In former centuries mathematics was, in many minds, intimately interwoven with mysticism. A conspicuous example of this, given in Maupin's book, is the proof offered by Kepler, when he was a young man, that there cannot be more than six principal planets. He imagined the planets moving along great circles of concentric spheres so placed with respect to the five regular solids, taken in a specified order, that each solid was inscribed singly in one sphere and circumscribed about the next inner sphere. Since God created everything according to number and measure, these five regular solids determine the radii of six spheres in such a way that the radii are proportional to the distances of the planets from the sun. As there are no more than five regular solids and the number of spheres in the above arrangement cannot exceed six, there cannot be more than six principal planets.

In this early speculation Kepler is careless as to his assumptions, and does not allow himself to be controlled by the facts. Later, intercourse with Tycho Brahe and Galileo taught him the importance of accurate experimental data. Kepler's maturer reflection, in which his imagination was incessantly controlled and corrected by the facts in the case, ended in the brilliant discovery of "Kepler's Laws."

FLORIAN CAJORI.

Leitfaden der Projections-Lehre. Ein Uebungsbuch der konstruierenden Stereometrie. Von Professor Dr. CARL HEINRICH MÜLLER, Oberlehrer am Kaiser Friedrichs Gymnasium, Frankfurt a. M. und Professor OTTO PRESLER, Oberlehrer an der städt. Oberrealschule, Hannover. Ausgabe A. Leipzig, Teubner, 1903. 293 pp., 233 figs.

THE German student is taught the principles of drawing, perspective, and the elements of descriptive geometry before leaving the gymnasium. While not, on the whole, having as much of what is usually taught in America under the name of solid geometry, the average student who has completed the course in a realgymnasium or realschule has much more definite ideas of the visual properties of space than the average freshman in our colleges and technical schools.

Until recently, very few good books existed on constructive geometry, as it is taught almost entirely by use of a brief syllabus and a great deal of practice. The present volume is therefore somewhat of an innovation, representing the modern tendency to prepare text-books on all elementary mathematical subjects.

The book is divided into two parts, the first (pages 1–120) treating of oblique parallel perspective, and the second (pages 121–293) dealing principally with normal perspective. The first part begins with a number of simple problems of construction when the angle of incidence and amount of foreshortening are given. It is unfortunate that the authors of many of our books on solid geometry and on spherical trigonometry do not bear these simple rules in mind when preparing their figures. The principles are applied not only to the ordinary figures used in solid geometry but to much more complicated constructions of spherical astronomy, botany, zoölogy, physics and chemistry. The amount of material is not so extensive as that given in most works of descriptive geometry, but is amply sufficient for the mathematical student, and it is presented in such a form that one may readily extend it. A liberal allowance of unsolved exercises is added to each chapter.

The second part begins with a much more formal discussion of the elements of parallel perspective. The front, lateral, and ground elevations of a point are treated in connection with a large variety of positions defined by oblique perspective. The same detailed discussion is applied to a segment of a line, to a triangle, and to polygons and circles. The first space figures treated are the regular polyhedra and regular pyramids, then follow the cylinder and both cylindrical and conical spirals. A full discussion is given to an approximative method for drawing spherical loxodromes, orthographic maps, mercator's charts, etc., and a generous list of exercises furnishes practice for further constructions.

Unlimited lines and planes are next taken up, the treatment being similar to that given in most works on descriptive geometry. An interesting application is the construction of sun dials for any given latitude. Plane sections of surfaces and their development are then discussed as a natural application of the preceding principles. The problems regarding conic sections can not fail to awaken the student's interest.

The section devoted to curves of intersection of two surfaces is a particularly useful one. The part pertaining to spheroquartics is very attractive. A long section discusses shades and shadows in each of the fundamental planes, and gives the usual list of exercises for the student.

Finally, about fifty pages are devoted to central (conical) projection in connection with normal projection. The matter

is so arranged that it may be read immediately after the general introduction to each part, as no knowledge of the other portions of the book is presupposed. It would seem that this portion could have been materially improved by putting less emphasis on coördinates and more on the facts of collineation. It would have been still further improved by the addition of conical perspective of plane figures, and its relation to homology. In an appendix stereographic projection and conical mapping are defined and discussed. A second very interesting appendix shows the relation between the problems here treated and others of a more complicated nature. The historical growth of the subject is also outlined.

In the hands of a competent teacher the book will be of great service in assisting students to get clear ideas of the visual properties of space. VIRGIL SNYDER.

Catalog mathematischer Modelle für den höheren mathematischen Unterricht. Von MARTIN SCHILLING in Halle a. S. 6th edition, 1903. 8°, xvi + 130 pp.

THAT the so-called Steiner school of mathematics (to which the great geometer did not himself belong) is gradually being superseded by other systems is shown by the remarkable increase in both the number and variety of geometric models and apparatus.

In 1899 the well known Brill collection of models was transferred to Mr. Schilling and the whole enterprise was put upon a more systematic basis. Beside having the active support of the former contributors, the collection is now supervised and augmented under the scientific direction of Professor F. Schilling in Göttingen.

The present catalogue begins with a brief historical sketch, followed by a well-arranged table of contents from which one can readily determine exactly what is to be found in the collection of about 300 pieces. The catalogue proper consists of two parts; the first (pages 1–76) gives a short description of each model, and the series are arranged in the order in which they were produced; the second part contains a more technical description, often a figure, and the series are arranged according to subject matter. A detailed explanation is included in the memoir which accompanies each model sent to purchasers.

The most important additions which have been made during the last five years are the following: