Science, Common Sense and Reality

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Scientific realism and the return of metaphysics

An interest in metaphysics is now fashionable in a way not seen since before the rise of logical positivism. Diverse factors have contributed to this trend. But in the philosophy of science a significant role has been played by the emergence of scientific realism as the new orthodoxy following the demise of positivism.

The positivists initially dismissed the topic of realism as vacuous. But by the late 1950s, the holistic implications of the partial interpretation account of meaning united with rejection of a sharp divide between observation and theory to foster a budding realist movement in the philosophy of science. A decade later, development of the causal theory of reference provided the basis for a realist semantics of science, which prompted reflection on metaphysical issues such as necessity, essential properties and laws of nature. Work in this currently active area is conducted in a philosophical climate that came into being as the result of the emergence of scientific realism as the dominant position in the philosophy of science.

While scientific realism has played a major role in the return of metaphysics, in this paper I focus on a more basic position. Scientific realists often appeal to common

sense as part of the case for their position. Commonsense realism carries with it a commitment to metaphysical realism that is an important aspect of the return of metaphysics. It is not my aim here to chronicle the rise of scientific realism, but to promote a scientific realism grounded in common sense.

Science and reality

With the exception of cultural relativists and social constructivists, scientific knowledge is widely held to be rigorously established knowledge and the methods of science to be a reliable means of establishing such knowledge. Indeed, some hold that science is our best, if not our only, source of knowledge. But to say that science provides knowledge is not yet to settle the question of what science is about. The question remains of the relation between science and reality. Does science provide us with knowledge of an independently existing reality? Does it reveal the truth about the 'external world'?

I propose a positive answer to the question of the relation between science and reality based on a realist philosophy of science. But before characterizing scientific realism, I will consider the positions of two influential anti-realists, Thomas Kuhn and Bas van Fraassen. I will then turn to the realist view of the relation between science and reality. As we will see, a significant issue emerges with respect to the relation between science and our commonsense view of the world. Some realists hold that there is a conflict between science and common sense which leads to the overthrow of common sense.

Kuhn's changing worlds

Kuhn's book, *The Structure of Scientific Revolutions*, introduced the idea of a paradigm as a scientific world-view that underlies an ongoing tradition of scientific research. Science advances by normal scientific puzzle-solving based on a paradigm, which is periodically disrupted by revolutionary change of paradigm.

One of the most perplexing features of Kuhn's account is his repeated use of the image of a change of world. A historian looking at past science may "exclaim that when paradigms change, the world itself changes with them" (1996, p. 111). Paradigm change is like space travel, "as if the professional community had been suddenly transported to another planet where familiar objects are seen in a different light" (1996, p. 111). Paradigm changes "cause scientists to see the world of their research-engagement differently", so "we may want to say that after a revolution scientists are responding to a different world" (1996, p. 111).

I prefer to interpret the world-change image as mere metaphor not to be taken literally. But a more common interpretation takes Kuhn's world-change image in a neo-Kantian sense. Paul Hoyningen-Huene, for example, interprets the image in terms of a distinction between the invariant and unknowable *world-in-itself* and knowable *phenomenal worlds* that are subject to variation with change of paradigm.

On such an interpretation, Kuhn's account of science yields a negative response to the question of the relation between science and reality. Science does not provide knowledge of an independently existing reality. It is impossible to have knowledge of the world-in-itself. Knowledge is confined to phenomenal worlds. But a phenomenal world

is not an independently existing reality. It is a constructed world built out of human concepts and sensory perception. Because phenomenal worlds vary with paradigm, knowledge is a relative notion. What one knows depends on the paradigm one adopts.

This may be a plausible interpretation of the world-change image. But it is not possible for the position itself to be maintained coherently. The position asserts the existence of a world-in-itself of which we may have no knowledge. But in order to make such an assertion, it must be assumed not only that there is a world-in-itself, but that we are able to know *of* the world-in-itself both that *it* exists and that we are unable to know anything about it. But it is not possible both to know that the world-in-itself exists and for the world-in-itself to be unknowable.

