SOME ADDITITIONAL OBSERVATIONS ON MORE RECENT CHANGES WHICH HAVE TAKEN PLACE IN THE STAR η ARGUS AND ITS SURROUNDING NEBULA.

By F. Abbott, F.R.A.S., F.R.M.S., Read 12th April, 1870.

I would remind the members present, that many of the notes in this short paper are intended to answer questions that have arisen in various discussions which have taken place on the preceding one on the same subject read in 1868.

These notes have been, for the most part, suggested by some critical remarks, made on the subject by Sir John Herschel, to which I shall presently refer.

In continuation of the observations detailed in the communications referred to, I now bring under the notice of the Society a third paper, with accompanying drawings, relative to this singular object which has of late caused long and animated discussion in the astronomical world.

When I first brought the subject under the notice of the Society (see Papers and Proceedings for June, 1863), I was fully aware that the varied changes there recorded as having taken place in the object, and particularly the fluctation of the Nebula, would cause great excitement; but did not expect it would meet with the severe critical test to which it has been subjected by Sir John Herschel, who, commenting on the drawing at a meeting of the R.A.S., remarks that "The question is not one of minute variations of subordinate features which may, or may not be attributable to differences of optical power in the instruments used by different observers, as in the case of the Orion Nebula—but of a total change of form and character—a complete subversion of all the greatest and most striking features, accompanied with an amount of relative movement between the star and the Nebula, and of the brighter portions of the latter *inter se*, which remind us more of the capricious changes of form and place in a cloud drifted by the wind. The great increase of light that has taken place in the brightness of the Nebula is very remarkable; it could not be seen at all by the naked eye, when I was at the Cape, but the changes which have taken place in the figure of the Nebula are still more startling. Mr. Abbott supplies two pictures, one representing the appearance of the Nebula as seen

in 1863, the other drawn in February 1868. Neither of these pictures resembles my drawing of 1834-8 in the slightest degree, nor do the two pictures in any way resemble each other, and Mr. Abbott remarks that a series of drawings taken at comparatively short intervals of time would afford even stronger evidence of the mutability; this is very strange, no phenomenon in nebulous or sidereal astronomy as yet ever turned up like this, and it must be settled."

Sir J. Herschel clearly supposes by these remarks, that my drawings are meant to indicate the true arrangement of the stars. He has been at great pains to try all possible means of reconciling his own splendid drawing of the Nebula with mine, so far as the distribution of the stars is concerned, but without being able to find a situation of the tracing paper, in which any tolerable coincidence of the stars in the two drawings could be noticed.

Lieutenant Herschel, Sir John's son, was sent out to India at the head of a party of scientific men to observe the great eclipse of August 18th, and was fully commissioned to settle in some way the nature of the capricious changes recorded of this object; how he succeeded can be seen by a comparison of his drawings with my own, and that of the Cape Monograph, now lying on the table. On the receipt of these drawings Admiral Manners, President of the Royal Astronomical Society, thought that Lieut. Herschel had not sufficient instrumental means at his disposal to settle the question.

The first object to be examined with the large Melbourne reflector was the Nebula in Argus, in reference to which Gen. Sabine, in his recent address to the Royal Society, regrets the temporary failure of that telescope from some cause or other not clearly known, but reminds the Society that it has been able to show some of the changes recorded in the Nebula of Argus.

These preliminary remarks will tend to show the present meeting a part of the interest excited by my last remittance to the Royal Astronomical Society on the subject, and I think the present paper and drawing will tend to set all doubts as to the fluctuations that have already taken place at rest.

The severe critical remarks of Sir John Herschel on the drawing and notes of 1868 were made with a view of disproving that which I never intended to prove, viz., a correct measurement of the distance applied to all the stars in the field of the telescope; this in all probability arose from my not having expressed myself with sufficient clearness in my remarks on the drawing which accompanied the observations. In this way the road to truth often runs through the midst of error, but that does not in any way alter the fact that changes have been, and still are taking place in the object—such

changes being principally confined to a space near to η and the so-called lemniscate*

As some objections have been raised on the ground that larger optical means than those employed by me are required for recording truthfully the changes which occur in this object, it may be well, perhaps, to state that the 5ft. equatorial previously mentioned, although the best for the purpose, is not the only instrument at my command; other telescopes have been used in the open air, from a $3\frac{1}{2}$ inch Cook and Son's, to a 7ft. Dollond—with, for the whole, a complete battery of Micrometers, and eye-pieces giving magnifying powers of from 25 to 450. This statement may go towards proving that with due care such observations can be correctly made without very large instruments.

