EMBEDMENT OF SPECIMENS IN CLEAR POLYESTER CASTINGS

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The plastic best known for embedment of biological specimens is poly (methyl methacrylate), trade-named "Plexiglas" (Rohm and Haas) or "Lucite" (du Pont), which is prepared by casting methyl methacrylate monomer. The castings have superlative optical properties, but the technique required is rather complex. The monomer must be washed free of inhibitor, a casting syrup must be prepared and degassed by vacuum, an oven (110–115° F.) is required to cure the castings, and final machining and buffing usually are required for planar surfaces because of the extensive shrinkage accompanying polymerization (Anonymous, 1960, Rohm and Haas Co.).

In contrast, the technique for embedment with polyesters is quite simple. Essentially, the procedure consists of building up the casting with a few successive layers of resin and allowing to cure overnight at room temperature. No heat is required, and if the proper mold is used no finishing operations are needed. Optical properties are not so excellent as those of Plexiglas but are still quite good.

MATERIALS AND APPARATUS

Chemical materials and sources are tabulated below.

Material	*Source*
Plaskon Polyester Resins PE-355 (preferably) or PE-370, and PE-375	Plastics Div., Allied Chem. Corp., P.O. Box 365, Morristown, New Jersey
PL-24 (promoter)	Same
Cobalt Octotate (12% Co)	Nuodex Div., Tenneco Chemicals, Inc., Box 242, Elizabeth, New Jersey
Lupersel DDM (60% methyl ethyl ketone peroxide in dimethyl phthalate)	Lucidol Div., Wallace and Tiernan, Inc., 1740 Military Rd., Buffalo, New York
Styrene (monomer grade)	Dow Chemical Co., Midland, Michigan

Small beakers or the like, glass stirring rods, and molds of some sort are required. A small syringe (e.g., 2 ml capacity) is convenient for dispensing the peroxide catalyst, but a calibrated eyedropper can be used. Appropriate balances are required, of course, for preparing the base mixture as detailed below. A supply of acetone is needed for clean-up of the equipment.

PREPARATION OF POLYESTER BASE

The base is prepared according to the following formulation.

Material	*Parts by Weight*
PE-355	700
PE-375	150
Cobalt Octoate	0.20
PL-24	0.40
Styrene	150

When PE-370 is used in place of PE-355 the PL-24 is reduced to 0.30 parts; in the present work PE-370 gave a very faint yellow tint to castings which in the same thickness (10 mm) were almost quite water-white with PE-355, and on this basis the latter resin is preferred. The above formulation is almost exactly that recommended in the polyester manufacturer's literature (Anonymous, no date, Plastics Div., Allied Chem. Corp.).

The cobalt octoate and PL-24, which are the promoters, are weighed out separately and washed into the mixture of resins with the styrene. Then the material is stirred well to obtain homogeneity.

The reason that two resins are used is that PE-355 (or PE-370) is a rigid resin, while PE-375 is a flexible resin and reduces brittleness in the casting. The additional styrene (the resin already contains a considerable amount) is to reduce viscosity so that air bubbles may escape more readily, and the promoters are needed to assist the catalyst (Lupersol DDM) in giving rapid room-temperature cure.

CASTING TECHNIQUE

For butterflies up to the body size of *Danaus plexippus* (L.) a casting thickness of about 12 mm is adequate, while greater thickness may be needed for heavy-bodied moths. The following examples will illustrate the method of casting.

1. *Petri Dish and Cover as Mold*

This method was used for all but two of the castings in the figure.

The inside of the cover of a Petri dish set (about 14.5 cm inside diameter; depth about 14 mm) was smeared with Johnson's J-Wax (cleaner/wax) and polished with tissue; the object was to clean the glass and leave an imperceptible layer of wax, which can cause a cloudy casting if present in visible amounts. The bottom of the Petri dish itself also was cleaned with the wax for use later in the procedure.

At zero time, 0.30 ml of catalyst (Lupersol DDM) was injected from a 2 ml syringe onto the surface of 55 ml base (using PE-355) in a small beaker, and the mixture was immediately stirred rapidly with a glass rod for 15 seconds. With no delay, the catalyzed base was poured into the Petri dish cover. The several milliliters remaining in the beaker were washed out with acetone and discarded, and the cleaned beaker and rod were set aside for the next step. The beaker had been marked at 55 ml so that the base could be measured directly into it.

Note that by 6 minutes the air bubbles in the resin usually have risen and broken. Any remaining bubbles may be teased off to the side of the dish with a pin.

