when F is a gravitational force varying as the inverse square"! The book closes with two chapters on the most fundamental points in the dynamics of rigid bodies. The book might prove of value in a class of unusually gifted freshmen requiring more than the usual first term college mechanics, or for sophomores, but is, in the opinion of the reviewer, hardly advanced enough for upper class majors in physics or mathematics.

H. P. ROBERTSON

La Causalité des Théories Mathématiques. By G. Bouligand. (Actualités Scientifiques et Industrielles, No. 184.) Paris, Hermann, 1934. 41 pp.

This booklet essays an investigation of the nature of generalizations by analysing the ultimate "causes" of mathematical proofs. The author distinguishes sharply between *algorithmic* proofs, which depend upon calculations, and *direct* proofs, which closely follow the intuition and so explain the real causes of the theorem. For example, the direct methods in the Calculus of Variations avoid artificial assumptions of differentiability. The same holds of the so-called "direct infinitesimal geometry"; in particular, Lebesgue's surface applicable to the plane but containing no line segment whatever is a striking revelation of the misleading results of algorithmic calculations.

A group of transformations can be viewed as a domain of causality. By this the author apparently means that the hypothesis and the conclusion of a geometric theorem should be invariant under the same group; if this is not the case the hypothesis or the conclusion can be generalized to give a more extended theorem. The numerous examples given include extensions of Meusnier's theorem and of the theorem of Dupin on triple orthogonal systems. This investigation of causes leads the author to argue for the objectivity of mathematics—that mathematics is a science studying a "mathematical nature" (the meaning of this naïve phrase is not explained). The objective causes in this science are obtained not only by the discovery of proofs, but also in the formulation of axiom systems and in the discovery of significant concepts (for instance, the notion of semi-continuity). Such an emphasis on the importance of definitions is indeed refreshing.

SAUNDERS MACLANE

Matière et Énergie. By Victor Henri. Paris, Hermann, 1933. 436 pp.

This book is a solid and well-written text in modern physics. The introductory chapters take up the kinetic atomic theory of matter, x-ray spectra and atomic number, and the periodic system of the elements. These are followed by an account of natural and artificial radioactivity and the role of isotopes in the periodic system, with emphasis on the experimental conditions and findings; these chapters offer of course but a beginning in nuclear physics and must be supplemented by reports on later work. The last 200 pages present the elementary parts of kinetic theory and the Bohr theory of atomic structure, again with emphasis on the empirical findings. The book should be found very useful in obtaining a descriptive orientation in the complex fields touched upon, preparatory to a more detailed and more mathematical study; for such a purpose it can be highly recommended.

H. P. ROBERTSON