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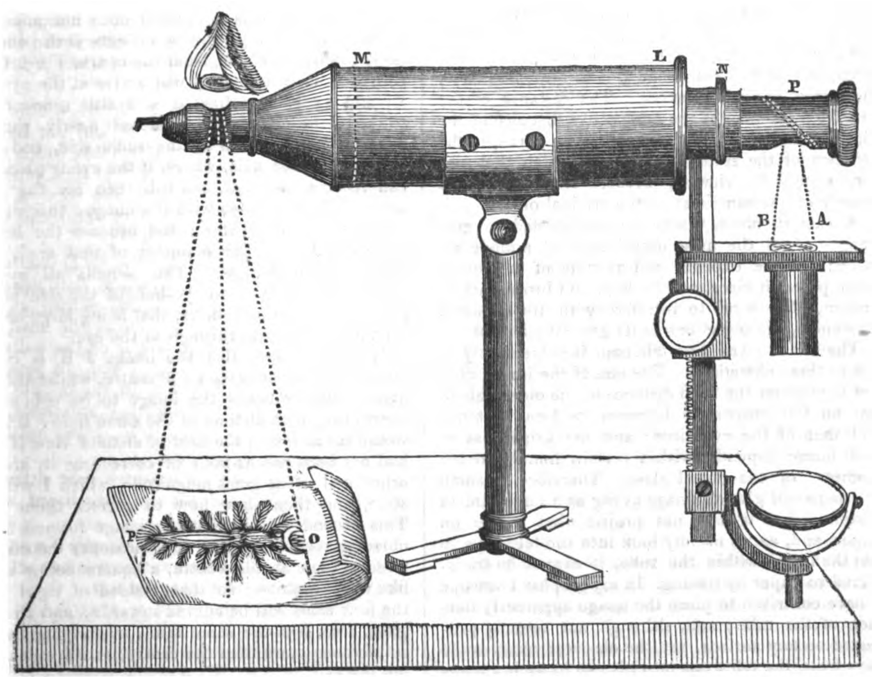
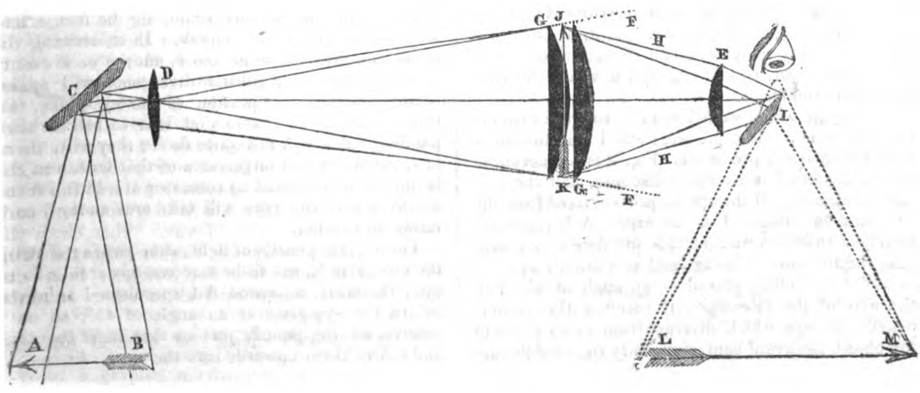
Fig. 1.



VARLEY'S GRAPHIC MICROSCOPE AND TELESCOPE.

Fig. 2.



VARLEY'S GRAPHIC MICROSCOPE AND TELESCOPE.

(As described by Mr. Varley to the Society of Arts, and published in their Transactions.)

In order to make this instrument better understood, I will first shew its difference from the previously known and really excellent instrument, the camera obscura; then explain its mode of action; thirdly, its construction; and, fourthly, the various purposes to which it may be applied.

Most persons know that the camera obscura is formed with a plain mirror and a lens, which projects a picture on paper; but to render that picture visible, the whole space from the lens to the paper requires to be inclosed in a dark chamber, so as totally to exclude all other light; hence its name. Images of any size, and of great brilliancy, may be formed by this instrument, if we use a large plane metallic speculum, and lenses of sufficiently long focus, and so well constructed as to bear, and have, the largest possible aperture. The distance of the lens from its focus is the perspective distance of the picture which it produces, or, in other words, is the distance of the station-point from which that picture should be viewed; because it then appears exactly of the same size as the original objects.

A camera obscura may be constructed to give images of all the most useful sizes at a moderate price; yet the expense and trouble of moving it from place to place, and its high and broad surface enabling the wind to interfere with its required steadiness, are objections to its general adoption.