In Mr. Proctor's article on the Nebula in Argo, (*Frazer's Magazine* for December, 1868,) it is stated not to be quite clear that the stars which appear in my drawing of 1868 have been really copied from the view given by the telescope, &c. In reply to this I beg to state that all the drawings, the present, as well as the former ones, were carefully copied from the object, as described in the *Astronomical Register* for January, 1869. There is little doubt but that Mr. Proctor's views on this subject would be much enlarged if he had the opportunity of seeing the star and its Nebula as they appear in the telescope, when above the Pole, at Hobart Town.

Having now seen the object with the large Melbourne reflector, and compared the effect with that produced by my own instruments during the last two years, I feel greater assurance in communicating the result of observations on the changes which have taken place since 1868.

On comparing the present with the former drawing, it will clearly appear that alterations have taken place, both in the magnitude of the star η, and in the dispersion of the Nebula, and from what follows it will be seen that the remarks made by Professor Loomis and others on the period of this star are premature. At the time of my visit to Melbourne (21st June last), Mr. Ellery considered the star η to be of the 7th magnitude, and Mr. Le Suer thought it to be $6\frac{1}{2}$. On returning to Hobart Town, and resuming the observations on this interesting object, I found by comparison with other stars, given in the drawing and recorded in the Cape Catalogue as of the

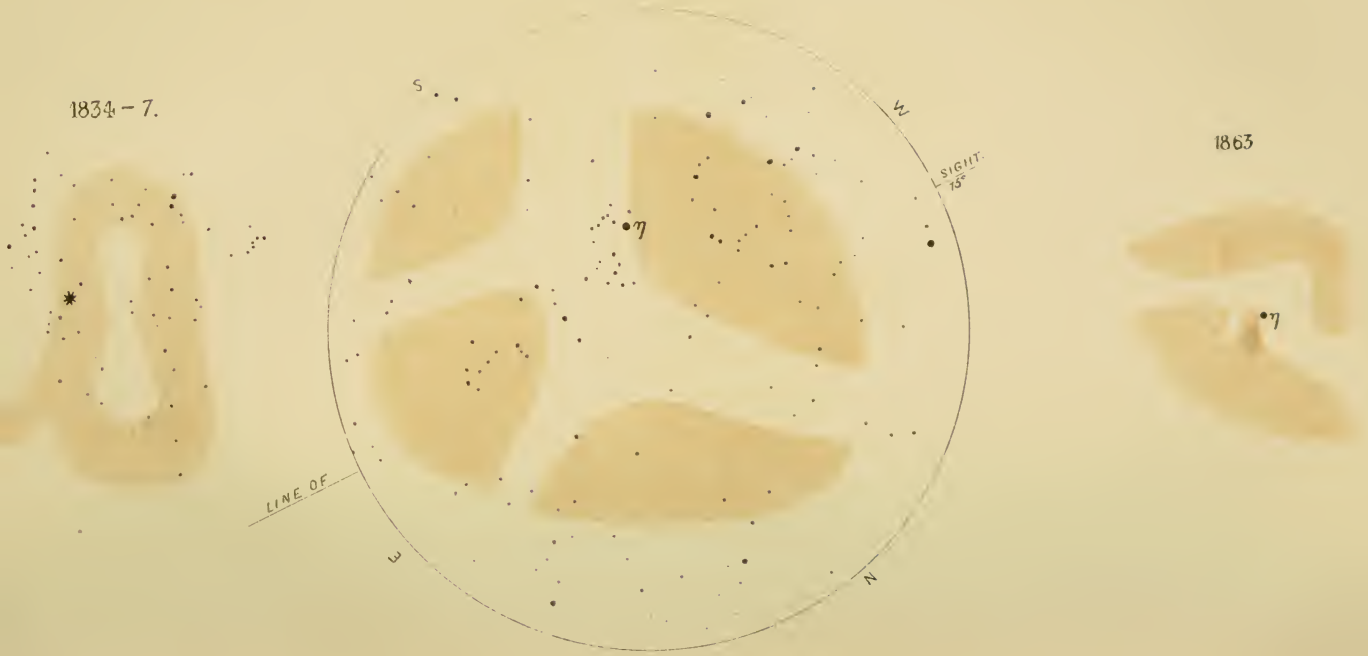
* I scarcely think this term a good one, *Lemniscate*, or *Lemniscus*—a curve formed as the figure 8, or a bow tied of a riband (Barlow and B. H. Smart). Such a curve is closed in the centre, which is not the case in the Cape drawing, the space being there shown as a long enclosure, slightly compressed in the centre. It was in this compressed part of the dark space that the star η appeared when out of the dense Nebula in 1863.

