

SCIENTIFIC REALISM: AN ELABORATION AND A DEFENCE¹

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Abstract: This paper describes the position of scientific realism and presents the basic lines of argument for the position. Simply put, scientific realism is the view that the aim of science is knowledge of the truth about observable and unobservable aspects of a mind-independent, objective reality. Scientific realism is supported by several distinct lines of argument. It derives from a non-anthropocentric conception of our place in the natural world, and it is grounded in the epistemology and metaphysics of common sense. Further, the success of science entitles us to infer both the approximate truth of mature scientific theories and the truth-conduciveness of the methods of science.

I. Introduction

My aim in this paper is to present the basic elements of scientific realism and the major lines of argument in support of the position. So as not to define scientific realism by contrast with any specific opposing position, I will state the position and the arguments for it in as general a manner as possible. There is a broad range of positions opposed to scientific realism. The opposition is not limited to any specific aspect of realism. Nor is it limited to any one single line of anti-realist argument.

The main point I wish to make is that there are a number of different arguments which work together to support scientific realism. Realists often speak as if there is one argument, the so-called success or 'no miracles' argument, which is *the* argument for scientific realism. While this argument no doubt plays a central role in the argument for scientific realism, it is only one of a battery of arguments which make up the case for scientific realism.

II. Elaboration

I turn now to the elaboration of scientific realism. Scientific realism does not consist in some one single doctrine. It is a family of interconnected doctrines. I will characterize scientific realism in terms of six basic principles. Inevitably, I will downplay some significant realist themes. So, after elaborating the principles of realism, I will comment on other salient realist themes.²

Scientific realism is, in the first instance, a doctrine about the aim of science. The first principle of scientific realism is the thesis that the aim of science is to discover the truth about the world. This view of the aim of science has an immediate implication for the nature of scientific progress. Namely, scientific progress consists in advance on truth.

It is possible for truth to be the aim of science and yet no progress be made toward that aim. But scientific realists tend to be optimists. They typically assume that science has discovered a measure of truth and that many of its well-established claims are true. Still, along with most contemporary philosophers of science, scientific realists tend to see science as an ongoing historical process that is far from complete. Hence, they do not assume that contemporary science has fully achieved the aim of truth. Contemporary scientific theories may be close to the truth or 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 upon the aim of truth by increasingly close approximation to that aim.

The second principle of scientific realism is a thesis about the interpretation of theoretical discourse. The scientific realist interprets scientific discourse about theoretical entities in a literal fashion as discourse which purports to be about real unobservable entities. Such realist treatment of theoretical discourse contrasts with an instrumentalist construal of such discourse. Instrumentalism denies the literal interpretation of theoretical discourse, treating it instead as fictional discourse. Theoretical entities are 'convenient fictions', useful only as an aid to prediction. By contrast with instrumentalism, the scientific realist understands theoretical discourse to refer to events and regularities that take place at the unobservable level. Scientists explain observed phenomena on the basis of underlying causal processes. The explanations they provide refer to unobservable entities whose behaviour is responsible for the observed phenomena.

By itself, a realist interpretation of theoretical discourse does not warrant the title of realism. Mere opposition to instrumentalism does not entail a realist metaphysics. What most clearly characterizes scientific realism as a form of realism in the traditional sense is the metaphysical doctrine of realism about the external world. This is the third principle of scientific realism.³ The world investigated by science is an objective reality that exists independently of human thought. The existence, structure and features of this world depend in no way on human experience, beliefs, concepts or language. It is a world of objects, properties and facts, which must be discovered by empirical inquiry. It is not a world that 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.⁴

The world about which science seeks the truth is, therefore, the objective, external reality which we inhabit. This raises the question of the nature of truth. The next two principles address this question.

The fourth component of scientific realism is the correspondence theory of truth. Truth consists in correspondence between a claim about the world and the world. 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 claim about a theoretical entity is true just in case the theoretical entity is as it is claimed to be. For example, the sentence ‘Electrons have negative charge’ is true if and only if electrons have negative charge.