At 22 minutes, the first portion of catalyzed base had gelled (did not flow when the dish was tilted), and a second batch was catalyzed and poured. At 26 minutes the bubbles had broken or been teased off to the side, and the specimens (*Heliconius charitonius* (L.) and *Danaus gillippus berenice* (Cramer)), taken from a Riker mount, were dipped in styrene (to prevent entrapment of bubbles by interfacial tension) and placed (at 26 to 28 minutes) in the syrupy liquid UPSIDE DOWN by grasping the underside of the thorax with forceps and forcing the insect down to the gelled layer.

Bubbles trapped under the wings may be worked out by sliding the specimen to one side and teasing out the bubbles with a pin if near the margin.

At 45 minutes the third batch was poured, and at 65 minutes a fourth batch was poured.

At 96 minutes the fifth and final batch was poured, and at 102 minutes the Petri dish itself, which is slightly smaller in diameter than the cover, was placed bottom down by dipping the edge in the still-liquid material near the edge of the mold and slowly lowering it so that the air-liquid interface ran slowly across the glass and the Petri dish finally was left floating on the liquid. Bubbles would have been trapped if the dish had been put down squarely. Some resin overflowed the mold, but no attempt to clean it up could be made at this point.

The assembly was left undisturbed at room temperature (70–75° F.) for 19 hours (from zero time), and then the glass was broken away by striking the edge of the casting with a steel tool handle. Finally, a hacksaw was used to cut away the tacky unprotected surface near the edge (air inhibits surface cure of the resin system), and the edge was filed fairly smooth. A hole for hanging was drilled in the 12 mm thick casting (No. 1 in the Figure).

It should be noted that the castings are advantageously cut and machined at 14–20 hours before they have cured completely and become more likely to crack on mechanical strain. In finishing, it must be remembered that the surface is relatively easily scratched and must be carefully protected.

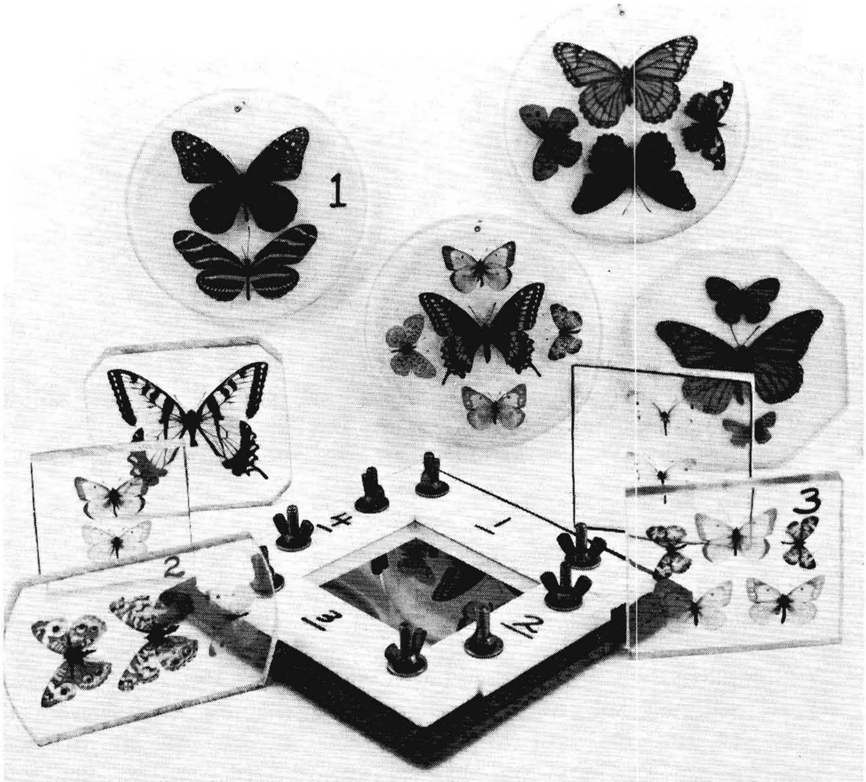

Figure 1.

2. Petri Dish Cover as Mold with Plastic Film to Cover Resin Surface

The first part of the procedure was similar to the above. The second batch was poured at 21 minutes, the specimens (*Colias eurytheme* (Boisduval), male and female) were placed at 27 to 29 minutes, the third batch was poured at 41 minutes, and the fourth batch, only 20 ml of which was used, was poured at 71 minutes. At 78 minutes, an Aclar film (Gen. Chem. Div., Allied Chem. Corp.) of 0.005 inch thickness was laid on the surface (starting at one edge), and bubbles were squeezed out by pressing down on the film. At 14 hours from zero time the film was peeled off easily to leave an excellent plastic surface. Then the glass was broken away, and a square containing the two specimens (No. 2 in the Figure) was hacksawed from the casting. The thickness in this case was 9 mm.

