Photomicroscope

with Automatic Exposure Setting Device

G 40 - 430 / II - e

OPTOVAR

If the upper knurled ring engages the notches marked **1.25**, 1.6, and 2, the magnification of the eyepiece is increased by these factors. In position **"Ph"** the Auxiliary Microscope is switched in. It is focused on the objective aperture by means of the lower knurled ring. Thus it is possible to observe to what extent the aperture diaphragm encroaches on the objective opening, and also, in phase-contrast observations, to adjust annular diaphragm and phase plate to one another.

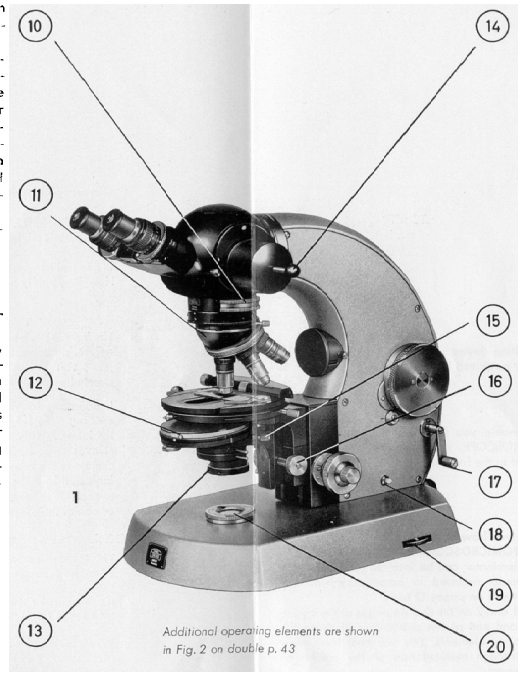
Revolving Nosepiece for five objectives exchangeable with epi-condenser (p. 27). All objectives are corrected for a mechanical tube length of 160 mm.

The first number engraved on the mount of an objective indicates its magnification (e.g. 40), the following number its numerical aperture (e.g. /0.65). If the objective is corrected for use with coverglasses having a thickness of 0.17 mm., this number also is engraved on the mount. Objectives of high magnification, having a short working distance, are provided with resilient mounts as a protection against injury from contact with the cover glass. That of oil immersion objectives can be locked in its upper position by a turn to the right, to facilitate application of the immersion fluid.

All immersion objectives presuppose the use of our non-resinifying and nonfluorescent immersion oil ($n_D = 1.515$).

Condenser for observation with transmitted light. All condensers for bright-field examinations are provided with an iris diaphragm. If this acts as an aperture diaphragm (Table 4 to 6, pp. 46/47) it is adjusted so that the objective opening is illuminated to about ½ to ¾ of its diameter in order to obtain the required contrast. The area illuminated can be controlled with the OPTOVAR (10) in position "Ph". Condenser apertures above 0.9 can be utilized only if the front lens of the condenser is joined to the underside of the slide with the accompanying immersion fluid. This is always necessary for dark-field observations with phase-contrast condenser V Z and ultra condenser 1.1/1.2 Z.

Condenser Auxiliary Lens IV is indispensable for the achromatic-aplanatic condensers. It can also be used with other condensers for illuminating the object in place of auxiliary lens I in the u p p e r holder of the condenser carrier.



Additional operating elements are shown in Fig. 2 on double p. 43

Beam-Splitting Slide

Position 1: (slide completely pressed in, catch at the white ring).
Position for observation. As shown in Fig. 13, a prism in the tube head directs all light through the tube into the eye of the observer.

Position 2: (catch at the red ring).
Position for observation for low magnifications with which the image is too bright in position 1. If in polarizing microscopy in this position an analyzer effect of the deflecting prism becomes disturbing, it is preferable to use position 1 and reduce the brightness with neutral filters.

Position 3: (catch at the black ring).
In this **position for photographing** the area of the image which falls upon the film appears in the tube. Fig. 14 shows a diagram of the beam splitting in the tube head.

Position 4: (slide completely pulled out).
For special problems the light passes vertically upwards through the tube head, which here is closed with a cap.

Two centering screws for **centering the image of the radiant field stop** in the plane of the specimen.

Condenser pinion for focusing the image of the radiant field stop by the condenser in the specimen. If with epi-illumination the condenser carrier is removed, the vertical range of stage movement on the dovetail is increased by 46 mm.

Crank for winding the spring which cocks the focal-plane shutter and advances the film.

Mechanical shutter release independent of the automatic exposure device: slightly press this knob for opening the shutter — at position *B* (24 in Fig. 2). Full pressure on this knob opens the shutter for the length of time indicated on the drum (24), and closes it.

Rear Diaphragm which is always opened for epi-illumination, and for transmitted light when using objectives having a magnification below 16.

Front Diaphragm for limiting the illuminated field with objectives having a magnification of 10 or 16 (Table 4-6, pp. 46/47).

The PHOTOMICROSCOPE

embodies a camera with fully automatic exposure setting device and automatic film advance. Wheter you are working with transmitted, incident, or polarized light, the focused image can at any time be photographically recorded on 35 mm. film.

The automatic exposure device must be calibrated for the film and development employed. All types of emulsions, black-and-white or color, can be used. A strip of calibrating exposures is made for the film and development employed, using the eight positions of the selector switch. The position giving the best exposure is recorded and used for subsequent exposures.

It is not advisable to use films of extremely high sensitivity in photomicrography. The grain of these emulsions becomes disturbing when the negatives are enlarged even as little as three or four times. Panchromatic fine-grain film of low to medium sensitivity is suitable. The automatic exposure device is designed for such sensitivity.

To enable you to fully utilize the PHOTOMICROSCOPE, its special features are described in the following.

After you have assembled the PHOTOMICROSCOPE,
the illuminator can be inserted (p. 17) and the instrument adjusted in accordance with the statements on pages 12 to 16.
Figs. 1 and 2 on the double pages at the beginning and end of this publication illustrate the operating elements. You will best learn their use through manipulation of the assembled instrument.

Microscope STANDARD UNIVERSAL

The STANDARD UNIVERSAL Microscope is not equipped with the built-in automatic miniature camera of the PHOTOMICROSCOPE.

In general its operation is the same as that of the PHOTOMICROSCOPE. However, kindly note the following differences:

The **built-in illuminator** is connected with interposition of a transformer adjustable between 2 and 8 V. Usually it suffices if the voltmeter registers 5 V. That increases the life of the lamp. It should be operated at overvoltage only for brief periods.

In adjusting the Microscope (section 3 on pp. 12 and 14) move the beam-splitting slide (14 in Fig. 1) into observation position 1 or 2. Regulate the **interpupillary distance** by changing the separation of the eyepiece sleeves with the chromed knurls. To compensate the resulting slight change in the tube length, adjust the two eyepiece sleeves to the value indicated by the scale on the circular disk lying between them. If your eyes differ in refractive power, this can be compensated by adjustment of one of the eyepiece sleeves.

Instead the Attachment Camera is used for taking **photomicrographs.** This is attached to a straight tube which is mounted on the tube head of the Microscope in place of the cap.

If your instrument is equipped with a revolving nosepiece (11) or epi-condenser (22) as not shown in Fig. 11, it is necessary first to insert lens 47 30 94 into the tube from below.

When taking photographs, the slide (14 in Fig. 1) is completely pulled out. Position 3 of the slide (arrested at the black ring) has no significance in conjunction with Microscope STANDARD UNIVERSAL.

Maintenance and Handling of the Instrument

A precision instrument like the PHOTOMICROSCOPE should be carefully handled and protected against dust. Cleaning of the instrument should be restricted to external surfaces.

Please cover the instrument with its protective hood during long pauses in operation. The eyepiece sleeves should be protected against the entrance of dust either by eyepieces or dust caps.

Dust can be removed from optical parts with a soft brush which has first been well degreased in ether, firmly adhering soil with a dust-free soft linen cloth (not leather). This can be slightly moistened with solvents such as pure water, benzine, or xylol, but not alcohol. In all cleaning operations please take special care that solvents **never** penerate bearings. These preserve their gliding properties through the presence of a grease film, which would be destroyed by solvents. The easy, steady movement of the bearings would be destroyed.

If immersion oil was employed, it should be removed, immediately after completion of the work, from all optical and mechanical parts. Instead of a linen cloth, rice paper, procurable from us, can also be used (Code No. 46 29 75).

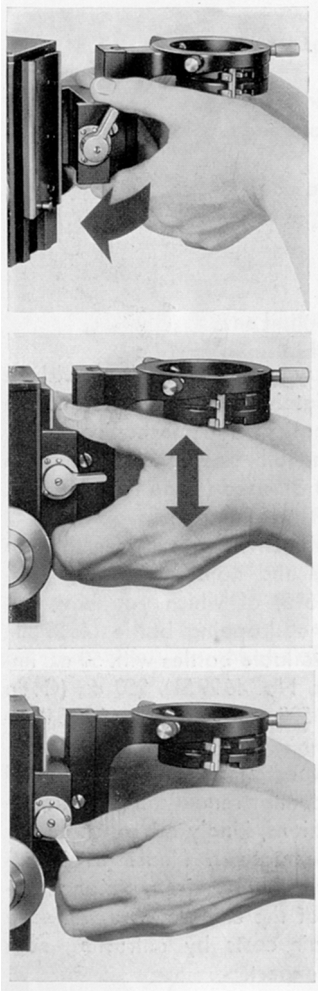
Our immersion objectives presuppose the use of nonresinifying and nonfluorescent immersion oil ($n_D = 1.515$) of which you have received 15 cc. in a dropping bottle (46 29 58). There also are available bottles with 50 cc. immersion oil (Code No. 46 29 51), 250 cc. (Code No. 46 29 53), and 500 cc. (Code No. 46 29 54).

If contrary to expectations difficulties should arise which you cannot remedy in accordance with these instructions, kindly advise us or our authorized representatives. Please avoid attempts to lubricate slide bearings, pinion mechanisms, or parts of the camera. You will save unnecessary repair costs by entrusting such operations to an expert.

Assemblage

After having unpacked the instrument, please check the individual parts with the packing list to make certain that nothing has been overlooked. Then the PHOTOMICROSCOPE can be assembled. To insure optimum performance of the instrument, please do not change any items of its equipment for others of the same kind.

This particularly applies if upon delivery they are provided with labels of the same color and bearing the same number. These labels are superfluous after assembly and can easily be removed. The packing list indicates the serial numbers of the parts belonging to your PHOTOMICROSCOPE.



Attaching the Condenser Carrier to the Dovetail

3

Set the clamping lever into its upper position. Apply the right guide rib of the carrier to the dovetail and swing the left against it until the spring bolt snaps in.

4

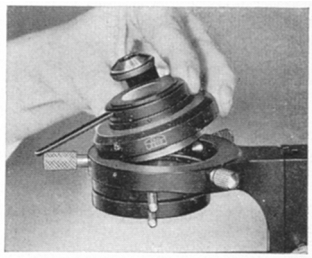
With the clamping lever in middle position, where it lightly engages, the carrier can be vertically displaced. Before attaching the stage carrier, lower the condenser carrier **until it strikes a stop . . .**

5

. . . then draw the clamping lever tight by swinging it downwards.

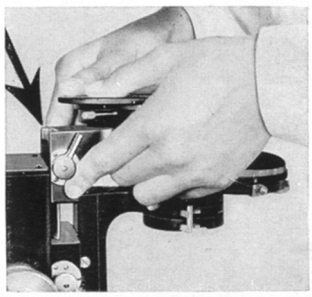
6

To insert the condenser for transmitted light, slightly tilt it and press spring bolt on the condenser carrier outwards with its conical holding ring. Place the condenser on the contact surface and rotate it until the spring bolt engages the notch in the holding ring.
Lower the condenser with the rack and pinion (16) until it meets the stop.



