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Electronic Flash Photography of Gadoid Otoliths

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A simple technique of photographing cod and other gadoid otoliths has long been needed. The usual method of photographing them using the same side-lighting system that is used for their examination through the microscope tends to give very variable and disappointing results on black and white film. However, in November, 1962 some promising results were obtained on colour film using this method of illumination. The writer was then asked to find a method and apparatus whereby consistently good results could be obtained easily.

The problems to overcome were partly photographic and optical: adequate even illumination and ease of focussing, and partly mechanical: always getting the otolith in the same position relative to the light source. Electronic flash was the obvious source of illumination. Parrish and Sharman (1959) have used a ring flash unit successfully for photographing herring otoliths by reflected light. Experiments showed that with the ring mounted in a suitable reflector this system could be used for side-lighting an otolith. A 35 mm single lens reflex camera overcomes focussing difficulties. The otolith mount and staging described below are designed to ensure that the otoliths are always photographed in the same position relative to the light source.

The complete apparatus is shown in Figure 1.

The Camera is an Edixamat Reflex D-L with a standard Edixa bellows extension. The waist-level viewfinder allows focussing on a ground-glass screen. Alternatively a pentaprism viewfinder is available. The lens used is a 38 mm focal length f 3.5 Schneider-Kreuznach Radionar with an adapter ring to fit the Edix lens thread. With this lens a linear magnification of 4.3 times is obtained at the 13.5 cm maximum extension of the bellows. This is sufficient magnification for all but the smallest gadoid otoliths, and the bellows allows the use of smaller magnifications for photographing the largest cod and haddock otoliths. A wide variety of standard lenses is available for this camera. The camera is mounted on a bracket which can be racked up and down a vertical support pillar.

The Electronic Flash Unit. The flash tube is a Mazda F.A. 16 operating at 350 volts and giving an output of 120 joules. The 2½" diameter ring is mounted in an aluminium reflector (Fig. 2A) which directs the light towards the centre of the ring. This is fixed to a pillar so that the flash ring itself is just over an inch above the mechanical stage when this is raised to its maximum height. A circular shield (Fig. 2B) fits into the centre of the upper side of the flash reflector, to prevent extraneous light reaching the camera lens. A small aluminium mirror is fixed at 45° on the top of this shield to reflect light onto the otolith surface for focussing.

The Stage consists of a Watson's Bactil-60 Mechanical Rotating and Centring Stage fixed onto a Wolf Electric Drill stand. This gives a vertical movement of about two inches which allows easy access to the otolith mount without the need to move the flash ring. When raised to its maximum height the stage is locked in position by a wing nut. The vertical movement of the stage is not used for focussing.

The Otolith Mount consists of two parts, a 3" x 1" x 1/8" brass plate with a small plinth 1/8" high fixed at its centre (Fig. 3A) and a box tube ½" x 3/8" internal dimensions which fits neatly over the plinth (Fig. 3B). There are 1/16" slots in the two long sides of the tube 5/8" from the bottom. A circular shield fixed to the top of the tube loosely fits into the shield on the flash reflector. The inside of the box tube, the edges of the slot and the shield on top are painted matt black. The otolith is mounted in plasticine stuck to the plinth. It is adjusted until it is roughly level and is then pressed down with a plunger (Fig. 3C) which just fits into the tube, until only 3/64" (about 1 mm) is above the level of the slots. By this means the otolith surface is always put into the same position relative to the slots and to the flash tube.

Operation. The otolith is mounted in the way described above. Best results are obtained from otoliths with a ground surface, (Bedford, this meeting) although broken otoliths can be used as long as the surface is not too uneven. The otolith mount is put on the stage which is then raised to its maximum height. A narrow beam of light from a microscope lamp is reflected onto the surface of the otolith by the aluminium mirror. The camera is racked up or down to give the optimum magnification. Minor adjustments to centre the otolith are made by means of the mechanical stage. Critical focussing adjustments are usually made with the lens focussing mount although the bellows movement may be used.

