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Admiral MANNERS, President, in the Chair.

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Henry Wm. Hollis, Esq., Ormston Manor, Derby;
Wm. Rossiter, Esq., Collingwood Street; and
Robert Wm. Skiffington Lutwidge, Esq., Barrister-at-Law,

were balloted for and duly elected Fellows of the Society.

On the Variable Star η Argûs and its Surrounding Nebula.

By Sir J. F. W. Herschel, Bart.

The changes recorded by Mr. Abbott, in his communications to this Society, published in vols. xxiv. and xxv. of the *Monthly Notices*, and more especially in the *Notice* which has just appeared (vol. xxviii. p. 200), are so very astonishing that it is high time the attention of every astronomer in the southern hemisphere provided with instruments at all competent to show, I will not say all the details—but—the brighter portions of the nebula, should be directed to its delineation, and to the relative situations of every star within 10′ or 15′ of the principal star. There is no phenomenon in nebulous or sidereal astronomy that has yet turned up, presenting anything like the interest of this, or calculated to raise so many and such momentous points for inquiry and speculation. The question here is not of minute variations in 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 nebula in *Orion* (the only one comparable to it in magnitude, complexity, and brightness), 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 reminds us more of the capricious changes of form and place in a cloud drifted by the wind than of anything heretofore witnessed in the sidereal heavens. In fact, not only as compared with the appearance of the nebula in 1834–7, which my delineations record, does Mr. Abbott's diagram of 1868 exhibit so astonishing a dissimilarity; but, when compared with the drawing given by himself at so recent a date as 1863 (vol. xxiv. p. 5), the difference is such that no one could possibly suppose the two representations referred to one and the same object.

η Argûs itself, though a variable star of the most extraordinary character, is nearly devoid of proper motion: the annual change due to this cause, in R.A. and N.P.D., as given in the Catalogue of the British Association, being only $-0^{sec.}\cdot001$ and $-0''\cdot09$, so that it is entirely owing to movements going on within the nebula itself that the change must be owing. But here comes the most astonishing part of the whole affair. The neighbourhood of *η Argûs* is thickly sown over with small stars. Of these, within the compass of a little more than a square degree, having η in the middle, I determined in 1834–7 the situations and apparent magnitudes of upwards of 1200; and, during all the course of my observations, never found reason to suspect the situations of any of these to be variable either *inter se* or with respect to η. Now Mr. Abbott's figure, as given in the recent Number of the *Monthly Notices*, shows this star accompanied by 150 stars of various magnitudes within a field of view (so I interpret the subscript figures $1^\circ\ 07'\ 47''$) of $1^\circ\ 8'$; and of these I have not been able satisfactorily to identify any one individual with any one in my Catalogue.

To be quite satisfied on this point, I laid down upon his figure a set of lines corresponding to the meridians and parallels of my chart,* being guided in their direction by the letters N S and E W (which I presume to express the situations of the North and South, and East and West points of his field of view at the moment of delineation); in their distance from each other in P.D. by the diameter 68′ of the circle, containing exactly 17 intervals of 4′, the distance between the parallels on my chart (4′ = 1000 micrometer parts), and in R.A. so as to correspond in due proportion to the intervals of $50^{sec.}$ of time between my meridians. This done, the places of Mr. Abbott's principal stars (within the limits of my chart) were read off as nearly as the small scale of the figure would allow, and are here set down — the magnitudes assigned being according to the best judgment I could form, from the size of the dots expressing them in the engraving, taking η itself as 6 mag. As regards the larger stars, this can hardly be very erroneous, though, as respects the smaller ones, no conclusion can be formed, since, though Mr. Abbott

* "Cape Observations," Plate ix.

states the *focal lengths* (5 feet) of the telescopes he used, he nowhere mentions their apertures.

Star's Mag.	Δ R.A. from η in Seconds of Time.	Δ N.P.D. from η in Microm. parts, each = 0″·004.	Star's Mag.	Δ R.A. from η in Seconds of Time.	Δ N.P.D. from η in Micr. parts, each = 0″·004.
η = 6 m.	0	0	8 m.	−42	−1600
6 m.	−165	−5950	7.8 m.	+30	+5200
9 m.	−147	−1750	7.8 m.	+45	+6000
9 m.	−120	−1400	8 m.	+77	− 450
8 m.	− 55	− 900	8 m.	+80	+ 400
8 m.	− 45	−1850	8 m.	+87	−1250

The following are the principal stars within the limits of Mr. Abbott's field of view, as given in my Catalogue*:—

Star's Letter and Mag.	Δ R.A. from η in Seconds of Time.	Δ N.P.D. from η in Microm. parts = 0″·004.	Star's Letter and Mag.	Δ R.A. from η in Seconds of Time.	Δ N.P.D. from η in Micr. parts = 0″·004.
η = 2 m.	0	0	λ = 8 m.	+ 37·8	−4143
ω = 8 m.	−148·0	−1332	δ = 8 m.	+ 66·7	−5486
O = 7 m.	− 65·5	−2023	σ = 9 m.	+ 78·9	+5014
C = 8 m.	− 51·6	+ 539	$\varkappa$ = 8 m.	+155·9	−1726
U = 7 m.	− 38·5	+4627	W = 6 m.	+158·3	+2782
D′ = 8 m.	− 29·1	+ 860	γ = 7 m.	+178·9	+3441
D = 8 m.	− 28·8	+ 798			

The utter disagreement of these two lists of the principal stars is apparent, and renders it unnecessary to go into a comparison of those of smaller magnitude.