In a later essay, Kuhn describes his position as a "post-Darwinian Kantianism". What he calls the "lexical structures" of theories provide "preconditions for possible experience" in a manner similar to Kant's categories (2001, p. 104). In his discussion of change of lexical structure, Kuhn reveals the incoherent nature of the position when he writes as follows:

> Underlying all these processes of differentiation and change, there must, of course, be something permanent, fixed and stable. But, like Kant's *Ding an sich*, it is ineffable, undescribable, undiscussible. Located outside of space and time, this Kantian source of stability is the whole from which have been fabricated both creatures and their niches, both the 'internal' and the 'external' worlds. (2001, p. 104)

Here Kuhn provides a detailed description of the nature and function of the underlying "source of stability" that he claims cannot be described. Some may be inclined to treat this infelicity as an unavoidable paradox that arises when one must speak of the ineffable.

But it is difficult to see why such fundamental incoherence should not be taken to fatally undermine the position.

Van Fraassen's constructive empiricism

I turn to the constructive empiricist position proposed by van Fraassen in *The Scientific Image*. Like Kuhn, van Fraassen holds that there are limits on our access to reality. For van Fraassen, these limits coincide with the bounds of human sensory experience.

For constructive empiricism, the aim of science is to arrive at theories which are empirically adequate, and scientists accept theories as empirically adequate. A theory is empirically adequate if all of its observational consequences are true. Theories routinely make claims which purport to refer to unobservable entities such as atoms and electrons. However, van Fraassen holds that the appropriate attitude toward such claims is an agnostic stance that suspends belief with respect to claims about unobservable states of affairs. Direct sensory experience is unable to determine whether claims of a non-observational nature are true, since such experience only provides information about observed phenomena. Claims about unobservable states of affairs may be true for all we know. But we must suspend judgement about such matters since they transcend empirical verification.

Constructive empiricism is a further example of a negative response to the question of the relation between science and reality. Van Fraassen does not deny that scientific theories may make true assertions about unobservable states of affairs. But we are in no position to know whether any such claims are true. Van Fraassen denies that we may

have knowledge of aspects of the world that are incapable of verification by human sense experience. So, while science may provide knowledge of observable dimensions of reality, it yields only limited access to reality. It cannot provide knowledge of unobservable aspects of reality.

As with Kuhn, this position is deeply problematic. For one thing, van Fraassen is unable to provide a uniform account of the use of instruments in science. He must enforce a sharp distinction between seeing through a telescope and seeing through a microscope. Because one can verify what one sees through a telescope by direct inspection of objects seen through a telescope, such objects are observable. But objects seen through a microscope are too small to see with the naked eye and are therefore unobservable. Given the epistemic significance that van Fraassen attaches to observation, the telescope may serve as a source of information about entities observed through the telescope, but the microscope may not. But the mere fact that some objects are observable by us, and others are not, is no reason to suppose that the principles which govern optical devices at the macro-level cease to operate when applied at the micro-level.[1]

A second problem derives from van Fraassen's strict empiricism. Van Fraassen assumes that our ability to acquire empirical knowledge does not exceed our sensory capacities. Experience is our sole source of information. It only provides information about actual states of affairs that we are able to observe by means of our native sensory apparatus. The limits of experience are contingent limits that may themselves only be

discovered empirically. But they are nevertheless significant limits on our capacity to acquire knowledge about the world.

Van Fraassen is no doubt correct that there are limits on what we may detect using unaided sense perception. But to impose such a strict empiricist restriction on the extent of our knowledge is to radically downplay the powers of human reason.[2] We may have no source of information about the world other than the evidence available to our senses. But such information may still be employed as the basis for theoretical science. Scientists develop theories about the nature of unobservable entities whose behaviour gives rise to observed phenomena. They conduct tests of the predictive consequences of such theories, which either confirm or disconfirm the theories. Theories may successfully predict a range of previously unobserved phenomena, the occurrence of which is difficult to explain if the theories are not at least approximately true. Reasoning about such unobservable matters is, of course, a fallible exercise. Its outcomes are less certain than the information directly available on the basis of immediate sense perception, though that, too, is fallible. Yet there is no need to postulate any sort of direct cognitive access to unobservable states of affairs to recognize that our capacity to reason takes us well beyond the limits of the merely observable.

Scientific realism

The two positions I have just considered are sceptical positions, either with respect to the world-in-itself or with respect to unobservable aspects of reality. By contrast, I wish to defend the view that we are indeed able to obtain knowledge of an independent reality.

