CAMERA REVIEW

The Exakta System

Part 3: Equipment for Macro Work and Photomicrography

Reviewed by Geoffrey W. Crawley

Extension tubes (Fig. 1)

Extension tubes with an SLR are perhaps less useful than with a coupled-rangefinder camera, where each tube and combination of tubes gives an exact reproduction scale and focused distance in the absence of reflex viewing. Extension bellows bring a continuous scale variation but need exact reflex focusing, such reflex housings add to the expense with a CRF camera, but are a built-in facility with an SLR.

Since the Exakta lens mount is a bayonet type, it is necessary to have a bayonet adaptor system to enable the screw-thread extension tubes to be fully combinable. The shortest extension is the 5 mm given by the 'Two-in-one' ring. This has a camera flange bayonet fitting on one end and the lens bayonet fitting on the other. The next extension length is of 10 mm, and is obtained by screwing together a camera flange adaptor and a lens fitting adaptor—front and rear bayonet rings as they are called. To increase extension further, the appropriate tubes are screwed between the front and rear bayonet rings; these tubes are available in three lengths, 5, 10 and 15 mm, and are sold as a set complete with the front and rear bayonet rings.

The rear bayonet ring has a useful feature consisting of a clamping collar, which enables the lens to be aligned with its setting scales uppermost, which does not always happen of itself when using extension tubes. This feature is, in fact, essential if it is intended to use the automatic diaphragm operation of the lenses with the tubes, in order to bring the lens release button into line with that on the camera body to enable the two to be connected by the Auto-couple, described below.

Miniature bellows attachment (Fig. 2)

This device is intended for general purpose close-up work with extensions of 35 mm–125 mm from the camera flange. It is specifically recommended for hand-held close-up work outdoors on botanical and biological specimens. It can also be used for short mount lenses. Although described as a miniature bellows attachment the size is greater than quite a number of modern standard bellows units in other ranges. It does, however, have the advantage of larger diameter bellows, which are hexagonal in cross-section. The unit is of twin-bar type without rack and pinion movement. The lens panel slides freely along the bars and can be locked by a screw on the left side at the point required. The right-hand bar is marked off at 10 mm intervals to give a guide to exposure factor increases and repro. ratios. The lens panel and the back panel are cowelled in shape and are in wrinkle-finish black. The former slides right back against the latter, in this way enclosing and giving complete protection to the bellows themselves, when not in use. This is very handy if one intends to use the unit out-of-doors. There are two tripod bushes, one under the back panel and one under the lens panel, so that front or back focusing may be used, or the centre of gravity of a particular lens can be suited. The absence of a rack and pinion movement is a little trying at first, but the rapid movement possible over the range of possible extensions is most convenient. It is often possible to make a fine focus setting on the focusing ring of the lens itself. The overall dimensions of the unit are 135 mm length × 95 mm height × 95 mm width, and the weight is 12 oz. There is no swivel for vertical format use.

The 35 mm minimum extension of this unit focuses the 50 mm lens down to a film-plane to subject distance of about 8 in., and the 135 mm lens to about 20 in., when set to Infinity. However, with the special Tessar 50 mm f/2.8 in sunk mount it is possible to focus across the close-up range to Infinity with the Miniature Bellows. The Miniature Bellows Unit is a very practical accessory for its purposes, although it could be made even smaller to advantage, for example, by mounting it on a single bar.

Autocouple extension release

This is a straightforward means of connecting the release button on the automatic lenses to the camera body release, when extension tubes or bellows are used. Two extension rods are provided, one 90 mm long for use with extensions up to about 60 mm, and the second, 150 mm long, for use with extensions up to a limit of the Miniature Bellows—125 mm. If the longer rod were used with the shorter extensions, there might be a danger of it appearing in the picture if the lens were stopped down very far. Two collars move on the rod and can be locked at the desired positions to couple the releases at the extension in use. Normally the back clamp is set on attaching the accessory and the forward one only tightened when the working distance has been decided on. The front clamp is screwed to the lens release, and the rear to the body release. The rear clamp has a finger grip of a most convenient design operated by the first two fingers, one above and one below the rod, pulling like a trigger. This gives a most precise control over the release movement, and the linkage along the lens mount makes it much easier to hand-hold the camera with extension tubes or bellows giving extra stability. There is some freedom of movement on the Auto-couple so that the linkage is not restrictive, and fine focus adjustments can be made over about a 5 mm range after the device has been attached at the approximate required extension. In addition, the Auto-couple rotates on an axis joining the two releases, so that the finger-grip release angle can suit individual preference in vertical or horizontal shots. Although there are ways in which the Auto-couple could be improved, the writer found it a much more useful and practical accessory than photographs suggest. Combined with the Miniature Bellows attachment, it makes 'opportunist' close-up work very convenient, and the use of the automatic lens diaphragms in such work has obvious advantages. The assembly also works well with eye-level viewing via the pentaprism finder. A spring-loaded finger-tip release on the clamp at the lens end, engaging in cross-cuts in the rod, would speed up the application considerably, by avoiding the necessity to untighten and retighten the lock screw at present used. The Auto-couple may also be used with the automatic lenses in reversed position for large magnifications as described below.

Lens reversing rings

Ihagee recommend that when a repro. scale greater than 1.5 : 1 is undertaken that the lens be reversed, except, of course, specially designed macro lenses. In practice, lenses can usually be used at greater magnifications than this,

except very high-speed types, but for critical work reversing rings are provided. These allow the lens to be screwed back to front to the tubes or bellows units by means of the lens-hood or filter 'screw-in' thread. The other side of the ring carries a normal bayonet fitting for insertion into the front of the extension system in use. Reversal rings are obtainable in diameters fitting all Exakta lenses likely to be used in this way.

