

duced, and the laws of calculation are shown to be still valid in the enlarged set. The author then extends the concept of the set to non-enumerably infinite aggregates, which allows him to introduce irrational numbers in the usual Dedekind fashion. Powers with both bases and exponents, arbitrary real numbers, and logarithms of arbitrary positive real numbers to arbitrary positive real bases are then treated. The book proper concludes with an exposition of some of the principal theorems of combinations, and the binomial theorem for a positive real exponent. An appendix is added to the book, giving extracts from some of the author's previous writings.

On account of the abstract nature of the subject matter, the book is not suitable for the beginner, but it should appeal strongly to every teacher of mathematics. Notwithstanding the abstractness of the subject, the matter is attractively arranged, and may be perused with profit by one who possesses general maturity, even without an extensive knowledge of the technique of mathematics. It is unfortunate that books of this type are so inaccessible to English readers.

F. W. OWENS.

Eine konforme Abbildung als zweidimensionale Logarithmentafel zur Rechnung mit komplexen Zahlen. By Dr. F. BENNECKE, Professor at the Victoria-Gymnasium in Potsdam, 1907.

THE above is the title of the Festschrift by Dr. Bennecke at the three hundredth anniversary of the establishment of the Royal Joachimsthal Gymnasium at Berlin. In the early paragraphs is given a statement of the literature of the subject. While the author makes no pretension of presenting an exhaustive bibliography, nevertheless the citations are suggestive of the historical development and of the general interest in graphic methods, particularly as applied to operations with complex numbers. The purpose of the pamphlet is to establish a method by which the logarithms of complex numbers may be calculated with sufficient accuracy for practical purposes by means of graphs. This purpose is accomplished by a conformal representation upon the (X, Y) -plane of the two systems of curves given by $x = \text{constant}$, $y = \text{constant}$, where

$$W = X + iY = \log z = \log (x + iy).$$

It is shown that any curve of either of the two resulting systems

in the (X, Y) -plane is congruent with any other curve of the same system, and that the curves of the two systems are likewise congruent with one another. The relation between the curves makes it possible to construct all of the necessary graphs by the aid of a single regular curve. The construction of these graphs is furthermore simplified by showing that, to find the logarithm of any number to the base ten, it is sufficient to map on the W -plane only that portion of the z -plane which lies in the first quadrant and between the circles whose radii are 100 and 1000 respectively.

The rectangular form of the functional region makes it feasible to divide that region into nine subdivisions, thus giving a more convenient arrangement for evaluating a logarithm than by means of one large chart. From the ten charts which follow the general discussion both logarithms and anti-logarithms of complex numbers may be approximately determined. Upon the assumptions made as to the accuracy in locating points of intersections of two curves and in reading the charts, the maximum error in the absolute value of the logarithm will not exceed 0.0005. This accuracy corresponds therefore to a three place logarithmic table. Of course, as in ordinary logarithms, these errors may accumulate in the process of computation, so that the final error may be larger.

Aside from a theoretical interest in the work of Dr. Bennecke as an exercise in mapping, students of physics and others will find the charts of practical value wherever computations involving the logarithms of complex numbers are necessary.

E. J. TOWNSEND.

Elementary Algebra. By J. W. A. YOUNG and LAMBERT L. JACKSON. New York, Appleton and Co., 1908. ix + 438 pp.

THE guiding principle of the authors in this book is "a minimum of mathematical theory and a fuller recognition of the utility of the subject." This does not mean that the logical value of algebra has been ignored, but rather that the proofs given are put in a form which will appeal to and satisfy the mind of an average high school pupil; when in a few places this seemed impossible, the authors have fallen back upon simple assumptions rather than upon the introduction of subtle distinctions and arguments savoring of higher mathematical methods. For example, instead of explaining the process of