Other papers have implications connected with the mathematics of computation, as would be expected in any current book on large systems. Thus in the Foreword, Simon Ramo remarks that "it could be said that systems engineering in today's sense became possible only with the introduction of the large digital computer." However, the papers in this volume contribute few direct suggestions concerning this use, and concern themselves largely with other general and specific aspects of systems engineering.

C. B. TOMPKINS

University of California
Los Angeles, California

26 [Z].—DANIEL D. MCCRACKEN, *A Guide to FORTRAN Programming*, John Wiley & Sons, Inc., New York, 1961, viii + 88 p., 28 cm. Price $2.95.

The usefulness of Fortran as an automatic programming system available on many different computers has prompted Dr. McCracken to publish this guide. It is addressed to people who have no programming experience but have a requirement to accomplish scientific computation or wish to get some appreciation of how this can be done.

The guide is developed pedagogically, with numerous examples, and includes a set of detailed case studies which provide examples from several fields of effort. These case studies illustrate the essential features of Fortran and suggest the range of its applicability.

An appendix summarizes the characteristics of a number of Fortran systems that have been established for different computers.

ABRAHAM SINKOV

National Security Agency
Department of Defense
Washington 25, D. C.

27 [Z].—FRANCIS J. MURRAY, *Mathematical Machines*, Vol. 1 and 2, Columbia University Press, New York, 1961. V. 1, vii + 300 p., 26 cm. Price $12.50. V. 2, vii + 365 p., 26 cm. Price $17.50.

Volume one of Professor Murray's two-volume work on mathematical machines, is concerned with digital computers. There are two parts in Volume 1: part I on desk calculators and punched card machines, and part II on automatic sequence digital calculators. These digital devices are presented in the order of increasing competence and complexity.

In part I, there are eight chapters. The first four chapters describe desk calculators, from the basic idea of register and counter to the description of many commercial automatic calculators. Chapter 5 covers electrical counters and accumulators. Punched card machines are presented in Chapters 6 and 7, and sequence calculators such as calculating punch and electronic calculator in Chapter 8.

Part II consists of ten chapters. The first four chapters describe the logic aspect of the computer as well as digital arithmetic. Chapter 5 is a general discussion on the use of Boolean analysis. Chapter 6 is concerned with circuit elements. The programming aspects are covered in Chapters 7, 8, and 9. Chapter 10 is a very brief survey of digital computers.

In this volume, the author succeeded in many cases in bringing out the principles and fundamental ideas. An example is the exposition on desk calculators. Although the material is mostly descriptive, it will serve a useful purpose as a general reference.

Volume two of Professor Murray's work on mathematical machines presents the subject of analog devices. There are three parts: part III on continuous computers, part IV on true analogs, and part V on mathematical instruments.

Part III consists of fifteen chapters. After a brief introduction in Chapter 1, Professor Murray describes mechanical adders, multipliers, dividers, and other mechanical components in Chapter 2. Cams, gears, and their computing applications constitute Chapter 3. This is followed by an excellent presentation on mechanical integrators, differentiators, and amplifiers in Chapter 4. Chapter 5 is a review of circuit theory. Computation by using potentiometers and condensers are described in Chapter 6, vacuum tube amplifiers in Chapter 7, electromechanical components of D'Arsonval movement, watt-hour meters, and synchros in Chapter 8, electrical multipliers including time division multipliers, strain gauge multipliers, step multipliers, cathode ray multipliers in Chapter 9, and function generation by using mechanical, electromechanical and electronic means in Chapter 10. Chapters 11 through 13 describe equation solution: linear equations in Chapter 11, harmonic analysis and polynomial equations in Chapter 12, differential equations in Chapter 13, and error analysis in Chapter 14. Chapter 15, the last chapter of this part, discusses the use of digital check solutions obtained by using numerical methods when the analog solution has narrowed down the range of parameters.

Part IV, consisting of nine chapters, presents the idea of true analogs. True analogs are direct analogies on which measurements can be taken more conveniently or more economically than the analog devices described in part III. The author examines the theory of true analogs and includes descriptions of dimension theory, models, and principles of spatial relationships. True analogs that are described include the use of electrolytic tanks, electrically conductive sheets, stretched membranes, photoelastic models, and electromechanical analogies.

Part V consists of five chapters. It deals with mathematical instruments that operate on data in a specified form and perform a few mathematical operations. These devices include slide rule, plotting devices, planimeters, integrometers, integraphs, and other geometrical and trigonometrical devices. This part is rather unique.

This volume again emphasizes principles. A significant portion describes mechanical analog devices. The treatment of analog devices in volume two is more extensive than that of digital computers.

As mentioned in the book, this work was sponsored by the Office of Naval Research. These two volumes are a contribution to the study of mathematical machines, and Columbia University Press deserves credit for an excellent printing job.

YAOHAN CHU

Electrical Engineering Department
University of Maryland
College Park, Maryland