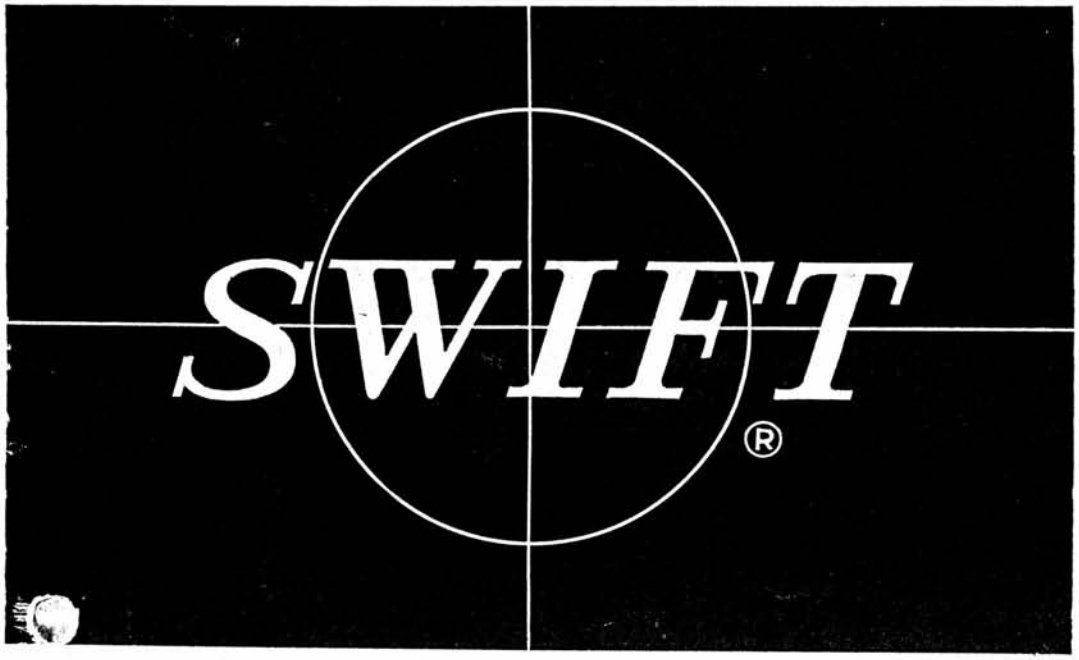
USE AND CARE OF SWIFT COLLEGIATE 400
TEACHING MICROSCOPE



USE AND CARE OF SWIFT COLLEGIATE M-400A SERIES TEACHING MICROSCOPE

Your SWIFT Collegiate M-400A Series microscope is an instrument of precision, both optically and mechanically and will last a lifetime with a minimum of maintenance. It is built to the highest and most rigid optical and mechanical standards and has many built-in features to insure durability and high performance in the hands of both student and professional users. It is designed to withstand the rigors of daily classroom and laboratory use with only normal care.

Unpacking: Your SWIFT Collegiate M-400A microscope arrived packed in either a fitted cabinet or molded styrofoam container. The objectives are in sealed plastic vials and care should be taken not to drop them or allow your fingers to contact the lenses. Install the objectives in a clockwise direction from the lowest to the highest power.

Familiarize yourself with the components of the microscope.

Arm:	The frame that supports all components above the base.
Body:	The unit comprising the inclined eyetube and prisms which control the path of light to the eyepiece.
Objective:	The optical system which does the initial magnifying to form the primary image.
Nosepiece:	The revolver which carries the objectives.
Eyepiece:	The upper optical component that further magnifies the primary image and brings the light rays to a focus at the eyepoint.
Condenser:	The optical lens built in the center of the stage.
Stage:	The table of the microscope on which the specimen is placed.
Base:	The component which supports the entire instrument. This component includes either an illuminator or a mirror to direct light through the condenser to the specimen.

Important terminology common to the science of microscopy:

Compound microscope: a microscope having a primary magnifier (the objective) and a secondary (the eyepiece) to further magnify the image and bring the light rays to a focal point (the eyes).

Achromatic Objective: an optical system corrected for two colors

chromatically and one color (yellow-green) spherically.

