

*On the Variable Nebulae of Hind (N.G.C. 1555) and Struve (N.G.C. 1554) in Taurus, and on the Nebulous Condition of the Variable Star T Tauri.* By E. E. Barnard, M.A., D.Sc.

The subject of the variability of the light of a nebula is of the highest importance. There are many of these objects that have been reported variable; but so differently do many of the nebulae appear in different telescopes and with different magnifying powers, that no sort of confidence can be placed in most of these statements, and a positive proof of an actual variable nebula, except in one case, is sadly wanting. It is quite reasonable to believe that some of the nebulae do vary in their light, but, from the peculiarities above mentioned, it will take decidedly strong proof to convince astronomers who are familiar with these objects that some deception has not misled the observer.

A better example of this kind of error is scarcely wanting than the celebrated *Merope* nebula of the *Pleiades*, which for so many years was believed by half the astronomers to be variable, while the other half refused to believe that it existed at all, but I think, since it has been so easily and repeatedly photographed, that few will call it variable now, and no one will doubt its existence.

This, however, is a class of nebula that needs, from its diffused nature, a low power and large field, for contrast, more than anything else, to make it visible. It is therefore particularly suited for small telescopes.

The more definite and condensed nebulae are not so much subject to deceptions of this kind, due to telescope and magnifying power, and estimates of their brightness by different observers with different instruments in many cases do not vary greatly, so that any very great discrepancy in descriptions by careful observers might be suggestive of actual variability. Such nebulae are better seen in the more powerful telescopes.

To this latter class we must refer Hind's variable nebula in *Taurus*. This object was discovered by Mr. J. R. Hind, 1852 October 11, at Mr. Bishop's Observatory, London.

It remained visible for a few years, with ordinary telescopes, and then seems to have faded from view.

In *Astronomische Nachrichten*, No. 839, we find Mr. Hind's original account of the discovery of this object. He says: "Last night (October 11) I noticed a very small nebulous-looking object in A.R.  $4^{\text{h}} 11^{\text{m}} 50^{\text{s}}$   $\delta = +19^{\circ} 8'$  for 1825.0, the epoch of our ecliptic charts; it was south, preceding a star of 10 mag., which, to my surprise, has escaped insertion on the map for  $4^{\text{h}}$  R.A. recently published—possibly it may be variable. [This is the variable star *T Tauri*.] The sky at the time was remarkably clear, but the object appeared faint; it preceded  $1^{\text{s}}.2$ , and was  $0'.7$  south of it [of *T Tauri*]. I suppose it will

prove a new nebula, none of our catalogues having anything in the above position. Its diameter did not exceed 30".

This was written 1852 October 12. This nebula was subsequently observed by D'Arrest, Struve, Lassell, and others. D'Arrest measured its position on four occasions during 1855 and 1856, but on 1861 October 3 it had disappeared. On that date he makes the following note: "I am not able to find any trace of this nebula, first seen by Hind in 1852. It was observed the first time by me, and frequently, during the years 1855 and 1856. Its position being determined four times. . . . Is not this nebula variable?"

He sought for it again 1861 October 4: "Sky very clear. I have examined the region with extreme care, aided by Schjellerup; the nebula is certainly absent."

Again he says: "I have searched for this nebula, with curiosity, under varied conditions during the months of 1862 January and February, but have found no certain evidences of it. That it has vanished meanwhile from the sky is attested by many astronomers, with more powerful telescopes than mine."

He states, however, that O. Struve and Lassell, with their great telescopes, never entirely lost this object during 1861 to 1864, but that by 1868 it had also absolutely vanished from the Pulkowa telescope.

When examining the region of this object early in 1868 Struve found another small nebula 4' preceding the place of Hind's nebula. This was subsequently observed by D'Arrest, who was sure that no nebula previously existed at that place.

