As to uses of the tables, Haselgrove himself has used the values of the first 600 zeros in his disproof of Pólya's conjecture. For later results on this theme, see R. S. Lehman, "On Liouville's function," *Math. Comp.*, v. 14, 1960, p. 311–320.

It is not inconceivable that study of these tables of $\zeta(\frac{1}{2} + it)$ may inspire some investigator to a new approach to the Riemann Hypothesis. Similarly, the table of $\zeta(1 + it)$ can be studied in connection with proofs of the prime number theorem. For both of these "uses," however, a graphical presentation is highly desirable, and it is regretted that a good collection of graphs was not included in this volume. For example, a graph of $\zeta(\frac{1}{2} + it)$ in the complex plane versus the parameter t—say from 0 to 30—is particularly interesting. See Fig. 1. Problem for the reader: If, in Fig. 1, the variable t is thought of as time, explain the initial counterclockwise motion in the orbit and the subsequent clockwise motion with a shorter and shorter mean period. Hint: Consider the formula

$$\zeta(s) = \left(1 - \frac{2}{2^s}\right)^{-1} \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^s}$$

for a fixed value of $s = \frac{1}{2} + it$. For what mean value of n does a block of consecutive terms in the series have all its terms in phase; in which block are alternate terms out of phase; and finally, which terms add in an essentially random manner?

Since it is known that Haselgrove has also computed complex zeros of the closely related $L(s)$ and other Dirichlet character series, and since he has not included these results, it would be desirable to issue a companion volume to make these related tables generally available.

Two very minor errors were noted in the Introduction.

Page xii, line 5: change $\zeta(\rho_n)$ to $\zeta'(\rho_n)$.

Page xvi, line 6 from bottom: change (3.7) to (3.32).

With respect to Liénard's table of $\zeta(n)$ for $n = 2(1)167$, which is mentioned on page xx, a recent extension should be noted: J. W. Wrench, Jr., "Further evaluation of Khintchine's constant," *Math. Comp.*, v. 14, 1960, p. 370–371.

D. S.

7[G, K, X, Z].—Anthony Ralston & Herbert S. Wilf, *Mathematical Methods for Digital Computers*, John Wiley & Sons, Inc., New York, 1960, xi + 293 p., 27 cm. Price $9.00.

This book contains contributions from twenty-four research workers in numerical analysis and related fields. Two of the contributors serve as editors, and, as the title implies, all contributors are definitely high-speed-computer oriented. It is interesting to note that ten of the twenty-four authors are from universities.

In the introduction it is stated that "the major purpose of this book is to present many—but by no means all—of the more commonly used tools of the modern numerical analyst along with some of the more promising newly developed methods. The motivation behind this presentation is not only to gather together in one place a partial survey of modern numerical methods but also, in each case, to acquaint the reader with the interplay between computer capabilities and processes of analysis".

The editors have done a good job in carrying out the purpose of the book. They have coordinated the efforts of their colleagues in a remarkable way. About twenty important and fairly representative problems are discussed by experts in various fields and the presentations, for the most part, are organized in a uniform manner. All but one of the authors describe programs for solving their problems in terms of the following topics:

1. The function of the program
2. A mathematical discussion of the problem
3. A summary of the calculation procedure
4. A complete flow diagram
5. A box by box description of the flow diagram
6. Standard subroutines required by the program
7. A representative sample problem
8. Memory requirements
9. An estimation of the running time
10. A list of references

Actual coding of the programs is omitted, as is any reference to a particular computing machine.

The book is divided into six parts: generation of elementary functions, matrices and linear equations, ordinary differential equations, partial differential equations, statistics, and miscellaneous methods.

Part I contains an interesting discussion of the generation of elementary functions by means of polynomial and rational approximations. Ten of the more common functions are examined in detail, and comparisons of the errors obtained using various approximation methods are included. Because of the nature of its subject matter this part has a format different from that discussed in Paragraph 3. Part II contains six chapters covering matrix inversion, systems of linear equations, and the matrix eigenvalue problem for symmetric matrices. Part III contains four chapters concerned with the numerical solution of ordinary differential equations, and Part IV contains five chapters discussing parabolic, elliptic and hyperbolic partial differential equations. There are four chapters in Part V covering multiple regression analysis, factor analysis, autocorrelation and spectral analysis, and the analysis of variance. The six chapters in Part VI discuss methods for numerical quadrature, Fourier analysis, linear programming, network analysis, and the solution of polynomial equations.

This book should serve as an excellent reference work for those workers who need to solve problems using electronic digital computers. For this reason the format, described above, is especially good. The book is not intended to be a textbook for introducing the subject of numerical analysis, but most students of the subject will find useful information here. Lists at the end of the various chapters contain over two hundred references relating to the problems under consideration.

The reviewer would like to see a supplementary volume appear containing many of the important methods not covered in the present volume. For instance, Part II does not cover the Givens method for finding the eigenvalues of symmetric matrices. Omitted entirely is any discussion of methods for finding the eigenvalues of arbitrary matrices. Other readers will find additional important methods they would like to see covered in a second volume.

Robert T. Gregory

The University of Texas
Austin, Texas