Angular Aperture: the angle (or cone) of light rays capable of entering the front lens of the objective from a point in the object. By increasing the angular aperture of an objective more light rays from the specimen can be taken in by the lens, hence the resolving power is increased.

Numerical Aperture (N.A.): a mathematical formula devised by Ernst Abbe for the direct comparison of dry and all types of immersion objectives for resolving power. Numerical aperture (N.A.) is the sine of half the angular aperture of the objective multiplied by the refractive index of the medium between the front lens of the objective and the cover glass on the slide. Numerical apertures of all Swift objectives are of research quality.

Condenser: a lens or system of lenses to collect light rays and converge them to a focus. Condensers are available for Collegiate 400 as follows: N.A. 0.65 with disc diaphragm, N.A. 0.65 with iris diaphragm and swing-out filter carrier, N.A. 1.25 Abbe condenser in focusing mount with iris diaphragm and swing-out filter carrier, N.A. 1.10 phase-brightfield (MA524) with phase annulus matched to 40X phase objective and including iris diaphragm and swing-out filter carrier. Also available is the MA511 Zernike phase set with phase annuli for 10X, 40XR and 100XR oil immersion, instantly convertible to brightfield.

Condensers available for the Quodlibet system of phase microscopy (instant convertibility to dark or brightfield) are as follows: N.A. 0.65 attached to a five aperture disc with phase annulus compatible with Phase 10X, Phase 40XR or Phase 10-50XR Zoom objectives. N.A. 1.15 attached to a five aperture disc with phase annulus compatible with Phase 10X and Phase 40XR objectives. N.A. 1.15 attached to a five aperture disc with phase annuli compatible with Phase 10X, Phase 40XR and Phase 100XR objectives.

Cover Glass: thin glass cut in circles, rectangles or squares, for covering the specimen, usually a thickness of 0.17 to 0.18mm. The majority of specimens should be covered by a cover glass, and this is a necessity when using the 40X lens.

Depth of focus: the ability of a lens to furnish a distinct image above and below the focal plane. Depth of focus decreases with the increase of numerical aperture or with the increase of magnification.

Eyepiece: the lens near the eye which magnifies the primary image of the objective so as to form a virtual image 10" away from the eyepoint.

Field: the area of the object that is seen when the image is observed. It may range in diameter from several millimeters to less

than 0.1mm. Also the size of the diaphragm opening in the eyepiece governs the diameter of the field of view.

Focal length: parallel rays of light after refraction through a lens will be brought to a focus at the focal point. The distance from the optical center of the lens to the focal point is the focal length or focus.

Objective: the lens system near the specimen which forms the primary image.

Parfocal: a term applied to objectives and eyepieces when practically no change in focus has to be made when one power is substituted for another. The objectives on your SWIFT Collegiate 400 Series microscope are parfocalized at the factory so that only a slight movement or no movement at all of the fine focus control is required when a change is made from high to lower powers.

Resolving Power: the ability of a lens to clearly separate fine detail. Resolving power is directly proportional to the numerical aperture of the objective. Also the shorter the wavelength of the light used, the greater the resolving power of the optical system.

$$\text{Resolving power} = \frac{\lambda}{\text{N.A.}} \quad \text{when} \quad \frac{\lambda}{\text{N.A.}} \quad \begin{matrix} = \text{wave length of} \\ \text{light being used.} \\ = \text{numerical aperture.} \end{matrix}$$

Widefield Eyepiece: is generally an ocular with an achromatic doublet for an eyelens and with the plano side of the lower lens nearest the objective. Such a corrected system does not have to be stopped down with a diaphragm, hence a large, flat field is assured.

Working Distance, Free: the distance between the front lens of the objective and the cover glass when the lens is focused on the specimen.

Coarse Focus: this is the large knob found on each side of the microscope and is used for rapid movement of the stage to bring the specimen near to focus.

Fine Focus: the smaller knobs within the larger coarse focus knobs. Fine focus controls are used to precisely focus the specimen to produce the sharpest image.

USING YOUR SWIFT COLLEGIATE 400 SERIES MICROSCOPE

Most student models of Collegiate 400 Series microscopes will be equipped with a widefield 10X eyepiece, objectives 4X, 10X and 40XR, condenser OA which has an N.A. 0.65 with disc diaphragm.

