etries; the former with general axiomatic foundations. The activity of investigation in hyperspace geometry, especially in Italy, is put in concrete evidence by the fact that the section devoted to this subject is the longest in the appendix.

E. KASNER.

Führer durch die mathematische Literatur mit besonderer Berücksichtigung der historisch wichtigen Schriften. Von FELIX MÜLLER. Leipzig und Berlin, Teubner, 1909. x + 252 pp.

IN the preface we are told that the present work aims to be a reliable guide through the mathematical literature for all those who may seek self-instruction in any domain of the science. It seems especially suited for those students who desire to complete their lecture notes by means of references to the literature and the history of the subject. In view of the size and the scope of the work it is evident that the specialist will, in general, make little use of it along the line of his specialty, but he will find in it much general information in a convenient form. It has been made generally and permanently accessible by its appearance in the *Abhandlungen zur Geschichte der mathematischen Wissenschaften*, Heft XXVII.

In general, each chapter begins with a brief statement of the main features of the subject to which the chapter is devoted and some historical notes relating to the origin of the subject. This is followed, in order, by a selection of classic works, newer textbooks, fundamental memoirs, and articles devoted to special parts of the subject. Great care has been exercised as regards the exact titles and references, but the number of these is so large as to make errors almost unavoidable. Some of them have been corrected on the five pages of Nachträge und Verbesserungen. Among those which have escaped we may mention W. J. Stringham on page 219 in place of W. I. Stringham, J. J. Hutchinson on pages 124 and 242 in place of J. I. Hutchinson, two incorrect numbers (7, 518) following Blichfeldt on page 236, and two (205, 218) following Halsted on page 241. The latter numbers should have been entered under Halphen.

The first forty-seven pages are devoted to the history of mathematics, biography, collected works, periodicals, bibliography, and encyclopedias. For many readers this will doubtless prove the most valuable part of the volume, since it contains a large amount of information which cannot be easily gathered

from other sources. The information in regard to the publications of various academies and societies, with details as to the dates of the most important serials, should prove to be of great value, not only to the student of the mathematical literature but also to those in charge of securing complete sets of important publications for libraries. The rapidly growing interest in the history of mathematics has doubtless led many professional mathematicians to wish for a reliable guide through the subjects treated in this part.

The second part covers eighty-four pages and is devoted to the following subjects: philosophy, pedagogy, algebra, arithmetic, analysis, and function theory. Although nearly all the space is used for references yet the extent of the literature on these subjects is so great that only a very small part of the total number of important references could be given. It can scarcely be expected that all would agree that the selections were the best that could have been made, as so much depends upon the point of view. American readers will especially miss such references as Dickson's Linear Groups, 1901; Bolza's Lectures on the Calculus of Variation, 1904; Pierpont's Theory of Functions, 1905; Bôcher's Introduction to Higher Algebra, 1907. Notwithstanding some unfortunate omissions this part contains a great deal of information in a convenient form, especially for beginners in these subjects.

The third and largest part of the volume under review is devoted to geometry, which is considered in sixteen chapters bearing the following headings: Foundations of geometry, elementary plane geometry, trigonometry, continuity, solid geometry, descriptive geometry, analytic geometry, synthetic geometry, infinitesimal geometry, higher plane curves, higher solid geometry, enumerative geometry, line geometry, transformations, geometry of more than three dimensions, kinematic geometry. Although a little more than one-third of the volume is devoted to this part yet some very important memoirs and works are not mentioned in the references. Among these is Kasner's excellent report on the present problems of geometry, which appeared in the BULLETIN in 1905.

The work closes with a valuable table of contents and a list of names quoted, with references to the pages. The preparation of a reliable guide through the mathematical literature clearly calls for very high attainments on the part of its author. By his long connection with the *Fortschritte der Mathematik* and his

many valuable earlier publications, the author of the present work has won the confidence of the mathematical public, and the usefulness of the present volume will doubtless increase this confidence. It is hoped that it may also inspire others to render such scholarly services even if their accomplishment demands a vast amount of time, care, and patience. The more our science grows the more need there will be for such works, and conversely such works contribute materially towards stimulating real growth.

G. A. MILLER.

Ueber das Wesen der Mathematik. Rede gehalten am 11. März 1908 in der öffentlichen Sitzung der K. Bayerischen Akademie der Wissenschaften von DR. A. VOSS, O. Professor der Mathematik in München. Erweitert und mit Anmerkungen versehen. Leipzig und Berlin, B. G. Teubner, 1908. 98 pp.

ADDRESSING a mixed assembly of scientists, Voss endeavors to answer the questions: What is the nature (Wesen) of mathematics? How does it happen that mathematics is the only science which presents truth in apodictic form? What has the past century accomplished toward the elucidation of the inner structure of mathematics?

Though not answering these difficult questions with the precision some may desire, the address is extremely able and instructive. The annotations occupy about half the space of the book and contain numerous valuable references to the literature of the subject. The author passes in rapid historical review the fundamental concepts of variables, functional dependence, and limits. He points out the triumphs of mathematics during the eighteenth century, a period which culminated with Laplace. This great savant made the well-known utterance, now admitted to be a gross exaggeration: An intelligence to whom at a given moment were presented the conditions of the entire material world would be able by mathematical analysis to survey the entire past and future of the world. In considering the various attempts to define mathematics, Voss passes from the antiquated "science of quantity" definition to the more recent ones based on the consideration of the logical steps involved, namely the definitions of B. Peirce, E. Papperitz, G. Itelson, B. Kempe, M. Bôcher, H. B. Russell, and L. Couturat. Geometry and mechanics belong to applied mathematics. Pure