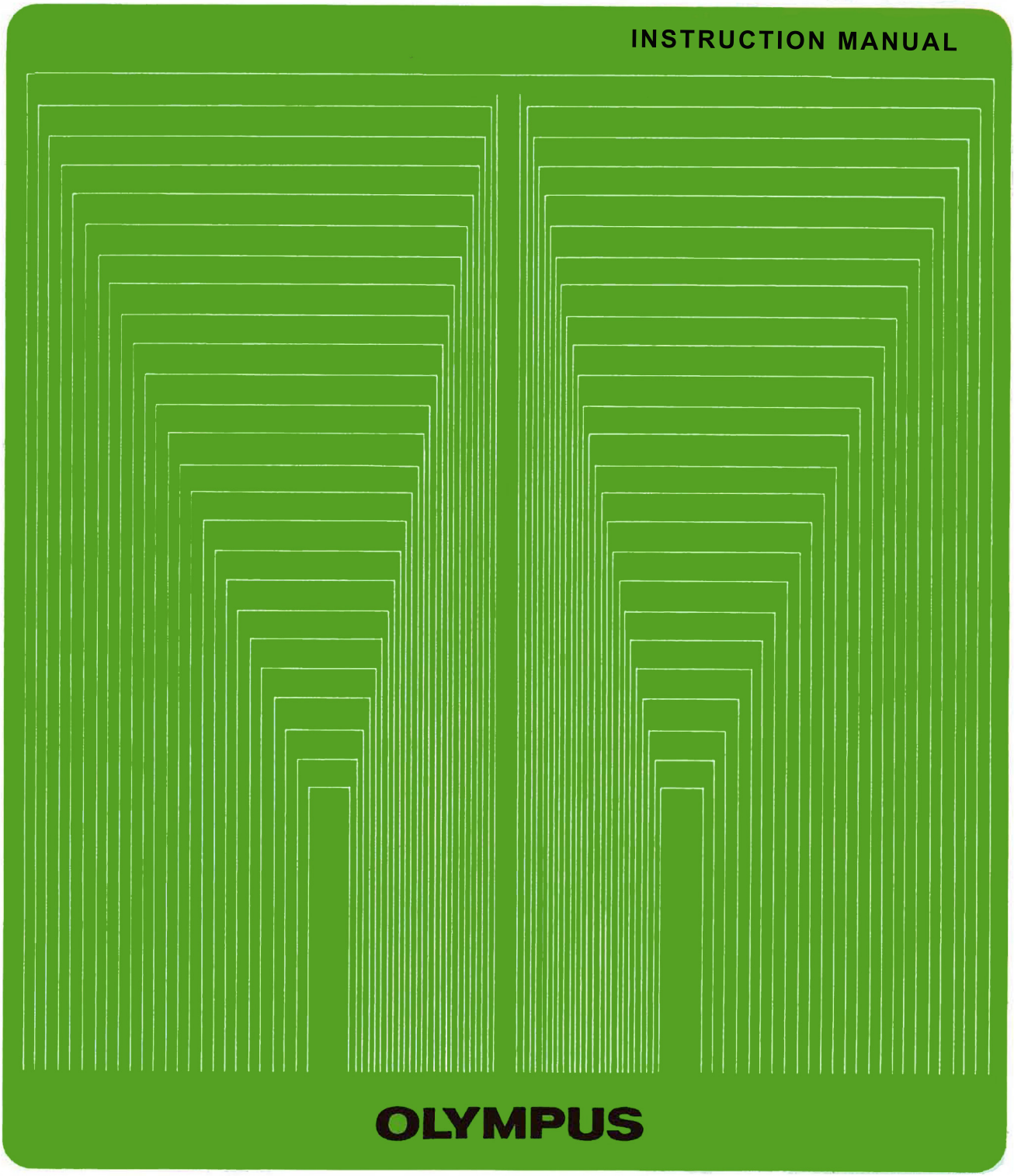
OLYMPUS POLARIZING MICROSCOPE

MODELS BHA-P & BH-P ATTACHMENT

INSTRUCTION MANUAL



OLYMPUS

This instruction manual has been written for the use of the Olympus Polarizing Microscope Model BHA-P and Polarizing Attachment Model BH-P. It is recommended to read the manual carefully in order to familiarize yourself fully with the use of the microscope on the polarizing attachment so that you can obtain the best performance and effectiveness.

IMPORTANT

Observe the following points carefully:

■ Operation

1. Always handle the microscope with the care it deserves, and **avoid abrupt motions.**
2. Avoid exposure of the microscope to **direct sunlight**, dust and vibration.
3. Only use the **tension adjustment ring for altering the tension of the coarse adjustment.** Do not twist the two coarse adjustment knobs in the opposite directions simultaneously, which might cause damage.
4. Ascertain that the **voltage selector switch** on the base plate is set to conform with the local mains voltage.
5. Disconnect the line cord from the AC power outlet for **fuse replacement.**

■ Maintenance

1. Lenses must always be kept clean. Fine dust on lens surfaces should be blown or wiped off by means of an air blower or a clean brush. Carefully wipe off oil or fingerprints deposited on the lens surfaces with gauze moistened with a small amount of xylene, alcohol or ether.
2. Do not use organic solutions to wipe the surfaces of various components. Plastic parts, especially, should be cleaned with a neutral detergent.
3. **Never disassemble** the microscope for repair.
4. The microscope should be stored in its container immediately after use. If this is not possible, it should be covered with a vinyl dust cover. It is best to keep objectives and eyepieces in a desiccator, containing desiccants.
5. Disconnect the line cord from the AC power source before fuse replacement.

