A short initial chapter discusses digital computers and programming in rather general terms. Chapter 2, "Erreurs," consisting of 70 pages, is perhaps the most complete and systematic single account in existence, discussing both rigorous bounds and probabilistic estimates. Chapter 3 considers iterative methods in general as applied to transcendental equations and to systems of equations. Chapter 4 is devoted to polynomials specifically, and Chapter 5 to characteristic values. Each chapter is supplemented by an extensive bibliography. An appendix gives numerical results of applying the various methods to some specific problems.

One can find fault with a few details. The method of Graeffe is given in the chapter on polynomial equations, although it is equally applicable to transcendental equations within a circle of analyticity. In the chapter on the characteristic-value problem, there is an interesting general section which derives the Jordan normal form, and develops the standard localization theorems of Gershgorin, Brauer, and others. But the treatment of the methods is somewhat disappointing, especially of the so-called "direct methods" (actually methods of reduction, although the reviewer himself is guilty of having propagated the misnomer). It is even stated that the method of Krylov is not to be recommended for large matrices, whereas it has been shown by Bauer and this reviewer that most of the known direct methods are only specializations of the Krylov method.

However, the authors could justify the rather sketchy treatment of the methods of reduction by arguing that these do not differ basically from methods of inversion, and are hence peripheral to their main interest, which would be the solution of the polynomial equation that can be obtained from a complete reduction. The treatment of this problem is by no means sketchy. In fact, it is the most complete and up-to-date account of known methods now in the literature, exhibiting well their interrelations, and often presenting them from a fresh point of view. This volume can be recommended highly, and one can hope that the subsequent ones will be equally well done.

A. S. Householder

Oak Ridge National Laboratory
Oak Ridge, Tennessee

82[X].—Herbert E. Salzer, Dexter C. Shoultz, & Elizabeth P. Thompson, *Tables of Osculatory Integration Coefficients*, Convair (Astronautics) Division of General Dynamics Corporation, San Diego, 1960, 43 p., 28 cm. (Paperback)

This publication contains tables to implement the use of quadrature formulas of the so-called osculating type, i.e., formulas in which the value of the integrand function and of its derivative at each point are used. The explicit formula considered is

$$(1) \qquad \int_{x_0+qh}^{x_0+ph} f(u)\,du = h \sum_{i=-[(n-1)/2]}^{[n/2]} \{C_i^{(n)}(p)f_i + D_i^{(n)}(p)hf_i'\} + R_{2n}(p).$$

The authors treat $n = 2, 3, 4, 5$; for $n = 2$ and 4, q is taken to be $\frac{1}{2}$, and for $n = 3$ and 5, q is taken to be 0. These choices of q permit use of symmetry relations to reduce the amount of tabulation. The coefficients $C_i^{(n)}(p)$ and $D_i^{(n)}(p)$ then are polynomials in p, and these are listed for each i indicated in (1). Ten-decimal tables of $C_i^{(n)}(p)$ and $D_i^{(n)}(p)$ are given for the same values of i and for $p = q(0.01)[n/2]$, and $n = 2(1)5$. Tables to aid in computation of an error bound are given.

The authors state that these tables were calculated on an IBM 704 and listed to 12 decimal places. These were subjected to "functional" checks using a desk calculator, and then were rounded to 10 decimal places. On the basis of these checks the authors believe the coefficients are all correct within about one unit in the tenth decimal place.

It seems to the reviewer an unfortunate circumstance that the details of the checks made with the IBM 704 and the desk calculator were not more precisely given. It would have been simple, for example, to have checked the integrals of monomials in the range of precision, and this would have made an excellent independent check of accuracy, well worth the additional time required for automatic calculation.

The authors express great enthusiasm over the accuracy of the method and illustrate it with four examples which indicate rather well the situations in which osculating formulas may be used. These situations are ones in which the derivative of the integrand is available without excessive additional work. In particular, the suggested applications to orbit calculations in which the position and velocity vectors are known seemed very appropriate. However, this very example also suggests that there would be some real interest in extending the domain of p so that extrapolations could be made. In that case $n = 1$ would have been a possible choice.

Mrs. Frieda Cohn of the Numerical Analysis Laboratory at the University of Wisconsin has calculated the integrals of a few monomials using these tables, and found that these checked within possibilities of round-off error.

P. C. H.

83[X, Z].—F. A. FICKEN, *The Simplex Method of Linear Programming*, Holt, Rinehart & Winston, Inc., New York, 1961, vi + 58 p., 24 cm. Price $1.50.

The book literature on the subject of linear programming is in a state of rapid increase and Ficken's contribution on the simplex method, the essence of the success of linear programming, is a welcome addition. It provides a rigorous treatment of old ideas in a 36-page discussion of duality, feasibility, boundedness, consistency, the simplex tableaux, degeneracy, etc. Brief material on inequalities, linear spaces, matrices, etc., appear in one appendix and theorems on existence and duality in a second appendix. The author's bibliography makes no specific mention of G. Dantzig, to whom the topic of the book owes its existence and who has contributed immeasurably to the development of linear programming. A second point is the absence of material on integer programming. It seems important that a book on the subject, appearing in 1961, should shed light on this significant development. The author has avoided mention of this new gem in which the simplex process plays an important role. Otherwise, the book is recommended for the material it treats and for its clarity and rigor.

THOMAS L. SAATY

Office of Naval Research
Navy Department
Washington, D. C.