Both these nebulae were observed by D'Arrest on three or four occasions, but, of course, not on the same dates. From these positions he gives the places of these objects for 1868.0:

	<sup>h</sup>	<sup>m</sup>	<sup>s</sup>	<sup>°</sup>	<sup>'</sup>	<sup>"</sup>
Struve's Nebula	α	4	14	0.4	δ+19	12 13
Hind's Nebula		4	14	15.5		+19 12 27

He says (*A. N.* 1689), "Struve's nebula is pretty small, nearly round, with eccentric nucleus = × 14 mag. In a full dark sky it would be equal to Herschel's Class II. Hind's variable nebula in 1856 was larger and considerably brighter [than Struve's in 1868]."

He would place Hind's object as faint in Herschel's Class I.

In the above paper D'Arrest gives the place of *T Tauri* 1868.0,

$$4^{\text{h}} 14^{\text{m}} 17^{\text{s}}.8 \quad +19^{\circ} 13' 4''.$$

In observing Hind's nebula, 1855 November 3, D'Arrest thus describes it: "Discovered by Hind, *Astr. Nachr.* No. 839. A very bright nebula, 1' in diameter; on its northern edge is a 10<sup>m</sup> star, which follows 2<sup>s</sup>.20, and is about 35" north of the middle of the nebula."

In *A. N.* 2212 Tempel has a very important and interesting

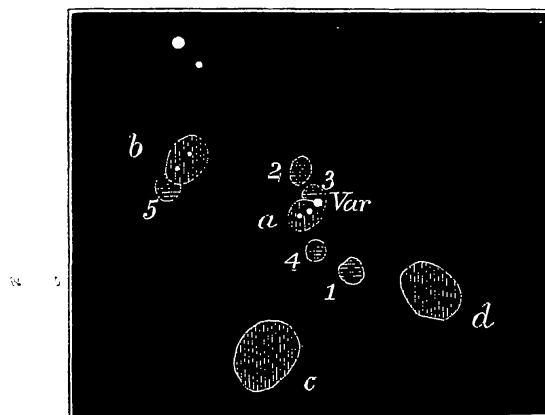
account of his observations of this region. They were made in 1877, and all the dates below refer to that year.

On November 5 he could see no nebulosity near *T Tauri* in the place assigned to Hind's nebula. On November 8 he found a nebula  $1\frac{1}{2}'$  diameter, in the northern part of which a small star shone. This nebula was  $1'$  south and  $15^s$  preceding *T Tauri*, and was recognised by him as the Struve nebula.

On December 12 he saw, in a very clear sky, two very small stars very close to *T Tauri*, but could see no nebulous appearance as he had so often seen previously. He could not see anything of the Struve nebula which he had seen November 8, but he saw two small stars at its place, the northern of which was the one he had seen on November 8 in the nebula, and which was about  $40''$  south following.

Tempel gives a very interesting sketch of the region in the paper referred to. This I have thought of sufficient interest to be here reproduced, so I send a copy of it. This is valuable, as it seems to point to the existence of several variable stars in this remarkable region.

Tempel found that the different positions of Hind's nebula as previously reported did not very well agree, so he has charted each of these for comparison.



1=Hind's position as given by him in *A.N.* 839.

2=The same, from Hind's description.

3=Auwer's position. Herschel's Gen. Catalogue.

4=D'Arrest's position in *Sid. Nebulosorum*.

5=Struve-D'Arrest's position in Dreyer's supplement to Gen. Cat.=the place of Struve's nebula.

a=The nebulous appearance which Tempel had so often seen about *T Tauri*, and where later he saw only two small stars without any nebulosity.

b=The nebula which he (Tempel) had seen 1877 November 8, and which he recognised as Struve's nebula. The southerly of the two small stars at this point is the one described by D'Arrest as being excentrically placed in the Struve nebula.

c and d are small star clusters seen by Tempel. The scale of this sketch is 1 millimeter =  $1^s$ .

