Review
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A Treatise on Spherical Astronomy. By SIR ROBERT BALL, F.R.S. Pp. xii + 506. 12s. net. 1910. (Cambridge University Press.)

" By Spherical Astronomy I mean that part of Mathematical Astronomy which lies between the vast domain of Dynamical Astronomy on the one hand and the multitudinous details of Practical Astronomy on the other."

These are the limits which Sir Robert Ball has set himself in the volume before us, and with the skill we expect in a writer and teacher of his long experience he has produced, from the immense amount of detail at his disposal, a text-book which not merely satisfies the requirements of Tripos candidates and the like, but which takes its place among the classics dealing with this branch of the science of which the author is so distinguished an exponent. Fortunately, for the reader and the student, Sir Robert has been tempted more than once outside the bounds, and on each occasion with definite intent and to some purpose. In his last two chapters he crosses the frontier of Practical Astronomy, and sets forth the fundamental geometrical principles underlying all astronomical instruments. He considers a " generalised instrument," a geometrical abstraction, in the theory of which the principles of ordinary instruments fall into line as special cases. Here we find in its proper place the novel and useful note contributed to the *Monthly Notices* for Jan. 1908, in which is derived the fundamental equation which can be made to apply to the altazimuth, the meridian circle, the prime vertical instrument, and the almucantar. The fundamental instruments themselves are treated in the final sections of the book. The intrusion into the field of dynamical astronomy is found in the chapter dealing with Kepler's and Newton's laws and their applications. Sir Robert is also to be congratulated on the felicitous introduction of the term *nole* to denote "that pole of a graduated great circle which lies towards the left hand of a man walking on the outside of the sphere along the circle in the direction in which the graduation increases," with, of course, "anti-nole" to denote the opposite pole. The archaic "nole" is still to be heard in remote parts of the country, in the sense of head, or neck, or even navel. The selection of nole from among the various forms in which the word appears is singularly happy as suggesting "north pole." The collection of examples includes a large number taken from College and Tripos papers. Solutions are in many cases given, and some of them are extremely neat. The book fills a gap. The student need no longer apply to American or German sources for the course required for Tripos purposes, and, at the same time, the book is distinct in character from such a work as Newcomb's "Compendium." Sections which may be omitted on a first reading are marked with an asterisk. What is left forms as admirable an introduction to the mathematics of Spherical Astronomy as exists in any language.

Elements of the Differential and Integral Calculus. By A. E. H. LOVE, F.R.S. 5s. 1909. (Cambridge University Press.)

"The Principles of the Differential and Integral Calculus ought to be counted as a part of the intellectual heritage of every educated man or woman in the twentieth century no less than the Copernican system or the Darwinian theory." It is half a century since the then Sedleian Professor of Natural Philosophy in the University of Oxford published the first of four volumes dealing with the Infinitesimal Calculus. How Bartholomew Price would have rubbed his eyes could he have looked into the future and read the above sentence from the preface to a work on the Calculus by a successor in his Chair ! For in his time he could say of pure and applied mathematics that "these, indeed, require very heavy and arduous study, inasmuch as they have peculiar nomenclature, language, and processes, and thus it is only to the few generally who have made them their particular study that they offer great interest." For the last six years Prof. Love has been giving an annual course of lectures on the elements of the Differential and Integral Calculus to classes mainly of chemists and engineers. He has necessarily arrived at a very clear notion of the amount of mathematical attainment that is requisite as a preliminary equipment. He finds, for example, that the Binomial Theorem and the Addition Equation in Trigonometry "are quite unnecessary." And the book before us demands no previous knowledge of mathematics "beyond the most elementary notions of geometry, a little algebra, including the law of indices, and the definition of the trigonometric functions."

The book, in fact, "is intended merely to help the reader to make a beginning." Within the limits thus laid down Prof. Love has achieved a distinct success. Nothing could well be simpler than the exposition, and the arrangement is all that can be desired. In a word, it is admirably done.

Serret, Lehrbuch der Differential- u. Integralrechnung. Vol. III., 3rd. edition. Edited by G. SCHEFFERS. **Differentialgleichungen und Variationsrechnung.** Pp. xii + 657. 13 marks. 1909. (Teubner.)

Dr. Scheffers has now completely rewritten and brought up to date Serret's work on the Calculus. Of the present volume eleven-twelfths are devoted to Differential Equations, and the rest, a single chapter, treats of the Calculus of variations.

Sammlung von Aufgaben zur Anwendung der Differential- und Integralrechnung. By F. DINGELDEY. Vol. I. *Differentialrechnung.* Pp. iv + 202. 6 m. bound. 1910. (Teubner.)

This useful collection of examples is divided into chapters under the headings that are usually found in text-books on the Differential Calculus. Each chapter begins with a précis of the subject-matter, and then follow examples, often with ample indications of the method of solution. The applications are made in the fields of geometry, chemistry and physics, engineering, etc., and should be found a useful supplement to the sets given in books on practical mathematics. In the 200 pages are about 100 diagrams. The book is beautifully printed and well bound. It forms the 32nd volume of the valuable series issued by Messrs. Teubner entitled, *Sammlung von Lehrbuchern auf dem Gebiete der Mathematischen Wissenschaften mit Einschluss ihrer Anwendungen.*

Analytische Geometrie der Kegelschnitte. By W. DETTE. Pp. vi + 232. Bound, 4.40 m. 1909. (Teubner.)

Nearly one-third of this book is devoted to solutions, hints, and answers to an excellent, carefully chosen and graded set of questions on the subject-matter of the various chapters. The arrangement in the text differs somewhat from that to which teachers are accustomed. For instance the treatment of the circle precedes that of the straight line. Emphasis is laid on the principle of duality from the outset. The ellipse follows the line, and the parabola is defined as the limit of a series of ellipses. The theory of poles and polars is lucidly developed and upon it is made to depend the theories of centres, diameters, and directrices. In all cases the canonical forms of the equations of the conics are obtained before the general equation is attacked. The questions for solution follow the text and are arranged in 46 sets averaging about 15-20 in each set. The book is beautifully printed, and is certainly worthy the attention of the student, and of the teacher to whom elasticity in methods is no bugbear.

Analytical Geometry of the Conic Sections. By E. H. ASKWITH. Pp. xiv + 443. 7s. 6d. net. (A. & C. Black.)

We hope that by the time this belated notice of Dr. Askwith's admirable treatise appears the merits of the book will have been substantially recognised both by private students and by teachers. There are several reasons why we do not think the book can be recommended for beginners, save perhaps for boys of exceptional capacity. The text demands a greater readiness in the manipulation of algebraical expressions than is likely to be possessed by a boy who is attacking the subject for the first time. The exercises are not easy enough for the beginner, and would require considerable additions in the way of supplementary questions, to make them suit the needs of those to whom the subject is new. But for those who have already made a successful attempt to grasp the elements of the subject the chapters i.-xiii. form an almost ideal group for careful revision, and are full of the most instructive and attractively presented material. There are plenty of novelties that will give the teacher, however experienced, food for thought and stimulus to experiment and divergence from the ordinary routine. We might, however, suggest that adherence to the purely analytical treatment throughout may tend to make the handling of material too mechanical. A more frequent reference to the figure gives a firmer hold of principles involved and to