Note on the Solar Eclipse of 1598. By J. L. E. Dreyer, Ph.D.

On 1598 February 25 (March 7) an eclipse of the Sun took place which was extensively observed in Germany. At that time Tycho Brahe, who had left Denmark in the previous summer, was staying at Wandsbeck in Holstein, close to Hamburg, and observed the eclipse there. His assistant, Longomontanus, observed it at Rostock, and a former assistant, Christen Hansen, observed it in Jutland. It is, however, more interesting that the eclipse was watched at the deserted observatory on the island of Hveen with one of the four great instruments which had been left behind on Tycho's departure from the island, and which were not removed till towards the end of 1599. As I had last year an opportunity of examining the particulars of this observation in the original MS. volume of observations from the year 1598, in the Royal Library of Copenhagen, a short account of it may not be uninteresting to the Society, particularly as some writers seem to have doubted that the eclipse was actually observed at Hveen.

In a letter to Magini, dated from Dresden 1598 November 28,* Tycho gives the following particulars about this eclipse :

"Martii d. 6. Eclipsis ☉ medium 11^h 5' a.mn. Uraniburgi in Dania. Magnitudo Eclipsationis ibidem apparuit a parte superiori intra 9 et 10 digitos."

He adds that all this agrees well with his own tables. In another letter to Magini from Prague, of 1601 January 24,† Tycho again alludes to this eclipse as having been observed at Uraniborg with one of the instruments left there. He refers for details to a paper enclosed in the letter, but this paper appears to have been lost. Some further particulars are, however, given in a letter to Kepler of 1599 December 9.‡ In this Tycho first states that according to his own tables the magnitude of the eclipse should be $9\frac{1}{2}$ digits, and continues : "qua etiam quantitate Sol deficere a quodam ex meis Uraniburgi isthic (ut 4 residuorum instrumentorum, quae prae magnitudine efferri tam cito nequibant, curam haberet) relicto studioso deprehensus est, et tempora alias per armillam aequatoriam, 18 pedum in diametro, a principio usque ad finem (fuit enim toto isthic tempore serenum) meae restitutioni apprime congruentia coelitus denotata sunt, quae erant ejuscemodi, ut deliquium inciperet isthic h. 10.10', finem haberet h. 12.19', ideoque medium existeret h. 11.12'."

In his book on optics (*Paralipomena in Vitellionem*, cap. xi.) Kepler discusses the observations of this eclipse, and states that it was by a student of Tycho's observed to commence at 10^h 3^m and to end at 12^h 32^m, the duration being 2^h 29^m. In the *Tabulae Rudolphinae* (pp. 110, 111) this eclipse is used as an

* *Carteggio inedito di Ticone Erahe . . . con G. A. Magini*, p. 222.

† *Ibid.* p. 238.

‡ *Opera Omnia*, ed. Frisch, i. 225.

example of the method for computing an eclipse for a particular locality, and it is shown that it lasted $2^h 21^m$. Kepler adds that the longer duration given in his *Optics* was erroneous: "Quin etiam addita observatio, tanquam Uraniburgica, quamvis neque Tychonis sit, qui tunc insula excesserat, nec Uraniburgica omnino, durationem tamen tantam convellit. Apparet enim ex fine h. 12.32', observationem esse Origani Frankofurdiani ad Oderam, qui hunc finem annotat: initium autem expressit sic: h. 10 $\frac{1}{2}$, quod alius superveniens legit h. 10.3'."

Did Kepler, then, when writing this, believe that the eclipse had *not* been observed at Uraniborg? It almost seems so, and Frisch evidently is of this opinion when using the expression, "De observatore Huennensi, seu potius Francofurtensi, vide annotationem sequentem," before reprinting the sentences quoted above.* And yet Kepler might easily have satisfied himself that the figures given in his *Optics* were not those deduced by Tycho from the observation made at Hveen, as Tycho's manuscripts were in his possession, though possibly he had not all of them at hand when writing the text to the *Tabulae Rudolphinae*.

In the MS. volume containing Tycho's original observations made during the years 1598 and 1599 the account of the observations made at Hveen is headed: "Eclipsis Solis Anni 1598 Mense Feb. die 25 Vraniburgi obseruata." Then follow sixteen diagrams of the solar disc with some figures beside each, which evidently represent the corresponding hour angles of the Sun. The first diagram shows that the Moon has already entered on the solar disc some five or six minutes before, as more than a tenth part of the solar diameter is eclipsed, and next it is written: "Tunc fuit Sol orienta. 26 g 25 m , H. 10 14 $\frac{1}{3}$," underneath which is written in Tycho's own hand: "Pone initium 28 graduum." At the following diagrams the hour angles are only given in degrees and minutes, not in time; and after the second one Tycho has written: "Sic Tycho . . . initium 10.10" (the dots represent an illegible word). The fourteenth diagram shows that the last contact is close at hand, and next it is written: "Sol occidentalis 4 40" to which Tycho adds: "Tycho fecit
O^H 18^M'

finem 12.19." Diagrams 15 and 16 are only blank circles with the hour angles 7.15 and 7.20, showing that the eclipse was over. The whole account occurs also in a quarto volume which contains copies (not originals) of observations made in 1593, 1590, and 1598-1600,† the only difference being that Tycho's concluded times of beginning and end of the eclipse are not given in this volume.

* *Opera Omnia*, ii. 441.

† This volume is numbered "1828, 4to," see my *Tycho Brahe*, p. 391, footnote 3. Probably the first part of the volume, containing observations made in 1593, has belonged to the set of quarto volumes used by Albert Curtz for the compilation of the well-known *Historia Coelestis*, as the year 1593 is omitted in the latter.

All this is in perfect accordance with the particulars quoted above from Tycho Brahe's letter to Kepler of 1599 December 9, and if the figures given by Kepler in the *Paralipomena* were copied from Origanus, this mistake was Kepler's own, and not Tycho's, as the latter concluded from the diagrams made at Uraniborg that the eclipse began for that place at 10^h 10^m and ended at 12^h 19^m.

Note on the Proper Motion of the Star L L 38239.

By J. L. E. Dreyer.

The magnitude of this star is given as 7.6 in the *Durchmusterung*, and it follows about 1^m after the Dumb Bell Nebula. I am not aware that the Proper Motion has been noticed before. The following positions are for 1890.0 and are referred to Auwers' fundamental system; Lalande's and Bessel's observations have been reduced anew by Asten's and Luther's tables.

Lalande 38239	^h 19 ^m 55 ^s 58.35	+ 22° 25' 25.5"	(1 obs.)	1796.6
Bessel (W. 1792)	58.72	13.1	(1 obs.)	1825.7
Rümker 7900	58.63	8.3	(4 obs.)	1840
Bonn (Beob. Bd. vi.)	58.79	3.8	(3 obs.)	1862.6
Berlin Zone	58.76	24 59.4	(2 obs.)	1881.7
Copenhagen, Pechüle	58.79	56.5	(2 obs.)	1893.7

The last observation was kindly made at my request. Lalande has two wire-transits in good accordance *inter se*. A proper motion = +0^s.0032 and -0^{''}.252 represents these observations as follows :—

Lalande	^h 19 ^m 55 ^s 58.65	+ 22° 24' 62.0"
Bessel	58.92	56.9
Rümker	58.79	55.7
Bonn	58.88	56.9
Berlin	58.79	57.3
Copenhagen	58.78	57.4

*Armagh Observatory,
1894 May.*