calculation, or to geometrical figures. These geometrical figures represent on paper, and on a small scale, the curves or orbits of bodies in space and time, and can be interpreted as such. Then, as in nature two bodies or portions of matter are never single gravitating points occurring alone, but are surrounded by the totality of existing things, the formula which reduces the action of gravitation to that of pairs of things, and to the elements of matter, requires to be extended to more than two—in fact to an infinity of elements. The infinitesimal calculus teaches us how to deal with such a progression from finite numbers and quantities to infinite numbers; or from relations which refer to infinitesimal elements to finite measurable quantities. We find very soon that our powers of calculation reach only a small way, and cover only a small extent of the ground which observation opens to our eyes. We are thus forced to deal with the element of error which creeps into our calculations; to be satisfied with approximations;[1] and instead of certainty, probability is

14. Element of error.

Gauss, Werke, vol. v. pp. 85, 293, &c.) Of Weber's electrodynamic measurements I shall speak later on. Absolute measurements were used by William Thomson (Lord Kelvin) as early as 1851, and owing mainly to his influence the present system was gradually established in the course of the following twenty years (see William Thomson, 'Popular Lectures and Addresses,' vol. i. p. 83, &c.) Fourier's theory of dimensions was first brought prominently before the scientific and teaching world by Clerk Maxwell in his treatise on 'Electricity and Magnetism' (1st ed., vol. i. p. 2). There also we meet for the first time with the use of astronomical magnitudes and relations by which the usual three units, time, mass, and distance, can be reduced to two. This is also lucidly explained by Lord Kelvin (*loc. cit.*) It has been followed up in detail in two interesting papers by W. Winter in Exner's 'Repertorium der Physik' (vol. 21, p. 775, and vol. 24, p. 471).

[1] The history of astronomical calculations since the time of Newton, when the theoretical basis was once for all laid, is a history of gradual approximations. Mathematically a conic section is sufficiently defined if the position of the focus (the sun in our planetary system) and three positions of the moving star are known by observation. But it was a long time before even tolerably complete methods of observation