Books

Principles of Numerical Analysis. By Alston S. Householder. 274 pp. McGraw-Hill Book Company, Inc., New York, 1953. $6.00. *Reviewed by P. M. Morse, Massachusetts Institute of Technology.*

Physicists, mathematicians and engineers are now in the throes of learning when a modern high-speed computing machine is useful and when it is not. It used to be that when we had to compute numerical answers we assembled a few tables, a slide rule, perhaps a desk computer and lots of paper and pencils and did our own work, adapting our computing methods, as we went along, to the specific requirements of the work; perhaps changing these methods as the answers came out. Now, if the work threatens to be laborious, we are tempted to ask a "giant brain" to do the job. We then find we have let ourselves in for a lot of work, though of a different kind.

The trouble is, of course, that these giant brains aren't brains; we have to do the thinking for them—*all* of it. We have to foresee *all* the pitfalls in advance and provide for them. All the steps have to be spelled out in detail, all the alternatives, which we used to work out when we came to them, have to be thought through before starting. In some cases this amounts to more work than the old-fashioned way; in many cases though, the results are well worth the effort; computations now can be tackled which were impossibly laborious by the earlier methods. But most of us still are in the process of learning how to use these "labor-savers" and no one can yet be quite sure how much labor he is going to save when he enlists their aid. Which, perhaps, makes it all the more interesting.

But one thing is certain: a good knowledge of numerical analysis is needed before one can hope to get the most out of a high-speed computer. Using a desk computer, one could expect to vary the computing means as the work progressed, according to the needs of the moment. But, now that the planning must all be done in advance, we must know which of the various approximation methods is best for the case at hand and must be able to estimate the final error in the result. This book of Householder is designed to give one the background knowledge needed for the task of planning for a digital machine.

The digital machine reduces all calculus problems to ones of finite differences, all analysis to algebra. Consequently, the subjects dealt with here include the solution of linear equations, the determination of the roots of non-linear equations, the eigenvalue problems related to a matrix, the problems of interpolation and the relationship between differentials and finite differences. There are chapters on each of these subjects and, in addition, there are good progress reports on two subjects, the analysis of computing errors and the Monte-Carlo method, which are rapidly expanding to meet machine programming needs.

This is the first book on numerical analysis to be written specifically for application to high-speed digital computation. It is written in the style of a textbook, with theorems and proofs, rather than as a manual of procedures. The modern fashion of terseness which is adopted makes it slow going, at times, for the novice; this reviewer feels that more general discussions and examples would have made the book more readable. Nevertheless the book will be a most valuable aid to those who are learning how to use high-speed computers.

The Collected Papers of Peter J. W. Debye. 700 pp. Interscience Publishers, Inc., New York, 1954. $9.50. *Reviewed by R. B. Lindsay, Brown University.*

This volume containing in English translation some fifty of the scientific papers of one of the world's great chemical physicists was timed to appear in honor of the 70th birthday of the author on March 24, 1954. The selection was made by Debye himself and reflects his view of the relative significance of his contributions to the fields with which his name will forever be associated, namely: x-ray scattering, dipole moments, electrolytes, and light scattering. A miscellaneous section contains the celebrated paper on specific heats, as well as articles on the scattering of light by ultrasound. The scientific status of each group of papers is summarized briefly in a short introductory article by a well-known authority. The translations are in general commendably clear and straightforward, though there are a few trivial errors which should not trouble the serious reader.

The promoters of this enterprise deserve great credit for making these fundamental papers available to a wider audience. Students of physics should receive more encouragement than they do from their teachers to turn aside occasionally from the standard textbooks to delve into the writings of the authorities on which the textbooks are based. This is particularly true in the case of a master of exposition like Debye, whose articles not only show the keen imagination of a genius at work, but are moreover characterized by careful organization and somewhat unusual lucidity. Here the young student, eager to find out how research in theoretical physics is prosecuted, will find not merely the bare bones of analysis but the physical intuition, the whys and wherefores, as well.

It is unnecessary to stress the versatility which these papers illustrate, ranging as they do all the way from mathematics, in which the author made such a fundamental discovery as the application of method of steepest descents, through classical physics to modern quantum chemistry. In every field studied one senses the uncanny ability to size up the problem from an ap-