Book Reviews

Mesons and Fields. vol. II, *Mesons.* Hans A. Bethe and Frederic de Hoffmann. Row, Peterson, Evanston, Ill. 1955. xiii + 446 pp. Illus. $8.

Mesons is the second volume of a two-volume set on the general subject of high-energy physics. Volume I, which has not yet been published, is devoted primarily to modern quantum field theory, whereas volume II is concerned largely with meson physics, and in fact, mostly with π-meson physics.

These books are the outgrowth of a series of lectures given by Bethe at Cornell University to an audience containing a good fraction of experimental physicists. As a result, a great deal of space is devoted to the analysis of experimental data in terms of fundamental theoretical parameters. This is an aspect of physics that is frequently shunned by "pure" theoreticians and its appearance will warm the hearts of experimentalists.

The first two chapters of the book describe the experiments that have uncovered the fundamental character of π-mesons—for example, spin, parity, mass, and so forth. Following an introductory survey of the experimental data, the subject of pion-nucleon scattering is taken up in earnest. The ideas of charge independence and the formalism of isotopic spin as applied to this problem are presented with great clarity. The analysis of scattering data in terms of phase shifts is treated in great detail, and all experimental data are closely scrutinized. The next major topic is the photoproduction of pions, where again the experimental data are gleaned from all information and translated into a form suitable for comparison with theory.

After a brief historical review of meson theory, the general theory of the Tamm-Dancoff method is developed in great detail and applied to a calculation of pion scattering on the basis of pseudoscalar meson theory. Various theories of photomeson production are described and compared with experiment.

A short discussion is given of several theoretical attempts at calculating nuclear force from meson theory. The theory of meson production is treated primarily phenomenologically. The book ends with a summary of the most important experimental facts and theoretical conjectures about μ-mesons and curious particles.

There is one feature of the book that may cause difficulty for beginners and that is the fact that very many theoretical calculations are described for a given process even when some of the treatments are quite contradictory. The authors have not chosen to be arbitrators. The dilemma that faced them was not of their own making: it has proved singularly difficult to extract reliable information from meson theory and a decision in favor of any given calculation is at the present time often hard to reach. Despite this difficulty, *Mesons* fills an important need and will be of great value to students and research workers.

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Astronomical Cuneiform Texts. vol. I, *Introduction: The Moon.* vol. II, *The Planets.* vol. III, *Plates.* O. Neugebauer, Ed. Lund Humphries, London, 1955. vol. I: xvi + 278 pp. Illus. vol. II: xii + 233 pp. Illus. vol. III: 255 pp. Plates. £5 5s. per set.

Conventional accounts of the development of the physical sciences are likely to begin with the creation of science in ancient Greece (the "miracle" of Greek science) and then skip to Galileo and his age (when "modern science" was "invented"). Research in the history of the exact sciences has been filling in two major gaps, the interval between the decline of ancient science and the age of Galileo, and the long ages before the Greek philosophers supposedly invented science. In recent decades, the heroic labors of O. Neugebauer and his associates have unveiled the pre-Greek history of mathematics and astronomy. We now know that many Greek discoveries, such as the Pythagorean theorem and the theorem of Thales that an angle inscribed in a semicircle is a right angle, were known long, long before to the Babylonians. Neugebauer, conscious of the scholarly tradition of which he is the greatest luminary, dedicates the present work to three Jesuit fathers who pioneered the study of Babylonian astronomy, J. N. Strassmaier, J. Epping, and F. X. Kugler.

The present work is based on some 300 clay tablets and fragments that were excavated in Mesopotamia and are now to be found in museums in Istanbul, Paris, London, Berlin, and America. These tablets contain ephemerides for the sun, moon, and planets, or computational procedures. Each table is transcribed in the now standard adaptation of Hindu-Arabic numerals to the sexagesimal notation of the Babylonians; for the scholar there are photographs and drawings of tablets. These astronomical tablets date from the Seleucid period, roughly coeval with Greek mathematical astronomy, and are much later than the mathematical tablets.

Although it was not Neugebauer's intention to write a history or descriptive account of Babylonian astronomy, the "general introduction" to each section and the discussions of each of the texts enable the reader to follow the main outlines of the subject. The primary object of the Babylonian theory of the planets proves to have been the determination of the time and longitude of consecutive "characteristic phenomena," such as the first and last visibilities and stationary points in the east and west for the inferior planets and the first visibility in the east, first stationary point, opposition, second stationary point, and last visibility in the west for the superior planets. This is quite different from the aims of Ptolemy's astronomy, in which the goal was to find the geocentric latitude (and longitude if needed) of any planet at any given time.

Neugebauer points out that this difference has a bearing on astrology in that the "characteristic phenomena" in the Babylonian ephemerides "play no role whatsoever in astrological practice." The position of the planets in the zodiacal sign at date of birth, which is of primary interest to the astrologer, can be found by the Ptolemaic methods, but this type of problem "is *not* immediately solvable from the ordinary Babylonian ephemerides." Neugebauer says: "The Babylonian approach is obviously the 'natural' one. What one realizes first about the planets is their appearance and disappearance in the nightly sky, their stations and retrogradations. To predict these phenomena seems to be the real problem and it was solved by our texts by means of very ingenious arithmetical devices. But it marks an enormous step forward to ignore the 'natural' problems altogether and to ask an apparently much more complex question: how to describe the planetary motion as a whole. It is this shift of emphasis which led Apollonius, Hipparchus, and Ptolemy to their enormous successes."

