possible to list all of the reported errors explicitly. In such instances references are given to published lists of errors. As may be expected most of these are to *Mathematics of Computation* (formerly called *Mathematical Tables and other Aids to Computation*), a quarterly publication of the National Academy of Sciences. Although *MTAC* (now *Math. Comp.*) has, for the last 20 years, been the fountainhead of information on mathematical tables, it is unfortunately still not known widely enough to the general scientific public. This *Index* provides more than an ample introduction to this valuable journal.

Advances in Computers, Volume 3. Franz L. Alt and Morris Rubinoff, eds. 361 pp. Academic Press Inc., New York, 1962. $12.00. *Reviewed by Peter L. Balise, University of Washington.*

CERTAINLY the rapid development of computer technology provides ample justification for the continued publication of this annual series. Although the title correctly represents the contents, the books' value is not limited to reporting advances; one can get a good general view of computers, particularly the applications of digital computers, from the three volumes that have so far appeared. Volume 1 considered business applications, weather prediction, language translation, game playing, recognition of spoken words, and binary arithmetic. Volume 2 discussed parabolic differential equations, orthonormalizing, linear programming, microelectronics, and theory of automata.

Such diversity is continued in the six topics of the present volume. Samuel Conte analyzes the problems of satellite orbit computation, noting the practical requirements of various missions and carefully describing the calculation of injection parameters corresponding to a particular orbit. He compares integrating total accelerations with deviations from a reference orbit, and he also compares computer integration methods and accuracy tests. E. F. Codd examines multiprogramming: its history, details of present practice, and suggestions for future development. A clear picture is given of general problems and systems, as well as specifics of operations, such as storage allocation, queueing, interruption, and program protection. Philip Wolfe reviews nonlinear programming, the difficulty of which has so far caused its neglect compared to linear programming, which is well developed for obtaining solutions that must to some degree be approximate for real inherently nonlinear systems. By classifying and briefly describing the principal currently available nonlinear programming algorithms, including differential gradient, large-step gradient, simplex, and cutting-plane methods, this paper orients the reader and provides motivation for further study. Garrett Birkhoff, Richard Vargar, and David Young survey alternating-direction implicit methods for the iterative solution of elliptic and parabolic partial difference equations. Convergence theory is emphasized, with specific recommendations on methods and selection of iteration parameters; these are supported by numerical experiments. Harold Skramstad considers a previously neglected area in the series, simulation, in an introductory treatment of combined analog-digital techniques. Examples are briefly outlined, and there is detail on one particular application, in which a variable is handled as a number plus an analog voltage representing the least significant digits. Reed Lawlor discusses relationships between information technology and the law. He notes that mechanical data processing is just beginning to be applied to legal information, and he briefly considers such problems as possible copyright infringement through text storage in computers.

Although the articles are generally introductory and only outline their subjects, they are excellent references, especially with their extensive bibliographies.

Matrix Iterative Analysis. By Richard S. Varga. 322 pp. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1962. $10.00. *Reviewed by J. Gillis, Weizmann Institute of Science.*

A GREAT deal of attention has been paid in recent years to relaxation procedures, and substantial advances have been made. The practical computer will continue to use a mixture of brute force with "trial and error", and so long as he gets his results, he will continue to sneer at the theoreticians. It is when the crude methods break down that we really want to know the details of the machinery. Only the especially zealous take any interest in what goes on under the hood of their car—so long as it runs smoothly.

However, there is more to the business than that. To extend the car analogy a little further, it is the driver who understands the engine who will get the extra spurt from it. And there is no doubt that anyone interested in the speed and efficiency of a relaxation problem must really understand what actually happens.

The wealth of new ideas and results in this area is scattered over many journals of varying degrees of accessibility, and it was certainly time to have them assembled in an orderly and usable fashion. The author, whose own original contributions to the subject are notable, has done this and more.

The work begins with some basic algebra of matrices, including concepts of norm and bounds for eigenvalues. There is then an account of the various iterative methods for solving linear equations. This includes the so-called "semi-iterative" methods, i.e., those in which one interrupts the blind iteration from time to time to take steps to promote the speed of convergence. Particular reference is made in this connection to Chebyshev methods, which the author himself has helped to develop. The remaining chapters are devoted to the application of these ideas to elliptic and parabolic linear differential equations.

There is no doubt that this book contains a most complete and up-to-date account of the role of iterative methods for the solution of linear systems. The presentation is logical and lucid. If it is not easy read-

ing, that is because the author has resisted the temptation to make things easy by the time-honored method of omitting the difficult parts. The bibliography is extensive and includes many references to papers published in 1962.