These models are used as follows:

1. Secure the slide to the stage by means of the stage clips.
2. Revolve the nosepiece to position the lowest power objective.
3. View through the eyepiece and use the coarse focus control to bring the specimen nearly into focus. The fine focus control is now used to complete the focusing of the specimen to produce the sharpest image.
4. The disc diaphragm is not intended to control the brightness of the illumination but induces contrast into the specimen by diffracting light rays. Focusing of the specimen should be done with the disc diaphragm opened to its largest aperture. If additional contrast is required to permit accurate viewing of the specimen, the diaphragm should be rotated one stop at a time until the details of the specimen are sharply defined. Care should be taken not to use an aperture too small to gain high contrast, as then fine structure of the image will be destroyed. Reducing the aperture does increase contrast and depth of focus, but it also reduces resolution and introduces diffraction. The aperture must be selected for each objective: i.e., the aperture for the 10X (N.A. 0.25) objective will not be the same as for the 40X (N.A. 0.65), since the angle of light required is determined by the numerical aperture of the objective. Proper selection of the diaphragm aperture is easily determined after a little experience with the microscope.

If your Collegiate 400 Series microscope is equipped with the 100XR oil immersion objective, it should also have condenser OC or OD which are Abbe condensers, N.A. 1.25. The rule governing condenser numerical apertures is: the numerical aperture of the condenser must be equal to or greater than the numerical aperture of the highest powered objective. In this instance, the 100X oil immersion objective has an N.A. of 1.25. Thus, the Abbe condenser (N.A. 1.25) is required to utilize the full resolving power of the objective. Collegiate 400 Series microscopes equipped with the Abbe condenser N.A. 1.25 do not have a disc diaphragm but include an iris diaphragm with swing-out filter holder. The iris diaphragm provides a continuously variable increase or reduction of the diameter of the cone of light from the illuminator. Proper focusing of the N.A. 1.25 condenser is important and is accomplished as follows:

1. Raise the condenser to its upper limits of focus. The iris diaphragm should be fully opened.
2. Focus the specimen with the 10X objective. (The diameter of the cone of light should fill the back lens of the objective. This utilizes the full resolving power of the objective. However, most

specimens react better to a cone of light approximately 3/4 the diameter of the back lens of the objective).

3. Remove the eyepiece and view the cone of light visible on the back lens of the objective.

4. Lower the condenser to achieve a cone of light approximately 3/4 the diameter of the lens.

5. Replace the eyepiece and view the specimen.

6. If additional contrast is required to permit study of the specimen, the iris diaphragm may be closed slightly.

Illuminator CIB will provide adequate illumination for most specimens at magnifications up to 1000 diameters. However, the illuminator CYHR is recommended because it provides a high intensity light necessary for critical viewing at high powers. It also includes a control to provide continuously variable illumination to provide the exact light intensity to best view each different specimen.

7. It is necessary to exclude air from the space between the cover glass over the specimen and the front lens of the 100X objective. This is accomplished by placing a drop of cedarwood oil, or the more commonly used, Cargille Immersion Oil, onto the cover glass. The controls are then manipulated to immerse the front lens of the objective into the oil. This forms an air tight connection through which the specimen may be viewed without interference from the atmosphere. Care must be taken not to come into direct contact between the lens of the objective and the cover glass since this may scratch or otherwise mar the viewing area of the lens itself.

Oil immersion objectives should be cleaned immediately after each use since the oil will dry after a time and prevent satisfactory viewing thereafter.

PHASE CONTRAST WITH THE SWIFT COLLEGIATE 400 SERIES MICROSCOPE

The phase contrast microscope reveals fine detail in transparent objects which possess very little contrast. Unstained living organisms and cells can be studied without danger of artifacts produced by killing, fixing or staining reagents. Before the advent of phase contrast such specimens could only be examined in transmitted light by closing down the substage condenser diaphragm to a small aperture. The narrow cone of illumination produced diffraction with destruction of detail.

