The Quantum Mechanics of Minds and Worlds, by Jeffrey A. Barrett. Oxford: Oxford University Press, 1999. Pp. xv + 267. H/b ??.

There is an important question in physics and philosophy which can be traced all the way back to Einstein; it was never really laid to rest; in recent years it has become if anything much more pressing. The question is this: does pure quantum mechanics (without any state reduction or hidden variables) describe any actual events? In particular, does it describe ordinary, actual, observable events? The orthodox response was always yes to the first question, so long as we are talking of the microscopic world; and no to the second, so long as we are talking of *observed* experimental events; for on observation, on the orthodox interpretation, the wave-packet collapses, and selects out one or another of the possible experimental outcomes. This was more than enough of a correspondence between formalism and experiment to be able to make predictions and tests. For physics it was business as usual. There remained only the problem of explaining how 'observation' could have such extraordinary effects—the *problem of measurement*.

The problem was supposed to be a philosophical one. In philosophy it festered. It was refreshing to learn, much later in the history of the subject, that the problem could be solved by changing the equations instead. In fact we have an embarrassment of solutions: the deterministic hidden-variable theory, due to de Broglie and Bohm, and a spectrum of stochastic state-reduction theories, for example the one due to Ghirardi, Rimini, and Weber. All these theories represent actual events uniformly, microscopic and macroscopic, observed and unobserved, as making up a single world (as a single space-time whole). There is no special role for 'observation'. This is very much the sort of solution which most of us desire. Alas there is a difficulty: it does not turn out to be possible to keep intact the Lorentz symmetries as well; the new equations cannot be made properly relativistic.

Physicists like their symmetries; none of these deviant theories has ever been taken seriously by the mainstream. And, beginning with Everett, a number of methods have been found for talking about definite events within quantum mechanics *without* any additional mechanisms. If there is any state reduction involved, so goes the jargon, it is 'effective', and not part of the fundamental equations. At the latter, deeper, level relativity is preserved. Or so it is claimed.

Why should all this matter to philosophy? It shouldn't, or not much, if the answer to our question is negative, and hidden variables and state reduction or whatever do have to be introduced into the fundamental equations. Most philosophers of physics do say that the answer to our question is negative, and recommend instead one or other of the non-covariant theories (no matter the unlikelihood that physicists will ever listen to them). It is very different if the answer to our question is positive, and one can extract real events from the unadulterated formalism after all. If so, it is likely to have a very big impact on philosophy. The implications hardly bear thinking about if any-

thing like Everett's original ideas are involved, for they imply a form of modal realism: all actual events can get to be real, but only so long as all possible ones are real as well. Welcome to 'many-worlds'.

This line of reasoning is so unsettling that few philosophers have been able to keep their cool when they consider it. Barrett is an exception: *The Quantum Mechanics of Minds and Worlds* is the first wide-ranging and open-minded survey of the field. And on the whole Barett is to be congratulated: his writing is solid, accessible, and organized; on many topics he has something new and perceptive to say; and for the most part he presents the various views he considers quite faithfully. The book is also self-contained, beginning as it does with a clear and simple introduction to quantum mechanics and to the problem of measurement. Barrett is particularly good at delving into some of the obscurities of Everett's original writings; he does a good job of developing some of David Albert's ideas on the subject; and he is good on the question of whether a given approach introduces ideas or mechanisms which, if taken seriously, could be used to *do away* with all of the worlds, save one; he keeps his head when it comes to the point, if there is one, to all of the additional worlds. On all of this he is to be congratulated.

He is less good on other questions. I say the book is open-minded; it verges on the credulous. As if modal realism were not bad enough, Barrett earnestly considers the various mentalistic approaches as well—approaches which break comprehensively with the principle that the mental supervenes on the physical. He is open to the most radical forms of dualism imaginable. Welcome to 'many minds'. What if none of the things that we ordinarily take to be physical are really physical? No matter. What if the physical turns out to be something that we can never see or imagine at all? Never mind. Barrett has no fear.

He pays a price for it. Open as he is to all-comers when it comes to mentality, he sees mysteries everywhere. One consequence is that he does not give the physicists their due when it comes to the 'preferred basis' problem. When one introduces hidden-variables or state reduction, certain kinds of physical quantities (the 'preferred' ones) get to be value-definite—among them the observed quantities (quantities like position, which are well-localized in space). Eschewing hidden-variables or state-reduction, still we have to pick out preferred quantities. How? And precisely which ones? This is the preferred basis problem. The tightrope that must be walked (if we are to make sense of quantum mechanics without hidden-variables or state reduction) is to show first, how certain sorts of quantities get to be preferred (the preferred basis problem), and second, how particular values get to be assigned to such quantities (the problem that going over to many worlds or to many minds is supposed to solve). The first is the problem that has been attacked by the physicists. They have made systematic progress with it: it is exactly the business of decoherence theory to extract 'effective' equations of motion, concerning those dynamical variables for which value-assignments can be made

in a way which is stable over time, and without 'interference effects' linking their different values. And indeed it turns out that the variables arrived at in this way are well-localized in space.

