

The moon's motions are really affected by several other inequalities, of very considerable amount, besides those which were thus considered by Hipparchus; but the lunar paths, constructed on the above data, possessed a considerable degree of correctness, and especially when applied, as they were principally, to the calculation of eclipses; for the greatest of the additional irregularities which we have mentioned disappear at new and full moon, which are the only times when eclipses take place.

The numerical explanation of the motions of the sun and moon, by means of the Hypothesis of Eccentrics, and the consequent construction of tables, was one of the great achievements of Hipparchus. The general explanation of the motions of the planets, by means of the hypothesis of epicycles, was in circulation previously, as we have seen. But the special motions of the planets, in their epicycles, are, in reality, affected by anomalies of the same kind as those which render it necessary to introduce eccentrics in the cases of the sun and moon.

Hipparchus determined, with great exactness, the *Mean Motions* of the Planets; but he was not able, from want of data, to explain the planetary *Irregularities* by means of Eccentrics. The whole mass of good observations of the planets which he received from preceding ages, did not contain so many, says Ptolemy, as those which he has transmitted to us of his own. "Hence^s it was," he adds, "that while he labored, in the most assiduous manner to represent the motions of the sun and moon by means of equable circular motions; with respect to the planets, so far as his works show, he did not even make the attempt, but merely put the extant observations in order, added to them himself more than the whole of what he received from preceding ages, and showed the insufficiency of the hypothesis current among astronomers to explain the phenomena." It appears that preceding mathematicians had already pretended to construct "a Perpetual Canon," that is, Tables which should give the places of the planets at any future time; but these being constructed without regard to the eccentricity of the orbits, must have been very erroneous.

Ptolemy declares, with great reason, that Hipparchus showed his usual love of truth, and his right sense of the responsibility of his task, in leaving this part of it to future ages. The Theories of the Sun and Moon, which we have already described, constitute him a great astronomical discoverer, and justify the reputation he has always

^s *Synt.* ix. 2.