is abundantly rich in exercises. With regard to the numerical work it is evident that the author believes in the pedagogic value of accuracy and the proper arrangement of computation. Great prominence has also been given to graphical methods.

The book differs from the general type of text-books in trigonometry in several points. Under each case in the solution of triangles there are two sets of examples, one in which the angles are given in degrees and minutes, and another in which they are expressed in degrees and the decimal part of a degree. Another feature is the treatment of spherical trigonometry, in deriving the formulas of which the author makes use of the principle of duality, which is stated in the following form: "If the sides of a general spherical triangle are denoted by the Roman letters a, b, c, and the supplements of the corresponding opposite angles by the Greek letters, α, β, γ, then, from any given formula involving any of these six parts, we may write down a dual formula by simply interchanging the corresponding Greek and Roman letters." This method has many advantages, a great part of the work required in deriving formulas being done away with.

The general appearance of the book is very attractive. The cuts, the typography, and the arrangement of matter on the page are excellent.

JACOB WESTLUND.

Dynamique Appliquée. Par L. LECORNU. Paris, Octave Doin, 1908. 534 pp. 5 francs.

Hydraulique Générale. Par A. BOULANGER. Paris, Octave Doin, 1908. Vol. 1, xvi + 382 pp. Vol. 2, vii + 299 pp. 5 francs each.

(Encyclopédie Scientifique. Publiée sous la direction du Dr. Toulouse.)

M. LECORNU's textbook on applied mechanics is divided into four parts: Résumé of the chief results of rational mechanics; Mechanical properties of materials; Applications of dynamics; Theory of machines.

The first part occupies seventy-one pages, and furnishes the theoretical foundation for the rest of the book. It is a summary of the well-known equations of translations, moments; kinematics of a point, a set of points, and a solid; dynamics of particles, momentum, lifting force; statics of systems, virtual work, restraints, equilibrium of solids and of jointed systems,

funiculars, statics of fluids; dynamics of free systems; dynamics of restrained systems; dynamics of rigid bodies; dynamics of fluids. The subject is evidently sufficiently vast, and one could scarcely expect to find in the small space assigned even a complete résumé. The author has succeeded however in including the chief results of a course in theoretical mechanics, rather as a review to the student than as a formulary for reference.

In the second part three topics are considered: friction, which receives very careful attention, resistance of the air, and impact. Under friction we find discussed the friction of journals, gears, screws, the universal joint, sliding pieces, friction clutches, skidding, cord on cylinder, cylinder on inclined plane, billiard ball, the tendency to extinguish the friction. These topics give some idea of the completeness of the discussion. The next chapters treat rolling friction, pivotal friction, and the stiffness of ropes.

The third part considers applications of theoretical dynamics to springs, to Watt's indicator, and to pendular movements — these rather fully. More briefly, the top, the hoop, the bicycle, the balancing of wheels, the equilibration of turbines. The fourth part discusses machines: in particular, motors, governors, brakes, and transmission of power.

The object of the book is to exemplify the great practical advantage in attacking problems of applied mechanics directly by the methods of rational mechanics. "It has for principal object the study of the general properties of machines, excepting questions concerning thermodynamics or electricity." The author has succeeded in his object and the illustrations he uses are very well chosen. It would be well if some such exemplification as this could be introduced into our textbooks on theoretical mechanics.

The latter of the two books under review is avowedly a systematic résumé of the results and methods of Professor J. Boussinesq, first presented in various memoirs treating of the movements of water. The problems discussed are well classified and treated with much completeness. The introduction establishes the fundamental laws of hydrodynamics; the first section discusses phenomena in which friction is negligible; the second section, phenomena in which friction has a sensible influence; the third section, the phenomena of turbulent movements. In

the second volume, which is devoted to singularities and applications, there are also three sections with the same headings as in the first volume.

The swell on the ocean is first discussed, followed by the solitary wave or wave of translation, and waves of emersion and impulsion. The flow of water through fine tubes, the phenomena of filtration, and rotatory flow are taken up in the next section. Under turbulent movement we find the uniform and the gradually varied flow in conduits and canals.

In the second volume the topics are: flow through orifices, flow over weirs, the extinction of the ocean swell and waves, resistance to immersed solids, motion in conduits and canals with singularities such as enlargements, contractions, bends, etc., natural water courses, motion in rectangular canals with eddies, waves in elastic conduits, and the water hammer.

The treatment of the subject is deep enough for the usual student and tends to incite reading of the original memoirs of investigators in this field. It is also calculated to interest the student of physics on the one hand and the scientific engineer on the other. If such courses as this were introduced into the senior year of our engineering colleges in place of certain customary "practical" courses which could just as well be read up outside by the intelligent student (and no other should be considered!), it would tend to improve the scientific study of many engineering problems now worked out only empirically and approximately. Particularly as the laws developed here are in general experimentally verifiable. In fact the title might be translated into Theoretical Hydraulics in contradistinction to Practical Hydraulics. With the definiteness found in the treatment throughout, the engineering student can scarcely fail to look upon his problems from a much higher point of view than if he has only the usual course in hydraulics.

These two treatises exemplify very well the scientific character of the Encyclopédie Scientifique. If all the projected volumes are kept up to the same level, the whole will undoubtedly be a collection which every student should possess. At least it would serve in America as a corrective to too much practicalism, and would encourage the scientific spirit in engineering. It is needless to say that courses in "engineering mathematics" would not suffice for the reading of such works as these.

JAMES BYRNIE SHAW.