assist in caring for reprint material dedicated to this use which the donors were themselves unable to store until after the war. This committee is especially concerned with the receipt of full and partial sets of periodical literature for all war-torn libraries, but is in full accord with my suggestion concerning the saving of unwanted reprint material, especially for Chinese libraries. Several organizations and many individuals are working toward this same general objective of anticipating the needs for reconstruction of libraries in the devastated areas. The greatest obstacles in their programs seem to be the lack of present storage space and of personnel to handle the accumulating material. These difficulties are slowly being overcome, but as yet there are only limited facilities for receiving material, except where the donor is faced with the choice of turning it in for the post-war reconstruction program or for the current waste paper collection. It is, however, hoped that there will soon be an extensive drive for literature for this purpose, and it is in this connection and with the approval of the present executive assistant, Dorothy J. Comins, of the above named committee of the American Library Association with offices at the Library of Congress, and of Charles H. Brown, the chairman of their Committee on the Orient and Southwest Pacific, that I am issuing this reminder of the need for saving reprint literature.

Daily reports of bombing, burning and looting on the far-flung battle-fronts give strength to our worst fears of wide-spread destruction of valuable libraries. Thus the future demand for reprints, both currently appearing and of earlier date, is sure to be urgent and all should anticipate the need. Besides the demands from war-destroyed libraries we may justly anticipate the similar needs of new institutions which are being established and which will be built after the war with an ever-increasing crescendo as a result of the war-time stimulus toward scientific development. Although current scientific and technical periodicals are being purchased and laid aside for the reconstruction program, it is impossible to provide for all needs even in the near future. Hence, some destroyed libraries will welcome reprint material to represent the serials of which they will be unable to obtain full sets. Of course one should not confine one's efforts to saving only reprint literature, for all worthy periodicals and separate books will be needed. Broken sets of serials, and those which have been partially mutilated by removal of articles of special interest, can be used in completing other partial sets. Reprints are often considered by their owners as so specialized that, unless they are of immediate interest, they may as well be thrown away. A comprehensive program of collecting and distributing literature, such as is projected, will lead to their eventual arrival where they can be of value. Hence scientists should continue to save their unwanted literature for the peace-time reconstruction of war-torn libraries until they can be gathered together and properly handled in a coordinated program.

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AMERICAN SOCIETY OF PARASITOLOGISTS

THE report of the meeting of the Cleveland meeting of the American Association for the Advancement of Science which was published in the October 27 issue of SCIENCE erroneously stated (page 270) that the American Society of Parasitologists canceled its entire meeting. The society canceled its sessions at which general papers were scheduled to be read, but continued with its symposium on "Parasitology in Relation to the War" which it held jointly with the American Society of Zoologists and the Section on Medical Sciences. The program of this symposium is given in full in the report of the Cleveland meeting.

Following the symposium, the American Society of Parasitologists held a general business meeting, at which Asa C. Chandler, Rice Institute, was elected president for the year 1945 and Donald L. Augustine, Harvard University, was elected vice-president for the same term.

F. R. MOULTON,
Permanent Secretary

SCIENTIFIC BOOKS

TABLES OF BESSEL FUNCTIONS

A Guide to Tables of Bessel Functions. By HARRY BATEMAN and RAYMOND CLARE ARCHIBALD. Vol. 1, No. 7, July, 1944. 104 pp. of *Mathematical Tables and Other Aids to Computation,* published by the National Research Council, 2101 Constitution Ave., Washington, D. C. Special Number, $1.75.

BEGINNING in January, 1943, the National Research Council started the publication of a quarterly journal edited by the Committee on Mathematical Tables and Other Aids to Computation. This publication is intended as a clearing house for information concerning mathematical tables and other computational aids in the wide range of book, pamphlet and periodical literature. Its scope includes not only the field of pure mathematics, but also such fields as astronomy, chemistry, engineering, geodesy, geology, physics, physiology, economics, psychology and other scientific disciplines.

