

Theory in the continental tradition

LEHRBUCH DER THEORETISCHEN PHYSIK, VOL. 2: KLASSISCHE PHYSIK I, MECHANIK GEORDNETER UND UNGEORDNETER BEWEGUNGEN. By Siegfried Flügge. 375 pp. Springer-Verlag, Berlin, 1967. \$12.00

by PETER G. BERGMANN

Siegfried Flügge, who holds a chair of theoretical physics at the University of Freiburg, West Germany, has given the standard introductory course in theoretical physics at several German universities for well over 20 years; at most institutions this course of lectures extends over four semesters and is attended by all students majoring in physics, once they have passed the course in experimental physics. Continental tradition has given rise to treatises covering theoretical physics in several volumes, and such treatises are to be found in American university libraries from the hands of Max Planck, Arthur Haas, and more recently, Lev D. Landau and E. M. Lifshitz. At its best, such a treatise affords the opportunity to select and to shape the material to be presented from a unified point of view. In the US the standard courses in theoretical physics are offered in the first two years of graduate work and are taught by different members of the staff, among whom coordination is usually somewhat imperfect. Accordingly each professor will suggest a separate list of texts to his classes, and the advantages of a unified approach are less apparent. The American reader of a continental text should in any case be aware of the varying curricular structures on which works coming from divers countries are based.

The Flügge treatise is organized into five volumes: The first three are devoted to classical physics, and the two concluding volumes are devoted to quantum theory. This present (second) volume is subtitled "The Mechanics of Ordered and Disordered Motion." The volume covers analytical mechanics, followed by statistical mechanics and thermodynamics. There is also a long chapter on the (phenomenological) treatment of elastic and fluid materials, including the (linearized) motion of a free surface. Throughout, the presentation is fresh and offers some material not to be found elsewhere at the same relatively elementary level. For the English-speaking student Flügge's

work offers an opportunity for collateral reading, written in a literate yet informal German that ought to prove helpful to the student intent on improving his reading competence in that language.

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The reviewer is a professor of physics at Syracuse University where he specializes in general relativity.

Flows at low densities

INTRODUCTION TO THE DYNAMICS OF RAREFIED GASES. By V. P. Shidlovskiy. Trans. by Scripta Technica. 80 pp. American Elsevier, New York, 1967. \$12.50

by ROBERT E. STREET

As a brief introductory treatment of the theory of rarefied gas dynamics, this new text differs from and excels above the other few introductory treatments available in English, in that it presents a large number of solved problems. Intended primarily for aeronautical and astronautical engineers, these problems are mostly concerned with the determination of pressures on and heat transfer to bodies moving through an inert gas under varying degrees of rarefaction.

The first chapter, a highly condensed survey of the elements of the kinetic theory of gases, essentially presents the Boltzmann equation, derives the macroscopic equations of motion and briefly surveys some of the methods of solving the Boltzmann equation. If the student does not have sufficient background in classical kinetic theory, he will have to go to the references given or depend upon the instructor for more detailed presentation. However, it is possible in a first reading to accept the equations of this first chapter as correct and go on to the next three chapters, which are the real substance of the book.

The second chapter treats problems in the flow of highly rarefied gases usually referred to as free-molecule flow. Nothing here is very new or unusual except for the discussion of Russian work on unsteady free-molecule flow and minimal-drag bodies in a free-molecule flow. Effusive flow, flow through tubes, drag and lift of bodies and heat transfer are presented as they are in other texts by Kennard and Hayes and Probstein.

The next chapter is concerned with

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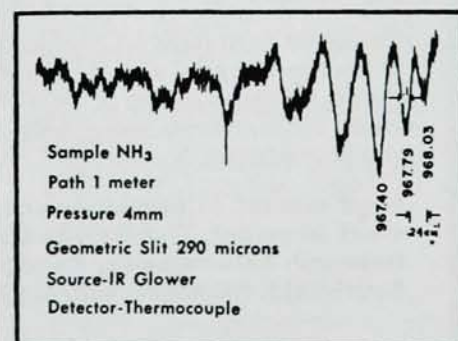
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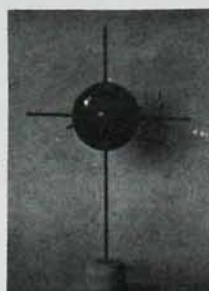


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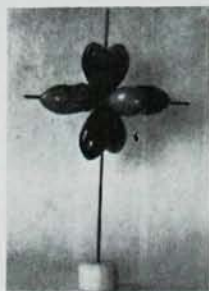
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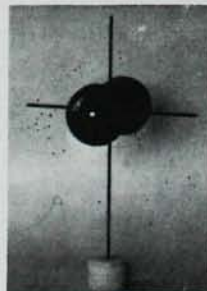
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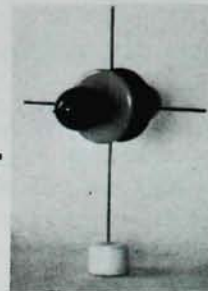
S orbital



$d_{x^2-y^2}$ orbital



p_y orbital



t_{23} orbital

Orbital models are designed by Dr. A. H. Norbury of Loughborough University of Technology to demonstrate the angular distribution of the s, p and d and f orbitals, and to show how these models may be used to illustrate a number of aspects of Molecular Orbital Theory and Crystal Field Theory. These three-dimensional models help students to understand ideas that many find difficult from two-dimensional drawings in textbooks.