Exakta miscroscope links

There are three main methods of applying the Exakta to photo-micrography, according to individual conditions and the work to be undertaken.

Micro-adapter No. 1. This consists of a wrinkle-black finished collar which is clamped around the top of the microscope draw-tube. The top part of the collar is hinged, and a catch releases or locks the hinged section. The top of the hinged section is threaded to take the standard extension tubes and bayonet camera adapter. In this way the actual projection distance from the eyepiece can be varied.

The hinged section which is attached via the tubes and/or adapter to the camera allows visual inspection of the specimen or interchange of eye-piece powers, without the necessity of removing the whole set-up. The utility of this feature will depend on the construction of the microscope in use, since the camera can exert a strain on lighter weight models if left hinged out, and this should in any case only be done with the camera angled to the rear of the instrument. It can, of course, be steadied with the hand if required for brief inspection or interchange. The clamp works simply and positively and the eyepiece rests in its correct position on the lip of the microscope draw-tube. The bayonet ring adapter, as already described, has a clamp collar permitting the alignment of the camera correctly in relation to the microscope stand. The No. 1 micro-adapter will take analysers and polarisers, its weight is 4 oz.

Micro-adapter No. 2 (Fig. 3). This adapter is attached to the microscope draw-tube by spring pressure, exerted by turning a capstan collar contracting three contact surfaces evenly around it. The upper part of the link has a fitting taking an intermediate ring with a curved dove-tail fitting. This dovetail fitting attaches directly—without screwing in—to the draw-tube link and a milled screw locks it. The intermediate ring is screw-threaded at its upper end and takes the standard Exakta extension tubes and/or the camera bayonet adapter ring, according to the projection distance from the eyepiece required. (With direct attachment of a camera to a microscope eyepiece, a reduction to about 1/3rd of the overall visual magnification of the set-up is obtained in the photographed image, a projection distance of about 10 in. is required to achieve the visual magnification. Some photo-micrographic attachments, such as the Leitz on 35 mm film, or the old Busch on larger formats, incorporate a a 3X magnifier to adjust for this. Modern practice tends to the use of short projection distances with adjustment of eyepiece magnification.)

The micro-adapter No. 2 dovetail fitting will also directly take the straight or inclined tubes on certain microscopes, having this type of fitting for their interchangeable inspection tubes. The adapter which takes analysers and polarisers can be left permanently in position during ordinary visual use, the camera being immediately attachable as required. The weight of the basic adapter without extension tubes is 9 oz.

Although it is quite possible, dependent on the stability and general design of the microscope limb, to use a camera mounted directly on to it, it is usually more satisfactory to take the weight of the camera by mounting it on the arm of a copy stand column. This can be of the 'Multi-purpose' Exakta type or a simple column type. If in addition, a bellows unit is used, the scope of the equipment becomes greatly increased, and for many purposes the direct mechanical coupling of camera to microscope rendered unnecessary. The Exakta accessory range provides for this method as follows.

'Shell' type microscope linkage. This system works in conjunction with the Ihagee Sliding-Bellows Unit described below—i.e. not the Miniature Bellows Unit already described. The front panel of this bellows unit is threaded to take a metal hood which acts as a light shield round the top of the microscope draw-tube. The eyepiece is removed and placed in the 'Shell' and replaced in the draw-tube. When the front panel of the bellows unit with its hood is brought down over the 'Shell', complete light trapping is effected. This method does not provide the immediate centring of camera over microscope gained with mechanical linkage, but the set-up can be precisely located in some way for alternate visual or camera use without great difficulty.

If it is required to increase the tube length with a given eyepiece in photomicrography, either of the mechanical links can be used in conjunction with the camera bayonet adapter, the bellows unit, and a column stand. Also the Miniature Bellows Unit fitted to a

Fig. 1. Extension Tubes with lens linked by Auto-couple. Magnear finder on the camera with x 5 Top Lens.

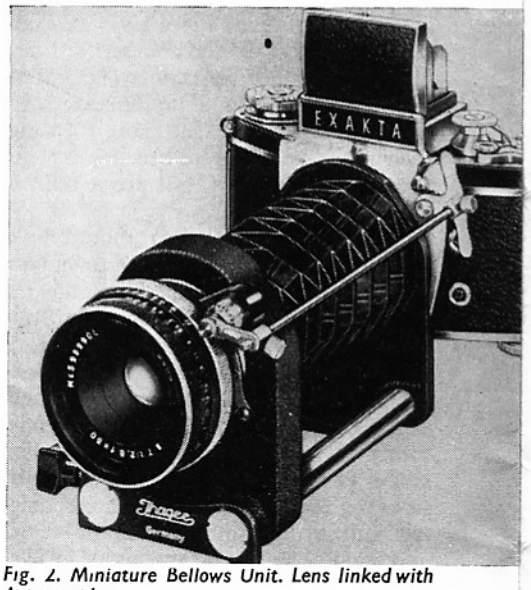
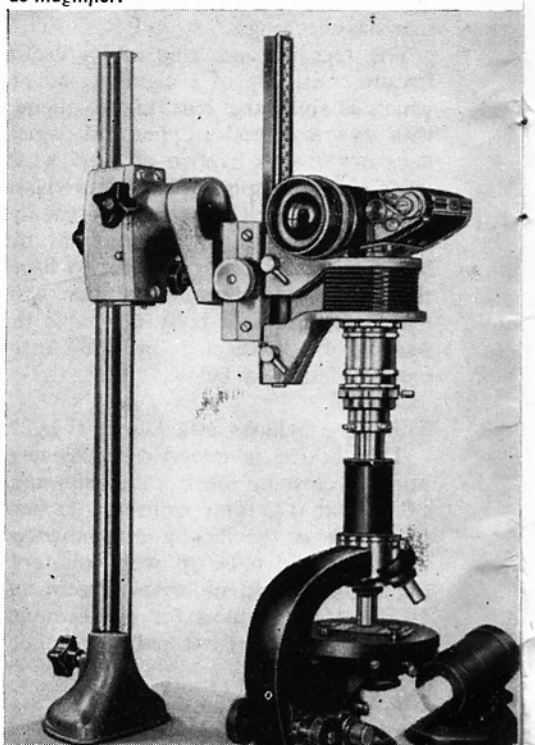


Fig. 2. Miniature Bellows Unit. Lens linked with Auto-couple.

