and non-metric methods are used, the theorems of Desargues and of Pascal (Pappus) being used for a basis for many of the constructions. Cases in which lines are parallel are considered as distinct from cases in which the lines merely fail to meet on the paper, a distinction which is of special importance in case an instrument for drawing parallels is available.

After a brief historical introduction, the book consists of five subdivisions. I. Unreachable points of intersection of two or more lines. II. Bisection of an angle with non-intersecting sides. III. Construction of triangles and polygons with unreachable vertices. IV. Problems in the theory of circles. V. Bibliography.

A large variety of methods is given, although some of those given as distinct differ in only slight particulars. The chapter on circles, in which points are given by means of non-intersecting circles, i. e., by circles of which parts lie on the paper, but whose points of intersection do not, is especially interesting.

It is much to be regretted that material on such subjects as this is not more readily available in the English language. Perhaps our poverty in well-written elementary books of such a character as to supplement our preparatory-school work is responsible for part of the difficulty in stimulating bright pupils to do work outside of the daily minimum requirement of the textbook. Much of the matter in this little book might well be used for this purpose.

F. W. OWENS.

Introduction géométrique à quelques Théories physiques. Par ÉMILE BOREL. Paris, Gauthier-Villars, 1914. viii+139 pp.

THIS book is centered about the theories of relativity and statistical mechanics, and is divided into two distinct parts, of which the first deals in textbook fashion with certain kinematical questions from a purely mathematical point of view, while the second is composed of seven papers, all published before and rather loosely connected with each other, dealing with various topics in mathematical physics in a critical and philosophical manner. The first part contains four chapters on the euclidean displacements in two and three dimensions, the four-dimensional euclidean geometry, a two-dimensional hyperbolic geometry, and the three- and four-dimensional hyperbolic displacements and their application to the kine-

matics of relativity. A fifth chapter, on functions of a very large number of variables, and areas and volumes in a geometry of 10^{24} dimensions, leads up to statistical mechanics, the number stated being of the order of magnitude of the number of molecules in the unit volume, or the number of dimensions of their velocity space.

The titles of the seven papers forming the second part are as follows: On the principles of the kinetic gas theory; statistical mechanics and irreversibility; the relativity of space according to Henri Poincaré; some remarks on the theory of resonators; on a problem in geometric probability; the kinematics of the theory of relativity; molecular theories and mathematics.

These investigations of some of the most modern questions in theoretical physics should prove of great interest to both mathematicians and physicists.

T. H. GRONWALL.

Grundzüge der Geodäsie. Von M. NÄBAUER. Leipzig, Teubner, 1915. xiv+420 pp.

THIS book forms volume 3 of Handbuch der angewandten Mathematik, edited by H. E. Timerding, and is written primarily with the purpose of acquainting students of mathematics with the modern methods of geodesy. This purpose is quite successfully accomplished by presenting just enough of the practical side of the subject to give the proper setting for the clear and terse mathematical discussion of the underlying principles and the sources of error in the various geodetic operations.

The first part contains the theory of errors and the application of the method of least squares to the reduction of observations. Part two, plane surveying, deals with the surveying instruments, the various kinds of field work (the paragraph on photogrammetry is especially well done), plotting and computation of areas. Part three, higher geodesy, begins with triangulation and the various kinds of coordinates on the earth considered as a sphere, proceeds to the earth ellipsoid, its conformal representation on the sphere and the determination of its dimensions, and ends with a brief account of the determination of the exact figure of the earth by astronomical and pendulum observations.

The mathematical apparatus is confined to the elements of the calculus, and the volume contains much that could be used