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XXXII. *On the Process of Daguerreotype, and its application to taking Portraits from the Life. By* JOHN WILLIAM DRAPER, *M.D., Prof. Chemistry in the University of New York.*

VERY soon after M. Daguerre's remarkable process for Photogenic Drawing was known in America, I made attempts to accomplish it application to the execution of portraits from the life. M. Arago had already stated, in his address to the Chamber of Deputies, that M. Daguerre expected, by a slight advance, to meet with success, but as yet no account has reached us of that object being attained.

More than one hundred instances are recorded in Berzelius's chemistry, in which the agency of light brings about changes in bodies; these are of all kinds: formations of new compounds, re-arrangements of elements already in union, changes of crystallographic character, decompositions, and mechanical modifications.

The process of the Daguerreotype is to expose a surface of pure silver to the action of the vapour of iodine, so as to give rise to a peculiar iodide of silver, which under certain circumstances is exceedingly sensitive to light. The different operations of polishing, washing with nitric acid, exposure to heat, &c., are only to offer a pure silver surface; the operation of hyposulphite of soda, and the process, which I shall presently describe, of galvanization, are to free the plate from it sensitive coating, and in no wise affect the depth of the shadows, as some of the French chemist at first supposed.

There is but on part of the Daguerreotype which does not yield to theory: on one point alone there is obscurity. Why does the vapour of mercury condense in a white form on those portions of the film of iodide, which have been exposed to the influence of light?—condense to amount which is rigidly proportional to the quantity of incident light?

Even on this point there are facts which appear to have a bearing.

(a.) It has long been known that if a piece of soapstone or agalmatolite be made use of as a pencil to write with on glass, though the letters that may have been formed are invisible, and though the surface of the glass may subsequently have been well cleared, yet they will come into view as soon as the glass is breathed on.

(b.) I have often noticed, that if a piece of very clear and cool glass, or what is better, a cold polished metallic reflector, has a little object, such as a piece of metal, laid upon it, and the surface be breathed over once, the object being then carefully removed, as often

as you breathe again on the surface, a spectral image of it may be seen, and this singular phaenomenon may be exhibited for many days after the first trial was made.

(c.) In a former number of this Journal I described a phaenomenon which relates to the crystallization of camphor on surfaces of dry glass, on which moveable traces have been made by the pressure of a glass rod; this also appears to belong to the same class of effects.

Berzelius (Traité, vol. ii. p. 186.) has attempted to explain (a.) and (c.) on this principle, that the changed and unchanged surfaces radiate heat unequally. There may be strong doubts with some as to the correctness of this, but is not the Daguerreotype due to the same cause, whatever it may be?

We must separate carefully the chemical changes which iodide of silver undergoes in the sunbeam, from the mechanical changes which happen to the sensitive film: iodide of silver turns black in the solar ray, the whole success of the Daguerreotype artist depends on his checking the process before that change shall have supervened.

The coating of iodine is not *immediately* necessary to the production of images by the mercurial vapour. The condition seems to be traceable to the metallic surface. If you take a Daguerreotype, clean off the mercury, polish the plate thoroughly with rottenstone, wash it with nitric acid and bring it to a brilliant surface, yet if it has not been exposed to heat, the original picture will re-appear on exposure to the mercurial vapour. Is not this a result of the same kind as those just referred to?

As a polishing material for the Daguerreotype plate, common rottenstone and oil answer very well. The plate having been planished by the workman, is to be rubbed down to a good surface, and as high a polish given to it as possible; it is to be heated and washed with nitric acid, as indicated in the French account, and finished by being rubbed with whiting (*creta praeparata*), in the state of a very dry powder, going over it for the last time with a piece of clean dry cotton; this gives an intensely black luster, which cannot be obtained by rottenstone alone, and thoroughly removes any film which nitric acid may have left.

To coat with iodine, I make use of a box about two inches deep, in the bottom of which that substance in coarse flakes is deposited; no cloth intervenes, but the silvered plate, with a temporary handle attached to it, is brought within half an inch of the crystals, and it becomes perfectly coated in the course of one to three minutes; no metallic strips are necessary to ensure the effect; if the edges and corners are thoroughly clean, the golden hue will appear uniformly.

M. Daguerre recommends, that the plate, after being iodized, shall be placed in the camera without loss of time. The longest interval, he says, ought not to exceed an hour. “Beyond this space the action of the iodine and silver no longer possesses the requisite photogenic properties.”