The image given by a telescope is subject only to few of these objections. The size of the image does not depend on the focal distance of the object-glass, but on the proportion between its focal distance and that of the eye-piece; and the brightness of that image depends, within certain limits, on the diameter of the object-glass. Therefore, a small telescope will give an image as big as a large camera obscura; bnt it will not project that image on paper, and, as we usually look into the telescope to see the image within the tube, it cannot be transferred to paper by tracing. In my graphic telescope I have contrived to place the image apparently outside of the tube; and, although not actually projected on any surface, yet the observer receives the rays from the telescope into his eye in such a manner that they may be made to appear to come from a sheet of paper suitably placed for the purpose; therefore, this image may be traced on the paper. The size of the image may be varied very considerably without altering the size of the apparatus: sketches, therefore, on a very large or very small scale may be made by the same instrument; and as it never requires any additional height, or any shade to exclude day-light from the image, it offers no broad surface to be affected by the wind, and thus be rendered unsteady.

The image which we are enabled to trace with my instrument is a telescopic one; and I will now shew how that image is produced. Fig. 2 is a diagram of one of the smallest graphic telescopes, half the real size, containing all the optical portion freed from the surrounding tubes. Let the arrow A B represent an object to be drawn; in this instance it is a near one, the instrument being used as a microscope: C is a flat speculum placed at an angle of 45° with the axis of the telescope; it receives the various pencils of rays which diverge from every point of the object (to avoid confusion, only the middle and two extreme ones are shewn), and reflects them to the double convex object-glass D: this is sometimes made with two such lenses; but the larger instruments have achromatic object-glasses; in all cases, the thinner the object-glass is the better: the object-glass refracts the various rays about its focus, so as to form the curved image J K: here these rays will cross and diverge, and are to pass through the eye-lens E, which will render them so nearly parallel as to give distinct vision of the image, the eye-glass being placed so that its focus just meets that of the object-glass. But though the central pencils of rays would proceed to the eye-lens E, it will be seen that the outer pencils would pass on in the direction F F beyond the diameter of the lens E, and be lost: to prevent this, another lens, or two equivalent ones G G, must be placed on the image J K, where the rays cross. A lens so placed does not affect the crossing of the rays, but it deflects each pencil in mass towards the axis, from the course F F into the course H H, where they will arrive at the eye-lens E, and by it be refracted at a still quicker rate towards the axis, and rendered nearly parallel. These pencils are all of the same size, and meet together in the axis, where, if the eye is placed, it can receive them all, and will then see the whole area of the lens filled with the image: this area is called the field of view; and because the lens G greatly increases the diameter of that area, it is called the field-glass. The pencils all meeting together, a cap with an eye-hole of the size of one pencil is usually put there, that being large enough for them all to pass through to the eye.

It will be seen that the image J K is convex about the object-glass as a centre, whilst the eye-glass evidently needs the image to be concave, to shew every part distinct at the same time: this evil would much lessen the field of distinct view if there had not been means both of correcting it, and another evil of as great magnitude, which I will now state, and then shew how to correct them both. This second evil is, that the image formed by the object-glass is larger as it approaches the circumference than at the centre, a square being shewn like a pin-cushion; so that, instead of right lines, the four sides will be curved inwards: and the eye-glass, also, has the same fault, magnifying the circumference more than the centre, and thus increasing the evil.

If the field-glass G is removed from the neutral point,—namely, that where the image is formed, or where the rays cross, and the two focuses meet,—and is placed nearer to the eye-lens, it will combine with it, and increase the magnifying power; but, if it is put nearer to the object-glass, it combines with that to shorten its focus, rendering the image less, and so diminishing the power. In shortening this focus, the rays converge more, and, after crossing, diverge more: this greater divergence will spread them over a larger portion of the eye-glass, and thus contribute to enable that lens to refract them parallel, but it will not quite do it; they will, therefore, require a still larger area of that lens, and that is only to be obtained by removing it a little further off, by which the rays will take area enough to be refracted parallel.

The various pencils of light, after passing through the eye-glass E, are to be directed upwards into the eye; therefore, a second flat speculum I is placed before the eye-glass at an angle of 45°, so as to receive all the pencils just as they meet together, and reflect them upwards into the eye. As the eye is to be put where all the pencils meet, there must be no portion of speculum higher than that little circle of congress; and as a portion of the eye is to be allowed to look over the edge of the speculum, its upper edge is ground as thin as can be done with safety. This completes the optical part of the instrument. If we now look downwards into the eye-speculum, and leave a portion of the eye to look over its edge toward the arrow L M, where the drawing-paper is placed, we shall receive the rays from the telescope in exactly the same direction and divergence as those that enter the eye from the paper, and both image and paper will be seen together distinctly, and will allow that image to be correctly traced on the paper. When drawing with this instrument, the eye can be so placed as to remove any portion of the image from the lower part of the paper: the pencil is best seen in this lower margin, where the image is beginning to disappear. For the sake of room in the engraving, the image L M is placed too near: in proportion to this diagram, that image would be nine inches below the eye-piece, and five times as large as it is drawn.