SWIFT uses the original Zernike method in which a clear annular ring of light from the substage condenser is matched with a 25%

transmission phase ring in the objective system to separate the central, direct light rays from the outer diffracted rays. Light rays can be retarded 1/4 wavelength by a coating of magnesium fluoride on the phase plate in the objective so that interference can take place at the eyepiece diaphragm to produce dark contrast in the image.

The Swift system of phase contrast is especially effective in the examination of living cells, chromosomes, protozoa, blood platelet counting and all studies involving phase contrast microscopy.

If you have equipped your Collegiate 400 microscope with our Zernike type phase set, Cat. MA511, you have phase objectives P10X, P20XR, P40XR, P100XR, and the special long working distance condenser N.A. 1.10 with a turret, housing three phase annuli, one matched to each phase objective, with the 40X annulus common to 20X. There is also a filter carrier, an iris diaphragm, and a fourth position for normal brightfield microscopy. Collegiate microscopes incorporating this phase set must use illuminator CYHR to insure adequate illumination at highest magnification when the P100XR oil immersion objective is used.

This phase set is used as follows:

1. Insert the phase condenser into the substage mount of the microscope to the maximum height and clamp it firmly with the securing screw. Rotate color coded disc until silver mark is indexed.
2. Focus the object with the 10X objective.
3. Change to the objective required and rotate the annulus indicator ring until the index marking shows the color corresponding to the objective. The correct annulus is now in position, below the condenser.
4. With the 40XR and 100XR objectives it is necessary to increase the illumination by means of the control on illuminator CYHR.
5. Insert the centering telescope in place of the eyepiece. Adjust the telescope until the enlarged bright annulus image of the condenser stop and the dark phase ring in the objective are sharp.
6. Adjust the metal ring carrying the phase annulus until the substage annulus coincides with and is covered by the stationary phase ring in the objective. A slight change of the substage condenser focus may be necessary for registration of annulus rings. The annular ring of light must be evenly illuminated.
7. Replace the eyepiece and observe a good phase contrast image.
8. A change of objectives requires operations 5 and 6 to be repeated. Once all the phase objectives have been matched with the

annuli of the condenser, they will remain centered. It is a good practice to recheck them occasionally.

SWIFT SYSTEM OF QUODLIBET PHASE CONTRAST MICROSCOPY

The Quodlibet system of phase offers phase contrast techniques in a form simple enough for even the newest science student, yet with phase contrasted results comparable to instruments costing many times more.

The SWIFT Quodlibet Phase unit may be ordered as a complete microscope or added to your M400 Series microscope that is presently equipped with a disc diaphragm.

HOW TO USE YOUR SWIFT QUODLIBET MICROSCOPE

You will note the 10X and 40XR objectives are designated "Phase". This means phase contrast may be achieved with these two objectives, while the 4X objective remains brightfield or darkfield only.

Look at the disc diaphragm found attached to the underside of the stageplate. Note the openings (called apertures) in the disc, and the green phase annulus mounted in a green cylindrical mount. Phase contrast is achieved by rotating the disc to position the green annulus under the condensing lens in the stageplate.

With the annulus positioned thus, the 10X and 40XR will produce a good, phase contrast image of the specimen.

Your Swift Quodlibet will also function as a normal, brightfield microscope. Simply rotate the disc diaphragm to any other position, which removes the phase annulus from the path of light, and your 10X and 40XR phase objectives will perform as normal brightfield objectives.

An additional feature of your Swift Quodlibet is evident when the disc diaphragm is rotated to position the phase annulus under the condensing lens in the stage, and the low power 4X objective is positioned for viewing. In this manner, the specimen is viewed brightly illuminated against a dark background. This is actually low powered darkfield microscopy.

SWIFT QUODMASTER PHASE MICROSCOPY

The Quodmaster Phase Contrast Set includes the following:

4X Achromatic (scanning lens), 10X and 40XR phase objectives. Substage, mount centerable, N.A. 1.15 condenser. Five aperture

rotatable disc containing one phase annulus common to both 10X and 40XR phase objectives. One darkfield stop common to 4X, 10X Phase and 40XR Phase objectives. One diffusion filter and two open apertures for brightfield use at all magnifications.

