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-

propriate physical point of view and to derive a practical physical result with the use of the simplest analysis.

An interesting, though all too brief, biographical sketch of Debye by Raymond M. Fuoss prefaces the collection.

Though the method of production (adopted doubtless for reasons of economy) is satisfactory for the ordinary text material, it scarcely does full justice to the graphs and mathematical equations, which are in many instances a trial to the eyes. This appears to be the only drawback to an otherwise fine production.

The Theory of Metals (Revised second edition). By A. H. Wilson. 346 pp. Cambridge University Press, New York, 1953. $8.50. *Reviewed by R. Smoluchowski, Carnegie Institute of Technology.*

Since the time of its first publication in 1936, Wilson's "Theory of Metals" has become such a well known and useful book that its new, second, edition is bound to meet with greatest interest. The well known characteristics of the book's first edition are still here: mathematical elegance and attention to detail in treatment of basic fundamentals together with rather short or even complete absence of descriptions of less developed or controversial subjects. Just as in the first edition, the accent is on the behavior of electrons in a perfect lattice of a pure monovalent metal, electric conductivity, thermal and magnetic properties and metallic structures. As the author points out in the new preface many theories which looked hopeful in 1936 ran up against serious troubles in comparison with later more quantitative experiments or in application to more complex problems. This necessitated various changes with the result that as compared with the first edition certain sections became considerably enlarged and others are entirely omitted. In the latter category are the early chapters on phenomena dealing with surfaces (rectification in semiconducting contacts, photoelectric effect, etc.), superconductivity, and optical properties. This rather radical surgery is to be regretted since the various theories however imperfect they may be do represent the present boundaries of our understanding of solids and of metals in particular. In fact, the reviewer is inclined to believe that most of the present interest and theoretical activity in the field of metals is focussed on the more speculative and intuitive parts of the modern theory rather than on the all embracing general mathematical formalism. The book is published with great care and typographic neatness.

Physical Meteorology. By John C. Johnson. 393 pp. Technology Press (MIT) and John Wiley and Sons, Inc., New York, 1954. $7.50. *Reviewed by S. F. Singer, University of Maryland.*

The physics of the atmosphere is a subject to which major contributions have come from many other fields of science: astronomy, radio physics, physical chemistry, spectroscopy, etc. Dr. Johnson has succeeded admirably in extracting and presenting the results of work which is spread throughout a very wide literature. As a consequence we have here a book which deals in a refreshingly direct manner with a great number of topics in physics which find application to the atmosphere. Excluded are meteorological phenomena, dealing with atmospheric circulation.

I think this book will appeal very much as a text to any serious student of physical meteorology. The presentation is fairly elementary, interesting, well-illustrated and sufficiently complete. Each chapter is followed by problems, by selected and up-to-date literature references, and by a list of source books. The specialist will like the book as a reference volume since he is not likely to be a specialist in all the topics presented here. These include: a general treatment of the physics of refraction and scattering of electromagnetic waves in the atmosphere and by small bodies; a specialization to radar waves and visible radiation; applications to atmospheric visibility, radar meteorology, rainbows, to mention just a few. Radiation processes in the atmosphere; heat budget, cloud physics and applications to artificial precipitation. A brief review of properties of the upper atmosphere, ionosphere, and ozonosphere. A fairly detailed discussion of atmospheric electricity.

As can be seen from this brief list the topics range from the mathematical theory of diffraction to discussions of aircraft icing. However the emphasis is one which will appeal to physicists.

Radio Receiver Design. Part I, Radio Frequency Amplification and Detection (Second Revised Edition). By K. R. Sturley. 667 pp. John Wiley and Sons, Inc., New York, 1954. $10.00. *Reviewed by W. T. Wintringham, Bell Telephone Laboratories.*

The reviews in the engineering periodicals of *Radio Receiver Design,* Part I, following its publication in 1943, suggested that this would be a useful text both for practicing radio engineers and in the classroom. Its appearance in a second edition indicates that such optimism was justified. This book has been revised by adding certain new material and by rewriting whole chapters.

Radio Receiver Design, Part I treats antennas and receiver circuitry as far through receivers as the detector. Audio frequency amplifiers, power supplies, receiver measurements, and the design of television and frequency modulation receivers are covered in Part II. While there is no explicit statement of the fact, the author's treatment is directed solely to receivers for use in the broadcasting field. Despite the inclusion of extensive bibliographies in each chapter, there is no indication that the author is aware of the specialized receiver design art found, for example, in the communication industry. Similarly, there is no suggestion that the author is aware of such specialized receiving antennas as the rhombic, which is used in the fixed radio services. However, within its own area this would seem to be a useful text.