**WHAT IS SCIENTIFIC REALISM?**

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**1. Introduction**

Tables and chairs, and people who sit at tables in chairs, are all objects composed of matter. Science tells us that the basic components of matter are atoms. Atoms themselves are made up of electrons, neutrons and protons. The neutrons and protons form a nucleus around which the electrons orbit. Apart from these particles, physicists have discovered numerous other particles, such as photons, quarks and neutrinos.

 Unlike tables, chairs and people, the particles of which matter is composed are entities which cannot be directly observed using unaided sense perception. We do not come to know of the existence and nature of such unobservable entities by means of sense experience. Rather, the existence of unobservable entities is a matter of inference, conjecture and hypothesis. Scientists postulate the existence of such entities when they develop theories which explain the observed phenomena as the result of more basic occurrences at an unobservable level. Because scientists postulate unobservable entities within the context of scientific theories, philosophers of science refer to such entities as *theoretical entities*. The terms that scientists use to speak about such entities are often called *theoretical terms* to distinguish them from the *observational terms* that are used to speak about observable things.

 When scientists tell us about such theoretical entities as atoms, electrons and other particles, what attitude should we take toward these claims? What is the status of such claims? Should such claims be treated as true, or approximately true, descriptions of actually existing things? Or are such claims to be treated as some sort of fictional discourse?

 There is considerable disagreement among philosophers of science about the status of discourse about theoretical entities. Those who endorse the position known as *scientific realism* say that scientific claims about theoretical entities should be taken literally, or at face value. They should be treated as true, approximately true, or at least as genuine attempts to make true or approximately true claims about objective reality. Those who endorse one or another *anti-realist* position reject the realist view that such claims should be regarded as true or approximately true claims about objective reality.

 Anti-realist philosophers of science disagree among themselves about how theoretical claims are to be understood. One well-known anti-realist position is the position of *instrumentalism*, according to which talk of theoretical entities is no more than “useful fiction” or a “convenient shorthand”. But there are other anti-realist positions. According to *internal realism*, the theoretical claims of science are candidates for truth, but truth is relative to conceptual scheme or value system rather than correspondence to objective reality. By contrast, according to *sceptical anti-realism*, theoretical claims about unobservable entities may well correspond to reality but empirical evidence may never be sufficient to provide support for the truth of such claims, which can at most be accepted as “empirically adequate” or “warranted”.

 So, while there are many philosophers who find scientific realism a compelling and powerful doctrine, realism is not a view not shared by all philosophers. There are many who fail to see the appeal of scientific realism. In part, this is because the doctrine of scientific realism is not always understood as well as it might be. In some cases, such lack of understanding may explain why its appeal is not noticed, though in many cases there are substantive disagreements which explain the lack of appeal. In this paper, I will attempt to provide a clear presentation of the doctrine of scientific realism in the hope that such a presentation may broaden the appeal of the doctrine.

**2. Scientific Realism as A Family of Doctrines**

Scientific realism is not a simple thesis that may be embodied in any single claim. Rather, scientific realism consists of a set of doctrines. Not all scientific realists agree about all of these doctrines. Thus, scientific realism is best characterized as a family of closely related doctrines.[[1]](#footnote-1) Another way to think of this is to say that there are a variety of different versions of scientific realism. In this, of course, scientific realism is not alone. As briefly indicated above, anti-realism is also best thought of as a family of doctrines.

 Despite being best characterized as a family of doctrines, some realist doctrines are more important or central doctrines of scientific realism than other doctrines. In what follows I will present and comment on five distinct doctrines which I consider to form the *core* of scientific realism. There are, however, a number of other doctrines which have a claim to be important scientific realist doctrines as well. I will discuss two doctrines which I consider important *non-core* doctrines of scientific realism. I will then mention two doctrines with which many scientific realists have sympathy, but which I consider to be *optional* doctrines for scientific realism. Following this presentation of scientific realist doctrines, I will distinguish scientific realism from the doctrine of scientism, with which it is sometimes mistakenly identified. I will then conclude by briefly sketching one of the main positive arguments in favour of scientific realism.

**3. The Core of Scientific Realism**

The five doctrines which I will now present are doctrines which form the core of scientific realism. These doctrines are so central to scientific realism that a view which denies any of them can only lay claim to the title of ‘scientific realism’ in a qualified sense.