Dr. Dreyer, in his Supplement to Herschel's Gen. Cat. of Nebulæ, says in 1877 : "No. 1689 of the *Astr. Nachr.* contains an observation by D'Arrest of an S nebula with an excentric nucleus

= \* 14<sup>m</sup>, which was first seen by O. Struve early in 1868, 15<sup>s</sup> p. the place of the missing [Hind's] nebula. At present there is no nebulosity distinctly visible, neither around this faint star, nor near the well-known variable star. On this point I am in perfect accordance with Dr. Copeland, observing with the large Dunecht refractor, and M. Tempel, who works with a fine Amici refractor of eleven-inch aperture (at Arcetri). In the Pulkova refractor, however, some traces of nebulosity seem still to be visible. M. Otto Struve informs me that he, from time to time, has observed the variable nebula, but that he avoids reducing and comparing his observations for fear of being pre-occupied with respect to this minimum visible. He does not consider the *Nova* from 1868 a separate nebula. 'What I see is certainly the variable nebula itself, only in altered brightness and spread over a larger space. Some traces of nebulosity are still to be seen exactly on the spot where Hind and D'Arrest placed the variable nebula.'"

After this these objects seem to have been fairly neglected by observers until 1890, when Mr. Burnham took up the matter with our great refractor. His paper on the subject was printed in *Monthly Notices* for 1890 December. As he states, he examined this region only under the best atmospheric conditions.

Misled by the position of *T Tauri* = *D.M.* + 19° 7' 06" given in *D.M.*, he erroneously assumed that Hind's nebula was identical with the variable star. He says: "The place of the nebula as given by Dreyer, on the authority of D'Arrest, is identical with that of *D.M.* + 19° 7' 06", the magnitude of which was estimated by Argelander as 9.4; and this is *T Tauri* of the variable star catalogues." This statement is true, but the position of *D.M.* + 19° 7' 06" as given in *D.M.* is erroneous.

The *D.M.* place of this star and the position of Hind's nebula, reduced to 1855.0, are as follows:

<i>D.M.</i> + 19 7' 06"	$\alpha = 4^{\text{h}} 13^{\text{m}} 31^{\text{s}} \cdot 2$	+ 19° 10' 6"
Hind's Nebula	= 4 13 31	+ 19 10.5

A sufficiently close agreement to suggest identity, which was further heightened by the fact that Mr. Burnham found that *T Tauri* was a nebula!

But, singularly enough, the *D.M.* place of *T Tauri* is about 18.8 too small in *A.R.*, and 0.7 too small in  $\delta$ , almost exactly the difference in right ascension and declination between the true place of Hind's nebula and *T Tauri*. So much so, indeed, that the *D.M.* place of *T Tauri* actually agrees with the position of Hind's nebula as given by D'Arrest!

Chandler, in his Variable Star Catalogue, *A.J.* 179, gives the place of *T Tauri* for 1855.0

$$4^{\text{h}} 13^{\text{m}} 33^{\text{s}} \quad + 19^{\circ} 11' \cdot 3$$

and this is the true place.

On the assumption, therefore, that *T Tauri* was Hind's nebula, Mr. Burnham says, in his paper: "This small star, if it is a star, is placed within a very small condensed nebula. It is somewhat elongated in the direction  $151^{\circ}7$ . A rough reading of the wires gave  $4''.4$  for the length of the nebula in this direction. It is less extended on the opposite side of the star or nucleus, with a shorter diameter of perhaps half that measured. It was examined with various powers, but it was impossible to say whether or not it had a disc like that of an ordinary star. If it were the bright nucleus of the small nebula, it would probably present the same stellar appearance. It will be noticed that the description of the nebula does not correspond with that of the early observations, where it was noted, when it was seen at all, as about  $1'$  in diameter."

Mr. Burnham asked me to examine this object with him, and I well remember that the small star was placed in an elongated nebula just as he describes.

The nebula was conspicuous and definite, not a nebulous glow. One would not hesitate a moment as to its being a very small fairly bright definite elongated nebula, the star to all appearance simply being a nucleus to the nebula.

