Extracted from:

The Achromatic Microscope
by Richard Beck, 1865

THE UNIVERSAL MICROSCOPE.

THIS instrument is the result of an endeavour to make a very low-priced Compound Achromatic Microscope by reducing its construction to the simplest possible form, still retaining all that a really useful instrument requires, together with such an arrangement as would admit of considerable additions being made without returning the stand to the makers. These features, together with other details, are fully explained in the following description:—

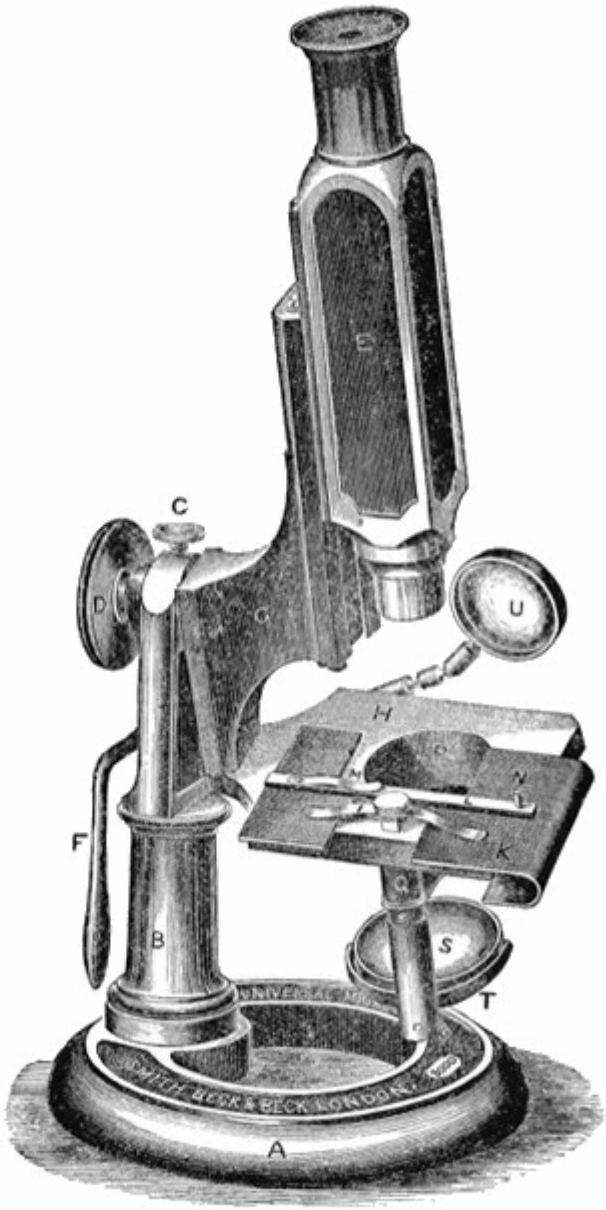
The foundation of the stand is a large circular base (fig. 37, A), and near its circumference, on the left-hand side, is a strong pillar (B); at its top is the axis upon which the remainder of the instrument turns, and with so equal a balance as never to require more than a slight screwing down of the small milled head, C, to secure any particular position.

On the same centre as the axis is a large milled head, D, by turning which a quick motion is given to the body, E; and depending from the smaller part of the same milled head is a lever, F; this of itself hangs free, but when held at the lower end, and pressed sideways, either nearer or further from the pillar, it obtains a gripe upon the milled head, which can then be turned so slowly as to constitute a very good slow motion.

The quick-motion milled head and the slow-motion lever are always in the same position, and do not alter with any inclination of the body; they are also so low down, that in using them the hands are very little raised from the table;

THE UNIVERSAL MICROSCOPE.

Fig. 37.



This illustration is drawn to a scale of half size.

this latter advantage also applies to the stage (H), which is screwed on at the lower end of the limb (G) at less than four inches from the bottom of the stand.

On the top of the stage is a double spring (I) branching right and left over a brass plate (K); on this there is a ledge (L) for the object to rest upon, and in continuation on the right-hand side the plate is bent over so that it may be firmly grasped by the fore and middle fingers underneath, and by the thumb above. With this arrangement the object can be moved freely in every direction, and will retain its position after the hand is withdrawn. If necessary, the short spring (M) may be used when the object has to be held firmly on the plate. The pin (N) is for holding the forceps. Beneath the stage is a cylindrical fitting (P) for all the apparatus required in that position.

Fig. 38.

½ size.

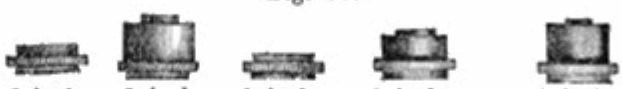
The diaphragm (fig. 38) is, however, made a fixture to the mirror-stem; but it will turn away entirely on the left side, when necessary; it is provided with one small aperture (X) for the lower powers, and this can be closed by a small shutter (Y).