It was once common to identify Tarski’s semantic conception of truth with the correspondence theory of truth. But many contemporary writers suggest that there is more to correspondence than Tarski’s T-scheme. However, the scientific realist need not adopt a specific stance on this issue. The realist is free to interpret the correspondence theory of truth in a broad manner. Provided that a theory of truth takes a statement to be true just in case a given extralinguistic state of affairs obtains, the realist may count it as a correspondence theory.⁵

Correspondence theories of truth contrast sharply with epistemic theories of truth, such as coherence or consensus theories, which identify truth with epistemic properties of beliefs. Epistemic theories of truth imply an idealist covariance of belief and reality, and therefore cannot be reconciled with realism about a mind-independent reality.⁶ Correspondence theories which treat truth as a relation between language and reality are the only theories of truth compatible with realism.

The fifth component of scientific realism stresses the objective nature of truth. It makes explicit the relationship between realism about the external world and the correspondence view of truth. The realist view is not just that there is an external world and that truth is correspondence. But, rather, it is the external world that renders our claims about the world true or false. Theoretical claims are made true or false by the way things are in the mind-independent, objective reality investigated by science. Thus, truth is objective in the sense that the truth-value of a claim is determined by the way things stand in the external world, whether or not we believe that it is true. This is a further reason why the realist is unable to countenance an epistemic theory of truth. For an epistemic theory of truth removes the dependence of truth on an objective reality.

The thesis that the world makes our claims true or false may seem redundant in light of the two preceding theses of realism about the external world and correspondence truth. But I prefer to state the thesis of objectivity separately in order to rule out non-realist interpretations of the correspondence theory of truth. The idealist may treat truth as correspondence between statements and states of affairs that are solely constituted by mental states. Alternatively, the Kantian may take the truth-making states of affairs to be jointly constituted out of sensory input from the external world and the conceptual contribution of the human mind. The requirement that statements be made true by correspondence with mind-independent reality insures that no such idealist or Kantian rendering of correspondence truth may qualify as realism.

Finally, the sixth characteristic thesis of scientific realism relates to the nature of scientific knowledge. The scientific realist does not simply assert that there is a mind-independent world about which science seeks the truth. Scientific realism has a fundamentally epistemological rationale. For the scientific realist, the scientific pursuit of truth gives rise to genuine knowledge of the natural world. Scientific realism therefore entails epistemic realism, according to which scientific inquiry yields knowledge of the objective world.

For epistemic realism, scientific knowledge is not restricted to the empirical level. It extends to unobservable aspects of reality as well. Epistemic realism is what characterizes scientific realism as an epistemological doctrine distinct from contemporary versions of empiricist philosophy of science which deny that it is possible to either have rationally justified belief or knowledge about unobservable states of affairs (e.g., van Fraassen 1980). It is also what epistemologically distinguishes scientific realism from neo-Kantian, constructivist views which deny epistemic access to the objective, mind-independent world, which lies beyond our phenomenal experience.⁷

Qualifications

The six principles that I have just presented yield a reasonably distinct picture of scientific realism. The picture may be a bit blurred around the edges. But the theses capture the key themes of scientific realism while ruling out the salient anti-realist positions as non-realist.⁸ There remain, however, a number of other important realist themes, of which mention should be made.

The first theme is a semantic one. There is a close connection between scientific realism and semantic realism. Neither empirical generalizations nor theoretical claims about unobservable states of affairs may be verified by observational means. They are 'verification-transcendent'. On a verificationist conception of meaning, such claims are devoid of cognitive significance. Yet despite the inability to determine whether the truth-conditions of such claims obtain, the scientific realist holds that they may constitute significant assertions about the world which possess a truth-value. Indeed, this is what gives point to the attempt by scientists to provide indirect evidence for theoretical claims and empirical generalizations the truth of which cannot be established by direct empirical means. Because of this, scientific realists tend to adopt a semantic realist conception of meaning, according to which the meaning of a synthetic claim consists in the conditions under which the claim would be true, rather than the conditions under which its assertion would be warranted.⁹

The issue of the truth of theoretical claims raises a question about theoretical discourse. Ian Hacking distinguishes between *entity realism* and *theory realism* (Hacking 1983: 27). Entity realism asserts the reality of unobservable entities discovered by science. Theory realism asserts that scientific theories may be true or have a truth-value. Traditional scientific realism combines entity realism with theory realism. However, Hacking notes that the two doctrines are logically distinct. The entity realist may allow that there are unobservable entities of which scientists possess knowledge, but of which no current theory provides a correct description. By contrast, the theory realist may assert that a theory is true though none of its terms denote unobservable entities, but refer instead to logical constructions out of experience.

