neutrons from accelerator sources will find much helpful advice about targets.

A well-prepared subject index, twenty-three pages long, will be of great value to the user.

An unavoidable drawback of a book which describes in detail experimental techniques in an active field is that parts of the book are somewhat out of date by the time they appear in print because of the long delay between writing and publication. Since the writing of the book, the difficult problem of distinguishing in a scintillation detector between fast neutrons and γ rays has been partly removed by the use of the different pulse shapes.

A reviewer is expected to mention some misprints to show that he has looked at the book. In regard to having his name misspelled in the book, this reviewer finds himself in the distinguished company of Glaser and Wilkinson.

The book can be recommended highly as a complete and competently prepared reference work in techniques used in fast-neutron physics.

Irreducible Tensorial Sets. By U. Fano and G. Racah. 171 pp. Academic Press Inc., New York, 1959. $6.80. *Reviewed by Freeman J. Dyson, The Institute for Advanced Study.*

THIS is a monograph in the strict sense of the word. Its subject is the algebra of tensor operators and their transformations under the rotation group. Most of the tools in daily use in atomic physics, for example, the use of wave functions with definite angular momentum or the *LS* and *jj* coupling schemes for handling two or more interacting particles, are special cases of this algebra. The authors develop the theory systematically from first principles, paying great attention to fine points such as the consistent definition of phases of tensor components. Their work will be of value to anybody who has to make calculations of complicated atomic processes; in such calculations a major fraction of the time is usually spent in establishing a consistent set of conventions for the phases.

The second half of the book is headed "Quantum Mechanical Applications". However, the reader will be disappointed if he expects to find here any discussion of the physical consequences of the formalism. The policy of the authors is to carry the mathematical development just far enough so that "any competent physicist can take over from here". Unfortunately, they stop short of explaining in detail how the physics is to be put into the formulas. To take one example, an important application of their methods is to the theory of angular correlation of successive radiations from a decaying nucleus. The short chapter devoted to this subject contains formulas of such tremendous generality that only one who is already an expert could understand how to use them.

Another example of the authors' refusal to digress into physics is their treatment of conjugation. They define and discuss in detail the algebraic operation of conjugation and its formal mathematical properties. A brief footnote calls attention to the fact that one physical interpretation of conjugation is the time-reversal operation of Wigner. The operation of charge conjugation is never mentioned. A clear discussion of the physical notions of time reversal and charge conjugation, and of their relations to the algebraic notion of conjugation, would have greatly increased the book's usefulness.

The authors have excluded from their book not only real physics on the one side, but also real mathematics on the other. Although their algebraic manipulations smell all the time of group theory and are often easier to understand in group-theoretical language, they sternly resist the temptation to talk in terms of groups. Their strange self-denying ordinance is the more regrettable, because Racah himself is a master of group-theoretical methods.

Perhaps one should not complain that a book like this is too narrow in its scope. The authors in the preface explain what they set out to do, and they do it well. They deliberately decided to walk along a tightrope of pure algebra, without falling into the morasses of physics on one side and of group theory on the other. The advantage of restricting their field in this way is that they were able to deal with their chosen subject thoroughly and with full attention to detail. Still one may wish that their taste had been a little less puritanical.

Quantitative Molecular Spectroscopy and Gas Emissivities. By S. S. Penner. 587 pp. Addison-Wesley Publishing Co., Inc., Reading, Mass., 1959. $15.00. *Reviewed by Rolf Landshoff, Lockheed Missiles and Space Division.*

PHYSICISTS, chemists, and engineers are vitally concerned with high-temperature phenomena among which the processes of emission and absorption of radiation play a dominant role. An understanding of such radiation processes is essential to the solution of problems which involve for example the interpretation of observed spectra, the minimization of radiation losses, the utilization of radiative transfer of energy, or the control of destructive effects of radiation. Such problems appear every day and it is very useful that the relevant concepts and techniques have at last been made more accessible.