In examining this region with the 36-inch at Mr. Burnham's request with him, I saw a very faint nebula close south preceding *T Tauri*. Of this Mr. Burnham says: "On [1890] October 15 I asked Mr. Barnard to examine this region with the large telescope. . . . After careful attention he was able to see an excessively faint round nebula, about  $\frac{3}{4}$  from the one previously described [*T Tauri*], in the estimated direction of  $185^{\circ}$ . This faint nebulosity was about  $40''$  or  $50''$  in diameter, and apparently not connected with the variable, and was of nearly the last degree of faintness for the light-power of the large instrument. It is perhaps too faint for any other telescope. Neither Mr. Barnard nor myself on any occasion could see the slightest trace of the  $O\Sigma$  nebula (seen also at times by D'Arrest, Tempel, and others, but invisible in the Rosse reflector), which should be  $15^s$  preceding Hind's, nor any nebula in the immediate vicinity. Subsequently we looked at the small nebula [*T Tauri*] with the 12-inch telescope, by way of getting a better estimate of its magnitude, and found that it was a very faint object, and in appearance precisely like any ordinary star of that magnitude. The nebulous surrounding was completely lost with the smaller instrument. I do not think it can be any brighter now than  $12.5$  magnitude of the scale used in my double star observations."

As a proof of the nebulous character of *T Tauri*, I quote from Mr. Burnham's paper further: "On the night of November 1 Mr. Keeler examined the nebula [*T Tauri*] with the small spectroscope, and found that it was probably of the usual gaseous type, although on account of the extreme faintness of the nebula only the principal line at  $\lambda 5005$  was visible. The spectrum of the nucleus could not be seen."



It will be noticed here that though Mr. Burnham was erroneously led, by the error in the *D.M.*, to identify Hind's nebula with *T Tauri*, he discovered the important fact, which was previously unknown, that the variable star *T Tauri* is a nebula—or a nebulous star.

I have quoted thus extensively from Mr. Burnham's paper, because I have recently made some observations of these objects that bear directly upon his work, as will be seen.

During his examination of this region Mr. Burnham—whose excellent custom it is to measure everything he comes across that is measurable, and who does not leave on record a simple statement only of what he has seen—measured the position of *T Tauri* with reference to the brighter star *D.M.* + 19° 704 (which is *W.B.* 4<sup>h</sup>. 274). He first measured the difference of declination, and got

$$\begin{array}{rcl} 1890\cdot775 & \Delta\delta & 243''\cdot65 \\ \cdot777 & & 243''\cdot40 \end{array}$$

He then measured the position angle and distance,

			Mags.	
1890·775	43° 5	336''·31	8·3	11·7
·777	43° 8	336''·07	8·4	12·5

From these last I derive the following differences (*T Tauri*—*W.B.* 4<sup>h</sup>. 274) :

$$1890\cdot776 \quad \Delta\delta = + 0^m \ 16^s \cdot 39 \quad \Delta\delta = + 243'' \cdot 25.$$

Having assumed, with Mr. Burnham, that Hind's nebula was really the nebula *T Tauri*, I paid no further attention to the subject until the past winter, when it occurred to me to look up the faint nebula I had seen close s.p. *T Tauri*.

On 1895 February 25 I examined the place with the 36-inch and found the nebula very easily ; it was faint, but not extremely so. Indeed it was by first finding the nebula that I identified *T Tauri*, so different did that star look from my previous inspection of it in 1890 with Mr. Burnham.

The star was bright, not less than the 10th magnitude, and the small nebula in which it shone in 1890 had absolutely disappeared. With no power could I see the small elongated nebula of which the star had previously formed the nucleus. The additional brightness of *T Tauri* could have nothing to do with this if the nebula was as conspicuous as in 1890. The star seemed perfectly stellar and of a reddish-yellow colour.

By comparing it carefully with a star of similar colour and magnitude, 50·6 seconds preceding and 3' north—which I shall hereafter refer to as A for convenience—I could, however, see that *T Tauri* was certainly surrounded by a very feeble indefinite nebulous glow for a few seconds of arc, but the definite nebula had certainly disappeared.

