inelastic and rearrangement collisions. Chapter 10 contains a discussion of invariance principles and their implications for scattering. In Chap. 11, the modifications necessary in the case of particles with spin are discussed. The final chapter is concerned with rather different topics, such as the distorted-wave approximation, scattering by a many-body system, and deals with the optical potential and resonances. The book is non-relativistic but attempts to carry out many of the discussions in the form which lends itself to generalization into the relativistic domain. The authors have paid considerable attention to details. For example, they adopt a consistent notation throughout the work.

A possible weakness of the book is the fact that it contains practically no illustrations of theory in relation to experimental data. This raises a question of philosophy as to whether in a first treatment of scattering it is wise to be concerned exclusively with the mathematical aspects of the scattering theory in contrast to its applications to atomic or nuclear physics. Here one is confronted with the prejudices of the reviewers who tend toward the feeling that the mathematics of scattering may be viewed as a branch of applied mathematics, whereas scattering theory together with representative applications becomes a branch of physics. Apart from this possible philosophical prejudice, the book deserves considerable praise.

All in all, the authors have produced a clearly written and useful book that is intermediate in scope between the all-too-brief treatments given in quantum mechanics texts and the comprehensive treatments such as Goldberger and Watson and Mott and Massey.

A. E. S. Green
B. S. Thomas

University of Florida
Gainesville, Florida 32601

October 31, 1967

About the Reviewers: Alex E. S. Green has been a Graduate Research Professor in the Department of Physics and Astronomy at the University of Florida since 1963 where he is conducting theoretical research programs in aeronomy and in meson-nuclear physics. Dr. Green received his graduate degrees from California Institute of Technology and the University of Cincinnati following earlier training at the College of the City of New York. He has held academic appointments at the University of Cincinnati and at Florida State University, where he directed research with the tandem Van de Graaff, and from 1959 to 1963 he was at General Dynamics Convair as Chief of Physics and as Manager of the Space Science Laboratory.

Billy S. Thomas is an Assistant Professor in the Department of Physics and Astronomy at the University of Florida. He attended Wayne State University and completed his graduate work in 1959 at Vanderbilt University. Dr. Thomas was a National Research Council Fellow. At the University of Florida since 1960, he is currently working on the theory of atomic and molecular scattering.

The Theory of Neutron Slowing Down in Nuclear Reactors. By J. H. Ferziger and P. F. Zweifel. Pergamon Press (1966). 310 pp. $13.50.

Sciences, today, tend to grow into maturity at a rather early age. Like many other new sciences, reactor physics has developed very quickly since the end of the Second World War. Perhaps for this reason the literature of reactor physics is somewhat disorganized. Much important work remains dispersed in obscure technical publications where it is difficult to find, and easily overlooked. Some of the best reactor physics work, the early work on slowing down, used to be the least accessible, but I'm happy to see that, thanks to the efforts of Ferziger and Zweifel, this is no longer true.

In their book Ferziger and Zweifel cover several different, though related, topics. They are at their best, I think, in sections dealing with a field one might call "classical" slowing down theory. I refer, here, to studies by Placzek and Marshak on slowing down in infinite media; to the P_L and B_L approximations in simply buckled systems; to the age, Selengut-Goertzel and Greuling-Goertzel approximations; to the moments method, and the theory of slowing down kernels. All these topics are treated very well.

In one section, for example, the authors discuss the relation between the B_L and P_L approximations. They bring out very clearly the various connections between these approximations, and the reasons for the superiority of B_L over P_L methods. Another particularly interesting section deals with the form of the differential cross section for elastic scattering. Ferziger and Zweifel show how this cross section is constructed, from its center of mass components, with the aid of the $T_{LL'}$ transformation matrices. Though the notation and techniques used here were developed some time ago by Hurwitz and Zweifel, their approach is probably still unfamiliar to many reactor physicists. I suspect that most readers will find both these sections, and many others like them, extremely helpful.

One gets the impression that classical slowing down theory is the principal subject of this book. Many other subjects are discussed, but they are not handled with nearly as much skill and care. Thus, for example, the sections on resonance capture have important defects. The term "resonance integral" is used, but is not very clearly defined. The NRIA equations are not explicitly derived, and they are written incorrectly on pp. 103 and 109. Moreover, the authors do not mention the development of the IR approximation, the most important development in the theory of resonance capture since 1962.

There are weaknesses, also, in the treatment of transport theory. It is asserted, on p. 138, that interface conditions in P_L approximations are trivial, and that all P_L moments are continuous at interfaces. But this is true only in one dimension, and only when L is odd. In fact, it is not very easy to derive interface conditions that are appropriate for use in multidimensional spherical-harmonics equations.

On p. 140 there is an error for which Ferziger and Zweifel cannot really be held responsible. The authors say that Marshak's boundary conditions are more accurate than Mark's in low P_L approximations, but less accurate in high approximations. This theory seems to have originated in Davison's book, and it was widely accepted when Ferziger and Zweifel wrote their book. Recent numerical work by Pellaud (*Trans. Am. Nucl. Soc.*, 9, p. 434) and by Schmidt and Gelbard (ibid, p. 432) indicates, however, that Marshak's conditions are generally better than Mark's in all P_L approximations.