I have characterized the realist interpretation of theoretical discourse as a defining principle of scientific realism. Given this, it is not possible for scientific realism to deny that theoretical discourse purports to refer to real unobservable entities.¹⁰ However, it is no great departure from scientific realism to assert the reality of theoretical entities while denying theory realism. Entity realism may therefore be considered a special version of scientific realism.¹¹

Mention must finally be made of a pair of metaphysical issues on which scientific realists may adopt a realist attitude. Scientific realists typically espouse a more substantive view of the world than the mere existence of a mind-independent reality. The world that we inhabit and which science investigates is not an amorphous world. It is a structured world of entities, properties and relations, which fall into naturally occurring categories. But while some realists adopt an essentialist account of natural kinds, others prefer a minimal ontology without natural kinds and essential properties. The second set of issues concerns the role of natural or physical necessity in causation and laws of nature. Scientific realists tend to reject Humean regularity accounts of causation and laws of nature in favour of necessitation accounts. But there are realists who diverge from this tendency. And, in any event, the nature of natural necessity is not a compulsory question for scientific realism, as that doctrine is understood here. In view of the variation of opinion about these issues among philosophers who otherwise count as scientific realists, it seems preferable to treat realism about natural kinds, causation and laws of nature as optional questions for the scientific realist.¹²

III. Defence

I turn now from elaboration to defence. I noted before that scientific realism does not consist in any one, single doctrine. It is an interconnected family of theses. Similarly, there is no one, single argument for scientific realism. The so-called 'success argument' has received a great deal of attention. But there are other arguments which deserve equal billing. There is no doubt that the success argument is an important part of the case for scientific realism. But it only comes into play once the ground has been laid by other realist lines of argument.

In what follows, I will not mention all known arguments for scientific realism, but only those which form part of the overall case that I hope to mount for scientific realism.¹³ The first two lines of argument turn on reflection upon our place in the natural order and an appeal to the epistemology and metaphysics of common sense. The second two arguments are versions of the success argument. The first version relates to the truth or approximate truth of theories, while the second version of the argument applies success at the level of the methods employed in science.

Our place in nature: the realist perspective

The basic argument for realism takes off from a founding intuition about our place in nature. We human beings are sentient, intelligent organisms. We inhabit a pre-existing natural world. We interact causally with this world. But we did not invent, construct or create it. We must act in the world in order to survive. To assure our survival, we must acquire knowledge of the way the world is. For knowledge about the way the world is enables us to reliably undertake actions which promote our survival. Thus, the realist concludes, we are creatures who inhabit an objective reality, of which, given our survival, we have the capacity to acquire genuine knowledge.

This is the perspective of realism, spiced, I should say, with a dash of evolutionary naturalism. The perspective is fundamentally opposed to views which conceive reality on the basis of human mental representation, such as belief or experience. The realist sees humans and their inner life as but a small part of a vast reality. Any view which takes human thought or experience as the basis of reality, or the concept of reality, profoundly misunderstands our place in the natural world. From the realist perspective, such a view commits the fundamental error of anthropocentrism (cf. Smart 1963; also Hooker 1987: 264ff).

The realist takes the external world as a given. The existence of the external world does not depend on thought or experience. It is a world in which we find ourselves embedded and which we inhabit. We are able to effect change in the world by means of actions which bring about such change. We construct buildings, grow

crops, and pollute the environment. But we did not make the world. Nor do the basic entities which populate the world, or the laws of nature which govern the behaviour of these entities, depend on us in any way. Thus, rather than take human thought or experience as primary in forming our conception of reality, the realist takes human thought and experience to form a part – indeed, a relatively insignificant part – of that reality.

The opposing, non-realist perspective has its origins in the sceptical problematic of traditional epistemology. Scepticism of the Cartesian variety challenges us to show that there is an external world and that we have knowledge of such a world. Traditional epistemologists took mental representations as the basis of their response to such scepticism. On the basis of beliefs, ideas or experience, they sought to show both that there is an external world and that we are able to have knowledge of it. Philosophers who attempt to meet the sceptic in this way typically find that the game is rigged against them. For the sceptic sets the standards too high, demanding absolute certainty where none is to be found.