As a further identification I measured the position of the star with reference to the 8<sup>m</sup> *D.M.* star south preceding :

$$\Delta\delta + 243''\cdot49 \text{ (2 obs.)}$$

which agrees with Mr. Burnham's  $\Delta\delta$  of 1890.

A rough difference of right ascension gave 17<sup>s</sup>, thus showing the identification was complete, and this has been further verified (see March 28, later).

As I have said, the nebula close south preceding the variable star was easily visible. It was round, quite definite, and very feebly brighter in the middle ; and was estimated to be of about the 16th magnitude. I think it was somewhat brighter than in 1890.

The following micrometrical position was obtained (nebula—*T Tauri*) :

$$\begin{aligned} \Delta\alpha &= -0^{\circ} 26''\cdot05 &= -0^{\text{m}} 1^{\text{s}}\cdot85 \text{ (2 obs.)} \\ \Delta\delta &= -0^{\circ} 26'\cdot26 \text{ (3 obs.)} \end{aligned}$$

It did not reach to the star, from which it seemed to be entirely independent.

I also carefully examined the place of the Struve nebula. There was no nebulosity visible at this point, close to which, however, was a small star of the 14-15th magnitude. I could not fully convince myself that there was not a feeble glow about this star, but it was too uncertain to be in any way positive.

Comparing my measures of the position of *T Tauri* with that given in the *D.M.*, I found, to my surprise, that the supposed coincidence of position with Hind's nebula was due to an error in the *D.M.* position of the star. I then looked up Hind's original account of his discovery in *A.N.* 839, and saw at once from his description that his nebula was by no means identical with *T Tauri*, and that he had observed both objects at that time, and furthermore that his nebula had the exact position occupied by this faint nebula close south preceding *T Tauri*, which I had just measured ; and that, indeed, this faint nebula, seen by Mr. Burnham and myself in 1890, was nothing else but Hind's nebula of 1852, which was supposed to have vanished from the face of the heavens !

On February 26 I examined this region with the 12-inch. *T Tauri* was easily visible. I could catch the feeblest glimpses of Hind's nebula by occulting the star ; if I had not known it was there, however, I could not have seen it, it was so excessively difficult.

I estimated *T Tauri* to be of the 10th magnitude. It was of equal brightness to the star A.

On March 4, in moonlight, with the 36-inch I measured the position of the small star close to the place of the Struve nebula, with reference to the *W.B.* star ( $4^{\text{h}}\cdot274$ ) south of it.

(Small star—*W.B.* 4<sup>h</sup>274)

$$\Delta\delta = +0^{\circ} 8' 29'' = +0^{\text{m}} 0^{\text{s}} 59 (3 \text{ obs.})$$

$$\Delta\delta = +3^{\circ} 8' 51'' (3 \text{ obs.})$$

The resulting position shows this is the object mentioned by D'Arrest as being a 14-mag. nucleus excentrically placed in the Struve nebula.

On this occasion I noted: "*T Tauri* with 520 certainly surrounded with a dense hazy nebulosity several seconds in diameter. The image of the star carefully focussed, it was perfectly stellar. It was compared carefully with the star A. Both of the same colour and magnitude. A was free of the nebulous glow seen about *T Tauri*."

On March 24 I again examined the region with the 36-inch. The sky was poor. Only the vaguest traces of Hind's nebula could be seen on account of the poor sky. "Not certain, but there is a slight haziness at the place of the Struve nebula. With 350 and 520 diameters *T Tauri* seems to be a reddish star in a feeble glow of nebulosity. Compared with A, *T Tauri* is certainly feebly nebulous, but the star itself is stellar. The nebula that Mr. Burnham and I saw in 1890, in which this star was placed, certainly does not now exist. *T Tauri* is, I think,  $\frac{1}{10}$  to  $\frac{2}{10}$  magnitude fainter than A. I think it fainter than at previous observations. The two stars reddish and very much alike."

