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Papers for students No. 15.

HAND LENSES AND MICROSCOPES FOR CONCHOLOGISTS

by
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Although many people start their study of conchology on the larger shells with features easily seen by the naked eye, sooner or later there will come the need to magnify. This may be necessary to sort out fine detail of outer shell sculpture and hinge plates of bivalves in order to confirm an identification or to begin studying some of the smaller species which are present in shell-sand or in leaf-litter samples.

Hand lenses.

For field use the best instrument is the hand lens which comes in magnifications from about x5 to x20. Most conchologists find that the x10 hand lens is the best for field use as it is powerful enough to resolve details of shell sculpture (e.g. checking a Nesovitrea hammonis) but it does have a larger field of view than most more powerful lenses and it is also easier to use under poor light in a woodland than a x20 lens. A range of hand lenses exists to suit all pockets and a routine x10 lens can be purchased from philately shops (or photographers, chemists and biological suppliers) at around 80p. Whilst it is nice to have a more expensive lens, this is best reserved for use in the study as hand lenses are remarkably easily lost (usually lent to fellow collectors!) and they also suffer from mud, rain, pond or sea-water on field excursions. It is always a good idea to mount the lens on a cord around your neck as this reduces the chance of losing it and it is also likely to stay cleaner, and less scratched than it would be loose in a pocket or haversack. Many people have difficulty in using a hand lens for the first time. Unlike a conventional magnifying glass, the hand lens is small and is best used close to the eye. The specimen is then brought closer and closer until it comes into focus. As a guide, the distance between the lens and the focused specimen is 1.7 cms (less than one inch) with my own x10 hand lens. Some naturalists like to use a Watchmaker's eye-glass which comes in magnifications of x4 to x15 and are priced around 60p. These enable both hands to be free for manipulating a shell. Another similar idea is a combined magnifier and specimen pot which is often used in junior schools. The specimen is held in a container (which can hold water) and screwed into the tube. These are particularly useful for those who just wish to see the specimen enlarged or to see the soft parts of an aquatic snail, but they are not really adequate for the serious student who wishes to check a particular small diagnostic feature on a shell.

Microscopes.

For the smallest mollusc, a microscope rather than a hand-lens is necessary. There are different types of microscopes built for different

purposes and it is important to select the type which best fulfills your needs. Most conchologists will find that one of the stereo-microscopes (also known as binocular or dissecting microscopes) will be the one to use as these are ideal for looking at detail on shells, sorting shell-sand or leaf-litter, or for dissections and cleaning shells. The traditional monocular microscope has a higher magnification than the low power stereo-microscope but its use to the conchologist is more or less limited to the study of radulae, jaws and serial sections of molluscan tissue.

Stereo-microscopes.

These range from magnifications of about x10 up to x50 with a limit of x160 but the magnification range of a particular instrument can be modified by the use of extra eye-pieces and sometimes extra objectives if these are interchangeable. Most stereo-microscopes, even those at the bottom end of the price range, give a choice of two magnifications. The total magnification can be worked out by multiplying the magnification of the eye-piece by that of the objective (the lower lens). For scanning shell-sand, widefield eye-pieces which give a broader field of view are particularly useful.

The cost of new stereo-microscopes starts at around £50 and the price range of the instrument which you select will be governed (apart from your own pocket) by the level of sophistication needed for the job which you have to do. Microscopes at the lower end of the price range are quite adequate for sorting shell-sand and most identification work. If you choose to specialise in particularly small groups of shells like Pisidium, one of the more expensive microscopes would be worth while and less tiring to use. Some of the more sophisticated microscopes have a zoom lens which, instead of a choice of just two magnifications, gives every variation between.

Apart from the optical qualities and specifications of a stereo-microscope, there are a variety of microscope bases to choose from. The simplest of these (as on the Swift M20E) is a flat base for the specimen with a metal tube at one end carrying the microscope up and down on a rack and pinion focusing mechanism. A variation of this is the type with a heavy central base and metal rod and with the microscope fitted on the end of a long horizontal arm. This type is ideal for dissection work as there is plenty of room under the microscope for a large dissection dish. Other stereo-microscope stands have a small specimen base and these are best suited for close study of individual shells or animals in very small dishes. It is not a good idea to place a large dissection dish (often with water in it) on a raised platform, as it is unstable, and dissection dish, slug and water are likely to end up in your lap ! Some makers have an interchangeable system of optical heads and bases so you could if you wish have two separate bases without having to buy two sets of optical heads.

