ested in the latest exciting developments on yin-yang coils, stellarators, and, of course, tokamaks, I strongly urge you to read the introductory few pages and the last section entitled "The Next Ten Years—And Beyond." The author, whose distinguished credentials are familiar to all, breathes here a spirit of fiery optimism. The tone may best be conveyed by quoting a single sentence—"Given a source of energy that is abundant, economical, and nonpolluting, mankind need have no fear of the future—without it he must again become Markham's 'Man With The Hoe'." For the veterans of nuclear fission technology—weary, bloody, and often bowed—it has a familiar 1945-ish ring. The temptation is great to shake our grey locks and warn that the fusion enthusiasts have a lot to learn. We might point out that the technology for molten lithium is at present mostly hypothetical and that there are likely to be massive engineering problems in operating cryogenic superconducting magnets in close proximity to such intense sources of radiant energy. We could suggest that a 5000 MW D-T fusion reactor, with its huge tritium inventory and tremendous leakage of penetrating 14 MeV neutrons, could hardly be described as nonpolluting or hazard free. But who knows—maybe Post is right after all. Now all we have to do is convince the U.S. Congress, the American public, and J. W. Gofman.

This reviewer has several times gone on record deploring the usual collected volume of review or survey papers. Even when the articles are of high quality (all too rare) the topics may be so specialized that any one reader is usually interested in only one or two of the papers. The high cost of these volumes then in effect bars him from making suitable use of those particular papers of value to him. It is only proper to note therefore that the *Annual Review of Nuclear Science* goes a long way to meeting these objections. The authors have always been distinguished in their specialties and the articles are therefore most often of corresponding high quality within the limitations of the format. The price of each volume is reasonable, certainly by today's standards, and bona fide students can obtain a further discount of 20%. And this year, arrangements were instituted to provide reprints of individual papers for $1.00 each. The *Annual Review of Nuclear Science* deserves a salute from the scientific community it serves. Long may it flourish!

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About the Reviewer: Dr. Goldstein, professor of nuclear engineering, Columbia University, returns to the Book Review section of Nuclear Science and Engineering *with his usual forthright style. As author, teacher, and investigator, he needs no introduction to the nuclear community.*

Nuclear Reactor Theory. By George I. Bell and Samuel Glasstone. Van Nostrand Reinhold Company (1970). 610 pp. $24.50.

Since its title promises nothing very unusual, it is easy to assume that this book is just another introduction to reactor physics. Therefore, I think it important to point out very quickly that *Nuclear Reactor Theory* is quite different from any other book already on the market. It is, in fact, not a primer on reactor theory but a comprehensive exposition of reactor physics at an intermediate level, addressed to readers already familiar with fundamental principles. This group of readers has been somewhat neglected in the past.

But the level of presentation in this book is not its only novel feature. It seems to me that the authors have given us, here, the first combined and integrated treatment of reactor physics and practical reactor computational methods. Their emphasis is definitely on physics, not on numerical analysis or applied mathematics; still, Bell and Glasstone's extensive coverage of computer codes and reactor computations, generally, is excellent as an introduction and is very valuable, even to the specialist, as a guide to the technical literature. From this book the reader can get a fairly realistic picture of the work of the reactor physicist in a typical laboratory environment dominated by huge computers. Only a nicely blended presentation of reactor physics and reactor computational methods can give such a clear and realistic picture.

Unfortunately, it is difficult to combine so much material into a single volume, even one as large as this. It is not surprising, then, that in some areas the presentation is rather skimpy. For example, Bell and Glasstone deal with Monte Carlo in only three pages. For readers totally unfamiliar with the Monte Carlo method these pages will be helpful; others will find this rudimentary treatment disappointing. More typical, however, is the patient and skillful development of other computational methods such as, for example, the P_N and S_N methods.

Bell and Glasstone start their book with careful derivations of the integral and differential transport equations in various geometrics. Important properties of the one-speed transport equation, and important solution techniques are discussed extensively in Chap. 2. Here the infinite-medium Green's function is derived twice, once by Fourier transform methods and once by Case's method. The use of Case's method at this point is a typical Bell and Glasstone innovation, typical in that Bell and Glasstone have consistently avoided blind acceptance of traditional modes of exposition. Throughout their book one sees the influence of recent developments and new ideas. Of course, the Bell and Glasstone treatment of Case's method is very elementary. Mathematical difficulties are quickly set aside, but what remains is still a clear first glimpse of Case's method in its simplest form.

In this second chapter, also, the authors formulate the slab P_N equations, and perhaps a comment on their derivation is in order. They say, on p. 87, that the spurious source required to convert the transport equation into P_N equations is equal to $(N + 1)\phi'_{N+1} P_N/4\pi$. In Weinberg and Wigner (p. 266) one finds, instead, the expression $(N + 1)\phi'_N P_{N+1}/4\pi$. To the reader who stumbles onto it, this discrepancy may prove confusing. Actually, both sources yield the same ϕ'_ns for $0 \leqslant n \leqslant N$. The latter source is so devised, however, as to guarantee that $\phi_n = 0$ for $n > N$. For this reason it is usually used in theoretical work on P_N methods; it is this latter source, rather than the source defined by Bell and Glasstone, that the reader will usually see elsewhere.

P_N equations are discussed more fully in Chap. 3 where, also, the double P_N equations are first introduced. The authors say something here about computational methods, but not as much as I would like. The algorithm used to solve one-dimensional diffusion equations is of fundamental importance in reactor computations. I think, therefore, that this algorithm merits more consideration than Bell and Glasstone chose to give it.

For lack of space I can only deal with other aspects of this book more briefly, and I'll mention only features that strike me as exceptionally noteworthy. Three chapters seem particularly good to me. One is Chap. 6, which starts with an excellent discussion of the meaning of the adjoint function and the properties of this function. The others are the final chapters, Chap. 9 and 10. These deal with many time-dependent problems (e.g., reactor dynamics and stability problems, burnup problems, xenon oscillation problems), and the computational methods used to solve them. It is interesting that the authors have adopted A. F. Henry's approach in deriving point kinetics equations. As a result, the sections on point kinetics and later sections on space-time kinetics are nicely tied together. Here again we have what is, in my opinion, a very worthwhile pedagogical innovation.

I noted, in my first comments, that this book is pitched at an intermediate level. Now, in closing, I feel I should say more precisely what seems to be expected to the reader. It is supposed that he already is familiar with the material covered in introductory texts (Lamarsh's, for example). In addition, it is assumed of our model reader that he knows enough mathematics to follow elementary arguments about matrices, differential equations, and complex functions. *Nuclear Reactor Theory* (which is well supplied with problems) would be appropriate for use by advanced undergraduates or beginning graduate students. I think it also will be useful to many a practicing physicist or nuclear engineer who wants a broader background in reactor theory. I've certainly found it useful myself, and have enjoyed reading it. All in all, in my opinion, it's a very good book.

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About the Reviewer: Ely Gelbard received his PhD in physics from the University of Chicago in 1954. Since that time he has worked at the Bettis Atomic Power Laboratory where he has specialized in the development of numerical methods, and principally in the development of methods designed to solve the neutron transport equation. Dr. Gelbard is a Fellow of the American Nuclear Society, a recipient of an ANS Special Award, and of the Ernest Orlando Lawrence Award.