On March 28 with the 12-inch, from eighteen transits, I determined the  $\Delta\alpha$  of *T Tauri* and the *W.B.* star 4<sup>h</sup>274—*T Tauri*

$$\Delta\alpha = +0^{\text{m}} 16^{\text{s}} 44,$$

which differs only 0<sup>s</sup>.05 from the value derived from Mr. Burnham's measures. At this observation *T Tauri* was of the same brightness as A.

If we refer to Tempel's sketch and descriptions we shall see that these observations have shown only one star at the place of the Struve nebula where he saw two. No star was seen near *T Tauri*, close north of which Tempel saw two that had finally taken the place of a nebula which had vanished. No trace of this nebula was seen.

Tempel's work seems to have been carefully done—his stars are missing. One can hardly doubt—knowing the remarkable nature of this region—but that these objects which he saw, and which are not now visible, are variable also, or of a temporary nature.

In reference to the actual nebulous condition of *T Tauri* there is no question but this star in 1890 October and November was the nucleus of a very small pretty bright nebula, as recorded by Mr. Burnham. There is also no question but that this small nebula had disappeared from the star in 1895 February and

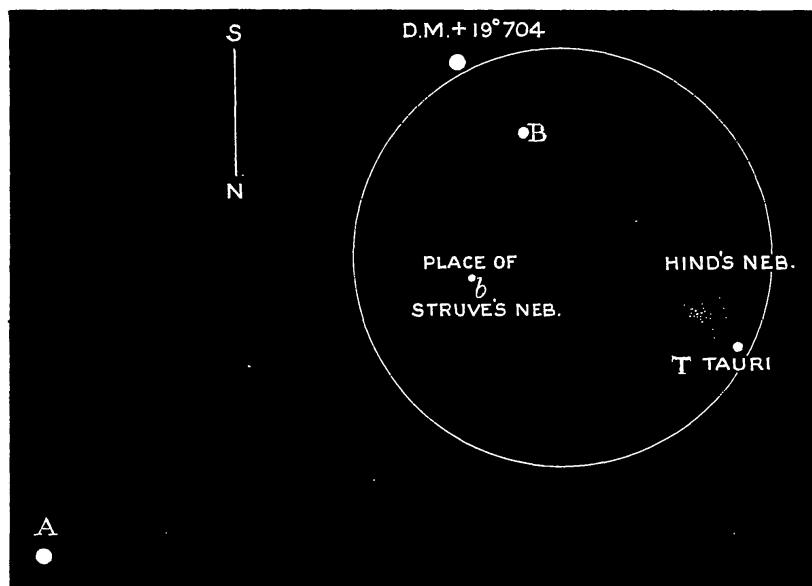


March, and that the star was perfectly stellar, but involved in a very faint diffused nebulous glow.

At the time of Mr. Burnham's observations this variable star was at its minimum brightness, and at the present observations it was bright though not at its maximum. Is it possible that in its fainter phases this star becomes essentially a very small nebula, or the nucleus of such, and at its maximum the nebulosity is absorbed into the star, or otherwise disposed of? I hope to carefully watch this star hereafter, and try to settle some of these points.

I think it probable there is a slight fluctuation in the light of Hind's nebula, for it was, I am confident, somewhat brighter in 1895 February than in 1890 October.

I send a sketch showing the present appearance of Hind's nebula with respect to *T Tauri* and several other stars. It is less than  $\frac{1}{2}'$  in diameter.



The star A is the one to which the light and physical appearance of *T Tauri* were referred.

B is a 12.5 or 13 mag. star, whose place on the sketch is by eye estimation.

*b* is the small star which was measured by me, and which was involved in the north part of Struve's nebula according to Tempel.

There may have been other faint stars in the field, but there were none near *b* nor near *T Tauri*.

