organizer, E. J. Richards, was at that time director of the Institute of Sound and Vibration Research at the University of Southampton. He has since become vice-chancellor of Loughborough University.

The volume consists of 17 articles, divided into five groups that are all related to some aspects of industrial noise. Topics covered include deafness in industry, social effects of noise, noise and the law, noise control in factories and roadway noise. On the average, about equal attention is paid to the origins of noise and to possible methods for its suppression. The conference was international to the extent that although eleven of the papers are by British authors, three German and two Dutch contributions are included as well as one from the US. The bibliographical references are moderately extensive, and sufficient regard is paid to recent relevant American studies, particularly along physiological and psychological lines.

The presentations are in general clear and illustrated with well drawn graphs and diagrams. The volume could, of course, have been made more useful if it had included a few summarizing sections to tie together the individual contributions and an index. However, one hopes that this publication will serve to attract more attention to the vital problems of noise and its control.

R. Bruce Lindsay
Hazard Professor of Physics
Brown University

Elements of Gasdynamics And the Classical Theory of Shock Waves

By Ya. B. Zel'dovich, Yu. P. Raizer
115 pp. Academic, New York, 1969. $3.95

This small paperback is identical to the first chapter of the two-volume work, *Physics of Shock Waves and High Temperature Hydrodynamic Phenomena* by the same authors. It was printed separately in order to reach a wider audience of students of gasdynamics and shock waves.

Consequently, as an introduction to a work devoted largely to shock waves, this book is entirely devoted to the simplest aspects of wave phenomena in gasdynamics. This includes an introduction to sound waves, the theory of characteristics, rarefaction waves, simple shock waves, effects of viscosity and heat conduction and a few simple examples. The latter are mostly strong-point explosions and expansion of a gas into a vacuum.

By considering flows with one space coordinate and the time coordinate, the authors keep the mathematics as simple as possible while emphasizing the physical and intuitive aspects. This is the style of the complete two-volume work and anyone who reads this first chapter will no doubt be motivated to turn to the larger work for the fascinating study of shock waves in real gases at high temperatures where the effects of radiation and dissociation play a primary role. Specific references to later chapters in the two volumes facilitate this.

Robert E. Street
Professor of Aeronautics and Astronautics
University of Washington

Nuclear Structure, Vol. 1

By Aage Bohr, Ben R. Mottelson
471 pp. Benjamin, New York, 1969. $25.00

This is the first of three volumes that took ten years to write. The authors are the two foremost living exponents of the collective and unified models of atomic nuclei. Since, according to the preface, the second and third volumes are concerned with "consequences of nuclear deformations" and with "collective phenomena," respectively, this volume may be regarded as preparatory. The collective model gives in some cases remarkable agreement with experiment. A systematic presentation of its theoretical justification should therefore be welcomed. This first volume is devoted mainly to single-particle motion and to "a summary of the important symmetry features of nuclear systems," which are applicable to the other two volumes as well.

As set forth in the preface the approach is concerned with "the identification of the appropriate concepts and degrees of freedom that are suitable for describing phenomena" through a combination of "approaches based partly on clues provided by experimental data, partly on the theoretical study of model systems," and of general symmetry relations. The more customary procedure consists in starting with data and hypotheses regarding nucleon–nucleon (N–N) interactions

the development of the consequences for nuclear structure and comparisons of these with nuclear data. The difference from custom is akin to that between inductive and deductive reasoning. The former is often more suited for finding a fruitful radical departure from the beaten path. But a deductive presentation frequently provides greater ease of assimilation.

Sections 1–3 on isobaric invariance are welcome, especially as a reminder of the essential unity of nuclear-structure physics and that of elementary particles. On page 55 there is a list of hypernuclei, and pages 57–65 contain an introduction to SU(3) and SU(6) classifications of elementary particles. Related mathematical material is discussed in an appendix, some 17 pages long, that is concerned with permutation symmetry and deals with symmetry quantum numbers (partitions), the symmetry classification of wave functions in occupation-number space and with unitary symmetry. This is followed by about ten pages of examples showing how the Young tableaux and partitions may be used for the construction of antisymmetrized-product wave functions with simple symmetry properties, how partitions may be related to states with sharp total orbital-momentum quantum number L and the classification of spin-isospin functions, a subject the cornerstones of which were laid by Eugene Wigner. The reviewer has found it difficult to locate in the text where this is stated, because the system of making references to the text in the author index lacks uniqueness of identification. The "cumulative bibliography," promised to appear at the end of Volume III, will be especially welcome if it will give the page numbers in the usual way. The arrangement of material just described for these examples is reasonably typical.

