TWO DISSECTION KNIVES FOR THE MORPHOLOGIST, HISTOLOGIST, AND SYSTEMATIST, WITH SUGGESTIONS FOR THEIR USE [1, 2, 3]

Norman T. Baker[4]

ABSTRACT: Two easily built, in expensive, high quality knives are described and discussed for use by insect morphologists, histologists and systematists.

The study of arthropod morphology is often hampered by the lack of suitable tools for dissection, both in the classroom and in the research laboratory. In the past few years I have developed two excellent knives which are dependable, easy to construct, and quite inexpensive. The first knife is used for the initial gross dissections. The second is used for the finer, more delicate dissections to see individual muscles, sclerites or other organs. The knives are useful in both traditional anatomic work and in histological preparations. Also both knives are sharp enough to cut thru an exoskeleton without crushing as most microdissection scissors do.

Materials and Construction

The first knife is constructed simply of an Xacto[R] Knife blade holder, No. 3001 and disposable double edge razor blades used for shaving. There are considerable differences from one brand of razor blade to the next in hardness, brittleness and the ability of the manufacturer to give a truly sharp cutting edge. A variety of blades may have to be tried before finding one suitable for your particular purposes or animal. In general I have found the stainless steel varieties do not have cutting edges well suited to slicing thru an exoskeleton. The best in my experience is the Gillette-Platinum Plus[R] blades. A pair of small sharp tin-snips and a pair of small needle-nose pliers are also necessary. Each razor blade is first cut into quarter sections as shown (Fig. 1). Each quarter is then trimmed as shown (Fig. 2). It will be

---

[1]Received June 29, 1979.

[2]Mention of particular commercial products does not constitute endorsement by the University of Minnesota or its staff or students.

[3]Paper No. 10,858 Scientific Journal Series. Mn. Agric. Expt. Stn., St. Paul 55108. Received for publication. NIH Grant No. A1-09559.

[4]Department of Entomology, Fisheries and Wildlife, University of Minnesota, St. Paul, NM. 55108.

impossible to trim the blade to a sharp point. Wax or grease put on the blade during manufacturing must be removed by soaking in chloroform or xylene. The resulting blade is then inserted into the Xacto knife blade holder. The cutting edge of the blade should be set at an angle to the knife handle so that when held in the hand the cutting edge is roughly parallel to the bottom of the dissecting dish (Fig. 3). The terminal end of the blade will be curved. The curve can be removed by gently bending the blade in the opposite direction with the needle-nosed pliers. The blade should not be gripped tightly with the pliers but only held loosely to avoid unnecessary bending. The edges cut by the tin snips will be quite ragged especially when viewed under a dissection microscope. A method to smooth the ragged edges will be described later. The final result is a dissection knife that is easily used, well balanced and has a supply of thin disposable high quality blades at low cost.

The second knife is more complicated to construct and requires a 1 cc. Tuberculin syringe, an 18 gauge metal hypodermic needle, a common sewing needle large enough in diameter to fit the opening of the 18 gauge hypodermic and a small Apollo^{R} Ceramic sharpening stone available from Arkansas Abrasive, Inc. Hot Springs, Ark. You will also need a pair of wire cutters. Carborundum and Hard Arkansas sharpening stones are not suitable. To construct this knife, the plunger is pulled from the syringe and its rubber cap removed. The wide flange on the base of the syringe is removed and discarded (Fig. 4a). A sewing needle is heated at the needles eye, and while hot, stuck into the tip of the plastic plunger of the syringe (Fig. 4b). The needle and plunger should be straight. When the needle has cooled, the rubber cap is forced down over the needle and onto its former position on the plunger (Fig. 4c). The assembled plunger and needle are then reinserted into the tube of the syringe. The needle should extend thru the terminal hole of the syringe (Fig. 4d).

