On a Property of Light, exhibited in the Examination of small Luminous Points by Telescopes[*]

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"The Edinburgh Journal of Science", conducted by David Brewster,
Vol. IV, November-April 1826, p. 306-309

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[...] The property of light, which I propose now to explain, and which I observed some time ago, enables us to distinguish the discs of the **satellites of Jupiter**, which have a sensible diameter from those of the fixed stars, whose diameter is inappreciable by our eyes.

In observing the stars with my telescopes, to which I have adapted a divided object-glass micrometer, I have remarked, when the magnifying power was sufficient to make the phenomenon perceptible, that, if I doubled the image, by separating the semi-lenses, the luminous discs became elongated, and assumed an oval form. The small diameter of the ellipse thus formed is equal to the diameter of the primitive disc. This elongation always takes place, provided that the telescope is well centered in a direction perpendicular to the section of the lens of the micrometer, and it is for this reason that the distance between two stars is in no way diminished. This elongation takes place only for the fixed stars, whose diameter is inappreciable by the eye, and even when the magnifying power is from 100 to 1000 times. With respect to objects of an appreciable diameter, as the planets would be, they are no subject to this luminous expansion, which alters their form; or, at least, I have not been able to observe it in them. I have noticed several times, that the discs of the satellites of Jupiter, though smaller in appearance than those of the fixed stars, preserve themselves perfectly circular, and have their contours well defined, even when their images are doubled. This furnishes us with an easy criterion for distinguishing between a real disc and an apparent one, and, consequently, for distinguishing, at first sight, a new planet from a fixed star; for, if the planet has not a disc extremely small, if we separate the lenses of the micrometer, this disc will preserve its form, while the image will lengthen itself, if the star is a fixed one.[**]

In seeking for the cause of this phenomenon, I found that the elongation of the images could not arise from any property of the semi-lenses, because the effect takes place even when they are removed, and shows itself with Newtonian telescopes, when half the aperture is shut up by a semicircle of card, in which case the image resembles that formed by a semi-lens. If the card is turned round, so as always to cover one-half of the mirror, the elongation, in the image of the star, will always take place in a direction perpendicular to the line which separates the open from the covered half of speculum.

It is easy to ascertain that this effect does not depend on the aberration of the light in the mirror, since, in this case, it would take place in the direction of the diameter of the semicircle of card, and of the section of the semi-lens.

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[*] This notice is an abstract of part of Professor Amici's Memoir on the Observation of Jupiter's Satellites in the Day-time.

[**] Sir William Herschel has published, in the *Philosophical Transactions* for 1805, several experiments, for the purpose of establishing the limits of the visibility of small objects in telescopes. He finds, that the rays reflected by the central portion of the great mirror tend to augment the false discs, while those reflected from the circumference tends to diminish them. The different effects, therefore, of the internal and external rays, reflected at the surface of a mirror ten feet in focal length, is a criterion for distinguishing a false from a real disc, provided that their diameter exceeds *one-fourth* of a second. - AMICI.

In order to be still farther satisfied that the elongation of the images did not proceed from the aberration of sphericity, I placed, at the end of a refracting telescope, a rectangular aperture, one of whose sides was quadruple of the other, and I put it symmetrically around the axis of the tube. Had any aberration been sensible, it would have shown itself by dilating the discs of the stars in the direction of the greater side of the rectangle; but this did not happen. The image of the star was accompanied with two long luminous tails, which, in turning round the card, kept always perpendicular to the greatest side of the rectangle.

This phenomenon, therefore, appears to me to be caused by the light inflected by the sides of the diaphragm, and this explanation is confirmed by another fact, which I have observed in using Newtonian telescopes. If, when the telescope is pointed to a star, the eye-glass is brought nearer the mirror than distinct vision requires, we perceive, in the margin of the luminous circle, which has the form of the mirror, a very narrow band of brilliant light, which shows itself even round the shadow of the small mirror, and of the arm which carries it. The same thing takes place, if the eye-glass is drawn out beyond the place of distinct vision. I cannot, therefore, attribute this phenomenon to any other cause than the inflection of light by the sides of the small mirror, and its support, and by the mounting of the large mirror.

If we examine attentively the formation of the image of a star, while bringing the eye-glass from the point of indistinct to that of distinct vision, we shall see that the false disc of the star proceeds, in a great measure, and almost entirely, from those luminous bands which I have mentioned. If a method is not found for remedying this defect, it will become an obstacle to the unlimited magnifying power of telescopes, which would be obtained, if we could form mirrors so as to give an image as distinct as the object itself. These telescopes, indeed, would always err from want of light.

Phenomena, analogous to those which I have described, take place also in achromatic telescopes; and the phenomenon of false discs is in this case still more remarkable. The image of a luminous point is now accompanied with a series of concentric rings,[***] which are easily discovered by bringing the eye-glass alternately within and without the place of distinct vision. The cause of those appearances appears to be the same in the two telescopes, but, in the achromatic ones, there is a certain arrangement which favours the production of these rays. Experience has taught me to form double object-glasses, so that I can make either one ring, or a greater number of rings, appear, by moving the eye-glass on each side of the place of distinct vision.

[***] See page 284 of this Number.