Nikon

MICROSCOPE MODEL S
(Coaxial Focusing Control Type)

INSTRUCTIONS

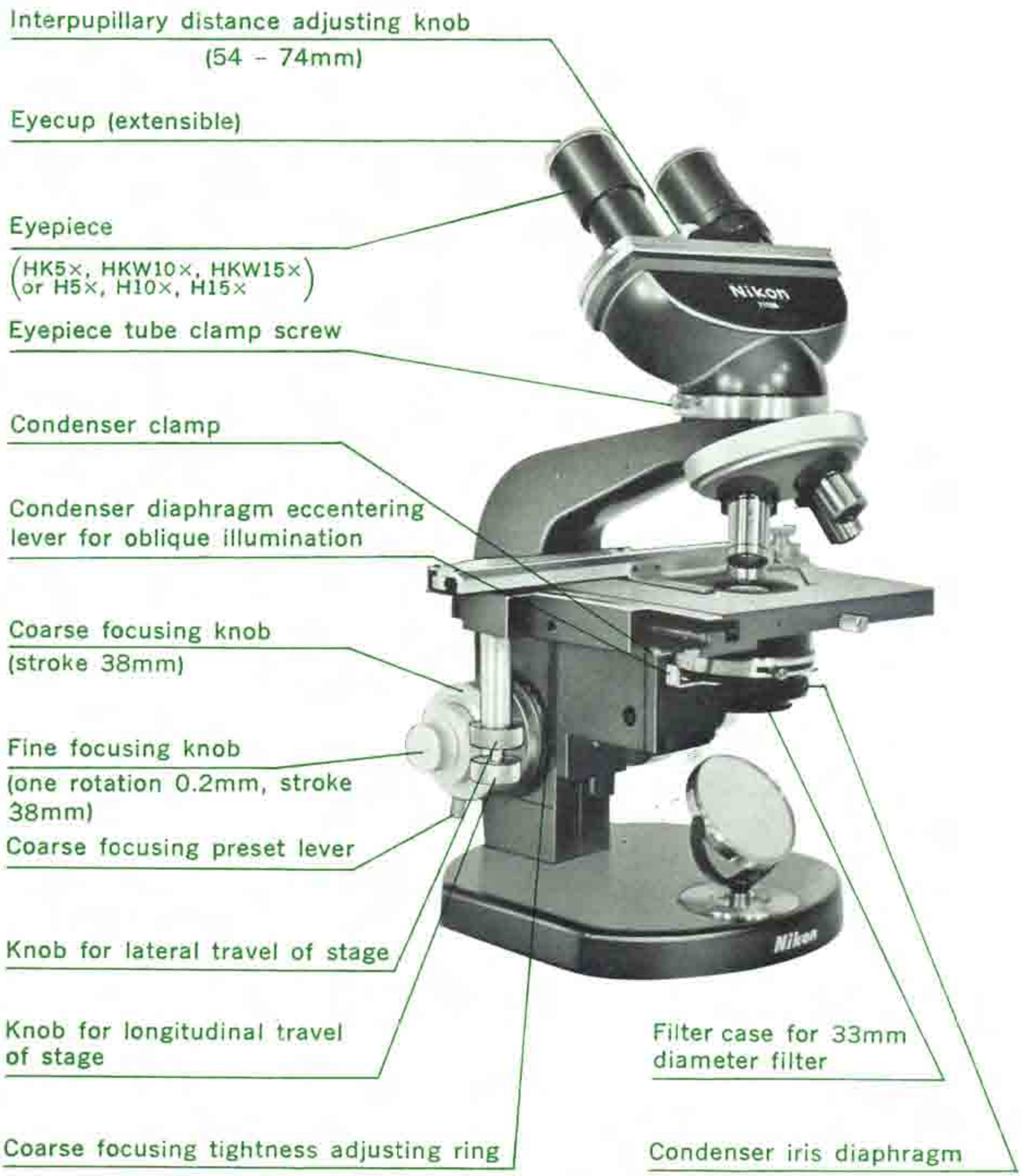
NIPPON KOGAKU K.K.

Caution in Handling and Maintenance

- Avoid touching lens surfaces with the fingers or with any coarse material. For dusting, use a feather or a soft lens brush. To wipe off finger-marks, use a washed-out soft cotton cloth wetted with xylol, but never with alcohol or ether.
- Dismantling of the microscope and the internal optical parts should not be attempted, as it may interfere with the performance of the instrument, and such a procedure can be performed only by an expert or the original maker.
- Do not apply any grease to the sliding surfaces of the coarse focusing adjustment and of the floating stage. If necessary, return the microscope to your dealer or to the manufacturer.
- The microscope, when not in use, should be covered with the vinyl cover or kept in the wooden cabinet.
- When keeping the microscope in the cabinet, do not forget to secure the locking screw of the body tube. Place the support under the microscope substage and secure it. Fasten the fixing screw of the microscope on the cabinet bottom.
- For transportation, pack the body tube, rectangular or circular stage and lenses—objectives, eyepieces and condenser—in a separate container.

CONTENTS

1. NOMENCLATURE (MODEL SBR)



Eyesight adjusting ring

Revolving nosepiece

Objective
(4×, 10×, 40×, 100×)

Slide holder lock

Slide holder

Condenser focusing knob
(stroke 28mm)

Mirror

Lock screw
for the condenser diaphragm eccentering lever

Stage lock screw

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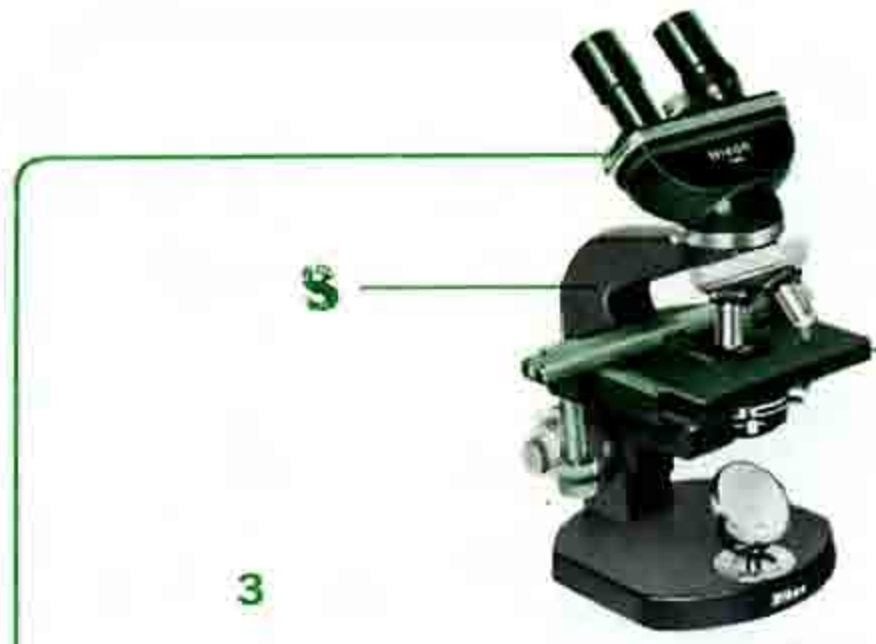
2. VARIOUS COMBINATIONS

The Nikon Microscope Model S is available in various combinations with objectives, eyepieces, condensers, eyepiece tubes, and stages. For example, Model SBR consists of Model S microscope stand with Binocular eyepiece tube "B" and Rectangular mechanical stage "R".



S

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U	T	B	I
Trinocular	Trinocular	Binocular	Inclined Monocular

R	C	G	P
Rectangular Mechanical	Circular Floating	Graduated, Circular Rotatable	Square Plain

(1) Interchangeable Eyepiece Tubes

- "U" Trinocular

  Magnification factor 1X. Has provision for diopter compensation and interpupillary distance adjustment from 54mm to 74mm. Observation binoculars inclined 45°, photo-tube upright, 360° rotatable. With built-in sliding prism system, light transmission can be switched over three ways to permit photomicrography through vertical tube while viewing through binocular tube; 100% light directed to observation binoculars by switching over light path; or whole light transmission directed to vertical photo tube for photomicrography, micro-projection or closed-circuit T.V. pickup.

- "T" Trinocular

  Magnification factor 1X. Has fixed beam-split ratio, 50% to observation binocular tubes and 50% to vertical photomicrographic tube. Inclined 45° and rotatable 360°. Has provision for diopter compensation. Interpupillary distance adjustment from 54mm to 74mm.

- "B" Binocular

  Magnification factor 1X. Inclined 45° and rotatable 360°. Has provision for diopter compensation. Interpupillary distance adjustment from 54mm to 74mm.

- "I" Inclined Monocular

  Interchangeable with other type eyepiece tubes. Inclined 45° and rotatable 360°.

(2) Interchangeable Stages

- "R" Rectangular Mechanical

  Stage surface 130mm×140mm. Has low-positioned coaxial X and Y motion controls which provide exceptionally fine, smooth crosstravel within range of 50mm×75mm. Scales graduated to 0.1mm on vernier.

- "G" Graduated, Circular Rotatable

  Stage surface 140mm in diameter. 360° rotatable. Goniometer divided into 1° increments and reads to 6′ with vernier. Centerable stage provided with clamping screw. Supplied with stage clips.

- "C" Circular Floating

  Stage surface 140mm in diameter. Provided with stage clips. Accepts attachable mechanical stage available on order. Moves smoothly in any direction within circle diameter of 18mm in straight and/or rotating motion. Can be clamped in any desired position.

