John T. Towson, "On the Proper Focus for the Daguerreotype," November 1839

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LVIII. *On the proper Focus for the Daguerreotype.*
By JOHN T. TOWSON.

To the Editors of the Philosophical Magazine and Journal.

GENTLEMEN,

The universal interest which the discoveries of Daguerreotype and the photographic art have excited, will, I hope, excuse my soliciting a space in the pages of your scientific Journal, for the purpose of explaining an important fact which has hitherto escaped observation, It appears from a note appended to page 37 of the English translation of "Daguerre's description," that he does not use an achromatic lens; and from p. 62, that the focus he uses is obtained by advancing or withdrawing the frame of the obscured glass until he obtains the outlines of the subject with the greatest neatness. This method would be most correct if the chemical rays were identical with the luminous rays. If such were the case the effect produced on his plate would be precisely that which had appeared on his obscured glass. But it is a well-known fact, that the chemical rays are more susceptible of refraction than the luminous rays; it is therefore necessary, in order to obtain the neatest effect, that the camera should be adjusted to the focus of the chemical rays.

M. Frauenhofer, by his investigation of the phaenomena of the prismatic spectrum, has shown that the index of refraction of each ray is as follows:

	Red.	Orange.	Yellow.	Green.	Blue.	Indigo.	Violet
Flint Glass	1·6277	1·6296	1·6350	1·6420	1·6482	1·6602	1·6710
Crown Glass	1·5258	1·5268	1·5295	1·5330	1·5360	1·5416	1·5465

I also find that the mean index of refraction of the invisible chemical ray is for flint glass 1·693, and for crown glass 1·536. The index for plate glass is also about the mean between those of flint and crown glass.

When we adjust a camera to the point at which the figure appears most distinct we obtain the mean focus of the luminous power of the united ray, because each coloured ray possesses a different degree of illuminating power; therefore the appearance of the figure is mostly influenced by the yellow ray, because it has the greatest degree of illuminating power; and least of all by the violet, because it yields the smallest degree of light.

The proportional light afforded by each ray is as follows: Red ·009; orange ·048, yellow 1·000, green ·440, blue ·84, indigo ·010; and violet ·001. On the other hand, each ray also tends to disturb the distinctness of the figure in proportion to its distance from the mean focus of the pencil to which it belongs; thus two rays would but occasion a similar degree of indistinctness to that which one ray of equal power would if situate at twice the distance from the mean focus of the pencil to which it belongs. The elements of our calculation, in ascertaining the point at which rays of various degrees of refrangibility produce the most distinct effect, must therefore consist both of the illuminating power of each portion of the spectrum, and its distance from the point required. By a calculation founded on these data, we find that the figure appears most distinct at the focus of the central yellow ray.

It must however be evident that this focus ought not to be used for photographic purposes, since the yellow ray, although it yields the greatest light, produces but a slight degree of chemical action, whilst the chemical effect of the violet ray is greater than that of any other luminous ray, but its illuminating power is the least ; the rays that produce even a greater chemical action than all the luminous rays combined possess no illuminating power. It has also been shown by Dr. Herschel that the extreme red ray and the invisible ray beyond the red portion of the spectrum produce a chemical effect of a contrary nature to that of the other rays. These considerations are sufficient to convince us not only that the chemical focus is differently distant from a lens than its luminous focal length, but also to prove that the distance between the two foci is sufficiently great to produce considerable practical results. It therefore becomes an investigation of considerable importance as connected with the photographic art, to ascertain the situation of the mean chemical focus of a lens. In conjunction with the data our previous observations have afforded, the elements of such a calculation must consist of the chemical power of those portions of the spectrum as have not already been noticed, which is as follows. Taking that of the invisible chemical ray as unity, that of the green will be ·01; the blue ·1, the indigo ·3, and the violet ·45. With these data, and adopting the same formula we used in calculating the mean luminous focus, we discover the mean chemical influence to be without the limits of the luminous portion of the spectrum, very near the extreme violet, ray, and that for all practical purposes we may find this focus for any lens by multiplying its distance from the point at which the figure appears most distinct by the factor ·969 if it be of flint glass, ·976 of plate glass, or ·984 of crown glass. Thus the chemical focus of a lens whose luminous focus is 16 inches would be if composed of flint glass about 15·504, of plate glass 15·616, or of crown glass 15·744 inches*. To demonstrate the importance of obtaining the chemical focus of a lens, I have inclosed two street views taken on the "improved photographic paper" sold by Mr. Richards of this town. This preparation produces lights which correspond with lights and shades with shades, consequently the effect of a correct focus is more perceptible than would be the case on papers that reverse the tints. The subject of both views is the same; the paper of each is from the same piece; and the times and the lights employed in taking them were as similar as possible, the difference of effect being solely produced by No. 2 having been placed in the mean luminous focus, but No. 1 in the mean chemical focus, discovered by the above formula. On observing the very great difference between the two views, the question immediately occurs, how then does Daguerre produce such clear pictures if he uses the wrong focus? When however we observe the imperfect view, No.

