

## MATRICES AND DETERMINOIDS.

*Matrices and Determinoids.* By C. E. CULLIS. University of Calcutta Readership Lectures. Cambridge University Press, Vol. I, 1913, xii + 430; Vol. II, 1918, xxiv + 555 pp.

THIS treatise was designed to occupy two volumes of theory and one of applications to vector analysis and invariants. The growth of the manuscript however has brought about three volumes for the theory and one for applications. Consequently the present volume instead of closing the theory leaves it still incomplete. The third volume of theory is to include the theory of matrices with functions as coefficients, if we read the indications correctly.

The greater part of the first volume is devoted to the notion of determinoid and theorems connected with this. The matrix itself is studied mainly in connection with the notions of addition, subtraction, and multiplication. A study of the solution of matrix equations of the first degree, which includes systems of linear algebraic equations, also is included in this volume.

The second volume deals with compound matrices, the minors of a matrix, some properties of square matrices, rank of a matrix, transformations of a matrix, equations of the second degree, extravagances of matrices, paratomy and orthotomy of matrices, and three appendices.

As has happened in treatises from some Cambridge mathematicians, a great addition to the existing mathematical vocabulary is to be found in this treatise. Whether so many new terms are necessary of course remains to be seen in their developmental use. One's first impression is, however, that the matter is overdone. Some of them are descriptive enough to explain themselves to some extent, but others are manufactured for the occasion and only to be understood by reference to the text or a glossary. There is a complete and systematic notation throughout, which is highly desirable, and after one has accustomed himself to its method, it is quite intelligible, though successive abbreviation renders it more and more compact.

*Definition of Matrix.*—The author follows the usual custom and defines a matrix as an assemblage of  $m$  rows of  $n$  elements