http://www.geology.19thcenturyscience.org/books/1858-Whewell-HistSci/README.htm

was not wanted for such observations. Ptolemy[10] says that he found it more convenient to observe altitudes by means of a square flat piece of stone or wood, with a *quadrant* of a circle described on one of its flat faces, about a centre near one of the angles. A peg was placed at the centre, and one of the extreme radii of the quadrant being perpendicular to the horizon, the elevation of the sun above the horizon was determined by observing the point of the arc of the quadrant on which the shadow of the peg fell.

As the necessity of accuracy in the observations was more and more felt, various adjustments of such instruments were practised. The instruments were placed in the meridian by means of *a meridian line* drawn by astronomical methods on the floor on which they stood. The plane of the instrument was made vertical by means of a plumb-line: the bounding radius, from which angles were measured, was also adjusted by the *plumb-line*.[11]

In this manner, the places of the sun and of the moon could be observed by means of the shadows which they cast. In order to observe the stars,[12] the observer looked along the face of the circle of the armil, so as to see its two edges apparently brought together, and the star apparently touching them.[13]

It was afterwards found important to ascertain the position of the sun with regard to the ecliptic: and, for this purpose, an instrument, called an *astrolabe*, was invented, of which we have a description in Ptolemy.[14] This also consisted of circular rims, movable within one another, or about poles; and contained circles which were to be brought into the position of the ecliptic, and of a plane passing through the sun and the poles of the ecliptic. The position of the moon with regard to the ecliptic, and its position in longitude with regard to the sun or a star, were thus determined.

The astrolabe continued long in use, but not so long as the quadrant described by Ptolemy; this, in a larger form, is the *mural quadrant*, which has been used up to the most recent times.

It may be considered surprising,[15] that Hipparchus, after having

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[10] *Synt.* i. 1.

[11] The curvature of the plane of the circle, by warping, was noticed. Ptol. iii. 2. p. 155, observes that his equatorial circle was illuminated on the hollow side twice in the same day. (He did not know that this might arise from refraction.)

[12] Delamb. *A. A.* i. 185.

[13] Ptol. *Synt.* i. 1. Ὥσπερ κεκολλήμενος ἀμφοτέραις αὐτῶν ταῖς ἐπιφανείαις ὁ ἀστὴρ ἐν τῷ δι' αὐτῶν ἐπιπέδῳ διοπτεύηται.

[14] *Synt.* v. 1.

[15] Del. *A. A.* 181.