Such knowledge is restricted neither to a phenomenal world constituted out of concepts and sensory input nor to aspects of reality that may be observed by means of unaided sensory experience.

The anti-sceptical position I defend is the position of scientific realism. For the scientific realist, the aim of science is to arrive at the truth about the world. Scientific progress consists in progress toward the truth. The world we inhabit, and which science investigates, is an objective reality that exists independently of human cognitive activity. We interact with this world by means of our actions, which are based on our mental states. But we do not create this world. Nor does it depend in any way upon our beliefs, concepts, experience or language.

The result of successful scientific investigation is knowledge. Scientists discover facts about unobservable entities whose behaviour is responsible for the behaviour of observable entities. They propose theories which refer to unobservable entities in order to explain observed phenomena. Empirical evidence provides reason to believe that theories which refer to unobservable entities are true. Scientific knowledge is not restricted to an observable or phenomenal realm. It extends to the underlying nature of reality by identifying unobservable causes of observed phenomena.

As science progresses, theories approach the truth by providing increasingly accurate descriptions of entities identified by earlier scientists. Early theories tell us a certain amount of truth about the entities that have been identified. Later theories increase the truth known about the entities referred to by earlier theories. Truth is a relation of correspondence between an assertion and reality. An assertion is true provided

that what the assertion states to be the case is in fact the case. Whether an assertion about the world is true is an objective matter. It depends on how things stand in the mind-independent world, rather than on what scientists believe to be the case.

A number of considerations combine to support scientific realism. In the first place, reflection on the place of humans in the natural world reveals that the overwhelming preponderance of items found in our immediate environment – to say nothing of the remainder of the universe – exist independently of human thought and experience. Secondly, realism about unobservable entities is a natural extension of realism about common sense. Third, scientific realism provides the best explanation of the success of science, since the empirical success of theories is best explained by means of the truth or approximate truth of such theories. Fourth, as an extension of this so-called "success argument", the success of the methods of science in producing successful theories is best explained by the reliability of the methods of science in reaching the truth about the world. Together, these considerations constitute a powerful case for scientific realism, though, of course, they fall short of apodictic certainty.

The realist position that I have just characterized presents a positive response to the question of science and reality. According to scientific realism, science provides us with knowledge of an independently existing world. As science progresses, it increases the amount of truth that is known about the world that we inhabit. But while realism provides a positive response to our opening question, there remains one bridge to cross. Science may provide us with knowledge of an independent world. But what world is

that? What is the relation between science and the world of our ordinary, everyday experience?

Eddington's two tables

Throughout the history of science, new scientific theories from heliocentric astronomy to the theories of evolution and continental drift have led to the overthrow of deeply held beliefs about ourselves and the world around us. This leads some to suppose there is a deep conflict between science and common sense.

Arthur Eddington began his Gifford lectures in the following terms:

> I have settled down to the task of writing these lectures and have drawn up my chairs to my two tables. Two tables! ... One of them has been familiar to me from earliest years. It is a commonplace object of that environment which I call the world ... It has extension; it is comparatively permanent; it is coloured; above all it is substantial ... Table No. 2 is my scientific table ... My scientific table is mostly emptiness. Sparsely scattered in that emptiness are numerous electric charges rushing about with great speed ... There is nothing substantial about my second table. It is nearly all empty space ... my second scientific table is the only one which is really there – whatever 'there' may be. (1933, pp. xi-xiv)

Note Eddington's words: the "scientific table is the only one which is really there". This suggests that the solid, "substantial" table of common sense does not in fact exist. Only the insubstantial, mostly empty "scientific table" is real. Thus, the example of Eddington's table appears to be a case in which science rejects common sense. The table of science is real. The table of common sense is an illusion.

There may well be a conflict between the scientific and commonsense *description* of the table. But Eddington's contrast between two tables is misleading. There is only one table, the one revealed to us in commonsense experience. It may well be that the

nature of the table is explained by science. Indeed, the scientific explanation of the solidity of the table may well displace the explanation provided by common sense. Nevertheless, Eddington's "scientific table" is the very same table as the table presented by common sense.