A telescopic image has an advantage over others, in that it can be placed at any required distance from the eye, and thereby be rendered distinct to any sight: and this is an important feature in the graphic telescope; for it allows us to place the paper at the most eligible distance from the eye, and then, by adjusting the telescope, to bring the image to exactly the same distance, when the pencil, or crayon, and the image will both be seen together equally distinct; and then both eyes may be open to see the pencil, though one only sees the image. When the eye-piece is drawn away from the object-glass to the utmost extent compatible with seeing the image of a given object distinctly, the rays from the eye-glass which enter the eye are parallel, and the image appears distant, so we cannot place the paper far enough to see both together; but by pushing in the eye-piece a little, the rays will diverge a little, as though they came from a nearer object; and if we push in the eye-glass as much as we possibly can, consistent with distinct vision, the rays will diverge as from the very nearest object that can be seen distinctly, and the paper would require to be placed as close to the eye as it could possibly be seen distinct. It is a very small distance that we have to move the eye-piece to produce the extreme effects; therefore, when good vision is obtained, it is easy to adjust the instrument so that the rays shall diverge exactly as much as those which come from the paper. The dotted rays from the arrow L M show the divergence of those that proceed from the eye-glass against the speculum and into the eye, and thus make the image appear to be at that exact distance. When I wish to make an extremely small copy from a large picture, I do not effect the whole reduction by giving the required distance to the picture, for ordinary rooms do not allow that distance; but I place the picture as far as I can, and do the rest by using spectacles, the focus of which is so short as to let me see the paper when placed so near as to reduce the image to the required size. This diagram represents the instrument in use as a microscope; for the object P O is near, and the image L M is larger than it; but the object-speculum C is made to revolve on the axis of the telescope, so, if it is turned a quarter round, it will receive rays horizontally from objects at any distance.

With a graphic microscope we may trace an image much larger than the stated magnifying power, for ten inches is the distance at which the magnified image is measured, and though we sometimes trace within that distance, yet I usually draw at the distance of eighteen inches, which makes the image four-fifths larger.

Having now described a stationary graphic microscope, I will show how the telescope may be used as a microscope: premising that whenever it gives an image larger than the object it is a microscope, and that, though a telescope magnifies most with an object-glass having a long focus, it is the reverse with the microscope; for that magnifies most with a short object-glass, and the further that is placed from the eye-piece the greater will be the power.

The telescope, Fig. 2, being suited to receive either a four or an eight-inch object-glass, I put the shortest one in, and pull the tubes out the full length, which is rather more than double the focus; therefore it will require the object to be placed within eight inches distance from the object-glass, to enable it to give an image at the eye-piece. This image will bear exactly the same proportion to the object as their respective distances are from the object-glass; in this case it will be a little larger, and the eye-piece will magnify the image about six times; and if the paper on which the image is traced be more than ten inches distant from the eye-piece, it will be still larger, so that this combination will make a miniature of one inch appear as large as life. I sometimes lay the object on the table or drawing-board, like P O, Fig. 1, because then the same board will hold all together quite steady, and gradually raise it till its image is given large enough. If the object is placed vertically on either side of the object-speculum, the instrument may be slid on the table to or from it till correct vision is obtained: even here, that all may be held together, I prefer clamping this side-support to the board. In this, as well as in a telescope, the image will be gradually lessened if we gradually increase the distance of the object, and gradually slide in the object-tube to regain distinct vision, so we can always choose the exact size that is most eligible. It is obvious that, by using object-glasses of shorter focus than those provided for the telescope, we may carry on the power till it equals the stationary microscope.

I will now show some of the advantages obtained by using this graphic telescope: premising that instruments not being masters, they cannot make artists of those who want the necessary previous knowledge and practice; but my instrument is a most excellent servant, and one that will greatly facilitate the progress of an artist.

In the first place, it sets him quite at liberty in the choice of the distance from which he will take his view, and also in the size of the sketches; for without such help we are frequently obliged to go much too near in order to see the leading features, and thus, by the violence of the perspective, lose much of the grandeur and true proportion. With my telescope there is no distance from which an artist would choose a view, but what it will shew distinctly, and of any size that he could wish. When a back-ground is mountainous, sketching further off brings them up in much grander proportion, and thus the telescope finds numerous fine views that before were unnoticed; intervening objects hiding them from a near view, and sometimes water removing us too far to see them large enough to claim our attention. In thus drawing attention to more distant views, I do not mean to neglect the grand and imposing effect so often obtained by a near view, where the artist is enabled, by the rapid increase or decrease of the perspective, to alter so much the apparent proportions of the object, as to render it greatly superior to its natural proportions as seen from a distance; but for these, drawing by the eye is frequently better than with any instrument.