Note: A 100XR objective is congruent with the large open aperture for brightfield oil immersion microscopy.

The Swift Quodmaster 100 is the same as above with the addition of a 100X Phase annulus in the disc and a 100XR Phase objective, affording phase technique with 10X, 40XR and 100XR objectives; darkfield technique with 4X, 10X and 40XR objectives; brightfield with 4X, 10X, 40XR including 100XR oil immersion.

35MM PHOTOMICROGRAPHY WITH THE SWIFT COLLEGIATE 400 SERIES MICROSCOPE

A recommended model:	CR-CIVT-05-OD-CYHR
Camera Attachment:	Cat. MA873
Camera suggested:	Beseler Topcon Super D, with cable release, high magnification waist level finder. Mounted to MA873 with Swift adapter "EX".

Determining the correct exposure for photomicrography has always been difficult because of the many factors involved. With the advent of the Beseler Topcon camera with a sensitive cadmium sulfide cell back of the reflex mirror, the problem of exposure determination, particularly for color film, has been solved and greatly simplified even for high powers of the microscope. Providing adequate illumination is employed, such as a Collegiate CYHR illuminator, an instrument magnification of 1000X will balance the exposure meter indicator and give the exposure time required. The configuration listed above is recommended for magnifications up to 400X. If oil immersion magnifications are to be employed, it is suggested the camera be mounted separately from the microscope and supported on a rigid stand, such as the Beseler BT47 stand. You can utilize the Beseler BT77 adapter to form a light tight connection to the microscope.

Objectives: Swift 4x, 10X, 40XR, 100XR Achromatic, Plan Achromatic and Phase Contrast objectives furnish excellent results for both black and white, and color photomicrography with the Topcon camera.

Condenser: All Swift substage condensers are excellent for photomicroscopy and the condenser OD, an Abbe N.A. 1.25, gives satisfactory results.

Filters: The swing-out filter carrier attached to many Swift substage condensers accept a variety of filters, available at most camera stores. Swift microscopes equipped with CYHR base and 100XR objective, include a blue 31.5mm diameter daylight filter, recommended for use with this illuminator.

PROCEDURE

1. Remove camera lens.
2. Attach EX "T" mount to MA873 adapter and mount on camera body. Then attach entire assembly to vertical tube of CIVT body.
3. Critically focus the specimen with the 10X objective.
4. Adjust the CYHR illuminator to maximum intensity.
5. Check the focus at the camera, and activate the Cds. cell by turning on the battery control switch. The exposure indicator on the right side of the finder should be approaching the black circle. If the indicator is to the left, increase the exposure time; if it is to the right, decrease the exposure time. To balance the exposure for an in between exposure setting, slightly open or close the substage condenser iris diaphragm. When the needle bisects the circle, activate the shutter with the cable release.

As the meter of the Topcon furnishes an average reading for the entire 35mm frame, should a large clear space be present in the frame, or if the objects are scattered, then give 50% to 100% more exposure time than indicated by the meter. Under these conditions an intensely stained specimen will require more exposure than one lightly stained.

Collegiate 400 series also accepts the Swift Polaroid® camera attachment, Cat. No. MA731. This comprises the Polaroid® film pack back, bridge with compensating lens, pull out light trap, Copal shutter 1 sec to 1/250 sec, cable release and W10X eyepiece.

This accessory is excellent for photomicrographs and mounts easily to the Collegiate body CIVT. Swift Polaroid® is simple and easy to use and has a built-in compensating lens. Detailed instructions are enclosed with this accessory and its use is completely explained in the Polaroid® instructional brochure.

ACCESSORIES

SWIFT Polarizing Attachment, catalog designation MA927-Z

This comprises a polarizer mounted in a 1" x 3" metal slide, special stage clips to mount the polarizer to PS Collegiate stage, and an analyzer which mounts on Swift eyepieces. This accessory is excellent in the study of crystals, fibres and thin rock sections, and for determining the optical characteristics of a number of botanical and biological specimens.

