There is some subtle humor, such as the explanation of the discrepancies between the British and USSR phase diagrams of Pu alloys being caused by the presence of "foreign" atoms. Wartime secrecy on the plutonium work has left some amusing scar tissue, such as the statement that for refractories for melting plutonium "compounds based on calcium, e.g., the fluoride or oxide, or cerium, e.g., the sulfide, may well meet (the) requirements." Also some understatements, such as the one concerning the criticality hazards of handling plutonium: "Beyond this point (criticality) the radiation hazard due to $\gamma$-rays and neutrons is vastly increased and the risk of explosion may be introduced."

The only reactor specifically referred to in the book is the Dragon, in the section on thorium. Perhaps this indicates, subliminally, enthusiasm for this concept.

Other evidence of provincialism is in the section on ceramic fuels in the statement, "To avoid the need for excessive enrichment a large number of uranium atoms per unit volume of fuel is desirable." It is not stated what is "excessive," nor are the possible advantages of diluted fuel discussed at all. In the same section the statement is made that "when minor additions are made, these are usually intended to ease fabrication." Some reference to the increase of thermal conductivity, the decrease of fission product damage, and the effect on temperature coefficient of diluted fuels would have been pertinent here.

In the section on graphite some unusual language is used. The flow of gas through the pores which is not dependent on the pressure is called slip flow, although this is usually called slip flow plus Knudsen flow. Also molecular weight is referred to as molecular complexity.

Nothing is said about the remarkable success both in England and in this country in decreasing permeability of graphite by impregnation and baking. This is somewhat surprising since the success of the Dragon reactor depends on this technique.

The conclusion that the corrosion rate by $CO_2$ on beryllium is negligible at 500°C in both wet and dry gas, given on page 305, does not seem to be in agreement with information in this country.

The book is easily readable, useful, and suitable for reference. It is more a prayer book than a Bible, but will give the nuclear engineer some general everyday guidance on what to expect and what not to expect from certain materials. Naturally to design a successful reactor, more religion is needed.

E. Creutz
*General Atomic Division*
*General Dynamics Corp.*

*(Editor's Note: Our reviewer, Edward C. Creutz, is Vice President — Research and Development — of the General Atomic Division of General Dynamics Corp. He is also the Director of the Division's John Jay Hopkins Laboratory for Pure and Applied Science. Previously he was head of the Department of Physics and Director of the Nuclear Research Center at Carnegie Institute of Technology. He received the Ph.D. degree from the University of Wisconsin and for two years thereafter was an instructor at Princeton. During the war he headed the first group to undertake metallurgical studies of uranium, beryllium, and aluminium for the Manhattan Project. He also worked with Professor E. P. Wigner at Princeton on measurements of resonance absorption of neutrons in uranium.)*

**Radioisotope Laboratory Techniques.** By R. A. Faires and B. H. Parks. Pitman, London, 1960. xii + 244 pp. $5.75.

The authors' preface states that this book is intended as a practical guide to the use of radioisotopes, stressing the practical rather than the theoretical. They have attempted, using their experience at the Isotope School at Harwell, to provide in this compact volume information that will enable a scientist to use radioisotopes safely and effectively. In severely limiting the size of the book, the authors have chosen to omit the more unusual applications, and to present a broad, rather than detailed, picture of the subject.

The book is divided into four main sections—nuclear and radiation physics, safety, detection and measurement, and examples of radioisotope application. Approximately half of the total space is devoted to methods of radiation detection and measurement. The first three chapters cover briefly but adequately the elementary nuclear physics of radioactive isotopes, the properties of alpha, beta, gamma, and neutron radiation, and the methods by which radioisotopes can be produced. The discussions of accelerator-produced and carrier-free radioisotopes are particularly clear and meaty. Oddly enough the production of radioisotopes in fission is not mentioned, although a few fission products are listed in an appendix.

An excellent chapter on the absorption of radiation energy in tissue serves as a bridge between the sections on physics and safety. The treatment of radiological safety is always a problem in books of this sort, since the hazards are so strongly dependent on the types and quantities of radioactive nuclides used, and also on the nature of the experimental work. The problems involved in the use of tracer quantities of carbon-14 or sulfur-35 are so trivial in comparison with those which arise when large quantities of powdery materials, or of isotopes like radium and strontium-90, are handled that they really cannot be discussed together. As a result, laboratory facilities and procedures appropriate for a moderate-to-high radiation level are often prescribed as general requirements. Even though the authors recognize this problem and refer to various levels of hazard on several occasions, this reviewer cannot help but feel that the general *tone* of these sections is such as to discourage the use of radioisotopes as requiring too expensive facilities and too burdensome restrictions. To avoid a charge of over-general criticism, two specific areas will be cited. First, excellent tracer level work is being done safely in many very conventional laboratories with the addition of only an isotope storage area, an area for making initial dilutions, and simple monitoring equipment. Secondly, at least under the regulations in effect in the United States, the vast majority of isotope users can (and do) discard their radioactive tracer wastes directly into the sewer system, with only the most elementary precautions.