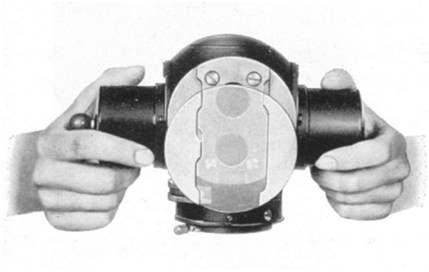
7

Attach the stage carrier from above in such a way that first the lower part of its guide rib, then the spring bolt on the left side, and finally the upper part of the guide rib (arrow) is set behind the dovetail. Centering rotating stages, which are sensitive to shock, are packed separately. They are inserted into the centering piece of the stage carrier so that the spring bolt engages the notch.



8

The reflector inset with aperture diaphragm for epi-illuminations is inserted into the housing, after removing the closing cap held by a knurled screw, so that the slide rests in the clearances. Make sure that the reflector inset is always inserted up to its stop.

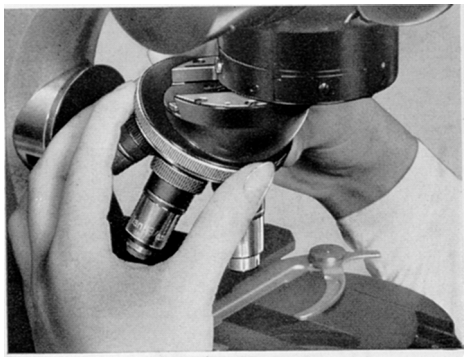


9

Hold the tube head with both hands and apply it to the flange on the stand at such a height that the two guide edges pointing inwards engage the two cutouts on the tube head. Then let the tube head glide down until it meets the stop and tighten the screw at the right of the flange, firmly but not with undue force.

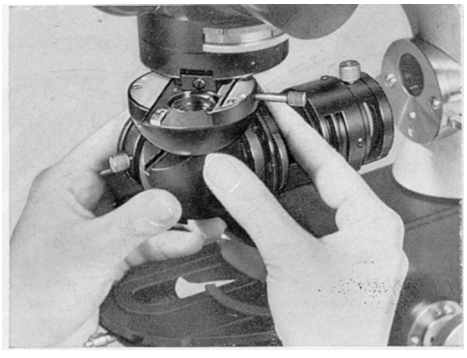
10

The tube is attached by loosening the clamping screw on the tube head and pressing back its spring bolt with the attachment ring of the tube. After the tube is completely inserted, the clamping screw is tightened again.



11

Apply the revolving nosepiece from the rear against the left side and press it forward to the stop, fasten with the clamping screw.

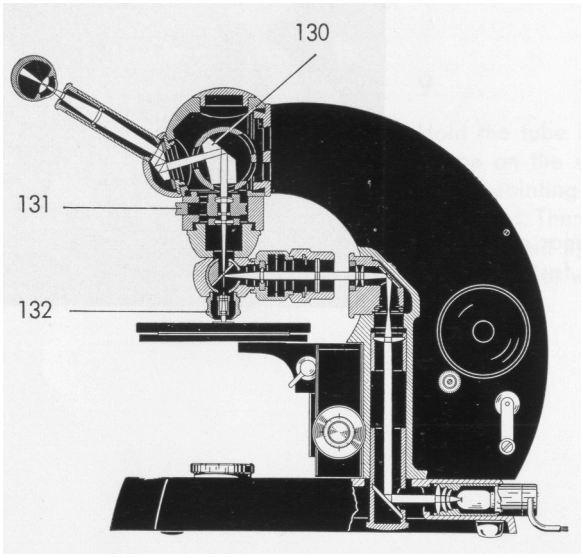


12

The epi-condenser is attached in the same manner from the front.

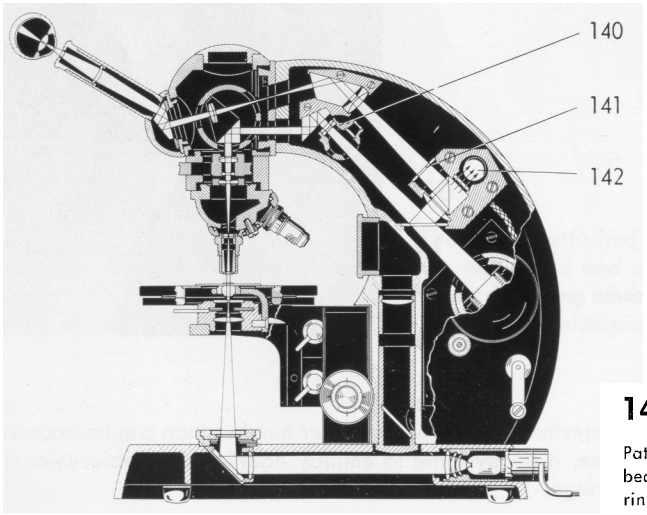
To avoid troublesome unscrewing of objectives when using a larger number than can be accommodated on a single revolving nosepiece, it is advisable to employ additional nosepieces or a slide for single objectives in centering rings.

Path of Rays in the PHOTOMICROSCOPE



13

Path of rays in the observation positions 1 and 2 of the beam-splitting slide (14) with epi-illumination.



14

Path of rays in photographing position of the beam-splitting slide (14) arrested at the black ring.

Illumination of transparent objects is carried out by way of the condenser below the Microscope stage (Fig. 14), that of opaque objects by way of the reflector in the epi-condenser (Fig. 13).
In any case the light arrives through the objective (132) and the OPTOVAR (131) at the beam-splitting system (130) in the tube head. From there it can take two basically different paths, depending on the position of the beam-splitting slide.

In positions 1 and 2 of this slide, the **observation positions** of the beam-splitting system, the light leaves the Microscope part of the PHOTOMICROSCOPE through the eyepiece (Fig. 13).
In position 3, the **photographing position** (Fig. 14), the object is imaged with one of the two projectives (140) in the film plane and on the optically correlated focusing graticule (141). At the same time a part of the light falls on the photoelectric cell (142) which controls the exposure.

The magnification at which the **microscopic image** appears to the eye in the observation positions of the beam-splitting slide (Fig. 13) is the product

of the objective magnification (e. g. 40 x),
the factor of the OPTOVAR (e. g. 1.6 x), and
the eyepiece magnification (e. g. 8 x).

Example: 40 x 1.6 x 8 = 510 x.

The magnification at which the **image** appears on the film and on the focusing graticule (141) is the product

of the objective magnification (e. g. 10 x),
the factor of the OPTOVAR (e. g. 1.25 x), and
the factor of the projective (e. g. 3.2 x).

Example: 10 x 1.25 x 3.2 = 40:1.

The area imaged on the film in position 3 of the slide appears magnified 3.5 x in the eyepiece 8 x. That is, the relatively small image on the 24 x 36 mm. film appears to the eye as if it were magnified to 9 x 12 cm.

Adjusting the Microscope

TRANSMITTED LIGHT

Bright Field

1. Connect the PHOTOMICROSCOPE with the automatic exposure device (only alternating current, usually 220 V) and turn this on with the switch (334 in Fig. 33), open the condenser diaphragm (12), OPTOVAR (10) in position 1.25.

2. **Push handle (26) upwards,** raise the condenser to its highest position with pinion (16), turn rotating disk of phase-contrast condenser to position "J".

3. **Pull out beam-splitting slide (14) to the black ring.** Slowly turning inwards the eyepiece sleeves of the tube (28) **sharply focus the cross of double lines** in the field of view for each of the two eyes. If this is not done, the photographs will lack in sharpness.

   Push in the beam-splitting slide up to the red ring or completely. Place the filter into the beam path; for color photographs: gray glasses in mount, and with daylight film a suitable conversion filter.

Phase Contrast

7. **Switch in the condenser diaphragm** ("1" or "2") **matching the phase-contrast objective** (marked "Ph 1" or "Ph 2") already switched in according to adjustment 4.

8. With OPTOVAR (10) in position "Ph" **focus** with its lower knurled ring the **image of the annular diaphragm and the conjugate zone** in the field of view. With the handles of the condenser, n o t the centering screws (15), **bring both to superposition.**

9. Switch in the observation position of OPTOVAR (10). When changing objectives, switch in the appropriate condenser diaphragm.

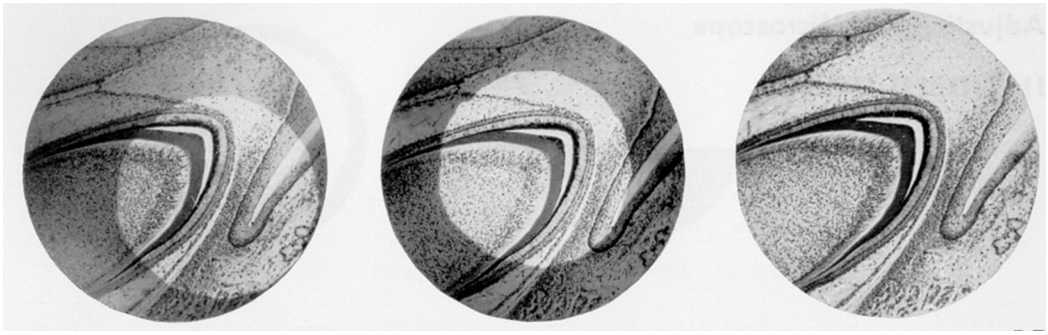
Dark-Field Observation

7. Without disturbing the centering screws (15), **insert dark-field condenser** in place of bright-field condenser. Phase-contrast condenser V Z contains a dark-field condenser in position "D". Immerse this or the ultra condenser free of air bubbles.

8. **Improve** the centering of the **dark-field condenser** in accordance with adjustments 5. and 6. Use objective 10x or 16x even if the field of view is not fully illuminated.

9. Switch in the observation objective. If an oil immersion objective is used, close its diaphragm to the stop. Focus the image.

10. Slowly open the iris diaphragm of the immersion objective, but only so far that the black background is not lightened.



A Radiant field stop imaged B Radiant field stop centred C Radiant field stop opened **15**

4. Sharply **focus** the specimen with objective 10 x or 16 x. If the adjustment is a preparation for phase-contrast examinations, use a phase-contrast objective.
5. Open rear diaphragm (19), closed front diaphragm (20) (Table 4–6, pp. 46/47).
6. With pinion head (16) adjust the height of the condenser (front lens swung in) until the **radiant field stop** is sharply **focused** in the field of view (color change blue/green) (Fig. 15 A). **Center** its image (Fig. 15 B) in the field of view with the two screws (15). **Open** the radiant field stop until the border of its image just disappears out of the field of view (Fig. 15 C). If now the field of view is not uniformly illuminated, slightly shift the lamp socket axially.

7. **Regulate image contrast** with condenser-(aperture-) diaphragm (12).

   Note: The diaphragm image focused with OPTOVAR (10) in position "Ph" should as a rule leave more than half of the objective opening illuminated.

8. Pass on to the objective used for the examination (11). For uniform illumination of the entire field of view always, depending on the employed condenser, proceed according to the data in Tables 4–6, pp. 46/47. If the rear radiant field stop (19) is imaged, open diaphragm (20), swing out the auxiliary lens, and repeat adjustments 6 and 7.

With medium and high-power objectives only **one** auxiliary lens (either I or preferably IV) should be swung in.

Adjusting the Microscope

INCIDENT LIGHT

Bright Field

1. Connect the PHOTOMICROSCOPE with the automatic exposure device (alternating current, usually 220 V) and turn this on with the switch (334 in Fig. 33), open the rear radiant field stop (19), OPTOVAR (10) in position 1.25, with slide (283 in Fig. 28), switch in the lens, not the central diaphragm.

2. **Push handle (26) downwards, insert reflector** "H-Pl" (plane glass) into epi-condenser (22) or the reflector "H-Pr" (prism).