- "P" Square Plain

  Stage surface 130mm×130mm. Provided with stage clips. Accepts attachable mechanical stage available on order.

3. OBJECTIVES, EYEPIECES, CONDENSERS

(1) Objectives

● For medical and biological use

Type	Individual Magnification	Numerical Aperture	Focal Length	Working Distance	Remarks
Achromatic Dry	4X	0.10	28.3mm	9.50mm	
	10X	0.25	14.8mm	7.10mm	
	20X	0.40	7.5mm	5.70mm	
	40X *	0.65	4.3mm	0.54mm	
	S40X	0.65	4.3mm	0.54mm	Spring-loaded
	NC40X	0.65	4.3mm	0.52mm	No cover glass type
Oil-immersion	100X	1.25	1.8mm	0.16mm	
	S100X	1.25	1.8mm	0.16mm	Spring-loaded
	100X	1.25	1.8mm	0.16mm	With iris diaphragm for dark-field
Plan Achromatic Dry	Plan 1.2X	0.03	35.8mm	29.7mm	
	2X	0.05	42.3mm	35.6mm	
	3X	0.08	37.7mm	28.6mm	
	4X	0.10	29.5mm	18.2mm	
	10X	0.25	15.6mm	7.0mm	
	40X	0.65	4.0mm	0.24mm	Spring-loaded
	NC40X	0.65	4.1mm	0.32mm	Spring-loaded, no-cover glass type
Oil-immersion	100X	1.30	1.6mm	0.12mm	Spring-loaded
Plan Apochromatic Oil-immersion	100X	1.30	1.6mm	0.12mm	Spring-loaded
Apochromatic Dry	40X	0.80	4.3mm	0.19mm	Spring-loaded
Oil-immersion	100X	1.40	1.6mm	0.10mm	Spring-loaded
Long-Working Distance Type Achromatic Dry	LWD40X	0.60	4.0mm	2.0mm	For tissue culture observation
Phase-Contrast Achromatic Dry	DLL 10X	0.30	15.9mm	6.4mm	Dark Contrast
	B-M 10X	0.30	15.9mm	6.4mm	Bright Contrast
	DLL 20X	0.40	8.2mm	4.5mm	Dark Contrast
	B-M 20X	0.40	8.2mm	4.5mm	Bright Contrast
	DLL 40X	0.65	4.4mm	0.54mm	Dark Contrast, Spring-loaded
	D-M 40X	0.65	4.4mm	0.54mm	Dark Contrast 〃
	B-M 40X	0.65	4.4mm	0.54mm	Bright Contrast 〃
Oil-immersion	DLL100X	1.25	1.8mm	0.16mm	Dark Contrast 〃
	D-M100X	1.25	1.8mm	0.16mm	Dark Contrast 〃
	B-M100X	1.25	1.8mm	0.16mm	Bright Contrast 〃
Long-Working Distance Achromatic Dry	D-M40X	0.60	4.0mm	2.0mm	Dark Contrast 〃 (For tissue culture work)

● For metallurgical use

Metallurgy Achromatic Dry	M5X	0.10	25.0mm	15mm	
	M10X	0.25	14.8mm	7.1mm	
	M20X	0.40	7.5mm	5.7mm	
	M40X	0.65	4.3mm	0.52mm	
	M100X	1.25	1.8mm	0.16mm	
Plan Achromatic Dry	Plan M10X	0.25	15.6mm	7.0mm	
	Plan M40X	0.65	4.1mm	0.32mm	Spring-loaded
	Plan M100X	1.30	1.6mm	0.12mm	Spring-loaded

The objectives are designed to give the above magnifying powers with the best definition, when used with the microscope whose tube length is 160mm.
Besides the magnifying power, numerical aperture or the angular aperture of the light cone admitted into the objective is also an important consideration, as it largely determines the resolution or defining power, depth of focus and the brightness of the microscope image.

All the above objectives are parfocal within the fine focusing range.
For 40×objectives, a cover glass (0.17mm thick) must be used. In case the cover glass is unusable, use an NC 40×objective.
* Jap. pat.: No. 213862, German pat.: T 8267, U.S. pat.: No. 2781694.

(2) Eyepieces

Type	Individual Magnification	Focal Length	Field Number	Remarks
High eyepoint, compensating	HK5X	50mm	21.0	With adjustable eyepiece collar
High eyepoint, compensating, wide-field	HKW10X	25mm	18.0	With adjustable eyepiece collar
High eyepoint, compensating, wide-field	HKW15X	16.7mm	14.0	With adjustable eyepiece collar
Compensating, wide-field	WF10X	25mm	18.0	High-power purpose
Compensating	K20X	12.5mm	8.0	General purpose
Huygenian	H5X H10X H15X	50mm 25mm 17mm	21.0 12.0 8.0	General purpose General purpose General purpose
Diopter adjustable, high eye-point, compensating, wide-field	DHKW10X	25mm	18.0	Supplied together with "U" eyepiece tube With 5X, 10X, 15X picture frames plus cross-lines for framing and focusing

The field number indicates the effective visual field of view for a particular eyepiece, which, divided by the power of the objective used, gives the diameter of the object to be covered in mm (real field).
All eyepieces are parfocal within the fine focusing range.
High eyepoint eyepiece enables easier observation especially for spectacled persons.

(3) Combinations of Objectives and Eyepieces

Total magnifying power obtained by the combination is the product of individual objective power multiplied by individual eyepiece power.
A selection of the combination will be decided so as to get the highest resolution of the image **(resolving power)**, the largest extent of object area **(real field)** which can be observed without moving the stage or slide, or the greatest thickness of object **(depth of focus)** which can be distinctly seen without raising or lowering the microscope stage, depending upon the purpose of using the microscope. Shown below are the results compiled from the different combinations of objectives and eyepieces:

Objective	Eyepiece	Total Magnifying Power	Working Distance (mm)	Resolution or Minimum Resolved Distance		Real Field of View (mm)	Depth of Focus (μ)
				in object (μ)	in image (mm)		
4X	5X 10X 15X	20X 40X 60X	9.5	2.7-5.5	0.05-0.11 0.11-0.22 0.16-0.32	5.25 4.5-3 3.5-2	100 64 52
10X	5X 10X 15X	50X 100X 150X	7.1	1.1-2.2	0.05-0.11 0.11-0.22 0.17-0.33	2.1 1.8-1.2 1.4-0.8	16 10 8
40X	5X 10X 15X	200X 400X 600X	0.54	0.42-0.84	0.08-0.17 0.17-0.34 0.25-0.50	0.52 0.45-0.30 0.35-0.20	1.8 1.2 1.0
100X	5X 10X 15X	500X 1000X 1500X	0.16	0.22-0.44	0.11-0.22 0.22-0.44 0.33-0.66	0.21 0.18-0.12 0.14-0.08	0.6 0.44 0.38

● The working distance is the clearance between the upper surface of the cover glass and the lowest edge of the objective critically focused. Note that, as shown in the above table, the working distance becomes very small for high power objectives.

- The resolution of minimum resolved distance (the limit of resolving power) is the minimum distance between object points discernible as separate under the microscope illuminated by the light of wave length 550mμ.
  The shorter the light wave length, the higher the resolving power, that is, the small resolving distance results. In the table, the smaller values indicate the resolution obtained by oblique and the larger values by central illumination. (see "Illumination" on page 11)
- The minimum resolved distance in the image is the value in the object multiplied by the total magnification of the microscope. If the resolving power of the microscope is important, choose the eyepiece by the use of which the image resolution comes within that of the naked eye 0.15—0.3mm (when the object is seen from the distance 25mm); generally accepted criterion on the upper limit of the total magnification of a microscope set up is about 500—1000X of the numerical aperture of the objective to be used. Note that in photomicrography it is useless to raise the magnification beyond the resolving power of the emulsion (usually about 0.05mm). However, since the resolution of the emulsion is higher than that of the naked eye, photographs are usually taken at a lower magnification and thereafter they are enlarged.
- Real field of view (in mm) represents the extent of the object that comes under observation. In higher magnification it becomes extremely small.
  Consequently, it is advisable to take aim at the object point to be examined first under lower magnification and then revolve the nosepiece to higher magnification.
- Depth of focus represents the thickness or height of the object in μ sharply seen when observation is made through the microscope. In photomicrography the depth of focus becomes smaller than the figure shown in the previous table. Therefore, careful attention must be made in focusing when taking microscope pictures.
  By closing the condenser diaphragm, the depth of field can be made greater than the value shown in the table.
- When focus is on the center of the field its circumference will usually be blurred, because a curvature of the image plane is unavoidable in the microscope, except when using a plan type objectives. In order to get sharp corner image, it is necessary to adjust the fine focusing knob and switch the focus from the center onto the corners.

(4) Condensers

Type	Numerical Aperture	Remarks
Abbe	1.30 Two lenses	For central illumination (without oblique illumination slider)
Abbe	1.30 Two lenses	For central and oblique illumination (with oblique illumination slider)
Aplanatic	1.40 Three lenses	For high-class microscopy
Achromatic	1.25 Five lenses	For high-class microscopy
Achromatic (long focal-length type)	0.7 Four lenses	Long focal-length type. Working distance 12mm. With turret-mounted annular diaphragms for phase-contrast and phase-interference microscopy.
Universal Dark-Field Condenser	1.20–1.40 for dark-field	Supplied in centerable mount. With outer diameter 36.8 mm. Objectives to be used 10X up to 100X. Ideally suited for fluorescence work. 100X objective used should have built-in adjustable iris diaphragm. Thickness of slide glass to be used, must be less than 1.2mm.
Low-Power Condenser	Single lens	For low-power macro-objectives, e.g., 1.2X, 2X, & 3X Plan Achromatic

These condensers are not only capable of concentrating light-beam for better illumination of the image field, but also gives a great influence on the resolution of microscope image, image contrast and depth of focus. In precise observation and photomicrography, the use of an achromatic or aplanatic condenser with the maximum numerical aperture 1.25 provided with an oblique illumination device and a filter case is specially recommended.