 The first doctrine is a doctrine about the aim of science:

1. ***Axiological realism:*** the aim of science is to discover the truth about the world, and scientific progress consists in advance toward that aim.

In the first instance, axiological realism is a thesis about the aim of science. As such, however, it has immediate implications about the nature of scientific progress, which is why I formulate it in terms of both an aim and progress toward that aim. Because the aim of science is to obtain the truth, progress in science must consist in advance on that aim. Hence, scientific progress consists in advance on truth.

 It is consistent with the doctrine of axiological realism to deny that science has made much progress toward the aim of truth. Indeed, it is consistent with axiological realism to deny that any progress at all has been made toward that aim. But scientific realists typically wish to say that a great deal of truth has already been discovered in at least some areas of science. Some may even be prepared to commit themselves to the truth of at least some of the more well-established claims of the sciences.

 However, along with most contemporary philosophers of science, scientific realists tend to understand science as an ongoing historical process that is, in all likelihood, far from complete. As a result, they do not assume that contemporary science has already achieved the aim of truth. At best, current scientific theories may be close to the truth, or they may be approximately true. Pursuit of the aim of science cannot, therefore, consist simply in the pursuit of the truth. It must also consist in seeking to advance toward the aim of truth by increasingly close approximation to that aim.

 Three further points are worthy of note. First, the idea that truth is the aim of science is in need of further qualification. It is not just that science seeks truth. For there are endlessly many trivial truths of no particular interest to science. Rather, science seeks to discover truths which are particularly revealing and interesting. Since science seeks to explain phenomena, we may say that science seeks truths of an explanatory nature. Second, it is worth noting that the choice of the term ‘discover’ in the formulation of axiological realism is a deliberate one. For the realist, the aim of science is to discover truth about the world. We do not invent, construct or fabricate the truth, as might be said by some anti-realist philosophers or by constructivist sociologists of science. Third, it is important to consider the status of the claim that truth is the aim of science. It is not an empirical hypothesis about the motivations of scientists, considered either as individuals or as a group. Nor is it a semantic claim to the effect that the concept of science is the concept of an enterprise that is directed toward truth. Rather, it is an epistemological claim that the purpose of a knowledge-seeking enterprise such as science is the pursuit of truth.

 The second core claim of scientific realism is an ontological thesis about the reality of theoretical entities:

2. ***Theoretical entity realism***: the unobservable theoretical entities postulated by scientific theories are to be conceived as real, genuinely existing entities.

Theoretical entity realism stands opposed to the instrumentalist interpretation of theories, which denies the reality of theoretical entities, and treats them instead as non-existent or fictitious entities useful only as an aid to prediction. For the theoretical entity realist, scientific knowledge is not restricted to knowledge of events and regularities that take place at the observable level. Rather, science seeks to explain observable phenomena as the result of underlying causal processes. In doing so, scientists acquire knowledge of the existence and nature of the unobservable entities whose behaviour is responsible for the observed phenomena.

 I have characterized theoretical entity realism as an ontological thesis about the reality of theoretical entities. But it is important to mention a complication. Ian Hacking distinguishes between the thesis of *entity realism*, which asserts the reality of theoretical entities, and the thesis of *theory realism*, which asserts that scientific theories are true or have a truth-value (Hacking, 1983, p. 27). Traditional scientific realism combines entity with theory realism. However, Hacking notes that the doctrines are logically distinct, since one may assert that there are entities not truly described by any theory, as well as that a theory may be true though none of its terms refer to any entities. As I understand scientific realism, it is not possible for a scientific realist to both assert theory realism and deny entity realism for the simple reason that a scientific realist cannot deny entity realism.[[2]](#footnote-2) It is, however, possible for the scientific realist to support entity realism without endorsing theory realism.

 In addition to the distinction between entity realism and theory realism, it is also important to distinguish a further thesis about the reference of theoretical terms. The thesis of theoretical entity realism requires not only that theories be genuinely committed to the existence of theoretical entities, but that it be possible for the theoretical terms employed by scientific theories to refer to such theoretical entities. The theoretical term, ‘electron’, for example, must be a genuinely referential expression which refers to real unobservable entities, namely electrons. Thus, it must be possible for the theoretical terms employed by scientists to enter into relations of reference with the unobservable entities whose existence is postulated by theories.[[3]](#footnote-3)

 The third core component of scientific realism is commitment to the basic metaphysical stance of realism about the external world:

3. ***Metaphysical realism****:* the world investigated by science is an objective reality that exists independently of human thought.

