

Macrophotography of the anterior segment of the eye

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Existing photo-slit lamps are used at magnifications of $\times 1$ to $\times 4$. These magnifications provide satisfactory survey photographs to show the site of a lesion, but even at magnification $\times 4$ there is less detail resolved in the photograph than the observer can obtain for himself by inspection through the slit-lamp binocular. My aim therefore has been to produce a camera capable of recording any detail which can be observed.

Choice of magnification

Camera magnification cannot be increased without incurring disadvantages: reduction in size of field of view, reduction in depth of field, and reduction of light reaching the film. These characteristics are directly related to the magnification used. Blur due to subject movement also increases with magnification and becomes a real problem even though exposure is made by electronic flash.

The ideal magnification therefore is the least which will meet the requirement of recording all visible details. Preliminary tests were made with a prototype camera which was capable of continuous adjustment from $\times 4$ to $\times 20$ magnification. It was found that the performance came up to the requirement at $\times 10$. At greater magnification it was difficult to obtain consistently sharp pictures and to obtain enough light for correct exposure.

Apparatus

The dimensions involved in an apparatus giving a magnification of $\times 10$ are shown in Fig. 1. The standard 35 mm. film format measures 24×36 mm.; at $\times 10$ magnification this corresponds to a field of view of 2.4×3.6 mm. (Fig. 2). The exposure factor at $\times 10$ magnification is $\times 121$ that for infinity focus.

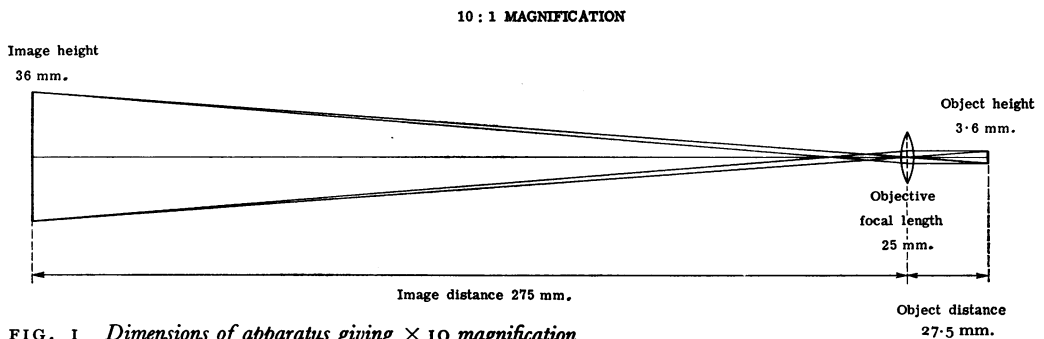


FIG. 1 *Dimensions of apparatus giving $\times 10$ magnification*

A macrophotographic objective, Taylor Hobson Cooke Anastigmat special 1 in. (25 mm.),* is used. This lens has a maximum aperture of $f2.7$, and is designed for the special relations of the conjugates involved in macrophotography. The relatively short focal length, 25 mm., makes it possible to construct a reasonably compact apparatus, since the dimensions are geometrically related to the focal length of the lens. The lens and camera are mounted at opposite ends of a tube which provides a fixed image distance of 275 mm. (Fig. 3). The object distance is 27.5 mm. which was not found to be too close for convenient use.