4. ATTACHING THE LENSES

Before attaching the objective and the eyepiece to the microscope, first clean their outer lens surfaces. Even a slightly stained finger mark may often interfere with the image contrast.


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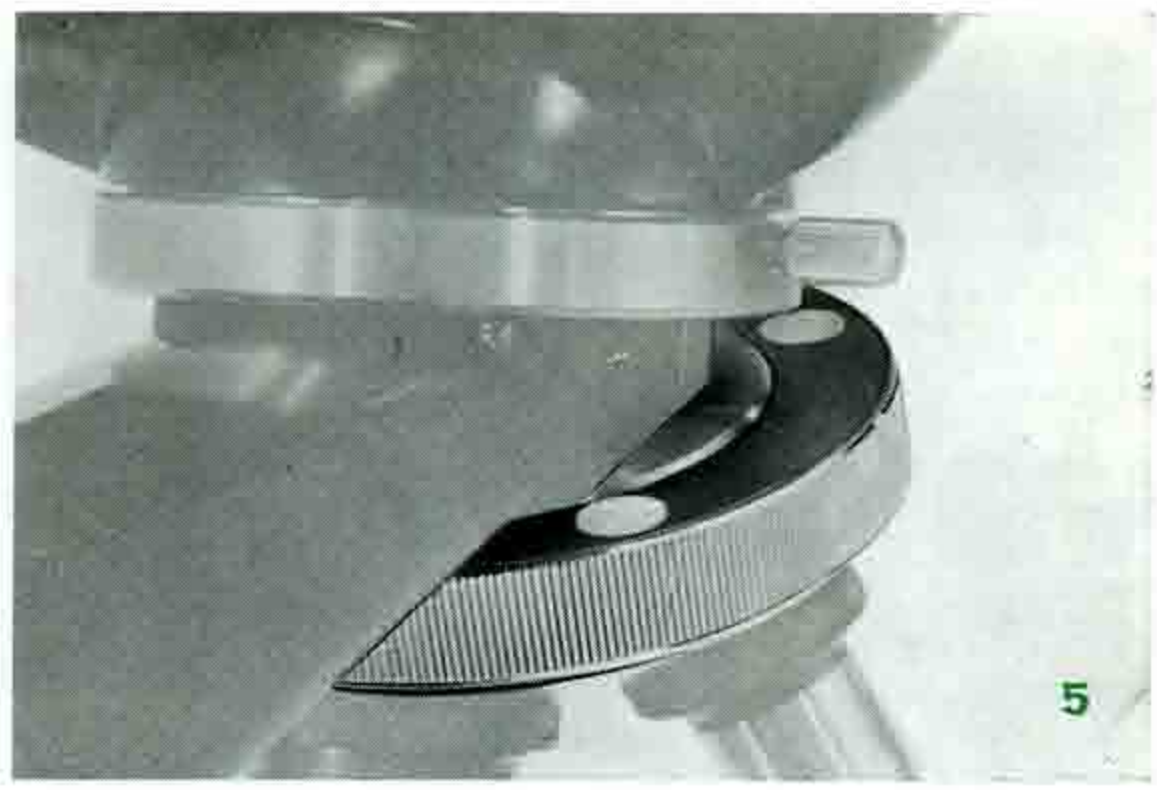
(1) Mounting the Objectives

Take special care in handling the objectives. Before attaching the objectives on the nosepiece revolver, lower the microscope stage sufficiently. Securing each objective with the fingers of one hand, screw it into each nosepiece hole with those of the other hand (**Fig. 4**). It is recommended to mount the objectives on the nosepiece orderly from low to high powers so that the magnification of each objective augments as the revolver is rotated clockwise.

Microscope Model S has on its upper surface of the nosepiece revolver four blank spots (**Fig. 5**) on each of which the objective magnification can be inked so that, by looking these indications from above, the objective located below can be identified without having to turn away your eyes from the eyepiece.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When rotating the revolver, hold its outer milled rim with your thumb and first finger, but do not push the objective barrels, otherwise alignment of the objectives may be troubled.

(2) Mounting the Eyepieces

For mounting, simply drop the eyepiece into the eyepiece tube. It is

recommended to leave an eyepiece in place even when it is not in use, in order to prevent the entrance of dust into the eyepiece tube. Or put on the eyepiece cap in place of the eyepiece removed. The inclined eyepiece body tube, trinocular, binocular or monocular, can be rotated after loosening the clamp screw for convenience in viewing from any desired direction without moving the microscope stand. By further releasing the clamp screw **(Fig. 6)** the body tube can be removed and replaced with another type eyepiece body tube.

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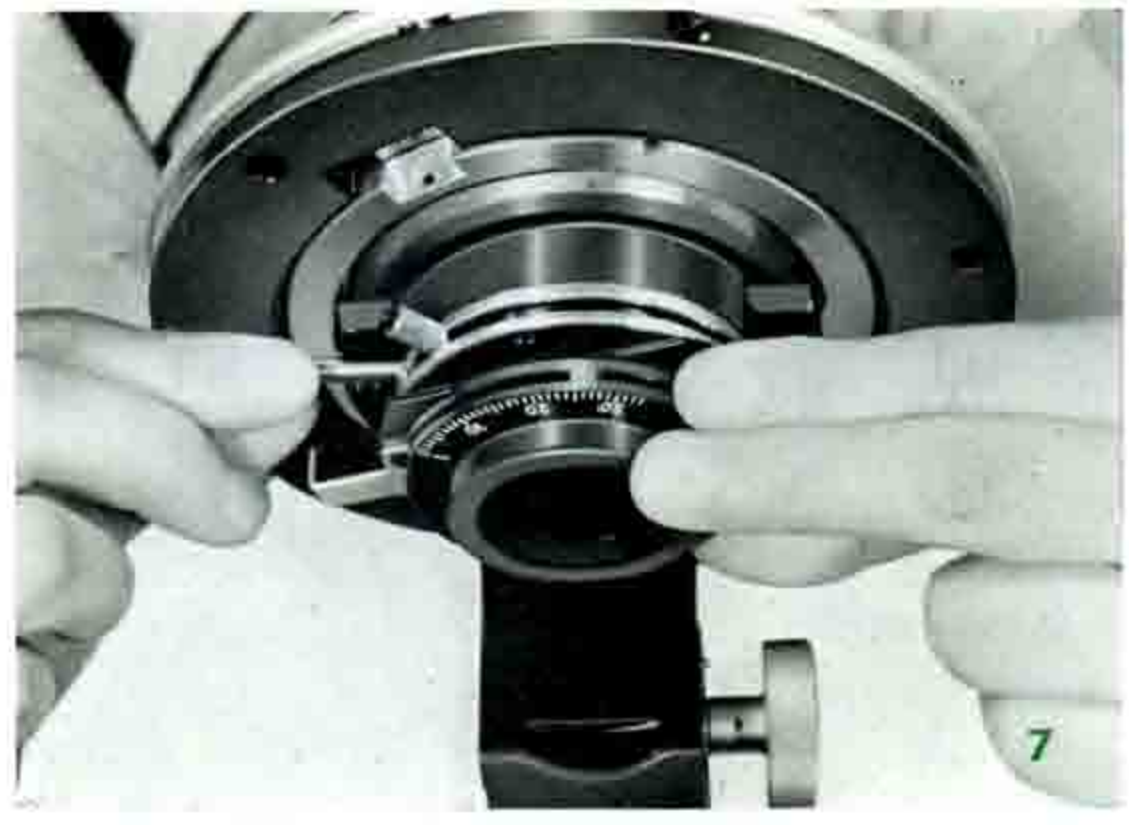
(3) Mounting the Condenser

