entries). For negative q, let $X = -X'$ in (1). When (1) has a pair of complex roots $R \pm I$, the authors tabulate R and I on opposite sides of a page, leaving the third root $-2R$ for the reader to find. When (1) has three real roots, the authors tabulate two, X_1 and X_2, on opposite sides of a page, leaving the third, $X_3 = -(X_1 + X_2)$, for the reader to find.

For solving the general quintic $ax^5 + bx^4 + cx^3 + dx^2 + ex + f = 0$, expressible as $ay^5 + gy^3 + hy^2 + ky + m = 0$ after the transformation $x = y - b/5a$, the authors make the further transformation $y = z(-m/a)^{1/5}$ to obtain

$$z^5 = pz^3 + qz^2 + rz + 1. \tag{2}$$

The authors tabulate, on pp. 181–201, just a single real root, namely, the smaller or larger positive root of (2) according as $p + q + r$ is negative or positive, for each of p, q, $r = -10(1)10$, to 5D (6S for over 60 percent of the entries). When $p + q + r = 0$, $z = 1$ is a positive root of (2).

For interpolation in (1) for nonintegral p and q, the authors give a 4-point bilinear formula in the fractional portions of p and q, with two examples. For interpolation in (2) for nonintegral p, q and r, the authors give an 8-point trilinear formula in the fractional portions of p, q and r, with one example. However, no mention is made of the accuracy attained by those interpolation formulas.

The introductory text consists of eight small pages for (1), two pages for (2), and a prefatory note by A. Zavrotsky.

The computation was performed on an IBM 1620 system in the Electronics Center of Computation of the University of the Andes, using FORTRAN programs for calculation and printout. For the cubic, Cardan's formulas were employed; for the quintic, Horner's method. Altogether, 115 hours were required for the computation.

The text contains a brief historical note mentioning 16 other tables for solving cubics, just by author, place, and year.

In view of the statement in the preface that it is believed that there is not a single error in the thousands of digits comprising the table, the defective page 142, where there is no printout of the imaginary part of the complex root of (1) for $p = 55, 56, 57, 58$ and $q = 0(1)50$, *may* be only in the reviewer's copy.

HERBERT E. SALZER

941 Washington Avenue
Brooklyn, New York 11225

40[2.30, 2.45, 8, 9, 12].—D. E. KNUTH, *The Art of Computer Programming—Errata et Addenda*, Report STAN-CS-71-194, Stanford University, January 1971.

Since Volumes I and II of Knuth's *The Art of Computer Programming* have been so well received, (see our reviews RMT **81**, v. 23, 1969, pp. 447–450, and RMT **26**, v. 24, 1970, pp. 479–482), it seems desirable to call attention to the extensive changes offered here. A July 1969 "second printing" of Vol. I already included "about 1000 minor improvements". A list of these changes is available from the author.

The present 28 pages of small print include $7\frac{1}{2}$ more pages of changes in Vol. I, but the main changes are in his second volume. Some of these are quite minor: spelling, middle names, notation, small numerical errors, and they would not justify this review. But, besides many other changes of greater significance, two sections of the book have been extensively revised to bring in recent research.

The first of these topics is Euclid's algorithm and now includes some new research by Philipp, Dixon and Heilbronn.

The largest change is an account of the new Strassen-Schönhage "fast Fourier multiplication" algorithm including

THEOREM S. *It is possible to multiply two n-bit numbers in* $O(n \log n \log \log n)$ *steps.*

It is clear that the Mersenne prime and related industries will have to completely retool to take advantage of this new technology. With such retooling, and the faster machines now available, we can expect a new prime $2^p - 1$ to show itself one of these days.

To make room for this new material while keeping the same pagination, certain topics in the first printing, such as gaps between successive primes, are deleted—through no fault of their own.

Naturally, Knuth is driving his publisher bananas with all these changes, and he begins his compilation here, amusingly, with "The author wishes to encourage everyone to stop doing any further research, so that he may finish writing the other volumes." Why such a mild way of trying to halt the tide of research; why not simply command it, as did his ancestor, the King?

D. S.

41[4].—JAMES W. DANIEL & RAMON E. MOORE, *Computation and Theory in Ordinary Differential Equations*, W. M. Freeman & Co., San Francisco, 1970, viii + 172 pp., 24 cm. Price $7.50.

Because of their training, physicists and engineers tend to stick to analytic methods as long as possible, before submitting their problems to a computer. In their treatment of problems in differential equations, they may sometimes end up by offering them to the computer in a form less suitable than the original version. On the other hand, the present generation of numerical analysts suffers from the opposite extreme: as computers grow faster and memories become larger, numerical analysts spend less and less effort on preparing a problem in differential equations analytically. They simply grind it through the mill. The book under review attempts to counteract this tendency and to resubstitute mathematical analysis, at least in part, for computing by brute force.

For this purpose, the authors present a variety of analytic techniques which may be used to transform a given system of differential equations into one which is better suited for numerical solution. Their main criterion for that "suitability" is the straightness of the "flow" defined by the system through its vector field. Thus, the transformations they study are designed to straighten out large local variations or curvatures in this "flow". This common strategy unifies the treatment in this book which is subdivided into sections on "a priori global transformations" and "a posteri-