3. *Specially Designed Mold*

The mold is shown in the Figure and consisted of 10 mm thick Teflon (du Pont) pieces bolted to a piece of composition board. A chrome-plated steel (ferrotype) plate covered the bottom of the mold cavity, which measured 9.1 × 10.7 cm. The Teflon strips were numbered to ensure correct assembly.

A casting (10 mm thick) made with this mold is shown at the right of the mold (No. 3) in the Figure. PE-370 was used in the formulation, and each batch consisted of 37 ml base and 0.20 ml catalyst. The second batch was poured at 20 minutes, the specimens, which had been soaked in styrene for 30 minutes, were placed at 27 to 31 minutes, the third batch was poured at 43 minutes, and the fourth batch (only 12 ml used) was poured at 73 minutes. An Aclar film was laid on the surface at 79 minutes, bubbles were squeezed out, and the assembly was left for 13 hours from zero time.

The casting was removed with great ease, and no finishing was required except for a minute of sanding to remove a little "flash" at the edge.

Cyasorb UV-9 (Am. Cyanamid Co.) is recommended for protection against sunlight (Anonymous, no date, Plastics Div., Allied Chem. Corp.), but when this was used at the specified 3.0 parts (per 700 parts PE-370, etc.) in a casting similar to the above a noticeable yellow tint resulted. If castings are to be kept out of direct sunlight this additive is unnecessary.

Discussion

The only deficiencies in the castings prepared as described above were occasional small bubbles and in some cases an effect which appeared as incomplete wetting at the basal areas of the wings and which developed during cure. Fortunately, the latter effect becomes invisible when the casting is viewed against a white background. Soaking the specimens in styrene for 30 minutes instead of merely dipping them seemed to reduce the occurrence of this condition.

The back surfaces of the castings may be painted with white lacquer if a permanent white background is desired. This was done in the case of the octagonal casting in the Figure.

In conclusion, a peculiarity of embedded specimens is that their wings are permanently "wetted" and transparent. Eliminating the styrene dip, incidentally, does not prevent this. The effect is like that obtained by the old technique of wetting the wings with chloroform or some other solvent to disclose the venation momentarily (Holland, 1931: 15). In the case of *Vanessa virginiensis* (Drury), whose upper and under side patterns differ considerably, the result is a combination of the two patterns whether viewed from above or below. Despite this effect, however, the species embedded did tend to be easily recognizable, as the Figure shows.

Admittedly, embedment is an undesirable method of preservation for specimens of particular importance not only because the insects are beyond retrieval for dissection but also because of the unnatural transparent appearance described above. However, embedded specimens are permanently protected from accidental breakage and pests and are decorative objects as well as excellent classroom displays to accompany the identification. Embedment may be useful when (1) a permanent view of the venation is desired, especially in relation to pattern (an advantage not afforded when the scales are scraped away to display the veins) and (2) the spatial relationship of upper side vs. under side wing patterns is of interest.

LITERATURE CITED

ANONYMOUS, no date. Transparent casting with "Plaskon" polyester resins; data sheet by Plastics Div., Allied Chem. Corp., P.O. Box 365, Morristown, New Jersey.

ANONYMOUS, 1960. Embedding specimens in methacrylate resins; brochure, SP-46 by Rohm and Haas Co., Special Products Department, Washington Square, Philadelphia 5, Penn.

HOLLAND, W. J., 1931. The Butterfly Book. Doubleday and Co., Inc., Garden City, New York.

A NEW PORTABLE BLACK LIGHT

A new portable fluorescent lantern, the Safari Lite, has recently been marketed by the Burgess Battery Company. Although the lantern is sold with an 8 watt "white" light fluorescent tube, it will accept a standard 8 watt BL tube, and appears to be the first truly portable power source for black light collecting.

The Safari Lite operates on either two 69 volt D.C. dry cell batteries or 110 volt A.C. The battery life is claimed to be 100 hrs. The total weight of lantern and batteries is only 9 lbs. The retail price of the lantern with batteries is about \$30.00. However, the unit is generally available at discount stores for under \$20.00. Replacement batteries can be purchased for about \$6.00/pr which makes the cost of operation about 6¢/hr.

It is necessary to remove the plastic shield from the lantern for black light operation in order to avoid filtering the u.v. light. It is probably also desirable to remove the reflector from the lantern to allow 180 degree broadcast by the bulb. With relatively simple modifications it is also possible to use the Safari Lite as a separate "power pack" to operate a 6 watt or 8 watt BL bulb in a trap.

The advantages in cost and convenience of this new black light source over the cumbersome and inconvenient "portable" paraphernalia heretofore available are obvious. The only limitation appears to be in the restricted bulb size that can be operated by the unit.—JOHN H. HESSEL, *6655 Calle de San Alberto, Tucson, Arizona.*