

VEBLEN ON ANALYSIS SITUS

The Cambridge Colloquium, 1916, Part II. *Analysis Situs*. By Oswald Veblen. New York, The American Mathematical Society, 1922. vii + 150 pp.

The present reviewer finds himself facing the infrequent experience of tackling the same work for the second time. That he derives no little satisfaction from it, is due to the fact that since the first review was written* he has made ample use of the book as an instrument of research, and hopes that the additional experience thus acquired will prove of value not only to himself but also to his readers.

Let us say at once that the *Lectures* have stood the test of usage very well indeed. Hitherto a beginner attracted by the fascinating and difficult field of analysis situs, was obliged to wade through many widely scattered papers, beginning with Poincaré's classic of the 1895 in *JOURNAL DE L'ÉCOLE POLYTECHNIQUE* and its multiple *Compléments*. Difficult reasonings beset him at every step, an unfriendly notation did not help matters, to all of which must be added, most baffling of all, the breakdown of geometric intuition precisely when most needed. No royal road can be created through this dense forest, but a good and thorough-going treatment of fundamentals, notation, terminology, may smooth the path somewhat. And this and much more we find supplied by Veblen's *Lectures*. That few, if any, were better qualified than the author, by temperament and scientific past, to produce such a work, is well known among the devotees of analysis situs, whose number it will assuredly increase. As this field presents difficult problems in profusion, with but few general methods, such an increment is very much to be hoped for.

Two streams are found in analysis situs: the one related to point-set theory, the other primarily of a combinatorial nature, wherein are treated manifolds which for example in the case of two dimensions, are depictable upon polyhedra with a finite number of plane polygonal faces. To this latter branch these *Colloquium Lectures* are almost wholly devoted. Withal the author is perhaps at his mathematical best at the points of contact of the two streams, say with the type of question presented by the occurrence of Jordan curves on a representative polyhedron.

Veblen has made extensive and very systematic use of the Poincaré

* See *Bulletin des Sciences Mathématiques* for 1922.

† A k -cell is any point-set continuously depictable upon the interior of a hypersphere in k -space.