As against traditional, sceptic-centered epistemology, the realist takes it as a basic starting-point that there is an external reality, and, indeed, that we are able to have knowledge of that reality. For the realist, the lesson of scepticism is not that knowledge of the external world is impossible, but that it is a mistake to seek epistemic certainty or to treat mental representations as the basis of either our epistemology or metaphysics. We know just as surely as we may know anything that there is an objective, external reality, and that we may come to have knowledge of it. But our knowledge need be neither certain, nor grounded in privileged representations of that reality.

Thus, from the perspective of realism, it is a mistake to base our concept of reality on human mental representation. Mental representations are but a small part of a greater reality in which we find ourselves embedded. Any philosophy which seeks to ground our conception of reality on our own mental representations commits the fundamental error of anthropocentrism, and should therefore be dismissed as fatally flawed.

Realism and common sense

The second strand in the argument for scientific realism turns on an appeal to common sense and the realism implicit in ordinary common sense. By ‘common sense’, I mean our ordinary, prereflective awareness of our immediate surroundings and of the broader world which extends beyond those immediate surroundings. This is a world that is made up of material objects of all shapes and sizes, of which we have more or less immediate knowledge by means of our sensory experience of those objects. It is a concrete world of mind-independent

objects with which we interact causally by means of bodily movement and action, but which is nonetheless beyond the immediate control of our powers of volition. It is also a world in which misperception and illusion have their place in the ordinary course of events, but in which a robust sense of reality nevertheless sustains a reasonable degree of practical certainty that things are by and large as they seem.

Realism about ordinary everyday objects and our epistemic access to such objects provides the starting-point for the commonsense realist component of the argument for scientific realism. Common sense gives rise to a body of beliefs about the objects in our environment and our epistemic and practical interactions with these objects. On the whole, we may assume that this body of beliefs is true. The point is not that our commonsense beliefs are certain, indubitable or infallible. Rather, commonsense beliefs are *prima facie* justified. They have an epistemic priority, which makes it difficult to dislodge them by rational argument. Any attempt to eliminate or overthrow such beliefs is to be regarded with extreme suspicion. Any argument that purports to show that common sense is to be discarded thereby shows itself more than likely to be unsound or invalid.¹⁴

Such a robust, commonsense attitude underwrites commonsense realism about ordinary, everyday material objects and our perceptual access to such objects. The scientific realist who takes common sense as a starting-point is thereby justified in assuming that there is an ordinary, everyday world of material objects, with which we interact causally and to which we have epistemic access by means of our senses. The scientific realist is free to build upon the basis of commonsense realism in arguing that scientific theories, realistically construed, are the best explanation of observed phenomena at the commonsense level. There is no need for the scientific realist to argue for the reality of ordinary, everyday material objects, since commitment to such entities has already been established at the level of common sense.

While the attitude of common sense leads to realism about the objects of common sense, such realism contains the seeds of a more full-blown realism about scientific theories and entities. For one thing, a tendency toward realism about scientific theories and entities is built into commonsense realism about ordinary objects. While we may be unable to observe the basic constituents of material objects with our naked eyes, we are accustomed to the idea that material objects have component parts, and that some of these parts may be too small to see. The full-blown scientific view that matter is composed of fundamental particles, atoms and molecules is but a highly sophisticated extension of the commonsense idea of the compositional nature of matter.

For another thing, commonsense realism treats the objects of ordinary common sense as real, objective entities, which exist independently of human mental activity. Scientists from different historical epochs, or scientists who work in different Kuhnian ‘paradigms’, occupy the same commonsense world of ordinary, everyday objects. Because scientists from different historical epochs inhabit the same commonsense world, modern scientists confront the same observable objects and phenomena as did ancient scientists who worked in the same domain. Equally, proponents of alternative Kuhnian ‘paradigms’ do not inhabit different ‘worlds’, but maintain common perceptual access to a shared domain of observable objects (cf. Kuhn 1970: 111, 150).¹⁵

While common sense coheres well with scientific realism, it must be admitted that a certain tension may sometimes arise between science and common sense. Here is a familiar example from the history of astronomy. Our senses tell us that the Earth is flat. Yet science tells us that the Earth is spherical. Our senses tell us that the sun moves across the sky each day, rising in the East and setting in the West. Science tells us that it is the daily rotation of the Earth that makes the sun appear to move. Our senses tell us that the Earth is immobile. Yet science tells us not only that the Earth rotates upon its axis, but that it revolves around the sun in an annual orbit.