CONTENTS

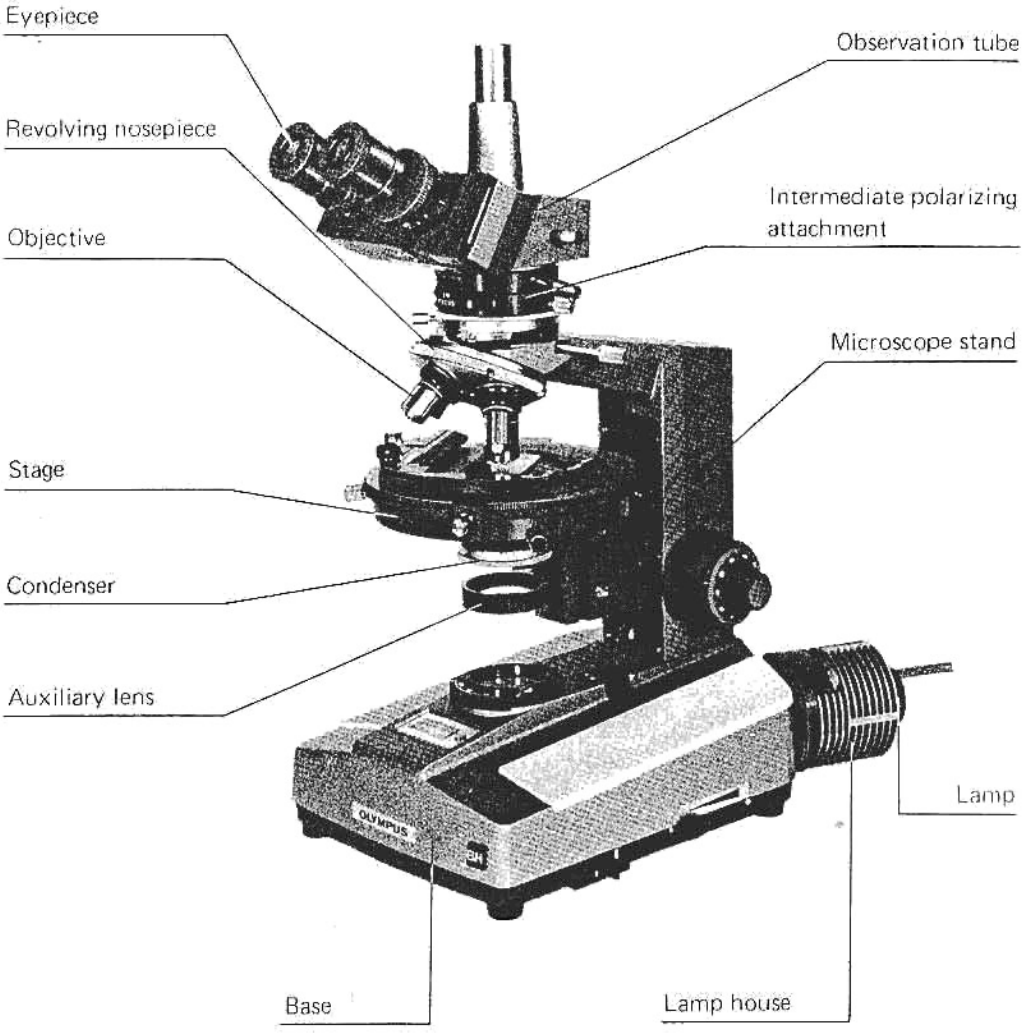
I. STANDARD EQUIPMENT

Model		BHA-651-P	BHA-751-P	BH-P-1	BH-P-2
Microscope stand with auxiliary lens	BHA-F	1	1	0	0
Revolving nosepiece	BH-PRE	1	1	1	1
Intermediate polarizing attachment	AH-PA	1	1	1	1
Quarter wave plate	AH-TP147	1	1	1	1
Sensitive tint plate (530mμ)	AH-TP530	1	1	1	1
Polarizing binocular tube (30°)	BH-PBI30	1	0	1	0
Polarizing trinocular tube (30°)	BH-PTR30	0	1	0	1
Circular rotatable stage	BH-SRP	1	1	1	1
Swing-out condenser	BH-POC	1	1	1	1
Tungsten lamp house	BH-LH	1	1	0	0
30-watt tungsten filament bulbs	LS30	3	3	0	0
Objectives (strain-free)	PO4X	1	1	1	1
	PO10X	1	1	1	1
	PO40X	1	1	1	1
	PO100X (oil)	1	1	1	1
Eyepieces	K5X (with cross hairs)	1	1	1	1
	WF10X (with cross hairs)	1	1	1	1
	WF10X (with 10/100mm micrometer)	1	1	1	1
	BiK5X	1	1	1	1
	WF10X	1	1	1	1
Photo eyepiece FK5X		0	1	0	1
Spare fuses		2	2	0	0
Filter 45C		1	1	0	0
Immersion oil		1	1	0	0
Vinyl dust cover		1	1	0	0

■ Optional Accessories:

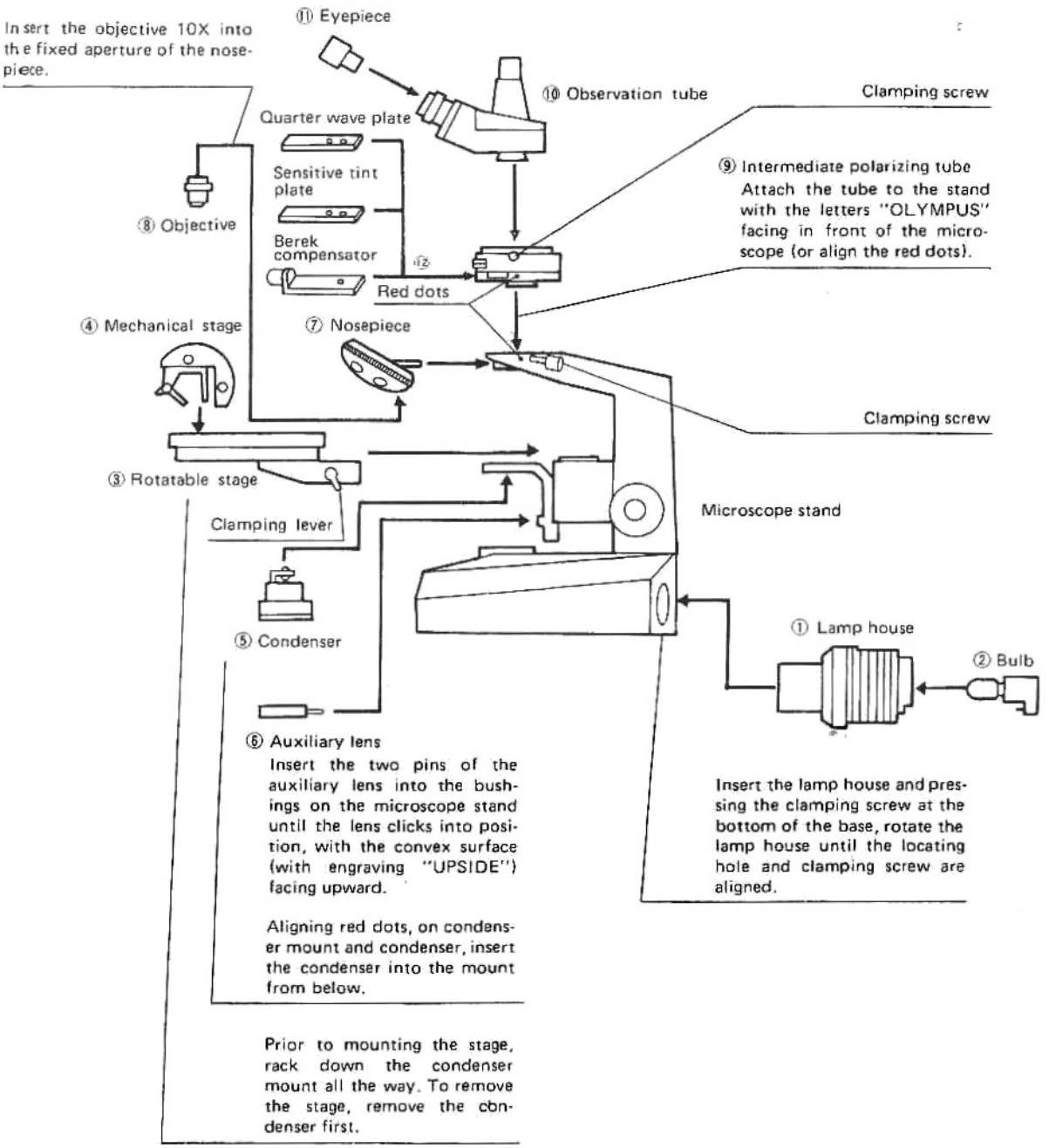
Mechanical stage for polarizing use	Model AH-FMP
Berek compensator	Model AH-CTP
Objective (strain-free)	PO20X