A concave mirror (fig. 37, S) swings in a rotary semicircle (T) which is attached to an outside sliding tube, the inner tube being screwed beneath the stage; on the opposite side a condenser (U) is fixed for the illumination of opaque objects; it is provided with ball-and-socket joints, which afford any necessary movement, and also the means of turning it out of the way when not in use. Its focus for a lamp or candle five inches from it is about $2\frac{1}{2}$ inches; for daylight, $1\frac{3}{4}$ inch.

There are five object-glasses with which the Universal Microscope may be furnished, viz. 2-inch, 1-inch, ½-inch,

$\frac{1}{4}$-inch, and $\frac{1}{8}$-inch (fig. 39); they differ from the powers of all other instruments in having, a smaller-size screw for their attachment to the body, and the settings of their lenses made as short as possible, these variations having been made to suit them to the "Combined" and "Binocular" bodies, described further on.

Fig. 39.



2-inch. 1-inch $\frac{1}{2}$-inch. $\frac{1}{4}$-inch. $\frac{1}{8}$-inch.

$\frac{1}{2}$ size.

The eyepieces (fig. 40) are of a construction introduced by Kellner, and they give a flat and, for their size, a large field of view. Their chief fault will, we believe, prove a general advantage: any dust or moisture upon the field-lens is so annoyingly apparent from its being in the focus of the eye-lens, that those who use this form will be compelled to wipe the lenses frequently; and not only this, but they will soon learn the necessity for the constant examination and the occasional cleaning of every surface of glass that they have about their microscopes.

Fig. 40.

No. 1. No. 2. No. 3.

$\frac{1}{2}$ size.

The apertures of the object-glasses of the Universal Microscope and their linear magnifying powers when combined with the eyepieces are given in the following list, together with the increase that may be obtained by the addition of a lengthening tube to the body—an arrangement which, under many circumstances, is of great advantage.

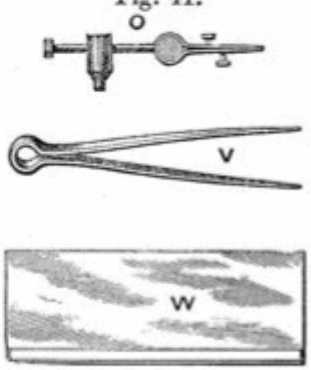
List of Achromatic Object-glasses for the Universal Microscope.

Focal length.		Linear magnifying powers, nearly, with eyepieces		
		No. 1.	No. 2.	No. 3.
2 inches,	with ordinary body	20	30	65
	with lengthening tube	40	55	100
1 inch,	with ordinary body	55	75	155
	with lengthening tube	95	125	250
½ inch,	with ordinary body	115	150	325
	with lengthening tube	190	250	500
¼ inch,	with ordinary body	175	225	480
	with lengthening tube	275	350	650
⅛ inch,	with ordinary body	315	425	865
	with lengthening tube	470	630	1250

The higher powers, viz. the ½ inch, ¼ inch, and ⅛ inch, have no adjustments for variations in the thin glass or other media interposed between their front lenses and the object; but they are corrected for a piece of glass ·008 thick, and these object-glasses will define the best when the object is covered with glass of such measurement.

The forceps (fig. 41, O), a small pair of pliers (V), and a glass plate with a ledge (W) are also generally supplied with this microscope.

Fig. 41.



½ size.

The case is made of mahogany, and of an upright form; the instrument, when put away, slides into it so that the pillar occupies the left-hand corner next the door; the stand is blocked to prevent any injury in carriage. One object-glass and one eyepiece are intended to remain on the microscope; a small board on the door receives the remaining apparatus, with room for any additional object-glasses or eyepieces that may be required. Provision is also

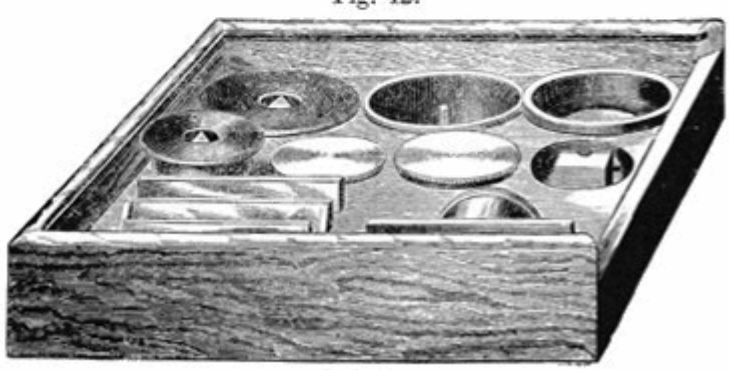
made in the case for a small box (fig. 42), to contain the extra apparatus alluded to hereafter.