When the final focussing has been done the microscope lamp is switched off and the electronic flash unit switched on. To obtain uniform results exposures must be made at the same charge level. With the present apparatus this is achieved by making the exposure within ten seconds of the lighting up of the charge level neon on the power-pack. If a voltage limiter is fitted into the power-pack circuit the maximum charge level will be maintained provided sufficient charging time is allowed between exposures.

Results

Two prints from Kodachrome II transparencies are shown in Fig. 4. These results are very close to what is seen through the microscope and viewers are agreed that their interpretation is easier than that of black and white prints. With this apparatus best results have been obtained using stops of f 5.6 and f 8, regardless of the size of otolith and lens extension used. Washing the otolith surface with a small quantity of xylene, creosote or cedarwood oil helps the penetration of light to the nucleus of otolith but narrow hyaline zones at the edge may be cleared too much.

References

Parrish, B. B. and Sharman, D. P. 1959 Otolith types amongst summer-autumn spawning herring in the northern North Sea. J. Cons. int. Explor. Mer, 25(1): 81-92. Copenhagen

Bedford, B.C. (This meeting) A Note on Two Mechanical Aids for Otolith Reading.

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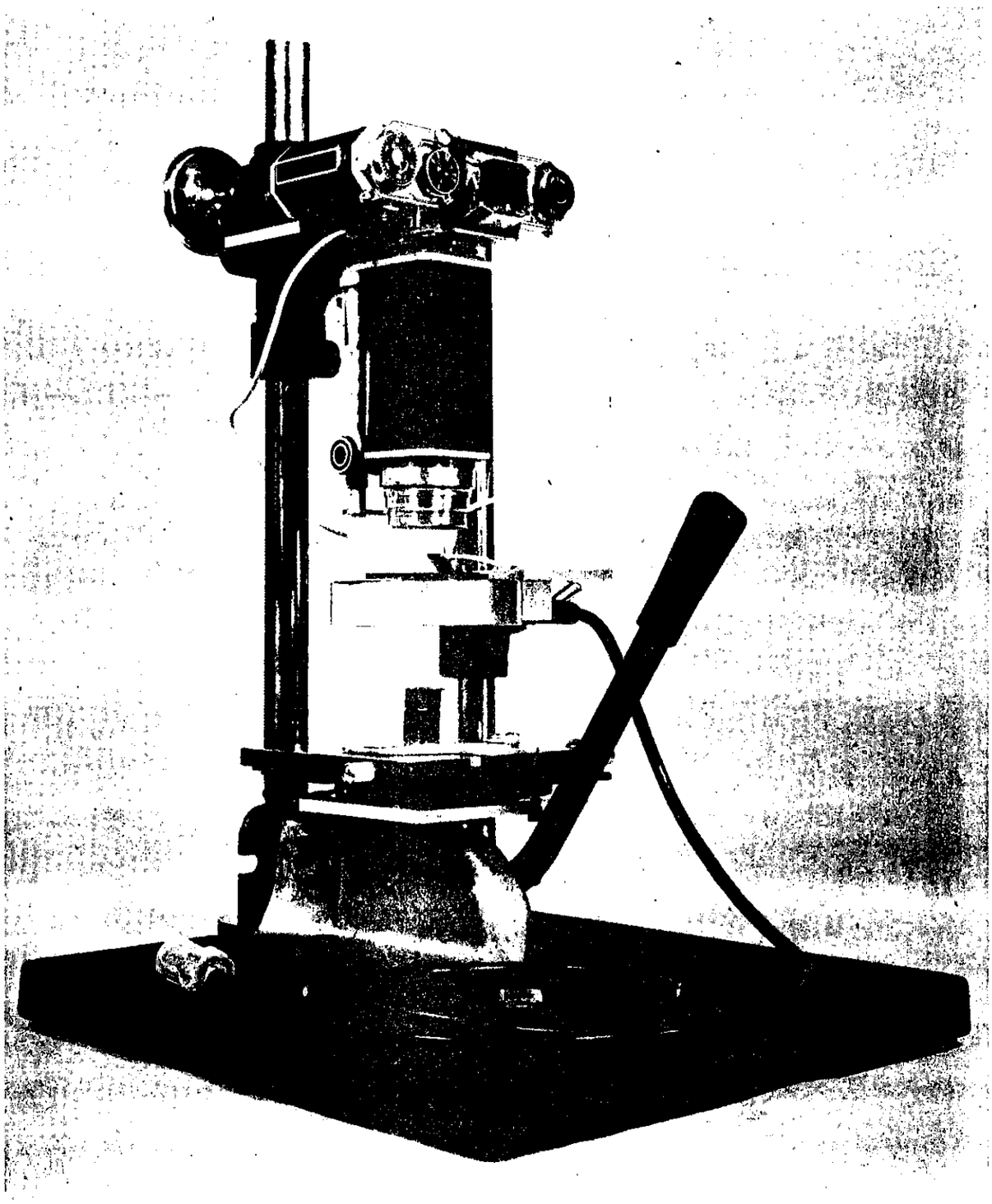

