to the reader who only knows Willy Ley as a renowned expert in rocketry and space science, but he will soon realize how boundlessly cultivated the author is and will not be too much surprised that he was educated as a zoologist.

Two features characterize the author's writing. The first one is the uncommon depth of information on various topics and the orderly exposition. The second feature is charm: A vivid presentation, a good deal of humor and a beautiful style add up to a delightful reading. Ley's book proves that scientists can write with elegance.

Of particular interest to physicists, and a wealth of information to teachers, are the essays that are a rebuttal of the fancy theories about the inclusion of such numbers as π in the Egyptian pyramids; a historical review of discoveries on gas theory; a precise analysis of the physical possibilities regarding the noise produced by meteors; stellar evolution, and the old riddles solved and the new ones posed by the space age.

* * *

The reviewer has taught physics and mathematics for several years.

Collective model advocate

COLLECTIVE MODELS OF THE NUCLEUS. By J. P. Davidson. 238 pp. Academic Press, New York, 1968. $12.00

by HENRY S. VALK

To those working in the field of theoretical nuclear physics, the name of John P. Davidson, physics professor at the University of Kansas, needs little introduction. He and his students have made many original contributions to our understanding of the nucleus, particularly its collective aspects.

With this background it is not surprising that Davidson's new monograph provides a lucid summary of the phenomenological approach to the collective nuclear models. The main text covers the fundamental physics of the liquid-drop model and describes specific classes of nuclei and their transitions. The work concludes with a chapter on mu-mesic atoms and their use as a tool for exploring the collective properties of heavy nuclei. The author wisely chooses to place the relevant algebra of angular momentum and other calculation detail in a set of appendixes. This keeps the book relatively self-contained and permits the reader to concentrate on the physics unhindered by lengthy mathematical digressions.

This book, the outgrowth of a review article prepared several years ago (*Reviews of Modern Physics*, 37, 105, 1965), fills a long standing need. The shell model and its close relations have found many expositors, but heretofore the phenomenological collective model has not had any representation in the nuclear physicists' library. It has now found an advocate.

* * *

The reviewer is a theoretical nuclear physicist and chairman of the physics department at the University of Nebraska.

A compendium of results

ELECTRON IMPACT EXCITATION OF ATOMS (NSRDS-NBS 25). By B. L. Moiseiwitsch and S. J. Smith. 116 pp. National Bureau of Standards, Washington, DC, 1968. $2.00

by BRUCE W. SHORE

This monograph provides a timely review of the computational and observational methods currently employed to determine cross sections for electron-impact excitation of atoms and ions. It also provides a valuable compendium of theoretical and experimental results, in both graphical display and in tabular form. Equally valuable is the authors' critical assessment of existing experimental results.

The authors, B. L. Moiseiwitsch of the applied mathematics department, the Queen's University of Belfast, and S. L. Smith of the Joint Institute for Laboratory Astrophysics at Boulder, Colorado, are respected for their work in atomic physics; Moiseiwitsch is perhaps best known for his application of variational methods (for example, *Variational Principles*, Interscience, 1966). This monograph was simultaneously published in *Reviews of Modern Physics*, **40**, 2, (1968).

The theoretical half summarizes the numerous approximation methods now used in computations. These range from the simple Born approximation through the elaborate close-coupling equations and include classical approaches, simplified methods for including exchange and approximations that guarantee unitarity. The major portion of the discussion concerns electron-hydrogen collisions, showing the relative simplicity of the electron-hydrogen system, with appreciable discussion of electron-helium collisions, and briefer mention of excitations of more complex atoms and positive ions.

The experimental half follows a similar pattern. The authors discuss methods for measuring excitation cross sections, results for hydrogen and helium and selected results for heavier atoms, particularly alkalis. They critically examine polarization and angular distribution effects, and take experimenters to task for paying insufficient attention to these and other sources of experimental errors. They conclude that significant improvements are now possible in the quality of published experimental results.

The coverage is thorough, the exposition lucid, and, as befits a review, it is well documented with references.

* * *

An associate professor of physics at Kansas State University, the reviewer is coauthor, with D. H. Menzel, of Principles of Atomic Spectra *(Wiley, 1968).*

From optical pumping to arcs

METHODS IN EXPERIMENTAL PHYSICS, VOL. 7B: ATOMIC AND ELECTRON PHYSICS. Benjamin Bederson and Wade Fite, eds. 374 pp. Academic Press, New York, 1968. $17.00

by GILBERT O. BRINK

This is the second volume of a two-part series on the techniques of experimental atomic and electron physics. It is intended as a summary of atomic and electronic interactions in bulk matter, primarily in the plasma state. As with any such book it only partially meets this goal because of rapid developments in the field. However, it still provides a useful starting point for a beginner, as well as a means for experienced workers to bring themselves up to date in bordering areas of physics.