7th magnitude, that η Argus cannot now be more than a 7th magnitude star. In the catalogue there are two stars of the 6th and nine of the 7th magnitude, the remainder being all of low magnitude. In the drawing the two 6th magnitude stars are out of the field, and the nine of the 7th magnitude in the field, are by careful comparison exactly the same magnitude as η, which is left among them not marked. The magnitudes of these stars are given by Sir J. Herschel, and may be considered correct.

Measures of these stars have recently been recorded as having been made by small transit means; but from my own experience in such observations, I believe it all but impossible to measure correctly such a cluster of small zenith stars by these means. Two years ago I dismounted a 24 inch transit by Varley in order to re-place it with a 30 inch by Dallmayer, made with a deep diagonal eye-piece for the purpose of reaching small zenith stars up to the 7th mag., as agreed upon for correcting any error in longitude between Hobart Town and Melbourne. Mr. Ellery selected 49 such stars, which were to be used at both places, reversing the instruments for each observation so as to eliminate any errors. With these means, and for this purpose, I find it difficult, and only under very favourable circumstances possible, to reach zenith stars of the 7th mag. My reason for not attempting measures with the equatorial is in consequence of a long experienced difficulty arising from the want of clock movement, which I consider indispensable for the accurate measurement of distances. I have therefore preferred an eye and hand drawing when the object has been in a convenient position—approximately 75° from the meridian towards the East, and 35° from the zenith.

A very singular circumstance in connection with the extraordinary object under consideration is, that although it has within the last few years undergone such rapid changes, causing great excitement amongst astronomers in Europe, and laying a foundation for new theories—yet, apart from the Melbourne Observatory, scarcely any one in the Australian colonies appears to know it, notwithstanding that on every fine night through the year it is to be seen above the horizon at Hobart Town, and particularly well situated for examination, when near the meridian. The only person who occasionally studied this object with myself was a member of this Society—the late Joseph Facy—who on suitable occasions would devote a few hours to an inspection through the telescope of some of the principal objects in the great Creator's workshop. He would, in his pious zeal, apart from theological theories, frequently comment upon the mode of manipulating, mechanical, geometrical, and

VARIABILITY OF THE SURROUNDING NEBULÆ
WITH THE MAGNITUDE AND POSITION OF THE ACCOMPANYING STARS 1868



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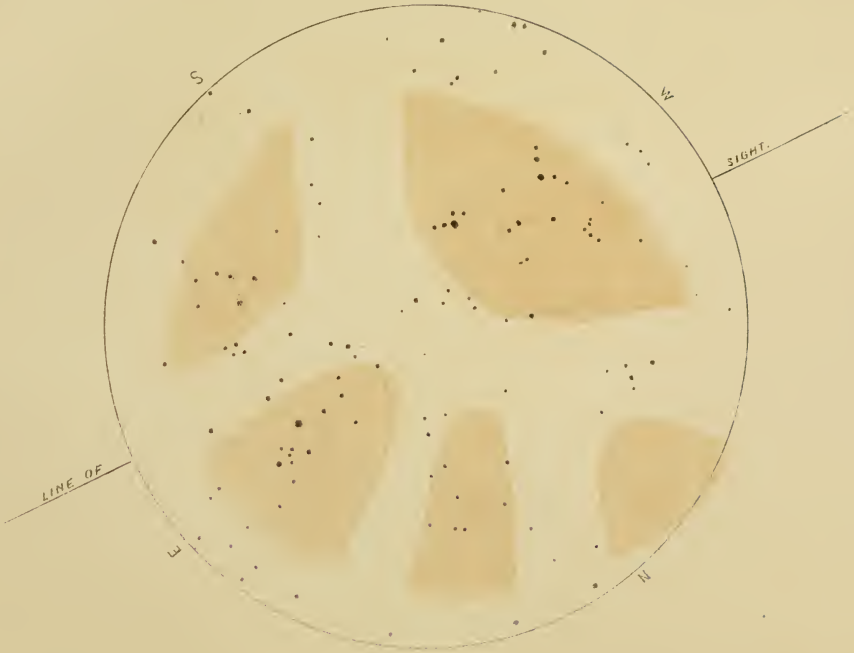
FROM THE YEAR 1834 TO FEBY 15TH. 1868.

VARIABILITY OF THE SURROUNDING NEBULÆ

WITH THE MAGNITUDE AND POSITION OF THE ACCOMPANYING STARS,

UP TO THE PRESENT TIME 1870.



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TAKEN JANUARY 28TH 1870.