A large part of the volume deals with ways of making calculations in the approximation that represents the wave functions as an antisymmetrized sum of products of single-particle functions built on shell-model configurations. Comparison of experimental material supplements these considerations. The phenomenological evidence for considering the mean free path as relatively large is described in particular on the basis of total cross sections for neutrons (section 2-1, figure 2-3). There is a nice tie-up between theory and experiment here and elsewhere in the volume.

The theory of resonance reactions is briefly discussed. On page 433 a seven-line paragraph mentions "the Kapur–Peierls and Wigner–Eisenbud formulations" referring to review articles by Brown and by Lane and Thomas. The generality and care with which Wigner's R-matrix formulation has been worked out are neither mentioned nor discussed.

The scope of the book is great and oversights are only natural. Among these is the omission of a reference to T. Hamada, Y. Nakamura and R. Tamagaki, (*Progr. Theoret. Phys.* (Kyoto) **33**, 769, 1965), who revised the "Hamada–Johnston potential" used for figure 2–35 so as to remove the bound states noticed by John Blatt. The Yale potential also mentioned in the figure legend is free of this defect and so are the later soft-core potentials of Reid. It is apparently not realized that the "Hamada–Johnston potential" was obtained with the aid of the Yale group, this reviewer having supplied to Hamada the latest results then available of the Yale n-p phase-parameter analysis before publication. The potential was adjusted by Hamada and Johnston for approximate agreement with these "phases."

The legend to figure 2–34 refers to a 1966 phase-shift analysis of nucleon–nucleon data by the Livermore workers as the source of values used for the graphs. It mentions a later (1968) analysis from the same institution and earlier (1962) publications of the Yale group. The successful introduction (1959) of multienergy analysis and the existence of reasonably extensive recent work (published in 1967 and 1968) by the latter group as well as related work in Japan and at Dubna (USSR), Harwell (UK), Pennsylvania and Ohio State Universities are not mentioned. In the same connection there is a reference to the book by R. Wilson (1962) concerned mainly with experimental aspects of the subject but not to a 170-page chapter dealing with N–N data phenomenology and theoretical questions by two Yale workers in a book on high-energy physics edited by E. H. S. Burhop (1967). The last-mentioned reference contains an extensive bibliography.

On pages 430–433 are found generalizations of the one-level resonance formula partly from the viewpoint of introducing a "small" perturbing part of the Hamiltonian H' and partly employing the "pole structure" of the

scattering amplitude. Since the smallness of H' is difficult to formulate and a rigorous treatment of the analytic structure of the scattering amplitude is hard to provide, it may be remarked that a treatment of a single-level formula with slowly varying background for a finite number of channels employing complex energies may be found in a 1940 paper (*Phys. Rev.* 58 1068, 1940) and concrete examples showing the failure of the relationship between the total width and the competition factors (Equation 3F-16 of Volume 1), under well defined conditions, may be found in a 1946 paper (*Phys. Rev.* 69 472, 1946) and other related and more extensive work has been carried out more recently by Moldauer. The former of these references assumes slowness of energy variation of relative wave-function values in and close to the nuclear interior. This condition is easier to deal with than the smallness of H', the criterion depending on relative values only.

There are occasional ambiguities of expression and slips of the pen, for example, on page 108 in the ninth line under Equation 1C-9 is found "quadratic blocks along the diagonal." There are two diagonals in square matrices. But such matters seldom worry physicists.

Judging by Volume I the "book" is promising, especially as a compendium of information valuable to those who wish to study nuclear levels and their properties, fitting the needs of each set of levels to one or another model.

G. BREIT
Professor of Physics
State University of New York, Buffalo

Lightning

By Martin A. Uman
(Advances Monograph Series) 264 pp.
McGraw-Hill, New York, 1969. $13.50

A comprehensive survey of our present knowledge of lightning has been wanting in our libraries for many years. This present volume fills this lack in an admirable way. The two recent books on this subject, one by B. Schonland and the other by his coworker Malan, have dealt primarily with the South African work on this subject, and neither was comprehensive in its treatment nor bibliographically complete enough to guide students to the current literature.