Fig. 3. 'Multi-purpose' unit fitted with Sliding Bellows on Slide Rail and Micro-adapter 2. Magnear finder with camera standard lens in position as magnifier.



column can be used to adjust projection distance if one of the mechanical links are used. With the accessory range available, virtually any set-up likely to be required in photo-microphotography can be achieved.

The Exakta interchangeable focusing screen system was examined in Part 2 of this system report, and their photo-micrographic applications described there. The Magnear finder examined in the same article is of particular interest in photo-micrography for critical focusing using the camera objective or the 5X Top lens.

The Ihagee 'multi-purpose' unit (Figs. 3 & 4)

This unit has been designed to be as adaptable as possible to all types of macro and micro photography, and will also naturally serve in photo-micrographic applications as described above. It can be built up on the Meccano set principle as needs arise.

The basic unit consists of the familiar baseboard, column and camera arm. The base-board size is 50 cm × 35 cm, 20 in. × 14 in., and the column fitting bolts to it without strain by three nuts and bolts tightened underneath the board. The board, which stands on rubber toes at each corner, is made of solid wood double-veneered top and bottom, and single-veneered at the sides. The sample examined was quite flat. The column fitting is exceedingly robust and the column is locked to it by a large hand-screw at the back, which thus allows turning the camera arm to the rear. Alignment was accurate at right angles to the base-board on the review model.

The camera arm moves up and down by friction drive on a metal bar attached to the column. The bearing length of the arm on the bar is 5 in. long so that there is no play, and there is a screw which locks the arm perfectly in a lateral direction. By these means absolute rigidity in all directions is achieved, the writer found, even with weighty set-ups. The column is fractionally wider in diameter than standard $1\frac{1}{2}$ in. columns and may be slightly proud to fitments designed for them, although the friction drive bar would in any case have to be unscrewed before they could be used.

The camera fitting itself is attached to the arm by a projecting flange which can be swivelled in relation to the main part of the arm. The swivel is through 360°, so that it can be locked at any angle required. By this means the camera can be turned in a full circle, with the waist-level finder facing the operator standing in front of the base-board. Also an angle bracket is supplied; with the camera fitted to the swivel via this, it will describe a full circle with the lens facing the operator.

The swivel arm also allows the maximum advantage to be taken of the column height and brings the camera to a minimum height above the base board. The maximum height which can be reached by the film plane over the base-board is about 65 cm and the minimum with arm swivelled round, about 12.5 cm. A disadvantage met on many copying stands is a limitation at the minimum camera height for very short working distances; this does not apply to this equipment.

Sliding Bellows Unit (Fig. 5). The Miniature ellows Unit could, with some practical difficulties, be used on the 'Multi-purpose' Unit, but there are bellows specially designed for this purpose. The Sliding Bellows Unit is assembled from two components—the Slide Rail and the Sliding Bellows Unit. The Slide Rail consists of a heavy guide block in which a steel bar can be moved back and forward on a rack and pinion movement by means of a milled wheel, with a locking screw on the opposite side. The bar is of dovetail shape in section and the Bellows Unit is accordingly grooved to slide on to it. The front and back panels of the bellows unit are heavy castings with long bearing surfaces, that of the front panel being specially designed for weighty attachments.

There is no racking movement on the bellows unit and the lens and camera panels are slid by hand and clamped at the required extension by tommy bars. Fine focusing can be done on the lens mount or by moving the whole assembly on the slide rail racking movement. After being accustomed to rack and pinion bellows focusing, the Ihagee Sliding Bellows seemed a little coarse, but as soon as one becomes experienced the method has its appeal, particularly in the initial rapidity gained in setting up roughly. The heavy duty construction of the assembly too, seems a little coarse at first, after the watch-type movements on similar purpose accessories of other makes, but the fact that the apparatus can be handled firmly, without fuss, and the obvious assurance of an indefinite working life under any conditions, soon offset any initial prejudice. The guide block of the slide rail is bushed for Continental and English threads to allow fitting to a tripod.

The length of the slide rail which is calibrated for repro-ratios and exposure factors is 29 cm and the variation in extension from the camera flange with the Sliding Bellows Unit is 35 mm to

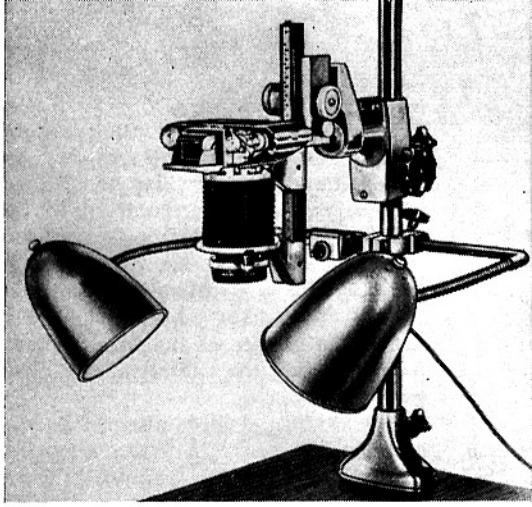


Fig. 4. 'Multi-purpose' Unit fitted with Sliding Bellows and Lighting Equipment.