II. NOMENCLATURE



III. ASSEMBLY

The picture below illustrates the sequential procedure of assembly. The numbers indicate the assembly order of various components. Remove dust caps before mounting components. Take care to keep all glass surfaces clean, and avoid scratching the surfaces.

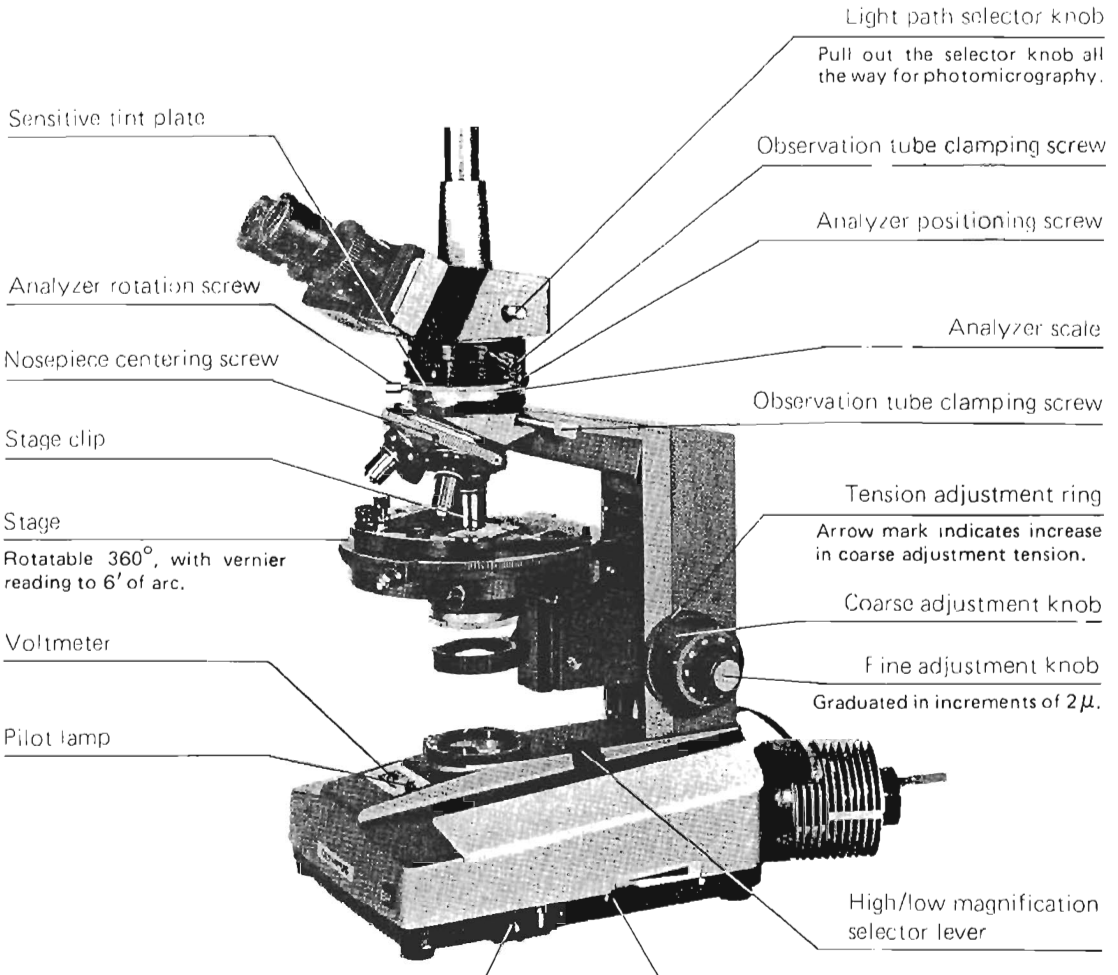