Prior to the publication of this book the scientist involved in these problems had to consult many sources such as Heitler on the theory of elementary radiative processes and Herzberg on molecular spectroscopy, which contain much of the information collected by Penner but also a great deal which is only of interest to specialists in other fields. In addition to information which is, with some labor, available in standard texts, the author also presents an up-to-date discussion of many specific results. Several chapters are devoted to the radiative properties of specific atoms and mole-

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cules. Experimental and theoretical results covering absolute and relative intensities and line widths are discussed in some detail for a few representative molecules and references are given for others. The skeleton of concepts and the meat of individual data make up roughly the first half of the book. In the second half they are combined into a body which is then put to work on a variety of practical problems. A large amount of space is devoted to the theory of infrared emissivities, where the population of molecular levels is in thermal equilibrium. Since radiation is usually not in thermal equilibrium with matter this lack will in general also upset the thermal equilibrium of matter and this leads to a description involving several "temperatures" which is presented in two chapters on flames. Two final chapters deal with practical problems concerning solid and liquid propellants.

In approaching radiative transfer problems the author attempts to formulate a method which is based on hemispherical emissivities. These are directional averages which do not lend themselves very well to the formulation of an equation of transfer and in the attempt to overcome this deficiency the mathematics gets somewhat tangled up. There are mysterious factors $\cos\theta$ which appear from nowhere. I have a feeling that there are some good ideas buried in this chapter but until someone cleans up the mathematics I shall continue to use the more standard methods as discussed for example in the writings of Chandrasekhar.

In the preface the author states that "in the selection of subject matter he has been strongly biased by the original researches performed by his own group. Nevertheless an effort has been made to prepare a coherent study." The extensive bibliography at the end of each chapter should prove very valuable in this respect. In addition to its use for the research scientists this book also is aimed at students in applied science and each chapter contains a number of problems. It appears to the reviewer that some of the so-called hints going with these problems are not very useful. One such hint, for example, refers to a technical report issued at the California Institute of Technology, and a student in a foreign country might have a hard time locating this reference.

This book definitely fills a gap which has been painfully apparent for some time. It should prove very valuable to research workers confronted with high-temperature problems which involve radiation.

Fluid Dynamics. By D. E. Rutherford. 226 pp. (Oliver & Boyd, England) Interscience Publishers, Inc., New York, 1959. $1.95. *Reviewed by J. Gillis, The Weizmann Institute of Science.*

THE University Mathematical Texts series has by now an established place in the mathematical education of undergraduates at British universities, but its usefulness extends over a very much wider field. This latest addition to the series is particularly welcome. It presents basic hydrodynamics in a refreshing way, combining mathematical rigor and exactitude with physical insight.

The book begins with the standard material on non-viscous incompressible flow. The welcome surprise follows in the form of a long chapter, indeed the longest in the book, on compressible flow. This includes linearized theory, a substantial discussion of shock waves, the Prandtl-Meyer expansion, the hodograph transformation, and many ancillary topics. The student familiar with the chapter may still be far from expert on compressible flow, but he will have many of the basic notions and will have a good idea of where and how to pursue the subject. The last chapter is devoted to a short and mainly qualitative account of boundary layer theory.

The Theory of Optimum Noise Immunity. By Vladimir A. Kotel'nikov. Translated from the Russian by R. A. Silverman. 140 pp. McGraw-Hill Book Co., Inc., New York, 1959. $7.50. *Reviewed by George L. Turin, Hughes Research Laboratories.*

THE American engineer is apt to be rather lacking in his knowledge of other languages and of foreign technical literature—especially so, sadly, if the language and the literature happen to be Russian. To this, and to the only recently diminishing unavailability here of Russian technical works, must be attributed the almost complete overlooking in this country of Kotel'nikov's important work on optimum communication systems. Originally a 1947 doctoral dissertation, and subsequently published (with minor modifications) in the USSR as a book, *The Theory of Optimum Noise Immunity* is now generally available in an excellent English translation. Only a brief scanning of the volume will convince the statistical communication theorist and the communication system engineer of the unfortunateness of the thirteen-year delay, for they will find that the author anticipated by several years much of the fundamental English-language literature in the field.

The book covers areas of what we should call the application to communication systems of hypothesis-testing and estimation theories, where the term "optimum noise immunity" refers to the minimization of an error criterion (probability of error, mean-square error). After a brief introductory section which presents the necessary mathematical tools, the remainder of the volume is devoted successively to the problems of digital communication, continuous-parameter transmission (e.g., telemetry), and waveform transmission and restoration. Those versed in modern communication theory will recognize many now-familiar concepts: the a-posteriori-probability computing receiver, minimum-variance parameter- and waveform-estimating receivers, geometrical (signal-space) models of communication systems, the sampling theorem, the noise-threshold effect, etc. Detailed general analyses of the performance capabilities of optimum communication systems are also presented, and the author, no pure theoreti-