Extract relating to the camera lucida from the Supplement to the fourth, fifth and sixth editions of the Encyclopaedia Britannica, Volume Second, Edinburgh, 1824

CAMERA LUCIDA. Dr Hook's instrument of this name is described in the *Encyclopaedia,* under the title CAMERA LUCIDA. The instrument which is to be, spoken of here, and which differs from Hook's both in its construction and in the purpose it is designed to serve, is one of the many ingenious inventions of Dr Wollaston. Its use is to facilitate the, perspective delineation of objects.

If a piece of plain glass be fixed at an angle of 45-degrees with the- horizon, end, if, at some distance beneath, there be a sheet of paper laid horizontally on a table,. a: person looking-downwards through the glass will see an image of the objects seated before him ; and, as the glass, which reflects the image is also transparent, the paper and pencil can be seen at the same time' with the image, so that the outline of the image may be traced on the paper. The image is an *inverted* one. This is the simplest form of the instrument, and may be constructed extemporaneously by fixing on a stand a plain transparent glass, with its surfaces ground parallel, or apiece of Muscovy glass, at an angle of 45 degrees, with the horizon; a card with a small hole in it will serve as a sight for keeping the eye' steady in one situation, whilst the pencil is tracing the image.

If there be a plain mirror at an angle of 22½ degrees with the horizon, and piece of plain, transparent glass be placed near it, at an angle of 22½ degrees with the vertical, the rays from the object will be twice reflected before they reach the eye, and consequently, on looking down through the transparent glass, an, erect image is seen, and the pencil may be drawn over the outlines of this image so as to leave a perspective representation on the paper. This disposition seen at fig. 1. Plate XLVI. where *be* is the mirror, *ab* the transparent plain glass.

As the image and pencil are at different distances, they cannot be both seen in the same .state of the eye. To remedy this inconvenience, a convex glass is used, of such focus as to require no more effort than is necessary for seeing the distant objects distinctly. By means of this lens, the image will appear as if it were placed on the surface of the paper. In fig. 1. *bd* is a convex glass of 12 inches focus, at *e* the eye is placed: *fghe is* the course of the rays proceeding from the object to the eye.

Those whose eyes are adapted to seeing near objects alone, will not derive advantage from the use of a convex glass, but wilt require a concave glass to be placed at *f*, in the course of the rays from the object-to the reflecting surface. In fig. 2. Plate XLVI *ik* is a concave glass placed in the above-mentioned situation; it is so disposed as to be turned at pleasure into its place, as the sight of the observer may require. Persons whose sight is nearly perfect, may use either the concave glass placed before the reflecting surface, or the convex glass placed between the paper and the eye.

In the actual construction of the instrument, a prism is used-instead of a mirror and a plain glass. The rays from the object fall upon the surface *bc* of the prism fig. 2. This surface *bc* is inclined 22½ degrees to the horizon. The refractive power of the glass allows none of the rays in this situation to pass out; they are all reflected from the surface *be* to the surface *bc,* and from that to the eye; *ab* makes an angle of 135 degrees with *bc,* and 22½ degrees with the vertical. The eye cannot see the pencil through the prism as it does through a plain glass; therefore, in order that the pencil may be seen, the eye must be so placed that only a part of the pupil may be above the edge of the prism, as at *e,* fig. 3.; and then the reflected image will be seen at the same time with the paper and pencil. There is a small piece of brass perforated with a hole, and moving on a centre at *e,* fig. 2.; this serves to keep the eye in one position, as it must be, that the image may be steady, and also to regulate the relative quantities of light to be received from the object and from the paper.

The instrument, being near the eye, does not require to be large. The smallest size which can be executed with accuracy is to be preferred, and is such that the lens is only three-fourths of an inch in diameter. Fig. 4. shows the instrument on its stand, and clamped to a board. The joint by which the prism is attached to the stand is double. The whole instrument packs in a box eight inches by two, and half an inch deep.

This instrument serves for drawing objects of all forms, and consequently also for copying lines already drawn on a plain surface. If it is required that the copy shall be of the same size as the original drawing, the distance from the drawing from the prism should be the same as the distance of the paper from the eye-hole. No lens will be necessary in this case, because the image and the paper *being* both at the same distance from the eye, coincide without the aid of a glass.

In order to have a reduced copy of a drawing, the drawing is to be placed at a distance from the prism greater than the distance of the paper from the eye-hole. If the distance is twice as great, a copy will be obtained, in which the lines are of one-half the size of the lines in the original, and so in proportion for other distances. A lens is necessary, that the eye may he enabled to see at two different distances; and, in order that one lens may serve, the distance between the eye-hole and the paper should be variable; to that effect, the stand is susceptible of being lengthened or shortened at pleasure.

