

in which this is described, did not appear till 1661, when it was published by Hevelius of Dantzic. Some of his papers were destroyed by the soldiers in the English civil wars; and his remaining works were finally published by Wallis, in 1673. The passage to which I here specially wish to refer is contained in a letter to his astronomical ally, William Crabtree, dated 1638. He appears to have been asked by his friend to suggest some cause for the motion of the aphelion of a planet; and in reply, he uses an experimental illustration which was afterwards employed by Hooke in 1666. A ball at the end of a string is made to swing so that it describes an oval. This contrivance Hooke employed to show the way in which an orbit results from the combination of a projectile motion with a central force. But the oval does not keep its axis constantly in the same position. The apsides, as Horrox remarked, move in the same direction as the pendulum, though much slower. And it is true, that this experiment does illustrate, in a general way, the cause of the motion of the aphelia of the Planetary Orbits; although the form of the orbit is different in the experiment and in the solar system; being an ellipse with the centre of force in the centre of the ellipse, in the former case, and an ellipse with the centre of force in the focus, in the latter case. These two forms of orbits correspond to a central force varying directly as the distance, and a central force varying inversely as the square of the distance; as Newton proved in the *Principia*. But the illustration appears to show that Horrox pretty clearly saw how an orbit arose from a central force. So far, and no farther, Newton's contemporaries could get; and then he had to help them onwards by showing what was the law of the force, and what larger truths were now attainable.

*Newton's Discovery of Gravitation.*

[Page 402.] As I have already remarked, men have a willingness to believe that great discoveries are governed by casual coincidences, and accompanied by sudden revolutions of feeling. Newton had entertained the thought of the moon being retained in her orbit by gravitation as early as 1665 or 1666. He resumed the subject and worked the thought out into a system in 1684 and 5. What induced him to return to the question? What led to his success on this last occasion? With what feelings was the success attended? It is easy to make an imaginary connection of facts. "His optical discoveries had recommended him to the Royal Society, and he was now a member. He