Next, take the hypodermic needle and remove all but 3-4 mm by clipping it with wire cutters (Fig. 4e). The closed end of the needle is opened by grinding away the stump perpendicularly on the sharpening stone. The hypodermic base is then inserted onto the needle and syringe (Fig. 4f). The projecting point of the sewing needle can then be ground into a small knife suitable for the type of dissection you wish. It is best to make a dozen or so of these at once so that a variety of knife shapes will help insure that a sharp one is usually available. When the needle knife is extended, the hypodermic needle base supports the base of the needle. After the knife is used on a dissection, the syringe plunger can be pulled just far enough to withdraw the point of the knife into the tube of the hypodermic needle where its point and cutting edge are protected from abuse (Fig. 4h). Knives constructed in this fashion last for years provided they are not dropped on their points or otherwise abused.

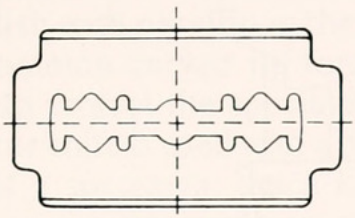


Fig. 1

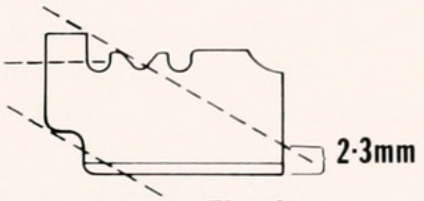


Fig. 2

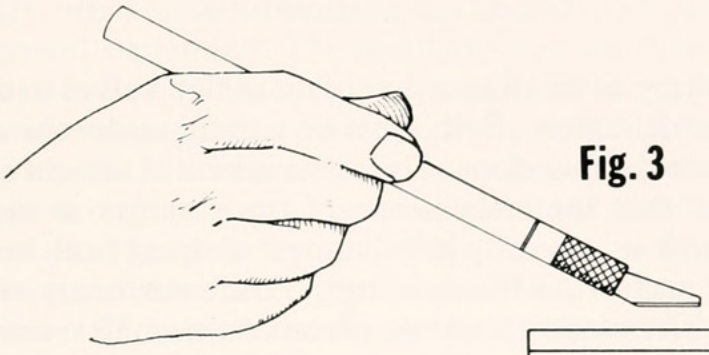
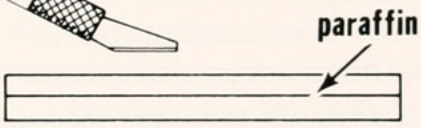