Commitment to a mind-independent, objective reality is perhaps what most fundamentally characterizes scientific realism as a form of realism. On such a view, there is a world which exists independently of our thought, the existence, structure and features of which depend in no way on human experience, beliefs, concepts or language. It is a world of objects, properties and facts, which we must discover by means of empirical inquiry. It is not a world which is in any way constituted or constructed out of the concepts or theories which we formulate as part of the process of empirically finding out about the world.

 I employ the expression ‘metaphysical realism’ in the ordinary sense of commitment to the existence of a mind-independent reality. This use of the expression differs from the way it is employed by Hilary Putnam, who uses it to stand for the view that there is a fixed totality of mind-independent objects, determinate relations of reference between terms and objects, and one true, complete theory of the way these objects are (Putnam, 1981, p. 49). I prefer a more minimal characterization of metaphysical realism in terms of commitment to a mind-independent world. Putnam’s use of the expression involves a number of controversial assumptions which a scientific realist need not embrace. For example, not all scientific realists may wish to assert either that there is a fixed totality of mind-independent objects or that it is possible in principle for there to be a single, complete theory of the world.[[4]](#footnote-4)

 The fourth component of scientific realism is a thesis about the nature of truth:

4. ***Correspondence theory of truth***: truth consists in correspondence between a claim about the world and the way the world is.

On such a view of truth, for a statement to be true the world must be the way that the statement says it is. It must correspond to the facts. Thus, a theoretical claim about an unobservable entity is true if and only if the theoretical entity really is how it is claimed to be. For example, the sentence ‘Electrons have negative charge’ is true if and only if electrons have negative charge.

 It is important to note that there are a number of alternative theories of truth which contrast with the correspondence theory of truth. Among the most prominent of these are the coherence, pragmatist, consensus and internal realist theories of truth. According to such theories of truth, truth is a property which a belief or statement may have in virtue of some epistemic property of the belief or statement. Examples of epistemic properties which have been proposed by advocates of such theories of truth include internal coherence, practical utility, agreement with one’s cultural peers, and ideal rational justification. Because such theories of truth identify truth with an epistemic property of belief, they are sometimes called “epistemic theories of truth” (cf. Devitt, 1991, pp. 36, 44-5).

 For present purposes, I will understand the correspondence theory of truth in a broad sense. If a theory of truth holds that a statement is true just in case a given state of affairs obtains, then it will count as a correspondence theory. This means that minimalist theories which take truth to be exhausted by the equivalence scheme “‘P’ is true if and only if P” are just as much correspondence theories as are the more substantive attempts to identify the relation of correspondence with causal relations between language and reality.[[5]](#footnote-5) What is characteristic of all such theories of truth is that truth is a relation of correspondence that obtains in virtue of the world in fact being the way that it is said to be.

 Correspondence theories of truth contrast sharply with epistemic theories of truth, which identify truth with epistemic properties of beliefs. Correspondence theories which treat truth as a relation between language and reality are the only theories of truth which are compatible with realism. It is difficult to see how an epistemic conception of truth may be reconciled with the realist commitment to a mind-independent reality. But I will not discuss this issue here.[[6]](#footnote-6)

 The fifth core component of realism makes explicit the relationship between the two preceding components of realism, viz., that it is the objective world that renders our claims about the world true or false:

5. ***Objectivity of truth****:* theories or claims about the world are made true (or false) by the way things are in the mind-independent, objective reality investigated by science.

This thesis may seem redundant in light of the two preceding doctrines. However, I have chosen to state the thesis as a separate doctrine in order to explicitly rule out possible non-realist interpretations of the correspondence theory of truth. It is possible to incorporate the correspondence theory of truth within an idealist metaphysics. For example, the idealist may treat truth as a relation of correspondence between statements and states of affairs that are either solely constituted by mental states, or jointly constituted out of sensory input from the external world and the conceptual contribution of the human mind.