The length of the stem is adjusted upon optical principles. When a distant object is to be delineated, the rays coming from it, and reflected by the instrument to the eye, are parallel, and it is required that the rays proceeding from the paper to the eye should also he parallel. This is accomplished by interposing a lens between the paper and the eye, with its principal focus art the paper. When the object to be delineated is so near that the rays which come from it to the eye are divergent, then it is required that the rays from the paper should likewise be divergent in the same degree, in order that the paper and the image may both be seen distinctly by the same eye; for this purpose the lens must be placed at a distance from the paper less than the distance of its principal focus. The stem of the instrument is marked at certain distances, to which the conjugate foci are in the several proportions of 2, 3, 4. &c. to 1, so that distinct vision may be obtained in all cases by placing the original drawing more distant.

If the convex lens be transposed to the front of the prism, and the proportional distances be reversed, a magnified image of the object will be obtained.

This instrument has deservedly come into use. Its advantages when compared with the camera obscura are, 1st, That it is small and easily carried about. 2dly, That no lines are distorted, not even those most remote frorn the centre, whereas, in the camera obscura, the lines which are not near the centre of the field are more or less distorted. 3dly, In the field of the camera lucida 70 or 80 degrees may be included, whilst the distinct field of the camera obscura does not extend beyond 30 or 35 degrees at most. The specification of Dr Wollaston's patent for the camera lucida is inserted in the *Repertory of Arts,* Vol. X. 1807, p. 162, and his description of the instrument in Nicholson's *Journal,* Vol. XVII.

If the camera lucida be fixed at the eye-glass of a telescope, it will reflect to the eye the image of the objects in the field of the telescope, so that a drawing of the image may be made: See Dr Brewster's *Account of some Philosophical Instruments.* A plain reflecting glass, fixed at *an* angle of 45 degrees with the horizon, and placed so as to receive the rays from the eye-glass of a telescope, will also give an image of the objects in the field, so situated that the image may be traced with a pencil. Varley's patent graphic telescope is upon this principle. In order that the field may be large, the magnifying power of the telescope should be small.

The inherent qualities *of* all the instruments for drawing in perspective being closely allied, it will be proper to say something of the principles on which these instruments are formed, and to mention some that are not described in other parts of this work.

To make a perspective drawing of an object is to lay down on paper a section of the perspective cone, whose apex is at the eye, and whose base is the object. An experienced draughtsman can draw the figure of this section without the aid of instruments. Others who have not acquired the facility of drawing the image they see, must have recourse either to *measurement,* or to the *instruments, which bring the image under the pencil.*

Drawing by measurement is performed by actually measuring the height of the principal parts of the object, and their horizontal distance from the eye, together with the distance of the paper from the eye, and from these dimensions the drawing is constructed by the systematic rules of perspective.

Another mode of obtaining a drawing by measurement, is to measure the angles at the eye. Suited to this purpose are theodolites, astronomical quadrants, or other instruments, capable of

measuring vertical and azimuthal angles at the eye. The angles to be measured are, the angles of altitude, and the angles of azimuth, between the point of sight and the principal points of the object; and if the tangents of the azimuthal angles be laid down with a radius equal to the distance of the paper from the eye, and the tangents of the angles of altitude with a radius equal to the distance of the paper multiplied by the secant of the azimuth, the situation of the principal points or the drawing will be determined. Or, if the instrument is capable of measuring angles in any plane, the angles between the principal points of the object and the point of sight are to be observed, and the azimuthal angles of these principal points with the point of sight; and the tangents of both are to be laid down on the paper, with a radius equal to the distance of the paper from the eye.

But these two modes by measurement are long, particularly the first. Usually, therefore, the instruments to which recourse is had for facilitating the operation of drawing, are such as give an image or section of the perspective cone on a plain surface, so that the pencil may be drawn over the outline of the image. These instruments may be considered under two heads. The first comprehending those in which the pencil is immediately drawn over the lines of the image. The second those in which the pencil has a motion parallel to that of the point which moves over the lines of the image.

