

## Veiled reality – Bernard d’Espagnat

This long book (450 pages) is concerned with conceptual issues around measurement in quantum mechanics. The author’s stated aim is philosophical, but as he states at the outset: “whoever tries to form an idea of the world... has to take the findings of quantum physics most seriously into account.” (pxvi). His method is to support his discussion with detailed analysis of quantum mechanical results. The book is “intended to be easily readable by first-year graduate students in physics and for the main part understandable by students in epistemology having a smattering of physics.” (pxix)

Chapter 1 presents a very adequate philosophical background to the epistemological issues, with particular emphasis on Hume, Berkeley and Kant. Following are detailed discussions firstly of the formalism of quantum mechanics, (using the Dirac notation), and later ever more discursive accounts of the particular quantum theoretical features of interest to epistemology.

Central issues are the nature of quantum states of individual and ensemble systems, completeness, hidden variable interpretations, EPR and the Bell inequalities – the author distinguishes three distinct Bell inequalities. The chapter headings reflect the breadth of the discussion: following the initial chapter “Philosophy and physics” we have chapter 2 “Matter Waves, Superposition, Linearity”, 3 “The Rules of Quantum Mechanics”, 4 “Comments”, 5 “Complements”, 6 “The Density Matrix Formalism” 7 “Proper and Improper Mixtures”, 8 “Quantum Mechanics and the Nonseparability problem”, 9 “The EPR Problem and Nonseparability”, 10 “On Measurement”, 11 “Variations on a Bohrian Theme”, 12 “Quantum Mechanics as a Universal Theory, Classical Appearances in a Quantum World”, 13 “Ontological Approaches (Hidden Variables and All That).

The final chapters, (14-16) constitute according to the author, “the essential part of the book” (pxviii). Here he draws philosophical conclusions from the preceding quantum analysis presenting his own views about the world. Conventional realism is rejected, albeit reluctantly, as incompatible with quantum theory and so he opts instead for kind of hybrid with idealism. “Veiled realism” is the view that there exists an independent reality whose structure is not known to us, indeed which may be “scientifically unknowable” (p367). So reality is the subject of physics but can only be described “allegorically” by physical theories (p355). The book by now is discursive almost to the point of being rambling – there are rebuttals to other interpretations and comparisons with other views and long asides on “Difficulties” countered with “Remarks”. Chapter 15 expounds the notion of “empirical reality” finding it close to Poincaré’s structural realism, and Bosnack’s empirical realism is another close relation. The last chapter seeks to extend the reach of the interpretation of quantum mechanics to other wider issues in philosophy and philosophy of science, ending with a discussion of Spinoza.

The book presents a thorough treatment which in the earlier sections is always informed by details from quantum mechanics. Comprehensive further reading is provided by a detailed bibliography at the end of every chapter.