There may be something peculiar in the preparation of the plate as I have described it, but it is certain that this observation must be received with some limitation. A plate, which has been iodized, does not appear so quickly to lose its sensitiveness. On the other hand, by keeping it in the dark for twelve or twenty-four hours, its sensitiveness is *often remarkably increased*. Other advantages also accrue. Those who have made many of these photogenic experiments, will have had frequent occasion to remark, that the film of iodine is not equally sensitive all over, that there are spots or cloudy places which do not evolve any impression, and often the whole is in that condition, that the bright parts alone come out, while the parts that are in shadow do not evolve correspondingly, nor can they be well developed, except at the risk of solarizing the picture. Now, a plate that has been

kept for several hours, is by no means so liable to these effects: I do not pretend to give any reason for this, but merely mention it as a fact, of considerable importance to the travelling daguerreotyper; he will find that the iodine does not lose its sensitiveness in many days.

In a paper read before the Royal Society, of which an abstract is given in the April number of this Journal for the present year (p. 333.), Sir John Herschel states, that there is an absolute necessity of a perfect achromaticity in the object-glass of the photographic camera. M. Daguerre appears to have been under the same impression, and recommends in his published account such an object-glass.

All the rays of light, with *perhaps* the exception of the yellow, leave an impression on the iodide of silver. The less refrangible rays, however, act much more slowly than those which are at the opposite end of the spectrum. In the common kinds of glass, the most energetic action takes place in the indigo, or on the boundary of the blue. Now the retina receives an impression with equal facility from each of the different rays, the yellow light acting as quickly upon it as the red or the blue. Vision is therefore performed independently of time, the eye catching all the colours of the spectrum with equal facility and with equal speed. But it is not so with these photogenic preparations. In the action of light upon them, time enters as an element; the blue ray may have effected its full change, whilst the red is yet only beginning slowly to act; and the red may have completed its change before the yellow has made any sensible impression. On these principles, it is plain that an achromatic object-glass is by no means essential for the production of fine photographs; for if the plate be withdrawn at a certain period, when the rays that have a maximum energy have just completed their action, those that are more dispersed but of slower effect, will not have had time to leave any stain. We work, in fact, with a temporary monochromatic light.

Under these principles I constructed the camera which I am in the habit of using, with a double convex non-achromatic lens. Some of the finest proofs were procured with a common spectacle lens, of fourteen inches focus, arranged at the end of a cigar-box as a camera; a lens of this diameter answers very well for plates four inches by three, reproducing the objects with the most admirable finish, copper-plate engravings being represented in the minutest particulars, and the marks of the tool becoming quite distinct under the magnifier.

In this instance, it is true, owing to the magnitude of the focal length compared with the aperture, but little difficulty ensues from chromatic aberration; but when with the same focal length the aperture is increased to three or four inches, then the dispersion becomes very sensible, and yet good proofs can be produced, by working in the method here indicated, the chief difficulty then arising from spherical aberration.

It has already been state, that the ray of maximum action for the Daguerreotype, when colourless French plate-glass is used, lies probably within the indigo space; it therefore follows, that the length of the camera should be diminished, after arranging it to the luminous focus. The importance of this is pointed out in a paper by Mr. Towson, inserted in this Journal last year; I was, however, in the habit of using this adjustment before reading the suggestions contained in that excellent communication. The amount of shortening which should be given to the camera, where the lens is fifteen inches focus, does not commonly exceed three-tenths of an inch. If the luminous focus be used, the proof comes out indistinct.

In the subsequent process of mercurializing, it is of little importance what is the angular position. Several experimenters were for a time under the idea that an angle of

45° or 48° was a necessary inclination, in order that the plate should take the vapour; this arose from a misinterpretation of the printed account. Plates mercurialize equally well in a horizontal as in any other position; perhaps a slight inclination may be of advantage, in allowing the vapour to flow with uniformity of the iodized surface, but the chief use of an angle of 45°, is to allow the operator to inspect the process through the glass.

Sometimes it is advantageous to heat the mercury a second time, when the proof is not distinctly evolved at first. Indeed, it occasionally happens, that a proof which did not evolve at all at first, will come out quite fairly on raising the temperature of the mercury again.

M. Daguerre recommends two methods of removing the sensitive coating from the plate, by washes of hyposulphite of soda, and a solution of common salt. The former answers perfectly, the second only indifferently well. There is, however, another process, which is very simple, and has an advantage over the former of these in cheapness. It adds not a little to the magic of the whole operation, in the eyes of those who are unaccustomed to chemical results. The plate, having been dipped into cold water, is placed in a solution of common salt, of moderate strength; it lies without being aced upon at all; but if it be now touched on one corner with a piece of zinc, which has been scraped bright, the yellow coat of iodide moves off like a wave and disappears. It is a very pretty process. The zinc and silver forming together a voltaic couple, with the salt water intervening, oxidation of the zinc takes place, and the silver surface commences to evolve hydrogen gas; whilst this is in a nascent condition it decomposes the film of iodide of silver, giving rise to the production of hydriodic acid, which is very soluble in water, and hence instantly removed.

