



LVIII. Description of the camera lucida

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well as alkali, when the disks being dried the pile ceases to disengage the electrical fluid, the affinity of the acid of the positive pole with the alkali of the negative pole enters into action, a muriatic salt is formed.

The radical of the muriatic acid is therefore a fact as certain as it is novel in chemistry, and for which we are indebted to M. Pacchiani; as well as for many others which have presented themselves almost spontaneously to others, but which no person except M. Pacchiani knew how to lay hold of. Keir and Cavendish seem to have been in this predicament, since they mention a little muriatic acid in the water produced by the combustion of hydrogen with oxygen, without having ascertained the true origin of it. On this subject we may consult the Essay on Static Chemistry, by M. Berthollet, part ii. sect. 1. chap. ii.

LVIII. *Description of the Camera Lucida.* By WILLIAM H. WOLLASTON, *Sec. R. S.**

HAVING, a short time since, amused myself with attempts to sketch various interesting views without an adequate knowledge of the art of drawing, my mind was naturally employed in facilitating the means of transferring to paper the apparent relative positions of the objects before me; and I am in hopes that the instrument which I contrived for this purpose may be acceptable even to those who have attained to greater proficiency in the art, on account of the many advantages it possesses over the common *camera obscura*.

The principles on which it is constructed will probably be most distinctly explained by tracing the successive steps by which I proceeded in its formation.

While I look directly down at a sheet of paper on my table, if I hold between my eye and the paper a piece of plain glass inclined from me downwards as an angle of 45° , I see by reflection the view that is before me in the same

* Communicated by the Author.

direction that I see my paper through the glass. I might then take a sketch of it, but the positions of the objects would be reversed.

To obtain a direct view, it is necessary to have two reflections. The transparent glass must for this purpose be inclined to the perpendicular line of sight only the half of 45° , that it may reflect the view a second time from a piece of looking-glass placed beneath it, and inclined upwards at an equal angle. The objects now appear as if seen through the paper in the same place as before; but they are direct instead of being inverted; and they may be discerned in this manner sufficiently well for determining the principal positions.

The pencil, however, and any object which it is to trace, cannot both be seen distinctly in the same state of the eye, on account of the difference of their distances, and the efforts of successive adaptation of the eye to one or to the other would become painful if frequently repeated. In order to remedy this inconvenience, the paper and pencil may be viewed through a convex lens of such a focus as to require no more effort than is necessary for seeing the distant objects distinctly. They will then appear to correspond with the paper in *distance* as well as *direction*, and may be drawn with facility, and with any required degree of precision.

This arrangement of glasses will probably be best understood from inspection of fig. 1. (Plate VIII.) in which ab is the transparent glass; bc , the lower reflector; bd , a convex lens (of twelve inches focus); e , the position of the eye; fgh , the course of the rays.

In some cases, a different construction will be preferable. Those eyes, which without assistance are adapted to seeing near objects alone, will not admit the use of a convex glass, but will, on the contrary, require one that is concave to be placed in front, to render the distant objects distinct. The frame for a glass of this construction is represented at ik , fig. 3, turning upon the same hinge at h , with a convex glass in the frame lm , and moving in such a manner that either of the glasses may be turned alone into its place, as
may

Camera lucida

Fig. 1.

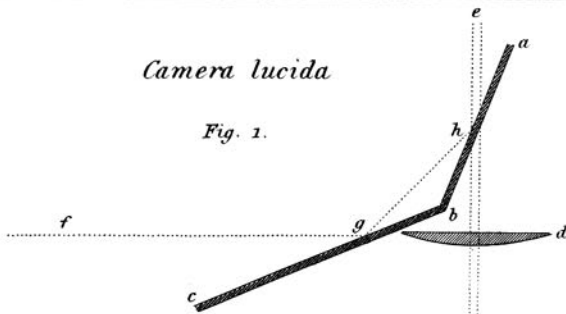


Fig. 2.

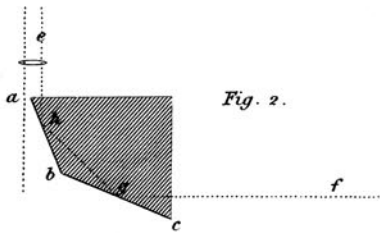
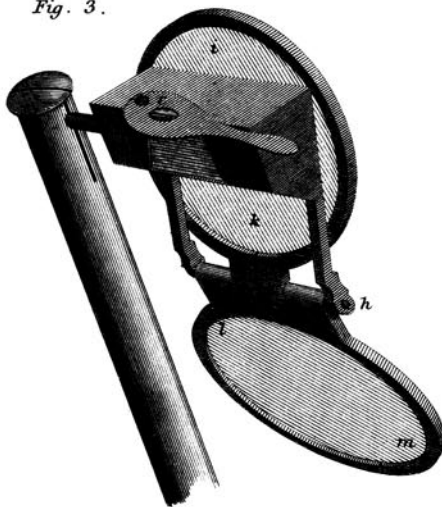


Fig. 3.



may be wanted to suit an eye that is long- or short-sighted. Those persons, however, whose sight is nearly perfect, may at pleasure use either of the glasses.

