

Dear Hugh,

Here is the review  
of the reprint collection  
that I showed you.

We very much  
enjoyed meeting you  
and talking with you.

Bryce DeWitt

the other physicists at my present institution. It seems safe to say that the new breed of physicist has not thought much about philosophy, and feels that such questions of interpretation are irrelevant to his research. This insouciance is present to such an extent that certain misconceptions are commonly held, which I shall return to later. I would be among the last to urge scientists to read about interpretation of quantum mechanics as an aid to research. For those students, scientists, philosophers, and scientifically learned nonscientists who are in the process of puzzling about the connection between quantum mechanics and reality, I recommend the present book. If one wanted to read one and only one book on this subject—not at all a bad idea—this is a good book to read. We proceed to a brief discussion of the many-worlds interpretation.

In quantum mechanics a system is described by a vector (wave function) in Hilbert space, the time development of the system described by the time dependence of the vector. The vector in Hilbert space generally is a probability distribution for an infinite number of classical states of the system. Speaking simply, then, quantum mechanics can provide only a probability for a given occurrence, and not a deterministic prediction of a fixed outcome. Thus quantum mechanics is not a physical theory by the criteria physicists used to insist on. Einstein, for example, could not reconcile himself to it. At the opposite extreme, the prevalent view today is that a calculation of probabilities is all we ask of science.

One's first efforts to reconcile oneself to quantum mechanics often begin with

unpleasantness, the Copenhagen view and the many-worlds view.

The first view essentially is that quantum mechanics is wrong. The equations are to be modified in some way so that the wave function always is peaked about a single classical state. Some mechanism "collapses" the wave function to a function peaked at a single classical state whenever it would "split" into a function peaked at a number of "classical" alternatives. There is a distinction, obscure to me, made between looking for a specific modification of the equations and merely postulating the "collapse." It should be emphasized that in any case such modification of quantum mechanics is real and would affect the results of experiments and calculations, although in a negligibly small way for realistic experiments.

I was one of those who embraced quantum mechanics bra, ket, and matrix. I believe there is a wave function of the universe satisfying some linear evolution equation, so I am in the many-worlds camp. The wave function describes a continuous infinity of classical states developing in time, "splitting" and "recombining"; God runs his finger along the function picking out our actual world. Hugh Everett III, in the second paper in the collection, has formalized such an interpretation of quantum mechanics. There is a continuous infinity of classical worlds coexistent at any time; we are in one nonexceptional member of this set. Although, as authors in the collection say, this seems "bizarre" and is "startling," in fact, it is the natural interpretation one is inescapably led to if one takes the view that quantum mechanics is the

## Philosophical Problems

**The Many-Worlds Interpretation of Quantum Mechanics. A Fundamental Exposition.** BRYCE S. DEWITT and NEILL GRAHAM, Eds. Princeton University Press, Princeton, N.J., 1973. viii, 253 pp. Cloth, \$12.50; paper, \$5.50. Princeton Series in Physics.

This book is a collection of papers concerned with the philosophy of quantum mechanics, and in particular the

tum mechanics. There are seven articles in the collection, the first by far the longest. I recommend to readers that they begin with articles 4, 3, and 2, in that order; they are not very lengthy and contain the heart of the material.

Philosophies of quantum mechanics are very personal matters; I approach this question as one who received a traditional physics education during the '50's and has been a practicing mathematical physicist ever since. By chance my personal view of quantum mechanics is close to that propounded in this book, here called the many-worlds interpretation. Preliminary to writing this review I recalled in my mind my past thoughts on the philosophy of quantum mechanics, and numerous past discussions with other physicists. I also undertook a casual survey of many of

the assumption that the wave function (vector) of the universe might be so peaked about a single classical state that the classical universe we live in could have its motion deterministically predicted by the wave function. Many physicists suffer this harmless delusion. As is discussed in the fourth article of the collection, the *Gedanken* experiment with Schrödinger's cat convinces us that this is impossible. Classical events, such as whether the cat lives or dies, or whether you buy this book or not, can be affected by quantum-mechanical-scale events. In the wave function of the universe—if one accepts quantum mechanics to this extent—there is a nonzero probability that you buy the book and a nonzero probability that you do not. There are two common philosophies to reconcile one with this

ultimate formulation of nature's laws, the universe is a vector in Hilbert space.

To those who immediately reject the many-worlds view in favor of the Copenhagen view, one should recall that the Copenhagen view has its own difficulties. All the processes that make up a classical object are described by quantum mechanics, but not the object itself. There is no natural scale at which objects become classical: When does the wave function collapse? How can one modify quantum mechanics to correctly collapse? Since the many-worlds view requires quantum mechanics and nothing more—no “collapse,” no “hidden variables,” no “classical observers”—it is the most conservative interpretation. The fact that most books on quantum mechanics do not present this view makes this book a desirable addition to

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the physics literature. Certainly in teaching quantum mechanics a number of articles in this collection are good references to give students desirous of some outside reading material on philosophy.

Having been entirely positive up to this point I would offer some criticism of the format of the present collection. There is no advice to the reader on how he might best read the seven articles collected. Certainly the first article presented is, by its length, the least palatable. I would have preferred an introduction and a different arrangement of the articles. In fact a textbook on the subject of the collection might be in order.

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