2, we are not to conclude that the luminous focus always produces so little distinctness. During the summer months I have, together with Mr. Hunt of this town, devoted considerable attention to the practice of the photographic art, and have succeeded in obtaining many very tolerably distinct views, although we used the luminous focus of the lens. This we effected by reducing the diameter of the lens or stop to a considerable extent, but by so doing we delayed the process of taking the view. This is also the mode by which Daguerre in a great measure neutralizes the effect of the imperfect focus which it appears he is in the habit of using. By thus reducing the size of the lens of a camera, that aberration of the glass which arises from the use of a wrong focus is diminished in direct proportion to the squares of the diameter of the lens or stop, but the number of rays transmitted is thereby reduced in the same proportion. The diameter of the stop of the camera employed in drawing the inclosed views was equal to one-sixth of the focal length of the lens, whereas it appears from the description of Daguerre's camera that his lens is of less diameter than 1/18th of its focal length, and the engraving which represents his camera shows a stop of one half that diameter. This being the case the aberration arising from the incorrect focus is reduced to 1/36th of the amount shown in view, No. 2. But by thus reducing the number of rays transmitted, much of the advantage which would arise from the sensitive character of his preparation is lost, and the value of less sensitive modes is reduced in a still greater proportion.

Daguerre informs us, that under very favourable circumstances a drawing may be obtained by exposing his plates in the camera during from three to five minutes. If then, by correcting his focus, he were enabled to use a lens of equal power to the one by which the inclosed drawings were produced, he would be enabled to make the necessary impression in from ten to twelve seconds.

During the discussion which took place at the Institute, after M. Arago had publicly announced the process of Daguerreotype, it was allowed to be a great desideratum that the art might be applied to taking portraits from life. The use of large lenses, which the correction of the focus enables us to adopt, would, I should imagine, render such an application of the art practicable; and the value of each use to which this important invention is applied, must also be increased by a knowledge of the means of obtaining the best possible effect in the least possible time.

I am, Gentlemen, your obedient servant,

JOHN T. TOWSON.

*From this result we might imagine that crown glass would he the best material for photographic lenses. This however is not the case. The least dispersive lenses intercept the greatest number of chemical rays, and therefore those of crown glass, and consequently achromatic lenses, cannot be advantageously employed for photographic purposes. This observation might be exemplified by reference to several interesting facts, but in so doing we should prematurely anticipate some of the results of an investigation, which my friend, Mr. R. Hunt, is now making relative to the power which various transparent media possess of transmitting chemical rays.

[End of text.]

EDITOR’S NOTES:

This article is referenced in John W. Draper, "Remarks on the Daguerreotype," *American Repertory of Arts, Sciences, and Manufactures* (New York) 1:6 (July 1840): 401–4.[1]

See also J. T. Towson, "The History of Photography to the Year 1844," *Transactions of the Historic Society of Lancashire and Cheshire* (Liverpool) vol. 5 (1865): 249–55.[2]

1. http://www.daguerreotypearchive.org/texts/P8400013_DRAPER_AMER-REP_1840-07.pdf
2. http://www.daguerreotypearchive.org/texts/P8650001_TOWSON_TRANSACTIONS_1865.pdf

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URL: http://www.daguerreotypearchive.org/texts/P8390028_TOWSON_PHILO-MAG_1839-11.pdf

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Original spelling/punctuation/grammar generally maintained without correction. Any in-text corrections are bracketed.