Quantum Theory and the Flight from Realism: Philosophical Responses to Quantum Mechanics

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The ambition of this book is a noble one: to provide a counter to the assumption, taken for granted made by many postmodernists, that quantum mechanics lends support to the view that scientific realism is nothing more than an outmoded fad. It is especially gratifying that this book comes from a literary theorist, author of a well-respected book on Derrida (Norris, 1987), who, by his own admission, has "previously published several books on literary theory that might be construed ... as going along with the emergent trend towards anti-realism and cultural relativism in various quarters of 'advanced' theoretical debate" (Introduction, p. 1). One wishes, however, that Norris had taken more time to familiarize himself with issues that he writes about, and that he had taken more care in constructing his arguments. Although "there will be more joy in heaven over one sinner who repents than over ninety-nine righteous persons who need no repentance" (*Luke* 15: 7, RSV), we should not let jubilation blind us to the book's shortcomings.

Among these is a lack of clarity in its central notion, that of realism. Early on, Norris quotes with approval William Alston's characterization of the alethic conception of realism, which is the conception advocated by Norris; the alethic conception "implies that (almost always) what confers a truth-value on a statement is something independent of the cognitive-linguistic goings-on that issued in that statement, including any epistemic status of those goings-on" (p. 41). As the book progresses, however, additional conditions on what is to count as a realist interpretation of quantum mechanics emerge. Realism apparently becomes synonymous with "causal-explanatory" theories, and in one passage, Norris goes so far as to suggest that realism entails a commitment to synthetic a priori knowledge of the physical world:

> Bell's calculations and those applied in interpreting the Aspect results are themselves dependent—no less than EPR—on a range of distinctly "classical" assumptions, among them the existence of a physical object-domain which, however puzzling its details, permits such experiments to be carried out and conclusions to be drawn from them. Nor are these assumptions so trivial or self-evident as to count for nothing either way as regards the debate between realist and instrumentalist QM theories. For they concern the basic realist contention—basic, that is, to the entire development of modern science from Galileo to Einstein and beyond—that the world exhibits various physical properties some of which are a matter of empirical observation, whereas others (like the conservation laws) are treated as synthetic a priori, and others again turn out to have the character of necessary (*i.e.* mathematical and logical) constants. (p. 65)

Fortunately, Norris does not provide an argument for his contention that regarding conservation laws as synthetic propositions known a priori is basic to scientific realism; such an argument, if successful, would render scientific realism a questionable position at best.

Norris also muddies the waters by treating various anti-realisms as if they were interchangeable. Norris' chief opponent is Niels Bohr's contention that quantum phenomena require a renunciation of causal space-time descriptions and calls instead for descriptions in terms of incompatible but complementary concepts. On the way, however, he has something to say about Quine's ontological relativism, Dummett's semantic anti-realism, Putnam's internal realism, Nelson Goodman's "worldmaking", and van Fraassen's constructive empiricism—all of which he regards as inspired by the instrumentalist construal of quantum mechanics. Unfortunately, Norris tends to conflate these disparate anti-realist views; one gets the impression that Norris feels that an argument that is effective against one brand of anti-realism will tar them all. Van Fraassen is particularly ill-served by this approach, as can be seen in the following passage:

> it may very well be the case that by far the greater part of our presently accredited "knowledge" will eventually prove either false, inadequate, or restricted in its range of application. But this argument has absolutely no bearing—*pace* van Fraassen—on the issue of whether there exist objective truths about objects, events, or real-world states of affairs that determine the truth-value of our statements concerning them, quite apart from our present (maybe limited) sources of evidence or means of verification. (p. 52)

This would be well and good, if van Fraassen's argument against scientific realism were an argument from the fallibility of human knowledge to the nonexistence of objective truths about the world. But van Fraassen neither denies that an objective world exists nor that statements about it are rendered determinately true or false by it. He contends, rather, that it is the path of epistemic wisdom to refrain from assenting to the truth of our best scientific theories, bestowing that assent instead on the weaker claim that they are empirically adequate. This is a position that deserves serious discussion; it finds none in this book.

Another weakness of the book is that Norris takes it for granted that Bell's theorem shows that the EPR-type experiments "must transpire in a space-time framework that permits violations of special relativity, or which allows for superluminal (faster-than-light) interaction between particles of any distance from each other" (p. 8). Although something like this is often said in popularizations, to phrase the issue this way entails ignoring a consideration that is essential to any philosophical treatment of quantum-mechanical nonlocality. Within the framework of quantum mechanics, a distinction is made between interactions modeled by terms in the Hamiltonian, and the probabilistic dependence exhibited by systems in an entangled state. Moreover, there seems to be a physical basis for this distinction, as a nonlocal interaction requires a preferred relation of distant simultaneity and furthermore, could be used for superluminal signaling, while the Bell-inequality violating dependence exhibited by entangled systems even in the absence of nonlocal interaction terms does not pick out a preferred simultaneity relation and cannot be exploited for superluminal signaling. Such dependence has no counterpart in classical theory, and it is not altogether clear that such dependence is incompatible with the structure of Einstein–Minkowski space-time. This distinction, often couched in terms of a distinction between "Locality" (Jarrett, 1984) or "Parameter Independence" (Shimony, 1986), on the one hand, and "Completeness" (Jarrett) or "Outcome Independence" (Shimony) on the other, has played a central role in philosophical discussions of quantum-mechanical nonlocality. In presenting his gloss on Bell's theorem in the way that he does, Norris implicitly assumes the distinction to be a spurious distinction, and leaves himself no room to discuss the issue of whether some forms of dependence between space-like separated events might be compatible with relativity (and if not, why not).

