

XII. *Observations on some of the Nebulæ.* By the Earl of Rosse, F.R.S., &c.

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AS every addition, however trifling, to the little we know with certainty respecting the nebulæ can scarcely be considered wholly uninteresting, I have ventured to communicate a few observations made with the speculum of three feet aperture described in the *Philosophical Transactions* for 1840.

In using that instrument, the object was rather to test its powers, and to decide the merits of progressive experiments, than to seek for astronomical results, and therefore the micrometer was not employed; in every case, however, the sketches were repeatedly compared with the originals, and having usually the advantage of the opinion of one or more friends, and always of that of my assistant, I believe they will be found to be tolerably correct. Without accurate micrometrical measurements any sketch can be of comparatively little value as an astronomical record, since it would be scarcely safe under any circumstances to consider it as decisive evidence, where the question was whether any change had or had not taken place in the general outline or internal structure of a nebula, or in the relative positions of the remarkable stars in or near it. Still measurements to be valuable must be exact; and it would perhaps have been misspent time to have employed the micrometer with an instrument not well suited to the purpose, when there was a prospect of being under the necessity of repeating the same operations again, probably at a very short interval, in making a complete examination of the nebulæ with the instruments now in progress.

From these trifling sketches, however, we may perhaps faintly see some indications of the course which our speculations on the physical structure of the nebulæ are likely to take under the guidance of increasing information. Some estimate may also perhaps be made of the amount of knowledge to be gained by an examination of all the known nebulæ with instruments like the present telescope, which astronomers favourably circumstanced may construct without any very serious difficulty.

The actual time in one year during which a powerful telescope can be used effectively is so short, that where observations must be accompanied by sketches, the progress is necessarily slow; and it is still more so when the micrometrical measurement of faint objects becomes an essential portion of the work. Out of a considerable number of tolerably good working nights there are very few, and even then often but for a short time, when high magnifying powers can be employed; so that upon the whole a great deal cannot be accomplished by one instrument in a limited period. As to the present telescope, it has not been constantly employed. Unless the beginning of the night was favourable nothing was ever done; a regular system

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of observing would have been quite incompatible with the constant care and attention required in the progress of the more important work, the construction of a telescope of greater power, so that much fewer objects have been examined than would otherwise have been practicable; and even with the great facilities afforded by Sir JOHN HERSCHEL's invaluable catalogue, the whole amount of work done has been no more than the examination of about two-thirds of the figured nebulæ, and a few others in the general catalogue, many of them, or rather, perhaps, most of them, under circumstances but moderately favourable.

The sketches were originally made in the gallery of the telescope, and represent the objects placed as they appeared, not as they actually exist in space. I have copied them without alteration, not thinking that anything would be gained by placing them approximately in their true positions, while they would perhaps be less convenient for future re-examination and correction. The references are to Sir JOHN HERSCHEL's Catalogue.

Plate XVIII. fig. 88 is one of the many well-known clusters; I have selected it merely for the purpose of showing that in such objects we find no new feature, nothing which had not been seen with instruments of inferior power; the stars, of course, are more brilliant, more separated, and more numerous. I fear that no amount of optical power will make these objects better known to us, though perhaps exact measurements may bring out something.

Fig. 81 is also a cluster; we perceive in this, however, a considerable change of appearance; it is no longer an oval resolvable Nebula; we see resolvable filaments singularly disposed, springing principally from its southern extremity, and not, as is usual in clusters, irregularly in all directions. Probably greater power would bring out other filaments, and it would then assume the ordinary form of a cluster. It is studded with stars, mixed however with a nebulosity probably consisting of stars too minute to be recognized. It is an easy object, and I have shown it to many, and all have been at once struck with its remarkable aspect. Everything in the sketch can be seen under moderately favourable circumstances.

Plate XIX. fig. 26, on the contrary, is a difficult object; it requires an extremely fine night and a tolerably high power; it is then seen to consist of innumerable stars, mixed with nebulosity; and when we turn the eye from the telescope to the Milky Way, the similarity is so striking that it is impossible not to feel a pretty strong conviction that the nebulosity in both proceeds from the same cause.

Fig. 29.—The annular nebula in Lyra; 2 is the star in Sir JOHN HERSCHEL's sketch; I have inserted the six other stars as in some degree tests of the power of a telescope. Near star 3 there are two very minute stars seen with great difficulty; the others are easily seen whenever the night is sufficiently good to show the nebula well. The filaments proceeding from the edge become more conspicuous under increasing magnifying power within certain limits, which is strikingly characteristic of a cluster; still I do not feel confident that it is resolvable. I am however disposed to

think that it was never examined when the instrument was in as good order, and the night as favourable, as on the several occasions when the resolvable character of fig. 26 was ascertained.

Fig. 47 is one apparently of another class. It has a star in the centre, and is of unequal brightness; the nebulosity is in patches, and I have sometimes fancied, though probably erroneously, that I could discover in it a faint resemblance to fig. 26. The star in the centre is easily seen, and there is nothing peculiar in its appearance; it is exactly like other stars seen in nebulae; still it may really be but the brilliant condensed centre of a very remote cluster. I have not, however, detected any gradual increase of brilliancy towards the centre.