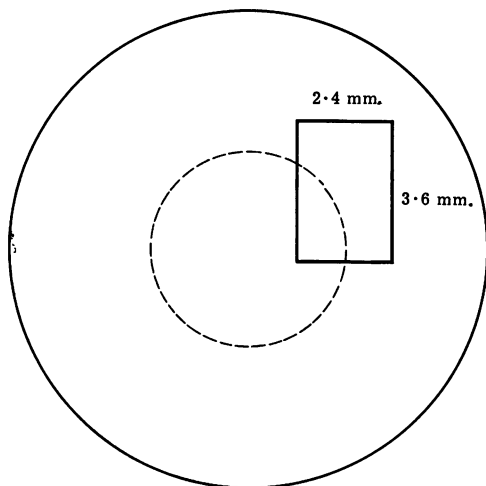


FIG. 2 *Field of view on cornea of normal diameter at $\times 10$ magnification*

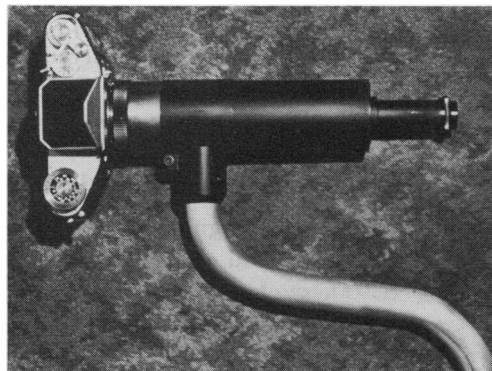


FIG. 3 *Apparatus for $\times 10$ macrophotography*

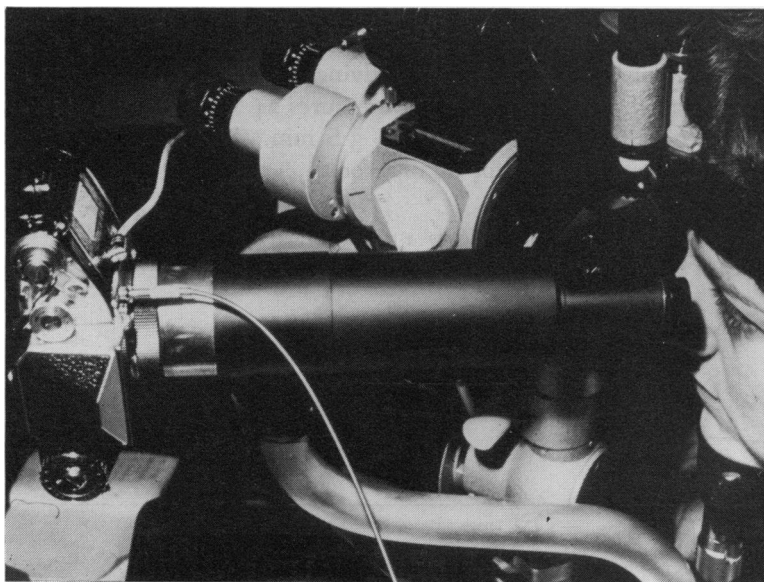


FIG. 4 *Apparatus mounted on Zeiss Photo-Slit Lamp*

*Supplied by Vickers Instruments, York

The camera is a 35 mm. single lens reflex and it is essential that this should be fitted with a clear screen and cross-hairs of the type supplied for photomicrography. The conventional ground glass screen is too coarse-grained for focusing the fine details. With the clear screen in place, the observer focuses upon the aerial image and the cross-hairs prevent his eye from accommodating. Focusing is performed at the working aperture, full aperture focusing being unnecessary with the clear screen. The view is excellent and similar in quality to that obtained with a monocular microscope. Any feature which can be seen in the viewfinder will appear on film if given correct exposure.

The whole apparatus is mounted upon the Zeiss Photo-Slit Lamp (Fig. 4), which provides filament illumination for viewing and synchronized flash for exposure.

Exposure

Photographs can be made by most of the forms of illumination used in slit-lamp practice, including broad beam, narrow beam, retro-illumination, and specular reflex. Diffuse illumination from a small electronic flash gun can also be used. Correct flash and lens aperture settings for these examinations have been determined by experience. The

