The speakers and their topics were:

The Problem of Error in Digital Computation, by John Todd

Techniques for Automatic Error Monitoring and Control, by Robert L. Ashenhurst

The Automatic Analysis and Control of Error in Digital Computing Based on the Use of Interval Numbers, by Ramon E. Moore

Error in Digital Solution of Linear Problems, by Ernest L. Albasiny

The Propagation of Error in the Digital Integration of Ordinary Differential Equations, by Peter Henrici.

John Todd's paper describes some of the recent efforts in analyzing the error in digital computation, illustrated with several examples which have arisen recently at Caltech. He has many suggestions for the future directed at various segments of the computer field from mathematician to design engineer.

Robert L. Ashenhurst discusses the effect on error propagation of various types of computer arithmetic. Starting with a precise definition of terms, the exposition leads to significance adjustment rules and the question of normalized versus unnormalized arithmetic.

In his paper Ramon E. Moore defines an arithmetic system of closed intervals which contains the real numbers as a subsystem. A topology is introduced which leads to the concept of continuity of set functions defined for these intervals. An integral calculus is then developed together with an interval form of Gaussian quadrature. The principal application is to the approximate solution of the initial-value problem for ordinary differential equations. By use of interval arithmetic and appropriate rounding procedures, numerical methods are described which give a numerical solution together with rigorous bounds on the error. The bounds themselves behave like the mesh size to an appropriate power. This method has been programmed for an IBM 7094, and the results of certain sample cases are given.

Ernest L. Albasiny discusses recent studies (mainly those of J. H. Wilkinson) of the effect of round-off errors in the numerical solution of various problems in linear algebra. Topics included are the solution of linear equations, matrix inversion, determinant evaluation, and the determination of eigenvalues.

Peter Henrici surveys recent developments in the numerical solution of the initial-value problem for ordinary differential equations by finite-difference methods. The problem of defining the term "stability" is discussed, and some consideration is given to the value of error estimates and error bounds.

As can be seen from the above discussion, this book brings together many of the recent developments of significance in the fields covered.

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42[X].—*The Universal Encyclopedia of Mathematics* (with a foreword by James R. Newman), Mentor Book, New York, 1965, 715 pp., 18 cm. Price $1.50 (paperbound).

This is an inexpensive paperback edition of the $8.95 hard-cover volume previously reviewed here in *Mathematics of Computation*, v. 19, 1965, p. 164, RMT **22**. See that review for further details. We might repeat the previously made point that the coverage is not as broad as that suggested by the title, since a publisher's press release states flatly: "Every subject of mathematics is covered in the encyclopedia, from absolute value (the first listing) to zero (the last)." While that makes it evident that *abacus* and *Zorn's Lemma* are not covered, the reader should know that other terms, more in the mainstream, such as *derivative*, are also missing.

D. S.

43[X, Z].—RALPH H. PENNINGTON, *Introductory Computer Methods and Numerical Analysis*, The Macmillan Company, New York, 1965, xi + 452 pp., 24 cm. Price $9.00.

This book is written for students of engineering or science with a mathematical background through integral calculus, but who have little or no acquaintance with digital computers. In the author's words, the book attempts "to give usable computer methods for solving the more elementary problems in applied mathematics and to give some perspective as to how easy or difficult these problems are to solve on a computer."

In line with these aims, about one half of the book is devoted to an elementary introduction to digital computers and to programming (primarily in FORTRAN), and the remaining half contains a slightly more advanced discussion of standard introductory topics of numerical analysis, with a view toward the application of computers.

The discussion on computers and programming begins with a very elementary presentation of number systems, followed by a description of the basic structure of digital computers and a discussion of the elements of machine-language coding for a simple hypothetical computer. Then the principal features of standard FORTRAN II are introduced, including FORTRAN functions and subroutines. An additional chapter presents some comments on computer running times and on de-bugging. The role of errors in numerical calculations is emphasized already very early in the book, this is followed later by a chapter on problems of error accumulation and loss of significance.

The second half of the book on numerical analysis covers the traditional topics expected in any text of this type: Simple quadrature methods, the iterative solution of algebraic and transcendental equations, the application of these methods to polynomial equations (including nice sections on the manipulation of polynomials and on Sturm sequences), the evaluation of determinants and the solution of linear systems of equations by elimination techniques, the Gauss-Seidel iteration, an introduction to matrices (including the solvability of m equations in n unknowns, eigenvalues and their determination using the Leverrier-Faddeev method), least squares, difference tables, polynomial interpolation and numerical differentiation, and finally a brief chapter on ordinary differential equations presenting some material on explicit linear, first-order systems as well as the Runge-Kutta and Milne method. Throughout these chapters a general discussion is followed by flow charts and frequently by complete FORTRAN programs. The text is interspersed with detailed numerical examples, and each chapter ends in a list of exercises, most of which ask the student to write particular FORTRAN programs or to apply some method to specific cases.