Such apparent conflicts between science and sensory evidence have led some realistically inclined philosophers to hold that there is an inherent tension between science and common sense (Sellars 1963; Feyerabend 1975; Churchland 1979). Common sense is the repository of primitive theory. It is the ‘metaphysics of the stone age’, in Russell’s words. With the advance of science, such primitive theory is inevitably corrected, refuted and ultimately eliminated. Thus, by the lights of science, common sense must itself be rejected. Common sense cannot therefore serve as the basis for a realist account of science.

It is undeniable that conflict may on occasion arise between science and common sense. But it is an exaggeration to inflate such conflict into a fundamental incompatibility between science and common sense. In such conflict, the commonsense description of the phenomenon is typically not corrected by science at all. What science corrects is the explanation of the appearances.

The Earth *appears* flat. The sun *appears* to move across the sky each day. Science places the appearances within the context of a theoretical system, which corrects the commonsense view by explaining how the rotation of a spherical Earth gives rise to the appearance of the sun’s daily transit across the heavens. This is precisely a case in which common sense is only renounced in favour of an improved explanatory structure, which both preserves and explains the appearances noted by commonsense observation.

Success and truth

As we have just seen, commonsense realism contains the seeds of scientific realism. There is a further sense in which this is the case. In the course of everyday practical activity, we routinely employ inference to the best explanation in seeking to understand why various events occur. Such reasoning is the basis of the best-known argument for scientific realism, the so-called success or ‘no miracles’ argument.¹⁶ The reasoning that forms the basis of one of the major arguments for scientific realism is therefore reasoning of a commonsense kind.

The classic formulation of the success or ‘no miracles’ 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 (this formulation is due to Richard Boyd), 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. (Putnam 1975: 73)

In this passage, Putnam argues that realism is the best explanation of the success of science. (Strictly, he says it is the *only* explanation, but this is a form of inference to the best explanation.) Putnam's argument turns on the claim that a philosophy of science which denies that theoretical entities are real, or that scientific theories are true or approximately true, must treat the success of science as a miracle that is incapable of explanation. An explanation which treats the success of science as an inexplicable miracle is an unsatisfactory explanation of such success. By contrast, scientific realism provides a compelling explanation of the success of science. On the whole, the unobservable entities postulated by theories exist, and scientific theories are true or approximately true. Given the reality of the entities to which scientific theories refer, as well as the truth or approximate truth of such theories, it is only to be expected that science should manifest the striking degree of empirical success that it does. Because scientific realism provides a compelling explanation of the success of science, while alternative approaches provide an unsatisfactory explanation, we should accept scientific realism as true.¹⁷

Various objections have been raised against the success argument. Of particular relevance in the present context are historical counterexamples to the success argument due to Larry Laudan (1981). Laudan presents a list of historical cases of scientific theories (e.g., 18th century chemical atomism, Wegener's continental drift theory), now considered to have been approximately true or referential, but which met with little or no success in their time. He also presents cases of successful theories (e.g., the ether and phlogiston theories) which are now thought neither to have been referential nor to have been true or approximately true. Laudan's counterexamples appear to show that there is no connection between reference and truth or approximate truth and the empirical success of a theory. If he is right, the claim that scientific realism is the best explanation of the success of science would appear unsustainable.

Recent work by Kitcher, Musgrave and Psillos suggests that the success argument may be revised in a way that renders it immune to Laudan's criticism. For one thing, if the criterion of scientific success is revised to include only those theories which exhibit a high degree of novel predictive success, then a number of Laudan's counterexamples may be dismissed as not displaying the requisite degree of success.¹⁸ For another thing, if credit for success is restricted to the constituents of a theory which are responsible for novel predictive success, this increases the likelihood that the relevant constituents will be preserved in the course of subsequent theory modification, and later considered approximations to the truth.¹⁹

I regard such revisions of the success argument as well-motivated. In attempting to determine whether a successful theory is true, it is important to employ a rigorous standard of success such as novel predictive success. It is also important to assign credit for such success to the constituents of theory specifically responsible for such success. But the result of so revising the success argument is a weakened position which fails to meet the epistemological needs of scientific realism. The realist does not merely wish to defend a claim about the truth of theories. It is of at least equal importance for the scientific realist to defend the epistemic realist view that the methods of science produce rationally justified belief, and indeed knowledge, about those aspects of the world about which scientific theories purport to inform us. Hence, the scientific realist must also defend a realist epistemology for science.