In the remainder of this paper, I sing the praises of common sense. Like Quine, I see science as continuous with common sense. It goes beyond common sense, but does not discard it. Rather than overthrow common sense, science explains it. Common sense provides us with a grounding in the world. It is the foundation upon which scientific realism rests. As we will see, it even provides protection against the anti-realist scepticism of Kuhn and van Fraassen.

Common sense

Before attempting to say what common sense involves, let me say something about what it is not. Common sense is not the same thing as practical skill. Tradesmen, athletes and technicians have many different practical skills. Common sense is something basic that may be shared by those who possess different practical skills, and indeed by those who lack practical skills. Nor is common sense the same thing as deeply held belief. Some commonsense beliefs may be deeply held. But there are many deeply held beliefs that defy commonsense. Throughout history, people have been deeply committed to a great variety of beliefs that defy common sense. So common sense cannot be the same thing as deeply held belief.

It may not be possible to draw a precise line between common sense, practical skill and deeply held belief. But common sense is more basic than either. The idea of common sense trades on two different meanings of the word 'sense'. We can use the word 'sense' to speak about the various modalities of sensory perception, such as sight, hearing or smell. But equally it may be used to signify sound practical judgement, as in having good sense. Common sense is typified by our ordinary, unreflective awareness of the world around us, and by the routine way in which we deal with objects in our immediate vicinity. Observation, and knowledge derived from observation, play a central role in common sense. But common sense goes beyond mere observation. It is common sense to believe that ordinary objects do not disappear while we are asleep and reappear just before we awake, though this is not something that we could observe to be the case.

Realism about the ordinary, everyday world is part and parcel of common sense. The world of common sense is a world of material objects of all shapes and sizes, with a multitude of properties. We acquire more or less immediate knowledge of such things by means of our sensory experience of those objects. The material objects that we encounter in everyday experience are independently existing things with which we interact causally by means of bodily movement and action. But though we interact with such objects, they lie beyond the control of our minds. Mere thought alone cannot bring about change in the world of objects. The commonsense world is also a world in which misperception and illusion have their place in the ordinary course of events without giving rise to scepticism. A robust sense of reality provides us with a reasonable degree of practical certainty that things are by and large as they appear to us.

Common sense gives rise to a body of beliefs about the objects in our environment, the nature of our interactions with these objects, and the means by which we may acquire knowledge of such things. On the whole, we may assume that this body of beliefs is true. This is not because commonsense beliefs are guaranteed in any way to be true. Like all beliefs, they are fallible. But they have a strong *prima facie* presumption in their favour. Common sense has a prior claim on our belief. Beliefs based on common sense occupy a central place in our belief system. As such, they are only to be rejected after less pivotal beliefs have been considered for rejection. Given their privileged status, any challenge to common sense is to be met with suspicion. Any such challenge faces an uphill battle, since we know in advance that it is likely to be mistaken.

Science and common sense

What I have just said about the special status of commonsense beliefs may strike some as unscientific. Throughout the history of science, scientific advance has been made by the elimination of commonsense beliefs in favour of scientific theories which show common sense to be mistaken. To place common sense in a protected position is to create obstacles to the sort of thoroughgoing critical inquiry that has enabled science to progress in the first place.

In my view, this objection rests on two mistaken assumptions. In what follows, I will identify these mistaken assumptions. I will then consider two further objections that may be raised against the special status that I ascribe to common sense.

Does common sense require protection?

The first assumption relates to the idea that common sense requires protection from the critical scrutiny characteristic of science. My point that common sense has a privileged status does not imply that commonsense beliefs are to be protected from critical scrutiny. On the contrary, they are subject to sustained critical scrutiny. Commonsense beliefs are put to critical test and survive such test on countless occasions each and every day. Our practical interactions with the world vindicate a commonsense view of the world every day of our lives. The point is not that commonsense belief requires protection from critical scrutiny. Rather, commonsense beliefs are among the most highly confirmed beliefs in our belief system precisely because they are subjected to critical scrutiny on a regular basis (see Devitt, 2002, p. 22).

It may even be speculated that the privileged status of common sense has an evolutionary basis.[3] Commonsense beliefs survive because they have survival value. Our species could not have survived if the majority of the commonsense beliefs on which we base our everyday interaction with the world were false. False belief does not typically give rise to successful action. Usually, it leads to failure. The risks to survival increase where action is based on false belief. Common sense both promotes survival and is the result of a process of natural selection. This claim reflects a naturalistic approach to epistemology. But it is a speculative point, so I place little weight upon it.