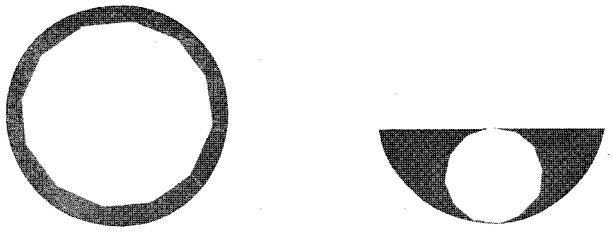
3. **Pull out beam-splitting slide (14) up to the black ring. Sharply focus the cross of double lines** in the field of view for each of the two eyes by slowly turning inwards the eyepiece sleeves of the tube (28). If this is not done, the photographs will lack in sharpness.

   Push in the beam-splitting slide up to the red ring or completely. Place the filter into the beam path; for color photographs: gray glass in mount, and with daylight film a suitable conversion filter.

4. **Image the specimen** aligned parallel to the surface of the stage with a low-power objective (10x or 16x).

5. Contract radiant field stop (284) and carefully **center** its image in the field of view with the two pins (please be sure that the image of the radiant field stop and the specimen are focused simultaneously). Open the diaphragm until the border of its image just disappears beyond the border of the field of view, if necessary recentering.

6. Close the aperture diaphragm on slide (282), switch OPTOVAR (10) into position "Ph", and with its lower knurled ring focus the image of this diaphragm.



A B **16**

7. By moving the slide (282) perpendicular to its axis, that is in direction of the beam path, **center the image of the aperture diaphragm** in the objective opening appearing as a disk of light. (With reflector "H-Pl" (plane glass) as in Fig. 16 A). For taking a photograph the aperture diaphragm should be opened with (282) as far as possible without undue loss of contrast, more than 4/5 of the objective opening should be utilized. When using reflector "H-Pr" (prism), the diaphragm image should lie in the semicircular area available for observation (Fig. 16 B).

   If the image of the aperture diaphragm travels when the specimen is rotated, it is necessary to level the specimen with the alignment press.

8. Switch in factor 1.25 or 1.6 on the OPTOVAR (10).
   After a change in magnification check centering of the image of the radiant field stop (284) (adjustment 5). **Regulate image contrast** with the centrally imaged aperture diaphragm (282) (adjustment 7). In order to avoid reflexes this **diaphragm** should be **opened as far as possible** except for observations and measurements in polarized light.

If the microscopic image with use of reflector "H-Pr" (prism) is not uniformly illuminated, the illumination can be improved by slightly shifting the height of the aperture diaphragm (282).

Transition to **Dark-Field Observation**

1. Focus the specimen in bright field with an **objective EPIPLAN HD.**

2. Insert **reflector "D"** in the epi-condenser.

3. **With slide** (283) **bring the central diaphragm into the beam path. Completely open aperture- and radiant field stop.**

Adjusting the Camera

After insertion of the loaded magazine (pp. 35 to 37)

Wind the clockwork (17), set the counter on "33", and make the blank exposures customary with any camera by pressing key **B** (Fig. 33). Set the selector switch of the automatic exposure device to the position determined by the calibration (p. 34).

1. Pull out slide (14) to stop on the black ring. The double lines of the diagonal cross in the field of view must appear sharp. If the area of the specimen included in the image is not satisfactory, change the magnification with OPTOVAR (10) or with projective (21). Correct the position of the radiant field stop and (condenser-) aperture diaphragm.

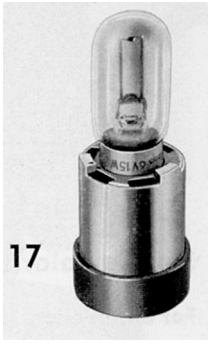
2. **Set the exposure** on knob (24)
   For manual exposures with knob (18) or key **B** of the automatic exposure device: on *1/10, ... 1/100* or on *B*.
   For automatic exposure with key **A** of the automatic exposure device (only when the correct exposure is longer than 1 sec.): set knob (24) on *B*.
   Before each automatic exposure with the knob on *B*, make sure that this position is still intact. If the film turns out to be underexposed, knob (24) was not set to *B*.

3. **Place** the **light filter** into the filter holder of the condenser or into the receptacle above the front diaphragm (20).

4. Release the **exposure.** In brightly illuminated rooms shield the eyepieces (28) against light entrance. Wait several seconds between exposures.

5. After the last exposure: Rewind the film into the daylight cartridge.

The Microscope



Built-in Illuminator

The **low-voltage lamp 6 V 15 W** of high luminous density installed in the base is operated by a multi-stage transformer installed in the automatic exposure device. If the automatic exposure device is connected to the rated supply voltage, the low-voltage lamp operates in the various positions of the switch (330 in Fig. 33) at the voltages shown in Table 1. The sockets on the back of the automatic exposure device (Fig. 34) lie at the same voltage as the lamp, so that the lamp voltage can be measured by plugging in an AC voltmeter. Usually it suffices to operate the lamp at undervoltage. That prolongs its life. It should be operated only for short periods at overvoltage. For color photographs the switch (330 in Fig. 33) is to be set on stage IX.

The Code number of the **filament lamp** is **38 01 77.** It is inserted into its socket with slight pressure, red dot above red line, and then turned.

Finger marks should be removed from the glass bulb with a cloth moistened with alcohol, before they burn in. The lamp socket can be inserted into the base of the Microscope when the dot of the knurled ring lies at the dot on the illuminating tube. The socket is clamped in the base by turning the knurled ring.

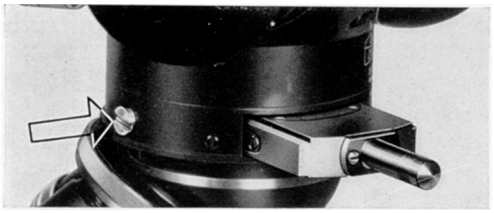
The lamp should be protected against shock at all times, especially while in operation, because its spiral is extraordinarily sensitive.

Achromatic objectives are corrected for the central portion of the visible spectrum. Therefore we recommend use of a **green filter** for black-and-white photographs in bright field and phase-contrast. The green broad-band interference filter which accompanies the instrument has its transmittance maximum at 546 mμ. A green filter can increase the contrast in phase-contrast examinations.

For photographs in natural colors best results are obtained with NEOFLUARS or Apochromats in connection with an achromatic-aplanatic condenser.

Table 1

Stage	I	II	III	IV	V	VI	VII	VIII	IX	X	
Voltage	2.5	2.75	3.0	3.3	3.75	4.2	4.8	5.4	**6.1**	6.9	V
Amperage	1.65	1.73	1.8	1.9	2.0	2.12	2.25	2.38	**2.52**	2.7	A



18

Simple Polarizing Equipment

For observations (not measurements)

The **simple analyzer slide** (Fig. 18) is inserted for simple observations in polarized light on moderately to highly doubly refracting objects and for determining their optical character.

The analyzer slide (47 36 61) can be subsequently installed in instruments bearing a serial number (on the base) from 46 666 upwards (excepting instruments with six-place numbers). Please order analyzer slide 47 36 63 for Microscopes to which the revolving nosepiece is attached as shown in Fig. 11. It is necessary only to loosen the screw indicated by an arrow in Fig. 18, replace the closing piece (29) by the analyzer slide, and again tighten the screw. In so doing the analyzer slide should not be completely pushed in nor completely pulled out, but be in a middle position.

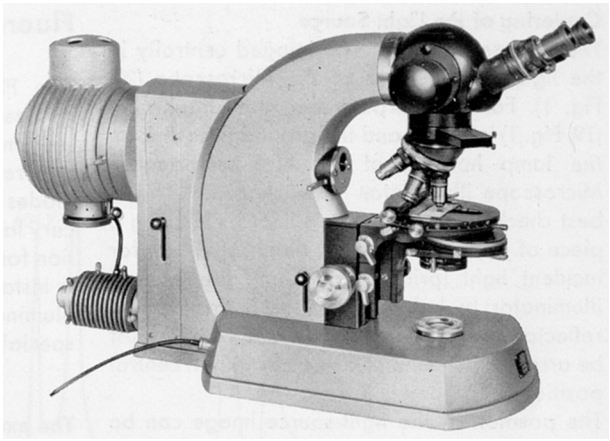
The vibration direction of the analyzer runs from front to back. If the installed slide is pulled out to the stop, a quartz plate lies in the beam path. This prevents that an analyzing effect of the tube prism becomes noticeable during observation in polarized light without analyzer.

A polarizing filter 32 mm. in diameter (47 36 00) is placed **as polarizer** into the vacant one of the two swing-out filter holders on the condenser. The two white marks on the rim of its mount indicating the direction of vibration should be aligned parallel to the handle of the filter holder. Then when the filter holder is swung in, the vibration direction of the polarizer runs right-left, that is, perpendicular to that of the analyzer. For observation with epi-illumination resp. with antiflex objectives the polarizer provided with a holding ring is correspondingly oriented in the filter pocket (280 in Fig. 28) of the epi-condenser.

When analyzer and polarizer are crossed, the field of view is dark. As the stage is revolved, only doubly refractive elements light up. The exact crossed position of polarizer and analyzer is ascertained by the darkness of the image background and can be adjusted by slight rotation of the polarizer.

The **quartz plate red 1st order** (47 37 00) has two planes of vibration at right angles to one another through which light passes at different speeds. The direction marked on the mount by γ indicates the plane through which light passes with lower speed. These two planes of the quartz plate must lie at 45° to the vibration planes of the polarizer and analyzer. To assure this, a correspondingly oriented slot for insertion of the quartz plate is located below the analyzer slide. When not in use, its opening should be covered with the rotary closing ring. The quartz plate generally is used for judging the character of a doubly refracting specimen. This appears blue in the addition position (plane of vibration of the slower wave train in the specimen parallel to the γ plane of the quartz plate). It is yellow in the subtraction position (plane of vibration of the faster wave train in the specimen parallel to the above mentioned plane).

A **revolving stage** is indispensable even for simple observation with polarized light.



19

Special Illuminating Device

The special illuminating device provides for the use of the gas-discharge lamps of the high-performance Microscope illuminator (operating instructions G 40-340) both at the STANDARD UNIVERSAL and the PHOTOMICROSCOPE. Furthermore, the illuminator 12 V 60 W can be attached as incandescent lamp.

The path of rays remains unchanged for this equipment which means that the auxiliary lenses I and IV usually belonging to the condenser can be employed.

When applying this special illuminating device the whole Microscope, and thus also the tube, will be slightly lifted. When employing the high-performance Microscope illuminator, the knob at the lefthand side of the equipment has to be directed downwards, when using the lamp 60 W it has to be directed upwards. If both illuminators are to be used simultaneously (phase-contrast fluorescence) the mirror inserted in this slider can be replaced by a partly transmitting reflector.

Arrangement

An orienting tube is supplied with the special illuminating device. It takes the place of the illuminating tube of the built-in lamp in the base. The screw on the Microscope base is loosened (Fig. 20), the orienting tube inserted and fastened by tightening the same screw. Then the 4 rubber supports are unscrewed from the base of the Microscope, the instrument arranged on its support in such a way that the orienting tube protrudes into the light-exit aperture of the special illuminating device. Four retaining screws are then inserted from below into the thread borings in order to rigidly connect the support and the Microscope.

Centering of the Light Source

The light source has to be imaged centrally in the light-exit aperture of the Microscope (20, Fig. 1). For this purpose the rear diaphragm (19, Fig. 1) is closed and the groundglass disk on the lamp housing of the high-performance Microscope illuminator is switched out. This is best checked for transmitted light by placing a piece of paper on the front diaphragm (20), for incident light (prior to attaching the vertical illuminator) by holding the paper in front of the reflector inset (23) whose slide (282, Fig. 28) must be arrested perpendicularly to its axis in central position.

