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

particles obtained through differential centrifugation appear in three chapters, while another section is devoted to similar particles in plant cells. It is apparent that problems like those of the biochemistry of sarcosomes, Golgi bodies, and rat liver particles need considerably more careful and exact research. The reader may here see where chemical contaminations of cell fractions must be avoided and can form a judgment on the growing importance of investigating the physics and chemistry of cells as *living* functions.

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Clinical Toxicology of Commercial Products. Acute poisoning (home and farm). Marion N. Gleason, Robert E. Gosselin, and Harold C. Hodge. Williams & Wilkins, Baltimore, Md., 1957. 1160 pp. $16.

This large manual is designed to guide physicians in quickly identifying and treating poisonings from commercial products. It is extremely well arranged and comprehensive. A unique frontispiece is a flow sheet of the procedure to be followed by the user and a guide to the differently colored sections to which he will turn.

The first section (white) is on emergency and first-aid treatment. Here are considered the imperative measures, necessary often within minutes, which should be carried out while more specific procedures are being arranged. The induction of vomiting or gastric lavage, for instance, is considered, from the standpoint of technique and indication.

The second section (blue) is an ingredients index of more than 1000 chemical substances. If the poison is known, this section should be consulted next in order to get a thumbnail statement about the poison and a reference to definitive treatment in the third section. The chemicals listed are primarily those commercially available and likely to be found in the home or on the farm. Drugs and natural substances are specifically omitted, although even here the authors have wisely included certain items, especially generic ones. Thus, *Amanita* and Jimson weed poisons are listed, and scopolamine and digitalis, but not synthetic and prescription drugs like the sulfonamides or chlorpromazine.

The third section (white) is the therapeutics index. This is the section in which the physician will find the specific instructions he wishes. The other sections mainly furnish different approaches to this section, the starting place depending on the type of information at hand. Thus, the second section, already mentioned, furnishes the approach when the active ingredient is known. There are 68 compounds or classes of compounds in this therapeutic section, which are prototype examples that cover the field. Thus, in section 2, under zinc one finds a reference to copper in section 3, copper being the example to serve for several metals. The therapeutic material starts with general considerations of toxicology and symptomatology, followed by clearly outlined treatment measures.

The fourth section is subsidiary to the third and describes supportive or general measures, such as the management of shock or suicidal disorientation.

The fifth section (yellow) lists, in more than 800 pages, some 15,000 trade names of poisonous or potentially poisonous products and the contained ingredients. From the critical ingredients one is led back to the second section for a reference to the specific treatment, in section 3. This progress through sections sounds complex but is, in fact, very easy, once the general system of the flow sheet is understood.

The sixth section lists general formulations, first in an index and then by general formula. Thus, if all that is known is that a suspected substance is a white tire wall cleaner, one is led to the general ingredients of tire cleaners and then to the ingredient section, as before.

Finally, there is a manufacturers' list, suggesting sources for further information.

The volume represents a vast amount of work. Certainly nothing so formidable has been prepared before in the field. Although the authors have bent every effort toward usefulness in specific accidents, the book will also have tremendous value as a reference volume. It should come to be a classic source of general toxicological knowledge for academic purposes as well as an invaluable guide to the treatment of individual patients.

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Thermodynamics. An advanced treatment for chemists and physicists. E. A. Guggenheim. North-Holland, Amsterdam, ed. 3, 1957 (distr. by Interscience, New York). 476 pp. Illus. $9.75.

The third edition of this well-known monograph contains several important revisions, so that the chapter headings now read as follows: (i) "Introduction and fundamental principles," (ii) "Digression on statistical thermodynamics," (iii) "Some relations of general validity," (iv) "Systems of a single component," (v) "Gaseous, liquid, and solid mixtures," (vi) "Solutions, especially dilute solutions," (vii) "Systems of chemically reacting species," (viii) "Solutions of electrolytes," (ix) "Electrochemical systems," (x) "Gravitational field," (xi) "Electrostatic systems," (xii) "Magnetic systems," (xiii) "Radiation," and (xiv) "Onsager's reciprocal relations."

The principal changes relate to the chapter on mixtures and the following one, on solutions, which originally comprised several chapters. The present condensation and revision represent a marked improvement. Perhaps the most important addition is the use of excess molar functions to describe the deviation of a mixture from ideal behavior. The brief introduction, in the last chapter, to the modern theory of irreversible processes appears in this edition for the first time. To simplify matters, only isothermal systems are discussed. It is strange, therefore, that electrokinetic effects and the electric double layer are considered, whereas the important and relatively simple case of isothermal diffusion in multicomponent systems is omitted. Further changes are in the fourth chapter, where there is a new discussion of sorption, and in the ninth chapter, where the pseudothermostatic theory of galvanic cells with transference has been eliminated. The page size has been reduced, which makes for easier reading.

The text is clear, well written, and scientifically accurate. However, there are several points worth discussing in the way of criticism. (i) The consequences of the phase rule seem to be ignored in several places. For example, the Duhem-Margules equation is really an approximation, since a two-phase, two-component system has only two independent intensive variables. However, in section 5.21 it is presented as though it were exact. The following section, 5.22, on pressure dependence is not sufficient to clarify the situation. Similarly, the definition of fugacity in condensed phases (sections 4.51 and 5.19) seems to imply that a gas phase always exists in equilibrium with a condensed phase. (ii) The position that it is entirely meaningless to consider differences of electric potential between phases of different composition (section 9.03) is no longer accepted by many experts, who believe that the difficulties are experimental, not conceptual, and may be overcome eventually. Professor Guggenheim is entitled to his views, of course, but an authoritative treatise should at least mention the existence of contrary opinions, and the several dogmatic statements in chapters 8 and 9 should be replaced by more critical comments. (iii) The discussion of the third law rests largely on results of statistical mechanics which are presented without