been to overcome the difficulty produced by a strong interaction between particles at short distances. This problem arose in nuclear physics when high-energy nucleon/nucleon scattering experiments seemed to require the presence of a strong repulsion at close range. Largely through the work of K. M. Watson and K. A. Brueckner, it was shown that one could reformulate many-body perturbation theory to replace expressions involving the very large matrix elements of the two-body interactions by expressions containing the much smaller elements of two-body reaction matrices. The concept of a reaction matrix had been familiar in radiation and scattering theory, chiefly through work of Heitler. The method was used by Watson for treating the scattering of a particle by a many-body system and later by Brueckner for the bound states of many-fermion systems. The lowest approximation for the ground state involves a collection of independent quasi-particles in a self-consistent single-particle potential. This is a generalization of the Hartree-Fock self-consistent field theory and promises to provide a theoretical justification of the nuclear shell model. So far this promise has only been realized in principle. The computations for actual nuclei are quite complicated and tedious, and the results, even for doubly closed shell nuclei, are not as yet in very close agreement with experiment. Rather more effort has been expended in testing the approximations on the fictitious infinite medium of nucleons referred to as nuclear matter.

Kumar's book is a systematic exposition of the literature on the Brueckner theory. An attempt has been made to maintain a critical spirit. The first two chapters present several forms of many-body perturbation theory. The next chapter introduces reaction matrices and shows how the energy shift may be reexpressed in terms of them. The long fourth chapter is devoted mainly to the Brueckner - Gammel calculations for nuclear matter. A brief report of how these have been used for actual nuclei by means of the local density approximation is included. An alternative approach to real nuclei by Eden and Emery is sketched. Unfortunately there is no treatment of the separation method of Moszkowski and Scott, which provides considerable insight into various physical effects described by the Brueckner theory. A six-page discussion of the relation between the normal states given by perturbation theory and the states described by the BCS pairing theory presents many interesting problems.

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Methods in Computational Physics, Vol. I. Edited by B. Alder, Sidney Fernbach, and Manuel Rotenberg. Academic Press, 111 Fifth Avenue, New York 3, New York. 304 pp. $10.00.

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This book is the first of a series to be published by the Academic Press. It is not a single unified work but, instead, a collection of disconnected papers on various topics. It will be seen from the Table of Contents, above, that these papers deal with statistical problems in several fields and that three of the papers have no direct connection with reactor analysis. Nevertheless, according to the preface, authors contributing to this volume have been directed to focus their

attention on numerical methods rather than on physics. Presumably, then, the book is meant for readers who are interested in numerical methods generally, as well as those who are interested specifically in the problems treated here.

Since the book deals exclusively with statistical phenomena it is not surprising that it's authors lean so heavily on Monte Carlo. Except for Carlson all the authors use Monte Carlo, and I shall discuss the Monte Carlo papers first. Of these, the one most relevant to reactor work is, of course, Davis' paper on critical-size calculations. Actually Davis describes not merely a critical-size calculation but a computation of reactor period. It is an analogue computation, basically. An initial distribution of N_0 neutrons is assumed at $t = \tau$ and these neutrons (as well as their descendants[a]) are followed until $t = t_0 + \tau$. At that time the number of neutrons is brought back to N_0 by roulette and splitting, and the computational cycle is repeated, etc.

I would say that two features of Davis' method are particularly noteworthy. First, his approximate treatment of slowing down is efficient and attractive. Second, his use of the kinetics of inelastic scattering (rather than an inelastic scattering matrix) seems a very good idea to me. But the method has severe limitations which he doesn't mention. It becomes unfeasible if the time to reach equilibrium is large, it yields only a crude flux shape, and it may require the manipulation of huge volumes of data specifying resonance cross sections. In short the Monte Carlo treatment of whole reactors (rather than cells or shields, for example) is still, in my opinion, beset with unsolved problems.

It will not be possible, here, to describe the other Monte Carlo papers in detail, but I shall attempt to discuss them briefly. Zerby outlines a computation which is almost entirely analogue, and he gives us a good introduction to some basic Monte Carlo techniques. We note, however, that he does not mention the use of probability tables. When sampling from distributions he always relies on techniques based on the analytic form of the probability function. As Berger points out later, it is often better to store and use tables of the distribution function (if storage space is available).

In all the other Monte Carlo papers, analytic and Monte Carlo methods are mixed in varying proportions and in different ways. We find such a mixture in Fleck's paper, for example. Fleck solves radiation problems in time-steps, breaking each time-step in two. In the first half of a time-step the temperature distribution is taken to be constant, and the photon density is determined by analogue Monte Carlo. Then the computed photon density, held fixed, is inserted into difference equations which determine the temperature distribution. Thus there is, in Fleck's paper, a sharp dividing line between Monte Carlo and deterministic techniques. In Berger's paper and those which follow, this line disappears and the two approaches are inextricably blended.

The Monte Carlo papers are, generally, clear and interesting. They tend to point up the versatility of Monte Carlo and to demonstrate that, in the last few years, it has been used with considerable ingenuity. I think we also see, however, that, in developing Monte Carlo codes for criticality calculations, we still have a long way to go.

In content, Carlson's paper is, of course, quite different from the others. For many readers this paper will be the most interesting of all, since it sheds light on the structure of S_N codes. Carlson deals separately with three of the most important features of discrete-ordinate codes, namely, the distribution of weights and placement of ordinates, the form of the difference equations and the inner iterative process. It seems that the selection of weights and ordinates is still no straightforward matter. Carlson's scheme, like all others proposed so far, is somewhat arbitrary.

For the most part Carlson's paper is readable and clear. I found, however, that the sections on difference equations in curvilinear coordinates were too compactly written and hard to follow.

In summary I would say that this first volume of *Methods in Computational Physics* gives a good (through not complete) picture of current work. It is well worth reading.

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[a]Davis seems to use the word "ancestor" in place of "descendant".