The book is divided into six independent and self-contained chapters, each devoted to a separate topic. Bibliographies, though not complete, provide suitable material for further literature work. It is possible to read

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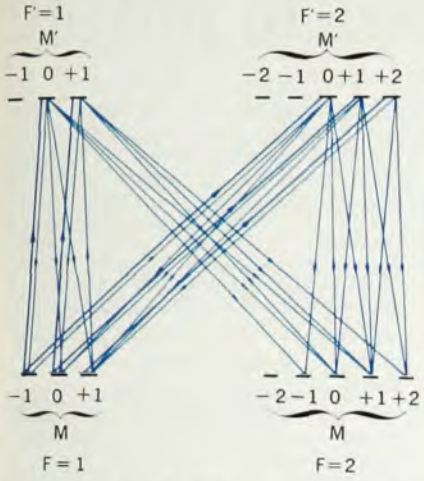

TYPICAL OPTICAL transitions are shown in the optical pumping cycle of an atom having a $^2S_{1/2}$ ground state, a $^2P_{1/2}$ resonant excited state and a nuclear spin $I = 3/2$.

the section of interest and obtain a current summary of that field. Graduate students should find it useful in surveying the current problems in atomic and electron physics.

The book begins with a chapter on optical pumping, in which not only the experimental, but also the theoretical foundations are discussed. The next section on electron swarms presents information on electron–atom interactions and also includes afterglow experiments. The discussion on shock tubes is primarily a rather complete description of production techniques of high-temperature shock waves in gases.

Chemical-reaction rate measurements at high temperature are included in the flame-kinetic studies, a section that has a particularly extensive bibliography. In dealing with the interaction of heavy particles with solids, the authors present, among other things, an interesting discussion of the "channeling" effect in crystals, where the incident particle moves between the layers of atoms forming the lattice. The book closes with a chapter on electric arcs, their production and application to the study of atomic processes.

In general this book should be useful to anyone working or thinking of working in atomic-collision physics. It is well written and provides a clear and concise review of current work.

* * *

Gilbert O. Brink is an associate professor of physics at the State University of New York at Buffalo and has been active in experimental research in atomic physics for 12 years.

Storage tubes

ELECTRONIC IMAGE STORAGE. B. Kazan and M. Knoll, ed. 498 pp. Academic, New York, 1968. $19.50

by LADISLAUS MARTON

B. Kazan and M. Knoll's book is an outgrowth of two of their own earlier publications. In 1952 they published a relatively short book titled *Storage Tubes and Their Basic Principles.* This was followed four years later by a critical review entitled "Viewing Storage Tubes," published in *Advances in Electronics and Electron Physics.*

Electron Image Storage, an entirely up-to-date and expanded version of the earlier book, begins with a thorough discussion of basic processes, such as secondary emission, photo emission, photoconductivity, electron bombardment, induced conductivity and luminescence phenomena. This section is followed by the description of writing and reading processes in charge-storage devices, by the discussion of signal-converter devices (which exist in a remarkable variety) and display devices, such as cathode-ray tubes, electrostatic film-deformation displays, xerographic displays, birefringent, crystal displays and many others.

The last two important chapters deal with camera-pickup devices and image-converter devices which, although not strictly storage devices, are sufficiently related to be included. A rather useful appendix at the end contains "Storage Tube Definitions" taken from the 1962 Institute of Radio Engineers Standards on Electron Tubes.

Although I have concentrated on the vacuum-device aspects, on which the authors are very well known authorities, the book contains an added short chapter on magnetic-storage devices. It is so condensed that it serves only to whet the reader's appetite for looking at the (fortunately sufficient) references. With the extremely widespread applications of storage and similar devices (television, telemetering, computers, teaching, decision making, and many others), it became quite timely to reissue an improved version of the authors' older book. The new version will, no doubt, be very well received by the scientific and technological community.

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The reviewer is with the office of international relations at the National Bureau of Standards.

Carbon and its modifications

CHEMISTRY AND PHYSICS OF CARBON: A SERIES OF ADVANCES, VOL. 4. Philip L. Walker, Jr. ed. 399 pp. Marcel Dekker, New York, 1968. $20.75

by MARTIN E. STRAUMANIS

This volume is the fourth in a series, edited by Philip Walker Jr, professor and head of the materials science department at Pennsylvania State University, and consists of six articles written by 11 authors, all of them experts in carbon research.

The first four chapters are of interest for the physicist. Considering the great importance of carbon and its modifications in nature, in industry and in research, there is no wonder that many crucial experiments and measurements were performed with carbon, graphite and diamond. It follows from the first article, written by W. Ruland, that the allotropy of carbon gave an impulse to one of the first structural studies with x rays. Accordingly the theory of scattering of x rays by carbon and graphite is in the first article, with mathematical descriptions of two-dimensional lattices, of small-angle scattering, order and disorder phenomena, lattice imperfections and preferred orientation.

Rates of carbon vaporization, heats of sublimation, composition of vapor, melting of graphite and similar problems are discussed in the next article by H. B. Palmer and Mordecai Shelef.

In the following chapter, S. B. Austerman discusses the crystallization of graphite from solutions in molten metals (iron, nickel, molybdenum, chromium). Iron can be evaporated from a solution of carbon in iron at 3000°C, and graphite crystals grow from the melt. There is also a possibility of controlling the amount of defects in such crystals. The article by T. Tsuzuku and M. H. Saito shows how internal friction measurements can determine the dislocation movement in