Of the first kind are the following. 1. The tracing pane, a very simple and convenient instrument, consisting iu a transparent plate of plain ground glass, or of Muscovy glass, placed vertically between the object and the eye; whilst the eye is kept fixed by a sight, the outline of the image is drawn on the glass with Indian ink. 2. Or the upright glass may be divided into small squares by lines crossing each other, and the paper on which the drawing is to be made, being similarly divided, the particular intersections on the glass that cover the principal points of the object are observed, and these points are laid down on the corresponding intersections on the paper. 3. The image seen in a plain mirror, may also be drawn on its surface with Indian ink. 4. In the camera obscura, different forms of which are described in the *Encyclopaedia* under the articles DIOPTRICS and OPTICS, the image to be drawn is formed at the focus of a lens. 5. In the camera lucida the reflected image is used.

In the second division of the instruments which give a section of the perspective cone susceptible of being delineated, the pencil does not move immediately over the lines of the image, but moves parallel to these lines. 1. There is a rod which can be moved in all directions, consistent with its remaining parallel to itself. If one extremity of this rod he moved in space over the outlines of the image which the eye sees, a pencil at the other extremity will necessarily move with a similar motion, and form a drawing of the object on paper. In Sir Christopher Wren's instrument, of which he has given the description and figure in the *Philosophical Transactions,* Vol. IV., the rod is suspended by strings passing over pullies, and the ends of the strings are fixed, to a counterpoise. On a similar principle is Peacock's instrument, described in the *Philosophical Transactions*, Vol. LXXV., p. 366; and the instruments treated of in the *Stockholm Transactions* for the years 1760, 1774, and 1790. 2.. The pencil may delineate the base of a cone similar and opposite to the perspective cone. If the rays from the extreme points of an object cross on the ray, from the centre, as they do in passing through a small hole into a dark room, and if it be supposed that in the place of one of the rays a slender inflexible rod is substituted, moveable on a centre at the hole, when this rod is moved, so that its outer extremity goes over the outlines of the external image, a pencil fixed to its inner extremity will form an inverted drawing of the object. Of this nature is the optigraph of Ramsden and Thomas Jones, described in this *Philosophical Magazine*, Vol. XXVIII. 1807, p. 67. The image of the object is seen in a telescope. There is a piece of plain glass near *c* in the focus of the eye-glass of the telescope F, Plate XLVI., fig. 5. On the centre of this piece of glass is a dot: a is a plain mirror, inclined so as to reflect the image of the object down into the telescope; this mirror remains fixed, whilst the telescope is moveable on a universal joint at its object-glass *b*. Near *c* is another plain mirror, which reflects. the rays to the eye-glass. The eye being placed at the eye-glass at *e*, the telescope is to be moved by the handle *h*, so that the dot in the focus of the eye-glass shall pass over the outlines of the image seen by the eye, and the pencil at L performing a similar motion to that of the dot, and sliding freely in its sheath, presses with its weight on the paper: a drawing of the object is the result. If the stand and-slider H be lengthened, an enlarged drawing will be obtained. The instrument packs in a box 14 inches by 6 and 3.

CAMERA LUCIDA. PLATE XLVI.

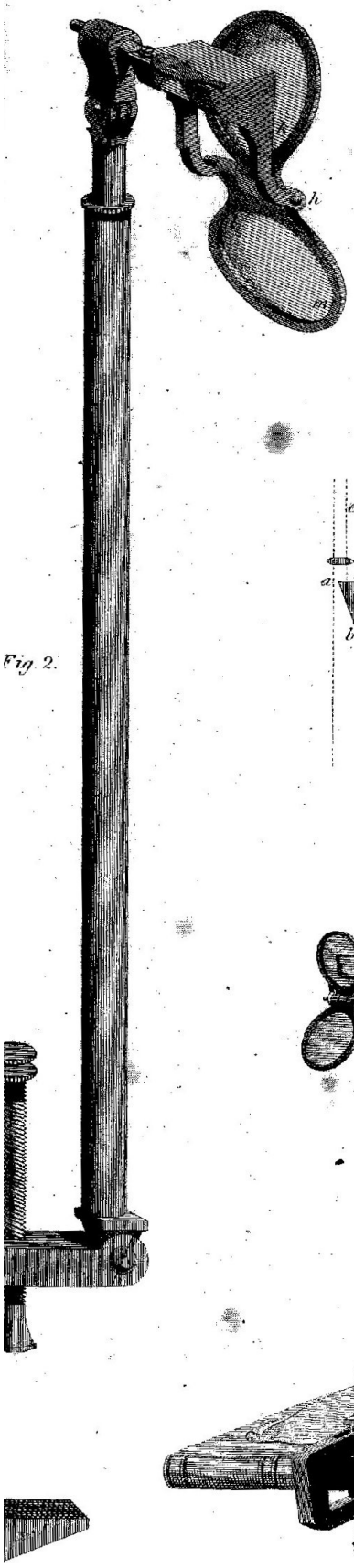

Fig. 2.

