitments to the unobservable structures described by them.

§3. Descartes as a Scientific Realist

Despite the previous interpretations, a more comprehensive reading shows that the project of the *Principles* goes beyond empirical adequacy, and that there is a further task consisting in finding out which of these possible explanations is the correct one. Granted, the task is hard and may not always prove to be successful, but Descartes takes it to be *the aim of natural inquiry* to engage in this task with the tools of reason. On this reading, Descartes would be more akin to scientific realism, since he relied on the theoretical virtues of his explanations to decide whether or not they correctly described the structure of the unobservable physical world.

There is plenty of textual evidence for this reading. For example, in Part III of *Principles* Descartes appeals to the virtues of generality and fertility:

> "in order to come to know the true nature of this visible world, it is not enough to find causes which provide an explanation of what we see far off in the heavens; the selfsame causes must also allow everything which we see right here on earth to be deduced from them. There is, however, no need for us to consider all these terrestrial phenomena in order to determine the causes of more general things. But we shall know that we have determined such causes correctly afterwards, when we notice that they serve to explain not only the effects which we were originally looking at, but all these other phenomena, which we were not thinking of beforehand" (AT VIIIA, 98-99/CSMI 255).

In addition, Descartes appeals to the virtue of simplicity when he says that:

> "If a cause allows all the phenomena to be clearly deduced from it, then it is virtually impossible that it should not be true… We would seem to be doing God an injustice if we suspected that the causal explanations discovered in this way were false. For this would imply that God had endowed us with such an imperfect nature that even the proper use of our powers of reasoning allowed us to go wrong" (AT VIIIA 99/CSMI 255).

Similarly, in a letter to Jean-Baptiste Morin, Descartes appeals to the virtue of unificatory power:

> "while there are indeed many effects to which it is easy to adjust different causes, one to the other, it is not always so easy to adjust one single cause to many effects, if it is not the actual cause from which they proceed. Indeed, there are often effects which are such that to specify one cause from which they can clearly be deduced is sufficient to prove it to be their true cause. And I maintain that all of those of which I have spoken are of this sort" (cited in McMullin 1990, 37).

The paragraph quoted in §1 must also be understood as inferring the correctness of an explanation from its intelligibility:

> "[I judge that] such effects in objects that can be perceived by the senses… in fact arose from just such an interaction of bodies that cannot be perceived – *especially since it seemed impossible to think up any other explanation for them*." (AT VIIIA 326/CSMI 288; my emphasis).

Here we see Descartes justifying his commitments to the correctness of his explanations by appealing to what we now call theoretical virtues, a move very similar to the ones made by contemporary scientific realists. But of course, one may wonder why these virtues are knowledge-conferring. Unfortunately, Descartes does not explicitly address this issue (which is controversial in the contemporary discussion as well!) However, his use of these virtues is certainly not arbitrary. For example, the idea of God as immutable gives a sense of the kind of virtues to be considered in order to understand God's creation, namely, simplicity, generality, intelligibility, etc. These virtues are also at play when understanding the laws of motion in terms of principles such as conservativeness. But in general, it seems that for Descartes is obvious that these are the features good explanations must have.

§4. Retroduction

According to Ernan McMullin, Descartes was the first philosopher who explicitly acknowledged the importance of inferring from plausible explanations of observable phenomena to the causal structures posited by these explanations. Following Charles Peirce, McMullin calls this form of inference *retroduction*:

> "[A]s a process of inference, [retroduction…] is not rule-governed as deduction is, nor regulated by technique as induction is. Its criteria, like coherence, empirical adequacy, fertility, are of a more oblique sort… It is a complex, continuing, sort of inference, involving deduction, induction, and abduction" (1992, 92).

