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INTRODUCTION: SCIENTIFIC REALISM AND COMMONSENSE

1. SCIENTIFIC REALISM

Scientific realism involves two key claims. First, science aims primarily at truth. Second, we can justifiably believe that our successful scientific theories achieve, or at least approximate, this aim. The contemporary scientific realism debate turns on the acceptability of these claims. To acquire a more robust picture of scientific realism, let us identify some of the related theses on which these key claims rest.

In opposition to, say, solipsists, the scientific realist insists that there exists an 'external' world with which we interact. Contra social constructivists, the scientific realist holds that this world includes events, processes, and/or entities that are not contingent on our beliefs. Scientific realists take truth to be objective and to express a correspondence relation between statements and the world. Such a conception of truth is often juxtaposed against those conceptions espoused by internal realists (e.g., Hilary Putnam, Brian Ellis).[1] Opposing idealists such as Berkeley, the scientific realist maintains further that we can be justified in believing that the objects we observe exist and that our basic claims about their observable properties are true. In contrast to classical instrumentalists, such as Ernst Mach, positivists (e.g., Moritz Schlick, Rudolph Carnap), as well as fictionalists, operationalists, and phenomenalists, the scientific realist construes scientific theories literally; most terms contained in scientific theories are intended to refer to real entities.[2] Scientific realists hold that, in general, theory change in science has been rational and progressive. Moreover, scientific realists tend to espouse the view that progress in science is determined by the extent to which its primary aim is achieved (or approximated).

These tenets of scientific realism collectively serve to provide a framework within which the *contemporary* debate on scientific realism takes place. Most prominent contemporary opponents of scientific realism

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— such as Bas van Fraassen and Larry Laudan — do not criticize this framework. Rather, the *contemporary debate* on scientific realism hinges primarily on the axiological and epistemological claims noted above. These can be made more explicit:

Axiological (Scientific) Realism: science aims, primarily, to express true statements about the world.

Epistemic (Scientific) Realism: we can be justified in believing that successful scientific theories are (approximately) true.

The majority of philosophers involved in the scientific realism debate assume that axiological realism rests on epistemic realism. In fact, so long as we take science to be successful, progressive, and rational, and so long as progress is determined by the achievement of (or the degree to which we approximate) our primary aim, truth, a defence of epistemic realism is required of any scientific realist. For this reason, the contemporary debate on scientific realism is, by and large, played out in the arena of epistemic realism.

So long as we interpret scientific theories literally, as the scientific realist advises, epistemic realism entails the claim that we are justified in believing that unobservable entities postulated by our successful theories exist. The type of inference that scientific realists usually put forward to support such a claim can be expressed as follows: The existence of an unobservable entity, U, (e.g., the electron) is the best explanation for the observable phenomena, O (e.g. observed electrical phenomena); therefore, we are justified in believing that U (e.g. the electron) exists. An argument of this sort is called an *inference to the best explanation* (IBE). It is generally thought to be the mode of inference that grounds or provides justification for epistemic realism.

Although IBE is employed to support our belief in the existence of unobservables, scientific realists maintain that it is not an 'exotic' mode of inference, utilized only by philosophers. They contend that scientists themselves employ IBE. In fact, realists tell us, IBE plays an integral role in our commonsense reasoning. Bas van Fraassen (though a non-realist) provides a nice example:

> I hear scratching in the wall, the patter of little feet at midnight, my cheese disappears — and I infer that a mouse has come to live with me. Not merely that these apparent signs of mousely presence will continue, not merely that all the observable phenomena will be as if there is a mouse; but that there really is a mouse. (van Fraassen 1980, pp. 19-20)

Scientific realists seek to justify belief not merely in the existence of particular entities but in the (aproximate) truth of our scientific theories. Toward this end, they typically apply a robust version of IBE. This is the 'no-miracles argument', made famous by Putnam (1975) — also known as the 'miracle argument,' the 'success argument' and the 'ultimate argument' — if our successful scientific theories were not at least approximately true, then their success would be a miracle. In other words, so long as we do not accept miracles as explanatory,[3] the *only* (and thus the best) explanation for a theory's success is that the world is as the theory says it is. If we accept this argument, we appear to be led to epistemic realism. And since the belief that our theory is (approximately) true entails the belief that the entities postulated by the theory exist, the no-miracles argument justifies the latter in so far as it justifies the former. Thus the no-miracles argument warrants a far greater range of beliefs than would be warranted by any specific inference to the existence of an unobservable entity.

Along with Alan Musgrave (1988), one could consider the no-miracles argument, as stated thus far, to be more akin to a slogan than an argument. Noting this, we are prompted to explicate it more precisely. Scientific realists typically claim that IBE is abductive, abduction being a form of reasoning famously articulated and advocated by C.S. Peirce (1958). Peirce construes abductive reasoning in the following way. We begin with a 'surprising' observation, (Q). A state of affairs is postulated, and that postulate, (P), would render (Q) 'a matter of course'. We conclude that 'we have reason to suspect' that (P) obtains (1958, p. 189).

