

about 1st-6th, 14th-16th, and 21st-22nd. In August and September they are often brilliant and exhibit features similar to the swift, streaking Perseids. In later months, when the observer may be watching the Orionids (October), Leonids (November), or Geminids (December), his attention will again be pretty certainly drawn to the Aurigids; their visible aspect will, however, have somewhat changed, though the point of radiation will remain the same at ζ - η Aurigæ.

Bishopston, Bristol,
1903, Feb. 20.

W. F. DENNING.

CORRESPONDENCE.

To the Editors of 'The Observatory.'

Flamsteed's Well.

GENTLEMEN,—

Perhaps you will allow me to add a very slight additional comment to your editorial note on Mr. Lynn's letter.

The impression has somehow or other obtained some currency that Flamsteed used his well to obtain naked-eye observations of γ Draconis during the daytime. As I mentioned in my last book, 'Astronomy without a Telescope,' p. 239, I am convinced that his object was entirely different, and that he wished to secure accurate measures of the distance of this star from the zenith. It is well known that he was very anxious to measure stellar parallax, or, as he prefers to call it, "the annual parallax of the Earth," in order to complete the proof of the Copernican theory of the motion of the Earth. For this he observed Polaris and Sirius with his mural quadrant, and believed that he had solved the problem, until Cassini pointed out that the displacements which Flamsteed believed to be parallactic occurred at the wrong times of the year. They were, of course, really due to aberration.

But in the course of this enquiry the suitability of γ Draconis for an observation of the kind did not escape him, and it seemed to him that he might obtain far more accurate measures of it than of any other star. Most of his observations of stellar position were made with his mural quadrant of seven feet radius. But at that time telescopes of enormous focal length were used in order to get rid of the effects of chromatic aberration. Such a telescope Flamsteed actually had, of 60 feet length, and mounted on a mast 80 feet high, which stood in the centre of what is now the lawn of the Astronomer Royal's Terrace Garden. But such telescopes were never used for accurate observations of star-places; they were too rickety and unwieldy.

One star, however, could be easily observed with such a telescope — γ Draconis. The object-glass could be placed in a horizontal position in the roof of a high building, and the observer

could watch the transit of the star from the basement, the method employed by Dr. Hooke in 1669 at Gresham College; or it could be firmly fixed in the mouth of a deep shaft, and the observer could descend to the bottom of the shaft and watch from thence. This would seem to have been Flamsteed's plan. It had the advantage that far greater stability could be thus given to the instrument than could be secured at that time in any other way whatsoever, and that a great focal length did not involve any material difficulty in the mounting and management of the lens. The illustration to which you refer shows clearly* that this was the arrangement adopted, as a wooden tube runs down the well and terminates just above the observer's couch. The eyepiece or plumb-bob—for it was both in one—is suspended in the tube. The tube, as well as the well, is noted by Flamsteed in one of his plans of the Observatory.

So far I think the matter is clear. Some other points are not so clear. Did Flamsteed have the well sunk specially for himself, or did he utilize an old well? I think the latter is more probable, for, on the one hand, so far as I know, there is no note among Flamsteed's accounts of the expense of sinking the well; whilst, on the other, the shafts and subterranean passages of Greenwich Park are numerous, and there may easily have been a way down to these within the precincts of the old Castle which Flamsteed could turn to account.

But did Flamsteed actually make any observations from the well? So far as I know there is no record of any. Flamsteed, in a long letter to Wallis on the subject of stellar parallax, mentions his observations of γ Draconis, but a comparison with vol. ii. p. 54 of the 'Historia Cœlestis' leaves no doubt that the instrument employed was the 7-foot mural quadrant.

Perhaps three very short extracts from the letter, which is given in full in Wallis's 'Opera Mathematica,' vol. iii. pp. 701-8, may be permitted:—

Epistola D. Johannis Flamsteed (Mathematici Regii Grenovici) ad D. Wallisium,
Dec. 20, 1698; *De Parallaxi Orbis Annui Telluris Observata.*

Interim spero Te non oblitum esse *Tentaminis* (Viri ingeniosi D. Hookii) *pro comprobando Telluris Motu* ex Observatis distantibus lucidæ Stellæ in Capite *Draconis* (quæ in *Bayeri* Tabulis signatur litera γ) à vertice Collegii *Greshumensis*. . . . Egregius ille D. Hook Tubi Telescopici, pedes triginta sex longi, lentem (quam vocant) Objectivam firmaverat ingeniosis Artibus in tecto suæ Cameræ, pro Observandis istius Stellæ distantibus à vertice. . . . Ejusdem Stellæ (Meridianum transeuntis) distantia à Vertice Observatorii *Grenovici* 1690 *Julio*, inventa est 4' 35", Septentrionem versus.

I think it is clear that at this time, December 20, 1698, Flamsteed had no satisfactory observations of γ Draconis made from

* [We are obliged to Mr. Maunder for his excellent exposition of these facts, but we regret that we did not state more clearly last month what was perfectly obvious to us, and must have been to anyone seeing the picture, that the bob of the plumb-line formed an eyepiece, as Mr. Maunder describes.—EDS.]

his well, or he would have mentioned them. Probably his highly ingenious notion of making the eyepiece serve as plumb-bob as well did not work. No doubt he found that it never remained at rest, and so spoiled his chances of getting accurate measures. Possibly too, as Mr. Lynn suggests, he found a well was not altogether a healthy form of observatory, especially to a man racked with neuralgia and rheumatism from early boyhood. So that it is very likely that nothing came of his experiment.

With regard to the *exact* site of the well, *two* plans of the Observatory by Flamsteed are extant—the one reproduced by Baily on p. 40 of his ‘Flamsteed,’ the other by Sir George Airy in plate ii., ‘Appendix to the Greenwich Observations for 1862.’ That the well was not a mere shallow pit is indicated by Flamsteed’s description:—“Puteus profunditatis 120. ped. cum Tubo pro Observ. Parallaxis Terræ.” The two plans differ considerably as to the position of the well, and Sir George Airy marked both positions on his plan of the grounds, plate i. of the above Appendix. The second place is manifestly in error, being on the sharp slope of the hill down into the Astronomer Royal’s garden. The first site is the one which Sir George Airy marked by a wooden post, and it was here that the subsidence in 1881 took place. But in view of the discrepancy between the two plans, and the manifest inaccuracy of the better finished of the two, I have been led to surmise that an old engraving, which rather seems to place it under what is now the Assistants’ Common Room, may possibly be more correct.

Yours faithfully,

Greenwich, 1903, Feb. 16.

E. WALTER MAUNDER.

The Eclipse of Alexander.

GENTLEMEN,—

The question in Mr. Monck’s letter of January 8, as to ancient eclipses in which the actual day is given by historians, has led me to discuss this eclipse again (respecting which you published a letter from me in vol. xv. p. 61 of the *Observatory*), because it is not only connected with a great historical event, but the date of the latter can thereby be fixed almost with certainty. In the year corresponding to our B.C. 331, Arrian tells us that Alexander marched from Egypt to Phœnicia and thence to the Euphrates, and arrived at Thapsacus on the latter in the month of Hecatombæon. Now this was the first month of the Attic year, and commenced with the New Moon following the summer solstice—in that year on the 9th of July. He did not hurry through Mesopotamia, until he received information that Darius was on the other side of the Tigris with a large army. On hearing this, Alexander crossed that river as soon as possible, and immediately afterwards occurred, we are told, a nearly total eclipse of the Moon. Pliny states that it began at the second hour of the night, and there is no doubt that the eclipse was the one shown by calcu-