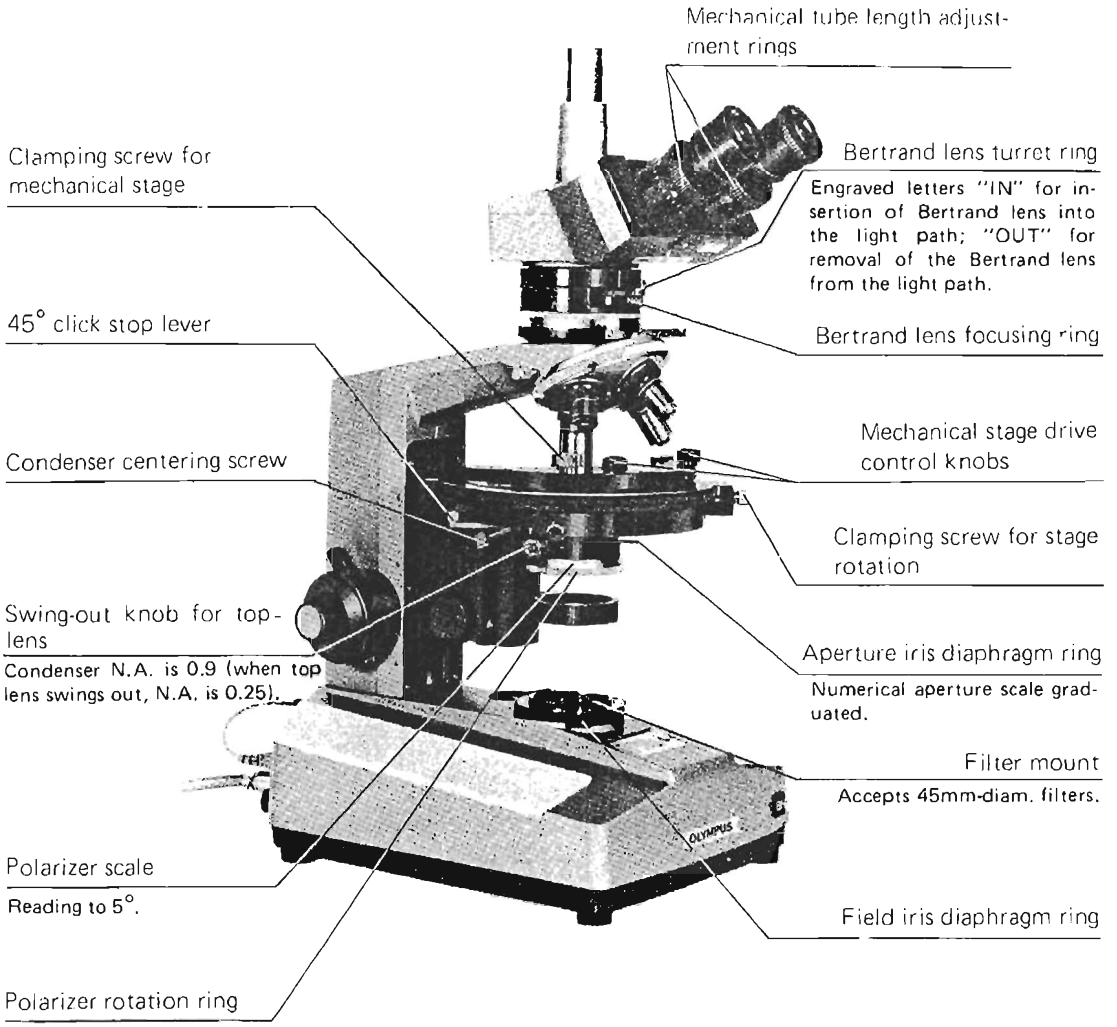
■ Electric connection

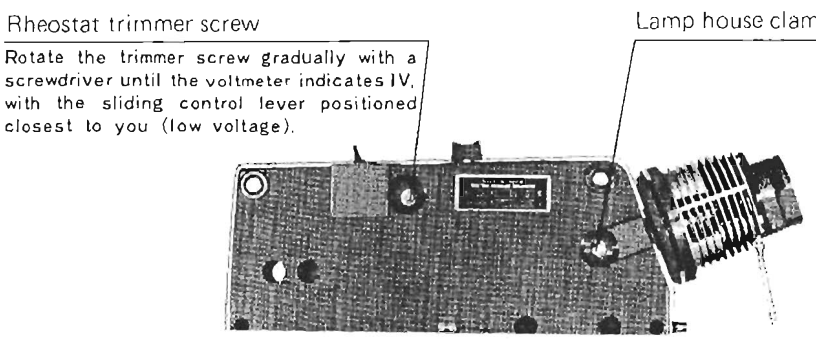
1) Plug in the connecting cord of the lamp house to the receptacle at the back of the base.

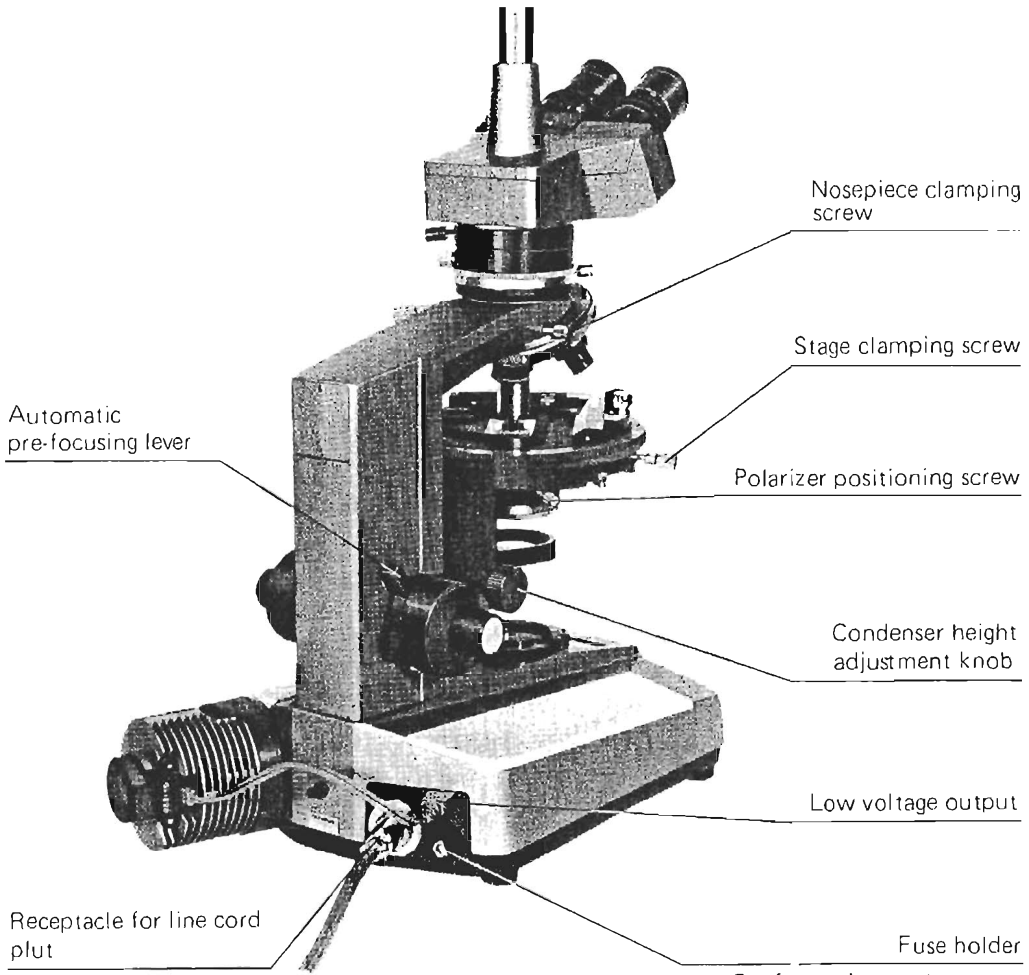
2) Insert one plug of the line cord to the line cord socket on the base and connect the other plug to the AC power outlet.