While scientific realists often tip their hats to Peirce, when presenting the no-miracles argument, the way in which it is to be expressed as a Peircian abduction is neither obvious nor generally explicated. We can begin by inserting the central realist claims into Peirce's argument. The scientific realist wants to direct our attention to the 'surprising fact,' (Q), that we have successful scientific theories. According to scientific realists, if our theories were (approximately) true, (P), then (Q) would be 'a matter of course.' The epistemic realist draws a bolder conclusion than that drawn by Peirce. The epistemic realist infers, not merely that 'we have reason to suspect' (P), but that we *are justified in believing* (P). This extra step might be legitimised if the epistemic realist can show that (P) is probable. But on what grounds does the epistemic realist base such a claim? Namely, her assertion that, aside from (P), the only state of affairs that could bring about (Q) would be a miracle. With this key premise of the no-miracles argument, we are closer to formulating that argument as an abduction. However, at least a few more hidden premises must be made salient.

1: Our theories are successful, (Q)

2: If our theories were (approximately) true, (P), then their success, (Q), would be a matter of course

3: The relationship expressed in (2) shows that the (approximate) truth of our theories, (P), provides an explanation of their success, (Q)

4: In fact, the (approximate) truth of our theories, (P), provides a *good* explanation of success, (Q)

5: To say that success, (Q), occurs due to a miracle is to provide no explanation at all

6: Aside from the (approximate) truth of our theories, (P), there is no other explanation available for their success, (Q)

Therefore, (probably) our theories are (approximately) true, (P)

Therefore, epistemic realism: we are *justified in believing* that our successful theories are (approximately) true, (P).

Though it is a start, this modified abductive argument does not exhaust the list of presuppositions involved in the no-miracles argument. Premises (3), (4), and (6) surely need further clarification and support. And even including our new premises and their requisite support, the full set of premises would *entail* neither the initial, nor the subsequent, conclusion. We are not *logically compelled* to infer from a phenomenon to its explanation, even if that explanation is the only one available. The argument, as a whole, is not deductively valid.[4] The scientific realist will grant this and will remind us that certainty about the world of experience is an unattainable demand. The argument is only meant to ground epistemic realism. It doesn't tells us what we can be certain of, but only what we can be justified in believing. And again, says the scientific realist, it receives its legitimacy from its use, not only in science, but in everyday life.

We have thus far been considering rather basic formulations of epistemic realism and the no-miracles argument. We can now note that scientific realists have introduced a number of variations of this inferential package. Some appeal to *truth* as the explanation of success (e.g., Wilfred Sellars (1962); André Kukla (1997)), while others appeal to *approximate truth* (e.g., Hilary Putnam (1975); Richard Boyd (1973)). Some claim that truth (or approximate truth) is the *only* possible or available explanation for success (e.g., J. J. C. Smart (1968); Putnam (1975)). Others (most contemporary scientific realists) claim the truth or approximate truth of our

theories to be the *best* explanation of success. Some scientific realists understand that which is being explained as *the success of a given theory* (e.g., Smart (1968); Musgrave (1985); Peter Lipton (1993), (1994)), while others see that which needs to be explained as being *the success of science in general* (e.g., Putnam (1975)). Some appeal to *general predictive success* (e.g. Putnam (1975); Boyd (1973); W. H. Newton-Smith (1981)), while others emphasize *novel success* (e.g., William Whewell (1840); Musgrave (1985), (1988); Lipton (1993), (1994); Stathis Psillos (1999); Howard Sankey (2001)). Some say we are justified in believing theories as wholes, while others focus on certain constituents of those theories (e.g., Philip Kitcher (1993), Psillos (1999); Sankey (2001)).

It is noteworthy that many scientific realists see their philosophy to be an 'overarching empirical hypothesis.' Scientific realism is taken to be an empirically testable position that shares the virtues of a scientific theory. Acknowledging this, we can clarify epistemic realism further. Epistemic realism is the thesis that we can be justified in believing the *hypothesis* that our successful scientific theories are (approximately) true.

With a framework in hand for understanding the position of scientific realism let us identify three important contemporary objections to that position. One is directed at the no-miracles argument specifically. Some non-realists contend that the scientific realist has put forward a false dichotomy. In seeking an explanation for the success of scientific theories, we need not make a choice between appealing to miracles and inferring that our theories are (approximately) true. Alternative explanations are available (challenging premise 6 above). For example, van Fraassen (1980) presents a Darwinian alternative: success is a requirement for a theory's survival; we simply wouldn't have retained our theories were they not successful. Other alternatives are offered by Laudan (1985), Rescher (1987), Fine (1984), Lyons (this volume), Worrall (1989), and Carrier (1991); (1993). Such alternative explanations deflate the motivation for inferring the epistemic realist hypothesis. They thus cut at the heart of epistemic realism. In reply, the epistemic realist often claims that (approximate) truth provides a *better* explanation than the non-realist contenders. Or she draws attention to a new 'surprising fact' (e.g., to novel success) and denies the non-realist's ability to explain it.

Another non-realist argument is the argument from the underdetermination of theories by data (Duhem (1906), Quine (1975), van Fraassen (1980)). In its basic formulation, this argument proceeds as follows. Any successful theory will have a high (if not infinite) number of empirically equivalent, yet incompatible, rivals. Since each of these rivals will share the empirical success of our preferred theory, we cannot be justified in