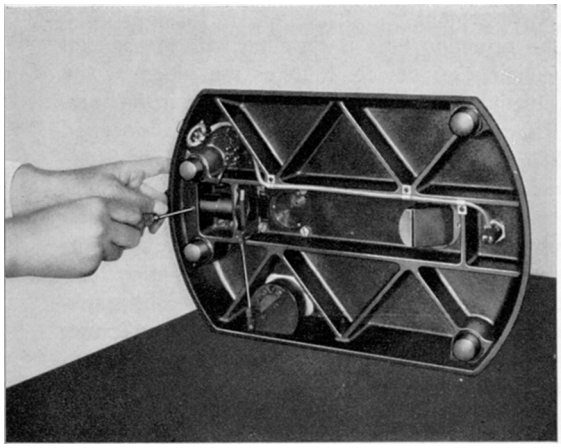
The position of the light-source image can be corrected

at the high-performance Microscope illuminator: by vertically shifting the lamp socket and by laterally swinging it by turning the adjusting screw, arranged at the side of the lamp housing;

at illuminator 60 W: by rotating both scews (272, Fig. 27) at the lamp socket.

After this centering, the rear diaphragm (19) is again opened and the ground-glass disk switched in, if necessary.

20



Fluorescence Examinations

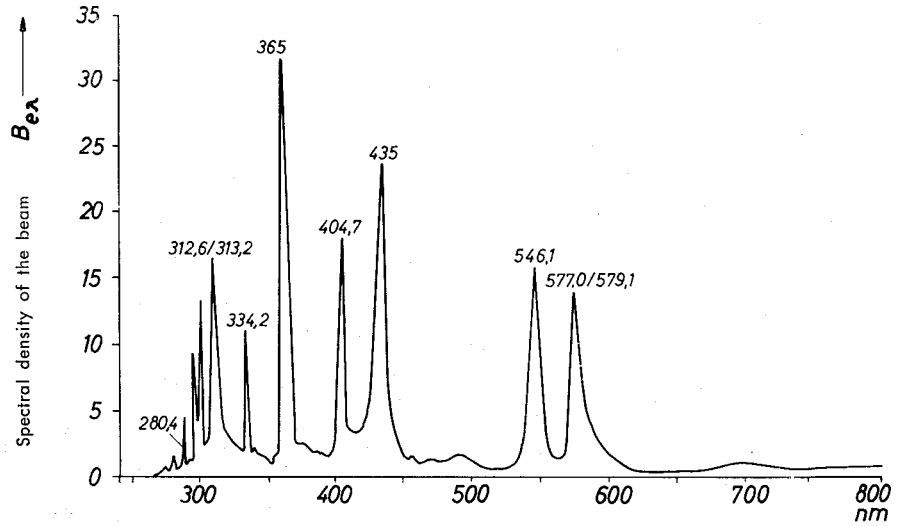
The PHOTOMICROSCOPE can be used for fluorescence examinations both with transmitted and incident light. Its illuminating lenses and reflectors are specially adapted to these modes of microscopy. The super-pressure mercury lamp HBO 200 is a proved source of radiation for the excitation of fluorescence. The lamp is installed in the housing of the multi-purpose illuminator which is attached to the subbase for special illumination (Fig. 19).

The excitation filters 32 mm. diam. (BG 3/4 mm., BG 12/4 mm., UG 5/3 mm., UG 1/3 mm.) are placed singly or combined into the filter receptacle in the Microscope base (at 20 in Fig. 1). For examinations with incident light they are inserted with holding rings into the filter pockets (280 in Fig. 28). A heat-protecting filter is unnecessary in both cases.

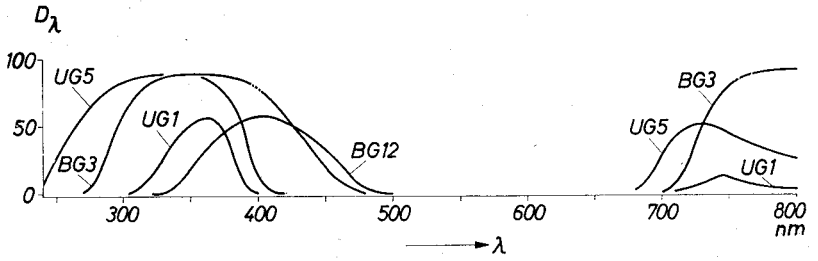
For fluorescence examinations with transmitted light we recommend condenser 1.3 Z whose aperture diaphragm should always be fully opened. The front lens of the condenser must be immersed (joined to the under side of the Microscope slide with a layer of liquid) in order to fully utilize its aperture. Our nonfluorescent immersion oil is a suitable immersion medium, likewise glycerin or water.

The barrier-filter slides (Fig. 24) are inserted into the slot in the tube head below the OPTOVAR (10). When not in use, the slot is protected against dust by a rotary closing ring.

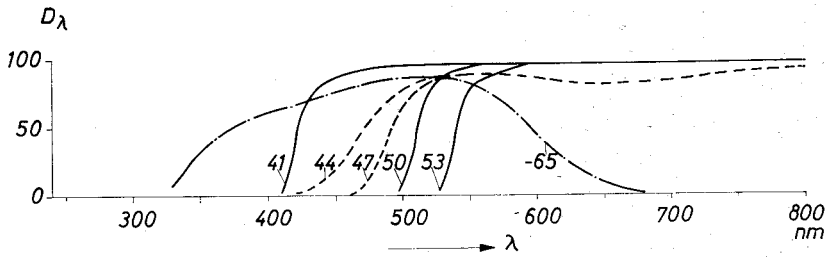
The two barrier-filter slides (Fig. 24) together contain eight filters. In each case they are designated by an abbreviated notation of the wave length. Barrier filters /65 are minus-red filters (absorbing red). They can be switched in



21 Spectral emission of the super-pressure mercury lamp



22 Spectral transmission of the excitation filters

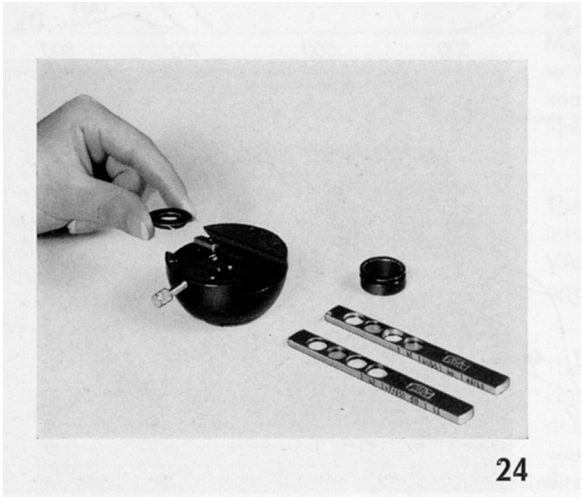


23 Spectral transmission of the barrier filters

with the UG excitation filter without filter BG 12. That combination excites specially intense fluorescence with correspondingly short exposures.

Barrier-filter slide I (46 78 77) contains barrier filters 41 (410 mμ), 41/65, 44, and 44/65; **barrier-filter slide II** (46 78 78), barrier filters 47, 47/65, 50, and 53.
The rear opening of the objective changer (11) or in the epi-condenser must be reduced with the flat diaphragm (Fig. 24), that in the closing cap (29) with the diaphragm having a higher rim. If the objective changer is attached to your instrument from below you will receive a flat metal diaphragm for the rear opening in the revolving nosepiece or epi-condenser.

Instructions for fluorescence microscopy are given in Instructions for Use G 40-215, references to the literature in leaflet 40-215.



24

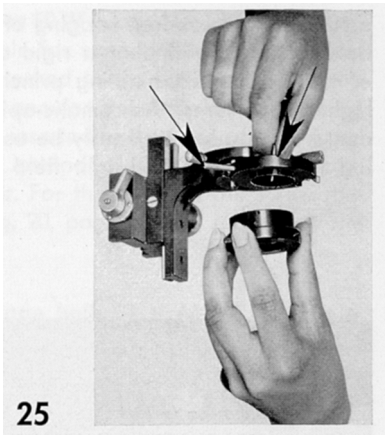
Condenser for Illumination with Transmitted Light

The **condenser auxiliary lens** is a prerequisite in order that the condenser can image the front diaphragm (20) as radiant field stop in the specimen. The PHOTOMICROSCOPE is equipped with auxiliary lens I for use in conjunction with condensers having a swing-out front lens as well as for dark-field condensers. It is placed into the swing-out holder immediately below the condenser (475 in Fig. 47, p. 41). On the other hand, auxiliary lens IV (13) goes with the achromatic-aplanatic condenser (Table 4-6, pp. 46/47).

If an achromatic-aplanatic condenser is used alternately with another, auxiliary lens IV can serve for both. In that case it is best to remove auxiliarly lens I from its holder in order to perclude the possibility of accidentally having both switched in.

Auxiliary lens IV is attached to the lower filter holder of the condenser carrier and centered as follows:

1. With aid of the accompanying key unscrew the retaining ring from the mount of auxiliary lens IV.
2. Swing out the lower filter holder of the Microscope. Insert the retaining ring from above, and from below screw the auxiliary lens into it (Fig. 25). With the flat key clamp the retaining ring in the position in which the two centering screws on the cylindrical mount of auxiliary lens IV, indicated by arrows in Fig. 25, point outwards when the filter holder is swung in.
3. Swing out auxiliary lens IV with filter holder.
4. Focus the specimen with a low-power objective (10 or 16x), with the condenser focus the image of the rear diaphragm (19) as radiant field stop, center and open as described on page 13 under adjustment 6.
5. Switch in the lower filter holder carrying auxiliary lens IV.
6. Raise the condenser with the pinion until the closed front diaphragm (20) is sharply imaged.
7. With the two centering screws on the cylindrical mount of auxiliary lens IV adjust the lens so that the image of the front radiant field stop (20) has the same central position as that of the rear diaphragm after adjustment 4.



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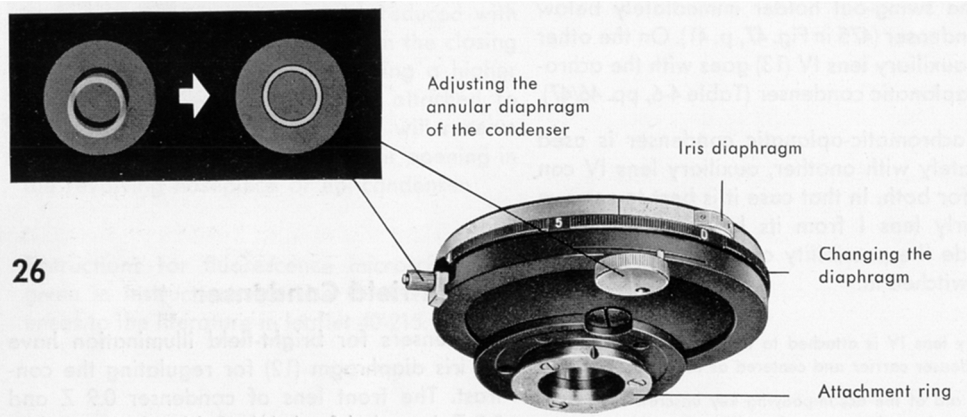
Bright-field Condenser

Condensers for bright-field illumination have an iris diaphragm (12) for regulating the contrast. The front lens of condenser 0.9 Z and 1.3 Z, intended for bright field only, as well as that of the phase-contrast condenser II Z (for bright field and phase contrast) can be swung out if observations are to be made with low-power objectives.
Tables 4 to 6 on pp. 46/47 give a survey of the manipulation and function of the diaphragm.

Achromatic-aplanatic condensers have an optical system of large aperture, well corrected spherically and chromatically. They must be used in conjunction with auxiliary lens IV (13). In order to obtain the benefits of their good correction and apertures between 0.95 and 1.4, it is necessary to optically join the front lens of the condenser and the under side of the Microscope slide with immersion oil. These condensers are not suitable for illuminating large object fields.
The excellent correction of these condensers

assures aberration-free imaging of the radiant field stop and with that a rigid carrying out of the Koehler illuminating principle, also at highest apertures. Achromatic-aplanatic condensers can advantageously be used in exacting investigations in bright field and phase-contrast, especially with objectives of high aperture.