Fig. 3



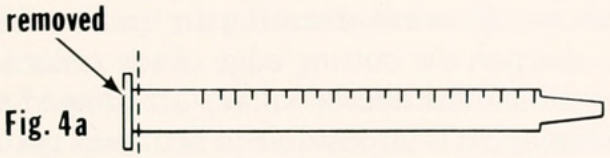


Fig. 4a

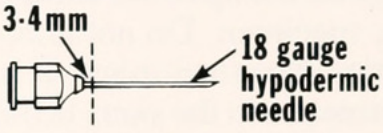


Fig. 4e

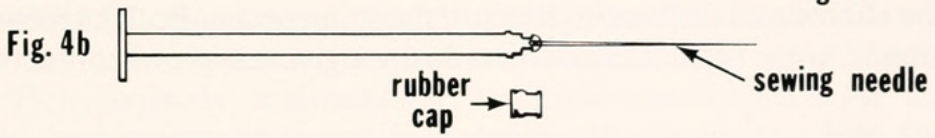


Fig. 4b

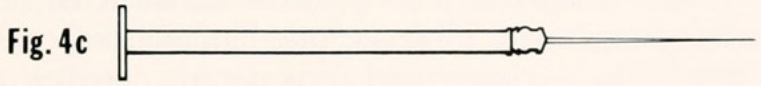


Fig. 4c

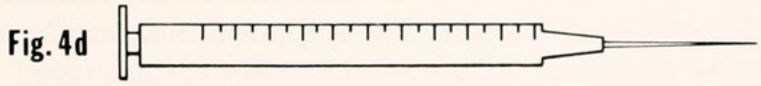


Fig. 4d

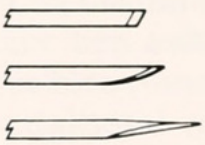


Fig. 4g

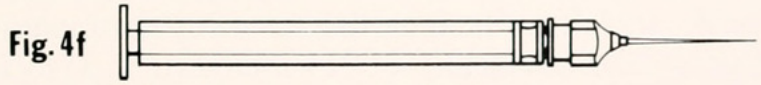


Fig. 4f

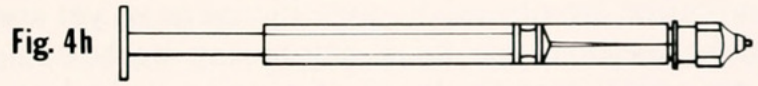
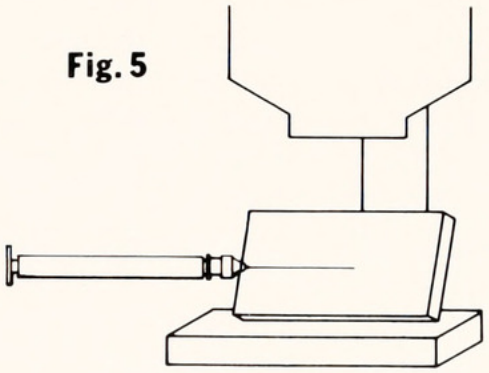


Fig. 4h

Fig. 5



Grinding something as small as either of these two knives to the proper shape must be done delicately. Both must be ground under the dissecting microscope on the sharpening stone. The stone is held at a slight angle from vertical (Fig. 5) so that the steep slope of the stone is in view in the microscope. The trick to carefully grinding and shaping both knives is to slide the stone back and forth while holding the knife stationary and in view in the microscope. The stone should be placed on a small tissue to avoid scratching the microscope stage. The razor knife should have the ragged edge on the tip of the blade ground smooth to avoid tearing the tissues within the specimen. Do not attempt to sharpen the cutting edge of the razor to a better edge than it has. It is impossible. The needle knives are shaped and sharpened in the same fashion. Although it is impossible to fashion a cutting edge on the needle knives as sharp as that on the razor blade, the needle knives can be sharpened well enough to suit most purposes. Both knives are held at about a 5° angle to the stone with only enough pressure to contact the stone.

The third tool is a simple inexpensive probe. It is constructed from disposable 1 cc Tuberculin syringes with 27 gauge, one-half inch disposable needles and minuten pins. The syringes and hypodermic needles are generally sold as allergy or diabetic syringes. The probe is easily constructed by inserting a minuten pin into the end of the hypodermic needle and crimping it in place with a pair of pliers in the manner described by Galbreath and Galbreath (1977). Several should be prepared at once.

Discussion

These two knives and probe are obviously quite inexpensive yet are of sufficient quality to make them usable on a day-to-day basis without excessive costs. They are also within the limits of a student's budget.

Consistent high quality dissections can be easily prepared by first injecting and flushing the specimen with a formalin fixative. The specimen should remain in the fixative a few hours (with shaking) and then rinsed and stored in ethanol before dissection or histological sectioning. To protect the

cutting edges of the knives and the points of forceps, all work should be done in a Petri dish with paraffin in the bottom. Specimens are most easily held with the common curved tip forceps. Small cavities scooped out of the paraffin help protect the specimen from distortion and crushing.

