

often failed him during the task;⁴ and subscribes to the judgment of Bailly: "After this sublime effort, Kepler replunges himself in the relations of music to the motions, the distance, and the eccentricities of the planets. In all these harmonic ratios there is not one true relation; in a crowd of ideas there is not one truth: he becomes a man after being a spirit of light." Certainly these speculations are of no value, but we may look on them with toleration, when we recollect that Newton has sought for analogies between the spaces occupied by the prismatic colors and the notes of the gamut.⁵ The numerical relations of Concords are so peculiar that we can easily suppose them to have other bearings than those which first offer themselves.

It does not belong to my present purpose to speak at length of the speculations concerning the forces producing the celestial motions by which Kepler was led to this celebrated law, or of those which he deduced from it, and which are found in the *Epitome Astronomiæ Copernicanæ*, published in 1622. In that work also (p. 554), he extended this law, though in a loose manner, to the satellites of Jupiter. These *physical* speculations were only a vague and distant prelude to Newton's discoveries; and the law, as a *formal* rule, was complete in itself. We must now attend to the history of the other two laws with which Kepler's name is associated.

Sect. 3.—Kepler's Discovery of his First and Second Laws.—Elliptical Theory of the Planets.

THE propositions designated as Kepler's First and Second Laws are these: That the orbits of the planets are elliptical; and, That the areas described, or *swept*, by lines drawn from the sun to the planet, are proportional to the times employed in the motion.

The occasion of the discovery of these laws was the attempt to reconcile the theory of Mars to the theory of eccentrics and epicycles; the event of it was the complete overthrow of that theory, and the establishment, in its stead, of the Elliptical Theory of the planets. Astronomy was now ripe for such a change. As soon as Copernicus had taught men that the orbits of the planets were to be referred to the sun, it obviously became a question, what was the true form of these orbits, and the rule of motion of each planet in its own orbit. Copernicus represented the motions in longitude by means of eccen-

⁴ *A. M.* a. 353.

⁵ *Optics*, b. ii. p. iv. Obs. 5.