Conceiving it possible, however, that the letters N, S, E, W, may be misplaced in Mr. Abbott's diagram, or that the nature of the inversion of his eye-piece may have been, by myself, misapprehended, I laid down, on the same scale, a miniature of my chart on thin paper, with the meridians and parallels, placing on it in their proper positions all the stars in this latter list. Then, oiling the paper so as to render it transparent, it was laid down on Mr. Abbott's diagram, the two stars η in each being brought to coincidence. Turning then the oiled chart round on the diagram, no situation could be found to bring about any tolerable coincidence of the stars in the one and the other. The same result was obtained when the oiled chart was reversed (laid *face downwards*) on the diagram, and turned round in the same way.

What then are we to conclude? Not only the nebulous masses would appear to have drifted far away from their situations in 1835, but the stars of the whole region over an area of nearly two-thirds of a square degree, including stars of the 6th, 7th, and 8th magnitudes, to have also either assumed new configurations *inter se*, or to have bodily fled away and given place to a new set!

* "Cape Observations," pp. 42, *et seq.*

Again, within a circle of 6′ radius round η, in Mr. Abbott's diagram occur 19 minute stars. In my chart, within a circle of the same radius, are laid down 57, of which two are of the 8th, four of the 10th, and two of the 11th magnitudes, but among all these not one can be satisfactorily identified with any of his. The best approach in general appearance is that of the line of five very small stars in close vicinity to η and to the immediate south of it, which may be considered as somewhat to resemble the crooked line of stars G, (ε), (ζ), (η), (θ), in my chart. But *these* are quite otherwise situated with respect to η, and their general direction makes an angle of 70° with the parallel (from *sp* to *nf*).

Another very puzzling feature in Mr. Abbott's description is the brightness he ascribes to the nebula, which he states to "give out fully twice as much light as that of the Nubecula major," "irrespective of size." How far the diminution of light in η from the 2d to the 6th magnitude may affect the visibility to the naked eye of the nebula in a dark night, I cannot pretend to say; but on no occasion do I remember to have perceived with the naked eye any nebulosity about it even in a dark night, and assuredly not in a twilight, such as just to allow stars of 2.3 mag. to become visible. *Such* a twilight effectually obliterates both the Nubeculæ, which, however, are both — the N. major especially — very conspicuous objects in a dark night.

It is much to be wished that some southern observer furnished with an equatoreally mounted telescope would *without further delay* set to work in earnest, and map down the stars visible within this most interesting area, down at least to the 10th or 11th magnitude. Possibly I may have done Mr. Abbott injustice by assuming that his diagram is intended to convey any *delineation* at all of the stellar contents of his field of view; or anything beyond the forms of the nebulous masses, as existing *among* scattered stars. But the question once raised is of the last importance and *must* be settled; especially in regard to what he himself says, *Monthly Notices*, vol. xxv. p. 4, as to the "increased number" [since 1837] "of brilliant isolated stars with a change in the position of η *Argûs*," as "the effect produced with a 5-foot achromatic;" in obvious reference to the *nebular hypothesis* of the formation of stars and planets by the condensation of nebulous matter. And this leads me to observe that, having taxed in vain my recollection as to the authorship of the passage which he there ascribes to me* on the subject of this theory, and not having

* "It will appear" . . . "that every succeeding state of nebulous matter is the result of the action of gravitation, and by such steps the successive condensation of it is brought to a planetary or stellar condition. Several instances are on record which connect the planetary with the stellar appearance. In those instances wherein the collection of nebulous matter was very extensive, subordinate centres of attraction could not fail to be established, around which the adjacent particles would arrange themselves, and thus the whole mass would in process of time be transformed into a determinate number of discrete bodies, which would ultimately assume the condition of a cluster of stars."— *Monthly Notices*, vol. xxv. p. 4.

succeeded in finding it in any of my published writings, I shall feel obliged to any friend who will refer me to the place where it occurs, as it certainly seems to convey a much more definite and decided view of the matter than I should *now* like to endorse.

Collingwood, June 8, 1868.

A determination of the Constant of Nutation from the observations in N.P.D. of Polaris, Cephei 51, *and δ Ursæ Minoris, made with the Transit Circle of the Royal Observatory, Greenwich,* 1851–1865. By E. J. Stone, Esq. (Abstract.)

The Transit Circle of the Royal Observatory, Greenwich, has been in regular use since the beginning of the year 1851, and the results, down to the year 1865 inclusive, are in the hands of astronomers. In the construction of the instrument no arrangements were provided for shifting the relative positions of the reading-microscopes, or the divisions under the microscopes, in any given position of the instrument. The same divisions are thus employed in the observation of a star for many years. This arrangement undoubtedly offers great advantages for the determination of a constant, like that of Nutation, where what we require is, that observations extending over many years should either be free from systematic error, or, which is quite as good for the present purpose, be affected only with constant errors. The division errors of the Greenwich Transit Circle were elaborately investigated in 1850 and again in 1857. The errors of the divisions under the microscopes, in the observations of the Nadir-point with the reflecting eye-piece, in the observations of *Polaris, Cephei* 51, and *δ Ursæ Minoris*, above and below pole, have also been separately investigated in 1857 and 1865.

The astronomical flexure of the telescope has been determined on the following occasions:—

Date.		Horizontal Flexure.
1850	Dec. 30	+0″·41
1851	Feb. 5	+0·88
1852	Dec. 23	+0·20
1857	Jan. 5	+0·46
1857	Jan. 21	+0·66
1860	Sept. 1	+0·67
1864	Sept. 7	+0·76

The mean value of the horizontal flexure = + 0″·58.

1867	April 25	−0″·34
1867	May 8	−0·31
1867	May 13	−0·37