

discussions, and physical philosophy is delightfully in evidence throughout involved physical discussions. Tables of numerical data help at times to increase the effective reality of the work. One thing, however, continental authors disregard to their serious detriment, and that is exercises for the student. When exercises are well selected they double the educational value of any book. Schaefer has the teacher's instincts and could easily have furnished excellent exercises.

It would be only too easy to stretch this review to great lengths, mentioning such clear-cut analysis as that of Boltzmann's "ergodische" systems with its unusual frankness in pointing out that there are no such systems (p. 439), of the total separation of Liouville's theorem and the equipartition of energy, etc., of the discussion of anomalies (Schwankungen) and its bearing on the work of Perrin and his followers. But there are too many details to cite, and we had best not begin. Let the book be widely read.

EDWIN B. WILSON.

*The Elements of Non-Euclidean Geometry.* By D. M. Y. Sommerville. Chicago, The Open Court Publishing Company; and London, G. Bell and Sons, 1919.\* xvi + 274 pp.

The printing of a second edition of this book, as well as the fact that it now, for the first time, appears as a publication of the Open Court Publishing Company, speaks well for the attention it has received from mathematical readers.

A careful comparison of the two editions shows no changes. The very few typographical errors and the somewhat more frequent unintended slips in the text remain. For instance, on p. 10, l. 20, a parenthesis is still lacking; likewise an "s" on p. 22, l. 1. There remains (p. 54) this remarkable series of statements:—"A triangle has therefore four circumcircles. . . . There cannot be more than one real circumcentre" [and may, of course, be none]. "This point, which we may call *the* circumcentre, . . . may be real, at infinity, or ideal." On p. 204, line 19,  $R$  is still called the earth's radius, although the radius of the earth's orbit is clearly meant.

It is to be sincerely hoped that the popularity of the book may before long require still another printing, and that a careful revision may then make it as accurate as it is interesting.

EDWARD S. ALLEN.

*Annuaire du Bureau des Longitudes pour 1921.* Publié par le Bureau des Longitudes. Paris, Gauthier-Villars, 1921. 7 + 710 + 130 pp.

Before 1904, each issue of the *Annuaire* contained all the information which the Bureau considered necessary for publication. Owing to the number of pages, which had gradually increased, it was then divided and certain articles in which there was little or no annual change were given only in alternate years. The volume has now grown again to a size which is near its maximum for convenient handling and one finds references which include the previous four volumes. Its chief annual feature is the full

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\* Originally published in 1914 by G. Bell and Sons, and reviewed in this *BULLETIN*, vol. 21, May, 1915, by J. L. Coolidge.

astronomical information for the current year and a briefer summary for the succeeding year. There are usually one or more appendices containing articles on various topics. This year M. Bigourdan writes on proper motions and radial velocities of stars—a summary which, starting at the beginning, takes the reader to the work which is now in progress at many observatories. A valuable feature is the full index of all matters contained in the current issue with references, where necessary, to the previous four volumes.

ERNEST W. BROWN.

*Die Grundlagen der Geometrie als Unterbau für die Analytische Geometrie.*

By Lothar Heffter. Leipzig and Berlin, B. G. Teubner, 1921. ii + 27 + viii pp.

The author's purpose is to provide a foundation for the study of analytic geometry and this he proposes to do by stating a set of projective postulates sufficient for the introduction of the double ratio, the fundamental concept of the projective scale. He explicitly states his intention to ignore the question of the independence of his postulates—and would have us regard them as “one possible way of idealizing the results of observation” rather than as a purely abstract gift from heaven. His undefined elements are point, line, plane and incidence. He lists twenty “axioms of alignment” (Verknüpfung), arranged in ten pairs of dual propositions, three “axioms of order” (separation), and one of continuity. To secure the restriction to the affine and then to the euclidean metric geometries, he introduces one axiom of parallelism and one axiom of orthogonality. To those interested in a brief formulation of the postulational foundation, from a projective point of view, for the study of analytic geometry the little pamphlet will be of value.

J. W. YOUNG.

*Les Théories d'Einstein.* By Lucien Fabre. Paris, Payot et Cie., 1921. 225 pp.

This book will be found of interest because of its valuable survey of the historical background of Einstein's theories. The author sometimes fails to define the symbols used. (For example, on pages 161, 179, and 243, and on page 196 there are incorrect definitions.) In spite of these defects, however, the book is one of the best elementary expositions of Einstein's work that has been published.

C. N. REYNOLDS.