The instrument represented in that figure differs moreover in other respects from the foregoing, which I have chosen to describe first, because the action of the reflectors there employed would be more generally understood. But those who are conversant with the science of optics will perceive the advantage that may be derived in this instance from prismatic reflection; for, when a ray of light has entered a solid piece of glass, and falls from within upon any surface at an inclination of only 22 or 23 degrees, as above supposed, the refractive power of the glass is such as to suffer none of that light to pass out, and the surface becomes in this case the most brilliant reflector that can be employed.

Fig. 2. represents the section of a solid prismatic piece of glass, within which both the reflections requisite are effected at the surfaces ab , bc , in such a manner that the ray fg , after being reflected first at g and afterwards at h , arrives at the eye in a direction he , at right angles to fg .

There is another circumstance in this construction necessary to be attended to, and which remains to be explained. Where the reflection was produced by a piece of plain glass, it is obvious that any objects behind the glass (if sufficiently illuminated) might be seen through the glass as well as the reflected image. But when the prismatic reflector is employed, since no light can be transmitted directly through it, the eye must be so placed that only a part of its pupil may be intercepted by the edge of the prism, as at e , fig. 2. The distant objects will then be seen by this portion of the eye, while the paper and pencil are seen past the edge of the prism by the remainder of the pupil.

In order to avoid inconvenience that might arise from unintentional motion of the eye, the relative quantities of light to be received from the object and from the paper are regulated by a small hole in a piece of brass, which, by moving on a centre at c , fig. 3, is capable of adjustment to every inequality of light that is likely to occur.

Since the size of the whole instrument, from being so
near

near the eye, does not require to be large, I have on many accounts preferred the smallest size that could be executed with correctness, and have had it constructed on such a scale that the lenses are only three-fourths of an inch in diameter.

Although the original design and principal use of this instrument are to facilitate the delineation of objects in true perspective, yet this is by no means the sole purpose to which it is adapted; for the same arrangement of reflectors may be employed with equal advantage for copying what has been already drawn, and may thus assist a learner in acquiring at least a correct outline of any subject.

For this purpose, the drawing to be copied should be placed, as nearly as may be, at the same distance before the instrument that the paper is beneath it; for in that case the size will be the same, and no lens will be necessary, either to the object or to the pencil.

By a proper use of the same instrument every purpose of the pentagraph may also be answered, as a painting may be reduced in any proportion required by placing it at a distance in due proportion greater than that of the paper from the instrument. In this case a lens becomes requisite for enabling the eye to see at two unequal distances with equal distinctness; and, in order that one lens may suit for all these purposes, there is an advantage in varying the height of the stand according to the proportion in which the reduction is to be effected.

The principles on which the height of the stem is adjusted will be readily understood by those who are accustomed to optical considerations. For, as, in taking a perspective view, the rays from the paper are rendered *parallel* by placing a lens at the distance of its principal focus from the paper, because the rays from the distant objects are *parallel*; so also, when the object seen by reflection is at so short a distance that the rays received from it are in a sensible degree *divergent*, the rays from the paper should be made to have the same degree of divergency, in order that the paper may be seen distinctly by the same eye; and for this purpose the lens must be placed at a distance less than

its principal focus. The stem of the instrument (which slides) is accordingly marked at certain distances, to which the conjugate foci are in the several proportions of two, three, four, &c. to one; so that distinct vision may be obtained in all cases by placing the painting proportionally more distant.

By transposing the convex lens to the front of the instrument, and reversing the proportional distances, the artist might also enlarge his smaller sketches in any proportion with every desirable degree of correctness; and the naturalist, by employing a deeper lens, might delineate minute objects in any degree magnified.

Since the primary intention of the *camera lucida* is already, in some measure, answered by the *camera obscura*, a comparison will naturally be made between them. The objections to the *camera obscura* are,

1st, That it is too large to be carried about with convenience; but the *camera lucida* is as small and portable as can be wished.

2d, In the former, all objects that are not situated near the centre of view are more or less distorted.

In this there is no distortion; so that every line, even the most remote from the centre of view, is as straight as those that pass through the centre.

3dly, In that the field of view does not extend more than 30, or at most 35 degrees, with distinctness.

But in the *camera lucida* as much as 70 or 80 degrees might be included in one view.

As it has been thought advisable to secure an exclusive sale by patent, those who are desirous of purchasing the instrument are informed that Mr. Newman, No. 24, Soho-square, has at present the disposal of it.