the mean value theorem to the finding of approximate roots of equations is given, and this feature should prove to be of practical value, especially when applied to transcendental equations. The examples given are unfortunately largely rational algebraic equations, for which Horner's method is probably simpler.

The chapters relating to space geometry and kinematics are interesting and attractive. A nice distinction is made between speed and velocity, leading to the notion of normal as well as tangential components of acceleration.

The part devoted to integral calculus includes a chapter on center of mass and moment of inertia. This is followed by a chapter containing a brief treatment of ordinary differential equations of the first and second orders.

An appendix contains notes on hyperbolic functions, the intrinsic equations of a curve (in the plane), and the length of a curve in space; also a number of exercises and problems, a brief table of integrals, a useful collection of figures of curves, and a very complete index.

The mechanical features of the book are attractive, and it is conspicuously free from typographical errors.

WALTER B. CARVER.

An Elementary Treatment of the Theory of Spinning Tops and Gyroscopic Motion. By HAROLD CRABTREE. London, Longmans, Green and Company, 1909. 8vo, xii + 140 pp.

"THE object of this book is to bring within the range of the abler Mathematicians at our Public Schools and of First Year undergraduates at the Universities [in England], a subject which has hitherto been considered too difficult for any but the more advanced students in Mathematics, while even they have in many cases failed to derive more pleasure from the study of spinning tops than is contained in submitting the problem to the action of a complicated piece of Mathematical machinery which automatically, though unintelligently, turns out the correct result."

This extract from the preface shows well the character of the greater part of the book. At the present time, the interest of the subject, in view of recent developments, renders such an exposition of value to an engineer. But it may be read with profit by those who wish to obtain some idea of the grade reached by the English student in his freshman year. It should be stated that the elements of statics and dynamics developed from the Newtonian laws of motion are considered as essential at an early stage as trigonometry, and they are usually commenced before the calculus. They are, however, developed from this point of view with the same degree of rigor which we usually adopt for the earlier parts of pure mathematics. The student thus imbibes the idea that physical phenomena are not isolated facts but rather the consequences of a few general laws.

Although the author starts from the laws of motion, apparently for the sake of logical completeness, it is implicitly assumed that the student is familiar with these laws and that he has had some practice in their applications. From this stage the fundamental property of the top is rapidly obtained: — that the main effect of a couple acting on the axis of the top is a motion of the axis in a plane perpendicular to the plane of the couple, provided the axis is free to move in any direction. An excellent collection of illustrations then follows. Besides the ordinary tops and gyroscopes, familiar to everyone, we find descriptions of Brennan's monorail system, Schlick's method of steadying ships at sea, the steering of torpedoes, the manner in which a cat always manages to land on its feet, the motion of a celt, the game of diabolo, and so on. These descriptions are always followed by explanations sufficient to show the manner in which the gyroscopic effect is involved. There are also numerous other examples taken from familiar experiences with bicycles, engine wheels, hoops, etc. In a few chapters at the end we find the usual mathematical developments.

Some obscurities likely to convey a wrong impression call for mention. On page 36, the text would lead one to infer that the orthogonal projection of an area was the same as the area seen from a point at a finite distance. The explanation on pages 1, 2 of the quasi-rigidity of a rapidly revolving chain or paper disc is unsatisfactory; surely it involves only the ordinary effect of inertia. On page 113, the simple statement that angular momentum is a vector quantity is hardly sufficient for the deduction of the rates of change with respect to moving axes: the author has mentioned no general theorem with respect to vectors.

These are, however, minor points. Mr. Crabtree's effort is decidedly successful and can be recommended as a useful addition to the working library of a department of mathematics, physics or engineering. The volume is well and fully illustrated with plates and diagrams. An attractive and luminous style has aided the author very considerably in his desire to make the subject clear; in this connection his dedication is not unworthy of notice.

E. W. BROWN.

Dynamics of a Particle and of Rigid Bodies. By S. L. LONEY. Cambridge, University Press, 1909. 8vo. 374 pp. $4.00.

PROFESSOR LONEY'S mathematical texts are so well known that it is sufficient to say that the high standards of the earlier books have been maintained in the present volume. The text is divided into two equal parts (184 pages each), the first of which is devoted to dynamics of a particle. In the dynamics of a rigid body the author has confined himself chiefly to motion in two dimensions. There is a short chapter on motion in three dimensions, and Lagrange's equations in generalized coordinates are developed for both finite forces and blows. The reader is supposed to have a working knowledge of the calculus, but the differential equations which occur are solved in the text, and an appendix contains a summary of the methods of solution.

It is assumed that the student has previously read a course in elementary dynamics and the present book is mainly a treatment of more difficult problems than occur in a first course. There is a large collection of very interesting examples which furnish excellent material for the cultivation of ability in the solution of problems.

The text has been made as brief as possible and in some places the prerequisite knowledge is greater than any American student is likely to have. For example on page 76 we find that the reader is supposed to be familiar with the (p, r) equations of the conics, where r denotes the distance from the origin O to a point P on the curve, and p is the distance from O to the tangent at P. A recent notice of an American book in an English publication* contains the remark: "In looking through the American text-book a British teacher is almost always puzzled as to what previous equipment the reader is supposed to possess." This statement implies a criticism of recent tendencies in our teaching of mathematics which may or may not be important, depending on the course of study pur-

* *Mathematical Gazette*, March, 1910, p. 215.