

A wise moderation has been exercised in the selection of topics, and the arrangement of the rich material is pedagogical as well as logical. The concept of the analytic function takes the central place, everything else is subservient to it, either by preparing for it or by illustrating it. By this means, a harmony and equilibrium between the different parts is attained, which impart to the whole in a remarkable degree the character of an organic unity.

Thus the authors have succeeded in producing not only a work of high scientific and pedagogical value but at the same time of a singular beauty and elegance. But there are numerous beauties of detail as well, for which, however, the reader must be referred to the book itself. A certain freshness and originality pervade the whole, even in places where the authors follow along beaten tracks, and give at every turn evidence of the complete mastery of the subject with which the book is written.

OSKAR BOLZA.

UNIVERSITY OF CHICAGO,  
June 30, 1899.

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#### McAULAY'S OCTONIONS.

*Octonions.* By A. McAULAY, M.A. Cambridge, The University Press, 1898. 8vo, 253 pp.

THIS treatise is a development of Clifford's biquaternions with applications to ordinary space. The starting point of the analysis is quaternions, combined later with methods from Grassman's *Ausdehnungslehre*.

The development is open to criticism, as a work for beginners, because of its extremely refined formal character. This is perhaps unavoidable because the book was first compiled as a scientific paper, and, as the author says, he did not feel justified in recasting the whole appropriately. Discussions of formal laws and expert reasoning upon terms that are imperfectly defined, relying upon subsequent developments to bring out their full meaning, are not conducive to clearness of apprehension on the part of a learner. Perhaps as good a review, therefore, as can be made of the book, which is indeed an extensive and thorough development of what must prove to be a valuable analysis, is to give a brief and clear exposition of the octonion system.

The octonion is a quantity defined by four numbers called its *tensor*, *scalar*, *convert*, and *pitch*, and an axis having a fixed position in space. This makes in all eight numbers, upon