To mount the condenser, unlock the clamp screw, and insert the condenser beneath the condenser holder as far as it will go. Then, tighten the clamp screw. In this case locate the diaphragm eccentering lever and its screw at a proper place so as to facilitate their manipulation with one hand **(Fig. 7)**. The correct distance to retain immersion oil between the lower surface of the slide and the top of condenser is secured when the condenser is raised to the upper limit by turning the condenser focusing knob.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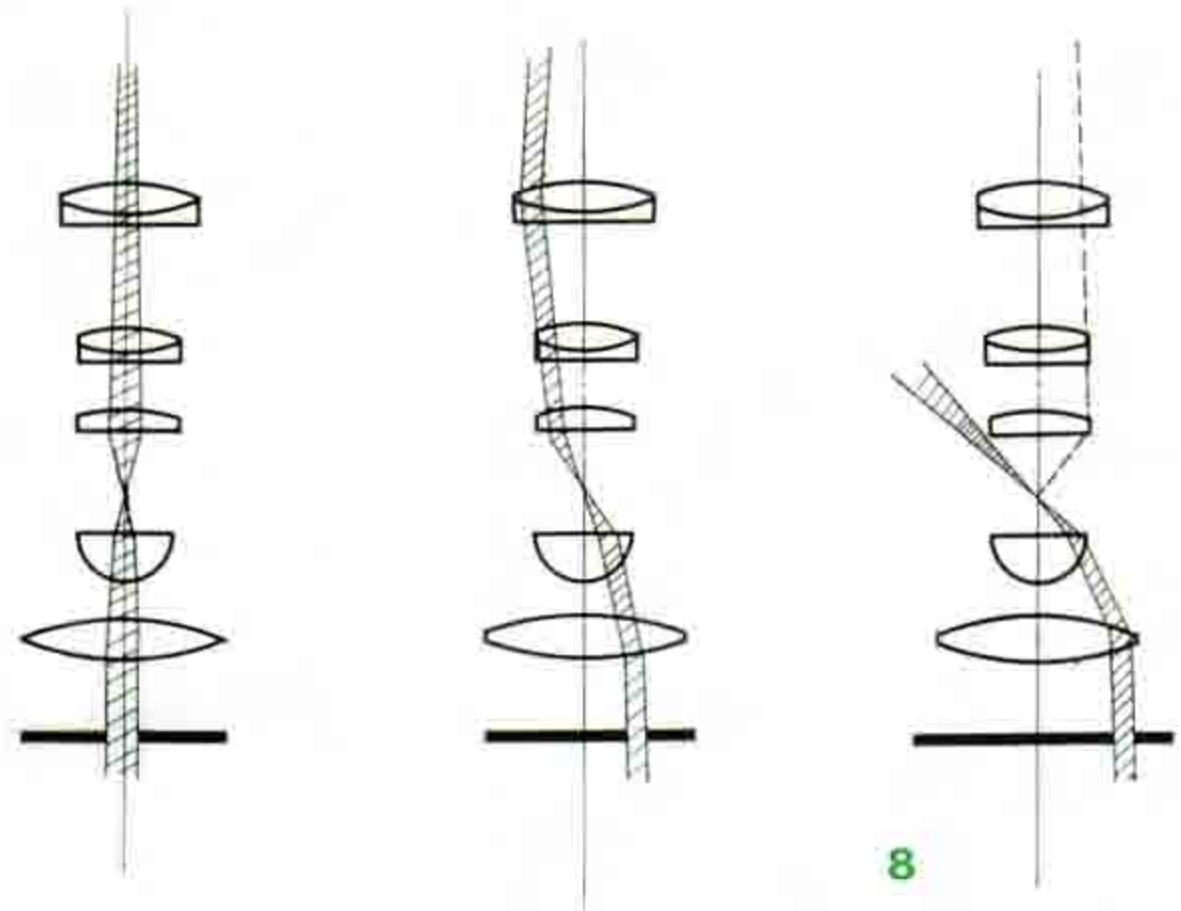
5. ILLUMINATION

Resolution and contrast of image are greatly affected by the method of illumination.

(1) Condenser Iris Diaphragm and Images

Stop down the condenser iris diaphragm and slide it in the radial direction from center to edge. The farther the iris diaphragm is off-centered, the higher becomes the contrast and resolution, which distinguish details of object by increased and unsymmetrical shadow at the boundary of object **(Fig. 8, a, b)**.



(a) Central illumination (b) Oblique illumination (c) Dark field illumination

When the iris diaphragm is positioned so as to let the light bundle enter into the object at an angle of incidence the same as the aperture angle of the objective the resolution reaches maximum and twice as much as the resolution by central illumination.

If the diaphragm is further eccentered to such an extent as not to introduce the light bundle directly into the objective, dark field illumination will be obtained. If the iris diaphragm is widely opened, images by various angle illuminations are integrated. An illumination angle not favorable for the object may be included.

In the central illumination the maximum resolution is obtained when the opening of the iris diaphragm just corresponds to the aperture angle of the objective. In this case excessive outer rays to be used as dark field illumination are cut off and flare is minimized. If the opening is made smaller, the contrast is enhanced, though the resolution is lowered. But if the iris diaphragm is large enough to cover 60 – 70% of the objective aperture, the decrease of resolution will not be remarkable.

If the diaphragm is stopped down to minimum for admitting only very small light bundles, the effects by diffraction, reflection, refraction, etc.,

may be exaggerated so that fringes may be seen at the image edges which may likely induce misinterpretation of the image, but it may be effective for special occasions (e.g. definition of general structure of non stained specimens). **(Fig. 8, c)**.

(2) Light Source

Avoid direct sunlight. A 60W electric bulb in normal use, with a day-light filter placed on the filter holder will supply sufficiently even illumination.

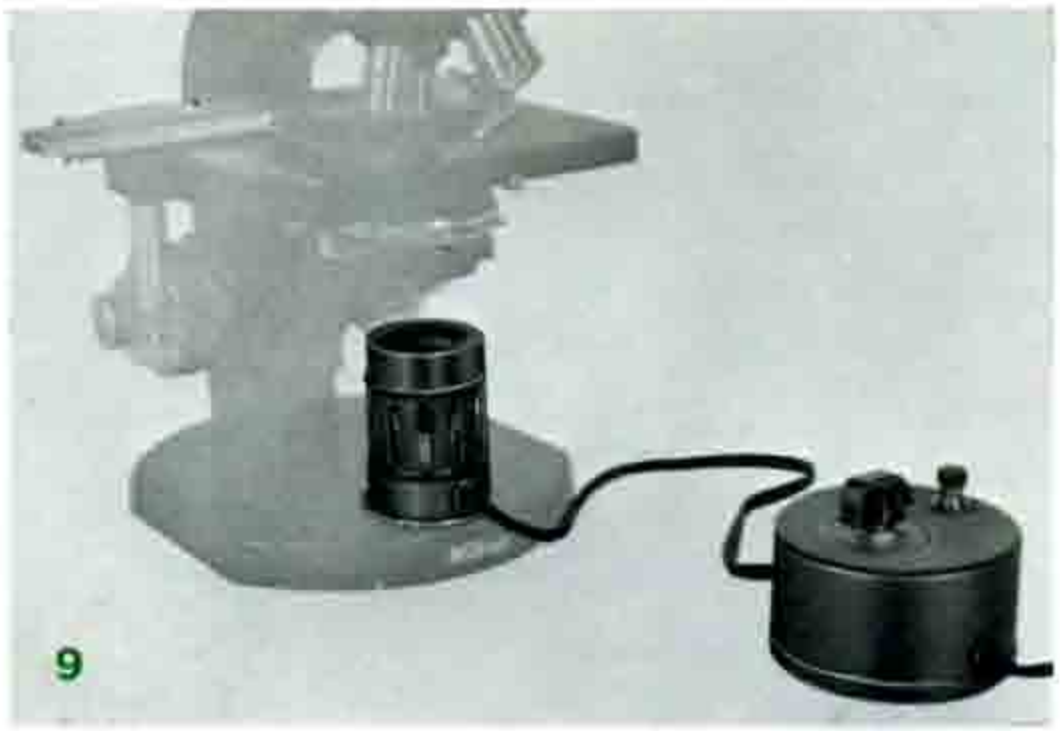
A small 100V, 15W sub-stage lamp **(Fig. 9)** is available, which can be attached onto the micro-scope base in place of the mirror.

For photomicrography or phase-contrast observa-tion, however, the exact Koehler method (ex-plained later) may be desirable, requiring the use of Nikon universal microscope lamp **(Fig. 10)** equipped with collector lens and collector dia-phragm.

Nikon Microscope Model S-Ke (with built-in Koehler illuminator) will give a satisfactory result in this case **(Fig. 11)**.

(3) Mirror

The mirror provided at the bottom of the micro-scope has a plane surface on one side and a con-cave surface on the other. The concave surface (numerical aperture=0.3) is used without the con-denser, when employing an objective with the individual magnification of 20× or less. **The plane surface is to be used with the condenser.**



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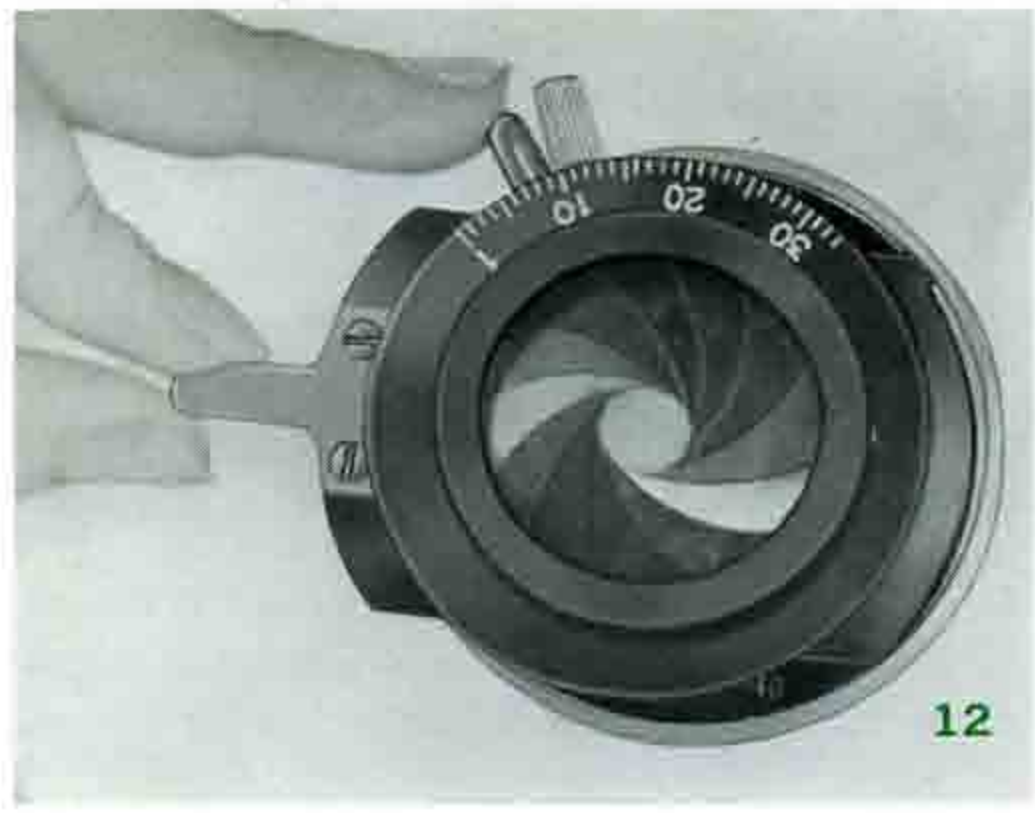
(4) Iris Diaphragm

The opening of the diaphragm may be continuously varied by moving a lever. The opening may also be off-centered in any direction by rotating the diaphragm and at the same time sliding it radially by means of another lever. This manipulation can be done as shown in **Fig. 12** only by using the right hand; the middle finger for opening or closing the diaphragm and the thumb and the first finger for off-centering.