The ephemerides of the moon show the Babylonian concern for calendarial problems. The beginning of each month occurred at the first visibility of the new moon's crescent. Hence the aim of Babylonian lunar theory was to predict accurately the evening on which this event would occur, which might be at the end of either a 29- or 30-day interval. Cognate problems are the determination of the syzygies, last visibilities of the moon, and eclipses. "The results," Neugebauer concludes, "are amazingly good and can hardly be improved upon with elementary mathematical means. It is not surprising that the theory of eclipses is the weakest part of the whole theory because one essential element, the parallax of sun and moon, is completely disregarded."

Neugebauer tells us that this edition of *Astronomical Cuneiform Texts* is "intended to furnish the basis for a chapter on Babylonian Mathematical Astronomy in a larger History of Ancient Astronomy." In that work, Neugebauer will undoubtedly deal with the major questions of the extent to which these mathematical methods may have influenced the later course of astronomy, on which topic he has given us an earnest in his *Exact Sciences in Antiquity*. For the present, we must be content with his careful presentation of the methods and calculations at almost the beginnings of exact physical science.

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The Chemistry and Fertility of Sea Waters. H. W. Harvey. Cambridge Univ. Press, London, 1955. viii + 224 pp. $5.50.

The vigorous and imaginative writings of earth scientists are in part responsible for the popularity enjoyed by their fields of interest. H. W. Harvey, one of the pioneering scientists of marine chemistry, has written a vigorous book on the chemical interactions of the plants and animals of the sea with their environment. His ability to focus attention on the significant variables influencing population changes in the ocean and the importance of his own extensive experimental work have given his previous writings a prominent and influential place in oceanography.

His present book is divided into two parts. The first concerns changes in the composition of marine waters as a result of biological activity, while the second part describes the chemical composition of the hydrosphere. A final chapter, in collaboration with F. A. J. Armstrong, considers some of the more popular chemical analyses made in productivity studies. The noncritical air that pervades this book is somewhat compensated by the full documentation and bibliography. The neglect of the extensive postwar Japanese work is disappointing.

The book will find and deserve its principal audience among entrants to the fields of marine biology and chemistry. The chapter on the carbon dioxide system of the oceans and marine water compositional changes owing to the flora and fauna stand out as elegant presentations. The recent successes of isotopic and atomic chemistry in interpreting natural phenomena, such as Thode's sulfur work and Urey's carbonate thermometry, are not cited. Such omissions are a neglect of potentially powerful tools that are available for application to the yet unsolved problems of marine productivity.

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Diffusion and Heat Exchange in Chemical Kinetics. D. A. Frank-Kamenetskii. Trans. by N. Thon. Princeton Univ. Press, Princeton, N.J., 1955. xii + 370 pp. Illus. $6.

As its title indicates, this interesting and important treatise deals with the theories of processes that involve chemical reactions as well as heat and material flow. The subject might be said to be intermediate between fluid dynamics and isothermal chemical kinetics in static systems, but it actually involves both of these. Scientific interest in the subject is a natural consequence of the rapid advances in classical chemical kinetics, but the subject has also acquired a major practical importance because of current industrial interest in rapid-flow reactors and in combustion phenomena. In the West, the subject has been approached more frequently from the point of view of fluid dynamics; in the U.S.S.R., it has been mainly explored by N. N. Semenoff and his pupils, who were trained as chemical kineticists. Among Semenoff's pupils, the author of this book is known for his many important theoretical contributions, which have placed him in a small group of internationally known experts in the field.

The book starts with a brief chapter summarizing the basic concepts of the theory of chemical kinetics and the theory of diffusion and heat transfer, including the effects of laminar and turbulent flow. Chapter II, "Diffusional kinetics," deals with reactions at surfaces the rates of which may be controlled either by kinetic or diffusional factors. The third chapter considers the condensation of vapors. The fourth is a brief exposition of the theory of thermal diffusion. Chapter V, "Chemical hydrodynamics," is devoted largely to the nature of the boundary layer in streaming fluids. The sixth, seventh, and eighth chapters are devoted to the theories of thermal explosions and of the propagation of flames. Chapter IX, "Thermal regime of heterogeneous exothermal reactions," deals mainly with the problem of ignition at solid surfaces. The last chapter contains brief comments on the theory of periodic chemical processes.

Even this brief listing of the main subdivisions of the book should give some idea of the importance of the problems dealt with. Throughout the text the author makes frequent use of dimensional analysis (similitude theory) and is thus able to obtain approximate solutions to problems that appear insoluble by analytic techniques.

To an experimentalist, the book will be a rich source of ideas for experimental work; a theoretician will find many problems requiring further analysis.

The translation of this difficult text is the work of the late N. Thon. "Editing was restricted to verifying technical consistency in translation and consistency with usage of expression in the field," states the editor. Unfortunately, very little evidence of this editing is apparent. Regarded as a first draft, the text is an outstanding accomplishment; as a final version, it is, to say the least, much below par. It abounds with technical inconsistencies ranging from an almost (but not completely) consistent reference to the Reynolds, Prandtl, and other such numbers as "criteria" to devoting pages 51 and 52 of the book to a discussion in which the term *mass velocity* is used when the subject matter is clearly momentum. The heat of reaction is indiscriminately referred to as "heat effect" or "thermal effect." Typographic errors are very numerous. Some polishing of the style would have made the book much more readable. The price seems excessive.

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Grundlagen der Analytischen Chemie und der Chemie in Wässrigen Systemen. Fritz Steel. Verlag Chemie GmbH, Weinheim/Bergstrasse, 1955. 348 pp. Illus. DM. 29.

As the author indicates in his foreword, this is not a textbook of analytical chemistry. It is, rather, a physicochemical treatment of the principles of chemical equilibrium as applied to aqueous solutions and a fundamental exposition of the theoretical principles of qualitative and quantitative analysis. As such, it may be expected to serve both as a supplement to sets of laboratory directions in beginning analytical chemistry