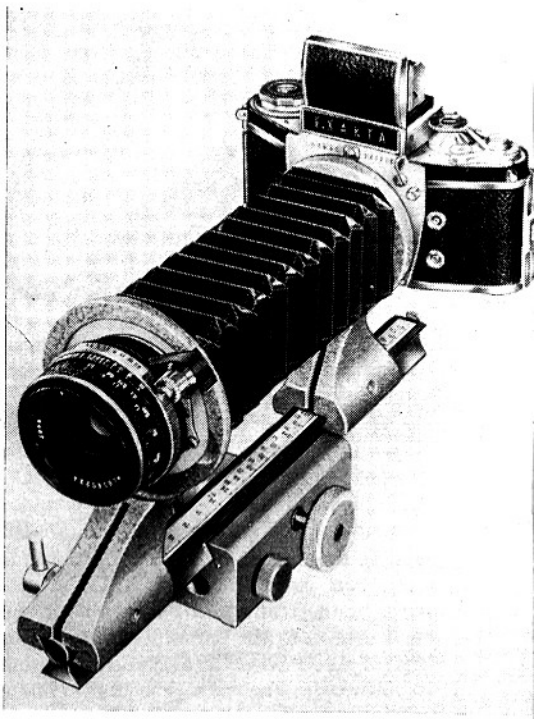
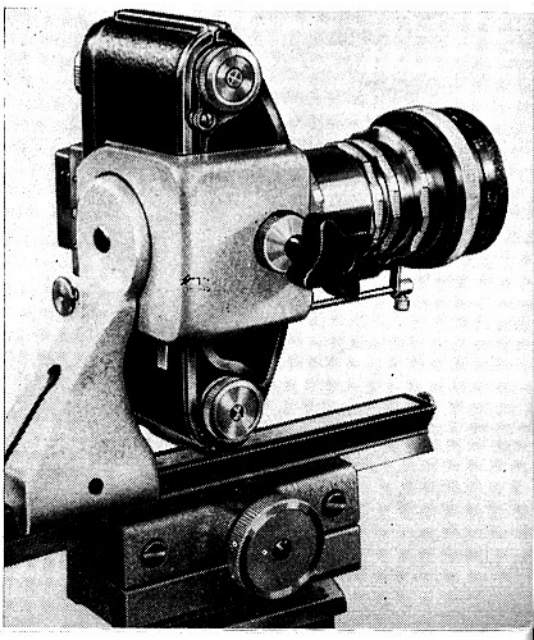


Fig. 5. Sliding Bellows on Slide Rail Unit.

Fig. 6. Camera cradle and angle bracket mounted on Slide Rail.



210 mm. Additional extension can be gained with extension tubes or, the writer found, by attaching the Miniature Bellows Unit to the front of the Sliding Bellows. If this is done it was found best to clamp the Min. Bellows at maximum extension and use the Sliding Bellows for adjustment, as this avoids the danger of the Min. Bellows rods impeding the subject at the close working distances.

The Sliding Bellows themselves are usefully broad—6 cm in cross-section, and the front panel is grooved to allow finger access to the lens bayonet lock. As described earlier, it is threaded to take the hood for the microscope attachment 'Shell'. There is a swivel on the back panel for vertical format pictures and in this position an angle plug must be used for M type flash synchronisation, as the socket is concealed under the back panel. The two panels close up together with a pin on the rear one locating in a hole in the front one. A screw locks this home and the Sliding Bellows can then be taken off the guide bar without any danger of the bellows dangling about.

Camera Cradle (Fig. 6). As an alternative fitment on the Slide Rail Unit, the Camera Cradle with swivel head and angular bracket can be attached. Like the Sliding Bellows Unit this has a dovetail groove which slides on to the rail, and a tommy bar will lock it at the desired point. This is a simple attachment, allowing camera working distance adjustment by means of the rack and pinion movement of the Slide Rail. If extension is required tubes are necessary, or the Miniature Bellows Unit can be attached to the camera, the height of the angle bracket and cradle ensuring clearance for the bars. The cradle has a swivel movement for vertical format work, a spring-loaded button at the back of the cradle engaging at 90° intervals. The Camera Cradle fitted on the Slide Rail Unit is also handy for facing up the camera accurately to a set-up, when no extension between lens and camera body is required. Placing the camera in the cradle raises the optical axis 85 mm above the Slide Rail. The camera screws into the cradle with its back located firmly against the back wall of the cradle. The cradle weighs 12 oz.

The tripod base for camera cradle

This is a metal plate, with a machined platform on one side and a dovetail bar on the other, bushed for English and Continental threads. The bar is the same fitting as that on the Slide Rail Unit and therefore the Camera Cradle can be slid on to it. Thus if the base-plate and cradle are fixed to a tripod a very steady assembly complete with swivel movement is formed.

The device is intended for use with front, heavy, long lenses or extension set-ups to bring the centre of gravity of the assembly over that of the tripod. This greatly assists freedom from shake and produces a set-up with much greater stability in conjunction with the Camera Cradle. Adjusting the cradle on the bar of the base-plate also provides a method of making small working distance adjustments without moving the tripod. The cradle base-plate used in conjunction with the Miniature Bellows Unit provides a most practical combination for outdoor close-up work.