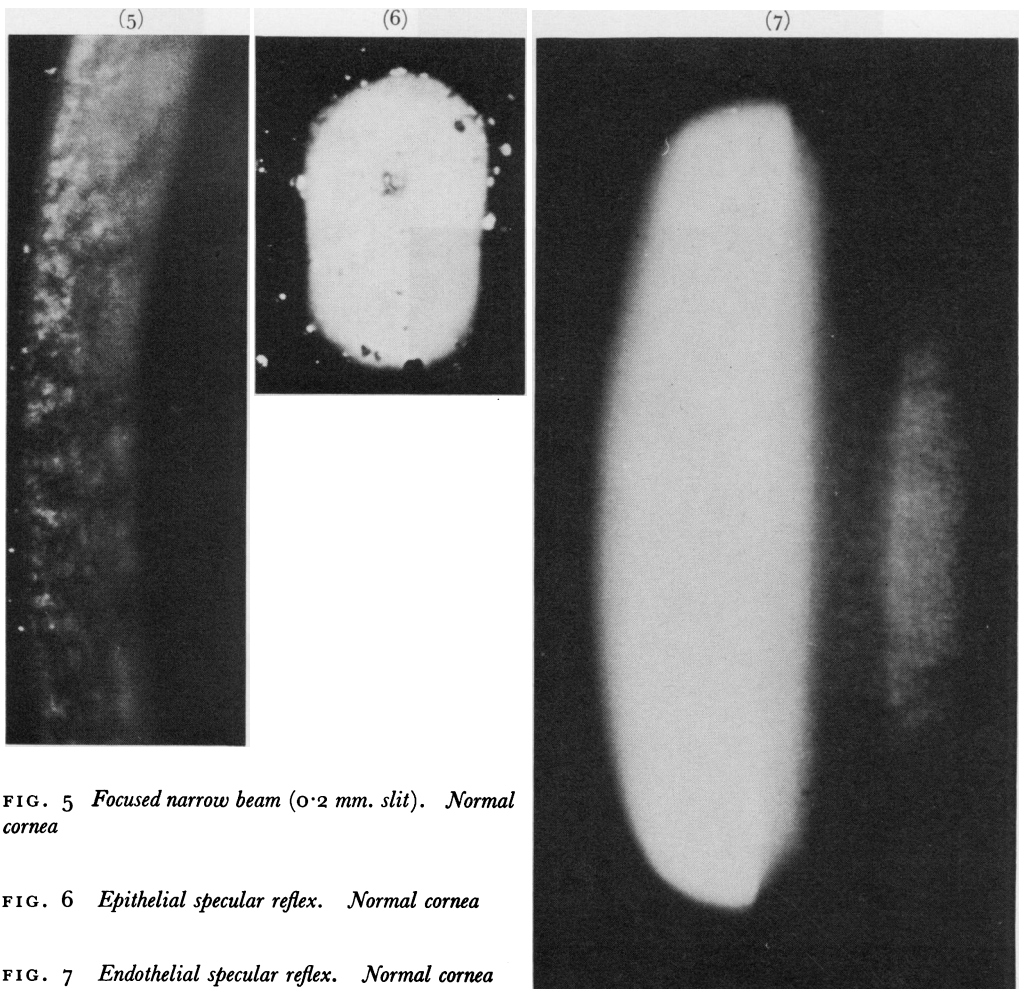


FIG. 5 *Focused narrow beam (0.2 mm. slit). Normal cornea*

FIG. 6 *Epithelial specular reflex. Normal cornea*

FIG. 7 *Endothelial specular reflex. Normal cornea*

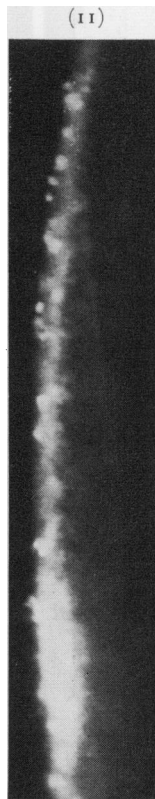
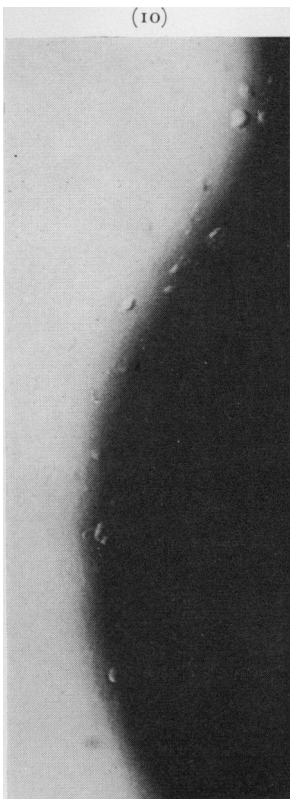
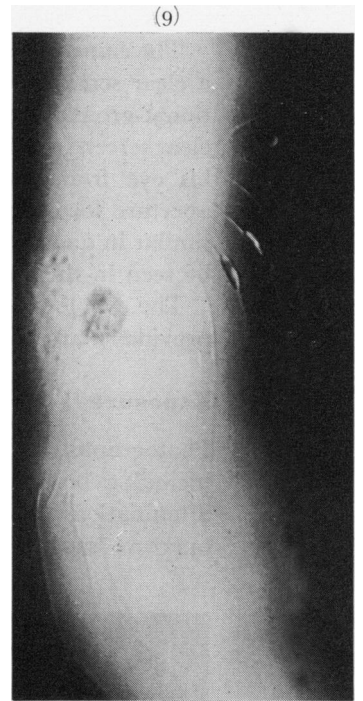
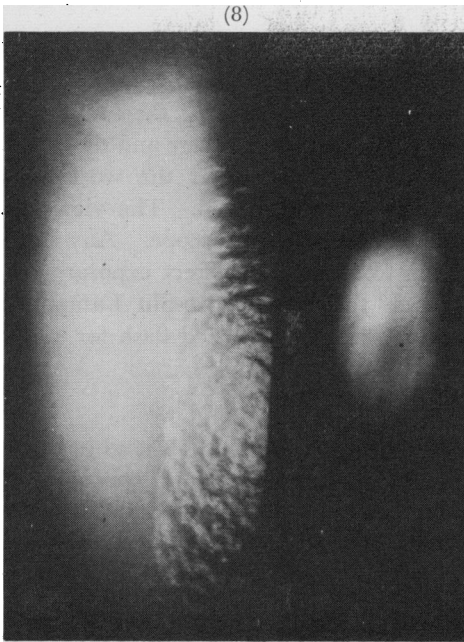