To get the best out of your stereo-microscope, good lighting is necessary. Many of the stereo-microscopes on the market do have a built-in light, but I personally prefer to use a separate light (or lights). For much routine work an ordinary office angle-poise lamp works well enough, although for very detailed work a high intensity illuminator (which concentrates light into one spot) is better. The virtue of a separate light source is that one can use it at almost any angle and low angle light is very good for showing up fine structural detail on a shell. It is also useful to be able to examine the same shell using light at different angles.

Some stereo-microscopes have understage illumination (a light source underneath an opaque glass specimen base). This is really for use with microscope slides and most work of conchologists would require overhead rather than understage lighting.

If you are likely to want to take photographs down the microscope, it is as well to check that the microscope you have selected can be fitted with a camera attachment. There are many different ways in which cameras can be fitted to microscopes. A single lens reflex camera with its lens removed can be attached at the top of the microscope tube: adaptor threads are available for most popular makes of 35 mm. single lens reflex cameras. Widefield eye-pieces are best for use with cameras. The estimation of exposure usually requires some experimentation but the use of a T.T.L. camera (with through the lens metering) can be a considerable saving both on time and film.

For a long working life, the teeth of the rack and pinion on the microscope base should be made of a hard metal. In my teaching career I have come across some stereo-microscopes in which the teeth were made of a soft metal which broke off after a few years of student use.

Monocular microscopes.

This is the traditional type of microscope with a magnification range of x70 to around x450 and x1000 using oil immersion lenses. With the lower magnifications it is possible to examine shells using an overhead light source, but the field of vision is very small, there is limited room between the stage and the objective lens for a large specimen and only one eye-piece is more tiring to use than a twin eye-piece, particularly for the beginner. Some research microscopes do have twin eye-pieces which are more relaxing to use for long hours of routine laboratory work but these are at the upper end of the price range. The depth of field is also less at the higher magnifications of the monocular microscope than it is in low power stereo-microscopes and thus one has more focusing to do.

Most work done on monocular microscopes depends on understage illumination and the transparency of the object. If the object is opaque (e.g. a shell) one just sees a silhouette using understage lighting. To get the best use out of a monocular microscope the specimen needs to be well prepared, (soft tissue must be in thin layers and is usually fixed, dehydrated, cleared and mounted on a microscope slide with a coverslip). This is part of the routine training of a biology student. Conchologists would be likely to use monocular microscopes for detailed study of radulae, jaws, gizzard plates, serial sections of prepared mollusc tissue or veliger larvae from the plankton, but all except histological studies of cells can equally well be done on one of the better stereo-microscopes.

For work at more than x100 a substage condenser is necessary: this concentrates incoming beams of light from the lamp into a small area around the specimen. It is usually controlled by a knob below the stage and the iris diaphragm of the condenser is usually controlled by a small lever at the side. As in stereo-microscopes, some monocular microscopes are provided with a built-in lamp and some are without. On most monocular microscopes, there are two focusing knobs, one for coarse adjustment (used with low power objectives) and the other for fine adjustment (used with high power objectives). Popular handbooks on microscopy give further details on the use of monocular microscopes.

Because of the simpler optical system, monocular microscopes cost less than stereo-microscopes and they start at around £30. (Cheaper childrens microscopes

are available on the market, but these usually have too high a magnification to be of much practical use). Second-hand monocular microscopes are also to be found through advertisements (e.g. Exchange and Mart).

In summary a stereo-microscope is likely to be the most useful type of microscope for a conchologist and a great aid in the enjoyment and study of molluscs. The names and addresses of makers and distributors of microscopes in the U.K. are listed below. Most of these would supply information and price lists on request. If you are considering purchasing a microscope you may find it helpful to contact the head technician of your nearby high-school or college and arrange to see the types of microscope that they use. A microscope which stands the test of student use is likely to give a lifetime of service. Catalogues of biological suppliers and suppliers of microscopes are often available in school or college technicians' rooms.

