Random Noise Techniques in Nuclear Reactor Systems. By Robert E. Uhrig. Ronald Press Company, New York (1970). 490 pp. $20.00.

This book deals with the current state-of-the-art in application of noise techniques to reactors. It covers in breadth and depth the theory, equipment, and techniques needed for such application. Therefore, it will be extremely useful to those in the nuclear field, as well as in other fields, who have use for these powerful methods.

The book begins with a review of basic concepts of probability and statistics and goes on to analysis methods based on observation of individual neutron counts. These include the classical Rossi alpha and Feynmann variance techniques, as well as the newer Bennett variance, distribution of counts or intervals between counts, deadtime and correlation methods. (This reviewer must take exception to the statement on page 51 that "The basic cause of the statistical fluctuation of the neutron population in most zero-power nuclear systems is the variation in the number of neutrons produced in each fission." Rather, the basic cause of the fluctuations is the randomness of all neutronic reactions. There would be fluctuations even if all fissions produced the same number of neutrons. Also, it should be pointed out that variance methods are not restricted to pulse counters. Current detectors may be used if means are provided for integrating their outputs.)

The basic theory of correlation functions and power spectra is treated, as well as the theory of reactor noise, in both the simple point-reactor and more elaborate space-independent models. The theory of practical noise analysis techniques is also covered, including the precision of noise measurements as affected by finite bandwidth and record length and by coherence in cross-spectral measurements. (The error in a two-detector cross-power spectrum measurement, a matter of considerable practical interest, is not explicitly discussed.)

The details of analog instrumentation for probability density, correlation function, and power spectrum determination are treated, including such devices as tape-loop delays and practical bandpass filters. Coverage of data acquisition, transmission, and recording includes brief mention of neutronic transducers and discussion of transducers for pressure, temperature, flow, and vibration. A more detailed discussion is given of data transmission, analog telemetering, analog and digital magnetic-tape recording, and some coverage of analog-to-digital conversion. (The matter of elimination of hum pickup and other extraneous inputs is briefly mentioned. It cannot really be overemphasized, because it is frequently a major stumbling block in the execution of noise experiments.)

The treatment of analysis techniques involving system excitation with pseudorandom binary and ternary sequences is very comprehensive, and includes detailed prescriptions for generating various types of sequences. A discussion of methods for digital processing of noise records to obtain correlation functions and power spectra is also quite complete and includes brief mention of the Fast Fourier Transform (FFT). That is limited, however, to a discussion of the capabilities of the technique. The actual structure of the FFT algorithm is not discussed, but suitable references are cited.

The book culminates in a discussion of a variety of actual noise experiments. These include both time and frequency domain measurements on subcritical and zero-power assemblies, as well as analyses of neutron flux and other plant variables in power reactors. The diversity of techniques employed serves well to illustrate the application of the principles presented earlier.

This brief summary should indicate the completeness of the book. Undoubtedly the availability of such a comprehensive account of the present state-of-the-art will stimulate further advances in the field as well as greater utilization of the capabilities of noise techniques.

Charles E. Cohn

Argonne National Laboratory
Argonne, Illinois 60439

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About the Reviewer: Charles Cohn has been active in reactor noise analysis at Argonne National Laboratory since 1956 and has contributed to these columns previously. His graduate training was at the University of Chicago.

Intermediate Energy Nuclear Physics. By W. O. Loch and D. F. Measday. Barnes and Noble, Inc., New York (1970). 320 pp. $13.50.

The progress of fundamental physics research is measured by the energy of its accelerators. Thus, in the days when I was just starting graduate school (some twenty years ago) accelerators in the range of several hundreds MeV were producing the exciting results. Just a few years later, the Cosmotron and Bevatron were producing protons of several GeV energy and led, among other things, to the discovery of the antinucleons. From there, the next quantum jump was to about 30 GeV, and today plans are underway to construct an accelerator at the National Accelerator Laboratory which, it is hoped, will eventually go to 500 GeV. These very high energy machines (and the proposed ultra-high energy machines) have led, and will no doubt continue to lead, to the confusing situation in high energy physics where many new particles have been discovered, and empirically classified, without a solid theoretical understanding of the underlying phenomena involved.

Meanwhile, the machines in the several hundred MeV range are still important, and indeed, new ones are being built, the concentration being on high beam currents (notably, the Los Alamos "Meson Factory"). The idea is to use these machines as a tool to understand nuclear structure, an area of research which has become "applied" by comparison with the study of "fundamental" particle physics at much higher energies.

The subject book is intended to review the status of experimental research in this "applied" area, and does a creditable job. It covers, in some detail (Chaps. 5 through 11), the experimental objectives, procedures, and some of the known data in the area of pion, gamma ray, and electron interactions with nucleons, and nuclei, nucleon-nucleon reactions, and nucleon-nucleus reactions. The volume should serve as a useful tool to the research worker in this energy range in that it provides an overall view of the experimental situation and a good bibliography (to about 1968). Details of experimental technique are lacking (appropriately so, I feel). On the other hand, the theoretical discussions, in Chapters 2, 3, and 4, are largely superficial. I would recommend that the research worker in the field first study something like Gasiorowicz's treatise "Elementary Particle Physics" or Frazer's book *Elemen-*

tary Particles. For the ANS member who merely wants to keep up with the important research being done in the energy region up to about 1 GeV, the book by Loch and Measday could be read with profit.

Paul F. Zweifel

Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

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About the Reviewer: We again welcome Paul Zweifel, professor of physics, Virginia Polytechnic Institute, to these columns as one with a broad and interesting background in physics and engineering in academic institutions and in both government-operated and industrial laboratories. His formal training was received at Carnegie Institute of Technology and Duke University.