 Thus, what the realist wishes to say about truth is not merely that there is an objective reality and that truth is a correspondence relation. In addition, the realist wishes to say that truth consists in correspondence with objective reality. Thus, whether or not a statement is true has nothing to do with whether we happen to believe that it is true. Rather, the truth of the statement is entirely determined by how things stand in the world, independently of us. This is a further reason why the realist is unable to countenance an epistemic conception of truth, since such a conception of truth removes the dependence of truth on an objective reality.

 In sum, thesis 3, the thesis of metaphysical realism, says nothing explicit about truth. It only says something about the nature of reality investigated by science. Thesis 4, the thesis of correspondence truth, says nothing about reality. It only says something about the nature of truth. Thesis 5, the thesis of the objectivity of truth, is needed in order to make explicit the relation between the thesis of mind-independence and the correspondence theory of truth. It combines the two preceding theses into the realist doctrine that it is the mind-independent world that makes our claims about the world true in a correspondence sense. The three theses about reality, truth, and the relation between reality and truth are distinct theses. In the interest of clarity, they should be stated as such.

**4. Two Important Non-Core Doctrines**

I will now discuss two doctrines which are not often mentioned as doctrines constitutive of scientific realism. But, in fact, both doctrines are important aspects of scientific realism. If they are not explicitly mentioned, it is probably because they are taken for granted. I doubt that scientific realism can be sustained without one or the other of these doctrines. I suspect that thesis 6 is crucial for scientific realism, though thesis 7 may not be.

 Thesis 6 is a thesis about the possibility of knowledge of unobservable dimensions of the objective world:

6. ***Epistemic realism:*** it is possible to have scientific knowledge about matters of fact that cannot be directly observed.

Epistemic realism is what sets scientific realism apart from contemporary representatives of the empiricist tradition who deny that it is possible to have rationally justified belief in claims about unobservable states of affairs, or deny that it is possible to have knowledge of such things.[[7]](#footnote-7) Indeed, it is hard to see what motivation there might be for scientific realism, if it does not have a basically epistemological rationale. For the scientific realist wishes to hold that scientific inquiry yields objective knowledge of both observable and unobservable aspects of the mind-independent world. At the very least, scientific realists should defend the weaker doctrine, namely, that it is possible to have rationally well-founded beliefs in the truth of the theoretical claims of science about unobservable entities, occurrences and states of affairs.

 A further important but “non-core” component of scientific realism is the following thesis about the meaning of empirical claims about the world:

7. ***Semantic realism:*** the meaning of the synthetic statements of empirical science consists in the conditions under which they would be true.

According to semantic realism, the meaning of a scientific claim about the world consists in the conditions under which the claim would be true, rather than the conditions under which the assertion of such a claim would be warranted. In some cases, however, the truth-conditions of a scientific claim may be unable to be verified to obtain – its truth-conditions may be “verification-transcendent”.

 In particular, it is impossible to conclusively establish by observational means alone the truth or falsity of theoretical claims about unobservable states of affairs (e.g., ‘Electrons have negative charge’). Similarly, it is impossible to establish by such means the truth of universal generalizations about observable entities or states of affairs (e.g., ‘All ravens are black’). Yet despite the inability to determine whether the truth-conditions of such claims obtain, the semantic realist holds that such claims may constitute significant assertions about the world, and indeed that they may possess a truth-value. This gives point to the attempt of scientists to provide indirect evidence for theoretical claims and empirical generalizations whose truth cannot be established by direct, empirical means.

 The doctrine of semantic realism is in contrast with the strict verificationism of the early logical positivism of the Vienna Circle. According to strict verificationism, the meaning of a synthetic claim consists in the empirical conditions under which it is verifiable, or in the means by which it may be empirically verified. On a strict construal of this doctrine, theoretical claims about the world are devoid of meaning or “cognitive significance”, because they are incapable of empirical verification. Later positivists reduced the demand for strict empirical verification to the weaker condition of non-conclusive confirmation. In so weakening the requirement of verification, the positivists conceded that claims about the world may possess verification-transcendent truth-conditions which are of relevance to the meaning of such claims. In allowing the relevance of such truth-conditions to meaning, the later positivists were conceding ground to semantic realism.