The razor knife is used with a back and forth slicing motion anywhere on the body of a specimen, much like carving a turkey. I commonly make sagittal or parasagittal sections of the entire body of an arthropod with relatively little distortion or crushing of the body and internal anatomy. Obviously, other dissection planes can be had to see any particular aspect of the arthropod's anatomy. The needle knives are then used to dissect away overlying muscles, sclerites or other tissues covering particular organs. The probes are used mainly as pointers or to position specimens or dissections for further work. Bending the point into a hook and using the hook to dissect specimens or organs from a specimen results in messy dissections with torn unclear edges. Muscle insertions and ligaments between sclerities and other organ placements are often torn loose. These knives are also of use to the taxonomist and systematist for genetalic dissections. The genitalia are either cleanly sliced from the abdomen with the razor knife or the articulating membranes between segments can be sliced thru with the needle knives.

Another aspect of considerable importance is dissecting small animals is the relative hydration and dehydration of the body of the specimen. Dissections are best done in ethanol. However, quite hard specimens are easier to slice and dissect apart in 30% ethanol than in 80% or 95% ethanol. Soaking the specimen in higher concentrations of ethanol temporarily stiffens the body, and makes very soft specimens such as larvae much easier to slice open and dissect. This also applies to museum specimens about to have their genitalia removed for taxonomic examination. Relax the specimens in a humidor as you normally would but then place them for a day in a humidor containing 80% ethanol. Remove them from the humidor and do the dissection immediately since they will dry out very quickly.

Relatively few books on microscopical technique give adequate instructions on tools for dissections either for anatomic examination or for organ preparation prior to histological sectioning. Kennedy (1932), McClung (1937), Eltringham (1930) Kingbury and Johannsen (1972) and many other such texts all describe a variety of tools, but in most cases the knives they describe are too large or too thick and bulky to be of use. Other texts such as Peterson (1964) usually assume that high quality scalpels and other dissection instruments are readily available. In most cases they are, provided one has the money - something with which most arthropod morphologists, systematists and histologists are not overly endowed. The two knives described here are sufficiently sharp and thin that dissections can be routinely and easily made.

ACKNOWLEDGEMENTS

Dr's. A. Glenn Richards, H.M. Kulman, and E.F. Cook are gratefully acknowledged for reviewing this manuscript.

BIBLIOGRAPHY

Eltringham, H. 1930. Histological and Illustrative Methods for Entomologists. Oxford at the Clarendon Press. 132 pp.

Galbreath, R.A. and Galbreath, N.H. 1977. A Simple Method for Making Fine Dissecting Needles. Ent. News 88 (5&6) 143-4.

Kennedy, C.H. 1932. Methods for the Study of the Internal Anatomy of Insects. H.L. Hedrick. Columbus, Ohio. 103 pp.

Kingsbury, B.G. and Johannsen, O.A. 1927. Histological Technique. A Guide for Use in a Laboratory Course in Histology. John Wiley & Sons, Inc. New York. 142 pp.

McClung, C.E. Handbook of Microscopical Technique. Paul Hoeber, Inc. 698 pp.

Peterson, A. 1964. Entomological Techniques. How to Work with Insects. 10th edition. Edward Brothers, Inc. Ann Arbor, Mich. 435 pp.

ANNOUNCEMENTS

Beltsville Argicultural Research Center Symposium V, Biological Control In Crop Production -Science and Education Administration, Agricultural Research, Beltsville, MD May 18-21, 1980. Contact: E.M. Dougherty, Chairman, Publicity Committee, BARC Symposium V, Building 011A, Beltsville Agricultural Research Center - West, Beltsville, MD 10705.

The Society of Kentucky Lepidopterists is devoted to any aspect of interest in butterflies and moths. While the particular focus of the group is Kentucky, members from any part of the nation and world are welcome. Membership dues are $3.00 per year for regular members, and $1.50 per year for associate members. Associate members receive publications and participate in activities when they can, but do not hold office or vote on Society affairs. All members receive the newsletter of the Society, "Kentucky Lepidopterists," by first class mail on a quarterly basis. Other published items appear irregularly, including reprints of interesting articles long out of print. Send application and any inquires to: Dr. Charles V. Covell, Jr., Department of Biology, University of Louisville, Louisville, KY. 40208 U.S.A. Make checks payable to The Society of Kentucky Lepidopterists.