

the discoveries of Ptolemy, although separated by a long interval of time; for these discoveries were only made by Tycho Brahe in the sixteenth century. The imperfection of astronomical instruments was the great cause of this long delay.

3. The Epicyclical Hypothesis was found capable of accommodating itself to such new discoveries. These new inequalities could be represented by new combinations of eccentrics and epicycles: all the real and imaginary discoveries by astronomers, up to Copernicus, were actually embodied in these hypotheses; Copernicus, as we have said, did not reject such hypotheses; the lunar inequalities which Tycho detected might have been similarly exhibited; and even Newton³⁶ represents the motion of the moon's apogee by means of an epicycle. As a mode of expressing the law of the irregularity, and of calculating its results in particular cases, the epicyclical theory was capable of continuing to render great service to astronomy, however extensive the progress of the science might be. It was, in fact, as we have already said, the modern process of representing the motion by means of a series of circular functions.

4. But though the doctrine of eccentrics and epicycles was thus admissible as an Hypothesis, and convenient as a means of expressing the laws of the heavenly motions, the successive occasions on which it was called into use, gave no countenance to it as a Theory; that is, as a true view of the nature of these motions, and their causes. By the steps of the progress of this Hypothesis, it became more and more complex, instead of becoming more simple, which, as we shall see, was the course of the true Theory. The notions concerning the position and connection of the heavenly bodies, which were suggested by one set of phenomena, were not confirmed by the indications of another set of phenomena; for instance, those relations of the epicycles which were adopted to account for the Motions of the heavenly bodies, were not found to fall in with the consequences of their apparent Diameters and Parallaxes. In reality, as we have said, if the relative distances of the sun and moon at different times could have been accurately determined, the Theory of Epicycles must have been forthwith overturned. The insecurity of such measurements alone maintained the theory to later times.³⁷

³⁶ *Principia*, lib. iii. prop. xxxv.

³⁷ The alteration of the apparent diameter of the moon is so great that it cannot escape us, even with very moderate instruments. This apparent diameter contains, when the moon is nearest the earth, 2010 seconds; when she is farthest off