IV. IDENTIFICATION AND FUNCTION OF VARIOUS COMPONENTS




Mechanical tube length adjustment rings
Clamping screw for mechanical stage
Bertrand lens turret ring
Engraved letters "IN" for insertion of Bertrand lens into the light path; "OUT" for removal of the Bertrand lens from the light path.
45° click stop lever
Bertrand lens focusing ring
Condenser centering screw
Mechanical stage drive control knobs
Clamping screw for stage rotation
Swing-out knob for top-lens
Condenser N.A. is 0.9 (when top lens swings out, N.A. is 0.25).
Aperture iris diaphragm ring
Numerical aperture scale graduated.
Filter mount
Accepts 45mm-diam. filters.
Polarizer scale
Reading to 5°.
Field iris diaphragm ring
Polarizer rotation ring


Rheostat trimmer screw
Rotate the trimmer screw gradually with a screwdriver until the voltmeter indicates 1V, with the sliding control lever positioned closest to you (low voltage).
Lamp house clamping screw



For fuse replacement, unscrew the cap of the fuse holder, and replace the defective fuse with a replacement fuse.
(Disconnect BEFORE REPLACEMENT.)

Summary of Putting the Microscope in Operation

Model BHA-P

A. Match the line voltage selector switch to local mains voltage (see page 6).

B. Switch on the light source.

C. Rotate the trimmer screw until the voltmeter indicates 1V (page 9).

D. Place a specimen slide on the mechanical stage.

E. Remove the Bertrand lens and analyzer from the light path.

F. Coarse focus with the 10X objective.

G. Make interpupillary and diopter adjustments (page 10).

H. Center the condenser (page 10).

I. Center the stage (page 12).

J. Center objectives other than 10X (page 12).

K. Swing in the desired objective.

L. Set the condenser, analyzer and Bertrand lens correctly according to your microscopic purpose (pages 13 and 14).

M. Adjust illumination system.

N. Adjust light intensity.

O. Fine focus.

P. Adjust aperture iris diaphragm and field iris diaphragm (page 12).

Adjustment of illumination system

Microscopic	Objective	Intermediate polarizing attachment	Condenser top lens	High/low magnification selector lever
Orthoscopic observation	4X to 100X	OUT	OUT	L
Conoscopic observation	20X to 100X	IN	IN	H

For biological use of the Model BHA-P, however, remove the analyzer, Bertrand lens and sensitive tint plates, and place the high/low magnification selector lever into the "L" position for 4X and 10X, and the "H" position for 20X, 40X and 100X objectives.

★ Cut off this page at dotted line and put it on the wall near the microscope for use as a reminder of microscopic procedure.

V. OPERATION

1. Electric System

1) Adjustment of Light Intensity

The minimum voltage required for the light source can be adjusted with the rheostat trimmer screw at the bottom of the microscope base in accordance with the line voltage and frequency. A silicon controlled rectifier (SCR) is provided for output voltage control. The SCR has the following advantages over conventional rheostat controls:

① Extremely fine adjustment of light intensity can be easily achieved.

② Flickering of the bulb filament is eliminated and light intensity is stabilized.

③ Increased life expectancy of the bulb.

2) Adjustment of Minimum Line Voltage

① Ascertain that the voltage selector switch is set to conform with the local mains voltage. (This switch can be turned with a coin, and can be set to the following voltages: 100V-110V-120V or 220V-240V.)

② Ascertain that the sliding control lever is positioned closest to you (low voltage), and then activate the main switch. The pilot lamp lights up.

③ If the bulb is dimmly lit, and the voltmeter indicates about 1V, the secondary voltage is correct, and you have only to push the sliding control lever forward in order to obtain optimum light intensity.

④ If the bulb does not light or lights up brightly immediately after switching on, rotate the rheostat trimmer screw gradually with a coin, until the voltmeter indicates about 1V.

3) Light Source

The standard light source incorporates a 30W pre-centered tungsten filament bulb, provided with a socket for positive contact, eliminating the problems of defective contact and over-heating.

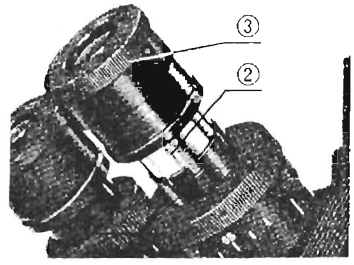
When used at the rated voltage 6V, the average life of the tungsten bulb LS30 is longer than 200 hours. This is, however, greatly reduced, if the bulb is used at higher voltage; for instance, the bulb life is reduced to 1/50 at 8V. Therefore, it is advisable to avoid prolonged use at readings over 6V (in the red zone).

If the light source should be used at high voltage constantly, it is recommended to use a high intensity halogen bulb.

★ Do not switch the tungsten bulb on with the sliding control lever at high intensity position (away from the user). It reduces bulb life.

2. Interpupillary Distance and Diopter Adjustments

1) Insert the eyepiece with cross hairs of your choice into the right eyepiece tube, aligning the positioning slot ① and positioning pin ② . (Fig. 1)



★ When the eyepiece positioning pin is inserted into the lower slot on the tube, the cross lines in the eyepiece coincide with the vibration direction of polarizer and analyzer at 0 settings. When inserted into the other slot, the cross lines are at 45° to the direction of vibration.

2) Looking through the right eyepiece (with cross hairs) with your right eye, rotate the diopter adjustment ring ① until the cross hairs are sharpty focused. (Fig. 2)

3) Looking through the both eyepieces with both eyes, adjust the interpupillary distance, sliding the knurled dovetail slides ② of the right and left eyepiece tubes, until perfect binocular vision is obtained.

