Ballistik. By Dr. Theodor Vahlen. Berlin, Vereinigung wissenschaftlicher Verleger, 1922. xi + 226 pp.

This book is an outgrowth of interest and investigation that were stimulated in the subject of ballistics during the World War. The author, who is professor of pure and applied mathematics in the University of Greifswald, served as an artillery officer, and during that period contributed a number of articles on ballistics to scientific and to military journals. These articles are referred to in the beginning of the book where a rather extensive bibliography on the subject is given, from the work of John Bernoulli in 1719 to the works of Cranz and of Lorenz in 1917.

The reason for writing the book is that there is no book in German literature which presents the mathematical developments of the subject in detail. Cranz has deliberately avoided these in his compendious work which is indispensable to the practical ballistician because of its useful tables and numerous illustrative examples. As no real progress in the science of ballistics is possible without a very close coordination between the theoretical and the practical, the author aims to supply a definite demand by presenting the subject from the standpoint of the mathematician.

There are four divisions of the subject: exterior ballistics, the behavior of the projectile after the powder gas has exerted its entire accelerating effect; interior ballistics, the behavior of the projectile until it begins to leave the muzzle; transition (Übergangs) ballistics which embraces the interval between exterior and interior; and, *Endballistik* which includes the functioning of shells, recoil, etc. The subject is divided further into old ballistics which rests upon the assumptions that the earth is flat, motionless, that gravity, both in magnitude and direction, and the density of the air (upon which the resistance of the air depends) are constant throughout the trajectory, and modern ballistics in which greater ranges and altitudes are encountered and in which the former assumptions are no longer adequate. The claim is made that both transition ballistics and, what I have called *modern* ballistics are treated systematically for the first time in this book. The author seems disposed to name the latter *universal* (that is, as applying to the universe instead of to the earth only) ballistics but refrains from doing so in that sense because the motion of a meteor belongs to the field of celestial mechanics and cannot be regarded a problem of what he calls "kosmische" ballistics.

Under the head of modern ballistics he gives just about what has been developed in this country during the same period, both in regard to the trajectory itself and in regard to small corrections. If there is any difference, his mathematics is more elementary. The coordinates of a point on the trajectory are expressed as power series in t (the time); in this country the coordinates of a point on the trajectory are expressed as functions of velocity, acceleration, and a quantity E which depends upon velocity, altitude, and the ballistic coefficient. The two methods are theoretically the same if we admit that our x and y may be expressed as power series in t. If different results are obtained by the two methods, it would be due to inaccuracies in tabulated physical data.