Building upon William Whewell and Peirce, McMullin defines retroduction as involving three steps. First, abduction is the process of formulating verifiable causal hypotheses. Then, deductions are performed that extract the possible consequences of these causal hypotheses. Finally, induction is both the verification of these hypotheses, and the generation of verifiable laws that will in turn require a causal explanation. In that sense, induction is an ampliative inference but restricted to the observable realm. Via abduction, a causal hypothesis is posited, which includes entities, processes and relations that would account for the phenomenon to be explained (which is usually a regularity arrived at by induction). Abduction is also an ampliative inference because, if successful, it provides a deeper form of understanding, and opens a yet unknown domain.

Understanding Cartesian explanations as relying on retroductive inferences, as defined by McMullin, allows us to see the kind of certainty they confer. Consider the following reconstruction of Descartes' explanation of the behavior of magnets:

Step 1. Induction: By experience we verify that a set of observed magnets attract each other, and by induction we establish that 'magnets attract each other'. This regularity is the *explanandum*.

Because of our clear and distinct ideas about the nature of the material substance, we know that the explanation of this regularity must be purely mechanical and must appeal only to the size, shape, and motion of particles of matter. What is more, we already have a good argument to establish that there are unobservable micro particles, and that our explanation can use them.

Step 2. Abduction: What else can be inferred from the nature of matter? Not much. Here that we must use our imagination, and postulate a hypothesis: magnets emanate screw-shaped particles that hook up to one another forming some sort of strings. These strings hook up to the strings emanating from the other magnet. Because of the action of vortex forces (which can also be explained mechanically), the strings are pulled back, thus creating a force that pulls the magnets together.

Step 3. Deduction: By appealing only to mechanical forces, this causal story can be used to deduce the observable behavior of magnet attraction.

Based on the virtues of this explanation, Descartes justifies his belief that the story in step 2 is correct and therefore that those screw-shaped particles actually exist and behave as described.

§5. Natural Explanations and Moral Certainty

We saw in §1 that Descartes himself admitted that his natural explanations, despite having the virtues outlined above, can be false because "the supreme craftsman of the real world could have produced all that we see in several different ways" (AT VIIIA 327/CSMI 289). How are we to interpret this possibility? In what follows, I argue that for Descartes these explanations can be false in the same way that we can be misled by our senses: we could be wrong about what our senses inform us, but it is not likely. Similarly, although claims concerning unobservable structures can be false, if they play a role in our best explanations of the observable reality, their falsity is very unlikely.

In order to see this point more clearly, we must understand the distinction between absolute or metaphysical certainty on the one hand, and moral certainty on the other. In the *Principles*, Descartes defines absolute certainty as the one that "arises when we believe that it is wholly impossible that something should be otherwise than we judge it to be" (AT VIIIA 328/CSMI 290). Moral certainty, on the other hand, is a certainty sufficient "for application to ordinary life, even though [what is morally certain] may be uncertain in relation to the absolute power of God." (AT VIIIA 327/CSMI 289-290). This distinction was already introduced in the *Discourse*, where Descartes explains that morally certain things are those that we cannot doubt "without being extravagant" (AT VI, 37-38/CSMI 129-130), although from the perspective of absolute certainty "we cannot reasonably deny that there are adequate grounds for not being entirely sure about them" (AT VI, 37-38/CSMI 129-130).

There are few things that can be known with absolute certainty, for example, "that God exists" and "that the mind is different from the body" (ATVII 6, CSMII 6). Other things include "that I am something", "that in the future it will be true that I have existed", "that two and tree added together are five", etc. (cf. AT VII, 21), but our knowledge of these things depends on our knowledge of God, "[f]or if [we] do not know this, it seems that [we] can never be quite certain about anything else." (AT VII, 21). If we do not believe in God, all we can hope for achieving is

moral certainty. In that sense an atheist, Descartes argues, "will never be free of [doubts about these things…] until he acknowledges that God exists." (AT VII, 141). It is in this context that Descartes writes his famous remarks in the *Replies*:

> "I do not dispute that an atheist clearly apprehends that the three angles of a triangle are equal to two right angles. I maintain only that his cognition is not true science, *since no cognition that can be rendered doubtful seems fit to be called science.*" (AT VII 141)

