Protein Chemistry falls into the latter class. The present volume contains only six articles, which occupy more than 550 pages. For a comprehensive view of the whole field of protein chemistry, it is necessary to peruse the entire series of volumes. Nevertheless, the current volume is required reading for all who are interested in protein chemistry. As in the earlier volumes, the articles are well written, and the editing has been done with great care.

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The Proceedings of the Third International Conference on Electron Microscopy, London, 1954. V. E. Cosslett, chair., editorial committee; R. Ross, General Ed. Royal Microscopical Society, London, 1956. xv + 705 pp. Illus. + plates. $15.

This impressive volume represents the text of papers contributed to, and the discussion offered at, the third international Conference on Electron Microscopy, the previous meetings being those at Delft, in 1948, and Paris, in 1950. The book is a rich source of information on many aspects of electron microscopy and related fields of endeavor; it deserves a place on the shelf of every professional electron microscopist.

The contributions, 158 in all, including three introductory survey papers, although of rather unequal quality, contain many papers of high quality. A prime advantage of a volume such as this is that it brings together, in conveniently accessible and brief form, a wealth of information on topics such as electron optics, specimen preparation, microtomy, the action of electrons on the specimen, and the attainment of high resolution, which in this era of very rapid expansion of the field is only to be gleaned otherwise from a rapidly increasing and formidably diverse list of publications and, moreover, is not to be found in the textbooks. For those involved in pursuits less orthodox than transmission microscopy, there are the sections on ion microscopes, x-ray microscopes, and emission and reflection electron microscopy. In addition, there are sections devoted to applications—for example, those concerned with biological fine structure, metallurgy, and industrial and chemical applications.

The format of the volume and the quality of the reproductions are excellent. The classification of the contributions under a wide variety of headings assists the reader in locating information of interest, but it is to be regretted that no author or subject index, however brief, was included.

A further cause for regret, and a more serious one, is the excessively long time interval between the meeting itself and the appearance of the *Proceedings*. Such a time lag is particularly undesirable if results presented to the conference will not become available to those interested until and unless they are published elsewhere in addition. The spectacularly rapid growth of the field of electron microscopy in recent years makes it more and more important that the proceedings of such conferences be published promptly, so that results of importance are circulated in as short a time as possible. The editorial committee and the Royal Microscopical Society are, in the present case, to be congratulated on carrying out a fine and very thorough job, even though they considerably overstepped their original aim of publication within 12 months of the conference. However, the need for more stringent measures is clearly indicated for future conferences of this character. In the present volume, the discussions following papers or groups of papers appear contribute but a small fraction of the useful information contained in the book, yet they must surely have demanded an inordinate amount of editorial time as well as entailing considerable delay in publication. Publication of such discussions could probably be eliminated without detracting too seriously from the value of such a volume. It must seriously be considered whether rapidity of publication of such proceedings is not more important than detailed reporting, especially of discussions which are often of a sporadic nature, uneven in quality, and of questionable bearing on the subject under discussion.

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Quantum Mechanics. H. A. Kramers. Translated by D. ter Haar. North-Holland, Amsterdam; Interscience, New York, 1957. xvi + 496 pp. $12.50. (pt. 1, 5 chapters, also published separately as *The Foundations of Quantum Theory,* xv + 228 pp. $6.50.)

"When I was asked whether I would be willing to prepare a translation of Kramers' monograph, and thus complete an English edition of all his published works, I agreed for several reasons, even if it meant the hazardous task of translating from one foreign language into another. The main reason was that I felt that this book still represents the best available exposition of quantum theory and that the English speaking world was the poorer for not having it readily available. Also, in this book, as much as in some of his papers, Kramers showed some delightfully elegant methods which might otherwise be lost to the physics world in general."