Transparency Copying Unit. This unit is built on a rod which is inserted into an aperture at the front of the guide block of the Slide Rail Unit and locked home with a screw. Camera extension adjustment is then made by movement on the Slide Rail. The height of the transparency holder can be adjusted to align exactly with the camera. The holder has the usual spring-loaded frame for the copy material with a diffusing opal incorporated at the back but in this instance there is also a pressure plate to ensure flatness of the slide. Each side of the frame, there is a film carrier for strips and rolls of unmounted material. To complete the unit a bellows attaches to a metal shield which, clipping on the film roll cups, slides into the camera side of the copying frame. This shields the lens from stray light, although it has been suggested recently that allowing a little light to be reflected on to the surface of the transparency might reduce excessive contrast. The copying unit is fully practical and like the other components of the Multi-purpose unit strongly built. It weighs 18 oz.

Lighting Equipment for 'Multi-purpose' Unit (Fig. 4). This attachment normally goes on the column of the 'Multi-purpose' below the camera arm. It consists of two reflectors on tubular arms allowing angling in any direction necessary. The angle of tilt of the bar to which these arms are fitted can also be varied by a locking hand-screw at the rear of the unit, behind the stand column. The elevation of the lighting unit on the column is locked by a hand-screw on the left, and the light switch is also on the left on the bar holding the adjustable arms.

This system review will be concluded next week with reference to specialised equipment, the macro-micro lightmeter and various practical data.

CAMERA REVIEW

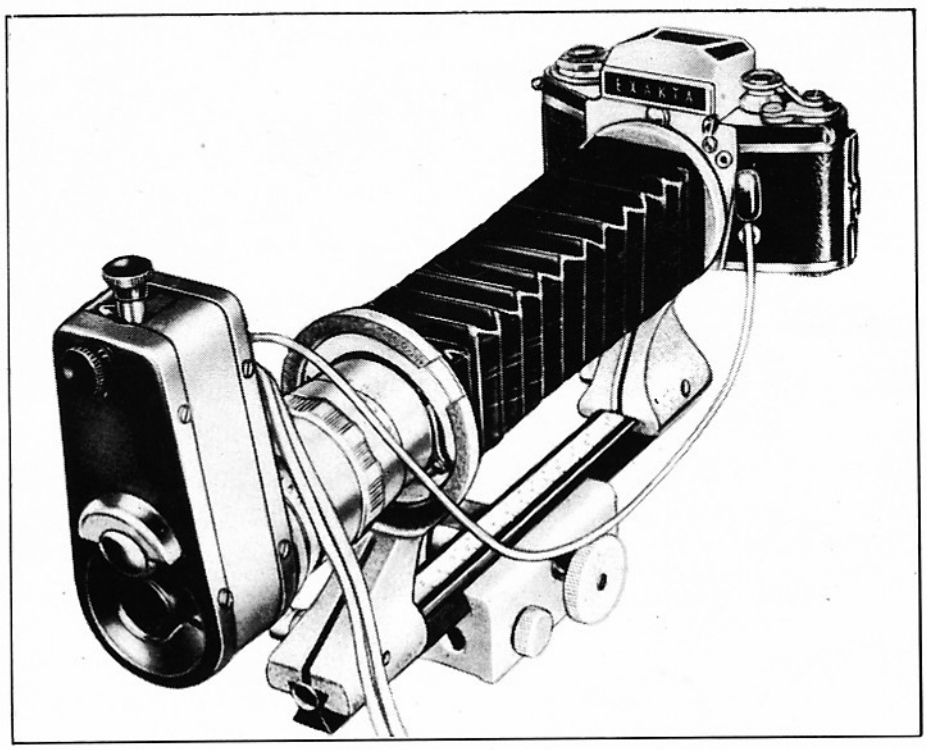
The Exakta System

Part 4: Specialised equipment and the Exa 1

Reviewed by Geoffrey W. Crawley

The Ihagee Kolpophot (Fig. 1)

THIS apparatus is specially designed for the photography of body cavities in human or veterinary medical photography and for the recording of small skin areas, etc. Its use of electronic flash as a light source makes it particularly useful for recording moving or palpitating tissue.



The Kolpophot apparatus stems from the 'Multi-purpose' unit, described in Part 3 of this report, in that the base is formed from the Slide-Rail Unit equipped with the Sliding Bellows, in this case mounted on a firm tripod. A special 135 mm f/4 lens stopping down to f/45 is standard, and there is a ring-flash unit with a pilot light and connecting assembly. The flash output is 100–200 Joules with an interchangeable flash tube, and the inspection pilot light can work off a transformer or use a 6 volt/15 watt lamp off a battery. Variation in the repro-ratio of the Kolpophot is obtained by moving the camera body backwards or forwards on the Slide-Rail. At full extension of the bellows a scale of ×1.6 is reached. The use of the pentaprism and plano-convex screen produces a visual magnification of ×7, so that fine detail that will be obtained of the specimen in the developed negative can be seen at exposure. At f/45 and a scale of ×1.6 a depth of field of 4.6 mm, computing for a 0.05 mm circle of confusion, is given. Owing to the freezing of movement ensured by the electronic flash, sharpness obtainable is claimed to allow ×10–15 magnification in the final print.

The Kolpophot has been very successfully applied in gynaecological endophotography and is used for photographing the ear, nose, throat, eyes and skin surfaces. It has also been used for taking pictures of the larynx and the vocal cords. In photography of the mouth a special table assembly is used with a chin and forehead support. For veterinary purposes there is another model of the Kolpophot. This does not give the same magnification as the standard unit since the bellows are omitted, and extension tubes and adapter rings used instead, and the standard lens is a 100 mm f/2.8. The ring-flash and pilot preview lamp are used in the same way however.

The following data provided by the manufacturer give an idea of exposure. Conditions, 40 ASA black-white film—f/16. Agfacolor CT 18 or CN 17—f/8.