Perhaps the greatest weakness of this book is the fact that, in spite of its subtitle, which suggests a survey of philosophical responses to quantum mechanics, the book addresses only a very limited range of interpretational programs. With the exception of the many-worlds interpretation, represented in this book by David Deutsch (1997), no realist program is mentioned except Bohm's. No mention is made of theories that take collapse of the state vector to be a real physical process, and, though van Fraassen's modal interpretation is briefly mentioned (pp. 29–30), we are not told what it is, nor is there discussion of other modal interpretations. It is true that, if one wishes to argue for the possibility of a realist theory that accommodates quantum phenomena, one example suffices to demonstrate this possibility. Bohm's theory does, indeed, provide a useful counterexample to Bohr's claim of the *necessity* of renouncing a causal space-time description, just as it provided Bell (1964, 1966) with a useful counterexample to proofs purporting to establish the impossibility of a hidden-variables theory. Norris' decision to focus on the Bohm theory, however, gives the misleading impression that the issue of interpretation of quantum mechanics reduces to a dilemma: Bohm or Bohr. This is unfortunate, because a realist attitude towards Bohm's theory requires one to take an instrumentalist attitude towards special relativity. If Bohm's theory is true, then physical space-time does *not* have the structure of Einstein–Minkowski space-time; it possesses a preferred relation of distant simultaneity. Nevertheless, Bohm's theory has it that everything observable occurs just *as if* space-time had the structure that special relativity says it has, as the limitations imposed by the uncertainty relations on our knowledge of the precise trajectories of individual particles prevents us from ascertaining *which* space-like separated events are really simultaneous. It seems that Norris takes just such an instrumentalist attitude towards special relativity, as in several places in this book he expresses the conviction that the violation of relativity exhibited by the Bohm theory is acceptable as long as superluminal signaling is not permitted.

Presenting the choice of interpretations of quantum mechanics as a Bohr/Bohm dichotomy also tends to obscure the fact that, although Bohm's view differs from the Copenhagen interpretation, there is also a deep affinity between the two views. Norris' presentation could lead the unwary reader to the conclusion that, on the Bohm theory, particles possess definite values for *all* physical quantities at all times. This is not the case; although, on the Bohm theory, particles have definite positions at all times, other quantities—such as spin-values—are not intrinsic properties of particles but emerge only in the context of a particular experimental set-up (see Bohm & Hiley 1993, pp. 106–113, 147–151), in accord with Bohr's insistence on "the necessity of considering the *whole* experimental arrangement, the specification of which is imperative for any well-defined application of the quantum mechanical formalism" (Bohr, 1949, p. 230). A reader whose introduction to the philosophy of quantum mechanics was through Norris' book would be astonished to find Bohm and Hiley saying,

> The context dependence of measurements is a further indication of how our interpretation does not imply a simple return to the basic principles of classical physics. It also embodies, in a certain sense, Bohr's notion of the indivisibility of the combined system of observing apparatus and observed object. Indeed it may be said that our approach provides a kind of intuitive understanding of what Bohr was saying. (Bohm & Hiley, 1993, p. 122)

At first glance, *Quantum Theory and the Flight from Realism* gives an appearance of great erudition. Norris cites a wide literature, and adopts a persuasively authoritative tone in discussing it. It becomes clear on a close reading, however, that Norris' encounters with his texts, even those that are central to his book, have been cursory at best. For example, the celebrated EPR paper (Einstein *et al.*, 1935) plays a central role in Norris's book (as well it should), yet Norris is unclear both about the nature of the thought-experiment discussed by EPR and about the conclusion argued for in the paper. EPR discuss a pair of systems prepared in a simultaneous eigenstate of the sum of their momenta ($P_1 + P_2$) and the difference of their positions ($Q_1 - Q_2$). This entails that, if one performs a position measurement on one system, the position of the other can be inferred; alternatively, if a momentum measurement is performed instead on the first system, the momentum of the other can be inferred. The example, often used in discussions of the EPR argument, of a pair of spin-$\frac{1}{2}$ particles prepared in the singlet state, was introduced by Bohm (1951, p. 614). Norris repeatedly attributes the Bohm example to EPR (pp. 19, 20, 64). Norris is also under the impression that EPR's conclusion is that one can simultaneously ascertain *both* the position and momentum of both systems, by performing one measurement on each system (pp. 11, 64), despite EPR's assertion that "one would not arrive at our conclusion [that quantum-mechanical description is incomplete] if one insisted that two or more physical quantities can be regarded as simultaneous elements of reality *only when they can be simultaneously measured or predicted*" (EPR, 1935, p. 780).

Similarly, although James T. Cushing's book, *Quantum Mechanics: Historical Contingency and the Copenhagen Hegemony*, looms large in Norris' discussion, Norris counts Cushing as a fellow realist (p. 87) and seems not to have noticed that, according to Cushing, the Bohm theory poses a "dilemma for the realist" (Cushing, 1998, p. 348) and is used by Cushing as part of an argument *against* scientific realism (Cushing, 1994, pp. 204–206).

It may be that some postmodernist will read this book and as a result hesitate before enlisting quantum mechanics in the cause of a favored version of antirealism. If so, then the book will have done some good. But philosophers and physicists interested in the foundations of quantum mechanics will find little of value in the book and much that is simply erroneous, despite Norris's expressed intention to "clarify these issues for the benefit of philosophers with an interest in theoretical physics and for physicists willing to consider philosophical questions that are often ignored or declared off-bounds in standard treatments of the topic" (p. 5).

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