Figure 1. General view of the apparatus with the stage lowered.

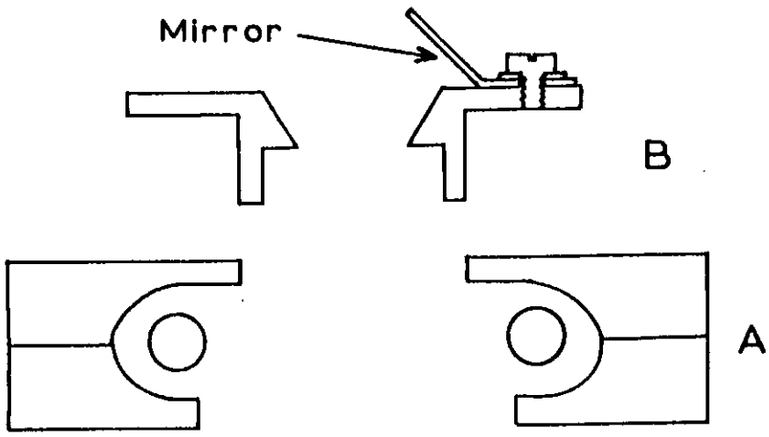

Figure 2. A section through the flash reflector (A) and the shield (B) with its mirror.

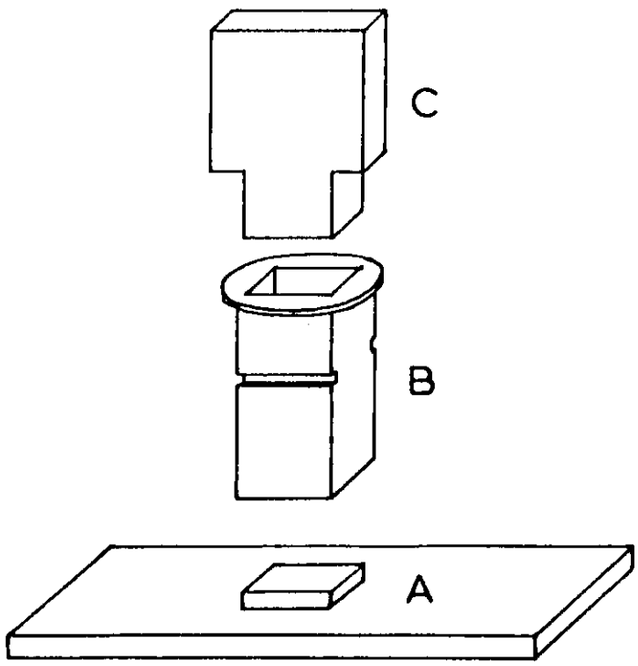

Figure 3. The otolith mount: A, the slide with its plinth onto which the box tube (B) just fits; C, the plunger for pressing the otolith into its correct position.