 The rejection of strict verificationism in favour of semantic realism is a significant stage in the historical transition from logical positivism to scientific realism. Though strict verificationism is perhaps a thing of the past, the issue is with us today in the form of the debate between realist theories of meaning which analyze the meaning of sentences in terms of truth-conditions as opposed to anti-realist theories of meaning which analyze sentence meaning in terms of assertability-conditions.

**5. Two Optional Doctrines**

I will now discuss a pair of “optional” metaphysical doctrines which are widely held by scientific realists. These two doctrines are logically distinct from the scientific realist position that has been outlined here. Hence, one might embrace scientific realism as so far characterized without thereby being committed to either of the following two doctrines. However, since both of the theses derive from a realist rejection of Humean empiricism, much sympathy will be found for the two doctrines among those who otherwise style themselves as scientific realists.

 The first optional doctrine is a doctrine about causation and laws of nature. As such, it is really a pair of closely related doctrines:

8. ***Causal/nomological realism*:** causal and nomological relations are real relations of natural necessitation.

Realism about causation and laws of nature stems from the rejection of the Humean empiricist view that both causation and laws of nature are to be conceived as regularities. Where Hume held causal connections to be contingent conjunctions of events, causal realists treat causation as natural necessitation. When one event causes another to occur, it is not just that one event temporally precedes the other. Rather, the occurrence of the causing event necessitates the occurrence of the event which is its effect. Similarly, on a Humean treatment of laws of nature, the laws of nature are no more than contingent, empirical regularities. For the nomological realist, by contrast, genuine, non-accidental regularities are themselves the manifestation of real, underlying laws of nature. Events which occur as the result of a law of nature do so as the result of natural necessity.

 The second optional doctrine is the doctrine of the existence of natural kinds:

9. ***Scientific essentialism:*** the theoretical entities of science are members of natural kinds, characterized by the possession of essential properties.

It might at first seem that realism about theoretical entities commits scientific realism to realism about natural kinds, since entities presumably belong to kinds. However, some scientific realists assert the existence of natural kinds, while others deny their existence. Indeed, it is possible both to assert the reality of theoretical entities and to deny realism about natural kinds. One may assert that electrons exist without asserting that the set of electrons forms a natural kind. The crux of the matter is the existence of kinds, not that of entities. One may assert that certain entities exist but deny that they all have any essential property in virtue of which the entities belong to a kind. Alternatively, one may assert the reality of a group of entities which have many common features, without asserting the existence of a natural kind ‘over and above’ particular entities.

 Neither thesis 8, realism about causation and laws of nature, nor thesis 9, realism about natural kinds, are essential doctrines of scientific realism. Endorsement of the core doctrines of scientific realism does not automatically commit one to either thesis. However, both theses form part of what one might broadly characterize as a “realist” outlook. Thesis 8 fits with the realist rejection of the metaphysics lying behind traditional Humean empiricism. Thesis 9 reflects the realist intuition that the world is not something amorphous or devoid of structure, and that the structure of the world is there to be discovered. Theses 8 and 9 also complement each other, since it is possible to argue that the necessity of laws of nature is in fact grounded in the essential properties of members of natural kinds (cf. Ellis, 1999).

**6. Scientific Realism and Scientism**

In the discussion so far, I have sought to present the basic outlines of the position of scientific realism. I would like now to further clarify scientific realism by contrasting it with a doctrine with which it is sometimes confused. Scientific realism is sometimes taken to be a form of scientism. Scientism is the doctrine that science is the sole legitimate source of empirical knowledge. The doctrine of scientism may be expressed in various ways, for example, as the positivist doctrine that cognitive significance is restricted to verification by means of scientific observation. A recent expression of scientism is the naturalist doctrine that the methods of natural science provide the sole means of epistemic access to the world. But while scientific realism may well sit comfortably with the attitude of scientism, it would be quite mistaken to identify scientific realism with scientism.

