BOOK REVIEW

Mathematical foundations of quantum mechanics, Mathematical Physics Monograph Series, By G. W. Mackey, W. A. Benjamin, New York, 1963. x+137 pp.

This book is a revised version of lecture notes written by the author for a course at Harvard. The aim is stated in the preface: "to explain quantum mechanics and certain parts of classical physics from a point of view more congenial to pure mathematicians than that commonly encountered in physics texts. Accordingly, the emphasis is on generality and careful formulation rather than on the technique of solving problems. On the other hand, no attempt is made at complete rigor. In places a complete treatment would have taken us too far afield and in others nontrivial mathematical problems remain to be solved. There are also places where completeness simply seemed more troublesome than illuminating. In sum, we have tried to present an outline of a completely rigorous treatment which can be filled in by any competent mathematician modulo the solution of certain more or less well-defined mathematical problems."

Several virtues of the book are

1. An emphasis on coordinate-independent formulations.
2. Insistence on clear statement of assumptions at all stages of the game, making it clear which are based on experiment, which are a priori, and which are technical mathematical assumptions.
3. A clear distinction between analogy and isomorphism.
4. The excellent little historical discussions which appear at various points throughout.

Chapter 1 begins with an outline of Newtonian mechanics, continues with an exposition of C_∞ manifolds, and then treats Hamiltonian systems in this context. There is a discussion of linear systems, in which an intrinsic complex Hilbert space structure can be introduced so that the Hamiltonian is half of the square of the norm and the dynamical group is a one-parameter unitary group. This is then (sketchily) extended to infinite-dimensional linear systems. Finally, there is a brief treatment of statistical mechanics and thermodynamics, including an information-theoretic "justification" (discovered independently by Mackey) of the use of the Gibbs ensemble.

Chapter 2, on quantum theory, begins with a bit of history. Then there is given a detailed account of some of the author's ideas on the logical and statistical basis of quantum theory. This is perhaps the