With these words the translator's preface to *Quantum Mechanics* starts. I would like to add at once that this admirable translation, of which the language in parts is smoother than that of the original, is a good book for the intelligent, self-taught, theoretical student who wants to get a thorough understanding of many of the principles of modern quantum theory, in particular if he plans to continue his studies later by more specialized books. Some students may consider it a drawback that there are no assigned problems and that the number of applications of the theory worked out in the text itself is relatively small. An instructor using Kramers' book as a textbook can, of course, provide his class with his own choice of problems picked from other textbooks. For the students, however, working out in detail some mathematical derivations which the book gives merely in the form of an outline may be an assignment more useful than some of the useless "exercises for the sake of an exercise" found in certain other introductory textbooks. By not burdening the student with such useless material, this book finds space for a thorough discussion of a number of important aspects of wave mechanics and of matrix mechanics which in many other textbooks are neglected.

The book is somewhat mathematical in character, although the author purposely avoids mathematical rigor (see the preface on page v !), but at no place are theoretical results compared with any illustrative experimental data. The book consists of two parts, of which the first is available as a separate book under the title *The Foundations of Quantum Theory.* Part I deals with nonrelativistic wave mechanics of electrons and does not discuss spin, Pauli's exclusion principle, or electromagnetic radiation. It may be sufficient as a textbook for an introductory course on wave mechanics. Since part II is available only together with part I, in a single volume, students who need quantum theory for their later work, or who may later want to find out at least for themselves about spin, exclusion principle, Bohr's quantum jumps, and photons, would do well to buy at once the complete *Quantum Mechanics,* containing both parts.

Part I starts out with a discussion of de Broglie waves and their superposition and the uncertainty relations. Among the further topics treated we note thorough discussions of eigenvalue problems; proper and improper eigenfunctions; the approximately classical motion of wave packets for interacting particles; the interpretation of the state vector; transformation theory; Dirac's bra-and-ket nota-

tion; time-dependent quantum operators; a particularly elegant discussion of spherical harmonics and the angular momentum; the Schrödinger theory of the hydrogen atom, including the eigenfunctions for the continuous spectrum for unbound electrons in a Coulomb field; perturbation theory of stationary states, also for higher-order approximations and for degenerate eigenvalues; variational methods for approximating energy levels and wave functions; a simple account of time-dependent perturbation calculus and the theories of scattering and transition probabilities; the quantum-mechanical adiabatic theorem for perturbations switched on slowly; and, finally, a brief introduction to the theory of the natural line width.

Topics which one might desire in an introduction of this kind but which are not discussed, or are insufficiently discussed, in Kramers' book are the distinction between pure-case and mixed-case assemblages and the impossibility of describing the latter by a single state vector; the subjective character of the state vector and its "reduction" after observation of the outcome of an interaction; Bohr's analysis of possible experiments for showing that wave-mechanical uncertainty relations do not show an incompleteness of the theory but describe experimental reality; the electron wave function in periodic potentials, Brillouin zones, and so forth; the application of the W.K.B. method for evaluating radial wave functions; virtual energy levels in a continuous spectrum; the phase-shift representation of scattering as an application of time-independent perturbation theory. Such fundamental principles as that the probability density of electrons is $\psi^*\psi$, and that $h\nu$ equals the total and not just the kinetic energy, are postulated without even an attempt at explanation.

Part II starts with Uhlenbeck and Goudsmit's theory of the electron spin and, through a classical and a semiclassical discussion of the spin and of the Thomas factor, then proceeds to the nonrelativistic, as well as the relativistic, theory of spinors, represented in a very elegant, clear, and concise form, which in turn leads to Dirac's equations in a manner far more heuristic and natural than Dirac's own axiomatic derivation, which is mentioned too. After the relativistic four-component wave functions for free electrons of given momentum, Kramers derives Pauli's theory of the spinning electron as an approximation to the rigorous theory for slow electrons and arrives at Breit's formula for the magnetic interaction between bound electrons. The Dirac theory of the hydrogen atom is concluded by a discussion of the wave functions of the continuous spectra for $|E| > m_0c^2$.