 First, let me note that it is no part of the family of scientific realist doctrines presented here that science is the only means of epistemic access to the world. The issue of knowledge only figures explicitly in the context of thesis 6, the thesis of epistemic realism, which asserts the possibility of scientific knowledge of the objective world. But this in no way implies that science is the sole source of empirical knowledge. It is consistent with epistemic realism, as it is with the remaining principles of scientific realism, to allow that commonsense experience is a perfectly acceptable means of access to the world. Nor is there any reason for the scientific realist to hold that there may be no empirical knowledge in disciplines, such as history, which might fail to employ the methods of natural science. Thus, scientific realism does not entail a scientistic attitude toward knowledge. That is not to say, though, that it is incompatible with such an attitude. To see this, I will now briefly trace a route that leads from scientific realism to scientism.

 Let us suppose that the only things that exist are material objects. Let us also suppose that all material objects are constituted out of the fundamental constituents of matter of which we are informed by physical science (e.g., molecules, atoms, etc.). Finally, let us suppose that anything which is not either a fundamental constituent of matter, or made up of a fundamental constituent of matter, does not really exist. This rather austere metaphysical picture is the metaphysics of materialism, or, to use a more contemporary name, physicalism. Such a materialist metaphysics is consistent with scientific realism, since it may be arrived at by extending the theoretical entity realism component of scientific realism. However, it is not entailed either by theoretical entity realism, or by scientific realism in general, because physicalism is based on the further assumption that the only things that exist are the entities described by fundamental physics, and things which are made up out of such entities.

 We are constrained in what we can know by the nature of what exists. Hence, ontology constrains epistemology. If physical things are all that exist, then this imposes certain constraints on our knowledge. We may only acquire knowledge of the properties of physical things by means that are available within a physical world. Since we are ourselves physical beings, our only means of epistemic access to the physical world must be by way of our causal interaction with it. Either we acquire knowledge directly by means of causal interaction of the world with our perceptual apparatus, or we acquire knowledge indirectly by means of causal relations with things to which we do not have direct perceptual access.

 The way is now clear to scientism. For if we are prepared to assume that the methods of science represent the sole epistemic use of causal relations with the physical world, then we may conclude that science is the sole means of epistemic access to the world. I do not myself find this an intrinsically abhorrent conclusion, as many do. But it should be clear that the route from scientific realism to such a scientistic conclusion is a circuitous route, which requires many further epistemological and metaphysical assumptions that play no part in the doctrine of scientific realism itself. It should also be clear that one may embrace scientific realism without taking the first step down the path to scientism.

**7. Conclusion**

My aim in this paper has been to present scientific realism in a clear manner, in the hope that better understanding of the position of realism may increase its appeal. However, clear presentation is only part of the task facing realists. It may remove objections due to misunderstanding. But not all resistance to realism is based on misunderstanding. To overcome the resistance that remains, arguments must be given in favour of scientific realism. In this final section, I will briefly sketch one of the main arguments in favour of scientific realism.

 One may loosely distinguish between negative and positive arguments for realism. Negative arguments against positions opposed to scientific realism increase the plausibility of realism. It might, for example, be argued that instrumentalism is to be rejected because it requires a sharp distinction between observation and theory. Similarly, positivism requires a sharp contrast between theoretical and observation language. But, as has been argued by a number of philosophers, observation is “theory-laden”, hence no sharp line may be drawn between observation and theory. Such negative arguments against an opposing doctrine may incline one towards scientific realism. But are there any *positive* reasons for scientific realism?

The main positive argument for scientific realism is the so-called *success argument*. The classic formulation of the argument is due to Hilary Putnam:

The positive argument for realism is that it is the only philosophy that doesn’t make the success of science a miracle. That terms in mature scientific theories typically refer ..., that the theories accepted in a mature science are typically approximately true, that the same term can refer to the same thing even when it occurs in different theories – these statements are viewed by the scientific realist not as necessary truths but as part of the only scientific explanation of the success of science, and hence as part of any adequate scientific description of science and its relations to its objects. (1975, p. 73)

Elsewhere Putnam remarks about theories which postulate such things as electrons, curved space-time and DNA molecules, that:

 If there are such things, then a natural explanation of the success of these theories is that they are *partially true accounts* of how they behave. And a natural account of the way in which scientific theories succeed each other – say, the way in which Einstein’s Relativity succeeded Newton’s Universal Gravitation – is that a partially correct/partially incorrect account of a theoretical object – say, the gravitational field, or the metric structure of space-time, or both – is replaced by a *better* account of the same object or objects. But if these objects don’t really exist at all, then it is a *miracle* that a theory which speaks of gravitational action at a distance successfully predicts phenomena; it is a *miracle* that a theory which speaks of curved space-time successfully predicts phenomena... (1978, p. 19)