This process, therefore, differs from that with hyphosulphite. The latter acts by dissolving the iodide of silver, the former by decomposing it. It is necessary not to leave the zinc in contact too long, or it deposits stains, and in large plates the contact should be made at the four corners successively, to avoid this accident.

After the proof is washed, all the defects in the preparation of the plates become apparent. If a film of mercury has existed on it, due to its not having been burnt at all, perhaps the former impressions which have been obtained will re-appear. This accident frequently happened in my earlier trials, when care had not been taken to give a due exposure each time to the spirit flame. Spectral appearances of former objects, on different parts of it, emerged,—an interior with Paul Pry coming out, when the camera had been pointed at a church.

There is no difficulty in procuring impressions of the moon the by Daguerreotype, beyond that which arises from her motion. By the aid of a lens and a heliostat, I caused the moonbeams to converge on a plate, the lens being three inches in diameter. In half an hour a very strong impression was obtained. With another arrangement of lenses I obtained a stain nearly an inch in diameter, and of the general figure of the moon, in which the places of the dark spots might be indistinctly traced.

An iodized plate, being exposed for fifteen seconds only close to the flame of a gas light, was very distinctly stained; in one minute there was a very strong impression.

On receiving the image of a gas light, which was eight feet distant, in the camera, for half an hour, a good representation was obtained.

The flame of a gas lamp was arranged within a magic lanthorn, and a portion of the image of a grotesque on one of the slides received on a plate; a very good representation was procured.

With Drummond's light, and the rays from a lime-pea in the oxy-hydrogen blowpipe, the same results were obtained.

In the first experiments which I made for obtaining portraits from the life, the face of the sitter was dusted with a white powder, under an idea that otherwise no impression could be obtained. A very few trials showed the error of this; for even when the sun was only dimly shining, there was no difficulty in delineating the features.

When the sun, the sitter, and the camera are situated in the same vertical plane, if a double convex non-achromatic lens of four inches diameter and fourteen inches focus be employed, perfect miniatures can be procured, *in the open air*, in a period varying with the character of the light, from 20 to 90 seconds. The dress also is admirably given, even if it should be black; the slight differences of illumination are sufficient to characterize it, as well as to show each button, button-hole, and every fold.

Partly owing to the intensity of such light, which cannot be endured without a distortion of the features, but chiefly owing to the circumstance that the rays descend at too great an angle, such pictures have the disadvantage of not exhibiting the eyes with distinctness, the shadow from the eyebrows and forehead encroaching on them.

To procure fine proofs, the best position is to have the line joining the head of the sitter and the camera so arranged as to make an angle with the incident rays of less than ten degrees, so that all the space beneath the eyebrows shall be illuminated, and a slight shadow cast from the nose. This involves obviously the use of reflecting mirrors to direct the ray. A single mirror would answer, and would economize time, but in practice it is often convenient to employ two; one placed, with a suitable mechanism, to direct the rays in vertical lines; and the second above it, to direct them in an invariable course towards the sitter.

On a bright day, and with a sensitive plate, portraits can be obtained in the course of five or seven minutes, in the diffused daylight. The advantages, however, which might be supposed to accrue from the features being more composed, and of a more natural aspect, are more than counterbalanced by the difficulty of retaining them so long in one constant mode of expression.

But in the reflected sunshine, the eye cannot support the effulgence of the rays. It is therefore absolutely necessary to pass them through some blue medium, which shall abstract from them their heat, and take away their offensive brilliancy. I have used for this purpose blue glass, and also ammoniacosulphate of copper, contained in a large trough of plate glass, the interstice being about an inch thick, and the fluid diluted to such a point, as to permit the eye to bear the light, and yet to intercept no more than was necessary. It is not requisite, when coloured glass is employed, to make use of a large surface; for if the camera operation be carried on until the proof *almost* solarizes, no traces can be seen in the portrait of its edges and boundaries; but if the process is stopped at an earlier interval, there will commonly be found a stain, corresponding to the figure of the glass.

The camera I have used, though much better ones might be constructed, has for its objective two double convex lenses, the united focus of which for parallel rays is only eight inches; they are four inches in diameter in the clear, and are mounted in a barrel, in front of which the aperture is narrowed down to 3 1/2 inches, after the manner of Daguerre's.

