show a simpler form of the defining relations, but inasmuch as the simplification is gained by using generators of a higher order its advantage is more or less a matter of taste. The arrangement of the tables is good, but the number of groups for a particular order is not always quite obvious.

The chief defect of the book, however, is its plan. It is evidently intended for beginners, but to set beginners immediately at work on group types is a procedure of very dubious wisdom. The methods involved are necessarily mechanical and monotonous—monotonous in that they demand the solution of a large number of congruences that differ but slightly, and mechanical in that the solution of such congruences adds little to the mathematical knowledge of the student. Moreover, the particular methods employed do not seem well adapted for extension to groups of a higher order—if the chapter on order $8p$ were a fair criterion, more complex groups would necessitate a prohibitive amount of labor. The last chapter however — on orders free from a quadratic factor—adopts Frobenius's method of a congruence with a double modulus, but terminates so abruptly that the author evidently intends to complete it later.

The book is unusually easy to read. Every needed theorem from other branches of mathematics is always fully stated and generally proved. And to those who are studying relations between abstract and linear groups the book may be recommended without hesitation. B. S. EASTON.

Elemente der Theorie der Determinanten mit vielen Uebungsaufgaben. Von Dr. P. MANSION. Dritte vermehrte Auflage. Leipzig, Teubner, 1899. 103 pp.

THIS book, which has passed through six French editions, is an excellent introduction to the more extended treatises of Baltzer, Pascal, and Gordan. Its scope is distinctly elementary. The more complicated developments of determinants, as Laplace's, are passed over with a statement of fact without proof while functional determinants, and the general development with respect to a row and column simultaneously are not mentioned.

The book opens with an introduction of twenty-two pages on determinants of the second and third orders, which are illustrated with a large number of problems. The usual discussion of the elementary properties of the general determinant follows. The points of greatest pedagogical interest are, first, the admir-

ably clear and thorough account of the special cases that occur in the solution of linear systems and their dependence, second, the treatment of Sylvester's dialytic method of elimination in which not only the necessity but the sufficiency of the condition that two equations have λ common roots is derived — a point in which most elementary texts are painfully deficient. A brief and hence necessarily unsatisfactory note appears in the appendix on the development of the properties of determinants by means of alternate numbers, a method which is extremely rapid, and with somewhat mature students quite teachable.

No geometrical applications are given, except in isolated examples. Problems are abundant, well graded and not trivial. Not only is the book sufficiently elementary to warrant its wide use as a text-book, but its many pedagogical excellencies make it very valuable to a teacher of the subject.

<div align="right">H. E. HAWKES.</div>

Liniengeometrie mit Anwendungen. Band I. By Dr. KONRAD ZINDLER, Professor an der Universität Innsbruck. Sammlung Schubert, XXXIV. Leipzig, G. J. Göschen, 1902. 8vo., viii + 380 pp., 87 figures.

IN this systematic exposition of line geometry, both synthetic and analytic methods are employed. It is the first book of this character since the appearance of Plücker's original treatise.* In fact, Sturm's Liniengeometrie in three volumes (1892, 1893, 1896) is purely synthetic; while other books, such as Koenigs's Géométrie réglée, treat only special parts of the subject.

Line geometry treats of manifoldnesses of straight lines in space. The names ruled surface, congruence, complex are applied to a one-fold, two-fold, three-fold system, respectively.

The present (first) volume treats chiefly of linear complexes and congruences and their applications; the second volume will be concerned chiefly with algebraic line configurations of higher than the first degree. The book is intended as a text-book; eighty-two exercises are scattered through the book, hints for the solution of certain of which are given in the appendix, with references for the others.

Chapter I treats of the Nullsystem and the Strahlengewinde. Let all the points of space be subjected to a given screw motion

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* Neue Geometrie des Raumes, gegründet auf die Betrachtung der geraden Linie als Raumelement, I, 1868 ; II, 1869.