The treatment of the theoretical aspects of radiation measuring instrumentation is surprisingly clear and adequate for such a compressed presentation. I was particularly impressed by the chapter on Special Counting Techniques. Although the description of each technique is necessarily too short to be comprehensive, enough information is given to permit a judgment by the reader as to whether a technique warrants further investigation for his specific problems. One might have hoped, under these circumstances, for a rather more extensive bibliography on these procedures. It is not really possible for an American reviewer to comment intelligently on the more detailed material on equipment since reference is almost exclusively to specific British instruments.

To sum up, the authors have partially succeeded in their aim. The chief value of the book would appear to be as an introduction to radioisotope techniques for the novice in the field, for a general view of the possibilities and requirements. It is to be hoped that he will have more detailed information and training before he tries to apply radioisotope techniques to his work.

ABRAHAM S. GOLDIN
*New York University Medical Center*
*New York, N. Y.*

*(Editor's Note: Our reviewer, Abraham S. Goldin, has specialized in environmental radionuclide analysis, radioactive pollution, and radioactive wastes. He received his Ph.D. degree from the University of Tennessee. From 1943 to 1950 he worked first for the Manhattan District in Columbia and later for the Gaseous Diffusion Plant at Oak Ridge. Following this, he spent nine years with the U.S. Public Health Service in Cincinnati as chief radiochemist. He was for a time the Chemical Director of the Atomic Energy Commission's Winchester Laboratory and is presently an Associate Professor of Industrial Medicine at New York University.)*

**Nuclear Reactor Optimization.** By P. H. MARGEN. Simmons-Boardman, New York, 1960. 79 pp., 31 figures. $1.75.

Mr. Margen is a reactor designer and heat transfer specialist. Educated in England, Margen joined the Swedish Atomic Energy Company in 1955. At present he is head of the Reactor Engineering Department and Deputy Director of the Industrial Reactor Division in that organization.

In his preface the author expresses his aim—that the methods "described in this monograph allow a single designer, supported by a physicist, to achieve the optimization of the main variables in a reasonably short time even without mathematical computers." The book is consequently more valuable for its philosophy than for the direct application of its method. It is doubtful that any project as costly as a power reactor system would not be supported by optimization computations using more refined engineering formulas and more precise mathematical methods. The cost of optimization by machine computations is offset many-fold when even small improvements in the design are effected.

Fourteen independent variables including reactor, lattice, and heat exchanger dimensions, coolant flow and flux flattening, are optimized by the method. The logic is divided into three major blocks, beginning with an initial guess for the design. The reactivity, the heat transfer in the primary coolant loop, and the thermodynamics of the steam plant are optimized in sequence and then the process is iterated. If optimizing is done separately in each block only one or two over-all iterations seem to be necessary. An example is worked out for a 250 MWe reactor with high temperature $CO_2$ coolant and a $D_2O$ moderator. The fuel assemblies are clusters of $UO_2$ rods where the number of rods in the cluster and the enrichment are determined by the optimization.

While the treatment lacks refinement of detail it does achieve breadth and generality. Unified into a single calculation are factors too often dealt with independently by the fuel accountants, core designers, heat transfer engineers, and plant economists. In order to do this and yet to preserve the mathematical simplicity he has set as his aim, Margen relies on empirical formulas. This technique is the fundamental point of the monograph. Particularly in the treatment of core data does Margen's approach bear fruit. Any phenomenon can be described in the range of interest by simple and routine operations such as polynomial expansion and tabulation. One can ill-afford to be too fastidious to employ these tools.

I am inclined to take issue with the assertion on page 14 that, because of the lack of sufficiently precise data, "hair-fine optimization of the reactor physics design is not as yet justified." It is indeed true that some areas remain where the lattice data are inadequate, but many other situations exist where precise data have not yet been fully exploited. Furthermore, differential information provided by iterating the optimization can permit the designer to estimate the money that should be spent on an experimental program to obtain these data. Here, by the way, is another reason why the optimization should be performed on a computer: the calculations will have to be repeated many times under varying conditions.

A realistic balance has been achieved in dealing with the components of the design, as based upon their relative effects on the cost of power. Indeed, the flowsheet on page 28 could be used as a skeleton for any optimization process, and the illustration of empirical relations to incorporate the data suggests almost unlimited application in other areas. Every designer of power reactors should be acquainted with this little book.

The monograph is one of a series of paperbacks entitled "Nuclear Engineering Monographs." High standards of technical writing, editing, and printing have been maintained throughout so that the set offers a readable yet succinct survey of the working methods of our English counterparts.

H. D. BROWN
*E. I. du Pont de Nemours and Co., Inc.*
*Savannah River Laboratory,*
*Aiken, South Carolina*

*(Editor's Note: Dr. Brown is in the Theoretical Physics Division of the Savannah River Laboratory. He has recently returned from assignments with the Halden (Norway) Boiling Water Reactor and with the Reactor Division of the International Atomic Energy Agency. At present he is working on a computer code for the optimization of heavy water power reactors.)*