ing mass of information into a limited space." Only three million more words are used in the Britannica today than in 1929, an amazing fact when one realizes that, in the sciences alone, more research has been done since 1950 than in all the years before.

What is the answer? To Einbinder it is the establishment of a new major encyclopedia. Whether this is possible or practical, the author and all users of the *Encyclopaedia Britannica* hope that the editors will take effective measures to improve this reference work.—*Margaret Knox Goggin, University of Florida.*

Information Storage and Retrieval: Tools, Elements, Theories. By Joseph Becker and Robert M. Hayes. New York: Wiley, c1963. xi, 448p. $11.95. (63-12279).

Messrs. Becker and Hayes have written the most useful book in English on the subject of information storage and retrieval (ISR). The text is carefully organized, the various ISR methods are clearly and accurately described, and the selected illustrations contribute to a better understanding of equipment and principles.

The authors are particularly well qualified by training, experience, and interest to write this book, for in combination they have had formal education in engineering, mathematics, and library science; practical experience in libraries and large information centers; and teaching experience in the field covered by this book. The footnotes and the list of journals containing material on ISR attest the authors' thorough study of the literature.

The book is refreshingly free of descriptions of methods for which exaggerated claims have been made but which have rarely proved to be as successful in practice as they were claimed in print.

Becker and Hayes point out the interdisciplinary character of their subject and warn that while their book is intended for the newcomer, the newcomer should not be a beginner to the field. Thus the nonlibrarian will find Chapter 2 a succinct history of librarianship and a useful account of the accomplishments of librarians in creating and working with records about information. The librarian will learn in Chapter 3 why subject specialists have felt themselves forced, by deficiencies of librarianship, to develop more satisfactory control over information. Here coordinate indexing, mechanized coding, formalized abstracting, and facet analysis (in classification) are contrasted to library procedures (selection, circulation, reference), controls (classification schedules, subject heading authority lists), and products (the dictionary card catalog) as described in Chapter 2.

Chapter 4 describes the information framework and the user, including a handy block diagram so that specialized equipment and methods can be evaluated against the needs of a total system. The authors particularly stress the fact that no total system has been attempted yet, using either a single general purpose machine or a complex of equipment.

Various printing methods are described, perhaps too fully, in Chapter 5, but they lead into a useful description of machine language and the many coding methods used in this kind of writing and reading. This description clearly shows the difficulties which exist in the effort to make satisfactory automatic character readers serve as input devices.

Chapter 6 deals with analysis, logical processing, and the computer. The authors describe the structure of the general purpose digital computer, various binary coding methods used to represent numbers and letters, the commands used to instruct computers in their operations, the process of programing computers, and the use of programing subroutines, editing routines, and compilers. There is a logical flow chart to show how a problem is treated, but unfortunately the problem is expressed mathematically. The chart could have been prepared differently and more usefully for readers of this book; it would show the computer output as information or references, rather than as data enabling a computer to continue a later run.

This chapter also includes a treatment of computerized information-searching experiments, indexing and abstracting experiments (both manual and automatic), language data processing, automatic file organization (and reorganization), and special purpose selec-

tors or searching devices, such as the Minicard equipment and magnetic tape comparators.

The relationship of indexing, documents, and storage media is treated in Chapter 7, based on the importance of order of originals, of records, and of marks or holes. Hence the reader finds punched tapes, edge-notched cards, peek-a-boo cards, and Hollerith cards (the familiar punched cards for electric accounting machines) treated here, followed by magnetic recording on tape, disks, drums, cards, and strips. Here also microfilms, microfilm rapid selectors, Minicard, Filmorex, Walnut, Verac, and photochromic images are described.

Chapter 8 is the first in the section on elements. In analyzing information systems, the reader has to recognize the interdisciplinary character of the effort. There follow sage words on the various responsibilities of users, operators, designers, and suppliers of systems. These responsibilities are elaborated in Chapters 9-12, but with interesting changes in emphasis. Chapter 9 shows the analyst's difficulties in determining purpose, criteria of value of a system, and in defining the typical user. The precise definition of an individual request is treated fully.

The responsibilities of the operators become the elements of organization in Chapter 10. Here the authors treat of order, vocabulary, syntax, coding, and format in the organization of files, and go on to the processes of input, posting or updating, and handling files. Then they show how the computing process fits here and how it differs from calculation, and the chapter closes with the organization of responses (output).

The elements of equipment are given in Chapter 11, as storage media, reading and recording, handling, filing, and logical capabilities.

Chapter 12 gives parameters (limits) of the ISR situation and many figures about their implementation. After outlining parameters of operation and equipment, the authors deal with the difficult task of evaluation of the performance of arithmetical and control units of computers, and of input and output devices, including printers.