An **achromatic-aplanatic condenser** should be used unconditionally for color photographs. Uncorrected condensers lead to color casts, depending on the focus.



Phase-contrast Condenser

These condensers have a complete bright-field condenser in their revolving disk, in phase-contrast condenser V Z it is an achromatic-aplanatic condenser. The bright-field condenser lies in the beam path when the revolving disk is in position "J". Phase-contrast condensers must be carefully centered, also for bright-field observation.

In order to obtain the phase-contrast effect, it is necessary to precisely superimpose the image of the condenser annular diaphragm in positions 1, 2, and 3, of the revolving disk and the conjugate zone of the phase plate in the phase-contrast objectives correspondingly designated by Ph 1, Ph 2, or Ph 3 (Fig. 26). The images of the annular diaphragm and the phase plate of the objective are visible when the OPTOVAR (10) is in position "Ph".

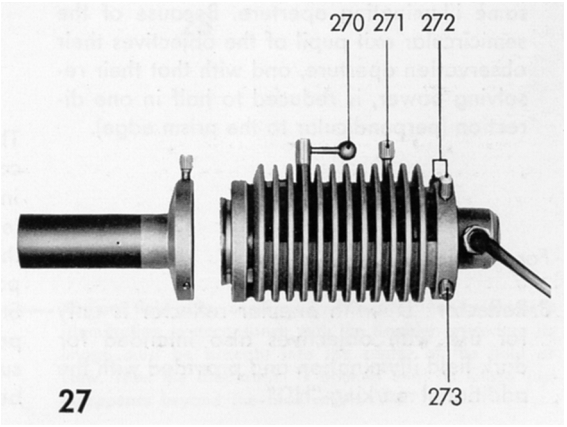
The achromatic-aplanatic phase-contrast condenser V Z is suitable for critical phase-contrast examinations, specially with objectives of high aperture.

Phase-contrast condenser V Z (Table 6) provides for observing the specimen with rapid transition from bright field to phase contrast and **dark field.** It does not illuminate a large area of the specimen. In position "D" of the revolving disk, for dark field, it is necessary to immerse the front lens of the condenser with an adequate amount of immersion oil. Also the ultra-condenser for dark-field illumination must be immersed.

The illuminator 60 W (Code No. 467040) is particularly suitable for examinations with incident light. It is attached to the connecting tube by means of an annular dovetail. This connecting tube is to be inserted in the base of the Microscope stand instead of the illuminating tube with collector. For this purpose the screw illustrated in Fig. 20, page 20, has to engage the tapped hole.

The low-voltage bulb 12 V 60 W (Code No. 38 02 16) is always operated with interposition of a transformer (Code No. 39 25 27). To center the inserted lamp:

1. Before attaching the epi-condenser, swing out the ground-glass disk (270), release the two clamping screws (273) for the spring bolts.
2. By axial shifting of the lamp socket focus the image of the lamp spiral on a vertical surface held 2 to 3 meters in front of the light-exit opening of the reflector inset (23 in Fig. 2). With the slotted screw (271) clamp the socket in this position.
3. Center the lamp spiral in the light-exit opening by turning the two screws (272) of the lamp socket.
4. Draw tight the two screws (273) for the spring bolts.



Condenser for Epi-illumination

The epi-condenser is attached from the right to the front of the instrument (Fig. 12). It is arranged for the reception of different reflectors. After releasing a clamping screw, the selected reflector is inserted into the epi-condenser from the left side up to a stop. A pin provides for correct orientation.

Three reflectors are available:

For bright-field illumination:

1. Reflector "H-Pl" with plane glass. Normally it will be used in all cases not requiring the following reflector.

2. Reflector "H-Pr" with a reflection-reducing coated trapezoid prism. It is indispensable for observations, and above all for measurements, in polarized light. In addition it is advantageous for increasing the contrast of faintly reflecting objects. The brightness of the image is about 5x greater than with use of the plane-glass reflector, assuming the same illuminating aperture. Because of the semicircular exit pupil of the objectives their observation aperture, and with that their resolving power, is reduced to half in one direction (perpendicular to the prism edge).

For dark-field illumination:

3. Reflector "D" with annular reflector is only for use with objectives also intended for dark-field illumination and provided with the additional marking "HD".

The individually mounted **epi-objectives** on epi-condenser II C (Fig. 28) are seated in a "changing ring" provided with a handle. The objective with the changing ring is inserted into the dovetail on the condenser and clamped in position by turning the handle backwards. Strainless epi-objectives for measurements in polarized light (e.g. ore microscopy) are not suitable for dark-field observations. They can be centered in the changing ring.

The filter pockets receive light filters which for convenient handling are first placed into holding rings.

Slot for insertion of an interference gradation filter with which examinations are carried out in monochromatic light of any specific wave length.

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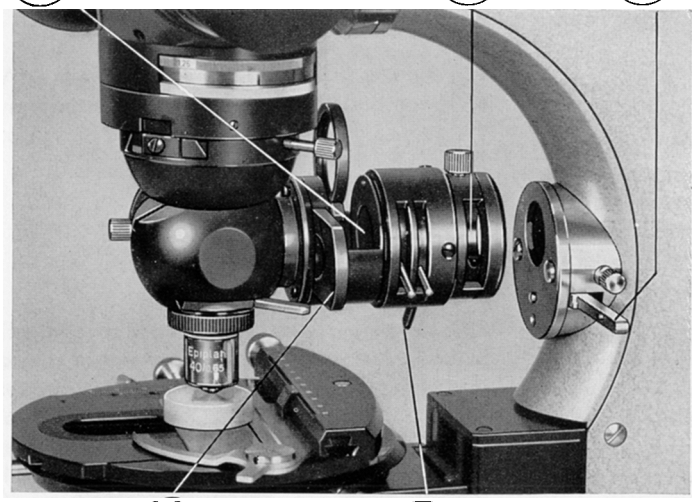

With this slide the opening of the **aperture diaphragm** is regulated and indicated in mm. on the scale. Moving the slide perpendicular to its axis changes the position of the diaphragm image lying in the rear aperture of the objective.
This image can be observed with the OPTOVAR in position "Ph". The image should lie:
with use of a plane-glass reflector: in the center of the exit aperture of the objective and illuminate 4/5 of its diameter (Fig. 16 A).
If a prism reflector is used, this image is shifted so that it lies in the center of and within the semicircular area free for observation (Fig. 16 B).

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Radiant field stop, centered by two pins. For bright-field illumination in accordance with the Koehler procedure its image must be brought into the center of the field of view. Then the diaphragm is opened until its image just disappears beyond the field of view (p. 14).

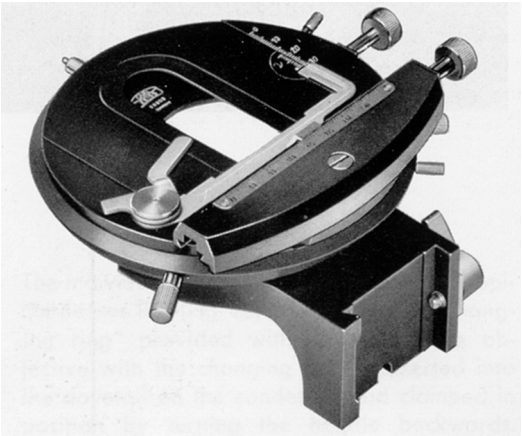
Slide for change between bright- and dark-field illumination.

Stages

Circular Rotating and Centering Mechanical Stage (Fig. 29)
Like the gliding stage this stage (range of movement 50 x 75 mm.) can be centered to the optical axis by means of two screws in a centering piece. This is readily accomplished with aid of a Microscope slide bearing a centering cross which accompanies the stage.

To bring the axis of rotation into the center of the field of view, the slide is placed right side up on the stage and the two scale readings are set to the values of the coordinates stated on the slide. The cross is first focused with a low-power objective and then brought precisely into the center of the field of view with the two centering screws of the stage.

If an eyepiece with cross lines is not available for this, a centered and then closed radiant field stop (Fig. 15 B) can be used for locating the center. The procedure is repeated with high-power objectives. For better recognition of the centering cross it is advisable to largely close the aperture diaphragm.



29

Circular rotating and centering mechanical stage with clamp-on stage carrier

Gliding stage

This stage should be lubricated semi-annually to retain its good gliding properties. It is accompanied by a small bottle of suitable oil.

The stage is taken apart for lubrication:

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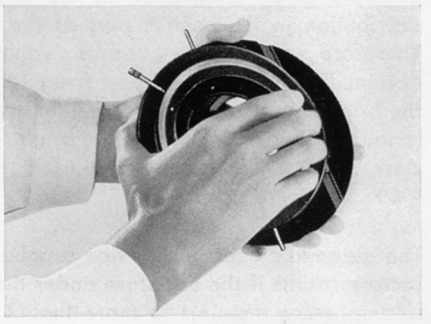
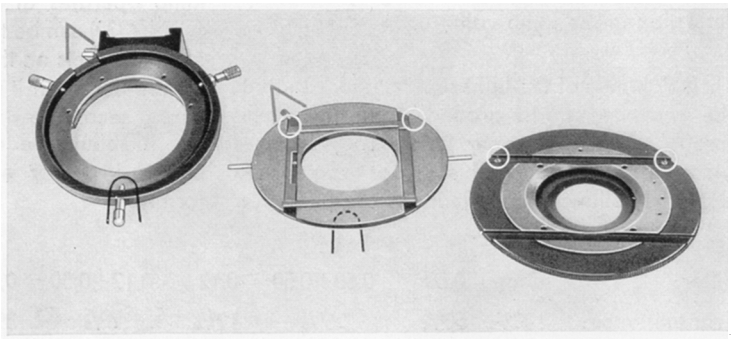
With the two pins for rotating the stage it is vigorously pulled forward and lifted out of its carrier.



31

The two adhering plates are moved at right angles to the line connecting the two pins and separated from one another. The gliding surfaces of both plates and of the glide frame are thoroughly cleaned with xylol. After drying the gliding surfaces, their grooves as well as the guide frame are coated with a very thin film of oil.



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In reassembling the stage, please notice the places marked in the illustration.

The Camera

The automatic exposure device

The automatic exposure device operates on the principle of an integration of the brightness distribution in the central part of the image. Therefore satisfactory results cannot be obtained if there are extreme irregularities in the brightness distribution, as e.g. in dark field (small portions of the image field bright, all else dark) or in similar cases of polarizing microscopy.

The automatic exposure device supplies satisfactory results if the exposure under the given circumstances amounts to more than 1 sec. If necessary, the brightness of the illumination must be reduced by means of gray filters or reduction in the lamp voltage.