Success and method

In the appraisal of a scientific theory, and the choice between alternative theories, scientists employ a variety of methodological norms, or rules of method, as I shall call them. They consider whether a theory is confirmed by the evidence, accurately predicts novel facts, unifies phenomena from disparate domains, and so forth. If a theory is certified by such rules of method, then a scientist is rationally justified in accepting the theory. Certification by rules of method therefore provides the basis for epistemic warrant in science.

The scientific realist wishes to defend the epistemic realist thesis that scientific inquiry leads to rational belief and knowledge about the transempirical world. The realist must therefore argue that use of the rules of method gives rise to theories which scientists are warranted in accepting as true or approximately true. For this reason, while I am favourable to the revisions of the success argument noted above, I suggest that emphasis should be placed instead on application of the success argument at the level of the methods of science.²⁰

In particular, I propose an approach that I have elsewhere described as *abductive realism* (Sankey 2001). According to this approach, the best explanation of the cognitive and pragmatic success of scientific theory and practice is that the rules of method are truth-conducive tools of inquiry, which serve as reliable means for obtaining truth.

Abductive realism forms part of a naturalistic theory of epistemic warrant. This theory treats rules of method as cognitive instruments, which serve as means for the achievement of epistemic ends. Such an instrumental construal of the rules of method enables the question of the warrant supplied by a rule to be understood as the empirical question whether use of the rule conduces to the epistemic end it is claimed to

promote. Rules of method which reliably promote the aim of truth provide scientists with epistemic warrant for accepting theories which satisfy those rules. Thus, the normative force of rules of method is grounded in empirical facts about effective means of inquiry into the mind-independent, natural world which we inhabit.²¹

Abductive realism addresses the question of why the rules of method are to be taken to promote the realist aim of truth. I call it an *abductive* strategy because it is based on inference to the best explanation, a form of abductive inference. An inference of this kind is required because of the lack of direct evidence for the connection between method and the truth of theory. Because the truth of the transempirical content of theories cannot be established by observation, no connection between method and the truth of theories may be shown to obtain by empirical means. Thus, the grounds for taking the rules of method to be truth-conducive can be at best abductive grounds.

Abductive realism places special emphasis on the regulative role of method in the selection and elimination of theories. The rules of method serve as a means of 'quality control'. Scientists employ rules of method as selection criteria on the basis of which to eliminate faulty theories in favour of ones that are serious contenders for truth.

The regulative role of the rules of method enables them to serve as the arbiter of success. Suppose that a theory satisfies the rules of method to a remarkably high degree. It accommodates all known data, and accurately predicts many surprising novel facts. It unifies disparate domains in a simple and coherent manner, while opening up exciting new areas of inquiry. From a methodological point of view, such a theory is an ideal theory.²² It manifests a near perfect level of success. According to abductive realism, the best explanation of such success is that the rules of method are regulative norms which 'screen for truth'. They are genuinely truth-conducive instruments of inquiry, which rigorously select only those theories which are either true, or on the track of truth.

It does not suffice, of course, to simply assert that realism is the best explanation of ideal satisfaction of method. An argument is needed. Here the abductive realist employs a metamethodological analogue of the classic 'no miracles' version of the success argument.

How might ideal methodological success be explained by the opponent of realism? Let us focus on the straightforward opponent of scientific realism. Such an anti-realist denies the realist's claims about truth and reference. The ideal theory is neither true nor approximately true. Its terms fail to refer to any real thing. None of the entities postulated by the theory exist.

Such an anti-realist is entirely without the resources to explain ideal methodological success. If a theory fails not only to be true but even approximately true, and none of its terms refer to any real entities, then the success of such theory is nothing short of a miracle. But that is surely not an explanation of the success of science.

IV. Conclusion

It is time to draw the threads of the discussion together. I will briefly conclude by commenting on some of the relations between the arguments I have offered for scientific realism and the various doctrines which comprise the position of scientific realism. Realism about the external world is supported by the rejection of anthropocentrism and the appeal to common sense. Because science is an extension of common sense, a realist treatment of theoretical discourse derives general support from common sense, though it derives more direct support from the appeal to the success of science. The epistemic realist thesis that we have genuine knowledge of unobservable aspects of reality gains broad support from commonsense. However, it is supported more directly by the success argument, and most directly by the metamethodological application of the success argument.