This passage should not be interpreted as if Descartes was claiming that only metaphysical certainty is suitable for natural inquiry, with the implication that atheists cannot engage in this inquiry. Rather, as Jorge Secada points out, the idea of this passage is that the atheist clearly apprehends (*clare cognoscere*) some relatively simple geometrical matter, but lacks "true science (*veram scientiam*)", because her cognitions can be rendered (metaphysically) doubtful (Secada 2009). The key point is that Descartes distinguishes between *Scientia*, which is a kind of cognition that is indubitable, evident, and absolutely certain (Pasnau 2017, 23), something that only him and a handful of other people has ever achieved (see Pasnau 2017, 24), and the clear cognitions of an atheist, which are not *Scientia*.

Now, there are many things about which moral certainty is the best that can be achieved, even if after going the meditational process outlined in *Meditations* one has become a true believer in God. Among these things are, for example, the existence of the external world as a whole, and the existence of the objects of our sensory perceptions. As he puts it in the introduction to *Meditations*:

> "[In the sixth meditation] there is a presentation of all the arguments which enable the existence of material things to be inferred. The great benefit of these arguments is not, in my view, that they prove what they establish – namely that there really is a world, and that human beings have bodies and so on – since no sane person has ever seriously doubted these things. The point is that in considering these arguments we come to realize that they are not as solid or as transparent as the arguments which lead us to knowledge of our own minds and of God, so that the later are the most certain and evident of all possible objects of knowledge for the human intellect." (AT VII, 15-16/CSM II, 11)

The unobservable causal structures posited by natural explanations are also the kind of things that can only be known with moral certainty. Support of this view comes from a section in the *Principles* entitled "Nevertheless my explanations appear to be at least morally certain", where Descartes provides the following examples that clearly illustrate the *kind* of certainty he sought in his natural explanations:

> "<Thus, those who never been in Rome have no doubt that it is a town in Italy, even though it could be the case that everyone who has told them this has been deceiving them.> Suppose for example that someone wants to read a letter written in Latin but encoded so that the letters of the alphabet do not have their proper value, and he guesses that the letter B should be read whenever A appears, and C when B appears, i.e. that each letter should be replaced by the one immediately following it. If, by using this key, he can make up Latin words from the letters, he will be in no doubt that the true meaning of the letter is contained in these words, it is true that his knowledge is based merely on a conjecture, and it is

> conceivable that the writer did not replace the original letters with their immediate successors in the alphabet, but with others, thus encoding quite a different message; but this possibility is so unlikely <especially if the message contains many words> that it does not seem credible>." (AT VIIIA 327-28/CSM I 289-90).

The idea of this passage is that, although we may never know with absolute certainty whether we found the real meaning of the letter, or whether Rome is actually a city in Italy, it would be absurd to think otherwise given the fact that the truth of our beliefs about the meaning of the letter or about Rome better explains the available evidence.

Evidently, neither the Rome case nor the letter case are fully analogous to the case of unobservable structures, for in the first two it is in principle possible to verify the truth of our beliefs either by going to Rome or by asking the author of the letter directly, whereas this is not available with respect to our beliefs about unobservables. However, the fact that Descartes uses examples based on unobserved structures to illustrate the moral certainty of natural explanations is significant. It suggests that in some cases hypothesizing about unobserved structures is epistemically analogous to hypothesizing about unobservable structures: as long as we have a good hypothesis (a hypothesis having certain acceptable theoretical virtues), it would be extravagant not to believe in its truth. The explanations must be simple (the hypothesis that all from whom the people who's never been in Rome got their information about the city were deceived is too complicated), general (the more words the letter has, the more likely the interpretation is the correct one), etc. In the case of natural explanations, these virtues feature in the highest degree, and for this reason having these explanatory virtues grants being morally certain about these hypotheses being correct.