In theory, the iris diaphragm should be adjusted so that the numerical aperture of the condenser is equal to that of the objective, in order to obtain the maximum resolution. In practice, however, to keep out straylight which would reduce image contrast, closing the aperture of the condenser down to 60-70% of that of the objective will bring about a good result in most cases. The coincidence of condenser diaphragm opening with exit pupil of objective can be ascertained by looking inside the microscope tube after removing the eyepiece and closing the diaphragm slowly. An experienced user, however, may dispense with such a procedure, and will obtain the same result by adjusting the diaphragm opening until satisfactory distinctness of the image results. If a transparent object is to be observed or greater depth of focus is desirable, the diaphragm should be closed more. In this case, however, the resolution will somewhat be reduced and the image will be accompanied by diffraction fringes along the edges which may readily give rise to misinterpretation of the image. To maintain resolution and contrast, oblique illumination is effectively used.



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(5) Day-light Filter

The filter case under the iris diaphragm is provided for bringing in place the filter to be used. When attaching a phase-contrast condenser, swing aside the filter case.

(6) Condenser Focusing Knob

The condenser is lowered and raised by turning the condenser focusing knob. This manipulation is necessary only in Koehler illumination or dark-field observation. The condenser is usually to stay at the upper limit and need not be lowered, except when a stray image of an outside object superimposes the specimen image too sharply or some uneven brightness interferes with the observation.

(7) Adjusting Brightness

For this purpose adjust bulb current by regulating the lamp transformer.

Adjustment by means of the condenser diaphragm cannot be relied upon, as it also tends to reduce image resolution. A neutral filter can also be utilized. The microscope itself has no device for the adjustment of image brightness.

(8) Koehler Illumination

The illumination method based on the so-called Koehler's principle is highly recommended as it may fulfill the following two requirements almost perfectly—

1. To illuminate the entire field evenly
2. To eliminate glare and flare, thus giving strong contrast to image

Koehler method is performed as follows:

Place Nikon universal lamp (**Fig. 10**) about 30 cm in front of the microscope mirror (use the plane side). Direct the lamp so that correct aligning of the illuminating beam to the center of the mirror is attained. Adjust the collector lens in the lamp and the microscope mirror, until a sharp image of the lamp filament is obtained in the center of the iris diaphragm under the microscope condenser. In this case full closing of the diaphragm or placing a piece of white paper on the diaphragm opening facilitates the above adjustment. The image of the bulb filament should be large enough to cover the entire area of the diaphragm.

Then, see if the image of the collector diaphragm in the lamp is brought to focus on the microscope stage plane, where the specimen is placed. If not, raise or lower the condenser by manipulating the condenser focusing knob until the image of the collector diaphragm and of the specimen appear sharp simultaneously under the microscope.

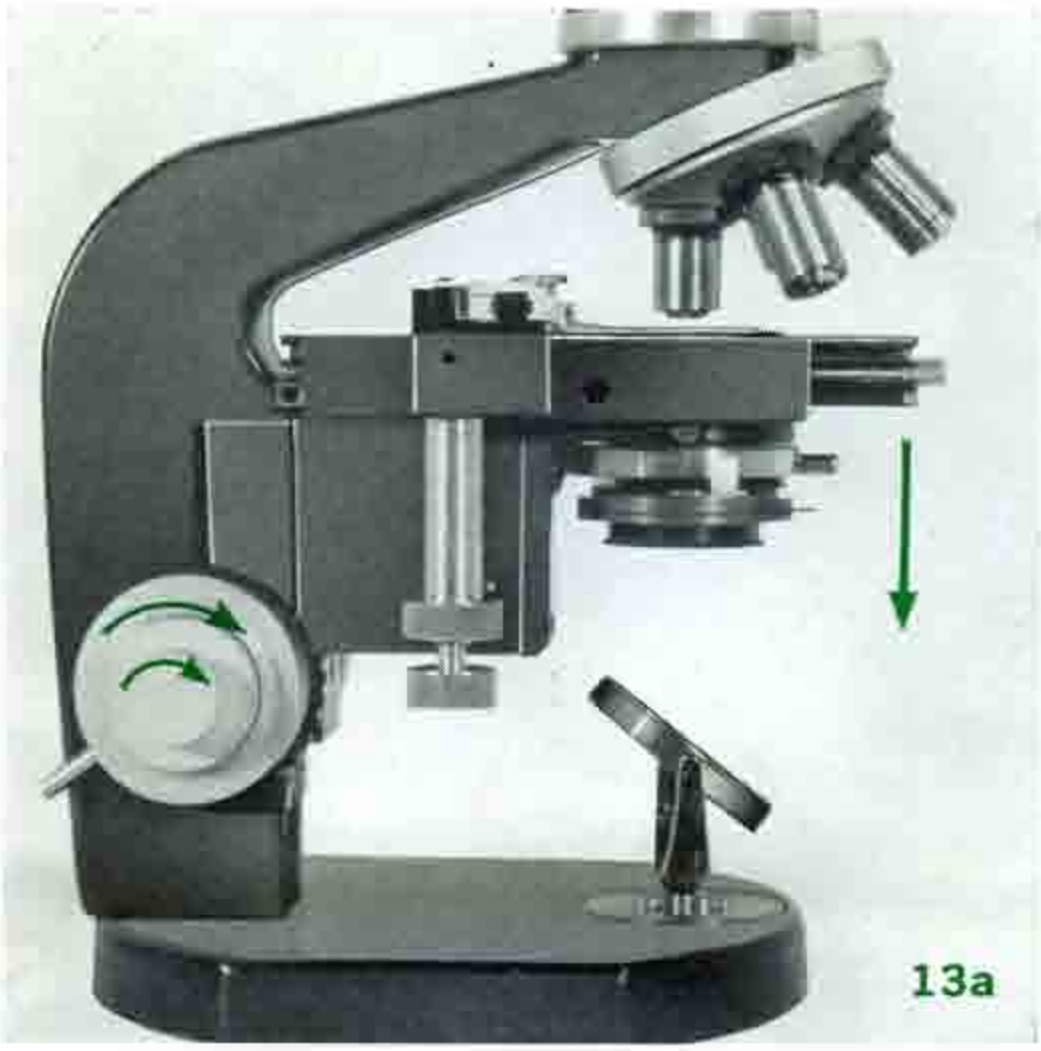
As a result of the above adjustment the illuminated area is determined by opening or closing the collector diaphragm and the brightness and numerical aperture are controlled by adjusting the condenser diaphragm.

When using low-power objectives such as 4×, unscrew the top lens of the condenser and lower the condenser. Otherwise the whole field of view will not be illuminated evenly. In this case, however, placing one or two frosted glass plates on the filter case may solve the problem in a more simplified manner.

6. FOCUSING

(1) Focusing Adjustment

The microscope model S is provided with coaxial, coarse and fine focusing knobs, both of which are located near the microscope base. Forward rotation of either of the focusing knobs by the operator raises the microscope stage and vice versa (**Fig. 13a, b**).