This does not exhaust the connections between arguments for realism and various principles of realism. But the fact that different strands of realist argument bear on different components of realism further illustrates my main point: scientific realism is not captured by any one doctrine. It is a complex position. Because it is a complex position, different lines of argument must be brought to bear in support of different aspects of the position.

Notes

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¹ *Acknowledgements:* this paper was presented at seminars at the University of Melbourne and the *Welt und Wissen* workshop, Zentrum für Interdisziplinäre Forschung, University of Bielefeld. I am grateful for comments to Stephen Barker, Mara Beller, Martin Carrier, John Clendinnen, Keith Hutchison, Tim Lyons, Graeme Marshall, Felix Mühlhölzer, Trevor Pinch, Graham Priest, Stathis Psillos, Robert Nola and Jay Rosenberg.

² My characterization of scientific realism in terms of a family of interconnected doctrines draws upon an earlier paper of mine, in which I propose a similar taxonomy of realist principles (Sankey, 2000b).

³ I employ the expression 'external world' because it is the expression traditionally employed by philosophers to formulate the claim that there is a material world, which exists independently of the human mind. However, the expression itself is objectionable, since it may seem to imply an untenable metaphysical divide between internal and external worlds, as well as to suggest that we are not part of the world. A further problem is that talk of an external world may provide the basis for the sceptical problematic – e.g., Cartesian questions about the certainty of our knowledge of an external world – which should itself be rejected in favour of a naturalistic perspective which denies the legitimacy of such sceptical questions.

⁴ My insistence on the mind-independence of the external world might be taken to suggest that scientific realism is restricted to the objects, properties and facts investigated by the natural sciences. But such a restriction is unnecessary. There may be perfectly objective, and indeed mind-independent, facts pertaining to the areas investigated by the social sciences. The point may be illustrated with the case of artifacts. While such artifacts as cars and tools would not exist if they had not been constructed by humans, the fact that there is, say, a screwdriver in the boot of my car is an objective fact that does not depend on my thinking it to be the case. (I am indebted for this point and the example of the screwdriver in the boot to Robert Nola.)

⁵ Thus, for example, Michael Devitt's substantive attempt to identify truth with a causal relation between words and their referents is an example of a correspondence theory (Devitt 1991: 29). But so also is Paul Horwich's minimalist theory of truth which takes truth to be exhausted by the T-scheme, since it embraces 'the idea that each truth is made true by the existence of a corresponding fact' (Horwich 1990: 112). What is essential for a realist correspondence theory 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, not any specific conception of the substantive or formal nature of the correspondence relation.

⁶ On epistemic theories of truth, see Devitt (1991: 36, 44-5). For the idealistic tendency of such theories, see also Devitt and Sterelny (1987: 196) and Musgrave (1999b).

⁷ The prime contemporary example of a neo-Kantian constructivist philosophy of science is, of course, Kuhn (1970). For such an interpretation of Kuhn's metaphysical stance, see, for example, Devitt (1991) and Hoyningen-Huene (1993).

⁸ It is important to at least briefly indicate how the theses adumbrated exclude some salient anti-realist positions. As we have seen, the realist interpretation of theoretical discourse is opposed to an instrumentalist treatment of such discourse, which treats theoretical entities as convenient fictions or mere predictive devices. The theses that the aim of science is truth and epistemic realism conflict with van Fraassen's constructive empiricism, as well as with the anti-realism of Larry Laudan. The theses of the correspondence theory of truth and the objectivity of truth both conflict with the internal realism of Hilary Putnam and Brian Ellis, which rejects the correspondence theory. They may also conflict with Kuhn's views about truth (cf. Kuhn 1970: 206). See my (1997: 57-60) for discussion of Kuhn's later views of truth.

⁹ One reason not to include semantic realism as a core principle of scientific realism is that there are theories of meaning which accord significant content to theoretical claims without doing so by means of realist truth-conditions. Still, scientific realists have tended to adopt such a realist truth-conditional approach to meaning, hence there is a close connection between the two views. Close but not necessary: any theory of meaning which allows that the content of theoretical discourse fails to be captured entirely in terms of observational discourse is open for consideration by the scientific realist.

