eighth chapter takes up the general partial differential equation of the first order by two methods. First the emphasis is laid on the geometrical methods of Lagrange and Monge, which are made to serve as an introduction to the analytical method of Cauchy given in the second part. Partial differential equations of higher orders are not discussed in this edition.

Zermelo's chapter on the calculus of variations in the second edition has been replaced by a shorter chapter with practically the same content. The notation has been changed to conform to the notation of the more recent articles and treatises. There is no treatment of sufficient conditions, merely a discussion of Euler's equations for the simplest problem of the calculus of variations, with some extensions to isoperimetric problems and problems in three variables. The subject matter is illustrated by the usual examples, the catenary, brachistochrone, etc. We note that in this edition, "Die Eulersche Differentialgleichung" replaces "Die Lagrangesche Differentialgleichung," a result probably of Professor Bolza's championship of Euler's claim to priority.

Harnack's appendix on the integration of partial differential equations and the few pages of "Bemerkungen" have been omitted in this edition.

As a third volume in a course in calculus, intended for students in their first three semesters, the present volume will be found rather advanced, notwithstanding the footnotes pointing out paragraphs and chapters which may be omitted. Scientifically, however, the new edition is a vast improvement over the old. The arrangement of the subject matter, the clearness of the language, the precise statement of definition and theorem, the copious index, and the typography place this work among the best reference text-books on differential equations in German or English.

A. R. CRATHORNE.

Kreis und Kugel in senkrechter Projektion, für den Unterricht und zum Selbststudium. Von Dr. OTTO RICHTER. Leipzig und Berlin, Teubner, 1908. x + 187 pp., with 147 figures.

THE author's aim as set forth in the preface is to furnish a supplement to the numerous elementary treatises on descriptive geometry. He proposes to give general solutions of certain fundamental problems which are studied for special cases only in books on descriptive geometry, and to give the student a

knowledge of the principles of stereometry which he has a right to know. The hope is expressed that the book may serve to promote skill in draughting, to increase the reader's ability to see things in space, and to arouse and develop in the youthful mind a sense of accuracy and beauty.

The first chapter is devoted to the ellipse, beginning in a most elementary fashion with the ellipse as an oblique section of a right circular cylinder. The geometrical properties of the curve are developed in detail, as well as all construction problems involved. This chapter may seem unnecessarily drawn out, but the author justifies it on the ground that the beginner with little or no knowledge of conic sections is enabled thus to collect his tools and become acquainted with much which will be of value in subsequent work.

The second chapter treats the sphere in like detail. This chapter introduces the idea of a non-euclidean (elliptic) geometry on a sphere with arcs of great circles as "straight lines," the object then being to represent on a plane the configurations of this geometry. Thus, in analogy to plane geometry, we erect the perpendicular to a straight line at a given point, bisect lines, bisect angles formed by two straight lines, extend two segments of straight lines and find their point of intersection and draw "tangents" to circles. Such problems as the construction of the poles of a plane and a general discussion of rectangular axonometry are included in this chapter.

The third and last chapter is devoted to applications, and forms more than one half of the text. This chapter is less detailed and more suggestive than the preceding ones. Many problems are left for the reader to complete or investigate entirely. The chapter is divided into five sections. The first treats of prisms, pyramids, cylinders, cones, and spheres. Two classes of problems are discussed, those involving relative position only, as inscribing a pyramid in a sphere; and those involving relative magnitudes, as drawing the beam of greatest strength in a given cylindrical log, the section to be rectangular. The drawing of the intersections of these solids is eventually included, but the cones and cylinders are only of the second degree. The second section is devoted to spherical wedges and allied forms. The third includes a classification and general method for representing Archimedean and Platonic bodies, and a "free" drawing of regular polyhedra including the Kepler and Poinsot star polyhedra. The fourth deals with bodies of

revolution and spiral forms, a greater part of the space being devoted to the torus and the spiral stairway. The closing section is concerned with the problem of representing cylinders, cones, and spheres having an orthogonal network of lines on their surface. This leads at once to drawing maps of the earth's surface and of the celestial regions. Throughout the last chapter numerous and really wonderful examples of regular and semiregular forms occurring in nature are pointed out, and in a few cases the principles of the text are employed in drawing a flower or plant.

While a portion of the book could be read with advantage by the beginner, it would seem to the reviewer to be most useful to the teacher in suggesting methods and examples. It is much more mathematical than American text-books on descriptive geometry, and less extensive than many of the German books on that subject, such as Geyger. On the other hand it does not cover the field of stereometry in general on such an ambitious scale as does Dr. Holzmüller in his four-volume Elemente der Stereometrie. In many cases the figures are rendered unnecessarily complicated by the attempt to use the same figure for a number of examples, often separated by many pages. The author has undoubtedly succeeded in thoroughly discussing the limited field he selects, and the reader who covers the book carefully will be certain to gratify the author's desire to increase his power of space perception.

D. D. LEIB.

Plane and Spherical Trigonometry and Four-Place Tables of Logarithms. By W. A. GRANVILLE. Boston, Ginn and Company, 1909. xi + 264 + 38 pp.

THIS is one of the excellent series of elementary mathematical text-books which are published under the supervision of Professor P. F. Smith, of the Sheffield Scientific School. The present volume is up to the standard for which the series has already earned a reputation.

The number of text-books in trigonometry is growing larger every day, but there always seems to be room for one more, provided it is written in a modern spirit so as to satisfy the needs of the present day. This book covers the usual topics and contains all the trigonometry that is usually taught in the undergraduate classes of colleges and technical schools. The demonstrations are simple and exceedingly clear, and the book