pursuit of this approach does not make for easy reading. The wood gets lost in the trees. Here is an example of how hard it is to keep a global perspective. The authors make use of Paige's error bounds, and these bounds are based on the model that the multiplication $w = Av$ is what it seems to be, that is, $w_k = \sum a_{kj} v_j$ where the sum is over nonzero elements in row k of A. Consequently, the results do not apply to some important applications where Av is merely shorthand for the solution of a set of equations of the form $(K - \sigma M)w = Mv$ and so $A = (K - \sigma M)^{-1}M$. This example is not to be construed as a blemish in the book but as an illustration of the quandary faced by the designers of an algorithm that succeeds but cannot be formally proved to succeed. What is to be done?

Apart from 'Convergence' theory, an important contribution made by the authors is the test they have gradually developed and refined for discriminating between desirable and undesirable eigenvalues of the tridiagonal matrix T. This is a fascinating topic but too technical for description here. After all, if T's order is three times that of A then some selection has to be made.

In their careful discussion of other ways of implementing the Lanczos algorithm, Cullum and Willoughby clearly believe that there is a "best", or preferred, way to do the job. Certain turns of phrase suggest that there may have been intellectual skirmishes between rival research groups. It is all rather tantalizing. To me, it seems far more likely that efficient execution of different tasks will require different implementations of the Lanczos recursion. Sophisticated structural engineers may well stick to their own nearly orthogonal set of Lanczos vectors. On the other hand, those scientists who need half or all of the spectrum of a conventional sparse symmetric matrix A will find the Cullum/Willoughby algorithm very hard to beat. And this book's description of it is a lesson to us all.

B. P.

17[30-02, 65E05, 42-XX, 30E20, 30C30, 30C50].—PETER HENRICI, *Applied and Computational Complex Analysis*, Vol. 3: *Discrete Fourier Analysis—Cauchy Integrals—Construction of Conformal Maps—Univalent Functions*, Wiley, New York, 1968, xiii + 637 pp., $23\frac{1}{2}$ cm. Price $59.95.

This text is another excellent, long awaited, important and welcome addition to the previous two volumes written by the same author. The titles and chapter headings of the now available three volumes are:

Vol. 1: Title, "Power Series—Integration—Conformal Mapping—Location of Zeros"; Chapters, 1. Formal Power Series, 2. Functions Analytic at a Point, 3. Analytic Continuation, 4. Complex Integration, 5. Conformal Mapping, 6. Polynomials, 7. Partial Fractions.

Vol. 2: Title, "Special Functions—Integral Transforms—Asymptotics—Continued Fractions"; Chapters, 8. Infinite Products, 9. Ordinary Differential Equations, 10. Integral Transforms, 11. Asymptotic Methods, 12. Continued Fractions.

Vol. 3: Title, given above; Chapters, 13. Discrete Fourier Analysis, 14. Cauchy Integrals, 15. Potential Theory in the Plane, 16. Construction of Conformal Maps: Simply Connected Regions, 17. Construction of Conformal Maps for Multiply

Connected Regions, 18. Polynomial Expansions and Conformal Maps, 19. Univalent Functions.

The study of applied mathematics and computation using tools of complex analysis provides an indispensable insight and understanding of not only when, why, and how well the methods of these subjects work, but also for deriving new methods. Unfortunately, an examination of the curriculum of most schools, or an examination of textbooks on complex variables, shows that the importance of this understanding is sadly underemphasized. Henrici's three volumes provide this understanding, and thus they fill a dire need in our educational system. The books are excellent reference books for applied mathematicians, engineers and physicists, and they may be used as textbooks for good students. Exercises, problems, and seminar topics appear at the end of chapters.

Henrici's Volumes 1 and 2 have been reviewed in *Math. Comp.*, v. 31, 1977, pp. 325–326, MR **51** #8378, and MR **56** #12235. The present reviewer wholeheartedly agrees with the praiseworthy remarks in these reviews.

Volume 3 shares features of Volumes 1 and 2, in that it contains exciting presentations which can be found in no other textbooks. Chapter 13 is a new, self-contained and well-written presentation of the DFT method. Here one finds an excellent exposition of the discrete Fourier transform method for Fourier, power series and integrals, numerical harmonic analysis for Fourier series and integrals, evaluation of coefficients of Laurent series, residues and zeros, the conjugate periodic functions, convolutions, and multivariate DFT. The material of Chapter 14, which was previously available only in technical monograph translations from Russian, provides powerful methods for solving problems of potential theory. Included in this chapter are methods of solution of the Riemann and Privalov problems for both closed and open arcs, as well as the recently developed Burniston-Siewert method for solving transcendental equations. Chapter 15 discusses a variety of methods of solution of Dirichlet and Neumann problems for planar potentials. Chapters 16 through 18 discuss conformal mapping, as well as the very exciting and newly developed area of the construction of conformal maps. One finds in these chapters a discussion of the osculation methods for numerical conformal mapping, the integral equations of Symm and Berrut, the mapping methods of Timman, Fornberg and Wegmann, and a formal theory of Faber polynomials and Faber functions. Finally, Chapter 19 presents an elementary and self-contained version of the recently discovered proof of the Bieberbach conjecture in the theory of univalent functions.

Congratulations to Peter Henrici for completing such a monumental, important and exciting work!

F. S.

18[41A50].—G. G. Lorentz, *Approximation of Functions*, 2nd ed., Chelsea, New York, 1986, ix + 188 pp., $23\frac{1}{2}$ cm. Price $14.95.

Approximation Theory is a well-established part of analysis which, after more than 100 years of activity, remains a vital research area with numerous applications. This branch of mathematics deals with the problem of approximating a complicated