equations, including trigonometry, plane and solid analytic geometry, empirical equations, differential and integral calculus, calculus of finite differences, and the harmonic analysis of periodic functions. The extensive use of graphs and illustrations is indicated by the fact that the book contains 409 figures. In addition to many worked examples there are almost 800 exercises. A few of the examples and exercises are taken from the examination papers of Cambridge, the University of London, and the Board of Education, but a very large number are related directly to technical applications.

One might expect almost anything in a book with the title "Mathematics," but when the subtitle "A textbook for technical students" is added, the contents are accurately described. This volume contains practically everything that goes to make up the mathematical equipment of a graduate of one of the best American technical schools. There are, of course, variations. Some topics are treated less extensively and some receive more attention than in our usual curricula, but the reviewer knows of no other single volume which covers so nearly the ground that is commonly regarded as desirable in our technical schools.

W. R. LONGLEY

Science and First Principles. By F. S. C. Northrop. New York, Macmillan, 1931. xiv+299 pp.

In the preface it is stated that the first principles "involved in a given verified theory are those which it takes as primary" and that the author's "task is the purely impersonal and objective one of dissecting the given scientific theories which our technical scientists have verified, to determine what concepts and principles are taken as primary or undefined." The analysis is centered mainly on relativity, quantum theory, and biology. Since the treatment is not convincing to the reviewer, some main conclusions will be presented in the author's own words; usually the conclusions are reached by the author in connection with an elaborate argument. The following quotations are from pages 120, 202, 270, 280, 288, respectively. "We have but to bring these different requirements together to discover that this universe must be constituted not only of the moving microscopic atoms of the traditional atomic theory but also of one large physical macroscopic atom, spherical in shape and hollow in its interior except for its inner field, which surrounds and congests them." [The foregoing conclusion is reached by means of an analysis of relativity.] "Thus we find biological evidence giving us an entirely independent argument for the existence of the macroscopic atomic theory." "In the first place, the macroscopic atom is a primary substance, with a determinate conscious experience. Secondly, were it not present neither nature nor man would exist; all would be flux." "The spherical shell of the macroscopic atom is a tremendous object off at the edge of the whole physical universe." "Once the traditional theory of first principles is supplemented with the addition of this atom, the problem of knowledge is resolved."

R. D. CARMICHAEL

The Emergence of Life. By John Butler Burke. Oxford University Press, 1931. ix+396 pp.

In the subtitle this book is described as "a treatise on mathematical philoso-

phy and symbolic logic by which a new theory of space and time is evolved." The guiding purpose is to clarify the nature of the conception of emergence. The mathematical tool employed is developed from the methods of Boole and particularly from his *Laws of Thought*. The author insists that the methods of Boole belong to "static" thought and he endeavors to show that the Hegelian logic admits of a symbolic treatment which comes into contact with "dynamic" thought. He says (p. 76): "The possibility of carrying the Booleian system beyond the ordinary static or Aristotelian laws of thought has, so far as I am aware, never been previously shown to be possible by algebraic means." In his preface the author says: "I hope that the use of algebraic symbols, without which the reasoning at times is too abstruse for words, will not be regarded as profane in dealing with some of the great and solemn problems under discussion; the language of mathematics being I conceive no less reverent than German, Irish, or Greek; whilst it has the benefit of being universal, pithy, and precise."

R. D. CARMICHAEL

Astronomy. By F. R. Moulton. New York, Macmillan, 1931. xxiii+549 pp. $3.75.

For many years Moulton's *Introduction to Astronomy* enjoyed well-earned popularity as a college textbook. The present book may be considered as a new edition of the former, but the publishers want to emphasize the fact that it is not a mere revision but an entirely new publication. Comparison of the two books shows that this is not an exaggerated statement.

Textbooks on astronomy have tried to keep in step with the rapid development of the younger branches of the science, and the treatment of the solar system is by no means the dominating subject that it was only thirty years ago.

This tendency is evident in Moulton's *Astronomy*. But the treatment of *Stars and Nebulae*, and of *The Sidereal System* is crowded into a smaller portion of the book than is usual in modern textbooks. However clever the exposition of "stellar" astronomy in these chapters is, in a few instances we see the effects of the attempt to cover too much in a limited number of pages.

An obvious danger is to give insufficient attention to some subjects that may be quite important. A rather striking case of this type is the treatment of the spectroscopic method of parallax determination. We find only brief indirect references to this subject on pp. 406 and 414, and the name "spectroscopic parallax" is not used.

Another consequence is that some subjects are covered in so few words that their characterization has become one-sided or even incorrect. As an example we may consider the statement (p. 445) that the spectral-line displacements of the cepheid variables, "interpreted as Doppler effects of radial velocities, do not vary in harmony with elliptic motion." This may be mathematically correct and the briefest possible way to state it. But would it not be preferable to remark how surprisingly well the Doppler shift can be represented by a fictitious elliptic orbit in the majority of known cases?

The influence of Milne's recent criticisms is apparent in the reference to the theory of the interior of stars. Eddington's mass-luminosity relation is almost reluctantly mentioned, and its importance minimized.