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INEXPENSIVE PHOTOMACROGRAPHY OF SMALL CRYSTALS AND MINI-MICROMOUNTS

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ABSTRACT

Standard 55 mm and 28 mm (wide-angle) lenses mounted in the reverse position on a 35 mm reflex camera provide an inexpensive means of obtaining photographs of small crystals. Magnifications are enhanced by addition of simple extension tubes. In the same manner, use of a 6.5 mm or similar lens from an old movie camera yields magnifications in the order of 30x. Addition of a tele-extender to the assembly greatly enhances depth of field in each case. There are advantages of using a small-diameter objective.

SOMMAIRE

Des lentilles normales de 55 mm et de 28 mm (grand-angulaire) placées en position renversée sur camera reflex de 35 mm permettent d'obtenir rapidement et à bas prix des photographies de petits cristaux. On améliore le grossissement en ajoutant de simples tubes d'extension. De même, l'utilisation d'une lentille de 6.5 mm (cinématographique ou autre) donne un grossissement de l'ordre de 30x. En ajoutant au dispositif un doubleur de focale, on augmente dans chaque cas la profondeur de champ. Il y a avantage à employer un objectif de petit diamètre.

(Traduit par la Rédaction)

INTRODUCTION

Prior to extracting very small crystals or other material for X-ray examination or for other purposes it is in many cases good practice to first photograph the sample. For the amateur the problem is to find a combination of lenses and accessories which yields optimum results at high magnifications. We describe here a relatively simple and inexpensive procedure that helps accomplish this.

Equipment used included a Nikkormat FT2 35 mm camera with standard 55 mm and 28 mm (wide-angle) lenses coupled in the reverse position. Following Lesser's (1973) advice, extension tubes and various accessory rings were employed to enhance magnification. Although not used in this present exercise, Lesser also recommends that a (3x) tele-extender be connected to the camera in addition to the preceding assembly. Unlike extension tubes the tele-extender contains glass-lens elements and changes the focal length of the lens as well as the resulting *f*-stop numbers. According to Lesser (1973) the result is a 50% increase in depth of field over that obtainable with a macro lens at any given magnification. Thus, whereas a macro lens is designed to work at magnifications of 1:1 in the normal position, a normal lens is used in the reverse position for magnifications of 1:1 or greater.

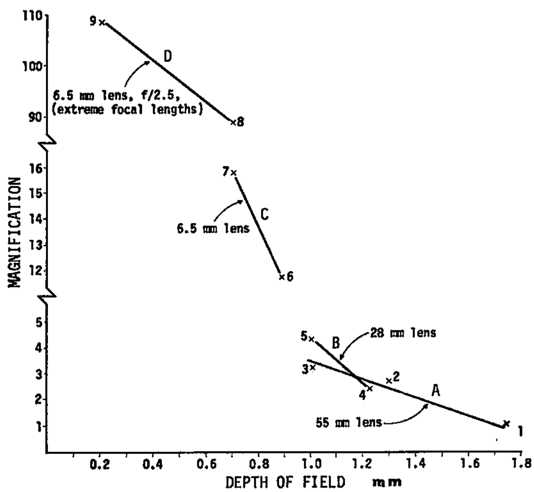

FIG. 1. Magnification *vs.* depth of field for: A) 55 mm, 1:1.2 lens coupled in reverse position with PK3 extension ring (1), with 15.2 cm extension tube (2), and with PK3 extension ring and 15.2 cm extension tube (3); B) 28 mm 1:2.5 wide-angle lens coupled in reverse position with PK3 extension ring (4), and with 15.3 cm extension tube (5); C) 6.5 mm 1:2.8 lens coupled in reverse position (6), and with PK3 extension ring (7). Note: In case D, measurements were made using the 6.5 mm lens at focal lengths of 62 cm (8) and 76 cm (9) using a ground-glass screen and maximum aperture.

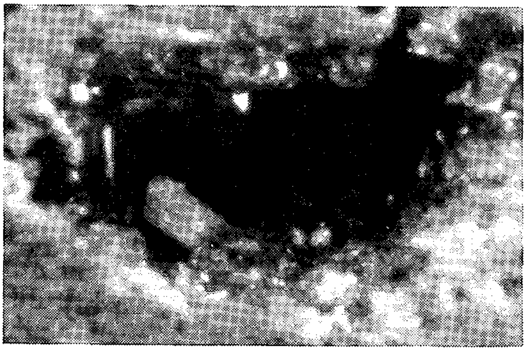

FIG. 2. Apatite crystal approximately 0.8 mm in diameter in tiny vug, x6; 6.5 mm (Mikar 8 mm movie camera), 1:2.8 lens coupled in reverse position with PK3 extension ring. Fibre-optics illumination; photographer D.J.M.

p. 9-10). Unless otherwise indicated, tests were conducted at $f/8$ on a graticule etched at 0.5 mm intervals and inclined at 45° to the line of focus. The results are summarized in Figure 1.

In addition we fitted a bayonet attachment to a wide-angle 6.5 mm objective from a Mikar 8 mm movie camera and this was likewise mounted in the reversed position. The advantages of cine lenses over others for photomacrography are described by Eastman Kodak Company (1969,

Comparison of the three lens-systems at the same magnification is difficult without increasing the focal length prohibitively. However, the results make quite clear the advantage of using the 6.5 mm lens when working with very small samples. Under the foregoing conditions details are brought out on crystals as small as 1 mm (Fig. 2). In practice the optimum aperture is rather larger than $f/8$; the exact amount may be determined experimentally. Alternatively, reference to standard working-curves may be made (Eastman Kodak Company 1969).

By increasing focal length drastically, magnification in the order of 100x may be obtained at little sacrifice in depth of field (Fig. 1, plot D) using the 6.5 mm lens. However, problems of illumination and diffraction result in unacceptable loss in depth of detail under these conditions (Wilson 1974).

Among the advantages of using a small-diameter objective that may appeal to micromounters and mineralogists alike, are: 1) ease of lighting the specimen (the narrow objective allows more light to be thrown on the object; fibre-optics lighting is ideal in this instance); 2) the apparatus is far less expensive than a macro lens and, under identical magnification, the image will likely be of higher quality if only for the fact that far fewer lenses are involved; 3) although a horizontal track is preferable to the vertical (which we used) the risk of vibration is far less when the small lens is used; 4) the results are better than those attainable photomicrographically unless an expensive apochromatic objective and compensating eyepiece are employed.

ACKNOWLEDGEMENTS

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