mechanical treatment of the hydrogen atom, but it works!

The book begins with a detailed treatment of electromagnetic radiation, that includes a discussion of interference, diffraction (of electrons and neutrons as well as electromagnetic waves), the Compton effect, and so forth, all of which then leads to wave mechanics, which is discussed next. This includes excellent sections on the harmonic oscillator, the rigid rotator and particles in a box.

Once this solid background in wave mechanics is established, a middle section of the book is devoted to atoms and molecules and the propagation of waves in solids, that is phenomena such as phonons and energy bands, conductors and insulators.

The final third of the book deals with nuclear and elementary particle physics. Excellent descriptions of the nuclear forces, nuclear models and alpha-decay by barrier penetration are present in the section on nuclear physics. The section of elementary-particle physics emphasizes symmetries and has particularly good discussion of the non-conservation of parity.

This book also contains several hundred problems, many with solutions in the back of the book.

GINO SEGRÈ
University of Pennsylvania
Philadelphia

An Introduction to the Theory of Atomic Spectra

I. I. Sobel'man
609 pp. Pergamon, New York, 1972. $40.00

I. I. Sobel'man's *Introduction to the Theory of Atomic Spectra* is clearly intended to be the modern atomic spectroscopist's Condon and Shortley (*The Theory of Atomic Spectra*, 1931 and 1951) updated by the explanation and use of Racah methods. It is a translation of Sobel'man's Russian edition, which appeared ten years earlier. In the English edition only "relatively insignificant corrections and changes" were necessary with the exception of the last (11th) chapter on collision theory, which was considerably revised. The latter chapter is one of the more unusual features to be found in a volume of this type. In addition there is a long chapter on line broadening.

One expects to be able to turn to such a book either to learn how to do calculations and/or (if one already knows how) to find the necessary mathematical tables to carry them out. That is the kind of book it is; a kind of handbook. There are also tables that have experimental results, but they seem to be meant only to illustrate the degree of success of the theory in certain cases. They are not exhaustive.

Although the book may serve as a latter-day Condon and Shortley, it is not simply a sequel to it, as it not only carries us beyond but also covers much of the same ground for completeness. There are three parts under one cover. The first, containing 55 pages, is described as "Elementary Information on Atomic Spectra," and begins with the hydrogen atom including the relativistic mass correction and spin-orbit interaction followed by a brief survey of some of the systematics of the spectra and structure of multi-electron atoms. Just from this part alone one gets a strong impression from the relative space devoted that there is a lot more known about atomic p^n configurations than d^n, and still less about f^n. This seems to be reflected in the examples and tables in the rest of the book as well. Indeed it is the nature of such a volume that one is much more likely to find well established conclusions concerning the applicability of the theory than speculations on research questions. One cannot get a feeling for the boundary areas of knowledge here, ex-

cept indirectly to some extent by noting obvious omissions.

The central part of the book is the second entitled "The Theory of Atomic Spectra" containing roughly 200 pages. It begins with a chapter on angular momenta in which Racah methods are introduced followed by a chapter in which the methods are applied to operations that are sums of one- or two-electron operators, and in particular to spin–orbit and the Coulomb interaction between electrons. The usual *LS*, *jj*, and intermediate coupling schemes are discussed, but there is also a section on *jl* coupling, which is not discussed in Condon and Shortley, but is important for the inert gases and higher excited states of certain atoms.

Sobel'man's work suffers a peculiar consequence of the fact that he did not wish to introduce group theory in order to make the book intelligible to a wider circle of readers whose background consists of "knowledge to the extent of the ordinary university course of quantum mechanics." He chose to omit treatment of some of the more complicated configurations, such as those involving unfilled f shells, because group theory would have been necessary for explanations. The peculiar consequence is that not many new configurations beyond those in Condon and Shortley are treated in detail in the tables. These are essentially d^4, d^5, and d^6. Of course all results are obtained with greater ease and generality using Racah methods.

Those whose interests are in rare-earth and actinide-ion spectra will of course not find much of what they need in this book because f^n configurations are not discussed. In fact I found no mention whatsoever of the research field of the spectra of ions in crystalline fields which involve transition elements (d^n configurations) as well as rare earths (f^n configurations). Although this field blossomed in the 1960's there was still a considerable amount of published work by 1961. The Stark effect is treated, however, but only out to quadrupole terms in the Hamiltonian (quadratic in the cartesian coordinates of electrons in the field). The higher-degree terms found necessary for crystalline fields are not presented.

The third chapter of the second part is concerned with the hyperfine structure of spectral lines and includes the usual nuclear magnetic dipole and electric quadrupole interactions with the atomic electrons but not the nuclear magnetic octapole. A nice feature is the discussion of isotope effects including both nuclear mass and volume effects. This is followed by a chapter on relativistic corrections.

The Zeeman and Stark effects are somewhat inappropriately included in the third part, which is entitled "Excitation and Radiation of Atoms; Elementary Processes." This part is largely concerned with (a) interaction of atoms with an electromagnetic field including multipole radiation and the calculation of oscillator strengths (he also discusses electric dipole line strengths under various coupling schemes), (b) the broadening of spectral lines, a welcome inclusion of an important topic to all kinds of spectroscopy and only barely discussed in Condon and Shortley, and (c) collisional excitation of atoms, mostly by electrons. Collisional excitation is not usually found in a book on atomic spectra. Sobel'man's selection of topics in this chapter of the edition in English is based on topics he considers of interest to spectroscopists rather than to specialists in the theory of atomic collisions. Sobel'man has contributed to this field himself as well as to the theory of line widths.

On the whole this is a good book to have. Perhaps if an atomic spectroscopist were shipwrecked on a desert island with only one theory book, this might be the one most worth having. On a desert island one would not mind the lack of adequate referencing. It would be even more useful if it had a list of the 128 tables and 84 figures and if the author had been more complete in citing references. Tables of experimental results, for example, rarely state the origin of the information, so there is no easy way to check into it or even to find out how recent it is. If one is in the market for a text such as this, one will have to decide between this one and J. C. Slater's *Quantum Theory of Atomic Structure*, volumes 1 and 2, which is of the same vintage.

ROBERT A. SATTEN
University of California
Los Angeles

Aeronomy

P. M. Banks, G. Kockarts
2 parts: 430 pp.; 355 pp. Academic, New York, 1973. Part A, $28.00; Part B, $24.00

Many readers of PHYSICS TODAY may not know what is meant by "aeronomy." To quote the authors of this two-volume survey, both distinguished theoretical aeronomers, "Aeronomy is the scientific discipline devoted to the study of the composition, movement, and thermal balance of planetary atmospheres." Phenomena studied by aeronomers include atmospheric photochemistry (the ionosphere and the ozone layer, for example), auroras and airglow, and the densities, temperatures and winds in the upper atmosphere.