INTERCHANGEABILITY

Collegiate 400 series microscopes are fully modular in design and construction. All major components of this series are unitized to permit their rapid and easy interchange from one model to another. This allows a versatility heretofore unknown in the teaching microscope field and permits the simplest model to be converted to a more advanced instrument at modest cost. Major components of Collegiate 400 series microscopes should only be disassembled or repaired by qualified, authorized technicians. However, each major component may be interchanged as follows:

1. Note there is an exploded view of all parts of Collegiate 400 series in this manual.
2. Arm C-1 is common to all models.
3. Screw 4S-5 is found at the top of Arm C-1 at the front. This screw secures the nosepiece assembly on which the objective revolver is mounted. Loosen this setscrew to remove any Collegiate 400 series nosepiece assembly.
4. When installing a nosepiece assembly, be sure it is inserted as far as possible into its receptacle in Arm C-1; then, secure it with setscrew 4S-5.
5. You may now install body CI (Inclined Monocular), CIVT (Inclined Monocular with additional Vertical Tube) or CB (Inclined Binocular Body). Each of the bodies has a small dowel pin, which mates with a hole in the nosepiece assembly. Gently press the body down to make full contact between the mating surfaces. Screws 4C-50 are now installed to secure the body to the nosepiece in the arm C-1.
6. If the body is not aligned to the arm C-1, loosen setscrew 4S-5 and turn the body into alignment, then retighten setscrew 4S-5.
7. Base CMF, CIB, CYVR and CYHR are mounted to arm C-1 by means of three large screws, Part No. 5S-15SCrm. These screws will be visible inside the base when the bottom plate, Part No. BA-3A, is

removed. This plate guards the interior of the base where required and is secured by 4 screws, Part No. 3T+6SCrm

8. Condensers OA, OB, OC, OQ, ZQ, QM and QM 100 are interchangeable and are installed in their receptacle in the stage holder. The condenser is secured by a small set screw, Part No. 4S-8, found on the front face of the stage holder, Part No. C-7.

Condensers OD and condenser with Zernike MA524 Phase Set must be installed in CR arm only.

9. The PS stage is installed in similar manner onto the stage holder, and is secured by a setscrew, Part No. 4S-12, found on the right side of the stage plate, as viewed from the rear. Note this setscrew is inset deeply in the stage plate and the screw itself is not visible from the exterior. The long end of a 2mm allen wrench should be used to tighten or loosen this setscrew.

10. You may now install your choice of objectives in the nosepiece revolver and whichever eyepiece you have selected into the eyetube.

Caution: No other modular change of Collegiate 400 Series microscope should be attempted except by qualified authorized technicians.

CARE OF YOUR SWIFT COLLEGIATE 400 SERIES MICROSCOPES

Your SWIFT Collegiate 400 Series microscope is a precision instrument and requires only routine maintenance. With ordinary care, the Collegiate 400 microscopes will last a lifetime. Microscopes like other precision instruments should be cleaned after each use, which prevents dust and other forms of contaminents from drying on exposed surfaces.

Eyepiece and objective lenses should never be wiped while dry. Particles of dust should be removed using a soft camels hair brush or air. Lens paper folded several times and moistened with an approved lens cleaner such as Xylol or Xylene should be used to clean glass surfaces. Lenses should never be disassembled except by qualified, authorized technicians.

The painted metal surfaces of your Collegiate 400 Series microscopes are finished with a formula of epoxy-ester-resin, and are resistant to staining or dulling from most reagents found in classrooms or laboratories. The finish should be wiped off periodically with a soft, moistened piece of flannel or chamois.

Periodic servicing is recommended. This should be done only by qualified technicians since general servicing includes disassembly,