Eight numbers of the journal have been published—January, 1943, to October, 1944. The articles have included "Tables of Trigonometric Functions in Non-Sexagesimal Arguments," "Tables of Certain Functions in Dynamics of Structures," "Mathematical Tables in Reports of the B. A. A. S.," "Notes on the Computation of the Bessel Function $I_n(x)$," "Mathematical Tables in *Philosophical Magazine*," "Optimum-interval Punched-card Tables" and "Numerical Testing of Series by Calculations to Many Places of Decimals." Under the heading "Recent Mathematical Publications," 94 detailed reviews have been published. Under "Mathematical Tables—Errata," 53 contributions; under the important heading "Unpublished Mathematical Tables," 28; "Mechanical Aids to Computation," 11; "Notes," 25; "Queries," 10; and "Queries—Replies," 11.

Since the committee felt that at the present time hardly any publication of the kind could be more important than "A Guide to Tables of Bessel Functions," an entire number of the quarterly was devoted to this. The report is divided into two parts, the first consisting of a "Guide to Tables and Graphs; Polynomial Approximations and Asymptotic Expansions" and the second to a "Bibliography of Authors of Tables and Graphs." The first part is divided into 13 sections which lists under various headings the known tables and graphs together with their authors and the ranges of approximation.

The remarkable character of this contribution and its usefulnes to science may be better understood from a more detailed description of its contents. But a preliminary word of explanation about the subject itself may prove helpful in this connection.

The term "Bessel functions" is applied to the solutions of the linear differential equation

$$x^2y'' + xy' + (x^2 - n^2)y = 0.$$

This equation is called *Bessel's equation* after F. W. Bessel (1784–1846), who, although anticipated in its discovery by more than half a century by L. Euler, was the first to give in 1824 a systematic description of the solutions and to compute brief tables of two of them.

Bessel functions rival in their wealth of application their cousins, the circular functions. This may be inferred from the fact that the first appearance of the functions was in connection with the vibrations of a stretched membrane and the second in the solution of Kepler's equation fundamental to the description of the motion of a planet about the sun. Since their discovery they have appeared in many applications, in the transmission of currents in electrical net-works, in problems of elasticity, in the flow of heat, the distribution of potential, the theory of diffraction, and even in problems as remote from their origins as mathematical economics.

With an increase in application, new forms of the solution of the basic equation and a variety of nomenclature for them were developed. In the early studies the Bessel function of first kind was denoted by $J_n(x)$. This function is that solution of the fundamental equation which is characterized by the fact that it is a power series which converges for all values of x, and has no singularities when n is a positive integer. But interest soon developed in the second independent solution of the equation. Although this solution was called the Bessel function of second kind, it was defined variously by different writers and numerous symbols were used in its designation. Today the preferred symbol for this function is $Y_n(x)$ and such extensive tables have been computed for it that its selection as the normal form for the second solution seems assured. Bessel functions of third kind are formed from those of first and second kind by means of the relationships: $H_n^{(1)}(x) = J_n(x) + i\,Y_n(x)$, and $H_n^{(2)}(x) = J_n(x) - i\,Y_n(x)$. Since Bessel functions in their application are not limited to real values of the variable x, numerous other auxiliary functions were developed in the study of the Bessel functions of a complex variable. To enumerate these various forms would be tedious and unnecessary to our purpose. For this and other information the reader is referred to the work of their modern biographer, G. N. Watson, whose classical treatise on the subject has been recently reissued.

Most conspicuous among the properties of the Bessel functions which have interested applied workers one finds the distribution and numerical values of the zeros. This is readily seen from the many tables of them which have been computed and the numerous ingenious devices which have been developed for their approximation. In other studies interest has centered upon the values of the functions for large values of the variable x or of the parameter n.

The work of the authors of the "Guide" under review was to enumerate all the tables of the values of the Bessel functions, of their zeros and of other related functions, together with a description of the extent to which the calculations have been carried. This has been accomplished by means of a compact notation illustrated by the following item under the heading $J_0(x)$ and $J_1(x)$: 12 *D*, Meissel 1, $x = 0$ (.01) 15.5, which means that these functions have been tabulated by Meissel in his first paper listed in the Bibliography, and that the computations are to 12 decimal places over the range from 0 to 15.5 at intervals of .01.