SUPPLIERS OF EQUIPMENT.

Hand-lenses.

Available from philately shops, photographers, opticians and some chemists. Also in catalogues of biological suppliers e.g. Griffin and George (see Griffin field studies catalogue).

Specimen magnifier.

Griffin and George. Field studies catalogue number S31-656. 43p each (1976).

Watchmaker's eyeglass.

Available from jewellers, watchmakers, philately shops etc. from 60p.

STEREO-MICROSCOPES

Griffin and George Ltd: Several microscopes are listed in the catalogue including one Griffin stereo-microscope, two Olympus models (with different types of base) and a Beck binomax.

Olympus microscopes: A range of different bases and heads. Some models are fitted with a photo-tube which is separate from the normal eye-pieces. Adaptors are available for attaching cameras to microscopes.

Prior and Co. Ltd. The Prior Stereomaster stands up well to student use and is also a useful design for dissection work.

Swift microscopes. (Pyser Ltd.) A good range of microscopes with an interchangeable system of optical heads and bases. Most of the optical heads are suitable for use with a camera attachment.

Nikon microscopes: Well-known in the camera field, Nikon also make a range of quality stereo-microscopes.

Vickers Instruments Ltd: An optical head is available for use with several types of bases, including a solid stand and arm for dissection work.

Wild microscopes: A range of quality microscopes which have wide use as standard research microscopes in universities and research laboratories.

Carl Zeiss Jena Ltd. A wide range of high quality equipment for research work.

Stereo-microscopes less than £100 (excluding VAT) from: Griffin and George Ltd. (Griffin stereo-microscope), Olympus (model HSC), Prior and Co. Ltd.

(stereomaster 250, 260); Swift (M20 E).

Monocular microscopes.

The following all supply standard student microscopes: Griffin and George Ltd., Olympus microscopes, Prior and Co. Ltd., Swift microscopes (Pyser Ltd.). It is advisable to choose a microscope with a triple rather than a single objective nose-piece to include some of the higher magnifications which may be needed for detailed study of the smaller radulae.

Servicing.

Most of the suppliers of microscopes do undertake servicing of the instruments.

ADDRESSES OF SUPPLIERS.

Griffin and George Ltd. (Now taken over by Gallenkamp).
Frederick Street, Birmingham, B1 3HT.

Olympus microscopes.
Olympus Department, Gallenkamp, P.O. Box 290, Christopher Street, London, EC2 2ER.

Prior and Co. Ltd.
London Road, Bishop's Stortford, Hertfordshire.

Swift microscopes (Pyser Ltd.).
Pyser Ltd., Fircroft Way, Edenbridge, Kent.

Nikon microscopes.
Projectina Company Ltd., Skelmorlie, Ayrshire, PA17 5RB.

Vickers Instruments Ltd.,
Haxby Road, York, YO3 7SD.

Wild microscopes.
E. Leitz (Instruments) Ltd., 48, Park Street, Luton, Bedfordshire, LU1 3HP.

Carl Zeiss Jena Ltd.
C.Z. Scientific Instruments Ltd., P.O. Box 43, 2 Elstree Way, Boreham Wood, Hertfordshire, WD6 1NH.

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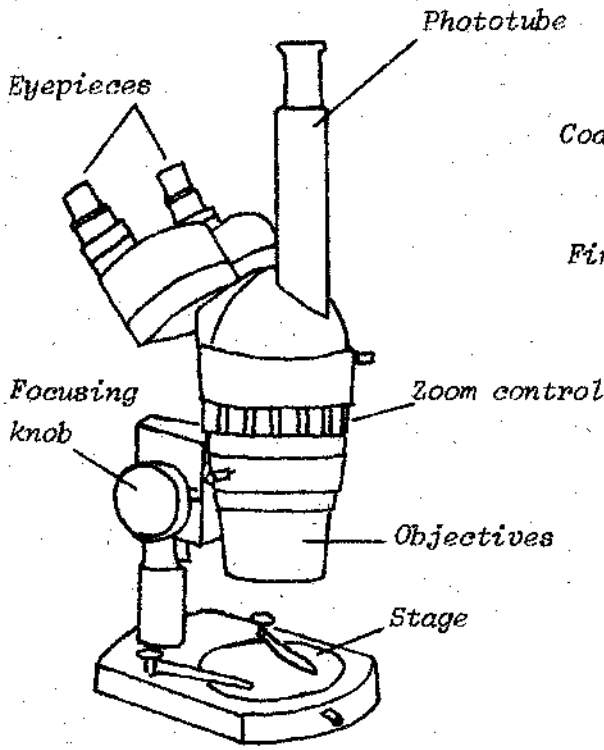
OLYMPUS STEREOMICROSCOPE WITH STAGE