Not to multiply sketches which soon may require correction, I shall merely add that in fig. 32 we also find a star in the centre, and in fig. 85 likewise a star in the centre, and many other minute stars in and close to it, so that it is really a cluster. The double nebula (fig. 72) consists of two clusters, between which there is a star easily seen on even an indifferent night. In fig. 49 there are minute stars between and about the three large stars, and I think there can be no doubt it is a cluster. Fig. 25 abounds in stars mixed with nebulosity; I have not seen it on a very fine night, but it was observed by my assistant, and by a gentleman who was with him, and they had no doubt but that the centre was completely resolved. In the little annular nebula, fig. 48, I see nothing remarkable, farther than a star in the north preceding edge; it is tolerably conspicuous, and is about half-way between the exterior and interior circumference of the annulus.

Fig. 45 is a very remarkable object. It is no longer a planetary nebula, but an annular nebula, like that of Lyra, with a similarly fringed edge, though much less distinctly seen: it is oval, but the central portion is not so dark as that of Lyra; it very closely resembles the annular nebula of Lyra seen with an instrument of inferior power.

In several of the other figured nebulae something has been discovered as to matters of detail. In some we have found perhaps a few minute and apparently accidental stars, in others a larger extent of nebulosity, and consequently a different form of outline, but nothing of sufficient importance to make it desirable further to prolong this paper. It appears to me, however, to be an important fact, that all we have seen strongly confirms the accuracy of Sir JOHN HERSCHEL's judgement in selecting the nebulae which he places in the class designated as resolvable. It is important from its bearing on future researches; for where the power of our instruments is insufficient to do more than to bring to light distinctly the peculiar characteristics of resolvability, these once observed with due caution and their reality ascertained beyond doubt, we shall conclude with little danger of error, that the object is really a cluster. We should err, however, were we to assume the converse of the proposition, that the absence of all symptoms of resolvability was evidence conclusive that the object was not a cluster. In some instances, with increasing optical power, the resolvable

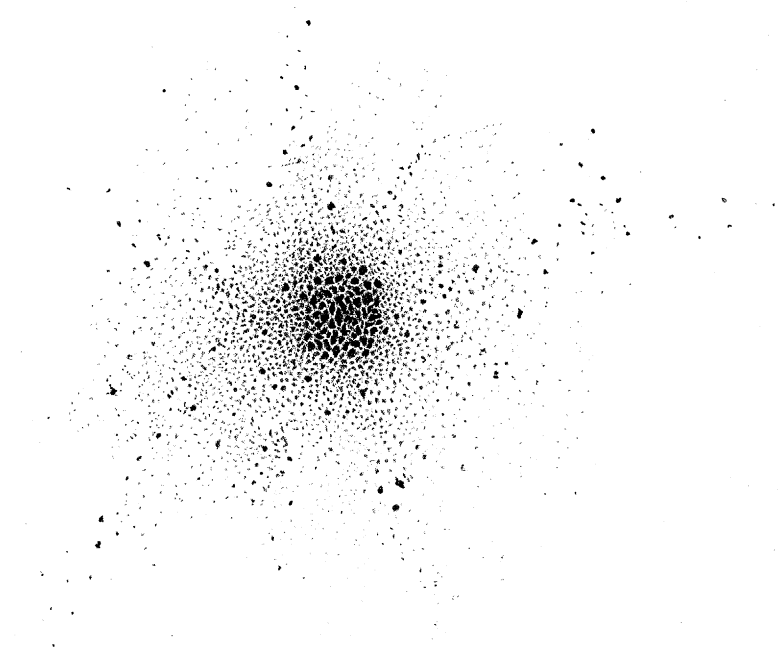
character has become clearly developed, as in fig. 26, and a further increase of power has shown the object resolved.

It is also perhaps important to observe, that now, as has always been the case, an increase of instrumental power has added to the number of the clusters at the expense of the nebulæ, properly so called ; still it would be very unsafe to conclude that such will always be the case, and thence to draw the obvious inference that all nebulosity is but the glare of stars too remote to be separated by the utmost power of our instruments.

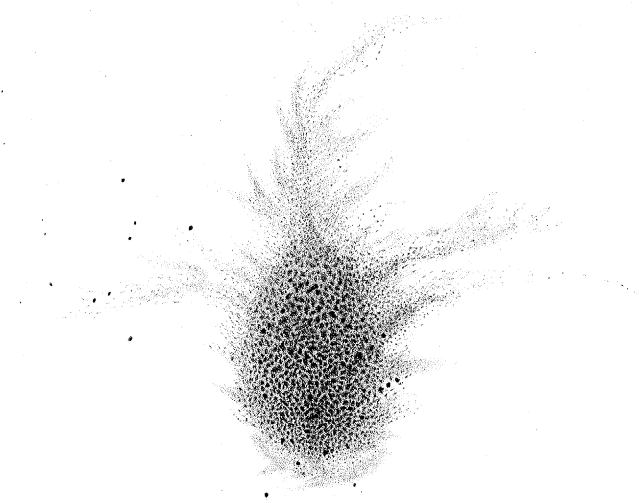
The magnifying powers I have usually employed vary from 250 to 800 ; occasionally much higher powers have been useful ; but to see every thing described in this paper, a power of 600 with perfect definition is sufficient.