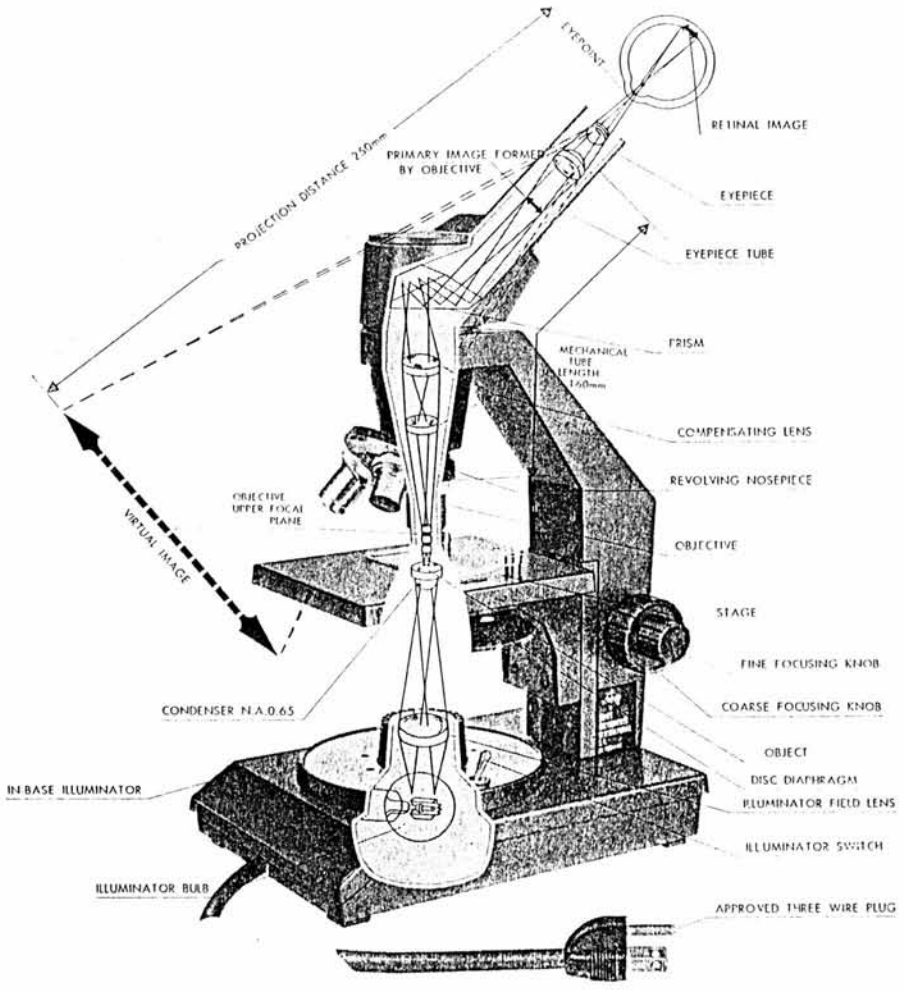
cleaning and relubrication. Also, at this time all parts are tightened and inspected for wear. Periods of maintenance will vary depending on the hours of use of the microscope each day. Some schools will find servicing every three years adequate, while others will require more frequent attention.

Swift Collegiate 400 Series microscopes operate best when lubricated only with lubricants recommended by Swift. Depending on the climate, moisture will evaporate from lubricants over a period of time, usually about three years. At that time, the lubricant no longer performs its function and should be removed and replaced to ensure ease of operation in the movement of parts on their bearing surfaces.

Your Swift Collegiate 400 Series microscope is covered by the most liberal warranty available, which is printed within all Swift brochures and is backed by a fully stocked and manned plant in Tokyo, Japan and San Jose, California, U.S.A., as well as service dealers in most states and many countries of the world.

Inquiries regarding the Collegiate 400 Series or other Swift products should be directed to your authorized Swift dealer, or:

SWIFT INSTRUMENTS, INC.
Technical Instrument Division
San Jose, California 95106


EYEPOINT
RETINAL IMAGE
PRIMARY IMAGE FORMED BY OBJECTIVE
PROJECTION DISTANCE 250mm
EYEPIECE
EYEPIECE TUBE
PRISM
MECHANICAL TUBE LENGTH 160mm
COMPENSATING LENS
REVOLVING NOSEPIECE
OBJECTIVE UPPER FOCAL PLANE
VIRTUAL IMAGE
OBJECTIVE
STAGE
FINE FOCUSING KNOB
COARSE FOCUSING KNOB
CONDENSER N.A.0.65
OBJECT
DISC DIAPHRAGM
IN-BASE ILLUMINATOR
ILLUMINATOR FIELD LENS
ILLUMINATOR SWITCH
ILLUMINATOR BULB
APPROVED THREE WIRE PLUG