

not more than 3° or 4° . In fact, about four o'clock the transmitted light was of a splendid green color, tinting the white walls of my room as though through the stained glass of a church. About the time I first noted the colors a strong north wind sprung up, continuing in gusts through the afternoon.

F. H. LOND.

COLORADO SPRINGS, *January 29, 1881.*

NOTE ON DR. HENRY DRAPER'S PHOTOGRAPH OF THE NEBULA IN ORION.*

BY MR. RANYARD.

*Read before the Royal Astronomical Society, Jan. 14, 1881.

Dr. Draper has sent me an enlarged copy of a photograph of the nebula in Orion, which he succeeded in taking on the night of the 30th of September last. Dr. Draper remarks that September is not the best time of the year, so that he hopes to obtain still better results next summer. The photograph was taken with an exposure of 51 minutes. He does not mention the instrument with which it was taken, but I conclude that it was with his great 27-inch reflector. On the photograph are nine white spots of various sizes; these represent 13 stars in and about the nebula, for the four stars of the trapezium are merged together by reason of over-exposure. In the corner is another small photograph taken with a shorter exposure, and showing three of the four stars of the trapezium. This is not the first occasion on which the stars of the trapezium have been photographed. I, and no doubt many others, have succeeded in obtaining photographs of them. But it is, I believe, the first photograph in which any trace of the nebula is shown. And Dr. Draper may, I think, be very much congratulated on the great success he has attained. The photograph shows the whole of the brighter nucleus of the nebula—sometimes referred to as the "Fish's head." I have compared it with the different drawings of the nebula by Bond, Herschel, Liapounov, Lassell, Secchi, the Earl of Rosse, and Tempel, and find that it does not correspond exactly with any of them. The drawings differ very greatly amongst themselves, and they differ in type as well as in minor details. They do not appear to differ continuously in order of time, so that the drawings do not afford any proof that the form of the nebula is changing. Photographs will of course afford much more valuable evidence with respect to any such change in the future. The photograph does not show any stars of less than the $9\frac{1}{2}$ magnitude, showing that the brighter masses of the nebula registered themselves on the plate when stars of the 10th magnitude left no trace. If in the future some much more sensitive method of photographing is devised, it will be necessary to contrive some plan by which the brighter parts of the nebula and the light of the brighter stars may be cut off from the sensitive plate during the greater part of the exposure, so as to prevent the irradiation from the brighter parts encroaching over the area occupied by the fainter parts. At present, however, we are very far from being able to photograph, with the sensitive silver compounds* made use of, all that can be seen with the human eye. But even if photography does not make any further advances, photographs such as these will be of very great value in showing the relative brightness of the brighter parts of the nebula.

Mr. Common: I do not agree with Mr. Ranyard, that we must look to photography to explain or prove any

change in the form of the nebulae, because various kinds of plates give different results, and you would not have the same effects produced by the same colored light. I should rely much more on accurate drawings than upon any photographs. If we compare these drawings, here you have [pointing to Father Secchi's drawing] a dark mass with a slope of light running from the left-hand corner down to the right hand. In the other [Lord Rosse's drawing] there is no division, except a large space divided into channels. The latter is wrong and the former clearly right. Before you give details you ought to represent the chief features of the nebula, because it is the features that most readily indicate change. With regard to Mr. Ranyard's remark that no star smaller than the 10th magnitude is shown, there are, I think, two—these fainter stars under the trapezium, which are certainly less than the 10th magnitude.

Mr. Ranyard: I have here the magnitudes given by Liapounov, and he gives one as the 9th magnitude and the other as the 9th to the 10th magnitude.

Mr. Common: Before we can discuss this photograph we want to know the instrument it is taken with, the focal length, in order to know the size of the image, and the kind of plates used, and the mode of development. If you want to detect any change in the form of the nebula you must entirely rely on the hand drawings.

Mr. Ranyard: I think that some considerable scientific use may be made of these photographs; they will at least enable us to compare the relative brightness of the different masses of the nebula as shown on any one photograph, for as far as we know, there is no great difference in the spectrum of different parts of the nebula, and so we have no reason to suppose that the photographic effects of different parts of the nebula in any one photograph would not be proportional to the light.