Does the Earth move?

The second error relates to the purported conflict between science and common sense. It rests on the assumption that for science to progress, common sense must be overthrown and eliminated. But it is not clear that this is what typically occurs in science. Scientific investigation leads to new insights into the nature of phenomena known to common sense. Rather than eliminate common sense, science provides illumination of commonsense phenomena.

Let me illustrate the point with an example from the history of astronomy. The geocentric idea that the Earth occupies a fixed position at the center of the Cosmos, and that the heavenly bodies revolve around the Earth, receives support from everyday experience. It appears to us that the Sun rises every morning and crosses the sky each day, setting in the evening. At night, the stars, the planets and the moon become visible, and move across the sky in much the same way as the Sun traverses the sky each day. But heliocentric astronomy teaches us that these appearances are misleading. The apparent movement of the Sun and other heavenly bodies is due to the rotation of the Earth upon its axis, combined with the movement of the Sun and other bodies. It is not the Sun that rises and sets. The Sun comes into view as the Earth rotates. The Earth's rotation brings the Sun into view each day.

Geocentric astronomy has a basis in commonsense experience. Because geocentric astronomy was rejected in favour of heliocentric astronomy, one might think that heliocentrism entails the overthrow of common sense. Heliocentrism shows common sense to be false, which leads us to reject common sense. But it is not clear that this is

what happens at all. Our commonsense experience remains exactly as before. The sun appears to rise, traverse the sky and set each day, and the objects in the night sky appear to behave in a similar manner. The appearances do not change. Nor does commonsense experience.

What changes is what we think happens. Our understanding of what takes place is altered. Heliocentrism explains why commonsense experience is the way that it is. It does not show that commonsense experience is false. It explains why we have the experience of heavenly bodies moving across the sky. At least in this case, science does not eradicate common sense. It teaches us how to understand commonsense experience. The assumption that science eliminates common sense, rather than providing an explanation for such experience, may therefore be rejected as erroneous.

Of course, a single case of science preserving common sense does not show that it always preserves it. But there is no reason to suppose that the present case is in any way exceptional. Conformity with empirical evidence is a standard requirement for theory-acceptance in science. Because it is primarily observational, empirical evidence typically forms part of or is at least available to common sense. To the extent that this is so, conformity of theory with evidence ensures that science preserves common sense.

Stone age metaphysics

We have now seen why the special status accorded here to common sense is not unscientific. Common sense need neither be dogmatically protected from critical scrutiny nor typically be overthrown by scientific advance. Still, it might be thought that appeal

to common sense remains problematic. I will now consider a pair of objections to the primacy of common sense: the first challenges the *epistemic* primacy of common sense; the second challenges its *ontological* primacy.

It is sometimes said that common sense is a false theory passed down to us by our primitive ancestors. It is the "metaphysics of the stone age". Common sense is therefore to be rejected as outmoded theory, rather than granted privileged epistemic status.

As I've previously noted, commonsense beliefs are fallible beliefs with no guarantee of truth. But while this is so, the assimilation of common sense to outmoded theory is to be resisted. This is why it is important to distinguish common sense from deeply held belief. Beliefs to which members of a society or historical epoch are deeply committed may be rejected in another society or epoch. But common sense operates at a more basic level than such transitory commitments. The common sense enacted in ordinary, practical engagement with the everyday world is the natural endowment of humankind, and may well be shared with some species of non-human animals. It is not something that passes in and out of social and historical fashion, but a precondition for successful practical interaction with the world.

But while we may defend the epistemic credentials of common sense in the way just noted, the ontology of common sense is also open to challenge. The world of the commonsense realist is the world of ordinary middle-sized objects with which we causally interact as we go about our daily lives. But it may be argued that there is no such world. There are no such objects. All that exists are the elementary micro-level entities

discovered by modern physical science. There are no rocks and mountains, tables and chairs. There is just "atoms and the void".