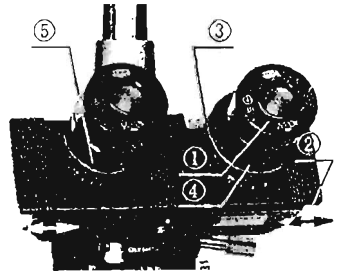


Fig. 2

4) Memorize your interpupillary distance setting by means of the scale ③

5) Rotate the tube length adjustment ring ④ on the right eyepiece tube to match your interpupillary distance setting which you obtained from the scale.

6) Look at the image through the right eyepiece with your right eyepiece with your right eye and focus on the specimen with the coarse and fine adjustment knobs.

7) Look at the image through the left eyepiece with your left eye and rotate the tube length adjustment ring ⑤ to focus on the specimen without using the coarse and fine adjustment knobs.

3. Light Path Selection

The trinocular tube is provided with a light path selector knob to direct the light to the observation tube or to the phototube.

Knob position	Amount of light	Application
Pushed in all the way.	100% into binocular tube	Observation
Pulled out all the way.	20% into binocular tube 80% into phototube	Photomicrography

4. Condenser Centration

1) Bring the objective 10X into the light path.

★ If a specimen is placed on the circular rotatable stage without a mechanical stage it is recommended to hold the peripheries of the specimen with the stage clips provided to the circular stage.

2) Swing in the condenser top lens, and bring the specimen into focus.

3) Stop down the field iris diaphragm with knurled ring ①. A slightly blurred image of the field diaphragm can now be seen in the eyepiece. (Fig. 3)

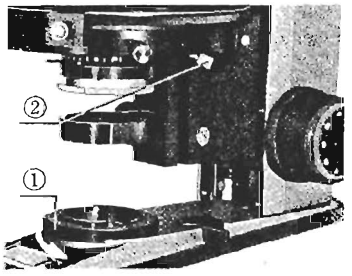
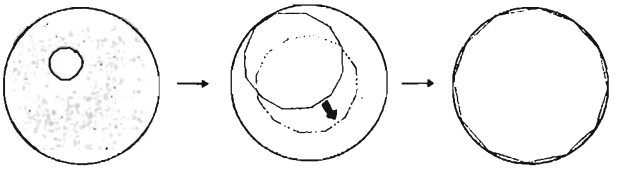


Fig. 3

4) Move the condenser up and down to focus on the image of the field diaphragm.

★ If the specimen slide is too thick, it is sometimes impossible to obtain a sharply-focused image.

5) While widening the diameter of the field progressively, use the condenser centering screws ② to bring the diaphragm image into the center of view. (Fig. 3)



6) Push the analyzer ① into the light path, and make sure that both polarizer and analyzer are set at position "0" to attain the "Crossed filter" position. Then loosen the clamping screw ② of the condenser. (Fig. 4)

7) Remove the specimen out of the light path so that a transparent area comes into the light path. Keeping the polarizer at the "0" position, rotate the polarizer rotation ring ③ until the optimum extinction is obtained, then clamp the ring. (Fig. 4)

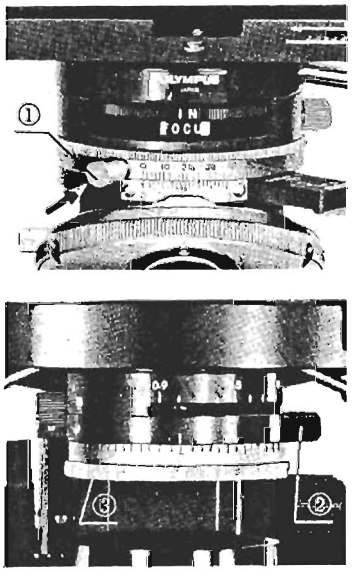


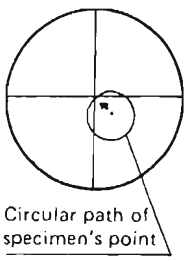
Fig. 4

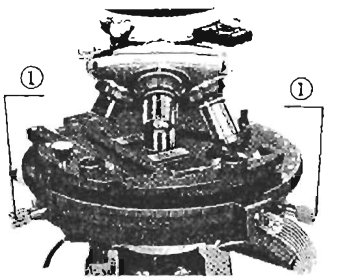
5. Centering the Stage

1) Looking through the eyepiece and objective 10X, determine some particular point, as you like, in the specimen image and coincide this point with the center of the cross hairs of the eyepiece.

2) Rotating the stage, coincide the center of the rotation of the specimen's point with the center of the cross hairs by means of two centering screws ① provided on the stage. (Fig. 5)

★ Repeat this procedure until the centration is secured.





6. Centering the Objectives

This centration is necessary to all the PO objectives except the pre-centered objective PO10X.

1) Connect a centering knob ① to each centering screw of the circular rotatable stage. (Fig. 6)

2) By means of these two centering screws, coincide the centers of the cross hairs and the rotation of the specimen.

3) After complete centration, remove the centering knobs.

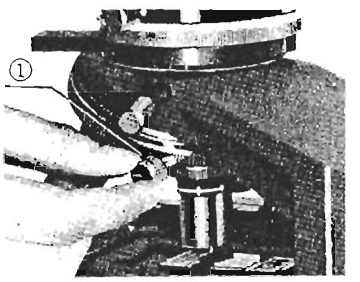


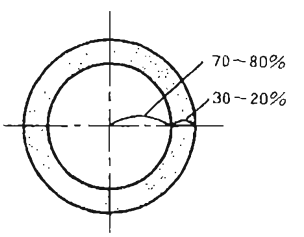
Fig. 6

7. Use of Iris Diaphragms

1) Aperture iris diaphragm

Adjust the opening of the aperture iris diaphragm according to the various conditions such as the numerical aperture of the objective, image contrast, depth of focus, and flatness of field. Generally it is often preferable to stop down the aperture iris diaphragm to the 70% or 80% of the N.A. of the objective.

After the eyepiece is removed from the observation tube, if necessary, look through the observation tube and check the opening of the aperture diaphragm at the objective pupil.



2) Field iris diaphragm

The field iris diaphragm controls the diameter of the ray bundle impinging on the specimen surface and thus increases image definition.

Generally, it is preferable to slightly increase the diameter of the field iris diaphragm until it is just outside the field of view.

8. Focusing Adjustment

1) Tension adjustment of coarse adjustment knobs
A tension adjustment ring ① is provided next to the right hand coarse adjustment knob. With this device the tension of the coarse adjustment is freely adjustable for either heavy or light movement depending on operator preference.
However, do not loosen the tension adjustment ring too much, because the stage drops, or the fine adjustment knobs slip easily.