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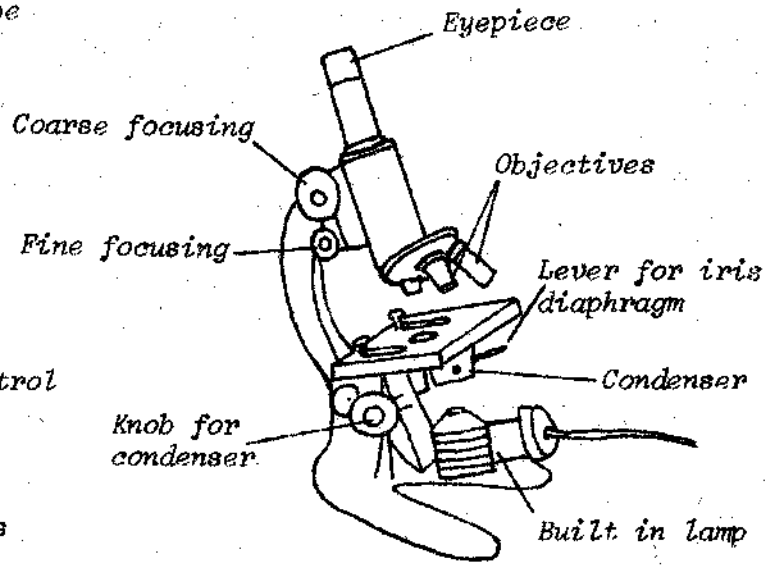
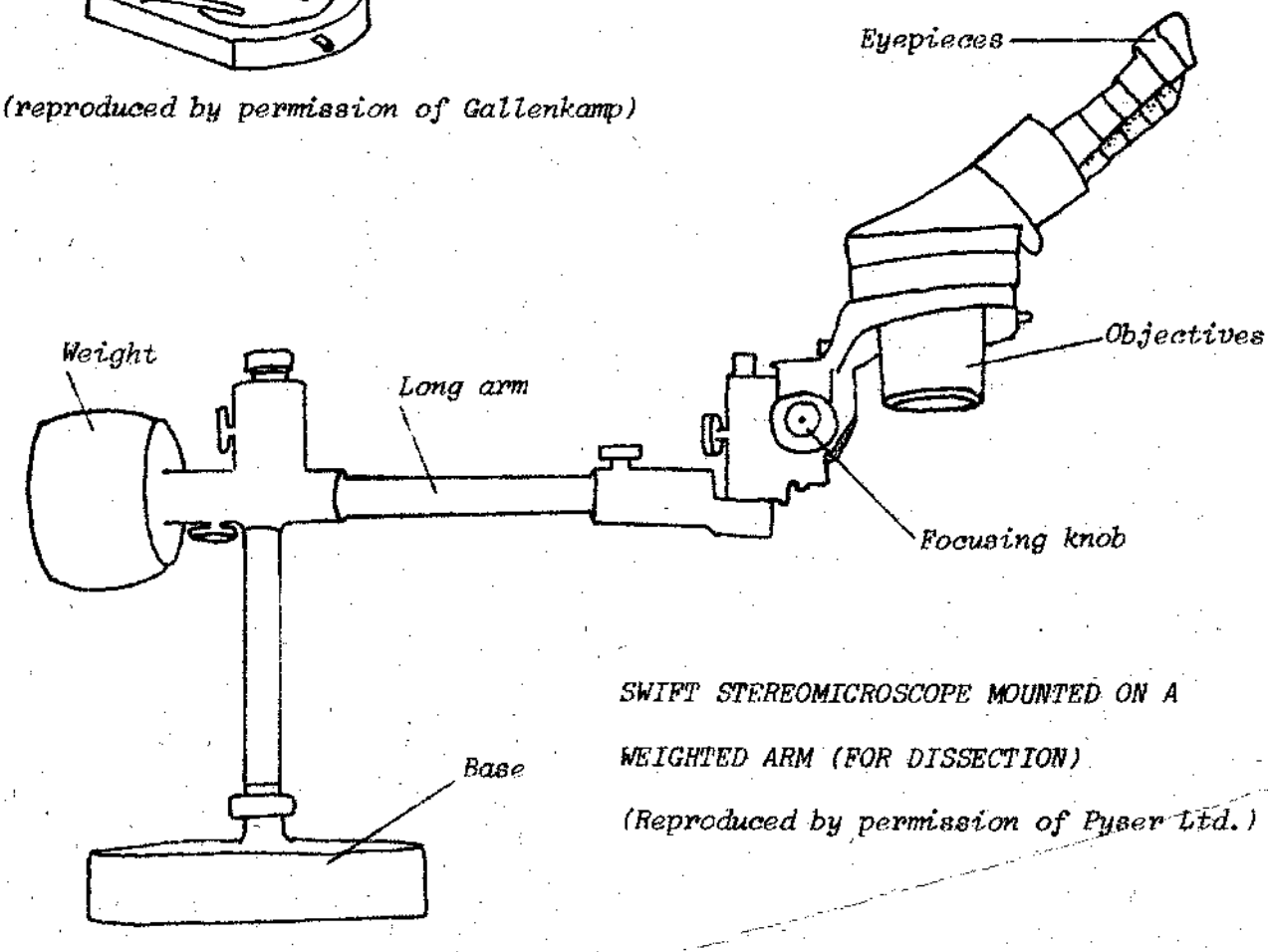
PRIOR MONOCULAR MICROSCOPE