 Putnam’s reasoning in these two passages may be reconstructed in the following manner. There is a particularly striking fact to be explained, namely, the success of science. Here success may be taken to include such factors as predictive accuracy and reliability, explanatory breadth, and technological control of the environment. Any philosophy of science which denies that theoretical entities are real or that scientific theories are true must treat the success of science as an inexplicable miracle. But to do so is to fail to provide a satisfactory explanation of the success of science. By contrast, scientific realism provides a compelling explanation of the success of science. It says that the unobservable entities postulated by theories by and large exist and that scientific theories are by and large true, or that they approach closer and closer to the truth. Given the truth of its theories and the reality of its entities, it is only to be expected that science should manifest the striking degree of success that it does. Because scientific realism provides so natural an explanation of the success of science, while alternative approaches provide an unsatisfactory explanation, we should accept scientific realism as true.

 This kind of argument is called an *inference to the best explanation*. It is an argument to the effect that a given hypothesis should be accepted because the hypothesis provides the best explanation of some phenomenon. Such arguments tend to be compelling but not conclusive. For example, one might argue that the hypothesis of an external world is a much better explanation of our experience than is a Cartesian hypothesis of an evil demon. We do not thereby conclusively show the Cartesian hypothesis to be false. But we provide a reason for believing the external world hypothesis. Similarly with scientific realism. Inference to best explanation provides reason to accept scientific realism without necessarily proving it true or refuting the alternatives.

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1. For a sample of the varying characterizations of scientific realism found in the literature, see Devitt (1991, p. 98ff), Ellis (1990, pp. 87-9), Hacking (1983, pp. 21-31), Leplin (1984, pp. 1-2), Newton-Smith (1981, pp. 29, 38-9) and van Fraassen (1980, p. 8). [↑](#footnote-ref-1)
2. The reason a scientific realist cannot assert theory realism while denying entity realism is that to do so would be to renounce scientific realism. To assert that a theory fails to make genuine reference to any unobservable theoretical entities, or to insist that a theory is to be interpreted so as not to be committed to such reference, would be to remove one of the central motivations of scientific realism, which is to emphasize that science seeks to explain observable phenomena in terms of unobservable entities whose behaviour is causally responsible for the observed phenomena. [↑](#footnote-ref-2)
3. The requirement of referential realism does not immediately commit the scientific realist to any particular theory of the reference of theoretical terms. At most, it requires the possibility of reference to unobservable entities. The latter imposes a restriction on realistically acceptable theories of the reference of theoretical terms. But it does not determine specifically how such reference is to be determined. There is a range of theories of reference, ranging from full descriptive accounts of reference to pure causal accounts, compatible with the requirement of referential realism. [↑](#footnote-ref-3)
4. Hacking (1983, pp. 93-4) suggests that no coherent sense may be made of the idea of a complete description of the world. Yet even if it were possible to make coherent sense of the idea, it seems unnecessary to burden the scientific realist with such a potentially objectionable assumption. The point is not that the realist may allow that there may be more than one complete true description of the world, but that the realist need not be committed to the possibility that there may be even one such description. [↑](#footnote-ref-4)
5. While not all minimalist conceptions of truth may count as correspondence theories of truth in the broad sense at issue here, at least some do. Paul Horwich, for instance, argues that his own minimalist conception of truth is able to embrace “the idea that each truth is made true by the existence of a corresponding fact” (1990, p. 112). For more substantive theories of truth, compare the attempt by Hartry Field and Michael Devitt to analyze the relation of correspondence as a function of a relation of reference between terms and their extension, where the latter is in turn to be analyzed by means of a causal theory of reference (Field, 1972; Devitt, 1991, p. 29). [↑](#footnote-ref-5)
6. But see Devitt & Sterelny (1987, p. 196) and Musgrave (1999, chapter 10) for discussion of the idealistic tendency of epistemic theories of truth. [↑](#footnote-ref-6)
7. For the denial of justified belief or knowledge at the theoretical level, see van Fraassen (1980) and Laudan (1996). [↑](#footnote-ref-7)