The single s orbital is a sphere symmetrical with respect to the axis. The three p orbitals shown by one red and one yellow sphere lie along either the x, y or z axis. The d_{z^2} orbital has two positive lobes separated by a negative disc with figure of eight cross section. The three d_{xy} , d_{xz} and d_{yz} orbitals have four lobes,

alternatively positive and negative, lying between the axes. The fifth d orbital $d_{x^2-y^2}$ has its lobes lying along the x and y axis. The f_z orbital has one positive and one negative lobe lying along the z axis with each lobe surrounded by a 'crinoline' of the opposite sign: f_{x^3} and f_{y^3} differ only in the position

relative to the axis. The remaining four f orbitals have eight lobes in f_{xyz} . They are symmetrically placed between the axis. In the other three, $f_{x(y^2-z^2)}$, etc., they are rotated by 45° with respect to the axis so that they lie approximately between them. The models are approximately ten inches high.

The complete set consists of sixteen models of orbitals—one s, three p, five d and seven f. Twenty-two sp hybrid orbitals (thirteen with large positive lobes and nine with negative) and twenty loose p orbitals are provided so that the form of a variety of molecular orbitals may be illustrated. Also available are sixty small white balls for showing the effect of point charges, and nine frames so that tetrahedral geometry may also be included. Models may be purchased singly or in complete sets of 16. All models are supplied assembled.



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the other limit of low-Knudsen number or slightly rarefied flows. The boundary conditions are derived in the same way as Patterson does in his book. After a brief discussion of the Burnett and Grad equations, solution of the Couette flow problem is based upon the Navier-Stokes equations. The boundary-layer equations are used for the flow over a semi-infinite flat plate in slip flow and in hypersonic flow. This chapter ends with the problem of supersonic flow around a blunt-nosed body. Again it is the solutions of Russian authors that is stressed.

The fourth chapter considers approximate solutions of those particular problems that have been found for arbitrary Knudsen number. There are very few of these transition-flow problems. One is the structure of a plane shock wave in steady flow using the Mott-Smith moment method. Another is plane and axisymmetric Couette flow, which are also solved by the use of moment equations. There is finally a discussion of Koshmarov's solution of Rayleigh's problem using the two-stream distribution functions of Mott-Smith.

All in all, this is a pretty good introduction to the theory of rarefied gas dynamics. It brings together under a single cover many widely scattered papers that, published over the years, contain solutions of the more elementary problems in this field. Approximate solutions of some of the more difficult problems, numerical solutions, Monte Carlo techniques, as well as all experimental results, are left out; the interaction of the gas with a solid surface, which leads to the boundary conditions, is inadequately treated. Additional references given by the translation editor help somewhat.

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The reviewer is a professor of aeronautics and astronautics at the University of Washington. He has published several papers in rarefied gas dynamics and teaches a course on the subject.

Maze of many-body theory

THEORY OF FINITE SYSTEMS AND APPLICATIONS TO ATOMIC NUCLEI. By A. B. Migdal. Trans. from Russian. 319 pp. Interscience, New York, 1967. \$17.50

by JOHN L. GAMMEL

With the publication of this book, another of the contributions to many-

body theory first published in the Russian language becomes available in English. This book may be grouped with Kirzhnits's *Field Theoretical Methods in Many-Body Systems* (Pergamon Press, 1967), Abrikosov's, Gorkov's, and Dzyaloshinski's *Methods of Quantum Field Theory in Statistical Physics* (Prentice-Hall, 1963), and Bonch-Bruевич's and Tyablikov's *Green Function Methods in Statistical Mechanics* (North Holland, 1962) to form a reasonably complete account of work along these lines in the Soviet Union up until approximately 1964.

The book does not represent an effort to derive all properties of finite nuclei from the two-nucleon interaction (and, of course, the Schrödinger equation). Kirzhnits refers to this book as a source of material that he omits relating to phenomenological aspects of many-body field theory. The idea is, as stated in the beginning of the introduction, that a number of quantities describing the simplest excitations and interactions between these excitations are introduced as phenomenological parameters and that the relationships between other quantities are rigorously derived. The author compares this procedure to procedures currently used in quantum field theory. I suppose he has in mind, for instance, the introduction of ρ -meson and a ρ -meson and a ρ -nucleon coupling constant and then working out some property of the nucleon-nucleon interaction from one- ρ exchange.

The book consists of three chapters (there is a fourth that consists of very brief abstracts of papers on nuclear theory) entitled (1) "Green's Functions in the Study of Fermi Systems," (2) "Fermi Systems in an External Field," (3) Applications to Nuclear Physics." One may expect that chapters 1 and 2 will overlap considerably with material already available (not only in Kirzhnits, Abrikosov and colleagues, and Bonch-Bruевич and Tyablikov but also in many other places—for example, Kadanoff's and Baym's *Quantum Statistical Mechanics*, Benjamin). Nor is chapter 3 an altogether unique English-language account of A.B. Migdal's work. In the *Proceedings of the International School of Physics Enrico Fermi*, Varenna, Italy, Course 36 edited by Claude Bloch "Many-Body Description of Nuclear Structure and Reactions," Academic Press, 1966), Migdal has a 63-page account of his work, and some of

Classical Readings

X-RAY AND NEUTRON DIFFRACTION

By G. E. BACON, University of Sheffield

Discusses the analysis of the 3-dimensional structure of solids through the application of the methods of diffraction analysis. The author explains the principles and practices of diffraction analysis by considering their development from the original x-ray work of von Laue and the Braggs to the research methods of modern scientists.

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APPLIED GROUP THEORY

By A. P. CRACKNELL, University of Singapore

This book takes an historical approach to the subject and includes the English translations of the most significant original papers by Wigner, Bright, Wilson, Jahn, Teller, Bethe, Seitz, Bouckaert, Smoluchowski, Opechowski, Tayger and Zaitsev.

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