OPTICAL SCIENCE.

A Treatise on Geometrical Optics. By R. A. Herman, M.A., Fellow of Trinity College, Cambridge. Pp. x + 344. (Cambridge : University Press, 1900.)

I N the preface to a recent book dealing with photographic optics, Prof. S. P. Thompson expressed the view that Sir John Herschel's article, "On Light," in the "Encyclopædia Metropolitana" of 1840 marks the culminating point of English writers on optics. Whether this is still the case or not perhaps need hardly be discussed; it may safely be said that Mr. Herman's book, which contains many novel points, constitutes a marked advance, and brings before English students a quantity of information which was not easily accessible to them before.

At the same time, the book undoubtedly suffers as a treatise on the subject from being a text-book for mathematical students at Cambridge. Mr. Herman has aimed at attracting a wide circle of students. The most elementary proofs of the simplest theorems are given alongside of mathematics which require a considerable training to follow easily. The book would have gained as a treatise if the author had assumed his readers to possess some elementary knowledge of the subject and its simplest formulæ. A Cambridge coach might put it in the hands of a beginner, marking, say, two-thirds as to be omitted at first reading ; that two-thirds, with some slight re-arrangement and addition, would make a more interesting book for the more advanced student than the actual volume now under review. Thus the theory of geometrical foci, the methods of constructing a figure to find the image of a small object placed perpendicularly to the axis, of a system of spherical reflecting or refracting surfaces and similar problems could all be put more briefly.

In Chapter ix. (General Theorems) we come to Fermal's theorem; the general theory of geometrical foci is here given, based on this theorem. The author remarks that all the theorems hitherto obtained for small pencils passing directly through a coaxial refracting system might be obtained from the formulæ arrived at ; the advanced student would have gained a closer grip of the subject as a whole had this course been taken. The formulæ can be extended to establish the collinear relation between the object space and the image space, and, when once this is done, the existence of the principal and nodal points follows, and the geometrical constructions based on a knowledge of their position are easily generalised. The introductory methods of Drude's recent "Lehrbuch der Optik" seems, in this respect, more suited to a treatise on the subject than those chosen by Mr. Herman, who appears to have been deterred from using them by his wish to make it clear throughout that the method of geometrical foci is only an approximation. But in spite of this the merits of the book are very great. The author, in his introduction, states that it has been one of his aims

"to introduce a new method of determining the properties of a symmetrical optical instrument in which the angle of divergence of a small pencil, rather than any coordinate of its origin, has been adopted as a leading feature."

NO. 1626, VOL. 63]

The method rests on a combination of Cotes' theorem of the apparent distance, and Helmholtz's expression for the linear magnification.

The simplification that results from its use in the case of a symmetrical pencil traversing a coaxial system of lenses is most marked; the lengthy calculation of the continued fraction by means of which the results are arrived at in Gauss's treatment of the subject is entirely avoided. The application of the method to the determination of the axial aberration of such a system is a striking example of its power; this is easily seen by comparing Chapter viii. (Aberration) with the corresponding portion of some earlier text-book.

In the chapter on instruments the discussion of telescopes is very satisfactory. The same can hardly be said for that on microscopes; probably it would be too much to expect an explanation of the complete theory within the limits of space which could be assigned to the subject, but the discussion should have come after the chapters on aberration and achromatism; it would then have been possible to refer to the problem of the manufacture of suitable glasses which Abbé set himself to solve in 1881—this is alluded to in a perfunctory manner in § 123—and to indicate in a general way the outlines of the theory and the methods in which the defects of one lens are corrected by the next.

The problems to be solved in the construction of photographic lenses can, perhaps, hardly be discussed fully without more complete calculations of the aberrations of oblique pencils than is possible in a general treatise ; still, space might have been found for a reference to von Seidel's work, and some discussion of the physical meaning of his five equations of condition would have been interesting and valuable even if the reader had been referred to the original papers for a proof of the conditions. In fact, the book would be improved in many places if the account given of modern German work were more complete; in the chapter on achromatism, for example, full details are supplied of the refractive indices and dispersive powers of several specimens of crown and flint glass; details as to Abbé's glasses, which contain salts of boron, phosphorus and barium, together with some note as to the effects produced on the optical properties of the glasses by these salts, might well have been added. The book is so notable and valuable an addition to the literature of a rather neglected subject, that it is a pity it is not more complete in these respects. It is printed by the Pitt Press in its usual admirable style; the collection of examples, both worked and unworked, is specially full, and will be found very useful to the student. As a text-book it is a marked advance on anything yet published in England.

OUR BOOK SHELF.

By Land and Sky. By the Rev. John M. Bacon, M.A., F.R.A.S. Pp. viii+275. (London: Isbister and Co, Ltd., 1900.)

MEMBERS of the British Association who were at the Dover meeting may find in this book, among other things, some account of the intentions and the performance of the balloon that occupied for so long a time the grounds of Dover College.