¹⁰ To spell the point out somewhat further, the scientific realist cannot assert theory realism but deny entity realism because 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. In particular, scientific realism emphasizes that science pursues genuine knowledge of both observable and unobservable aspects of reality. For example, scientists seek to explain observable phenomena in terms of unobservable entities whose behaviour is causally responsible for the observed phenomena.

¹¹ Of course, formulation of an entity realist version of scientific realism would require removal or modification of realist theses which involve the notion of truth. A number of possibilities are available here. Instead of taking the aim of science to be discovery of truth about the world, the aim of science might be characterized as discovery of the way the world is. It is not clear, in any event, that the entity realist need discard the notion of truth altogether. The entity realist need only assert that full-blown theoretical descriptions of unobservable entities are false or fail to have a definite truth-value. But the entity realist must surely admit that existential claims about such entities are true. Moreover, Hacking even seems to allow that a variety of low-level truths may be known about theoretical entities, since he comments that 'We know an enormous amount about the behaviour of electrons' (Hacking 1983: 272).

¹² For an indication of the range of opinion about these matters amongst philosophers of a generally realist cast of mind, see the essays collected in my (1999).

¹³ Putnam (1975) distinguishes between negative and positive arguments for realism. In this paper, I will for the most part ignore negative arguments for realism, though these have been historically very powerful arguments for realism. Negative arguments are arguments against opposing positions, examples of which include the series of arguments proposed in the late 1950's against the logical empiricist treatment of theoretical discourse.

¹⁴ The point that common sense is more likely to be correct than any philosophical argument against it is emphasized by Armstrong (1999), Campbell (1988) and Devitt (2001), who credit the basic thought to G.E. Moore.

¹⁵ The point that common sense tells against the incommensurability of paradigms is well made by Campbell (1988).

¹⁶ In addition to the success argument, there are a number of other positive arguments for scientific realism, e.g., Wes Salmon's argument from the common cause (Salmon 1984: 206ff) and Ian Hacking's direct 'experimental proof' of realism (Hacking 1983: 265). But such arguments may be assimilated to the success argument. For example, the existence of an entity which is the common cause of a number of different phenomena is the best explanation of those phenomena. Similarly, the existence of an unobservable entity which produces certain experimental results is the best explanation of successful laboratory practice.

¹⁷ In my gloss of Putnam's 'no miracles' argument, I have also drawn upon the following passage from Putnam (1978), which speaks less about reference and more about the entities referred to by theories:

... the modern positivist has to leave it without explanation (the realist charges) that 'electron calculi' and 'space-time calculi' and 'DNA calculi' correctly predict observable phenomena if, in reality, there are no electrons, no curved space-time, and no DNA molecules. 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... (Putnam 1978: 19)

¹⁸ The importance of novel predictive success is urged by Musgrave (1999a: 55) and Psillos (1999: 105).

¹⁹ For the claim that credit for the success of a theory should be accorded to only those parts of a theory responsible for the success, see Kitcher (1993: 143-9) and Psillos (1999: 108).

²⁰ The strategy of applying the success argument at the level of method has been championed by Richard Boyd (e.g., 1984: 58 ff). In related ways, it has also been employed by Rescher (1977) and Kornblith (1993). In my recent attempt to develop a naturalized epistemology for scientific realism, it is the strategy that I employ as well (Sankey 2000a; 2001).

²¹ I have developed this general line of argument in my (2000a; 2001). For the naturalistic view that the rules of method may be viewed instrumentally as means to cognitive ends, see, Laudan (1987), Rescher (1977) and Stich (1990).

²² I do not assume that the methodologically ideal theory is the theory that will be reached at the ultimate end of ideal inquiry. Rather, it is an ideal theory which might be reached at some more mundane point of inquiry. However, it is worth briefly addressing the issue of the methodologically ideal theory reached at the ultimate end of ideal inquiry. Because the scientific realist takes truth to be defined as correspondence between language and reality, rather than in terms of ideal satisfaction of epistemic criteria, the theory reached at the ultimate end of ideal inquiry could well be false, as Putnam suggests is the case for the doctrine he calls 'metaphysical realism' (1978: 125). While Putnam's internal realism identifies truth with ideal rational justification, scientific realism in the form that I have presented the position here opposes any such identification. But denial of such identification does not debar the scientific realist from holding that the best explanation of ideal methodological success is that the theory reached at the end of ideal inquiry is true in the realist correspondence sense.