Decoherence theory does not solve the preferred-basis problem on its own, but there are candidate solutions in the literature which depend on it heavily. Barrett hardly gives them a look in, because he thinks there is a blanket objection to any approach which relies on decoherence. For according to Barrett (§8.6), decoherence may pick out the *wrong* basis for consciousness; he supposes that it is entirely mysterious what has to be definite, in order for consciousness (our sort of consciousness) to be definite; this is a reason, for him, to appeal directly to mentality *sui generis* to solve the preferred basis problem. The argument, if sound, would apply equally to the de Broglie-Bohm theory and to the various state-reduction theories, for they too may be picking out the wrong basis; even *classical* physics is now hostage to the problem of mentality.

Barrett has a related worry about decoherence. He thinks that a small change in the environment will make for a difference in the decoherence basis. It is a pity he never considers any quantitative estimates; if he did he would find that ordinary differences in our ordinary environment make for differences in the basis that show up many, many orders of magnitude smaller, and more fleeting, than anything of relevance to molecular processes (let alone to anything directly observable). Here as before Barrett makes an assumption that he never critically examines. Granted, it cannot be an approximate matter as to which basis is involved (to be settled FAPP, 'for all practical purposes'), if it is a question of the fundamental dynamics; but in decoherence theory it is explicit all along that the state-reduction is only 'effective'. Barrett is perhaps convinced that the basis problem cannot be answered FAPP, for the basis determines the worlds or whatever that are actually to be realized. And once put in this way, the objection seems very strong: how can the question of what exists be settled by approximations? Or are all the bases supposed to exist?

But there is an extensive literature on this question. Barrett does consider a part of it, namely Gell-Mann and Hartle's suggestion. They incline to the latter view, that all bases exist; the one observed, however, will depend on who or what does the observing. And according to them, the physical makeup of the observer is to be settled by evolutionary considerations. It will be 'adapted' to one basis rather than another—and, say Gell-Mann and Hartle, a decohering basis will be advantageous. Now, quite what 'adaptation' can mean in this context is unclear. It is not obvious that there can be any sort of selective pressure. Barrett is right to view this strategy with suspicion. But the objections that he comes up with (p. 241–242) are disappointing; they are mostly to do with free will; they apply equally to ordinary evolutionary biology. The only complaint he makes that is specific to quantum mechanics is that decoherence, in Gell-Mann and Hartle's sense, does not explain the

existence of records. But existence is not what needs to be explained, on Gell-Mann and Hartle's view! Rather, it is why records are to be found in decohering histories. The answer could not be clearer: it is a theorem that sequences of projections which encode records decohere, as Halliwell and others have proved (*Stochastic Evolution of Quantum States in Open Systems and in Measurement Processes*, L. Diósi and B. Lukács, Singapore: World Scientific, 1994, p. 54–68).

Turn now to that other great bugbear of the Everett interpretation, the interpretation of probability. The fundamental difficulty, if one really tries to make do with pure quantum mechanics, is that there is no univocal criterion of identity over time, not of persons and not of objects; or none that is *locally* coded into the formalism (I shall come back to this qualification in a moment). Just this is what Barrett, and practically every other philosopher writing on this subject, is sure is needed; for how else are we to make sense of talk of what *we* will see? (We, the very same?) Or of what *the apparatus,* the very same, will record? Barrett is insistent on this point; and he is clear too on the consequences of introducing new parameters to say which instrument or person is identical to which over time; for with such extra parameters we will be able to solve the problem of measurement *without* introducing any extra worlds or minds. (Of course, we are then likely to have arrived at a hidden-variable or state-reduction theory in the usual sense, with the usual problem with relativity.)

Ultimately Barrett accepts the logic of this argument, for he can see no other way of making sense of probability. He does in the end introduce new parameters, and indeed he does appeal to them to get rid of all the additional worlds and minds. But there are alternatives he never considers. For example, if one works throughout with global histories, as do Gell-Mann and Hartle, without writing down any local dynamics for the ways that they diverge, then there is no problem in making sense of identity over time, no more here than in the worlds of Lewis's modal realism. Nor, if he will insist on a local dynamics, does he challenge his basic assumption: whether identity with its traditional formal properties might not be so fundamental after all; whether in fact, as Parfit has persuasively argued, identity is not what matters in survival, but rather that something else does. Perhaps quantum probabilities concern this something else instead. Chalmers and others have made this point in the literature (*The Conscious Mind*, Oxford: Oxford University Press, 1996, p. 352–3); just here, where the need for genuinely philosophical thinking could not be plainer, Barrett has nothing to say.

The book is a curate's egg, good in parts. Here is the part at the end. It is Barrett's tentatively favoured solution, the one also developed by Euan Squires (*Conscious Mind in the Physical World*, New York: Adam Hilger, 1990; this book too goes unmentioned). It is a one-world dualistic theory, with the usual double-standard of all the mentalistic approaches: whilst the physics is precisely described in mathematical terms, although it concerns nothing that

we ever actually observe, the mental—in the Squires-Barrett case a single *collective* mentality—is imprecisely described in non-mathematical terms, despite the fact that it contains everything under empirical control. It is Kant inside out.

If we were to have a precise dynamics for this collective mentality, using terms (as we must) that are ordinarily thought of as physical, only on a point of terminology would the theory differ from a state-reduction or hidden-variable theory. The problem of how to actually carry this out, and of how to resolve the potential conflict with relativity, will emerge anew. But it may be that only in this purely nominal sense can one solve the problem of measurement without modifying the equations, and without modal realism. The choice, between accepting Everett's proposal and giving up relativity, will be all the more clear-cut if it is.

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