The brightness of the light source, and with that the exposure, can be graded by the factor 0.5 through use of the **gray filters.** They can be placed into the beam path singly or in combination. The following combinations are possible:

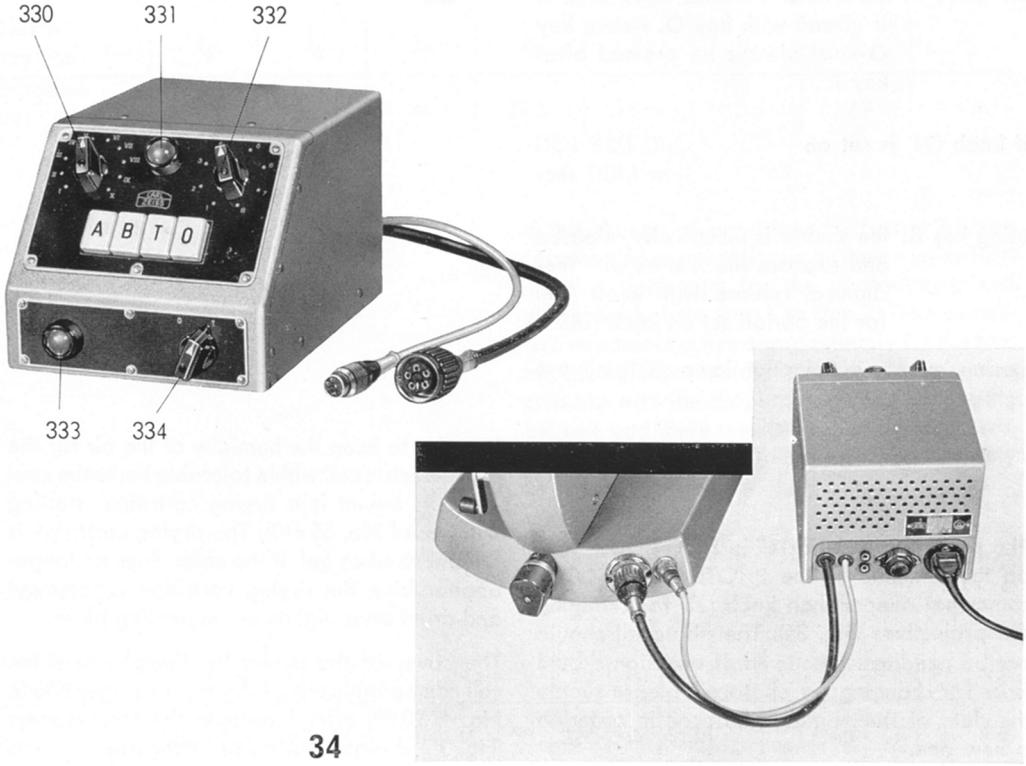
The housing of the automatic exposure device encloses all the parts which automatically bring about correct exposure of the film dependent on the brightness in the film plane. In addition it contains the step transformer for the built-in illuminator (p. 17). The automatic exposure device is designed for connection to an alternating circuit of 40–60 cycles. Usually it is supplied adjusted for 220 V. There is provision for a simple change to other voltages. The power consumption of the transformer is 40 VA. In order to function properly, the automatic exposure device must be grounded.

The voltage with which the 6 V low-voltage lamp operates at the individual positions of switch (330) can be tested with an AC voltmeter at two sockets on the rear of the automatic exposure device. If it should be necessary to connect a second low-voltage lamp to these sockets, it should be operated only for a brief period in order not to overload the transformer.

Filter:	none	0,50	0,50+0,50	0,12	0,12+0,50	0,03	0,03+0,50
Transmittance:	100%	50%	25%	12%	6%	3%	1.5%

A microfuse in screw mount on the primary side is also placed on the rear of the housing. For connection to a 220 V circuit a fuse rated at 0.4 A medium load is employed, for 110 V 0.8 A medium load. The voltage selector can be changed after removing the fuse. The automatic exposure device must be operated at the voltage which is indicated when the fuse is inserted. When the instrument is first put into use, please make certain that the setting of the voltage selector agrees with the rated voltage of the supply current.

The automatic exposure device is connected to the PHOTOMICROSCOPE by means of two cables with screw plugs (Fig. 34). The black cable supplies the illuminator and the camera shutter. The white cable leads to the photoelectric cell.



Turn on the automatic exposure device and at the same time the illuminator with switch (334). Pilot lamp (333) lights up. Then, besides the mechanical release with knob (18 in Fig. 1), there is a choice of opening the **camera shutter automatically** or electrically.

If knob (24) is set on B

using key **A**: key released immediately after depressing: the shutter opens and closes automatically after correct exposure of the film.

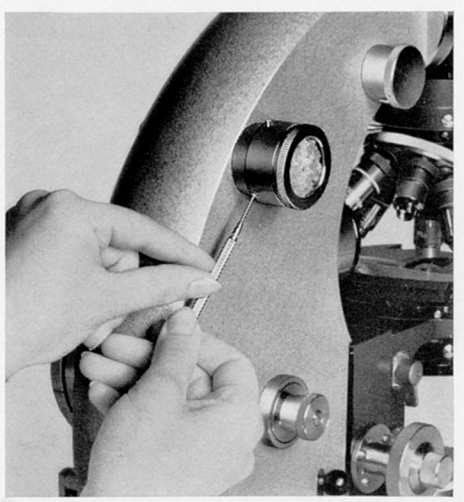
using key **B**: the shutter remains open as long as the key is depressed.

using key **T**: the shutter remains open until it is closed with key **O**. Hence key **O** must always be pressed after key **T**.

If knob (24) is set on *1/10, 1/25, 1/50* **or** *1/100* sec:

using key **B**: the shutter is electrically released and exposes the film as with mechanical release with knob (18), for the period set on knob (24).

During exposure the pilot lamp (331) always lights up.



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The **photoelectric cell** (142 in Fig. 14) is located on the left side of the PHOTOMICROSCOPE somewhat deeper than knob (21) for changing the projectives (Fig. 35). The photocell should not be needlessly removed. If occasion should arise for changing the photocell, please supply the data of the original photocell in ordering a new one.

In order to keep the humidity of the air for the photoelectric cell within tolerable limits the cover of its mount is a drying cartridge (starting with serial No. 55 610). The drying cartridge is filled with silica gel. If the color does no longer appear blue the drying cartridge is removed and dried on a slightly warm heating plate.

The cover of the mount for the photoelectric cell can be replaced by drying cartridges (Code No. 47 20 90) after loosening the three screws (Fig. 35) if older models are concerned.

Adjustment of the automatic exposure device

The exposure latitude of the automatic exposure device suffices for all photographic emulsions at present coming into consideration for photomicrography. A strip of calibrating photographs for specific photographic conditions accompanies the instrument. If one of these conditions changes, such as the type of film or its processing, the adjustment of the automatic exposure device must be changed accordingly. The correct adjustment is found by taking a new series of calibrating photographs before beginning work.

The photosensitivity of the automatic exposure device is primarily regulated by the **selector switch** (332). For black-and-white photographs the knob of the diaphragm for the **photoelectric cell,** located at the right side of the instrument above the film magazine, can be in position 2, its normal position (Example 1). With increasing steps of the selector switch (332) (diaphragm for the photoelectric cell in position 2) the successive exposures of the automatic exposure device will be reduced approximately by the factor 2 (i.e. about halved).

Example 1:

Switch position	1_2	2_2	3_2	4_2	5_2	6_2	7_2	8_2
Exposure sec.	183	86.5	46	22.5	11.5	5.5	2.9	1.5

If this change of exposures by factor 2 is too coarse, a finer gradation is achieved by switching the diaphragm for the photoelectric cell alternatively from step 1 to step 2. Then successive exposures differ approximately by the factor 1.5. In other words, intermediate steps are possible with the diaphragm of the photoelectric cell, and there results a series of exposures, shown in example 2, differing approximately by the factor 1.5.

Example 2:

Switch position	1_1	1_2	2_1	2_2	3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2	7_1	7_2	8_1	8_2
Exposure sec.	300	183	142	86.5	76	46	38	22.5	19	11.5	9	5.5	4.5	2.9	2	1.5

Calibration

1. Using any desired optical system and specimen, adjust the Microscope in accordance with the instructions on pp. 12 or 14. In taking color photographs, select a part of the specimen which as nearly as possible is achromatic in order to avoid a color cast on the neutral background. Use an achromatic condenser, operate the lamp at stage IX (Table 1), switch in conversion filter, if necessary a gray filter.

2. Release **one** exposure at **each** of the eight positions of the selector switch (332) with the diaphragm for the photoelectric cell set on "2" (Example 1).

   For black-and-white photographs it is best to switch selector switch (332) into position 8, regulate the illumination with the transformer (330 in Fig. 33) or with gray filters so that the first exposure in position 8 amounts to about 2 seconds (Example 1, page 33).

3. Develop the film under the conditions which are to be uniformly employed subsequently.

4. Select the correct exposure and for subsequent exposures use the position of selector switch (332) which produced this exposure.

The **following filters** of our production program can be used with the automatic exposure device without recalibration:

Yellow filter GG 11
Blue filter BG 23
Green filter VG 9
Orange filter OG 3
Interference band filter green max. = 546 mμ
Interference wide-band filter green = 546 mμ

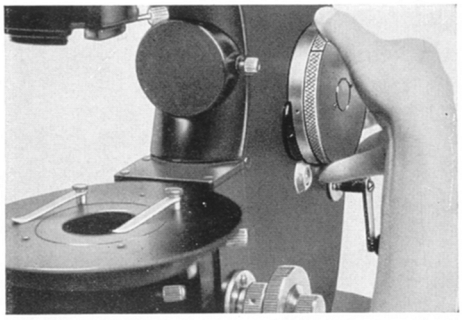
If other filters are to be used, as e.g. red filter RG 2, the automatic exposure device must be recalibrated. Use of panchromatic material is a precondition.

The **Schwarzschild effect***) becomes noticeable with much longer exposures (about factor 10) than required for producing the correct trial exposure. That is, long exposures require correction factors for increasing the exposure. It is necessary to turn back the selector switch by 1 to 3 steps. The correct position of the selector switch for these longer exposures is best ascertained by separate trial exposures.

This is specially important for color photographs, since the Schwarzschild effect is specially noticeable in color film.

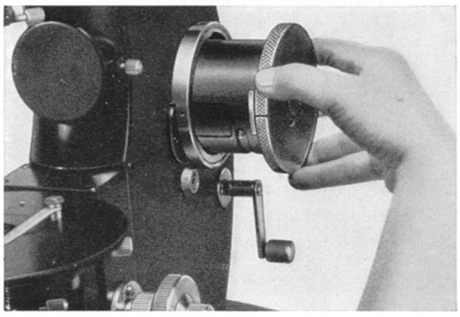
*) Angerer, Wissenschaftliche Photographie, 4. Auflage, Akadem. Verlagsanstalt, Leipzig, 1950. — Michel, Die Mikrophotographie, Springer-Verlag, Wien, 1957. — Michel, Die Grundlagen der Theorie des Mikroskops, Wissenschaftliche Verlags GmbH., Stuttgart, 1950.

Inserting daylight cartridges into the film magazine



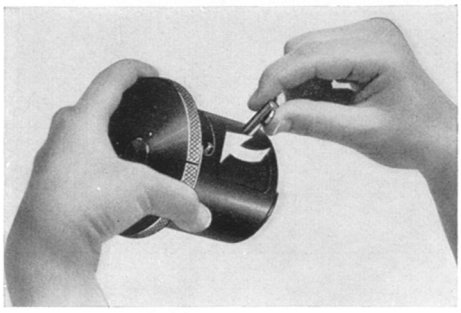
36

To remove the old film, turn the magazine leftwards to the stop where it bears a red marking line for reinsertion...



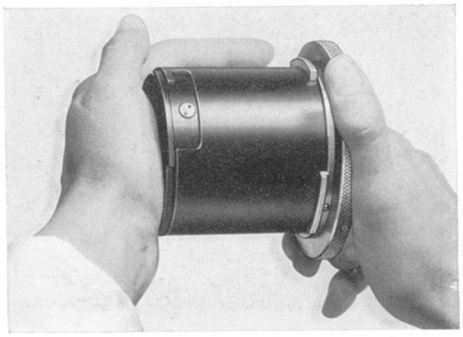
37

...and pull it out.



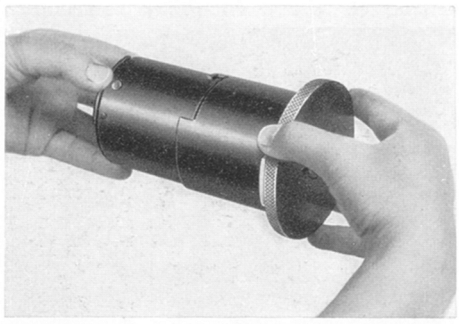
38

With the accompanying key rewind the film into the cartridge.



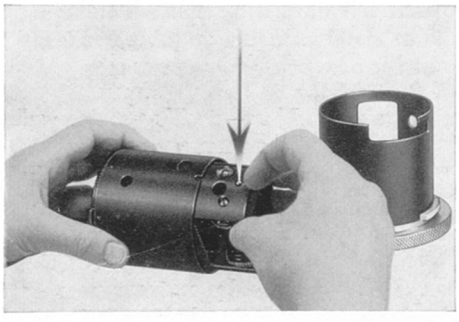
39

Press against the bottom of the magazine, turn the upper part and . . .