From my observations of the relative positions of *T Tauri* and *W.B. 4<sup>h</sup> 274*, and adopting the position of the latter star as given in the catalogue, the following is the place of *T Tauri*:

$$1895.0 \quad 4^h 15^m 52^s.39 \quad +19^\circ 17' 8''.1.$$

The resulting place of Hind's nebula will be

$$1895^{\circ} \quad 4^{\text{h}} 15^{\text{m}} 50^{\text{s}}.54 \quad +19^{\circ} 16' 42''.1.$$

Also, from the *W.B.* star, the following is the position of the 14th magnitude star supposed to be the one forming the "eccentric nucleus" of Struve's nebula :—

$$1895^{\circ} \quad \alpha = 4^{\text{h}} 15^{\text{m}} 36^{\text{s}}.54 \quad \delta = +19^{\circ} 16' 13''.1.$$

These, carefully reduced to 1860.0, become

Star in Struve's Nebula	$\alpha = 4^{\text{h}} 13^{\text{m}} 34^{\text{s}}.39$	$\delta = +19^{\circ} 11' 1''.6$
Hind's Nebula ...	$\alpha = 4^{\text{h}} 13^{\text{m}} 48^{\text{s}}.37$	$\delta = +19^{\circ} 11' 31''.1$

These objects are respectively Nos. 1554 and 1555 of Dreyer's New General Catalogue of Nebulæ; their places, as given in N.G.C., for 1860.0 are

Struve's Nebula (1554)	$\alpha = 4^{\text{h}} 13^{\text{m}} 33^{\text{s}}$	$+19^{\circ} 11' 0''$
Hind's Nebula (1555)	$\alpha = 4^{\text{h}} 13^{\text{m}} 48^{\text{s}}$	$+19^{\circ} 11' 2''$

These two nebulæ, Hind's and Struve's, make the best authenticated case of variability in the light of a nebula that we have. The facts concerning them stand incontestable.

Here were two nebulæ which less than half a century ago were easily visible in ordinary telescopes, and which were bright enough to be placed, one in Herschel's first class, the other in his second class, and which were observed and measured by the best observers then living. One of these nebulæ has disappeared from the face of the heavens, the other has become so faint that it can be seen only in the most powerful telescope.

There is a satisfaction in this—it is so above any uncertainty, and the facts are so clear, that even the feeblest doubt can never be raised to question the case.

#### *Another Probable Variable Nebula.*

There is nearly as remarkable a case as the foregoing, which I have myself encountered. Unfortunately, however, it rests alone on my own observations, and therefore has not the independent testimony of other observers that should always be required to satisfy the scientific spirit of the age. The facts are none the less true, and may some time be supported by other evidence, and so I shall insert them here to await the testimony of time.

This was the case of a nebula which I found with the 12-inch 1888 November 30. I have already called attention to this object in *A.N.* 3097, but I wish further to place it on record in this paper, as it should properly be recorded in connection with the present subject. As the account in the *Nachrichten* is clear, I shall copy a portion of it for record here, and insist that

I am still as fully convinced as I was at the time I wrote the article, that the nebula became visible as a bright object where no nebula was previously known, and then, some time between 1888 November 31 and 1891 November 22, faded down to a very faint object in the same telescope in which it had appeared conspicuously bright.

Here is the account from *A.N.* 3097 : "On 1888 November 30 I discovered a small pretty bright nebula in *Cetus*, and was surprised, from the brightness of the nebula, to find that it was not in any catalogue. I carefully measured its position with the micrometer, and examined it the next night for motion, suspecting it to be a comet. No motion being detected, it was not observed further. I have a very distinct recollection of the object, and from my description I would estimate that it was between the 9th and 10th magnitudes. In its centre was a very small stellar nucleus of the 13th magnitude. Not having seen the nebula in my subsequent sweeps in that neighbourhood, I was led in 1891 to examine its position with the 12-inch. The nebula was found with some difficulty. It was extremely faint, and was only identified by the aid of the comparison star of the previous observation. This was 1891 November 22. I estimated it to be  $13\frac{1}{2}$  magnitude,  $\frac{1}{2}'$  in diameter, with perhaps a faint nucleus. I again examined it on 1891 December 24, and could see a very faint nucleus. The nebula was estimated 13 magnitude, round,  $\frac{1}{2}'$  in diameter. In a note it is recorded that from recollection the nebula at these last observations could not be one-fifth as bright as on 1888 November 30.