Two features of the "Guide" which the authors regard as of special importance are "(1) the complete listing of every known Unpublished Table of Bessel

Functions now available for consultation; (2) the assembly of information regarding known Errors in the tables recorded." The extensive character of this work is readily seen from the fact that there are 282 references to tables and graphs of $J_n(x)$ alone, and for all the functions one finds a total of 1,071 references.

Another service which this work supplies is to help in attaining some uniformity in the symbolism of the functions. Each enumeration of tables is preceded by an extensive account of the functions tabulated, together with a standard notation for them and some description of their origins. Although symbolism has improved in recent years by the publication of such well-known tables as those of the British Association for the Advancement of Science, the present "Guide" has given considerable support to the problem by agreeing "as far as possible with (the symbolism) used by English writers."

One particularly useful part of the work is the concluding section devoted to a summary of the literature on "Polynomial Approximations and Asymptotic Expansions," which was entirely the contribution of Professor Bateman. Much of the modern development of asymptotic series arose out of problems presented by Bessel functions, as one may infer from the fact that the perfection of the powerful saddle-point method, or method of steepest descents, is a product of the study of these functions. Computers and other statistical workers will be especially indebted to this section of the work.

From this it may be inferred that science has received a very useful addition to its tools in the publication of this "Guide," and it should prove to be an indispensable addition to standard works on the subject of Bessel functions.

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RADIO COMMUNICATIONS

Fundamentals of Radio Communications. By AUSTIN R. FREY. xii + 393 pp. Illustrated. New York: Longmans, Green and Company, Inc. 1944. $4.00.

WITH the large number of well-written texts on the subject of electronics and related fields, an author assumes a considerable responsibility in adding to the list. The author of this book, however, has not just written another book but has made a real contribution in offering a work which will prove of great value, not only to the student who desires to make a serious study of the field, but also to the practical engineer who may not be sufficiently interested in radio communications to maintain a complete library on the subject. The writer of this book struck a very effective balance between writing a text which is sufficiently complete and rigorous to satisfy every one and, at the same time, kept the mathematical treatments on a basis which stressed the physics of the problem rather than the mathematical niceties.

Obviously, the most important application of electronics to-day is in radio communication and this book properly stresses that application. However, a number of subjects which are not as important in communication as in other electronic applications are discussed in sufficient detail to make this book a valuable addition to the library of those not specifically interested in communications.

The treatment of the various subjects follows fairly conventional lines. The first chapter, devoted to a very complete discussion of resonant circuits, is especially effective. The next few chapters deal with thermionic emission and introduction to an elementary mathematics of the triode. Voltage amplifiers are discussed and this subject is brought up to date by a good discussion of the most recent developments in the field of ultra high frequency applications. Power amplifiers are then covered in a rather conventional manner. The chapter on oscillators is another one which the author treated rather better than the average. Not only is the theory worked out in a decidedly satisfactory manner, but many of the minor details which are important to an engineer are discussed. Chapters on modulation, demodulation and R.F. transmission lines follow with some emphasis on the more recent work on frequency modulation.

The last chapter in the book dealing with radiation is again one of the most satisfactory chapters in the book. In a rather brief but most effectively written chapter, the subject of radiation and antennas is discussed. Obviously, this discussion would not enable an engineer to design an antenna system, but a thorough reading of this chapter should enable any one to understand the basic principles of the subject. Most treatments of this important subject are so beclouded with mathematics that the results can only be dug out with considerable difficulty. In this chapter, the author began with a really simple equation for the instantaneous magnetic field at a distance r from a conductor. This equation, which he wisely does not attempt to derive but to which he gives adequate reference, is the starting point for all the subsequent discussion. By comparatively simple mathematical manipulation, the radiation field from a dipole and the other type of radiators follows.

For the benefit of those who would use this book in teaching classes, each chapter is followed by a number of selected problems of moderate difficulty. The usefulness of these problems, however, would be considerably increased if answers to at least some of them would be provided.

The book, as a whole, is very well written and is a good example of fine expository writing. A minor criticism of the book is that the drawings are definitely