(Reproduced by permission of W.R. PRIOR & CO. LTD.)





SWIFT STEREOMICROSCOPE MOUNTED ON A WEIGHTED ARM (FOR DISSECTION)

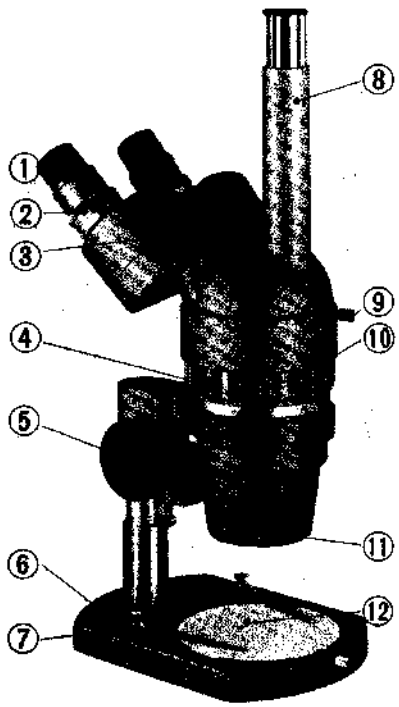
(Reproduced by permission of Pyser Ltd.)

OLYMPUS MODEL SZ-Tr

Trinocular Zoom — Stereo Microscope

■ SPECIFICATIONS

- Microscope body: With combination binocular observation tube, inclined 45°, and vertical phototube. Interpupillary distance adjustment 53mm to 79mm; eyepiece converging angle 12°; both eyepiece tubes have graduated diopter adjustment; graduated zoom ring with a 5.7 to 1 zoom ratio, and built-in objective 1X (W.D. 88mm), magnification range 0.7X to 4X. Observation tube rotatable through 360° and lockable. Microscope body swings over an arc of 80°, centering on the pillar.
- Mounting bracket: With rack and pinion focusing mechanism. Focusing range 55mm and dual focusing control knobs with adjustable tension.
- Widefield eyepiece G10X, paired: Provided with eyepiece shields, paired.
- Photographic eyepiece P10X, single.
- Stand: Consists of a base, 182mm x 127mm, with opening and clamping screw for stage plates, and stage clips, paired. The pillar is spring-loaded and extensible to extend range of focusing movement by 47mm, with locking lever. The post adapter accepts microscope portion. Stage plates, clear and black-&-white, are provided.
- Observation magnification: Total mag.= Objective power(1X) x Eyepiece power x Zooming ratio x (Aux. obj. power)



