Directions.

Place the apertometer plate, with the graduation facing upwards, upon the stage of the microscope and roughly focus the centre of the small slit in the circular silver disc with the objective which is to be examined together with any eyepiece. In the case of immersion lenses introduce the appropriate immersion fluid. When focussing, the tube length should be that which the objective demands in ordinary use. To begin with, set the radial arm of the apertometer so that the reading index may be at zero.

Unscrew from the microscope body tube the draw tube, and to its lower end, where it has a diaphragm secured to it, screw the auxiliary objective (Fig. 1) so that the latter will be within the tube. Into the other end of the draw tube slip a HUYGENS eyepiece, and with the **'auxiliary microscope'** so obtained refocus the image of the cross by a sliding motion of the draw tube.

When sliding the tube in and out exercise care not to disturb the focussing of the objective which is to be examined. It is a good plan, when displacing the draw tube, to press the main tube with one hand firmly against the microscope body.

When testing **high power** objectives the preliminary focussing upon the hole in the silvered disc may be dispensed with and the auxiliary lens used at the outset. The apertometer plate should then be centred by setting the slit, which will be seen in the field of the auxiliary microscope, centrally with respect to the image of front lens of the objective, which will be visible at the same time. Then the objective together with the tube should be moved down by means of the coarse adjustment until the field of view of the auxiliary microscope becomes as large as possible, after which the image of the cross should be focussed by means of the draw tube.

Now set the radial arm with the cross in the cursor away from zero until its centre exactly coincides with the periphery of the bright circular surface, which is the apertural image of the objective, i. e. so that only one half of the cross is to be seen. When this is the case read off the corresponding position of the index line on the scale. Next displace the cursor to the other side until the centre of the cross exactly coincides with the other side of the periphery, and again take a reading. **The mean of both readings gives the required value.** In the event of the cross not appearing sharply defined at the extreme edge correct the position of the auxiliary microscope.

The outer scale, the one nearer the edge of the apertometer plate, supplies the value of the numerical aperture, whilst the inner one reads the corresponding apertural air angle.

The **illumination** required for measuring the aperture should be so adjusted that the light may fall horizontally upon the cylindrical surface of the glass plate. Should the width of the source of light not be sufficient for this purpose, so as to produce on both sides a sufficiently bright image within the tube, place in front of the microscope a semicircular translucent screen such as a suitably bent

sheet of thin white paper. The upper edge of this screen should lie a little higher than the surface of the apertometer, or in the alternative turn the microscope for every setting into an appropriate position.

The power of the **eyepiece for the auxiliary microscope** should rise, generally speaking, with the power of the objective under test, so as to obtain a sufficiently large image of the cross. Since the ocular diaphragm, however, becomes smaller as the magnification increases, one should guard against the diaphragm of the eyepiece encroaching upon the image of the bright circular surface which appears in the auxiliary microscope.

When the apertometer is to be employed for determining the **value of low apertures** (under 0.4, of 50°), with which are generally coupled long foci (of 7 mm. and more), the apertural image of the objective should be viewed without the auxiliary microscope, that is with the unaided eye. After focussing the microscope upon the slit in the silver coating the eyepiece should be removed and replaced by a disc of sheet metal or cardboard having a small hole at the centre, such as the centring stop used in photo-micrography. This provides a means of maintaining the eye in a constant central position, the eye being then simply made to look towards the objective through this hole.

Further details respecting the theory and the use of the apertometer will be found in the following publications:

ABBE, Gesammelte Abhandlungen, Vol. I, pp. 113—118 and 227—243.
DIPPEL, Das Mikroskop, second edition, Vol. I, pp. 348—354, 1882.
Journal of the Royal Microscopic Soc. (1), I, pp. 19—22, 1878.
Journal of the Royal Microscopic Soc. (1), III, pp. 20—31, 1880.
E. J. SPITTA, Microscopy, pp. 96—98, London 1907.

Prices.

Indentif Nr.		Basic Number	Codeword
12 76 02	Apertometer with cursor and apertometer objective, in case	70	*Mimadme*
12 76 07	Apertometer with metal base and apertometer objective, in case	90	*Mimadoa*

From: Spitta (1920)

The illumination must be shifted from right to left or up and down, so that the light falls horizontally upon the edge of the glass.

It should be noted that if the apertometer be used on *low*-power objectives, such as an inch, *with high N.A.*, owing to the size of the back lens having to be so large, the *auxiliary* combination may not be of sufficient diameter to give the maximum N.A. of the objective under examination. Also, and this is commoner still, with medium powers, say $\frac{1}{4}$, $\frac{1}{5}$, or $\frac{1}{6}$, it is not at all improbable the ordinary eyepiece, whether achromatic or compensating, may not command sufficient field of view; so between the two troubles a false N.A. may be obtained. This actually happened in our case when testing an inch N.A. '3, an apochromatic quarter-inch, and an achromatic sixth, the mistake being only discovered when applying as a check one of the following methods about to be described, when different results were obtained. To remedy the first fault with low powers, let the observer look down the microscope after the first focussing, and regulate the indices *without* the auxiliary lens, using no eyepiece at all; whilst to avoid the latter trouble it is best by far to employ an ocular having no diaphragm on all occasions.