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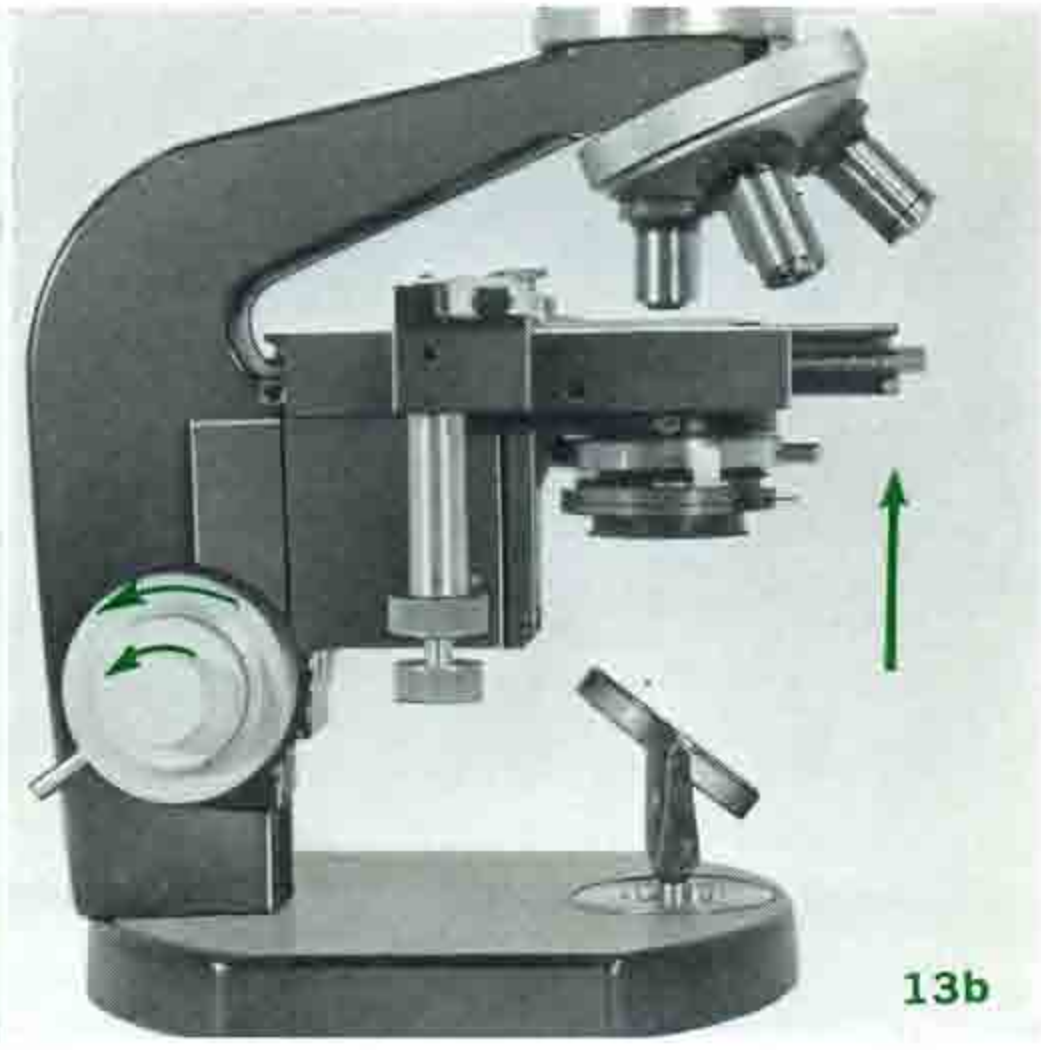

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(2) Eyepiece Adjustment

When using a binocular or trinocular eyepiece tube for observation the adjustment of the user's eye-sight (diopter) discrepancy between the right and left eyes is necessary which is made by rotating the adjusting ring on the lefthand eyepiece.

After focusing with your right eye by raising or lowering the microscope stage, turn the adjusting ring left or right to obtain the sharp image with your left eye, too. Then, regulate the interpupillary distance of the binocular or trinocular tube by sliding the eyepieces left or right by means of the knob (**Fig. 14**), until the viewfields of both eyepieces merge together. It will be advantageous to memorize the attained diopter and interpupillary distance readings for future use.

The red dot engraved on the interpupillary distance scale indicates the position where the mechanical tube length becomes exactly 160mm. The HK (high eyepoint type) eyepieces have an eyecup on top, the rotation of

which will give proper eye-to-lens distance. For those wear eyeglasses, eyecup should be screwed in.

(3) Coarse Focusing

The coarse adjustment may be eased or tightened by means of the coarse focusing tightness adjusting ring.

If the revolution of the coarse focusing knob is too loose, turn the adjusting ring counterclockwise. Too much tightness may be adjusted by the clockwise turning.

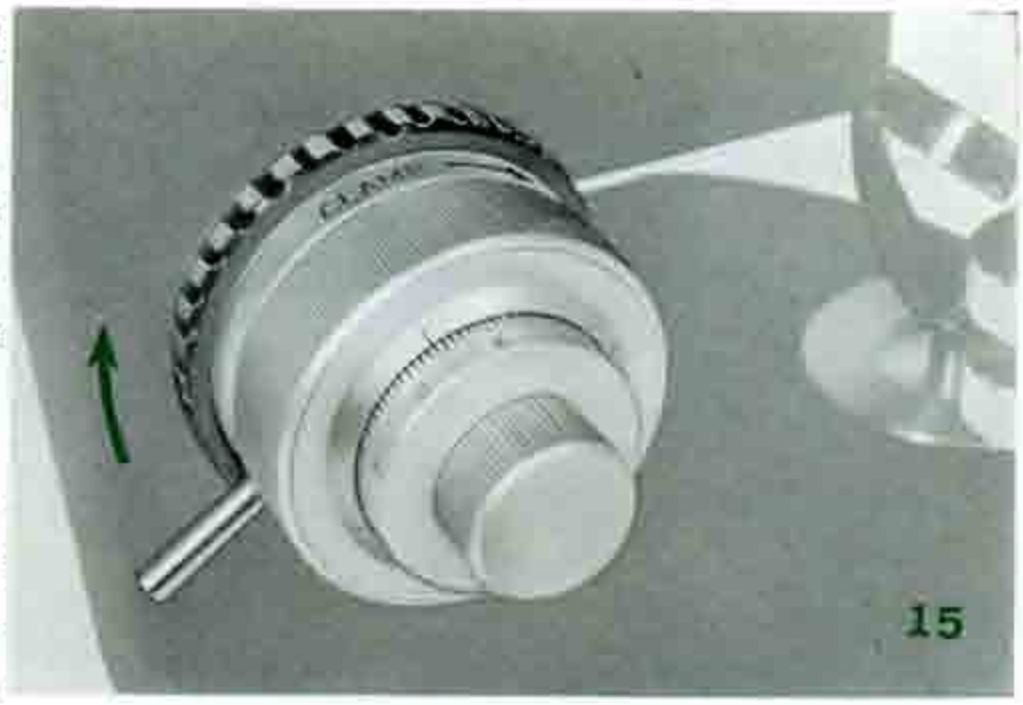
Never twist the focusing knobs for this adjustment as in the traditional microscope whose focusing knobs, coarse and fine, are located separate (not coaxial). Focusing may be performed as follows: First, raise the microscope stage until the distance between the specimen and the objective becomes less longer than the working distance of the objective to be used (see table on p. 8), then looking through the eyepiece, lower the stage until the specimen to be examined is plainly visible.

4X, 10X, 20X, 40X and 100X objectives are parfocal, and are approximately in focus when revolved into position one after another, the use of the fine focusing knob only being required for critical focusing.

(4) Preset Device

The right-hand focusing knob has a preset lever on its drum (**Fig. 15**). When the lever is fastened by turning clockwise (as indicated by the arrow engraved besides) until it stops, the coarse focusing knobs cannot be turned in the direction to drive the stage closer to the objective. This presetting is

utilized for quick refocusing after the stage has been lowered and outfocused for changing the specimen or applying immersion oil. The preset device, when fastened, prevents at the same time the danger of damaging the objective front and slide glass.



(5) Fine Focusing

Manipulation of the fine focusing knob **(Fig.15)** is necessary:

a. To obtain the sharpest image.
b. To transfer the focus from center to a corner of the viewfield.
c. To focus upon the different layers of a thick specimen.
d. To correct a slight blurring which may take place when shifting the slide.
e. To measure the thickness of object under examination.

The microscope is so designed that one revolution of the fine focusing knob raises or lowers the microscope stage 0.2mm. This permits direct reading on the left-hand knob scale, looking from the front, up to 0.002mm (2μ). The whole range of fine movement is 38mm; the same as of coarse focusing.

(6) Oil Immersion

When using 100X objective, the application of immersion oil in the minute space (0.1mm) between the objective top and the cover glass is necessary to attain the specified numerical aperture. For critical work the immersion oil is to be filled between the top lens of the condenser and the slide as well as between the objective and the cover glass. Oil immersion observation is performed as follows: First, using 10X or 40X objective (dry system), bring the specimen in focus and in the center of the viewfield. Set the preset lever by turning clockwise. Lower the microscope stage and revolve the nosepiece revolver to 100X objective. After applying a drop of immersion oil onto the cover glass, raise the stage up to the preset limit. Then, focus up by looking through the eyepiece and raising carefully the stage by manipulating the fine focusing knob. The oil immersion 100X objective is designed to attain its critical focusing by about 1/3 forward rotation of the fine focusing knob, that is, bringing the stage about 0.08mm closer to the objective from the parfocal position. Air bubbles in the immersion oil, which may sometimes intervene the microscope image and are visible when looking into the microscope tube without the eyepiece, can be removed by repeating slight movement of the nosepiece revolver, by adding a certain quantity of immersion oil or by means of a needle.

Remaining stiffened oil may often impair the image. Therefore, im-

mediately after finishing the work, clean off the remaining oil from the lens using a soft cotton cloth wetted with xylol. Never use alcohol or immerse the top of the objective in xylol.
Be careful not to use immersion oil that has been thickened by age. The refractive index of the immersion oil should be 1.515.