FIG. 8 *Anterior lens shagreen. Normal lens*

FIG. 9 *Retro-illumination. Finger-print lines in healed recurrent erosion*

FIG. 10 *Retro-illumination. Meesmann's epithelial dystrophy*

FIG. 11 *Focused narrow beam. Meesmann's epithelial dystrophy*

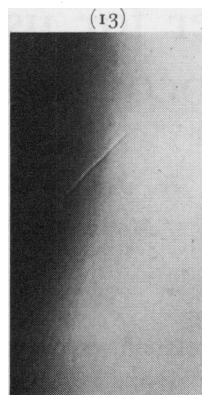
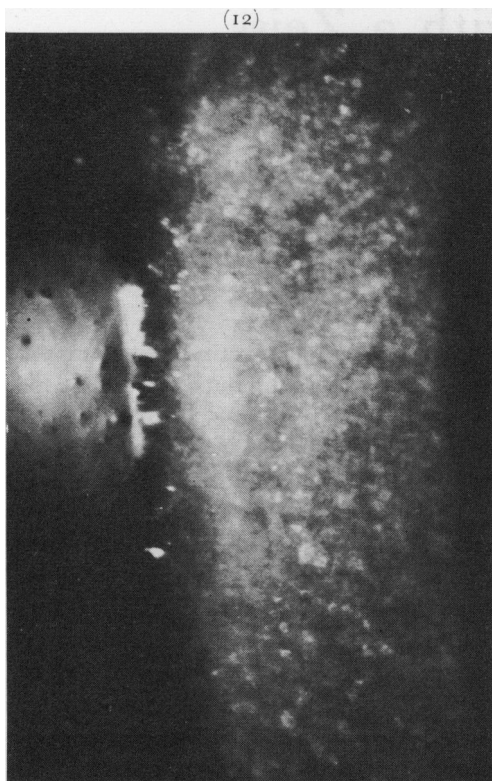


FIG. 12 *Broad beam and specular reflex. Meesmann's epithelial dystrophy*

FIG. 13 *Retro-illumination. Onchocerca microfilaria in cornea*

focused narrow beam of the slit lamp has proved to give the least light, with which correct exposure is obtained using a 0.2 mm. slit, full flash power, the lens aperture fully open at $f2.7$, and a film speed of 160 ASA. High Speed Ektachrome is used for colour and Ilford FP4 for black-and-white photographs. For other exposure situations smaller lens apertures are used down to F11.

Examples of the photographs so obtained are shown in Figs 5 to 13 (above).

I wish to thank Prof. Barrie Jones for his help and encouragement and for permission to publish photographs of his patients, and Mr. Frank Sheen of the Institute of Ophthalmology who made the apparatus for me.