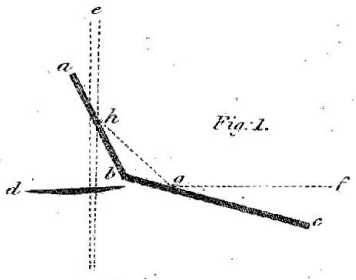

Fig. 1.

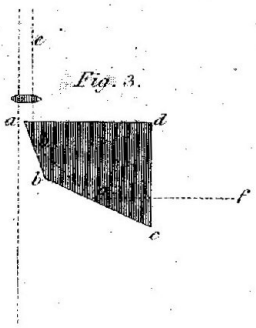

Fig. 3.

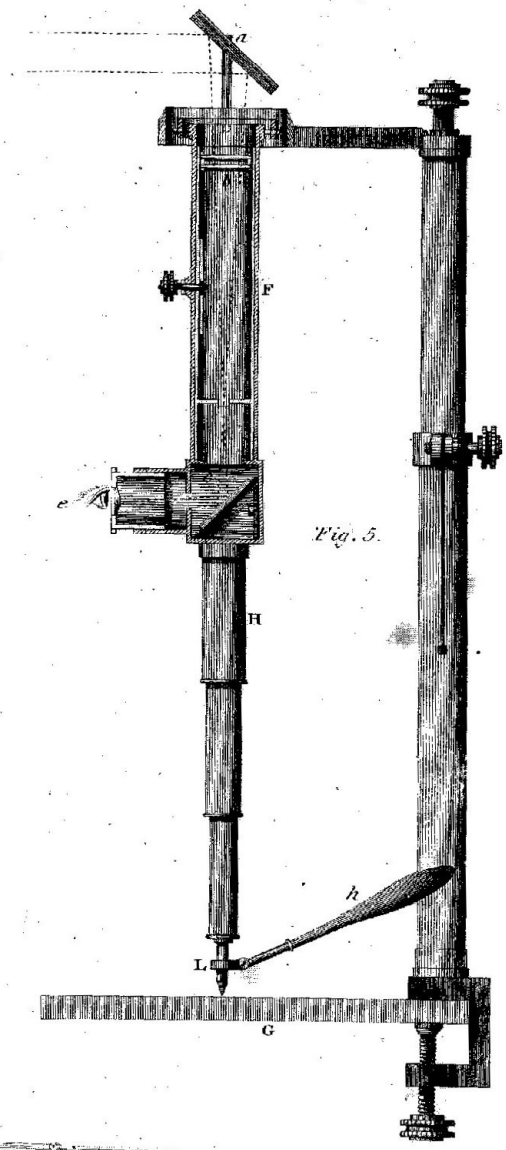

Fig. 5.

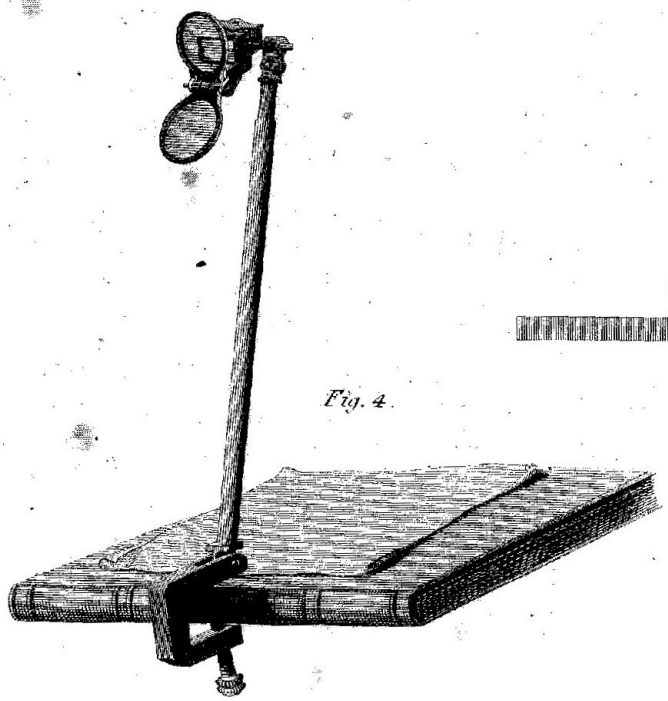

Fig. 4.

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