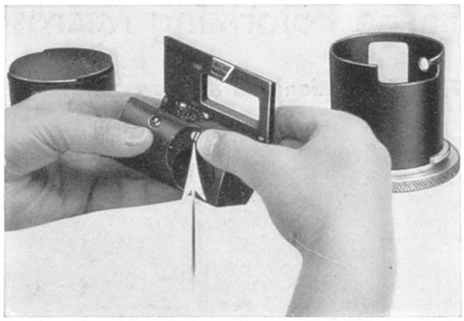
40

. . . pull out the released inner part.



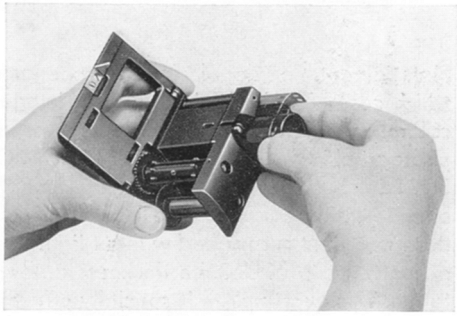
41

In this lies the "spool" which must be taken out (please watch the pin in reassembling).



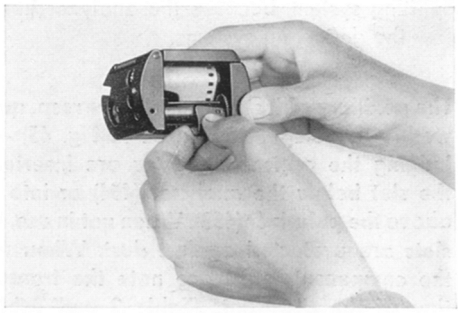
42

Now press on the extending slotted bolt and the cover springs open. Remove the old cartridge.



43

Introduce the new cartridge, draw the film, emulsion side up, over the rollers so that its perforations lie over the film advance roller. Close the cover and snap home.



44

From below fasten the film to the slot in the spool and draw it tight by turning the toothed spool disk.

Insert the magazine in the reverse order as shown in Figs. 41 to 36.

Large Polarizing Microscope

For Observation and Measurement

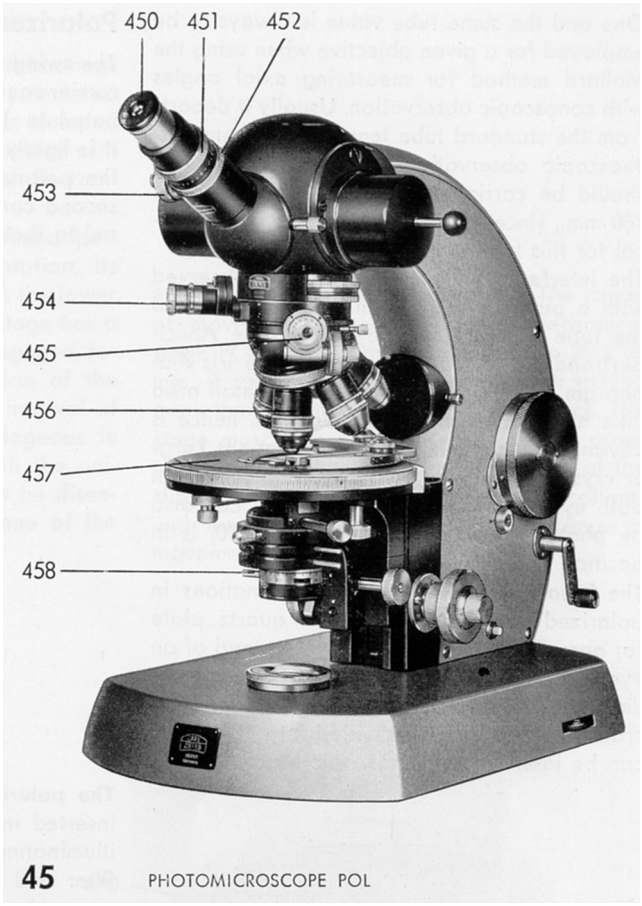
No perceptible depolarization phenomena, which could falsify the interference images or colors, occur in either the observation or in the photographic beam path of PHOTOMICROSCOPE POL (Fig. 45). The analyzer effect of the beam-splitting prisms in the tube head Pol of this instrument is annulled without light loss by a quartz plate of definite thickness and orientation. This quartz plate is specially effective in positions 1 and 3 of the beam-splitting slide (14 in Fig. 1), and above all when objects are observed in plane-polarized light, that is without analyzer. Observations or measurements with analyzer are not influenced by the beam-splitting system, because the analyzer lies below the deflecting systems.

The auxiliary objects – red 1. order resp. quartz wedge or compensators (455 in Fig. 45) – for judging the optical character are inserted in the slot below the analyzer (454) or into that above the polarizer (458). When not in use, both slots are protected against dust. When using the compensators, please note the transposition of the quadrants (Table 2 and Table 3, pp. 44/45).

The Tube

Each tube is clamped in oriented position to the tube head POL (Fig. 10). A pin on the attachment ring of the tube secures its correct position. The eye lens of the eyepiece POL is focused on the cross lines (resp. micrometer). If the orientation pin on the eyepiece (450) lies in the central notch on the rim of the tube, the horizontal line of the cross lines visible in the eyepiece is aligned parallel to the vibration plane of the polarizer (in 0 position), the vertical line to that of the analyzer (likewise in 0 position).

The monocular polarizing tube contains a swing-out Amici-Bertrand lens which is centered with two knobs (453). It is switched in for conoscopic examination of the specimen and for examining the exit pupil of the objective, as in adjusting the aperture diaphragm for epi-observation. A collar (451) on the tube provides for focusing the system, consisting of this lens and the eyepiece, on the interference figures. The system constitutes an Auxiliary Microscope. The tube extension for which an objective is corrected can be read off on the scale of the collar.



45 PHOTOMICROSCOPE POL

450 Eyepiece POL
451 Collar for focusing the system, consisting of eyepiece and Amici-Bertrand lens, on the exit pupil of the objective
452 Tube iris diaphragm
453 Switching-in and centering of the Amici-Bertrand lens
454 Swing-out rotatable analyzer
455 Compensator
456 Centering objective POL
457 Polarizing rotary stage II with ball bearings
458 Swing-out and rotatable polarizer

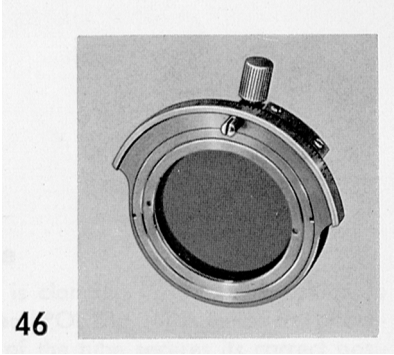
One and the same tube value is always to be employed for a given objective when using the Mallard method for measuring axial angles with conoscopic observation. Usually it departs from the standard tube length of 160 mm. Orthoscopic observations, on the other hand, should be carried out with a tube length of 160 mm., since the objectives are made parfocal for this tube length.

The interference figure can also be observed with a pin-hole diaphragm. It is inserted into the tube instead of an eyepiece. The Amici-Bertrand lens is swung out. The tube iris diaphragm (452) serves for isolating a small area (like a crystal) from its surroundings, hence is advantageous in conoscopic observations. Larger crystals can be judged conoscopically with both eyes in the binocular tube and can also be photographed, if the OPTOVAR (10) is in position "Ph".

The binocular tube POL for examinations in polarized light also contains a quartz plate for annulling the analyzer effect. Instead of an eyepiece, a pin-hole diaphragm or an Auxiliary Microscope (like 46 48 21 with built-in micrometer plate 5 mm., divided into 100 parts) can be inserted for conoscopic observation.

Polarizers

The swing-out polarizer (473) on the condenser carrier can be rotated through 210° and is graduated in 15° intervals. At 0°, 90°, and 180° it is lightly arrested. A slot immediately above the polarizing filter serves for insertion of a second compensator which always lies diagonal to the vibration plane of the polarizer.



The polarizer for ore microscopy (Fig. 46) is inserted into one of the filter pockets of the illuminating attachment the same way as a light filter and clamped by means of the knurled screw. A rotation of 0.5° can be read directly at the vernier. In the 0 position the plane of vibration of the polarizer runs from right to left. **The analyzer** (454) is mounted in a slide between the lenses of a Telan system in tube head POL. It can be clamped by a lever in any position of rotation.

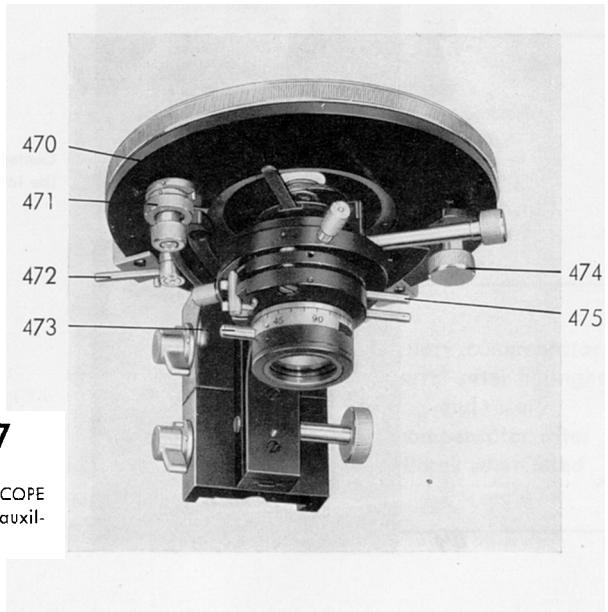
In turning the drum clockwise the analyzer, viewed in direction of the light leaving the objective, turns in the same direction. Its azimuth can be read on the drum. To the value at the right of the index line on the drum with smaller diameter is added that indicated on the vernier.

The Stage

The polarizing rotary stage with ball bearings (457 in Figs. 45 and 47) is permanently centered and falls into correct alignment when clamped to the dovetail. Its rotation can be arrested with lever (472). The angle of rotation can be read directly to 0.1° on two verniers.

By means of the upper knob (471) a fine adjustment is engaged for the stage rotation, its rapid rotation being carried out with the lower knob on the same axis. Finally the stage has a click-stop device (474). It can be engaged for any optional position in the rotation of the stage and marks every subsequent interval of 45° by a slight clicking in (advantageous in working with compensators, or with the universal rotary stage). This device can be **disengaged** only when the stage is **in one of the click-in positions.**

Examinations with epi-illumination: The range of movement of the attachable mechanical stage POL (30 x 38 mm.) is reduced to 25 x 38 mm. if specimens are observed which extend more than 18 mm. above the stage surface. The stage must then be lowered so far, in order to focus the image, that during rotation of the stage the attachable mechanical stage collides with the stand towards the end of its range of movement.



47

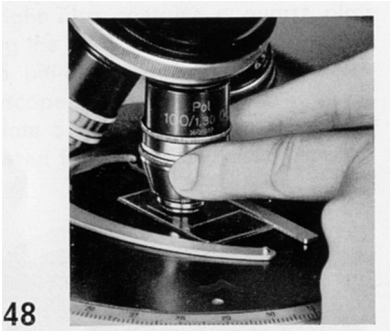
Stage and condenser assembly of PHOTOMICROSCOPE POL with polarizer (473), condenser, and condenser auxiliary lens 1 POL (475).