Those concerned with linear problems would do well to study the book carefully before embarking on computation. Nothing at all is said in it about nonlinear systems, and this too is a fairly accurate reflection of our present state of knowledge!

Hilbertsche Räume mit Kernfunktion. By Herbert Meschkowski. 256 pp. Springer-Verlag, Berlin, 1962. Clothbound DM 58, paperbound DM 53. *Reviewed by Dagmar Renate Henney, University of Maryland.*

WERE it not for the first two chapters which contain an introduction to the theory of Hilbert spaces, this book could be recommended as an informative reference book. The notation used by the author is not the standard one and is liable to confuse anyone whose first contact with Hilbert spaces is through this text. There are mistakes in the proofs of certain theorems, and it might have been better had the author referred the reader to other well-known books for such a background. Here are a few of the reviewer's objections:

On page 6, a linear space with inner product is defined to be a metric space. This notation is very unfortunate, impractical, and easy to misunderstand, since it is not standard notation.

On page 15, a subset $H' \subset H$ is defined to be complete, if the orthogonal space consists only of the origin. From this it would follow that every dense set H' of H is a complete metric space.

The remainder of the book obviously contains the subject matter which is dear to the author. Here the material is well organized and carefully presented. The following subjects are discussed in detail: orthonormal systems with special properties, Hilbert spaces with reproducing kernels, Hilbert spaces with positive matrices, double orthogonality and extremal problems, Hilbert spaces of solutions of elliptic differential equations, and kernel functions in the theory of several complex variables. I do not know of any other book in this field that contains such a variety of material. It develops into a remarkable book as the author progresses.

Distributions. An Outline. By Jean-Paul Marchand. 90 pp. North-Holland Publishing Co., Amsterdam, 1962. Distr. in US by Interscience, New York. Paperbound $4.75. *Reviewed by T. Teichmann, General Atomic Division, General Dynamics Corporation.*

THE theory of distributions (with its concomitant, the theory of generalized functions) has become a fashionable and useful part of modern pure and applied analysis. Together with the related, though not entirely equivalent, modern operational calculus, it enables the direct solution of a variety of important problems involving some degree of nonuniformity which previously required special and not entirely unequivocal treatment in each case. Because the subject was developed from the pure mathematical side, it has, however, been difficult to find adequate short descriptions for the reader more interested in applications—though the books of Erdelyi and Lighthill do cover restricted areas rather well, while the more extensive works of Mikunsinski and Gelfand and Schilow (in German) provide comprehensive and clear treatments of both the theories and their applications. The present book purports to cover a wider range concisely and from a simple point of view. It is allegedly aimed at the physicist, and as such, it should be welcomed. Unfortunately, while the 80-odd pages (at more than five cents a page!) do contain the essence of the theory of distributions and operational calculus, this is somewhat obscured, at least to the physicists, by the author's evident desire to prove his mathematical purity by complicated notations and a specious axiomatic treatment. If one overcomes these hurdles, one finds very little to get one's teeth into: in the chapter on distributions, for instance, there is not even an explicit treatment of improper integrals! The chapter on operational calculus is somewhat more down to earth, but still replete with unnecessary formal jargon.

There is certainly a need for a book covering what this one purports to do, but it has not yet been met. The reader who wishes to learn about these topics, even if only for some applications, will have to do so from the more extensive works mentioned earlier.

Flows in Networks. By L. R. Ford, Jr. and D. R. Fulkerson. 194 pp. Princeton Univ. Press, Princeton, N. J., 1962. $6.00. *Reviewed by Arthur Ziffer, US Naval Research Laboratory.*

THIS book presents one approach to that part of linear programming theory that has come to be encompassed by the phrase "transportation problems" or "network flow problems". Ford and Fulkerson use the latter designation because it is more nearly suggestive of the mathematical content of the subject and also because many of the applications they examine have nothing to do with transportation.

The first chapter, "Static Maximal Flow," studies the problem of maximizing flow from one point to another in a capacity-constrained network. Most of the chapter is concerned with the statement, proof, amplification, and extension of a basic result which the authors call the max-flow min-cut theorem. The proof is constructive and yields a process which forms the basis for almost all the algorithms presented later in the book. Also included in this chapter is a brief discussion of how the max-flow min-cut theorem is a kind of combinatorial counterpart, for the special case of the maximal flow problem, of the more general duality theorem for linear programs.

The first part of Chapter 2 develops several theo-