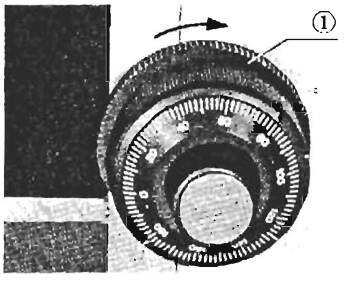


Fig. 7

★ Be careful not to rotate the right and left coarse adjustment knobs in the opposite directions simultaneously.

2) Pre-focusing lever
This lever ① is locked after coarse focus has been accomplished. It prevents further upward travel of the stage by means of the coarse adjustment knobs, and automatically provides a limiting stop if the stage is lowered and then raised again. (Fig. 8)

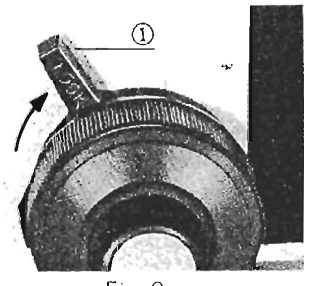


Fig. 8

9. Orthoscopic Observation

1) Swing out the top lens of the condenser.
In principle, polarized light enters the light path, parallel to the optical axis, to enable observation of the optical characteristics of the specimen. However, this method will darken the field of view and lower the resolving power of the objective extremely. Therefore, swing out the top lens of the condenser, using only the lower aperture of the lower condenser lens.

2) Insert the analyzer into the light path, and attain the crossed filter position with analyzer and polarizer at 0 setting. At this position, the polarizer vibration is in the north-south direction, and the analyzer vibration in the east-west direction. To open the filter position, pull out the analyzer rotation screw.

3) Rotate the stage until the extinction of the image is attained, and move the 45° click stop lever ① toward the operator (Fig. 9)
From this position, it is easy to rotate the stage in 45° increments without having to refer to the angular scale, and the stage clicks at the diagonal position, at which position, the retardation angle is measured. To release the 45° click stops, push back the 45° click stop lever.

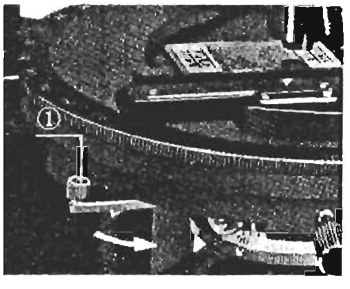


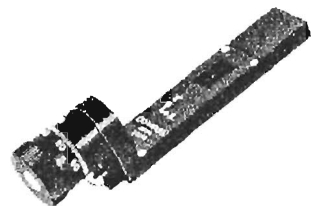
Fig. 9

4) Insert the quarter wave plate or sensitive tint plate into the slot in the intermediate polarizing tube.

★ A Berek compensator is optionally available to measure the birefringence of a specimen.

Sensitive tint plate

Quarter wave plate



Berek compensator

10. Conoscopic Observation

1) Swing in the top lens of the condenser, and illuminate the specimen with no need to immerse between the condenser and specimen slide.

2) Bring the specimen into focus, rotate the Bertrand lens turrent ring into the IN position.

3) Focus on the interference figure formed at the back focal plane of the objective from 20X to 100X.
The pinhole cap provided may be used in place of the eyepiece to directly view the interference figure mentioned above. In this case, the Bertrand lens is disengaged.

11. Photomicrography

1) Photomicrographic equipment
Photomicrography with the Model BHA-P requires photomicrographic equipment such as the photomicrographic system camera, exposure meter, photo eyepiece, etc. Read the instruction manuals for each equipment, and follow the steps below:

① It is recommended to use a low power photo eyepiece FK2.5X.

② Photomicrographic magnification is same as with the standard optical tube length, although the optical tube length for this use is prolonged because of the intermediate polarizing tube.

VII. OPTICAL DATA

Objective / Eyepiece	Magnification	PO4X	PO10X	PO20X	PO40X	※ PO100X
	N.A.	0.10	0.25	0.40	0.65	1.30
	W.D. (mm)	18.77	6.78	1.58	0.61	0.11
	Focal length (mm)	28.45	16.08	8.13	4.33	1.81
	Resolving power (μ)	3.4	1.3	0.84	0.52 (Spring loaded)	0.26 (Spring loaded)
K5X (Field number 21)	Total magnification	20X	50X	100X	200X	500X
	Focal depth (μ)	300.0	48.0	15.56	4.99	1.05
	Field of view (mm)	5.25	2.1	1.05	0.53	0.21
WF10X (18)	Total magnification	40X	100X	200X	400X	1,000X
	Focal depth (μ)	172.5	27.60	9.19	3.03	0.66
	Field of view (mm)	4.5	1.8	0.9	0.45	0.18

※ Immersion objective. Resolving power is obtained when the objective is used at the full aperture diaphragm.

The eyepieces K5X and WF10X incorporate a sliding eye shield. This eye shield can be pulled out to prevent glare and loss of contrast caused by ambient light hitting the eye lens.

○ W.D. (Working distance):
The distance between the specimen or cover glass and the nearest point of the objective.

○ N.A. (Numerical aperture):
The numerical aperture represents a performance number which could be compared to the relative aperture (f-number) of a camera lens. N.A. values can be used for directly comparing the resolving powers of all types of objectives. The larger N.A., the higher the resolving power.

○ Resolving power:
The ability of a lens to register small details. The resolving power of a lens is measured by its ability to separate two points.

○ Focal depth:
The distance between the upper and lower limits of sharpness in the image formed by an optical system.

○ Field number:
A number that represents the diameter in mm of the image of the field diaphragm that is formed by the lens in front of it.

○ Field of view diameter: the actual size of the field of view in mm.