Now, Descartes' own explication of natural explanations is a little bit misleading. He claims that they are carried out via *deduction* from the principles of shape, size, position and motion of matter:

> "there is nothing in the whole of nature (nothing, that is, which should be referred to purely corporeal causes, i.e. those devoid of thought and mind) which is incapable of being *deductively explained* on the basis of these selfsame principles" (AT VIIIA 315/CSM I 279; my emphasis).

One way of reading this passage is as if Descartes' goal was to know these unobservable structures with absolute certainty, thus extending the ideal of absolute certainty from metaphysics to the natural sciences. After all, if explanations of natural phenomena are *deductions* from the material principles of size, shape, and motion, and if these principles are themselves deduced from absolutely certain beliefs such as the existence of God, the nature of matter as an extended substance, and of humans as thinking things, then our knowledge of the unobservable structures posited by these natural explanations would inherit the epistemic strength of those rational beliefs. In the *Principles*, for example, he suggests that these explanations are not just morally, but absolutely certain:

> "[P]erhaps even these results of mine will be allowed into the class of absolute certainties, if people consider how they have been deduced in an unbroken chain from the first and simplest principles of human knowledge… it seems that all the other phenomena, or at

> least the general features of the universe and the earth which I have described, can hardly be intelligibly explained except in the way I have suggested" (AT VIIIA 328-29/CSM I 290-91).

If the explanations are *deductions* from principles we know with absolute certainty, our knowledge of the micro structures they posit should be *metaphysically* certain, and not simply morally certain.

I believe, however, that this passage does not warrant this conclusion. Descartes starts saying that all other phenomena have been deduced from the principles, but then immediately backs off and narrows the scope of his assertion, focusing only on "the general features of the universe and the earth", and even for these cases he qualifies the knowledge he has about them with *hardly*. Part of the issue is that Descartes mistakenly describes his own method of explanation as purely *deductive*. For starters, it is impossible to deduce every phenomenon from a fixed set of principles without taking the initial conditions into account, which can only be apprehended by experience. But more importantly, as we have seen, in his own practice of advancing natural explanations Descartes appeals to retroduction, which is a mode of inference that is not purely deductive. For example, although it may be in principle possible to deduce (what Descartes' thought to be) the fact that magnets emanate screw-shaped particles, in practice this cannot be done. Rather, this can only be hypothesized as the best plausible explanation of magnetic attraction. It is true that, according to Descartes at least, from this hypothesis magnetic attraction deductively follows, but this does not mean that the shape of those particles was inferred from the principles of size, shape and motion. As he points out at the end of *Meditations*:

> "[I]t must be admitted that in this human life we are often liable to make mistakes about particular things, and we must acknowledge the weakness of our nature" (AT VII 90/CSM II 62)

§6. Conclusion

There is an ongoing debate regarding whether Descartes had at some point in time hoped that he could extend this ideal of absolute certainty to the natural sciences by actually deducing all natural phenomena from the principles of God, humans as thinking things, and matter as an extended substance, or rather, that he never thought this to be possible (see Dellsén 2017 for an overview). Despite this debate, there is wide consensus that, at least in the *Principles*, Descartes' goal was not to actually deduce all the observable effects from these three principles mentioned above. In that sense, the kind of natural inquiry introduced in the *Principles* is not *Scientia*. Now, as Pasnau convincingly argues (2017, 25), if Descartes had thought that only the products of *Scientia* are knowledge, he would have been a skeptic, because we would have held that we lack knowledge concerning almost everything, including for example that there is an external world. But he was not such a skeptic. Rather, he thought that we can indeed acquire knowledge of things outside the domain of *Scientia*. What I have shown in this chapter can be interpreted under this light: the fact that, from a metaphysical perspective, we could be wrong about natural explanations, does not entail that it is not possible to *know* that the microstructures cited by natural explanations exist. If the conjectures have the right explanatory virtues, then we can be morally certain that the posited microparticles are indeed arranged in the way described. For Descartes it would be an extravagant form of skepticism to think otherwise, as extravagant as the kind of skepticism of the person who indeed believes that we may be dreaming and we know little about the external world.

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