The next chapter deals with the exclusion principle and with "second quantization" as a formalism equivalent to describing the state vector by means of Slater determinants. Although the second-quantized wave function is introduced and its usefulness is shown, Fock's elegant theory of 1932, of second quantization in configuration space, is not presented in full. Instead, use is made of creation and annihilation operators and of a transformation from the configuration space to the occupation number representation of the state vector.

Next discussed are singlet and triplet states, exchange integrals, and the multiplet situations in the N-electron problem. Here the eigenvalues of the angular momentum are shown to follow algebraically from their commutation relations. Then, the spin functions in multiplet situations are treated, and the group-theoretical reduction of the space functions of various symmetry types is executed without the use of group theory by Kramers' elegant "symbolic method." The chapter is concluded by a discussion of Russell-Saunders coupling and by an introduction to the theory of homopolar chemical bonds.

Surprisingly *not* discussed in this part of the book are the wave-mechanical explanation of such features of atomic theory as the vector model, Hund's rules, and Stark effect, the periodic system of atoms, and the Thomas-Fermi statistical model. Clebsch-Gordan coefficients are not mentioned.

The last chapter exhibits the fundamentals of quantum electrodynamics; its study is seriously recommended to any student planning to read Heitler's famous *Theory of Radiation.* Kramers starts from the classical theory of radiation and shows how already before the development of quantum electrodynamics, by Heisenberg's interpretation of matrix elements of the "observable" electric polarization, it was possible to derive formulas for Einstein's transition probabilities B and A for absorption and for emission. Kramers also discusses the interaction of radiation with the "spin current." A brief account is given of multipole radiation, and the semiclassical treatment thus far given is justified by Bohr's correspondence principle and the W.K.B. method.

Kramers then discusses the quantization of the radiation field in a vacuum and the transverse nature of photons. The theory becomes particularly elegant where circularly, instead of linearly, polarized light waves are considered. Kramers' discussion of the interaction of photons with electrons is unique and forms the historical background to Schwinger's later relativistic theory of mass renormalization. In Kramers' treatment, the mass is always the experimental mass, and the field acting on an electron excludes the so-called "eigenfield" (proper field) of the electron. It is shown that in a secular approximation —neglecting periodic terms which have no effect over long-time intervals—the interacting fields then can be described by the canonical formalism of Dirac's radiation theory. The book is concluded by a few applications of quantum electrodynamics, absorption and emission of photons, natural line width, Rayleigh scattering, Smekal-Raman effect, Compton effect, semiclassical scattering theory, coherent scattering, and dispersion.

Few printing errors were found. An occasional error in the original has tacitly been corrected in the translation, some obscure statements of the original have been elucidated, and some newer literature references have been added. This is a fine translation of a remarkable book, which is recommended to every serious student of theoretical physics.

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Mitochondria and Other Cytoplasmic Inclusions. No. X. Symposia of the Society for Experimental Biology. Academic Press, New York, 1957. 198 pp. Illus. + plates. $9.50.

The tenth volume of the symposia series of the British Society for Experimental Biology, comprised of papers read at a symposium held at Oxford, September 1955, is highly satisfactory. It begins with J. R. Baker's almost devastating attack on the Golgi artefact and ends with Randall's interesting observations on the electron microscopy of *Spirostemum.* All of the 11 papers in the symposium deal with mitochondria and other cytoplasmic inclusions. Two chapters in defense of the Golgi apparatus help to complete the book.

Particularly clear illustrations of living cells are found in the analysis of phase-contrast and interference microscopy by Barer and Joseph. These authors lay stress on rotation phenomena of mitochondria around the nucleus and are at pains to reconcile their data with those of Chèvremont and Frederic, but, even with their biochemical findings, there is much to be desired. Excellent photomicrographs, with studies on vacuoles and neutral-red-staining bodies in small amebocytes, are offered by G. N. C. Crawford. Perhaps some readers may be disturbed by his exact disclosure of discrepancies brought out in all microscopic structures by the addition of fixing agents.

In another direction, interesting cytochemical problems are explored. Relationships between enzymatic activity and