

## SPHERICAL ASTRONOMY.

*A Treatise on Spherical Astronomy.* By Sir Robert Ball, F.R.S. Pp. xii+506. (Cambridge: University Press, 1908.) Price 12s. net.

IT is difficult to decide what limits an author should set himself in writing a text-book on this subject. Gravitational astronomy on the one hand and descriptive and general astronomy on the other should be, for the most part, omitted. A more difficult question arises as to what details of practical astronomy should be included. It seems to us that the aim of such a book should be to show how the geometrical positions of stars and other heavenly bodies are defined and accurately determined, and how these positions vary with the place and time of observation, and from such causes as refraction and aberration. Some description of the more important instruments, e.g. the transit circle, the equatorial, theodolite, and sextant, should be included, and preferably in connection with the class of astronomical problem to which they are applied, and the geometrical problems to which they give rise or which arise in connection with them. The excellent little book, written by Sir Robert Ball in 1877, fulfils this condition. Godfray's "Astronomy" is incomplete and antiquated, but in this way is an admirable manual for students.

In the work under review the instruments are considered as particular cases of the "generalised instrument." This mode of treatment is of considerable geometrical interest, but it does not give the student an adequate idea of the use of astronomical instruments or the parts they play in astronomical investigations. As the author explains in the preface that he proposes to avoid the multitudinous details of practical astronomy, this criticism is perhaps beside the mark, but the student will, we think, need to read concurrently with this work one on the outlines of practical astronomy. The most striking illustration of the difficulties which arise from the separation of the geometrical problems from the instruments which furnish their data is found in the scanty treatment of the determination of latitude and longitude. With the exception of Sumner's method, only incidental references are made to a subject which requires at least one chapter for an account of the various methods applicable under different conditions.

Within the limits the author has imposed on himself, the book will be found very useful by students whose mathematical attainments are sufficient to obtain a first class in the mathematical tripos at Cambridge. The author usually treats questions generally and analytically, and then proceeds to transform, simplify, and approximate. This method is naturally and necessarily employed in treatises, such as Chauvenet's, intended for the actual requirements of astronomers, and is the simplest for students to whom the mathematics does not present difficulty. For other students more elementary methods applied to the simplest cases will be found necessary.

A valuable feature of the work is the constant introduction of the numerical values of the astro-

nomical constants, and the frequent solution of numerical examples. The short exposition of the art of interpolation properly finds a place in the book.

In the chapter dealing with the use of spherical coordinates, it is pointed out that the direction of graduation of a circle enables the two poles to be distinguished, and the use of the word *nole* is suggested for the one generally called the North Pole. Such a term is a useful one, as the words North Pole can then be restricted to the actual North Pole of the heavens.

We are glad to see that a short account is given of the theory of map-making. It is very desirable that a knowledge of the principles on which maps are constructed should be more widely known, and not confined to students of pure mathematics.

Attention may be directed to the chapter on refraction. This subject presents difficulties both to the astronomer and the teacher. The theories of Bessel, Gylden, and Radau are too complicated for a text-book, and yet the importance of the subject demands more than is usually given when these are omitted. The author, who gives a simple approximate integration of the differential equation of refraction (for which he expresses his indebtedness to Prof. E. T. Whittaker), has presented the whole question in a satisfactory and adequate manner.

The geometry of such questions as aberration, parallax, and occultations is well presented. Generally speaking, the book will be found very useful both by teachers and students in all applications of spherical trigonometry to astronomy. The collection of exercises is well chosen, and the numerical applications, both in the text and among the exercises, serve to give a real connection between the mathematical formulæ and astronomical phenomena. F. W. D.

## THE CELL AND ITS WORK.

*The Cell as the Unit of Life, and other Lectures delivered at the Royal Institution, London, 1899-1902. An Introduction to Biology.* By the late Allan Macfadyen. Edited by Prof. R. Tanner Hewlett. Pp. xvi+381. (London: J. and A. Churchill, 1908.) Price 7s. 6d. net.

THE volume before us is the outcome of courses of lectures delivered some years ago by the late Dr. Allan Macfadyen in his capacity of Fullerian professor of physiology in the Royal Institution. Naturally, owing to the time that has elapsed since they were delivered, some modification must have been rendered necessary, and Prof. Hewlett, who has undertaken the task of editing the book, is to be congratulated on the way in which he has performed his part.

The lectures themselves deal principally with the cell as the morphological and physiological unit of organic life. The author strongly emphasises this point of view. It is one which, in our judgment also, still affords the most comprehensive as well as the most effective grasp of the problems presented by living beings, notwithstanding the attacks that have been from time to time directed against it. The