the usual order. A short chapter on confocal conics is inserted, while the treatment of higher plane curves and of solid geometry are unusually brief.

The most interesting novel feature is the early introduction of the determinant notation and its continued use throughout the book. In the first equation of the straight line (*i. e.*, in terms of the coordinates of two known points) the determinant form is given side by side with the explicit equation. Even if the student has had no previous treatment of the determinant, a few minutes of class-room explanation will enable him to grasp this simple form and the continued use will certainly give him that realizing sense of the geometric value of this notation which he too often fails to get in his formal course in algebra. E. B. COWLEY.

Lehrbuch der analytischen Geometrie. Erster Band: *Geometrie in den Grundgebilden erster Stufe und in der Ebene.* Von L. HEFFTER und C. KOEHLER. Leipzig, Teubner, 1905. 8vo. 16 + 526 pp.

THIS volume is in strong contrast to the book just noticed. While the authors aim to make the treatment elementary, they wish to give the student an introduction, at least, to the modern methods of relating the various parts and kinds of geometry into one comprehensive whole. They endeavor to follow the way suggested by Cayley's Sixth memoir on quantics and sketched by Klein in his Erlangen Programm. They consider that this can be done only by the early introduction of the transformation group, proceeding from the projective group to its subgroup, the affine, and then to its subgroup, the so-called "äquiform"; and not in the inverse order. This first volume contains the geometry in all spaces of one dimension, and in the plane. The second will be devoted to the finite "Bündel" and to ordinary space. In each case, the procedure is from projective to affine and then to æquiform geometry.

A condensed account of the contents will be useful in giving some idea of the ground covered. After an introductory chapter devoted to definitions and a few general considerations, there follows the first part, which is on geometry in spaces of one dimension. The first chapter relates to projective and affine geometry in the point range. The next takes up the quadratic equation and the point pair and its involution. This part is concluded by a consideration of the projective and æquiform geometries of the real pencils. The second section begins, under the heading of geometry in a plane, with a chapter on projective geometry in the plane and coördinates. The second chapter considers the principle of duality and projective theorems concerning points and straight lines. In the third, the projective and the reciprocal transformations of the plane are discussed. Then follow two chapters on the elements of the affine and æquiform geometries in the plane, and one on the general projective properties of curves of the second order and second class. After the projective classification of conics and the consideration of polarity in reference to conics, come three chapters treating of pencils and ranges of conics, the first in projective and the other two in affine geometry. The twelfth chapter takes up the æquiform geometry of conics. The next two deal with principal axes and foci and focal properties. In the last chapter is found the æquiform geometry of systems of conics (ranges and pencils). The book is concluded by an appendix on determinants. No knowledge of the calculus is presupposed.

The original plan was to begin with a systematic treatment of the axioms and base all subsequent work upon them. However, consideration for the mathematical immaturity of the students has led to some modifications; for example, the lengthy and abstract discussion of the axioms is omitted and a few theorems are inserted without proof. One naturally asks about the treatment of cross ratio. It is defined (page 36) in terms of the ratios of segments which have been measured in the ordinary way. With this metrical definition, it is used in projective geometry. In the footnotes, however, references are given to books in which the student will find a purely projective treatment.

The question that arises as one reads is that of the advisability of beginning with the spaces of one dimension. Will the beginner really grasp the ideas, are they concrete enough for his full comprehension, or will he fail to appreciate the purpose of the discussion, even though he may follow the separate details? In other words, it is a logical order; but, is it psychological? These are questions that can, perhaps, be answered only after one has attempted to use the book as a text. We are too ready to assume that a method of approach that is unusual will necessarily be difficult for the student. The style throughout is clear and simple, as well as stimulating and suggestive. The general plan seems admirable; and the student should have mastered in the end not only the usual collection of time-honored facts about conics, but a few of the well-known theorems such as Desargues's, Brianchon's, and Pascal's, as well as an introductory idea, at least, of that most important geometric concept, — the group of all projective transformations. E. B. COWLEY.

Tratado de las Curvas Especiales Notables. By F. GOMES TEIXEIRA. Madrid, "Gaceta de Madrid," 1905, ix + 632 pp.

THIS volume had its inception in a prize problem proposed in 1892, and repeated in 1895, by the Royal Academy of Sciences of Madrid, requiring "An orderly list of all the curves of every kind to which definite names have been assigned, accompanying each with a succinct exposition of its form, equations and general properties, and with a statement of the books in which, or the authors by whom, it was first made known." This programme our author has closely adhered to except in one particular. To attempt to give the properties of all such curves would be extremely difficult and would make the resulting work unwieldy, he has therefore wisely limited himself to a list of over one hundred curves so selected as to include almost all of especial importance.

This treatise and Loria's work, "Spezielle algebraische und transcendente ebene Kurven," which appeared a little earlier, cover almost the same field. Both authors seem to have taken their suggestion from the theme of the Royal Academy. Teixeira, however, has followed that programme more closely. Loria's work is arranged in a more satisfactory manner and is somewhat more advanced in treatment. Teixeira's has the advantage of giving a considerable discussion of space curves.

The first two chapters (98 pages) of Teixeira's treatise are devoted to a detailed exposition of the properties of the most important cubic curves. In the third, fourth, and fifth chapters (158 pages) he treats of quartics and in the sixth chapter (68 pages) of algebraic curves of order higher than the fourth. He considers in the seventh chapter (39 pages) a number of transcendental curves, most of them of considerable physical importance. The spirals are considered in Chapter VIII (47 pages), the parabolas and hyperbolas $y = a^{1-k}x^k$ in Chapter IX (10 pages), and the cycloidal curves in Chapter X (56