Endoscopy

Special fitting and adapter rings are manufactured by Ihagee to enable endoscopes to be attached to the Exakta (Fig. 2). The adapter ring to the individual makes of endoscope is specially made to fit it, and a sample of the eyepiece may need to be sent to the factory to enable this to be done, or the adaptation could probably be done by a competent house over here. Behind this ring, there is another ring fitting the endoscope-adapter to the camera lens mount. The pentaprism is normally used on the camera to allow the normal viewing position with the endoscope to be used. As regards light source, it is suggested that the inspection lamp in the endoscope be a 12 volt type, and that for the exposure itself it should be run at 24 volts. In this way exposure times of 1/25th sec on 160 ASA black-white film are possible. It is in applications such as this that the clear screens of the Exakta are especially valuable with their high light transmission and focusing clarity.

The Macro-micro light meter (Fig. 3)

This device consists essentially of a selenium barrier layer cell mounted in a metal sheath inside a panel. The panel attaches to the camera bayonet lens fitting and bears a similar one on the front. In this way the cell can be used as a behind the lens photometric device in conjunction with the bellows units, extension tubes, photomicrographic attachments, etc. In use it extends the system by 20 mm.

The cell is moved into position by sliding down the panel, there are lugs each side as grips. The cell locates in the centre of the optical path in the down position and slides up out of the way.

The cell is metered by a micro-ammeter not supplied with it. This should measure across the range 5–35 μA with an impedance of 1,000–5,000 ohms, according to the maker's recommendations. A cable plugs into the top of the panel of the cell housing, and it is only necessary to attach the wires to a suitable micro-ammeter to put the device into use. It is not possible to

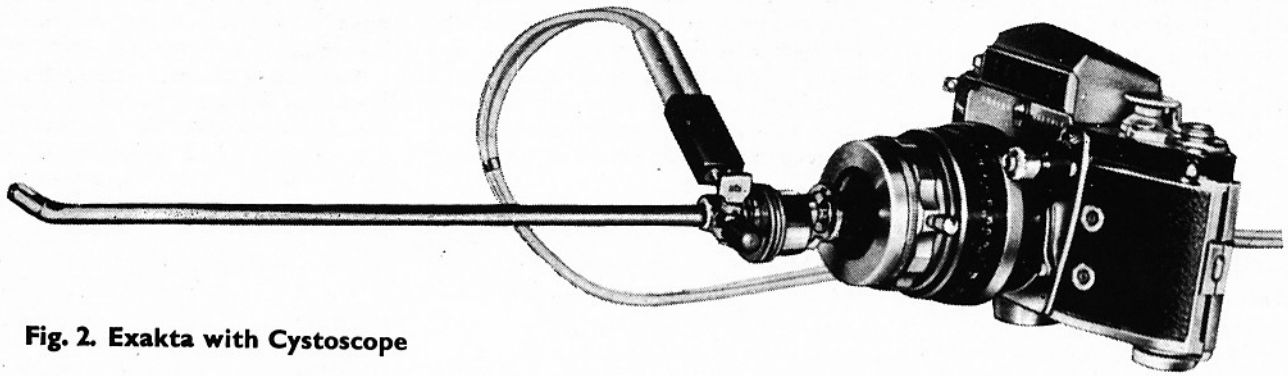


Fig. 2. Exakta with Cystoscope

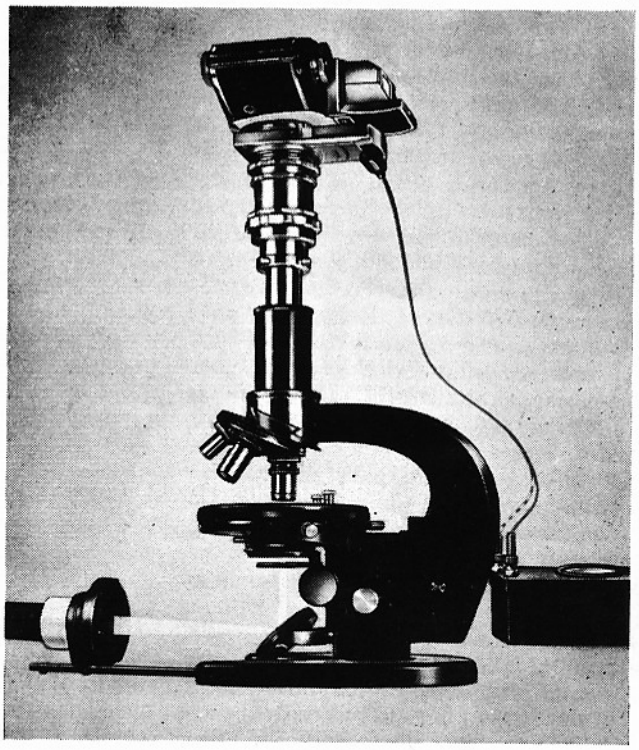


Fig. 3. The Macro-micro light 'meter' in photo-micrography with Type 2 Micro-adapter

expose a frame by accident with the cell in the down position, since the right-hand lug for sliding the cell shields the shutter release until it is raised out of the optical path.

The writer found that the most useful meter in conjunction with the behind lens cell unit was one with a measuring range of 0–50 microamps. For photo-micrography, the sensitivity was not all that useful: with 600 ft candles measured at the mirror, the deflection with a 16 mm apo. N.A., a 11× eye-piece and a projection distance from exit pupil to film plane of 11 cm, was only in the region of 1μA with a light yellow biological specimen. This deflection corresponded to an exposure time of $\frac{1}{2}$ to 1 second it was found.