Mr. Stone: With regard to discrepancies in drawings, I never knew two persons asked to make a drawing of the same faint object make them exactly alike. It is evident that observers draw that which happens to arrest their attention, and one feature will strike one observer, while the attention of another is attracted by something else. A very good instance of this occurred during the eclipse of 1874. Two observers were sitting side by side drawing the corona. The one drew a small nearly quadrilateral corona, while the other drew a large corona with great rays in the equatorial regions. Before a totality was over the observer who had drawn the small corona looked at his neighbor's drawing, and, on looking up again at the corona, recognized the outline which his neighbor had drawn, and commenced to put it on paper when the eclipse ended. There is therefore a great element of uncertainty about drawings, one observer overlooks one part, or is struck by one part, and another by something else.

Mr. Rand Capron: I think that Mr. Common is right, that photographs of objects taken with different instruments and plates will probably never usefully bear comparison; but I agree with Mr. Ranyard that photographs of the same object taken from time to time with the same instrument and the same plates can most usefully be compared.

Mr. Burton said: I should like to suggest that the difficulty which Mr. Ranyard has referred to, with regard to the irradiation from stars interfering with the fainter parts of the nebula, might be got over by placing a prism of small angle, made of quartz or Iceland spar, between the object-glass and the photographic plate. The images of the stars would be drawn out into lines, while there would be three or four images of the nebula which would not interfere. The principal plane of the prism might then be turned round into a different position-angle, and another photograph taken, so that the spectra of the stars would fall in another direction.

Mr. De La Rue said: I recollect very well the time when the Earl of Rosse's drawing was made. I compared

*[Note by Mr. Ranyard.] It seems probable that the small pencil of light, which passes through the pupil of the eye from the faintest object perceived, produces an actual change in the matter of the rods and cones, which is rapidly obliterated by the circulation and vital processes going on about the retina. This is now, I believe, pretty generally agreed to by physiologists. If in the future the matter acted upon in the rods and cones can be isolated, and the change produced by light can be rendered permanent, it seems probable that, by means of large lenses and reflectors, we may some day obtain photographs of objects too faint to be visible with the naked eye.

it with the nebula with very great interest at the time, and I cannot agree with Mr. Common in preferring Father Secchi's drawing. It seems to me that the Earl of Rosse's drawing is much the more accurate in respect of details. As regards contour and outline, that depends very much upon the amount of light, which impresses one man's eye rather than another's so that the general outline may be extended much more in one case than in another. Lord Rosse's drawing does not give the whole sweep of the nebula, and does not take in so extensive a field as Father Secchi's drawing. Lord Rosse's drawing is better seen in the black upon white print than in the white upon the black ground.

Mr. Common said that there was a great black channel in the nebula, which is well shown in Father Secchi's drawing, but is lost in the Earl of Rosse's drawing. The latter drawing seemed to him too full of detail.*

Mr. Ranyard said although the actual brightness of various parts of an object like a nebula or corona cannot be judged of from the opacity of corresponding parts of photographs, yet a photograph will enable one to tell with great certainty which is the brightest region of the object photographed, and it affords a very valuable permanent photometric scale, by which various degrees of brightness of one region relatively to another may be judged of. For example, Dr. Draper's photograph shows that a nebulous mass on the preceding side of the trapezium is the brightest region of the nebula. This does not correspond with any of the drawings. It is of course possible that the actinic light of the nebula does not correspond with its luminosity as observed by the eye, but this supposition is not very probable, as the spectroscope does not show any striking differences in the composition of the light of the nebula. The photograph enables us to judge very well of the relative magnitudes of the stars involved in the nebula. I have compared the magnitudes of the images of the stars in the photograph as enlarged by irradiation, with the magnitudes of the same stars as given by Liaponnov, and I find that they correspond very accurately. No doubt it may also be assumed that the brightness of various regions of the nebula may be compared with equal safety by noting the opacity of corresponding parts of the photographic film. With regard to Father Secchi's drawing and the drawing of the Earl of Rosse, I agree with Mr. De La Rue that I rather prefer the Earl of Rosse's. It shows a much smaller region of the nebula, and I must remark that I have not much faith in the existence of these outlying nebulous structures shown in Secchi's and Tempel's drawings. If such structures exist the nebula would occupy an area of more than a degree, and it ought to be seen with the naked eye better than with any telescope. Every one is familiar with the way in which a faint structure like the tail of a comet—which can be easily seen with the naked eye—is lost when viewed with the best of telescopes. A telescope of whatever aperture will not increase the brightness of an object occupying a sensible area.