This telescope will give all the views strictly correct, without any care or anxiety about the perspective; it is therefore very valuable for drawing shipping and boats, the various curves of which cannot be known, yet are hereby given quite correct. Trees may be drawn more correctly, and with much more of the details, than otherwise we should have patience to attend to. Indeed, all local objects,—wagons, and the various implements of husbandry, which must be had, and yet are scarcely worth the trouble, animals, figures, and birds,—may readily be drawn; and by taking away the object-speculum, these objects or views may be drawn at once on stone the reverse way, and so be printed the right way: thus we may now publish real sketches from nature.

Wild or savage animals may be sketched from a place of safety, at such a distance as not to rouse or disturb them; also timid animals, which will not remain still if we go near them. In this case a good artist needs not always to trace; the image of the animal may be in one part of the field, and a copy made of it close by the image, which is a peculiar advantage when the object is in motion.

Portraits of any size may be drawn from life. To do this it is convenient to place the head of the sitter in contact with a V-shaped gap in a board, attached to the back of a chair.

The instrument is of great use for copying or reducing from statues or pictures, architecture or machinery. It also supplies with the greatest ease all those magnificent effects produced in mountain scenery by accuracy in geological details.

Artists may also employ mere draughtsmen to sketch correctly the inferior details for them, and thus save their time to attend to the nobler parts of the art. Few flowers remain in the same state long enough to be drawn correctly, with the lights, shadows and reflections, caused by sunshine: with this instrument that may be done. Also the most minute botanical or entomological specimens may be drawn as large as needful to shew the particular details.

If this telescope, table, and draughtsman, were mounted on a polar axis, (a strong axis placed parallel to that of the earth,) and moved by a clock, a most perfect map of the stars could be traced, of any required size; for he would then direct his telescope to succeeding portions, as though they were all quite stationary.

PREPARATION OF PIGMENTS.

(Resumed from page 176.)

Periodide of Mercury.—Iodine, which is one of the elements of this color, is a simple substance discovered about thirty years since, in treating with sulphuric acid the sea-water of the soda of Varec. The name iodine is derived from the beautiful violet color which this substance takes when it is the state of gas.

At the common temperature it is solid, and has a metallic lustre resembling black lead; it volatilizes at the temperature of boiling water. Combined with the deutoxide of mercury it takes a scarlet color brighter than vermillion. In England this pigment is sold under the name of geranium red, and is used chiefly in water-color painting. The following process is one of the best for preparing this color:—Iodine and zinc (forming iodide of zinc) are first to be combined; for this purpose the zinc must be finely powdered, either by throwing it into water when it is melted, or by levigating it in a mortar until it loses its cohesion and can be easily divided.

The powdered zinc must then be put into a mattrass with the iodine and distilled water, and, by help of a moderate heat, the iodine will combine readily with the zinc, and forms with that metal an iodide, which is then filtered.

Perchloride of mercury (corrosive sublimate) is then dissolved in distilled water; the two liquids are then mixed, and immediately a large quantity of precipitate is formed; this deposit is washed first with distilled water, and afterwards with filtered river water. The working of this color is of the greatest consequence, and must be done with peculiar care.

The Lakes.—This name was originally given to designate merely the purplish color called crimson, and when employed alone it always bears that appellation; but in its more extended sense it is applied to all colors prepared by combining a coloring matter or tincture with a basis which is commonly alumine: hence we have yellow, green, or violet lake.

The term itself appears to be of Indian origin. It is probable that the first lakes used in Europe came from India, and were made from the resinous lac so abundant in that country, which yields a purple coloring matter at present very essential in painting, because in many respects it takes precedence of cochineal.

It was first imported into England, where it is called, in commerce, *lac*, or *lac dye*. The people of India collect this resin, bruise it, and then boil it in water slightly alkaline, which separates the coloring matter; the solution is then precipitated with alum, and is formed into cakes and dried. This is the way in which it is imported.

Preparation.—The manufacturers commence this process by preparing that which is called "the white body of lake," which is composed of a paste of pure alumine, or of alumine and chalk, upon which the coloring matter being thrown, fixes itself in a manner more or less durable.

To prepare this paste, a quantity of alum is to be dissolved in water; and this solution is then precipitated by subcarbonate of soda or potass, * in the proportion of three parts of good potass to five of alum: it is easy to ascertain whether the whole of the alumine is precipitated without an excess of alkali; when the precipitate has fallen to the bottom of the vessel, some of the clear liquid should be drawn off into two glasses; into one of these is thrown some drops of a solution of potass, and into the other a little alum water; if the precipitation is

* Soda is preferable for this purpose. Four parts and a half of this material are required to saturate five parts of alum.