The chair in which the sitter is placed, has a staff at its back, terminating in an iron ring, that supports the head, so arranged as to have motion in directions to suit any stature and any attitude. By simply resting the back or side of the head against this ring, it may be kept sufficiently still to allow the minutest marks on the face to be copied. The hands should never rest upon the chest, for the motion of respiration disturbs them so much, as to bring them out of a thick and clumsy appearance, destroying also the representation of the veins on the back, which, if they are held motionless, are copied with surprising beauty.

It has already been stated, that certain pictorial advantages attend an arrangement in which the light is thrown upon the face at a small angle. This also allows us to get rid entirely of the shadow from the back-ground, or to compose it more gracefully in the picture; for this, it is well that the chair should be brought forward from the back-ground, from three to six feet.

Those who undertake Daguerreotype portraitures, will of course arrange the back-grounds of their pictures according to their own tastes. When one that is quite uniform is desired, a blanket, or a cloth of a drab colour, properly suspended, will be found to answer very well. Attention must be paid to the tint,—white, reflecting too much light, would solarize upon the proof before the face had had time to come out, and owing to its reflecting *all* the different rays, a blue or irradiation would appear on all edges, due to chromatic aberration. It will be readily understood, that if it be desired to introduce a vase, an urn, or other ornament, it must not be arranged against the back-ground, but brought forward until it appears perfectly distinct on the obscured glass of the camera.

Different parts of the dress, for the same reason, require intervals, differing considerably, to be fairly copied; the white parts of a costume passing on to solarization before the yellow or black parts have made any decisive representation. We have therefore to make use of temporary expedients. A person dressed in a black coat, and open waistcoat of the same colour, must put on a temporary front of a drab or flesh colour, or by the time that his face and the fine shadows of his woollen clothing are evolved, his shirt will be solarized, and be blue, or even black, with a white halo around it. Where, however, the white parts of the dress do not expose much surface, or expose it obliquely, these precautions are not essential; the white shirt collar will scarcely solarize until the face is passing into the same condition.

Precautions of the same kind are necessary in ladies' dresses, which should not be selected of tints contrasting strongly.

It will now be readily understood, that the whole art of taking Daguerreotype miniatures, consists in directing an almost horizontal beam of light, through a blue coloured medium, upon the face of the sitter, who is retained in an unconstrained posture, by an appropriate but simple mechanism, at such a distance from the back-ground, or so arranged with respect to the camera, that his shadow shall not be copied as a part of his body; the aperature of the camera should be three and a half or four inches at least, indeed the larger the better, if the object be aplanatic.

If two mirrors be made use of, the time actually occupied by the camera operation varies from forty seconds to two minutes, according to the intensity of the light. If only one mirror is employed, the time is about one-fourth shorter. In the direct sunshine, and out in the open air, the time varies from under half a minute.

Looking-glasses, which are used to direct the solar rays, after a short time undergo a serious deterioration; the foil assuming a dull granular aspect, and losing its black brilliancy. Hence the time, in copying, becomes gradually prolonged.

The arrangement of the camera, above-indicated, gives reversed pictures, the right and left sides changing places. Mr. Woolcott [Wolcott—ed.], an ingenious mechanician of this city, has taken out a patent for the use of an elliptical mirror for portraiture; it is about seven inches in aperture, and allows him to work conveniently with plates two inches square. The concave mirror possesses this capital advantage over the convex lens, *that the proof is given in its right position, that is to say, not reversed*; but it has the serious inconveniences of limiting the size of the plate, and representing parts that are at all distant from the centre, in a very confused manner. With the lens, plates might be worked a foot square, or even larger.

Miniatures procured in the manner here laid down, are in most cases striking likenesses, though not in all. They give of course all the individual peculiarities, a mole, a freckle, a wart. Owing to the circumstance, that yellow and yellowish browns are long before they impress the substance of the Daguerreotype, persons whose faces are freckled all over give rise to the most ludicrous results, a white, mottled with just as many black dots as the sitter had yellow ones. The eye appears beautifully; the iris with sharpness, and the white dot of light upon it, with such strength and so much of reality and life, as to surprise those who have never before seen it. Many are persuaded, that the pencil of the painter has been secretly employed to give this finishing touch.

[End of text.]

EDITOR'S NOTES:

Draper's efforts with portraiture had been previously noted in this publication:

> PORTRAITS IN DAGUERREOTYPE.
>
> Professor Draper, of the University of New York, informs us in a note dated March 31st, that he has succeeded during the winter in procuring portraits by the Daguerreotype and that they have all the beauty and softness of the most finished mezzotint engraving and only require from 20 to 45 seconds for execution. (16:105 [June 1840]: 535.)

Draper references an article by Towson appearing in the same publication: John T. Towson, "On the proper Focus for the Daguerreotype," 15:97 (November 1839): 381–85.

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