

dimensional rotation group  $SO(4)$  rather than the geometrical symmetry group  $SO(3)$ . In 1964 we again see references to these early papers appearing, this time in connection with the group structure of all levels of the atom, not just those for fixed energy, including even the continuum. The new time-dependent symmetry operators together with the previous time-independent symmetry operators generate the conformal group whose single irreducible representation now describes all levels and degeneracies of the atom. Such generalized symmetry groups have been called "dynamical groups."

Englefield's book is an introduction to these recent developments on which there exists considerable literature and activity in view of similar models in particle and high-energy physics. The author addresses himself to an audience with a knowledge of the quantum theory of angular momentum only, but not necessarily more group theory beyond this. After a brief initial review of Lie algebras and the theory of angular momentum he develops explicitly some representations of the simplest noncompact groups like  $O(2,1)$  or  $SU(1,1)$  and  $O(3,2)$ . These are the prototypes and building blocks of other noncompact groups. The calculations are explicit. One feels, however, that more knowledge of modern group-rep-

resentation theory would make the description of the subject matter more compact and elegant. In fact the representation theory of noncompact groups enters more and more into many areas of theoretical physics. This is not surprising, because the theory of the special functions of mathematical physics can now be based geometrically on the representations of noncompact groups. This is a very beautiful branch of mathematical physics and will soon become part of the general education of theoretical physicists. For these reasons the potential utility of the book goes beyond the particular Coulomb problem.

The last part of the book is devoted to the actual Coulomb levels and to the calculation of transition probabilities and form factors. Since the book was written more progress has been achieved in the relativistic version of the problem, where actually new results have been obtained by group theoretical methods, which at the same time facilitate the rather formidable relativistic calculations in processes such as photoeffects. Perhaps these results will find their way in a future sequel of a book like the one under review.

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## The Politics of American Science: 1939 to the Present

J. L. Penick, Jr., C. W. Pursell, Jr., M. B. Sherwood, D. C. Swain, eds.  
453 pp. The MIT Press, Cambridge, Mass., 1972. \$4.95

*The Politics of American Science: 1929 to the Present* has now been issued in a revised edition. As a contribution to the history of science in America, it is helpful and useful, for it

illuminates certain aspects of the growth and development of the post-1939 federal scientific establishment, and, as such, carries the story beyond the terminus of historian A. Hunter Dupree's well known *Science in the Federal Government* (1957). Although *The Politics of American Science* is a collection of public documents, not a

formal history like Dupree's book, it can be considered a companion effort. Given the perils of putting the immediate past into proper perspective, perhaps *The Politics of American Science* has more value at this time than would a formal historical narrative and analysis. And, in a field such as the history of science in America in which the number of historical accounts is pitifully small, any contribution that has been reasonably well executed is obviously most welcome.

The editors' emphasis is on the growth of federal scientific agencies and other institutions and groups relevant to their recent history, upon certain patterns of development, change, and decay, which, although they are undoubtedly familiar to the readers of *PHYSICS TODAY* in a general sense, are nonetheless valuable because of the specificity of the attitudes and phenomena contained in the documents themselves. The editors have provided succinct introductions to the documents; the documents themselves are public records. They emphasize what the actors in the drama of the growth of the federal scientific research establishment wanted to insert in the public record. This does not mean that the documents are completely self-serving, or that they are only meaningless rhetoric. There is, for example, much valuable information in many of the documents. And the documents themselves portray the values of two generations of politicians, scientists, and administrators who helped build the federal scientific establishment and articulated its rationale. Now that that establishment has come under serious attack, and now that it is being dismantled, piece by piece, it is essential for both historians and scientists to understand as much as possible about it.

Readers familiar with the original edition will wish to know how the revised edition differs from the first. Onto the older edition, which had sections on preparedness and war, postwar planning for science, the middle years of the 1950's before Sputnik, and the years of response (1957-65), the editors have grafted two new sections. One is a historical overview based on public documents; the other incorporates documents on the questioning of military research and the search for new priorities. Except for minor editorial changes made for the sake of consistency, the sections in the first edition are the same in the revised edition.

The timely publication of the revised edition will hopefully instruct both historians and scientists about the topic of obvious professional relevance and should encourage historians and social scientists, the expert editors included, to pursue further research and inter-



pretation in a new area the importance of which this volume has convincingly demonstrated.

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## Quantum Mechanics

Donald Rapp  
638 pp. Holt, Rinehart and Winston, New York, 1972

Donald Rapp, of the University of Texas at Dallas, has considerable experience in the study of atomic and molecular collisions, and these interests are clearly reflected in his book on quantum mechanics. The book may be most valuable to chemistry students since it provides an introduction to the theory of collisions as well as discussing the properties of stationary states in simple atoms and molecules. Research into collision processes is being pursued vigorously in many chemistry departments, but most textbooks on theoretical chemistry give little attention to this topic. Physics students who are particularly interested in atomic physics may also find the book useful.

A major theme throughout the book is the comparison between time-dependent and time-independent quantum mechanics. The first four chapters are devoted to a mathematical treatment of wave packets that may severely test the perseverance of students who find mathematics difficult or tedious. In later chapters the time-dependent theory is developed into the semi-classical theory of heavy particle collisions, and this development provides one of the most valuable portions of the book.

The influence of Rapp's chemical background is evident in the chapters on exact solutions to one-dimensional problems. The traditional treatments of bound states in the square well and harmonic oscillator potential are supplemented with a solution for the Morse potential, and transmission probabilities are calculated for the Eckhart barrier as well as the more familiar rectangular barrier. These calculations are followed by a comprehensive presentation of the JWKB approximation, and an interesting comparison between exact and approximate methods is possible. In this section the concept of resonant scattering is introduced, but this topic is not developed in the later chapters on electronic and atomic collisions. By failing to follow up this concept, the author misses an opportunity to link some of the basic formal theory with an active research area.

Following a discussion of the exact solution of the three-dimensional

Schrödinger equation, through the separation of variables, Rapp discusses two further approximation techniques, namely perturbation theory and the variational method. The Rayleigh-Ritz variational method for bound states is described, followed by several applications to small atoms and diatomic molecules. The systems chosen for these examples have at most three electrons, and the special techniques, such as the Hartree-Fock and Thomas-Fermi methods, that have been developed for larger systems are not discussed.

Much of the concluding section of

the book is devoted to scattering theory. The description is in terms of phase shifts and scattering amplitudes. Many formal equations receive little or no attention—I could find no reference, for example, to any of the scattering matrices, or to unitarity or detailed balance. There is a brief discussion of the behavior of the phase shifts for elastic scattering at very low energy, but the conditions under which this analysis is applicable are incorrectly stated. The major aim of the author appears to be to demonstrate how a few important methods are actually applied. The excitation and ionization

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