

management control. General tools for systems analysis and specific data-processing techniques are also described here.

Part Six, "Equipment Acquisition and Utilization," presents in a nontechnical manner a methodical approach for evaluating, selecting, installing, and implementing automatic data-processing systems for business problems. Considerable space is devoted to the preparation of feasibility studies, application studies, and equipment acquisition proposals. This is followed by a detailed discussion of the problems entailed in the installation of new equipment.

The concluding portion, Part Seven, "System Re-examination and Prospective Developments," touches on a variety of mathematical techniques for the solution of management problems and concludes with a discussion on anticipated future developments in automatic data processing.

Three appendices are:

- I. History of Computation and Data-Processing Devices
- II. Questions and Problems
- III. Glossary of Automatic Data-Processing Terminology

Although the treatment of the basic principles of computer programming illuminates many of the complex and important aspects of business data processing, the authors give little heed to the practical requirements for large-scale production system runs. Such concepts and techniques as rerun procedures, interior tape labels, alternation of servos, and programming methods for effective utilization of buffering are not even mentioned, while the subjects of editing, flow charting of instruction routines, and sorting techniques for large tape files are glossed over. But on the whole, the informative and lucid presentation of the general principles of automatic data processing from the standpoint of business systems will provide management personnel with a short, intensive, and enlightened education on electronic computers and their impact on business data processing.

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61[Z].—ANTHONY G. OETTINGER, *Automatic Language Translation*, Harvard University Press, Cambridge, 1960, xix + 380 p., 24 cm. Price \$10.00.

Automatic Language Translation by Anthony G. Oettinger is the eighth in a series of Harvard Monographs in Applied Science. "These monographs are devoted primarily to reports of University research in the applied physical sciences, with special emphasis on topics that involve intellectual borrowing among the academic disciplines." Professor Oettinger's monograph is devoted to the lexical and technical aspects of automatic language translation, with particular emphasis on Russian-to-English translation.

The contents of this work can quickly be conveyed by the titles of its chapters. Chapter 1, "Automatic Information-Processing Machines," discusses the organization, elements of programming, and the characteristics of information-storage media. Chapter 2, "The Structure of Signs," differentiates the notions of use, mention, and representation of signs; mathematical transformations; and mathematical models. Chapter 3, "Flow Charts and Automatic Coding," treats the use of flow

charts, addressing, algorithms, and programs. Chapter 4, "The Problem of Translation," is a general discussion of the possibilities and types of automatic translation, grammar, and interlingual correspondence, and syntactic and semantic problems. Chapter 5, "Entry Keys for an Automatic Dictionary," discusses inflection, paradigms, affixes, stems, and inflection algorithms for Russian. Chapter 6, "Morphological and Functional Classification of Russian Words," consists of a detailed account of Oettinger's morphological and functional system for Russian words; nominal forms, adjectival forms, and verbal forms; and an appendix that gives synoptic classification tables. Chapter 7, "Dictionary Compilation," describes the structure of the Harvard automatic dictionary by giving the structure of items and files, methods of detecting and correcting mistakes in transcription and classification, and English correspondence and grammatical codes. Chapter 8, "Dictionary Operation," describes the function of the Harvard automatic dictionary, lookup procedures, and word-by-word translation; and is followed by an appendix that presents an edited trot, the transcription of the edited trot, and an example of conventional translation. Chapter 9, "Problems in Dictionary Compilation and Operation," discusses the problems of paradigm homography, stem homography, "short" words, and a detection and correction of mistakes in dictionary compilation. Chapter 10, "From Automatic Dictionary to Automatic Translator," presents the author's views on how the Harvard automatic dictionary might lead to a complete system of automatic translation.

Since this is the first book published in America devoted to automatic translation of languages, it is a landmark. Several cautions should be mentioned, however, for those who are not familiar with the state of progress in machine translation. First, this book is not a work devoted to the general problem of translating one natural language to another. It is highly specialized, since it treats only the Russian-to-English translation problem. Second, much of the book is devoted to the very detailed description of the particular automatic dictionary compiled at Harvard University. This description does not permit conclusions to be drawn "automatically" about dictionary compilation at other machine translation research centers. Third, all detailed computer descriptions are in terms of the Sperry-Rand UNIVAC I computer, whereas almost all other machine translation programs in the United States are written for IBM 704 or 709 computers.

Nevertheless, Professor Oettinger is to be congratulated for presenting the first detailed, and scientifically accurate description of any machine translation project in the U.S., if not in the world. As such, this book will be of interest to computer scientists, mathematicians, linguists, and to others interested in acquiring knowledge about this important subfield of modern linguistic analysis. As this reviewer has often emphasized, the gains to be made in linguistic analysis will overshadow those which have been made in numerical analysis.

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