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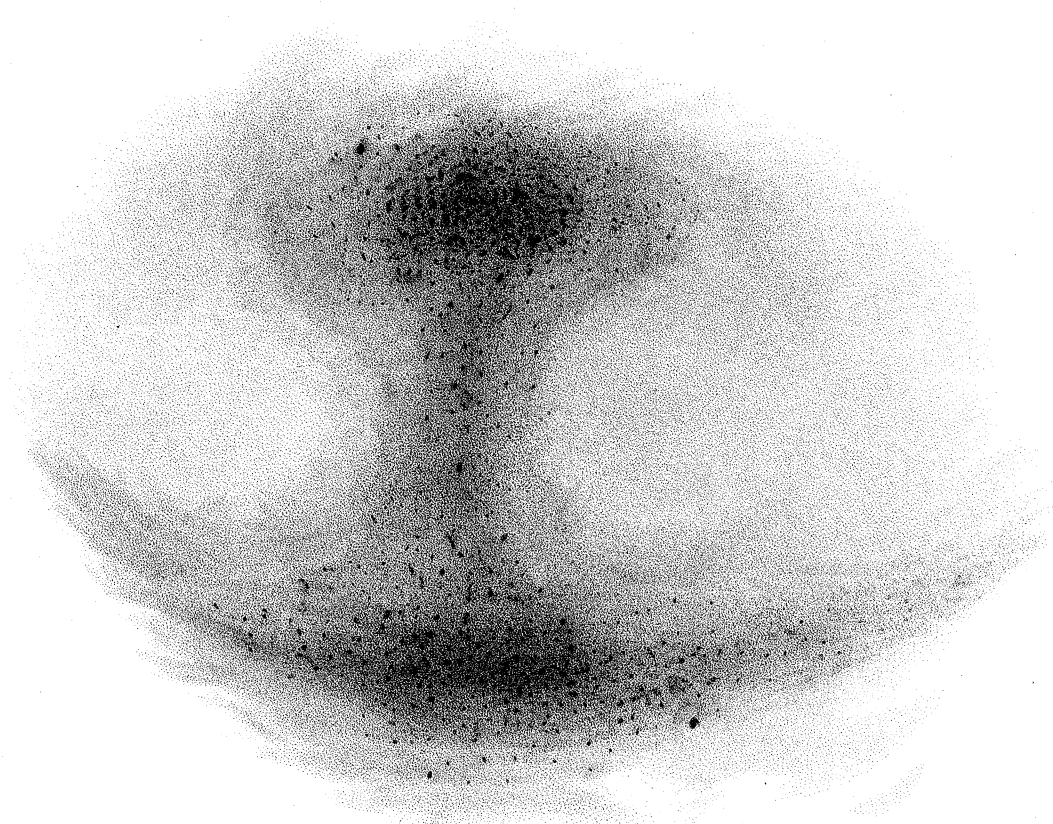
In my paper on the Reflecting Telescope, in the Philosophical Transactions for 1840, there is an error which I am anxious to take this opportunity of correcting. In page 523, line 14, instead of "to the polisher," it should have been "to the bar which moves the polisher measured on the edge F of the tank." We have always estimated the effect of the excentric G by the space on the edge of the tank traversed by the bar : the number 2·7 was entered down at once from the journal-book, whereas, to have suited it to the form of expression made use of, it should have been reduced to the centre of the polisher.



*Fig. 88.*      *R.A.*  $21^{\text{h}} 25'$   
              *Dec.*  $1^{\circ} 34'$  *South.*

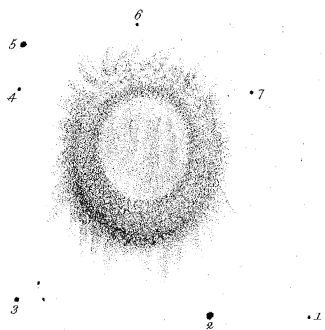


*Fig. 81.*      *R.A.*  $5^{\text{h}} 24'$   
              *Dec.*  $21^{\circ} 53'$  *North.*



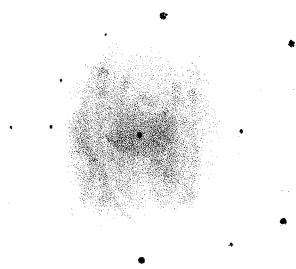
*Fig. 26.*

*R.A.*  $19^{\text{h}} 52'$   
*Dec.*  $32^{\circ} 49'$  North.



*Fig. 29.*

*R.A.*  $19^{\text{h}} 47'$   
*Dec.*  $32^{\circ} 49'$  North.



*Fig. 47.*

*R.A.*  $20^{\text{h}} 15'$   
*Dec.*  $19^{\circ} 34'$  North.