Where this thought goes astray is in failure to appreciate the nature of physical composition. Ordinary material objects are themselves composed of more basic components, such as molecules, atoms, and elementary particles. To think that ordinary objects do not exist because they are composed of microscopic entities is to assume that a thing that is made out of other things is not itself real. But the fact that a thing is made out of other things does not mean that it is not real. A computer assembled from component parts is still a computer. Unassembled computer components do not constitute a computer until they are put together to form one. The computer only exists once its component parts are assembled in a particular way. The ordinary objects of commonsense exist despite being composed of myriads of particles too small to see.

In light of the foregoing, I propose that we treat common sense as both an epistemic and an ontological basis for the position of scientific realism. Indeed, as I will now indicate, common sense provides a platform on the basis of which to confront anti-realist views of the kind considered at the outset of this paper.

Common sense versus scientific scepticism

To return to the changing worlds of Kuhn and the constructive empiricism of van Fraassen, both positions are sceptical positions with respect to knowledge of an experience-transcendent reality. Both positions run afoul of common sense.

On the Kantian interpretation, Kuhn holds that in the transition between paradigms the world-in-itself remains the same, but the phenomenal worlds of scientists undergo transformation. From the point of view of the commonsense realist, however, this is false. The beliefs, concepts and theories that scientists apply to the world may be profoundly affected by scientific revolution. But scientists inhabit the same world before and after a revolution. There is one world, the world of common sense. This world does not undergo radical transformation in change of paradigm. Adherents of alternative paradigms do not occupy different worlds. Scientists maintain common perceptual access to a shared domain of objects before and after a revolution. Practical action brings them into direct physical contact with a shared world of independently existing objects.[4]

As for constructive empiricism, van Fraassen is himself a commonsense realist who holds that observation provides access to an independent reality. However, he holds that knowledge is restricted to the observational level, so that we can have no knowledge of what cannot be observed by unaided sense perception. But van Fraassen underestimates the power of common sense. Minute objects that are almost too small to see are a familiar part of everyday experience. Equally, the compositional nature of ordinary objects is a familiar part of our experience. So the idea of component parts of objects that are too small to see is an idea readily available to common sense.

Thinking systematically about the unobservable entities of which ordinary material objects are composed requires an extension of commonsense. It requires us to develop and evaluate hypotheses about the unobservable entities whose behaviour underlies observed phenomena. The reasoning employed involves epistemic norms which fall

within the methodology of science, such as criteria of theory appraisal and explanatory adequacy, as well as principles of ampliative inference and experimental design. But the reasoning as well as the norms that govern such reasoning are no more than a systematic refinement of patterns of inference employed by common sense. So far from coinciding with the limits of sense perception, common sense admits of systematic refinement that enables us to extend knowledge beyond the range of what is immediately accessible to our senses.

Conclusion

To conclude, the position I have described is meant to serve as the basis for a realist view of science. Science discovers the truth about the independently existing world in which we find ourselves. It starts from common sense, which embodies a realist view of the objects of everyday experience. Occasionally it conflicts with common sense. But science does not lead to the overthrow of common sense. It explains why commonsense objects appear as they do. It explains why in some cases the commonsense appearance of things is misleading. But commonsense realism survives as the basis for our ongoing interaction with the world. Given common sense, scientific realism is the most natural position to adopt as an interpretation of scientific inquiry into the world around us.

Notes

1. The point is analogous to one made by Kitcher with regard to Galileo's extension of the telescope to the celestial realm (2001, pp. 173-4). For the extension of Kitcher's Galilean strategy to the case of the microscope, see Magnus (2003, pp. 468-70).

2. This point is reminiscent of a point made by Alspector-Kelly, who speaks of "an uncomfortable reversion to rationalism" in the realist search for "an inferential tool" that enables a "leap over the fence into unobservable territory" (2004, p. 333).

3. The point is made by Campbell with regard to sense experience: "The survival value of perceptual reliability is so overwhelming that the first creatures to attain it would inherit their niche" (1988, p. 171). A similar point was famously made by Quine in relation to induction: "Creatures inveterately wrong in their inductions have a pathetic but praiseworthy tendency to die before reproducing their kind"(1969, p. 126). The appeal to evolutionary considerations in the latter context has been challenged by Stich (1990, ch. 3).

4. For a related point about the stability of common sense and its role in theory-change, see Campbell (1988, p. 173).

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