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.

<div style="text-align: right;">JAMES BYRNIE SHAW.</div>

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-

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

tivity. Minkowski set the matter in a clear light in his lecture at Cologne in 1908 ;* recently Klein has been elaborating it ;† both authors, however, are naturally more interested in the new relativity than in the old ; both assume a considerable amount of mathematics unfamiliar to the technical student. Föppl begins his discussion of relative motion with a clear and searching treatment of the relativity of ordinary mechanics ; these pages should be read by nearly every one. In the applications of relative motion to various problems the text follows Coriolis's theorem in much the usual manner.

The second part of the work deals with generalized coordinates and Lagrange's equations. There are numerous applications, chiefly to various sorts of pendulum motion and to the rolling wheel. The third part is on the top, just over an even hundred pages. This long development of a somewhat difficult subject is amply justified by the ever increasing practical use of the gyroscope. The Schlick apparatus for regulating gyrostatically the motion of ships receives especial mention ; the Brennan and Scherl monorail cars are barely touched upon. The author very naturally gives some account of his own interesting experiments to obtain the angular velocity of the earth from observations on the motion of a " top." A short fourth section of the text, entitled various applications, is chiefly occupied with the theory of the governor with and without friction ; a very short discussion of planetary motion is given. It will be noticed that Föppl sticks closely to the subjects which are of most interest and importance to the engineer.

The fifth and last section of the book is on hydrodynamics. Some of the subjects treated are : the irrotational flow of liquids in two dimensions with applications of the theory of functions of a complex variable, various kinds of water waves, the theory of vortices, the theory of the turbine, and the motion of viscous liquids with applications to the motion of a sphere and to frictions on journals. In view of the fast increasing interest in aeronautics some aerodynamics might advantageously have been added. Although the mathematics of this section and of this volume as a whole is somewhat more advanced than that of the first four volumes and might offer some difficulties to the general run of our undergraduate students of engineering even in our best schools, it is no more than should be required, and

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* See the *Jahresbericht der Deutschen Mathematiker-Vereinigung*, vol. 18 (1909), p. 75.

† See ibidem, vol. 19 (1910), p. 281.

in some institutions is required, of students for the master's degree. In conclusion let us hope that Föppl's lectures will continue and grow in popularity not only in their home but abroad; their merits are of the highest; their use can but inure to the benefit of the user. Once more we wish we had this work or such a work in English.

E. B. WILSON.

CORRECTION.

ON pages 454, 455 of Professor Glenn's paper in the June BULLETIN, in formulas (6), (7), (8), for − read +.

NOTES.

THE July number (volume 12, number 3) of the *Transactions of the American Mathematical Society* contains the following papers : " On properties of a domain for which any derived set is closed," by E. R. HEDRICK ; " Important covariant curves and a complete system of invariants of a rational quartic curve," by J. E. ROWE ; " An application of Moore's cross ratio group to the solution of the sextic equation," by A. B. COBLE ; " On the use of the co-sets of a group," by G. A. MILLER ; " The southerly deviation of falling bodies," by W. H. ROEVER ; " An application of a (1–2) quaternary correspondence to the Kummer and Weddle surfaces," by VIRGIL SNYDER ; " On semi-discriminants of ternary forms " by O. E. GLENN.

THE July number (volume 33, number 3) of the *American Journal of Mathematics* contains the following papers : " The rational plane quartic as derived from the norm-curve in four dimensions by projection and section," by J. R. CONNER ; " On the analytical basis of non-euclidean geometry," by W. H. YOUNG ; " Curves in non-metrical analysis situs with an application in the calculus of variations," by N. J. LENNES.

AT the meeting of the London mathematical society held on June 8 the following papers were read : By G. H. HARDY, " On the multiplication of Dirichlet's series " ; by G. H. HARDY and J. E. LITTLEWOOD, " On the range of Borel's method for the summation of series " ; by W. H. YOUNG, " On the con-