Mr. De La Rue: Lord Rosse's drawing does not embrace such a large area as Secchi's, and you do not see the contour definitely marked as you do in Secchi's. If you cover those parts of Secchi's drawing down to the extent of Lord Rosse's drawing then the difference of outline that strikes Mr. Common would to a great extent disappear.

Mr. Mitchell: If you get a definite chemical compound with which you make your photographic plate,

* [Note by Mr. Common.] Reference to the drawings here mentioned was only made incidentally, and with regard to one point. As to which of the two is the better one, I have no doubt in my mind, nor need any one have who looks at them with a recollection of the real object. What I wanted to point out was, that owing to a proper contrast not having been made in Lord Rosse's drawing, the general appearance, or what we would call the leading features, was lost, and a drawing excellent in all the detail fails in these leading features.

and can obtain a definite exposure, and know the other conditions of temperature, and so on, I think that it can not be doubted that you would have a more reliable record than if the varying conditions of the brain, at one time and another, have to be taken into account. If the condition of one man's brain has to be compared with the condition of the brain of another man, physiological difficulties come in which may be avoided by means of photography. In comparing photographs you have only mechanical differences and physical conditions to consider, which certainly involve much less complication than physiological differences.

ASTRONOMY.

MAGNITUDE OF JUPITER'S THIRD SATELLITE.

On the evening of February 2, Jupiter was passing near the star B. A. C. 303 (73 Piscium, and the opportunity was taken at the Observatory of Harvard College to compare photometrically the third satellite of the planet, with the star. Three observers took part in the work, and four sets of measurements, each consisting of eight single comparisons, were made. The result obtained was that the star was fainter than the satellite by 0.38 magnitudes of Pogson's logarithmic scale. For the magnitude of the star we have 6.16 by the mean of the available estimates on record, and 6.17 by the observations made at this observatory with the meridian photometer. The resulting magnitude of the satellite is 5.28 or 5.29, in close agreement with the value, 5.24, found by a very different method, in the *Annals of the Observatory*, Vol. XI., p. 276.

SWIFT'S COMET.—We are indebted to Prof. Pickering for the following list of dates on which observations of Swift's Comet (1880 e), were obtained at Harvard College Observatory, by Mr. Wendell:

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| 1880, Nov. 3, | 1880, Nov. 27, | 1880, Dec. 28, |
| " 8, | " 29, | " 30, |
| " 9, | Dec. 2, | " 31, |
| " 11, | " 3, | 1881, Jan. 1, |
| " 18, | " 4, | " 3, |
| " 19, | " 7, | " 7, |
| " 21, | " 11, | " 8, |
| " 22, | " 19, | " 18, |
| " 23, | " 22, | " 20, |
| " 26, | " 23, | |

URANIA.—The first number of the new *International Journal of Astronomy* contains in a very convenient form of 24 demy 4to pages, a number of interesting articles. Among others are the following papers: "Observations of the Spectrum of Comet 1880 d. (Hartwig) at Dunecht," by Copeland and Lohse. "A New Planetary Nebula," by Dr. Copeland. "Observations of Comets 1880 b, c, and d, at Dunecht. "Über die Auflösung der Lambert'schen Gleichung für Parabolische Bahnen, by Professor Klinkerfues.

PROF. WILLIAM A. ROGERS, of Cambridge, has recently made a visit to Washington to compare the copies of the English and French standards of length, with the standards of our Government deposited at the Coast Survey Office. Prof. Rogers obtained very accurate copies of the yard and metre during January and February, 1880 having made a trip to Paris and London for that purpose.

WE learn of the recent death of Baron Dembowski, the well-known double-star observer, at the age of 69. For upward of twenty-five years he had devoted himself to the re-measurement of the stars of the Dorpat Catalogue, and for this work was awarded in 1878 the gold medal of the Royal Astronomical Society.

W. C. W.