noticed that this flexure is different at different angles from the perpendicular, and there is an elaborate collection of measures of the flexure at different angles, made by means of an instrument devised for the purpose. There is also a collection of similar measures of the refraction when the ray passes from air to glass, and when it passes from glass to water. This part of Ptolemy's work is, I think, the oldest extant example of a collection of experimental measures in any other subject than astronomy; and in astronomy our measures are the result of *observation*, rather than of *experiment*. As Delambre says (*Astron. Anc.* vol. ii. p. 427), "On y voit des expériences de physique bien faites, ce qui est sans exemple chez les anciens."

Ptolemy's Optical work was known only by Roger Bacon's references to it (*Opus Majus*, p. 286, &c.) till 1816; but copies of Latin translations of it were known to exist in the Royal Library at Paris, and in the Bodleian at Oxford. Delambre has given an account of the contents of the Paris copy in his *Astron. Anc.* ii. 414, and in the *Connoissance des Temps* for 1816; and Prof. Rigaud's account of the Oxford copy is given in the article *Optics*, in the *Encyclopædia Britannica*. Ptolemy shows great sagacity in applying the notion of Refraction to the explanation of the displacement of astronomical objects which is produced by the atmosphere,—*Astronomical Refraction*, as it is commonly called. He represents the visual ray as refracted in passing from the *ether*, which is above the air, into the air; the air being bounded by a spherical surface which has for its centre "the centre of all the elements, the centre of the earth;" and the refraction being a flexure towards the line drawn perpendicular to this surface. He thus constructs, says Delambre, the same figure on which Cassini afterwards founded the whole of his theory; and gives a theory more complete than that of any astronomer previous to him. Tycho, for instance, believed that astronomical refraction was caused only by the *vapors* of the atmosphere, and did not exist above the altitude of 45°.

Cleomedes, about the time of Augustus, had guessed at Refraction, as an explanation of an eclipse in which the sun and moon are both seen at the same time. "Is it not possible," he says, "that the ray which proceeds from the eye and traverses moist and cloudy air may bend downwards to the sun, even when he is below the horizon?" And Sextus Empiricus, a century later, says, "The air being dense, by the refraction of the visual ray, a constellation may be seen above the horizon when it is yet below the horizon." But from what follows, it