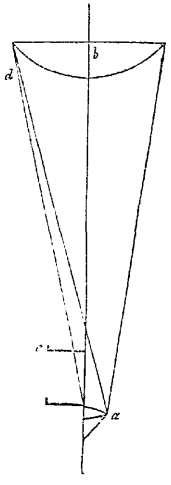
Remarks *on the* Binocular Microscope.

By F. H. Wenham, Esq.

I have been frequently asked why I have not termed my binocular the "Stereoscopic Microscope?" I may reply that the prevailing idea of stereoscopic vision is more connected with the combined effects of two separate objects, or pictures, than the solid appearance of a single body, having bulk or thickness. What I should term a "Stereoscopic Microscope" would be literally two microscopes, with their object-glasses, placed side by side, like an opera glass, with similar adjustments for the distance between the eyes. If such an instrument were furnished with erecting-glasses and draw-tubes, for varying the magnifying power, only one power of object-glass would be requisite, and I have no doubt that in many applications it would be found serviceable, as for the detection of forged trade-marks, &c., and irregularities of pattern. Two single lenses, of about 1½-inch focus, afford some curious results. Taking for example such objects as the similar titles of two different advertisements from a newspaper, or the headings from the various pages of a book in large type, the letters will appear in some places to rise up hill, and in others to fall away, or lay all aslant in a most fantastic manner, indicating that the type has not all been cast in the same matrix, and that the spaces are irregular, both in parallelism and thickness. Two postage-stamps also afford good objects. Many will be found so nearly alike that their combined images appear quite flat, but very frequently the head appears like a bust, either above or below the matted ground, accordingly as they are transposed either to the right or left, thus showing that there is considerable irregularity either in the plates or the mode of printing.

The numerous microscopes that have been altered into binoculars in accordance with my last principle, and also the large quantity still in the course of manufacture, will, I think, justify me in making the assertion without presumption, that henceforth no first-class microscope will be considered complete unless adapted with the binocular arrangement. Taking this for granted, it will be to the interest of our best makers to get up their object-glasses in future so as to give every possible advantage to the requirements of the principle. There have been some complaints that, with the highest powers, as the $\frac{1}{15}$th and $\frac{1}{8}$th, and in some instances (but not always) the $\frac{1}{4}$th or $\frac{1}{3}$th, a portion of the field of view is obscured, rendering it almost impossible to use the two

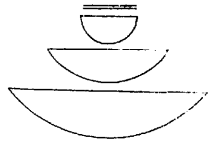
highest powers. This does not arise from any defect in the principle or in the construction of the prism, for this, if neatly and properly made, divides the pencil with a knife-like precision and with no appreciable loss, for the total reflection is perfect and effective quite up to the sharp edge. The obscuration of part of the field is caused by the long distance of the back lens from the prism, and it will be found experimentally that when this distance is increased by adapters, or otherwise, a still greater portion of the field is lost. In the low powers, including the $\frac{4}{10}$th, the posterior or conjugate focus is long, and the back combination of large diameter; consequently, in a relative sense, the prism is comparatively much closer to the back lens, and any small section of the field cut off is beyond the limits of the lowest eye-piece. The annexed figure will demonstrate the reason of this dark portion appearing, as it does, more or less with the highest object-glasses. *a* is the object-glass of a compound microscope taken as a semilens for the simplicity of the illustration. The rays from this half, if unimpeded, will fill the whole of the field-lens (*b*) of an ordinary Huygenian eye-piece, but supposing a stop on the prism (which acts precisely as a stop for either half) bisecting the aperture be raised from contact with the back of the object-lens to the position *c*, it then appears that the rays from the diameter cannot reach the side of the field-lens at *d*; and as we continue to raise the stop, with its edge to the axis, more and more of the field of view and of the object is cut off, and finally, when the prism arrives close to the eye-piece, we should get merely half the field of view and half the object in each eye, and in this position it would be impossible to see the same spot in the object, with both eyes at once, with any of the object-glasses; the object being simply divided into two separate portions.



It is obviously impracticable to bring the lower face of the prism quite close to the back of the object-glass; but I

would earnestly recommend the makers to construct the settings of the highest powers in future as short as they safely can, in order to obviate this want of field as far as possible. I can offer no other suggestion, and the remedy is solely in *their* hands.

I have before stated that the employment of a strong direct light should be avoided for the illumination of objects observed with the binocular microscope, as direct rays tend to destroy the stereoscopic effect. For this reason I recommended the use of diffused light. The annexed figure shows a form of illuminator that has been found to give an excellent effect. It



consists of three plano-convex lenses of the diameters and radii shown; it condenses a very large *area* of light, and consequently gives great intensity. The final emergent pencil has an angular aperture of 170°. Just above the top lens of the combination there is a sliding-cap, the crown of which contains the diffusing film. For this I have had some difficulty in finding a perfectly white and homogeneous, and at the same time partly transparent, material. What I now employ is the beautiful snow-white powder obtained from turning glass with a diamond turning tool. This may be procured from the opticians, and should be well washed, to free it from the larger particles. A thin film of this impalpable powder is then compressed between two discs of thin glass, and fixed in the top of the sliding-cap, which is to be raised or lowered till the most intense light is obtained on the film. This illuminator is employed in the position of the achromatic condenser. I generally place a disc of slightly coloured neutral tint glass below the bottom lens, as it increases the purity of the light, and gives greater distinctness to objects. The effect of this diffusing film is sometimes enhanced by condensing light down on the object from above as well as below. In fact, in the use of the binocular microscope, I am constantly in the habit of placing the light so as to illuminate both as a transparent and opaque object at the same time, so that each method is ready to be used separately or together as may be found requisite.