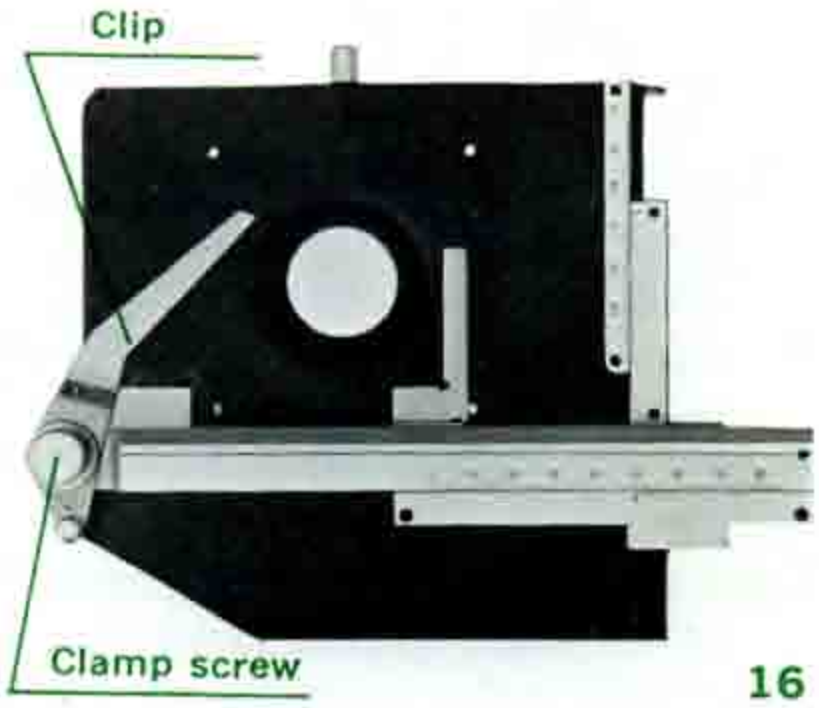
(7) Exchanging the Stage

Lower the stage by means of the coarse focusing knob and then unlock the stage lock screw. The stage, then, can be removed.

7. MOVING THE SPECIMEN ON THE STAGE

(1) Rectangular Mechanical Stage "R"

This stage enables fine crosswise travelling of the slide in the range of 50×75mm, allowing reading of the movement down to 0.1 mm by the use of the vernier provided.
For securing the slide on the stage in position, open the clip.
Each travelling is performed by rotation of two coaxial knobs located one above the other on the vertical rod protruded below on the left side from the front, the upper knob being for longitudinal and the lower one for lateral travel of the slide on the stage.



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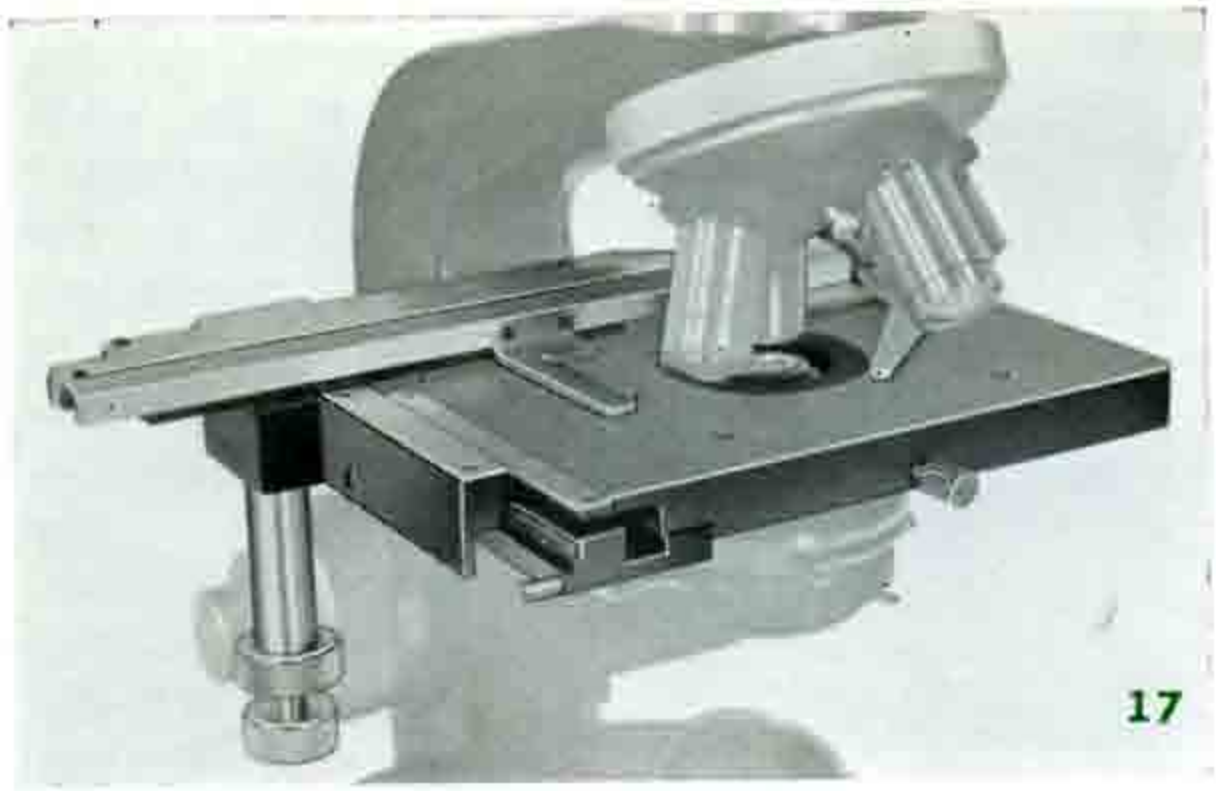
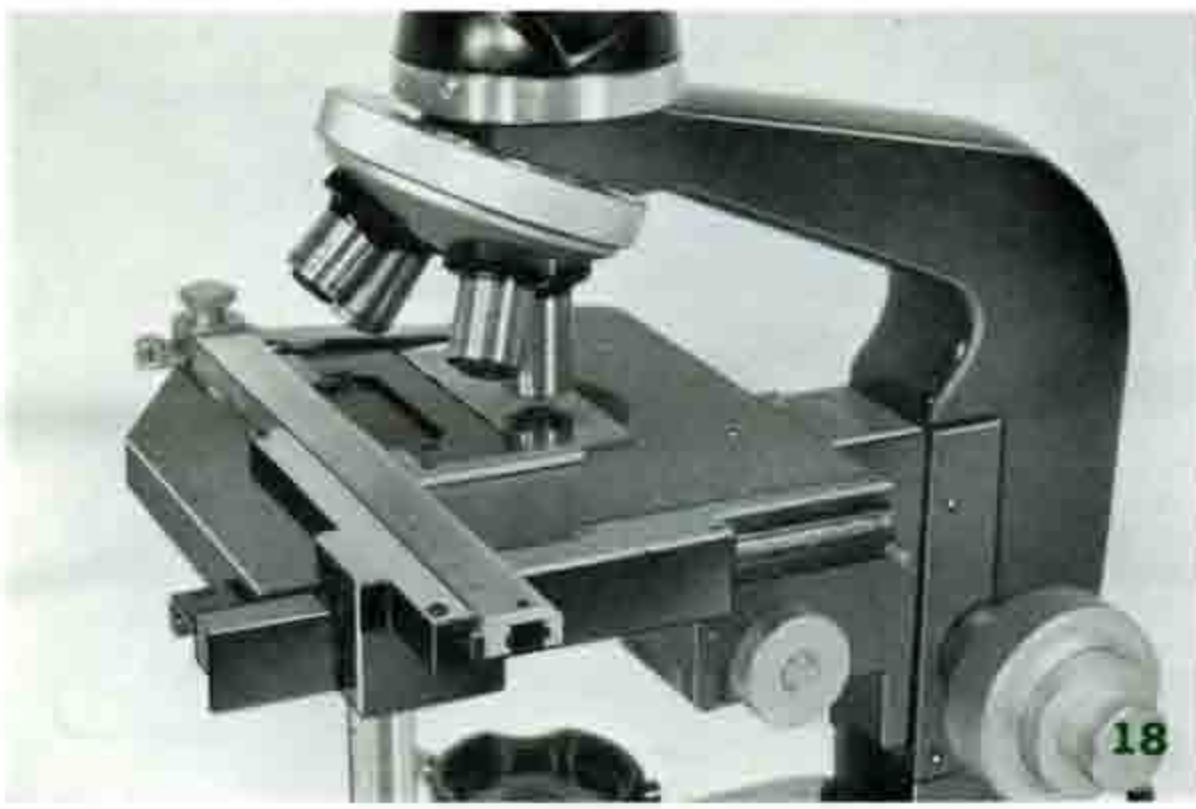
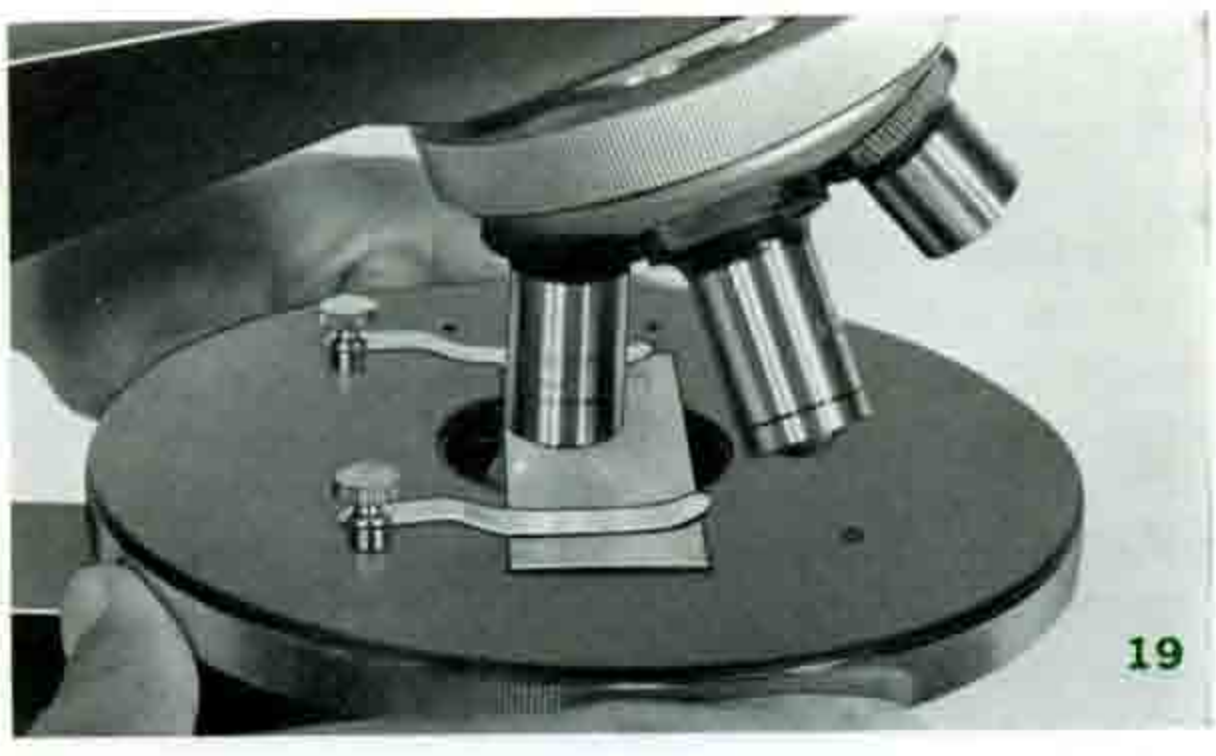
In fluorescence microscopy or in using oil immersion objectives, where the clearance between the condenser and the slide also should be oil-immersed, stiffened oil may cause unsmooth travel of the slide.
In this case, removing of the circular opening plate at the center of the stage or fastening of the clamp screw will be helpful to a positive travel of the slide (**Fig. 16**).