This microscope can be kept in perfect working order by a little attention to one or two parts. If the body work loose in its dovetail fitting, it can be corrected by unscrewing the screw (fig. 37, *a*) at the upper part of the limb half a turn, and by screwing up the one (*b*) at the lower part of the limb to the same extent; or if this should not be sufficient, it may be repeated until the body will not rock in its fitting. This operation is really that of pushing up by the lower screw, a dovetailed wedge; but, to retain this in its proper place, it is always necessary that the upper screw should also be screwed down firmly upon it.

The chain connected with the quick and slow movements may also work loose; if so, it can be tightened by carefully turning round from left to right the smaller screw-head (*c*) at the upper end of the limb.

The extra apparatus, which may be added to the instrument at any time without its being sent back to the makers, is common to the third as well as this class of microscopes, and is described in pages 83 to 88 inclusive; but the case for containing it is shown in the accompanying figure.

Fig. 42.

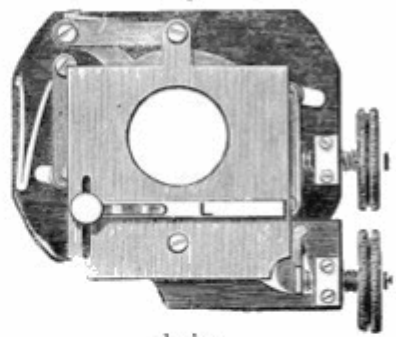


½ size.

Stage with Actions.

The double spring (fig. 37, I) which holds the stage-plate (K) can be removed by unscrewing; after this is done, the opening (P) will receive what is commonly called a Stage with actions (fig. 43); this is so contrived to fit on as to admit of its being turned round as a whole, and consequently always central with the body; or, in other words, during the rotation, the object will not move out of the field of view; the amount of movement at right angles is half an inch each way, and is effected by means of the milled heads (I, K); the object can be moved to and fro on the ledge (L), which slides up and down, and a small spring can be turned to clamp the object, when necessary.

Fig. 43.

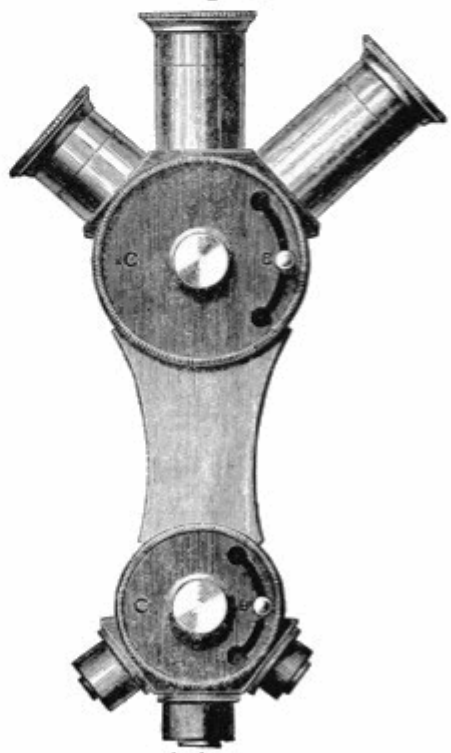


½ size.

The Combined Body.

This is a contrivance for the attachment of three object-glasses and three eye-pieces to the instrument at once (see fig. 44).

Fig. 44.



½ size.

Only one of each of these can be central with the axis of the body at the same time; but any of the others can be brought into the central position by pressing in the rounded head of the pin (B), when either of the disks (C) can be turned in the required direction, and will be stopped again by the pin (B) springing out.

This arrangement may be appreciated by those who are deterred from making a casual use of the microscope, either from the trouble of putting an instrument up, or from the delays which the necessary changes involve, whilst it will considerably assist in the investigation of objects which are undergoing a change either in their position or their structure, and when a great range of power is required with the least possible delay. As a luxury, it will apply to every use of the microscope.

Fig. 45.

½ size.

The change from the square body (fig. 37, E) to this one is made by unscrewing a large screw which is at the back of the dovetail piece fitting into the limb, and the body will then push off downwards. This process is, of course, reversed when a body has to be put on; but then some care must be taken that the screw in the lower end of the body fits the slot it slides into at the lower end of the dovetail piece, to effect which the screw may require either a little screwing up or unscrewing before the body is put on.

Wenham's Binocular Body for the Universal Microscope.

This Binocular Body (fig. 45), as applied to the Universal Microscope, possesses the following advantages:—The object-glasses are mounted on a rotating disk, as already described under the combined body; an adjustment for different distances between the eyes is made by turning the milled head (F), which will move the draw-tubes (E, E) up or down. The reflecting prism is placed close behind the back lens of each object-glass, and with this arrangement the field of view is not cut off when the objects are viewed as transparent, with the highest power.

The change to the binocular body can also be made with the same facility as has been already described under the "combined body."

Full directions for the use of Wenham's Binocular Body have been already given in pages 48 to 55, inclusive, of this treatise, and apply generally to this particular form of it.