In summary I would say that Ferziger and Zweifel have written a very good book on classical slowing down theory. Their book will also be useful to many students as an introduction to resonance escape theory, to transport theory, and to the numerical methods used in reactor computations. But many parts of the book that deal with these peripheral subjects could be substantially improved.

E. M. Gelbard

Bettis Atomic Power Laboratory
West Mifflin, Pennsylvania 15122

August 10, 1967

About the Reviewer: Dr. Gelbard is an Advisory Scientist at the Bettis Atomic Power Laboratory, and a Fellow of the ANS. He received a PhD in Physics at the University of Chicago in 1954. Since that time he has worked at Bettis, where he has specialized in the development of numerical methods for use in reactor physics computations.

Neutron Noise, Waves and Pulse Propagation. AEC Symposium Series 9, CONF-660206 (May 1967). 761 pp. $3.00.

This book is the proceedings of a symposium held at the University of Florida in February, 1966. As such, it is a record of the status of the field at that time. Comparison with the Proceedings of the previous Florida conference (*Noise Analysis in Nuclear Systems*, AEC Symposium Series 4, TID-7679), held just over two years prior, shows how the field had developed during that interval.

A few specific topics will serve as examples. First, there is the technique of pseudorandom binary cross correlation. The original work on the technique was reported at the previous conference. The present conference had a number of papers dealing with the use of the technique in the measurement of transfer functions of critical and subcritical reactors and the determination of the characteristics of nuclear-rocket propellant systems.

Another new technique that was discussed by its originators is the method of measuring reactor noise by taking the cross correlation between the signals from two detectors. This simplifies the interpretation of the measurements by giving the detection-noise component a zero expectation value, and allows some relaxation of the detection-efficiency requirement.

There is also mention of the "polarity correlation" method of noise analysis, in which correlation functions are calculated for two-valued variables, whose values at any time depend upon whether the corresponding observed random variables are above or below their means. The method greatly facilitates the use of digital techniques at a cost of very little loss of information.

A great deal of work is reported, both theoretical and experimental, in the area of space-dependent reactor kinetics. A large segment of this deals with neutron-pulse and neutron-wave experiments and their interpretation in terms of dispersion functions. It is shown that results of the P_1 approximation (telegrapher's equation) do not agree with the experimental data as well as do those of diffusion theory, although the difference appears only at very high frequencies.

Consideration is given to the application of noise analysis to the acoustic and gamma radiation produced by reactors. Finally, there is a great deal of theoretical and experimental work directed toward the application, extension, and elucidation of older methods of noise analysis.

The papers are of uniformly high quality, and are well ordered by subject. The physical quality of the book is excellent. However, because of the $1\frac{1}{2}$-year publication delay, the book does not show the very latest advances in a number of areas.

Charles Erwin Cohn

Argonne National Laboratory
Argonne, Illinois 60439

October 30, 1967

About the Reviewer: The reviewer is a physicist at the Argonne National Laboratory where he has had interest in experimental nuclear and reactor physics, particularly in reactor kinetics and noise analysis, since 1956. Dr. Cohn had his training at the University of Chicago where he held a National Science Foundation fellowship.

Radioisotope Measurement Applications in Engineering. By Robin P. Gardner and Ralph L. Ely, Jr. Reinhold Publishing Corporation (1967). iii + 482 pp. $16.00.

This volume was prepared as a text for radioisotope methods (under the auspices of the U. S. Atomic Energy Commission). The two authors are connected with the Research Triangle Institute and North Carolina State University. The text is organized into four major subject areas: characteristics of nuclear radiation (six chapters), radiotracing (three chapters), radiogauging (four chapters), and radiography (one chapter). At the close of the book, fifteen laboratory experiments are presented which correspond to the four areas of the text.

The authors suggest the book for a two-semester, three-credit course with two lectures and one laboratory or problem period per week. The book appears to be particularly useful for teaching because of its problems and laboratory exercises.

In this text the authors' goal is to cover the basic material pertinent to applications rather than to cover a large number of applications and, as a result, the book has only limited use as a general sourcebook on radioisotope applications.

In the first part of the text, 156 pages are devoted to nuclear reactions, radioisotope decay processes, sources and interaction of radiation with matter, radiation detectors and their response, and radiation safety. This brief coverage is intended to serve as introductory material for engineers who are not familiar with radiation or radioisotopes.

The following sections of the book describe a variety of applications and reflect the experience and work of the authors. As a result of this "selective" coverage, the text will be particularly helpful to an engineer or scientist interested in a better understanding of the fundamentals and the mathematics relating to the well-described applications. The applications which are covered most thoroughly are: (1) studies of the frequency response of systems; (2) the determination of particle size by sedimentation; (3) the study of the batch grinding of coal relating to the ability to predict the size-weight distribution and to determine performance of the grinding system; (4) a study of two-component flow systems including suspensions, powder slurries, gas liquid systems (void fraction in water-steam system), and two-component liquid solutions; (5) soil moisture and density gauging; and (6) determination of salt content of aqueous solutions.

Other applications, covered in less detail, include determining: fluid properties; flow patterns and rates; leak detection; tracer dilution; isotope dilution; wear; mixing and residence time; laminar flow; diffusion and mass