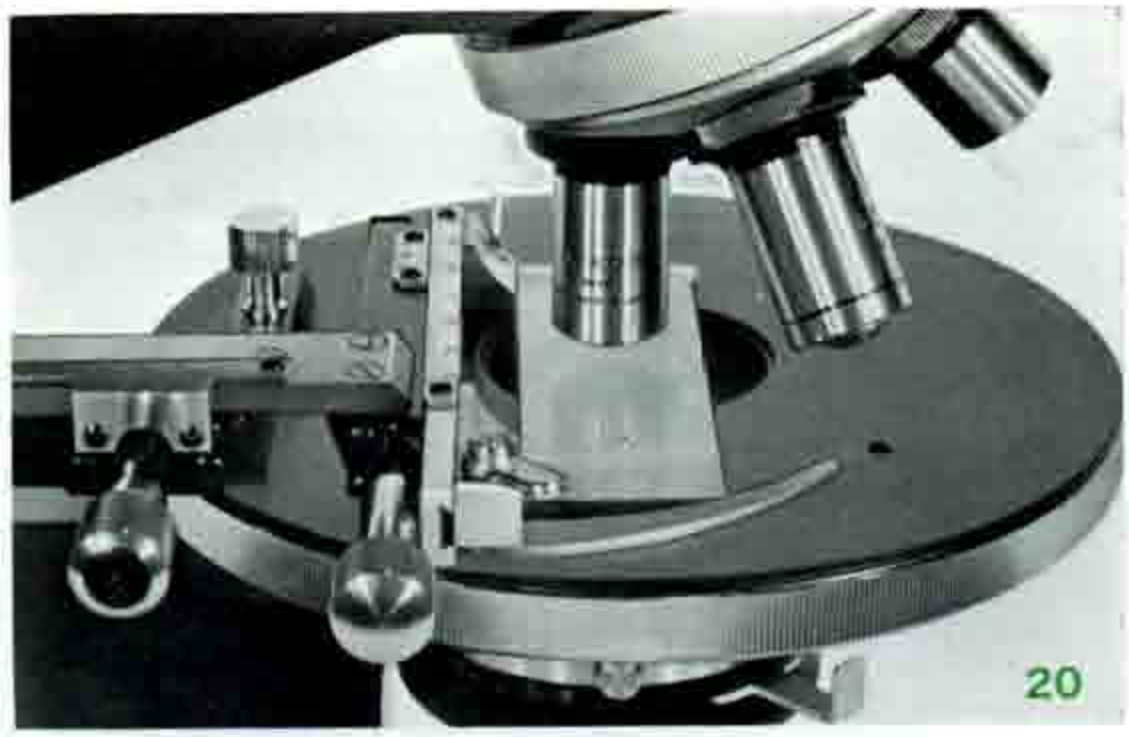


By unlocking the lock knob on the edge of the stage, the stage can be rotated horizontally for convenience in the observation from the opposite side of the microscope (**Fig. 17**), where the eyepiece tube is to be rotated 180°. This rotation of the stage may often be of use in photomicrography, when the picture format is changed from vertical to horizontal or vice versa. It is recommended to use the slide adapter on the stage (**Fig. 18**) for a sufficient longitudinal travel of the slide in such reversed position.

(2) Circular Floating Stage "C"

The circular floating stage (**Fig. 19**) glides and rotates smoothly and precisely in any desired direction simply by pushing the rim of the stage by the fingers, within a circle of 18mm in diameter.

To fasten the floating stage in position, pressing the stage



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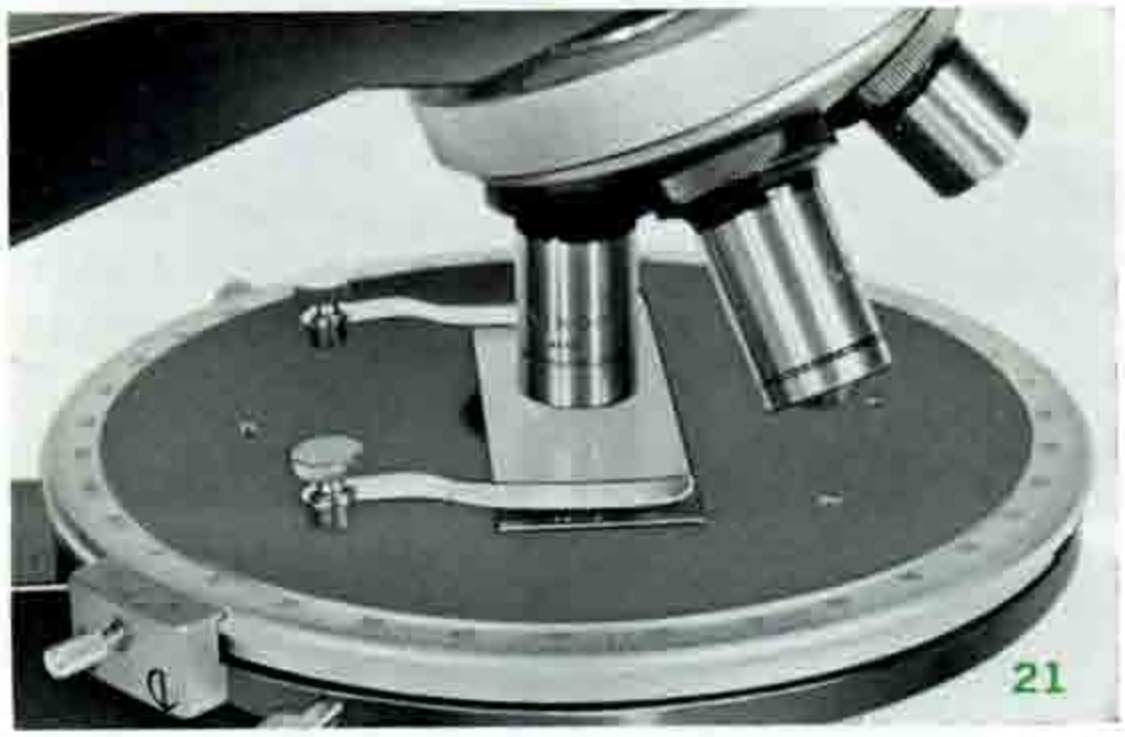

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downward, turn the rim of the stage counter-clockwise.
Fastening of the floating stage is necessary, when using an attachable mechanical stage (**Fig. 20**), which will be available on order.
The circular rotating stage type G is also available, which permits measurement of the rotating angle of specimen with its circular scale (**Fig. 21**).

8. PHOTOMICROGRAPHY

The Microscope Model S incorporating the Koehler illumination device with light source built in the microscope base, enables convenient and perfect microphotograph only by additionally mounting a camera connected to the microscope eyepiece with any photomicrographic adapter.
Therefore, when taking photographs of the microscopic image on 35mm film, it is recommended to use the Nikon Microflex Model EFM (with built-in exposure meter) or AFM (with built-in exposure meter permitting automatic exposure setting) and the Nikon F or Nikkormat camera or Nikon Dark Box for using with the above attachments. For details of photomicrographic methods, refer to the "Instructions of Using Nikon Microflex EFM" or "AFM" and any general works on photomicrography.

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NIPPON KOGAKU K.K.

Tokyo, Japan

Printed in Japan

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