VIII. TROUBLESHOOTING

Troubles	Causes	Remedies
1. Optical System		
(a) With the illuminator switched on, the field of view cannot be seen.	The high/low magnification selector lever is not correctly positioned.	Place the lever in correct position.
	The condenser is lowered excessively.	Raise the condenser to the upper limit.
	Analyzer and polarizer are in the "crossed filter" position ("0:0").	Set them at the position "0:90" or "90:0".
(b) The field of view is cut off or illuminated irregularly.	The light path selector lever is stopped midway.	Push the lever all the way.
	The high/low magnification selector lever is not correctly positioned.	Place the lever all the way.
	The auxiliary lens is not correctly attached.	Correct the lens position.
	The nosepiece is not click stopped.	Slightly rotate the nosepiece until it clicks into position.
	The nosepiece is not correctly attached to the stand.	Insert the sliding dovetail mount into the stand all the way, until it stops, then lock.
	The condenser is not correctly mounted on the ring mount.	Re-insert the condenser all the way.
	The sensitive tint plate is stopped midway.	Push the plate all the way until it clicks.
	In case of orthoscopic observation, the condenser top lens stays in the light path or stops midway.	Swing it out of the light path.
	The field iris diaphragm is stopped down excessively.	Open the diaphragm fully.
	The lamp is not correctly attached.	Re-insert the lamp correctly.
(c) Dust or dirt is visible in the field of view.	Dust or dirt on the glass surface at the light exit on the base.	Clean off the dust or dirt.
	Dust on condenser top lens.	
	Dirty specimens.	
	Dust on eyepiece.	

Troubles	Causes	Remedies
(d) Excessive image contrast.	The condenser is lowered excessively.	Raise the condenser.
	The aperture iris diaphragm is stopped down excessively.	Open the diaphragm.
	The auxiliary lens is not mounted.	Mount the auxiliary lens.
	The high/low magnification selector lever is not correctly positioned.	Place the lever in correct position.
(e) Resolution problems: ○ Image is not sharp. ○ Insufficient contrast. ○ Image details lack definition.	The nosepiece is not correctly attached.	Insert the sliding dovetail mount all the way, until it stops, then lock.
	The objective is not correctly positioned in the light path.	Slightly rotate the nosepiece until it clicks into position.
	Dirt on objective front lens.	Clean the objective.
	The immersion objective is used without immersion oil.	Apply immersion oil.
	Bubbles in the immersion oil.	Remove bubbles.
	The Olympus designted oil is not used.	Use the designated oil.
	Dirty specimen.	Clean.
	Dirt on condenser lens.	
	The specimen is not properly illuminated.	Adjust the illumination.
(f) The field of view is partially out of focus.	The nosepiece is not correctly attached.	Insert the sliding dovetail mount into the stand all the way, then lock.
	The objective is not correctly positioned in the light path.	Slightly rotate the nosepiece until it clicks into position.
	The specimen is not correctly positioned on the stage.	Place the specimen on the stage and secure it with the specimen clips.
(g) The image goes out of focus eccentrically.	The nosepiece is not correctly attached.	Insert the sliding dovetail mount all the way, until it stops, then lock.
	The objective is not correctly positioned in the light path.	Slightly rotate the nosepiece until it clicks into position.
	The condenser is out of center.	Center the condenser.
	The auxiliary lens is not correctly mounted.	Mount the lens correctly.
	The high/low magnification selector lever is stopped midway.	Place the lever in correct position.

Troubles	Causes	Remedies
(h)When objectives are changed, they are not parfocal.	The mechanical tube length is not correctly adjusted.	Adjust with the tube length adjustment rings on the observation tube.
(i) Light intensity does not increase although the voltage is raised.	The condenser is not correctly centered.	Center the condenser.
	The condenser is lowered excessively.	Raise the condenser.
(j) The condenser does not come to the correct position for optimum extinction.	The observation tube and condenser are not correctly mounted.	Re-mount them correctly.
(k)No conoscopic image can be seen.	The condenser top lens is not in the light path.	Swing it in.
(l) The crossed filter position is not atteined.	The analyzer is out of the light path.	Push it in.
2. Electric System		
(a) The illuminator is too bright (or too dark).	The rheostat trimmer screw is not matched to the mains voltage.	Adjust the trimmer screw to match the mains voltage.
	The mains voltage is too high (or too low).	Adjust the mains voltage with a variable voltage transformer.
	The rheostat trimmer screw is not correctly adjusted.	Adjust the trimmer screw until the voltmeter indicates 1V.
(b)Output voltage for the illuminator cannot be regulated.	The voltage selector switch is not matched to the mains voltage.	Adjust the mains voltage selector switch to the mains voltage.
	The mains voltage is too low or too high.	Adjust the mains voltage with a variable voltage transformer.
(c) The light flickers and the intensity is unstable.	The mains voltage is unstable.	Use a variable voltage transformer.
	The filament of the bulb is likely to burn out.	Replace the bulb.
	Loose electrical connection.	Secure the connection.
(d)Fuse burns out too often.	The fuse is not a standard fuse.	Use a standard fuse.
	The voltage selector switch is not matched to the mains voltage.	Match the switch to the mains voltage.
(e) The pilot lamp lights but the bulb does not.	The bulb is burned out.	Replace the bulb.
	Loose electrical connection.	Secure the connection.

Troubles	Causes	Remedies
(f) Reduced bulb life.	The voltage selector switch is not matched to the mains voltage.	Match the selector switch to the mains voltage.
	The bulb is not a standard bulb.	Use a standard bulb.
	Mains voltage is too high.	Use the tungsten bulb under 6V as well as possible, or use a high intensity bulb, such as a halogen bulb.
3. Focusing		
(a) Coarse adjustment is too tight.	Tension adjustment ring is tightened too much.	Loosen the tension adjustment ring properly.
	The user is trying to raise the stage passing over the upper focusing limit imposed by the engaged pre-focusing lever.	Unlock the pre-focusing lever.
(b) The stage drops and the specimen goes out of focus.	The tension adjustment ring is too loose.	Tighten the ring properly.
(c) The stage cannot be raised to the upper limit.	Automatic pre-focusing lever is engaged in lower than focusing position.	Unlock the pre-focusing lever.
(d) The stage cannot be lowered to the lower limit of the working range.	The condenser mount is lowered too much.	Raise the condenser mount.
(e) The objective front lens hits against the specimen.	The specimen is mounted on the stage upside down.	Reverse the specimen.
4. Observation Tube		
(a) Incomplete binocular vision.	Interpupillary distance is not correctly adjusted.	Correct the interpupillary distance
	Diopter adjustment is incomplete.	Complete the diopter adjustment.
	Right and left eyepieces are not matched.	Use a pair of matched eyepieces.
	The user is unaccustomed with a binocular vision.	Prior to looking at the image of the specimen, try to look the entire field of view, or look at a far away object before resuming microscopic observation.
5. Stage		
(a) The image easily goes out of focus when you touch the stage.	The stage is not correctly clamped.	Clamp the stage securely.
(b) The specimen stops midway on the east-west traverse.	The specimen is not correctly positioned on the stage.	Adjust the specimen position.