Die Determinanten. By EUGEN NETTO. Leipzig, Teubner, 1910. 8vo. vi + 129 pp. 3.60 marks.

THE enormous growth in recent years of both mathematics and engineering is nowhere shown better than in the appearance in both Europe and America of many small handbooks particularly designed to give in little space the main features of some definite field of these large subjects. This volume is of such a character. It undertakes to develop the elementary theory of determinants with some applications. The applications are not technical.

The first two chapters are devoted to the elementary properties and expansions. Then follows one on evaluation, and one on products. A chapter follows on arrays, which are here called matrices. Then comes a chapter on particular determinants, one on the solution of linear equations, and one on resultants. Following is a chapter on linear substitutions, which could have properly formed part of the chapter on matrices. In our opinion, it is a mistake to consider the array of symbols merely as an array. The composition of matrices, if not the mere ordering, makes the symbols stand for more than mere arrays. They are indeed n^2-fold multiple quantities and should at least be treated as multiplexes if not as operators. From this point of view the linear substitution is merely one example of a matrix. A chapter is devoted to geometric applications. The book is closed by a very brief chapter on differentiation and one on functional determinants, which last however would have been labeled more correctly "The Jacobian." As a whole the treatment is clear, well illustrated, and all that could have been given in the space.

JAMES BYRNIE SHAW.

Die Theorie der Kräftepläne. By H. E. TIMERDING. Leipzig, Teubner, 1910. 8vo. vi + 99 pp. 3 marks.

THIS little volume is number 7 in Teubner's Mathematisch-physikalische Schriften. It undertakes to occupy a middle ground between the purely theoretical or geometrical side of graphical statics and the purely practical or engineering side. The object is to interest the engineer in a more general mathematical point of view and to show the mathematician that applications furnish very interesting developments of pure theory. Thus we find the null-system of Möbius used throughout to show the reciprocal relations of the force polygon and the funicular polygon. Few detailed solutions are given, the emphasis being rather on the first principles and the essential similarity of the various methods in use. The space figure over the plane figures is utilized to assist the development.

Engineers who want detailed methods will find little here to interest them. Those who desire a knowledge of fundamentals which will enable them to devise their own methods will find this text very suggestive. Mathematicians will find here concrete examples of some geometrical transformations, but little that would serve to advance the theory of such transformations. Where the " finest flowers bloom along the way of application " the author scarcely shows.

JAMES BYRNIE SHAW.

Vorlesungen über technische Mechanik. Von AUGUST FÖPPL. Band 6: *Die wichtigsten Lehren der höheren Dynamik.* Leipzig, Teubner, 1910. xii + 490 pp.

VARIOUS volumes in various editions of Föppl's lectures on mechanics have been reviewed in this BULLETIN,* always with unstinted though measured praise. That the public shares our enthusiasm for the work is fully indicated by the rapidity with which new editions follow one another. The work as now constituted, in what may perhaps be believed its final form, has six volumes instead of the original four. The titles are Einführung in die Mechanik, Graphische Statik, Festigkeitslehre, Dynamik, Die wichtigsten Lehren der höheren Elastizitätstheorie, and Die wichtigsten Lehren der höheren Dynamik. It is this last which is now under review. But before we begin let us repeat from an earlier review the wish that our students of technology had the advantage of such a work as this in English. There are not nearly enough exercises and examples to suit our needs, but the text we believe is far superior to anything we have.

The first section of the work deals with relative motion. Now-a-days we hear a great deal about the principle of relativity, according to which all actual motions in our physical universe are representable by differential equations which are invariant under the transformations of the Lorentz group, that is, the orthogonal group which leaves the form $x^2 + y^2 + z^2 - c^2t^2$ invariant. This has served to emphasize the fact that the old-fashioned Newtonian mechanics has also its principle of rela-

* See vol. 9, p. 25, and vol. 13, p. 520.