As regards close-up and copying work the cell was very useful. Here strong deflections are obtained at the lighting levels commonly used for this work. On some occasions, particularly with dark copy material, it was still advantageous to take the reading at a fairly wide aperture and then adjust the exposure time to that of the stop used for the exposure. The writer compiled the following data as a general guide:

(a) Light-toned copy. Newsprint, etc.
Scale deflection 35 μA at f/2.8.
Correct exposure 1/100th at f/2.8, 1/5th approximately at f/11, at 64 ASA on black-white material.

(b) Medium-toned copy material. Photographs, etc.
Scale deflection 25 μA at f/2.8.
Correct exposure 1/50th to 1/25th sec., 1/5th approximately at f/8 at 64 ASA on black-white material.

(c) Dark-toned, deep coloured, copy material.
Scale deflection 7 μA at f/2.8.
Correct exposure 1/50th to 1/25th at f/2.8, $\frac{1}{2}$ to 1 sec at f/8, at 64 ASA on black-white material.

The readings, as can be seen, are not wholly consistent, and like any other cell this one must be used intelligently, observing the proportion of deep and light toned areas of the subject. Its readings do, however, give a most useful starting point and are of course, quite independent of repro scale and other factors, except reciprocity failure. There is usually a fair amount of latitude in macro work owing to the frequent absence of deep shadows, and bracketed exposures based on a general guide given by the meter will ensure a good quality negative is available. It should help in economising on colour materials. The Exakta Macro-micro Light Meter—it should be named 'cell' really—is not highly priced and should save time and material once a little experience is gained.

50 mm f/2.8 Sunk-mount Tessar

In the report of the Sliding Bellows Unit, it was mentioned that a special version of the 50 mm f/2.8 Tessar was available for use with bellows. The standard mounted camera lenses will naturally not focus to infinity in the Bellows Units, and although this facility is not particularly important when setting up for macro work with extension units, it can be very useful to be able to focus to three or four feet or more without changing the whole set-up. The Special Tessar covers this eventuality by a countersunk mount. In this way, used in either the Miniature Bellows or Sliding Bellows Units, a wide range from 'just beyond infinity' to a working distance of 1$\frac{1}{2}$ inches with the Miniature Bellows Unit, and 1 in. with the Sliding Bellows Unit is obtained. The lens front element is recessed 3 cm in a deep hood, which is very essential in excluding unwanted light in indoor macro work, where artificial light sources tend to be close around the lens. The hood-

ing is very efficient in preserving good contrast in such work, and the lens gave noticeably better results in this respect than the standard mounted 50 mm f/2.8 Tessar with its normal lens hood. The dimensions of front and rear glass are identical with those of the standard Tessar, and performance in distance work was equally good, although focusing towards infinity precisely was difficult owing to the sliding movement of the bellows. The front rim of the lens controls the diaphragm, which is not click stopped and shuts down to f/22. The diaphragm ring moves well beyond f/2.8, but no more light is passed. The lens weighs 2½ oz, the overall length is 53 mm and the overall diameter of the barrel 52 mm.

Lines per mm

Using the lens at close-up distances of 15× the focal length, the writer obtained the appended (Fig. 4) resolution figures on Panatomic-X film. The figures given are mean approximates over the range across which subjective inspection of the projected image might differ. Since this lens will be mainly used for scientific work where it is used primarily for recording information, irrespective of the quality with which the information is recorded, such figures are valid and helpful; in other applications qualitative factors are as important, since most modern lenses give satisfactory resolution per aperture for their type and price range. Also such figures are influenced by certain mechanical factors, notably, presuming focusing of the test target is made in the focal plane of the camera rather than in the reflex image, the degree of flatness with which the film is held in register. Such variations may not be inherent in the tracking and pressure plate design of the camera, but can be due to chance pulls and torques set up during winding on, etc. In the tests from which these figures were gained there was noticeable variation in extreme corner definition probably traceable to such mechanical factors. The corner variation was quite random, pointing to wind-on factors. The figures quoted are the best obtained. The Exakta track and pressure-plate system is certainly at least as efficient as any other. In addition, traces of residual astigmatism influenced the simultaneous resolution in vertical and horizontal lines in a given area, as with many lenses. Direction of lighting can also influence the result of lines per mm tests, particularly in low contrast detail. The amount of light, if any, spilt into the lens from light sources influences low contrast resolution too. This last factor was not introduced in the testing of this macro-lens, but can be of considerable importance when comparing standard camera lenses. The better designs, particularly of the mount, give a superior performance in such adverse conditions over other lenses of the same specification. Such points may not be brought out in straightforward 45° illumination testing.

Sunk Mount Tessar f/2.8

	Centre	Edge	Corner
f/2.8	40	40	20
f/4	50	50	25
f/5.6	50–55	50–55	30
f/8	55	55	50
f/11	55	55	55

(Fig. 4) Resolution in lines per mm on Pan-X film in F.X.14. Subjective assessment of projected image. Light source over camera 300 ft. c. on subject. Black-on-white test target of approximately newsprint contrast.

Exa 1 (Fig. 5)

The Exa cameras are designed to give many features of the Exakta in a camera of modest price. The Exa 1

model 1963 is the latest in the line. The general styling of the camera is very similar to that of the Exakta, but the front and back are both bow shaped. The dimensions with the finder hood closed are 132 mm × 89 mm × 48 mm without lens and the weight, also without lens, is 22 oz. The 50 mm f/2.9 Meritar increases the width to 80 mm and the weight to 25½ oz. The shape of the camera makes it particularly convenient to hold, and the quality of the finish is as high as that on the Exakta itself. The front panel does not carry the shutter safety-catch lever as on the 11A, and this has been placed on the back of the camera near the viewfinder hood, where it is very convenient to the thumb. Turned to the left, the lever discloses a red mark which indicates that the safety catch is on. The shutter speed dial is on the left of the top plate, and there are four speeds—1/30th, 1/60th, 1/125th, 1/175th—and B. On the top of the shutter speed dial, which is of the rotating type, not the 'lift, turn and drop' of the 11A, is the film reminder. The shutter is X and M synchronised.

