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# Conservation of Flood Damaged Birdwing Butterflies.

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**Background**

During the summer of 2000, a water pipe running above Harrow School's Lepidoptera collection burst and led to flooding. Four drawers of post-display Oriental/Australian butterflies that were waiting to be put away, were exposed to the full effects of the downpour; the drawers were completely saturated. Fortunately, the wooden cabinets that housed the rest of the collection prevented more widespread damage. The damage was discovered within 2 days of the incident and dehumidifiers were installed within the following 36 hours. Mould began appearing on the specimens after about a week. Once the specimens and drawers had dried out, they were presented for conservation.

**Introduction**

The damaged specimens belong to the butterfly family Papilionidae, genus Ornithoptera (Birdwings) and are approximately 80 years old. These large robust butterflies vary in wingspan from 17cm down to 9cm. In total 22 specimens were affected, ranging from those where the wings had just 'relaxed' to specimens that had become stuck to the base of the drawer. This adhesion was due to the reactivation of glue used to affix the lining paper, or in some instances the gumming effect of re-softened paint that had been applied to the drawer bases in the past. Mould that had grown on both the specimens and their labels was a further problem. A few specimens also had structural damage, for instance a detached wing or abdomen (Fig. 1).

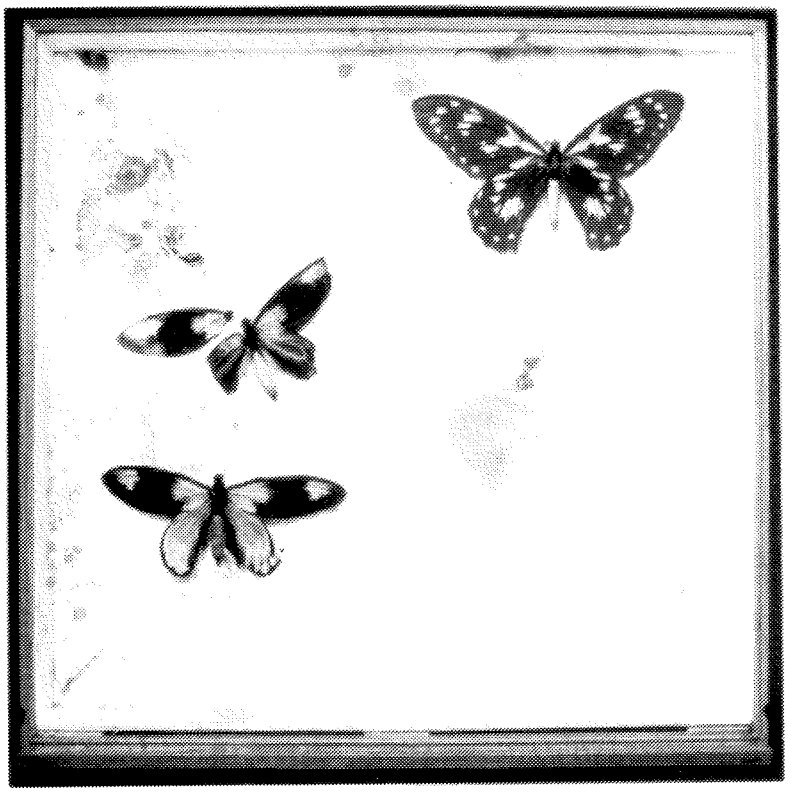


Figure 1. Drawer in original state before conservation.

Closer examination revealed that some of the specimens had been conserved in the past. Earlier remedial measures had involved either re-pinning or wing repair accompanied by painting to conceal damage.

All the specimens had to be taken from the drawers, cleaned to remove the mould, re-pinned, re-set and repaired, before they could be correctly identified and re-curated back into the refurbished drawers.

Conservation Strategy

All the drawers were bagged and frozen for 72 hours at -30 °C. This was done for two reasons - firstly to kill any insect pests that might be present, and secondly to help kill off the active mould. Freezing can kill off some of dormant conidia but not all. Only when the drawers had returned to room temperature was it safe to remove them from the bags. The specimens were then extracted. In some cases this involved dampening those parts, usually the wing tips, that had adhered to the base of the drawer. Dampening was achieved using distilled water and a fine paintbrush, size 00, and then using the same brush, easing the wing away from the base. In a couple of instances the adhesion was so great that the top layer of the base had to be carefully cut away from the drawer. This layer was then soaked with water and gently peeled away from the specimen piece by piece, using a pair of fine forceps and the paintbrush for support. Moisture application was kept to a minimum, particularly in areas that had mould, as it may become activated.

One set of data labels was also stuck to the base. Again these were moistened (checking first that the ink was waterproof) and gently lifted. These were dried out between two pieces of mounting board interleaved with pieces of Glassine paper to prevent adhesion, this was all held together with bulldog clips. Through all stages, great care was taken to ensure that specimens did not become disassociated from any data labels. The drawers were then free to be refurbished.