① *Eyepiece*
② *Diopter adjustment ring*
③ *Prism housing*
④ *Zoom control ring*
⑤ *Focusing knob*
⑥ *Stage*
⑦ *Stage clip*
⑧ *Phototube*
⑨ *Light path selector knob*
⑩ *Clamping screw*
⑪ *Objective shroud*
⑫ *Stage plate*

Eyepiece	G10X							
Zooming ratio (on zoom ring)	0.7	1	1.5	2	2.5	3	3.5	4
Total magnification	7X	10X	15X	20X	25X	30X	35X	40X
Depth of focus (mm)	2.6	1.3	0.58	0.33	0.24	0.20	0.18	0.17

- Photomicrographic magnifications
  = Photo eyepiece power (P10X) x Zooming ratio 1/2 . . . with PM-10
  = Photo eyepiece power (P10X) x Zooming ratio 1/3 . . . with PM-6

Photomicrographic Magnifications

Zoom ratio on zoom ring / Camera	0.7	1	1.5	2	2.5	3	3.5	4
PM-10	3.5X	5X	7.5X	10X	12.5X	15X	17.5X	20X
PM-6	2.3X	3.3X	5X	6.6X	8.3X	10X	11.6X	13.3X

- Working distances between specimen and objective front lens:
  Objective 1X (without auxiliary lens) = 88mm
  (with auxiliary lens 0.5X) = 159mm
  (with auxiliary lens 0.75X) = 105mm
  (with auxiliary lens 1.5X) = 45mm
  (with auxiliary lens 2X) = 30mm

■ STANDARD EQUIPMENT

Microscope body	1
Stand & pillar with stage clips, paired	1
Eyepieces, G10X	2
Photo eyepiece, P10X	1
Stage plates, clear	1
black and white	1
Eyepiece shields	2
Vinyl dust cover	1

OPTIONAL ACCESSORIES

1. Photomicrographic System Camera Model PM-10

The PM-10 is a complete system camera with alternative models to suit various types of work and providing for several forms of photographs. Choice of manual units PM-10-M or automatic PM-10-A: 35mm standard, 3¼" x 4¼" or 4" x 5" may be used.

2. Photomicrographic Camera Model PM-6

Produces sharp and clear pictures on 35mm film. Shock proof shutter for shutter speeds B and 1 sec to 1/50 sec.

3. Photomicrographic Exposuremeter Model EMM-7

Facilitates the determination of correct exposure time and color temperature for light balancing in conjunction with the Models PM-10-M and PM-6.

4. G15X and G20X Eyepieces

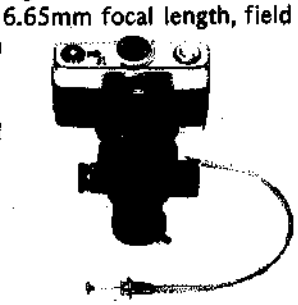
For wide field viewing with full chromatic and distortion correction. G15X with 16.65mm focal length, field number 13. G20X with 12.5mm focal length, field number 12.2.

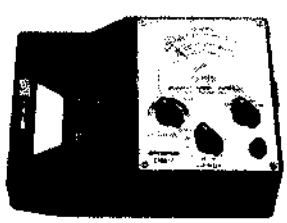
5. Universal Illuminator
Model LSD and Transformer Model TE-II

6. Epi-illuminator
Model LSG-2

7. Trans-illuminator Base
Model X-DE

8. Auxiliary Objectives
0.5X, 0.75X, 1.5X and 2X
Can be thread mounted to the bottom of the objective shroud of the microscope.





As we are continually improving and developing our products, the equipment supplied may not agree in all details with the descriptions and/or illustrations shown in this catalog.

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