The Exa 1 shutter has an interesting novelty of design. It is, in fact, attached to the mirror assembly. As the mirror goes up, a curved under-shutter slides down and to finish the exposure the bottom flap comes up again. This simplified shutter allows a reduction in manufacturing costs, whilst at the same time retaining in an inexpensive camera the facility of interchangeable lenses which a between lens shutter cannot give. Although not, of course, as efficient as a focal plane type, the Exa 1 shutter mechanism allows the use of lenses up to 100 mm focal length without vignetting, but over this focal length, long focus lenses may give cut-off. Telephoto lenses at a given focal length may be better in this respect. For example, the 135 mm f/4 Sonnar gives only a light shadowing at the top of the frame, but this might be objectionable in colour photography. There is no outer bayonet fitting for the longer focal length lenses. However the interchangeability provided within the price range makes the camera excellent value and the wide angle lenses work normally.

The Exa 1 uses the same finders which are therefore interchangeable with the screens for those on the Exakta. In this way it makes an excellent second camera for the Exakta user or his family.

The camera back and base plate are one unit, which is unlocked by turning a grip surrounding the tripod bush. The tripod bush is bolted to the die casting of the camera body, and the removable back and base locate around it. The camera interior is well finished and retains the cassette-to-cassette film travel feature of the Exakta. There is, however, no cutter blade. The same take-up spool is used as on the 11A. The rewind button is on the top plate to the right of the hood and the rewind knob is on the left over the shutter speed dial in the normal way as film transport in the Exa 1 is in the conventional left-to-right direction.

The Exa 1 has as standard lens the 50 mm f/2.9 manual pre-set Meritar. This three-element lens gives a good performance with excellent centre sharpness at full aperture, extending across the frame with stopping down to f/5.6 and f/8. The mount is of much simpler type than the Exakta lenses, but the bayonet mount fitting is the same. Thus the camera could be purchased with any of the other lenses available for the Exakta, for example, the four-glass 50 mm f/2.8 Domiplan, which is not as expensive as the Zeiss Jena 50

mm f/2.8 Tessar, but retains the automatic diaphragm feature.

The Exa 1 is outstanding value at 19 guineas with the f/2.9 Meritar. Many Exakta accessories fit, although extension devices extending the lens to film plane distance beyond 70 mm will bring vignetting. As suggested earlier it is an excellent second camera body for the Exakta user and a very good introduction to serious photography for enthusiasts of any age.

Another camera, the Exa 2, roughly double the price of the Exa 1, is also available; this has a permanent built-in pentaprism, and a focal plane shutter. It permits the use of Exakta lenses of any focal length. The standard lens is the 50 mm f/2.8 Domiplan.

The Ihagee Exakta system is one of the two great surviving pedigree lines of 35 mm camera development going back to the early days of the format. The other, of course, is the Leitz Leica system. To some extent they resemble each other, since they both have retained much of the original shape and philosophy of their earliest models. This is particularly true of the Exakta 11A, and of the Leica up to 3G at least, quite definitely. With the M3 the Leica altered in many ways, whilst still retaining much of the original Barnack concept. It was forced to change to be *au fait* in various features with the movement of the times. The Exakta now faces a similar dilemma to that of the Leica before the M3 was produced.

This view is not meant to imply that the Exakta is not fully practicable today; if it is not, then a large number of other cameras are not either, including all Leicas prior to M3. Also we can be rather inclined to fall into the trap of judging cameras by their applicability in candid work and photo-journalism. In this respect the Exakta is without doubt slower in use than many other SLRs. On the other hand, its cassette-to-cassette loading and the cutter make it the fastest reloading camera in the field. However, the writer is quite certain that the Exakta would open up new fields for itself, without losing any of its existing reputation and applicability, if the film transport lever and its movement were redesigned. Briefly, a shorter travel and a quick thumb action when the camera is used at eye-level would satisfy the requirements of rapid operation and initiate a greater mass appeal. A firmer location of the interchangeable screens on the register platform is also desirable if the camera is to be used under really arduous out-of-door professional conditions. The shutter has been much improved and in particular the slow speed chain has now a very sweet and noise-free operation. The camera also needs an instant return mirror.

It is in the field of scientific and applied photography that the Exakta has made its reputation, and, if one accepts the thesis that the reflex is the best instrument for these fields, then without doubt it is unsurpassed in its range of accessories and applicability. It is certainly the only camera body which is fully suitable as a self-contained unit for critical photomicrography, although the Edixamat with slow speeds approaches it closely. Many cameras today are designed with the opportunist function of the miniature foremost in mind, and the technical and scientific applicability is left to follow on. The Exakta, however, is designed to cover the pictorial and technical field with detailed convenience and adaptability, and its opportunist and photo-journalism applicability left to follow on. However, in this way it retains its potentiality to branch out into new fields from firm roots. The other types must remain geared to their own market, which will make an extension of their applicability in the technical field likely to be less comprehensive. Interesting design problems will arise in both types of camera over the years.

Always in concluding a system review, it is interesting to speculate what the next step will be, and here this is more than ever the case. The readership of this Journal have an especial interest in the matter, since they comprise a large number of users for those fields in which the Exakta has special applicability.

Exakta equipment is manufactured in East Germany by Ihagee Camerawerk AG Dresden and is distributed in this country by Photomarketing Limited. Kingsbury House, Blackburn Road, London, N.W.6.