Objectives POL

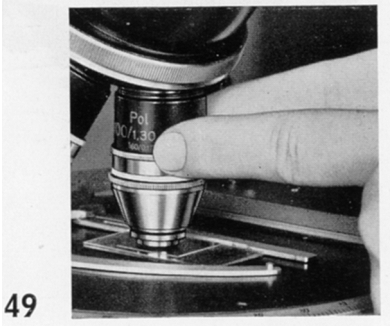
To facilitate centering of the objectives, the axis of rotation of the polarizing stage is first marked by moving, with the attachable mechanical stage, a minute, conspicuous detail of the specimen, such as a dust particle, into the point in the field of view about which all other elements revolve as the stage is rotated.

The axis of rotation of the stage and the Microscope axis are brought into coincidence by turning the centering device of the objectives (Figs. 48 and 49) until the point marking the axis of rotation coincides with the intersection of the eyepiece cross lines.

The field of view, especially with high-power objectives, becomes lighter between crossed polarizer and analyzer. In conoscopic observation the impression is given like that of an interference image of a uniaxial, slightly positively doubly refracting object observed perpendicular to its axis. Due to the unavoidable rotation of the plane of polarization at the highly curved surfaces, the exit pupil of these objectives is completely dark only in the directions blocked by the polarizers.



48 Centering the objective with the lower knurled ring



49 Centering the objective with the upper knurled ring

Knob for switching in one of the two projectives 3.2 and 6.3 which, as shown in Fig. 14 on p. 10, affect the imaging scale on the film.

Epi-condenser II C for the observation of opaque specimens in reflected light. Details on pp. 26, 27.

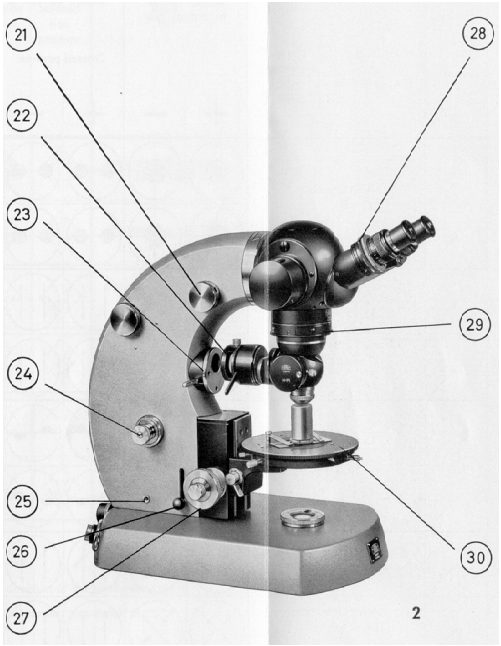
Reflector insert with aperture diaphragm for epi-illumination. The scale on the slide indicates the diameter of the aperture diaphragm in millimeters.

Here the **exposure** 1/10 (flash photography), 1/25, 1/50 or 1/100 sec. is set, if the camera shutter is mechanically released by pressure on the hand-release knob (18) or electrically with key **B** of the automatic exposure device (Fig. 33). In position *B* of this knob the shutter remains open as long as knob (18) is depressed or key **B.**
For automatic exposures (p. 32) **set knob on** *B*.

Synchronizing contact for photographs with electronic flash.

Handle for switching from epi- to transmitted illumination and vice versa. Here: in position for epi-illumination.

Focusing pinion. The knurled ring on its right axis regulates the action of the coarse adjustment. An interval of the scale on the fine adjustment equals a displacement in height of 2 μ (= 0.002 mm.). The fine adjustment should be operated as far as possible near the center of its range of about 2 mm. Two marks on the right side of the pinion box indicate its range limits.

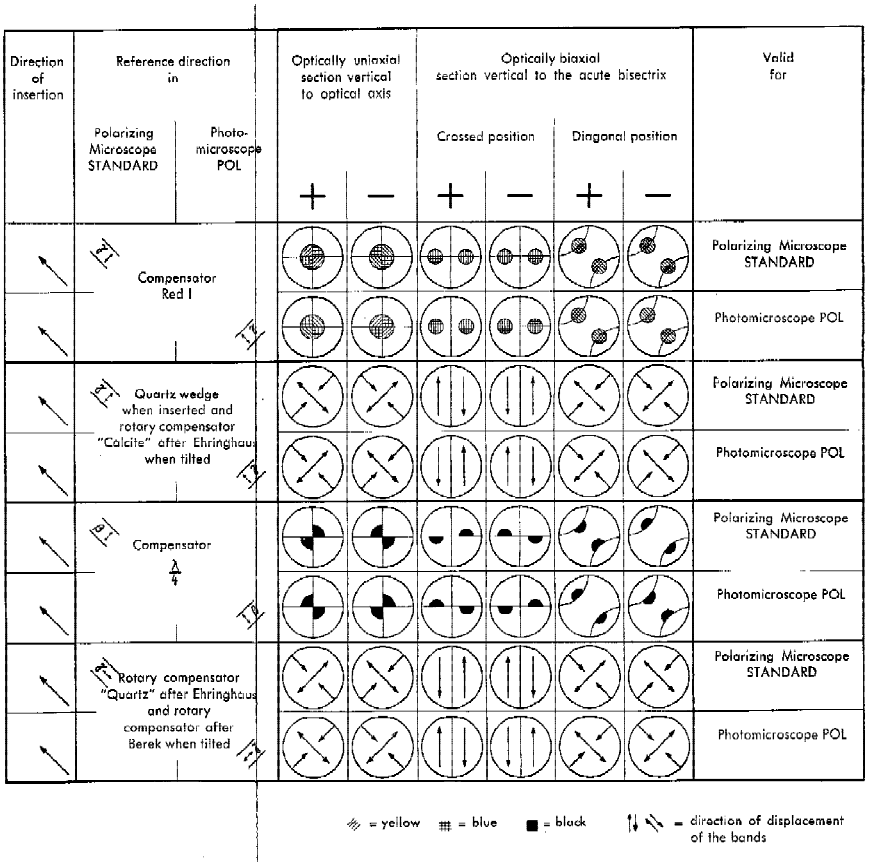


Binocular tube, detachable from the tube head for transportation. After adjusting the interpupillary distance, and with the beam-splitting slide (14 in Fig. 1) in position 3, the length of the eyepiece sleeve is regulated with the knurled collars so that the double lines on the focusing graticule appear sharp for each eye. Then any desired position of the slide may be used. Notches in the eyepiece sleeve serve for orientation of the cross-lines eyepiece in polarizing microscopy.

The closing piece is interchangeable with the simple analyzer slide for general examinations with polarized light (Fig. 18). **Compensators** (455 in **Fig. 45**) for polarizing microscopy as well as **barrier filters** for fluorescence microscopy are inserted into the slot below this slide. When not in use, the slot should be closed to protect it against dust.

The gliding stage on its carrier can be interchanged with other stages (e. g. the rotating mechanical stage Fig. 1). It can be rotated and moved directly by hand in any horizontal direction. It can be centered and its rotary movement clamped. The stage, like the condenser carrier, is mounted on the dovetail (Fig. 7).

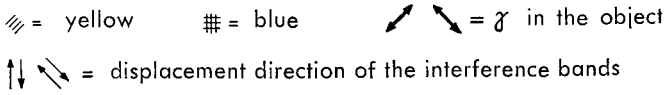
Table 2
Optical Character in the Conoscopic Interference Image



Please note that the addition resp. subtraction colors appear transposed by 90°.

Table 3 **Optical Character in an Orthoscopic Image**

Direction of insertion	Reference direction in: Polarizing Microscope STANDARD	Reference direction in: Photomicroscope POL	Addition position	Subtraction position	Valid for
↗	Compensator Red I				Polarizing Microscope STANDARD
↗					Photomicroscope POL
↗	Quartz wedge when inserted and rotary compensator "Calcite" after Ehringhaus when tilted				Polarizing Microscope STANDARD
↗					Photomicroscope POL
↗	Rotary compensator "Quartz" after Ehringhaus and rotary compensator after Berek when tilted				Polarizing Microscope STANDARD
↗					Photomicroscope POL



Please note that the addition resp. subtraction colors appear transposed by 90°.

Illuminating System for the PHOTOMICROSCOPE

The data in tables 4 to 6 are valid for eyepieces having a field of view number 18 (e.g. Kpl 8x), OPTOVAR (10) in position 1.25. Column 2 shows the diameter of the area of the object included in the image.

The lowest magnification on the film is obtained with Planachromat 1/0.04. It is used without a condenser but with switched-in auxiliary lens and rear diaphragm (19 in Fig. 1) opened. In this case the front diaphragm (20) functions as aperture diaphragm.

Table 4

Condenser with swing-out front lens **0.9 Z; 1.3 Z; phase-contrast condenser II Z,** also POL **with condenser auxiliary lens I**

<table>
<tr><th rowspan="2">Objective</th><th rowspan="2">Object field diam. mm.</th><th>Front lens</th><th>Aux. lens</th><th rowspan="2">Condenser diaphragm</th><th>Front diaphragm (20 in Fig. 1)</th><th>Rear diaphragm (19 in Fig. 1)</th></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>2.5
4
6.3[1])</td><td>5.5
3.6
2.25</td><td colspan="2">switched out</td><td>open</td><td>Aperture diaphragm</td><td rowspan="2">open</td></tr>
<tr><td>10
16</td><td>1.45
0.9</td><td rowspan="3">switched in</td><td>in</td><td rowspan="3">Aperture diaphragm</td><td>Radiant field stop</td></tr>
<tr><td>25
40
63[2])
100[2])</td><td>0.56
0.36
0.23
0.15</td><td>out</td><td>open</td><td>Radiant field stop</td></tr>
</table>

[1]) Utilizes only apertures up to 0.14. This combination to be used only with Cond. 1.3. With other condensers and an objective aperture greater than 0.16 (e.g. Neofluar 6.3/0.20) use the same combination as for objective 10.

[2]) Apertures above 0.9 obtainable only with condenser 1.3 and immersed condensers. A precise imaging of the radiant field stop is impossible, due to aberrations in the condenser.

Table 5

Achr. apl. condenser 1.4 Z; achr. apl. **phase-contrast condenser V Z with condenser auxiliary lens IV**

Objective	Object field diam. mm.	Front lens	Aux. lens	Condenser diaphragm	Front diaphragm (20 in Fig. 1)	Rear diaphragm (19 in Fig. 1)
1	2	3	4	5	6	7
2.5	5.5	without condenser [4]	switched **in**	none	Aperture diaphragm	**open**
4	3.6					
6.3	2.25[5]				Radiant field stop	
10	1.45					
16	0.9	fixed	switched **out**	Aperture diaphragm	**open**	Radiant field stop
25	0.56					
40	0.36					
63[5]	0.23					
100[5]	0.15					

[3] Object field barely fully illuminated, remove the condenser to illuminate the entire field of view. Then however the full aperture is not utilized.

[4] For an **orienting survey** of the specimen it suffices to **illuminate the field of view** by merely lowering the condenser and switched-in auxiliary lens, without consideration of aperture diaphragm and radiant field stop.

[5] The condenser aperture can be fully utilized only with immersed condenser.

Table 6

Phase-contrast condenser IV Z/6, III Z, III Z/6 with auxiliary lens IV

Objective	Object field diam. mm.	Front lens	Aux. lens	Condenser diaphragm	Front diaphragm (20 in Fig. 1)	Rear diaphragm (19 in Fig. 1)
1	2	3	4	5	6	7
2.5[6]	5.5	fixed	switched **in**	**open**	Radiant field stop	Aperture diaphragm
4	3.6					
6.3	2.25					
10	1.45		switched **out**	Aperture diaphragm	**open**	Radiant field stop
16	0.9					
25	0.56					
40	0.36					
63[7]	0.23					
100[7]	0.15					

[6] Fully illuminated only with condenser having a focal intercept of 6 mm. Phase-contrast condenser III Z illuminates only 4 mm. ϕ. Therefore remove this and switch in only auxiliary lens IV. Then the front diaphragm acts as aperture diaphragm. Open the rear diaphragm.

[7] Good imaging of the radiant field stop is impossible at high apertures, due to aberrations in the condenser.

The illustrations are not binding in every detail for the design of the instruments.

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