They deal with implementation in nine pages, outlining it as planning and design, data gathering and definition, establishment of relationships, flow diagraming, evaluation and selection of equipment, computer programing, equipment installation, and conversion from the old to the new system. This small portion deserves treatment as a book in itself. The topic is very new; there is only one example which has been carried out as outlined here and its history is only partly in print: it is the MEDLARS project performed for the National Library of Medicine by the General Electric Company.

In the implementation section the authors refer to the pioneering book, *System Engineering*, by Harry H. Goode and Robert E. Machol (New York: McGraw-Hill, 1957) under the entry "Good and McCall." The book *is* good but it didn't appear in *McCall's!* Actually, bibliographical errors are rare in this book.

Chapter 13 deals with the role of a theory. The chapter contains a number of warnings which ought to be regarded seriously by all who are unfamiliar with the foundations of information system design as they are presently known. The authors point out that the fundamental theory behind librarianship and information handling has not yet been developed. They describe the place of mathematical models in the development of theory and specifically select Boolean algebra, truth tables, and lattices to deal with classes, sets, and relationships. They point out that it is possible to quantify aspects of information system theory by using linear algebra, matrices, probability, and stochastic processes, but they emphasize the fact that the basic values required for the employment of these parts of mathematics are rarely available in a working or experimental situation. They offer wise advice on the construction of tests of information systems and upon the interpretation of the results of such tests as have been conducted up to the present time.

Those who are not mathematically inclined can benefit by reading the short description of scientific method on pages 331-32 followed by the limitations on the scientific method on pages 357-58. Perhaps a careful reading of these pages would reduce the tendency of librarians to jump into the information systems pool before their pool has been filled with water. The authors indicate that information system theory is still being assembled from fields outside the ac-

tivity; it is not yet being developed from knowledge and data collected within the field.

Chapter 14 is entitled "Theories of File Organization" and the work described in this chapter was supported in part by the National Science Foundation. The authors say that their general theoretical structure is based on the view that: "1. Large files represent a multiple level structure whose characteristics are determined by both the physical parameters of the storage form and the logical problems in evaluating relevancy. 2. Such a structure, in order to be responsive to the usage of the file, must provide some procedure for reorganization in terms of the changing usage."

"With this view, the purpose of information systems can be considered as *providing relevant responses to an environment*" . . . and "the attempt must be made *continually to fit the organization of the stored responses to the environment* rather than vice versa."

In their effort to define file items the authors adopt five premises: (1) the contents of a file should reflect its total utilization, that is, both the contents of a library and representations of the requesters, of the requests, etc.; (2) the contents of the file are homogeneous; (3) a quantitative model and measure for relevancy are possible; (4) there is no essential relationship between the method of representing an item and the organization of groups of items into a file; (5) organization is the grouping of items or records which are then handled as units and lose to that extent their individual identity.

They then proceed to weight indexing terms for both indexing and request efforts. They also attempt a definition of relevancy by measuring the degree of association of relevancy, closeness of terms, and arguments, employing connection or association matrices.

The last three sections of the chapter deal with the logical organization of terms, by means of classification, subject headings, etc.; organization by activity to recognize the ways in which people use the collections; and reorganization to make the files meet new requirements.

The authors have combined their own efforts and the work of others currently active in this field into a stimulating chapter. The result should encourage other investigators to select the portions from mathematics which they require to provide an improved understanding of the topic of file organization.

Chapter 15, Theories of System Design, represents work supported in part by the United States Air Force. It is an effort to make a mathematical model of system design in ISR. While stating that the operational interrelationships are more important than the physical interrelationships, the authors use tape units, core memories, drum memories, disk units, and rotary card files as examples in their modeling. This chapter should point out to the nonmathematical, non-system-oriented librarian the hazard, if not the sheer folly, of making choices and decisions relating to new equipment and methods which will produce results he cannot anticipate or control, at a time when experts are still working out the theoretical foundations of his profession. Conversely, this chapter can suggest to these librarians that the employment of systems experts for their problems increases the probability of getting satisfactory results in comparison to the results of do-it-yourself efforts.—*C. D. Gull, Indiana University.*

History of American Schoolbooks. By Charles Carpenter. Philadelphia: University of Pennsylvania Press, 1963. 332p. illus. $6.50. (62-10747).

Librarians who have been privileged to examine prospective gift collections of books in lofts, smokehouses, and garrets, are well acquainted with the slender little volumes, bound in overprinted olive, tan, or blue boards, that constituted early American schoolbooks. Webster's spellers, Lindley Murray's grammars, Morse's geographies, McGuffey's readers, and other volumes prepared for school use by such worthies as Frost, Rush, Olney, Hunt, and Spencer, probably interlace 90 per cent of the nineteenth-century Americana collections still in private hands, but we know surprisingly little about them.

Carpenter's *History of American School-*