"Following are the observations of the nebula 1888 November 30 (neb — ★) :

$$\Delta\alpha = +1^m 44^s.13 \text{ (10 obs.)}, \quad \Delta\delta = -5' 47''.2 \text{ (3 obs.)}.$$

The comparison star was  $W_1$  0<sup>h</sup>.594, the position of which for 1888.0 was  $\alpha = 0^h 36^m 11^s.58$ ,  $\delta = -8^\circ 42' 19''.3$ , and the position of the nebula

$$1888.0 \quad \alpha = 0^h 37^m 55^s.71, \quad \delta = -8^\circ 48' 6''.5.$$

"The observations of 1891 November 22 gave (neb — ★)

$$\Delta\alpha = +1^m 43^s.88 \text{ (6 obs.)}, \quad \Delta\delta = -5' 49''.0 \text{ (3 obs.)}."$$

I have examined this nebula several times since with the 12-inch, but it has always been a faint object.

*Mount Hamilton, California :*  
1895 April 1.

*On a Great Photographic Nebula in Scorpio, near Antares.*

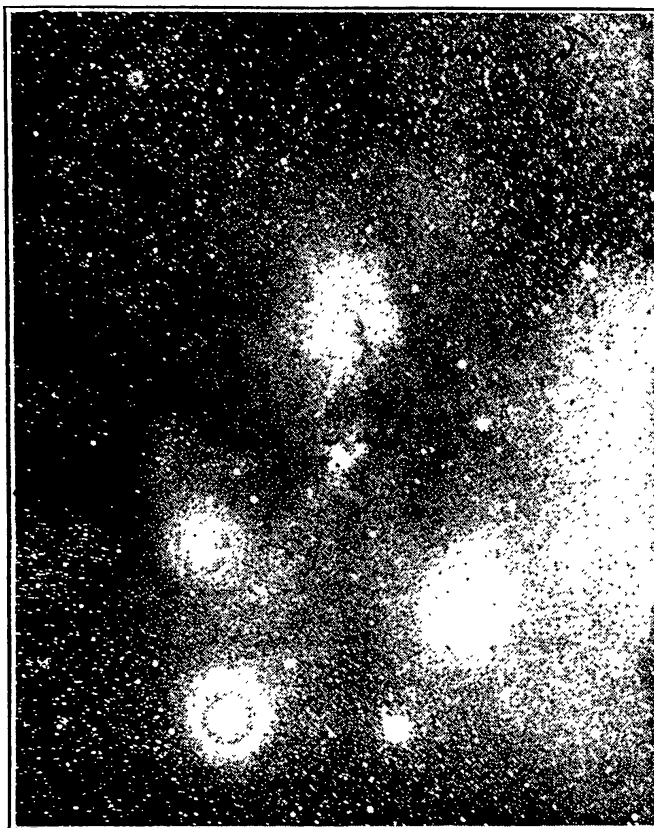
By E. E. Barnard, M.A., D.Sc.

For many years I have known of a vast but vague nebulosity in the region of *Antares*. This has been encountered in my comet seeking. It was so indefinite, however, that it could not be definitely located. With a large field, on a small telescope, the entire sky in that region seemed to be covered with a very feeble nebulosity. A portion of this I had located about 22 *Scorpii* and at other points.

I have recently photographed this region. The resulting pictures have shown that a magnificent nebula occupies a large portion of this region of the sky. The brightest portion of it condenses about the stars.

	m	h	m	s	°	'
$\rho$ <i>Ophiuchi</i> , 22 <i>Scorpii</i> , and two	9.6	16	17	47	-24	9.3
small stars in (1875.0)	8.0	16	17	52	-24	10.3

This great nebula occupies a remarkably vacant region. It seems to fill in a great hole among the stars. From this vacancy



Great Nebula near *Antares*, 1895 April 19. Lick Observatory, 6 in. Willard portrait lens.