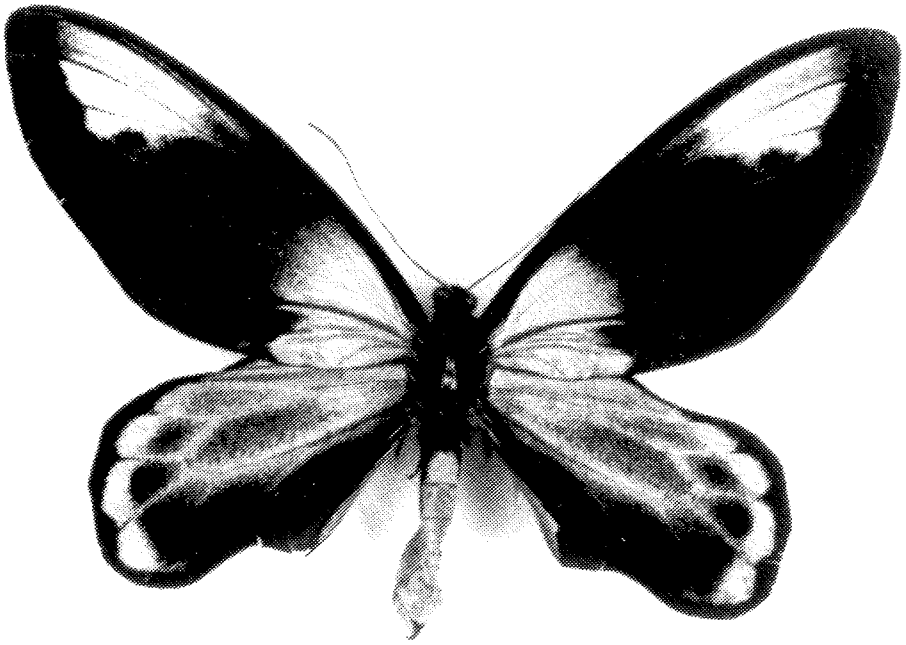
Mould

In elementary terms, the visible mould seen on the surface of an object consists of a mass of hyphae that cover and penetrate the object; this mass is called the mycelium or vegetative body. The hyphae produce enzymes that digest complex proteins, carbohydrates and fats from the object and turn them into simple amino acids, simple sugars and fatty acids. The dusty surface of the mycelia consists of conidia or spores which lie dormant awaiting a suitable environment, usually a damp or wet surface, so that they can germinate and produce new mycelia. Although the mycelia can be killed using a variety of methods, the dormant conidia are very difficult to kill and can easily become airborne so contaminating the surrounding area.

The task of removing mould should be carried out using a positive-pressure fume hood and should not be done by anyone who suffers from allergies or asthma. After treatment the area should be sterilised by swabbing down using 70% alcohol; the used swabs should be disposed of carefully (Florian 1997).

In removing the mould, the use of chemicals was kept to a minimum. The dry mould was removed from the wings by gentle brushing with a dry fine sable paintbrush size 00. A worn brush, which had shorter bristles, was the most effective. The initial strokes of the brush were in the direction of the scales with subsequent strokes gently across the scales, while gently blowing the mould away. Brushing had to be done very carefully so that the actual scales themselves were not damaged or loosened; this was checked using a microscope or hand lens (x10). The mould was removed from the long hair-like scales on the thorax and abdomen by agitating them with the brush and gently blowing, to lift the mould away. The legs and antenna required slightly different treatment. Where there were no scales, the mould tended to adhere more firmly to the cuticle. These areas were treated with the same brush, which had been dipped into 95% alcohol, and slightly more pressure was applied while brushing. In this way most of the mould was removed from the specimens. Although there were a couple of areas where staining had occurred at least most of the dead mycelia and as many dormant conidia as possible had been removed

Figure 2. Specimen coverd with mould
Figure 3. Specimen from Figure 2 after cleaning



(Figs 2 & 3).

Re-pinning and setting
Due to the distorted and unstable condition of the old pins, it was decided to re-pin all the specimens with new stainless steel pins. Most of the old pins had corroded producing either rust or verdigris and some were broken or bent. The specimens were relaxed by pinning them in an airtight box, with an absorbent material in the base to hold water; thymol crystals were used as an antifungal agent. The specimens were left in this box for between 48 and 72 hours depending on their size. The specimens had to relax sufficiently to restore movement in the basal wing joints and for thoracic muscles adhering to the pin to be softened. Specimens must not be allowed to become waterlogged. Not only does this damage the wing scales, in extreme cases the whole specimen can disintegrate due to the breakdown of tissue fibres. Each old pin was then carefully removed by slowly twisting as it was pulled upwards out of the thorax. In one or two cases the pins were so bent, it was necessary to remove the head by clipping so that the pin could be pulled through from below. To prevent further damage the new pins were placed in the original holes in the specimens. In some cases were the new pins where slightly loose, a small drop of glue was used to prevent the specimen spinning.

The specimens were then placed on to setting boards; these are made from a softwood and have a grove down the centre to take the abdomen. Once the wings had been positioned, they were held in place with glassine paper strips and pins (see Dickson, 1976, for full explanation of setting). In the case of specimens with particularly large wings, additional paper braces were used to re-enforce the glassine strips. The most difficult specimens to re-set were those that had been repaired with glue in the past; this prevented a full range of movement so the wings could not be placed in the correct position but as near to it as possible. The specimens dried quickly in about a week at room temperature as the RH was low (about 35%).

Repairs
Once the specimens were quite dry, it was safe to remove them from the setting boards for any necessary repairs. Seccotine glue was used as it dries clear and is soluble in water. This enables it to be thinned and also re-dissolved at any future date. Any legs or abdomens that had broken off were glued back on, as were the wings that had become detached. Either a setting board or additional strips of plastazote were used to support the wings in the correct position while the glue dried (Figs 4 & 5).

Traditionally, damaged wings are repaired with pieces of wing from other discarded specimens (not always of the same species). Indeed, this method had already been used on a number of these specimens. The damaged area had been trimmed back and an additional piece of wing glued in place. The disadvantage of this is the extra weight it produces particularly if the repair is at the tip of the wing; this causes extra stress to the wing attachments and to the area immediately surrounding the repair. Also getting hold of 'discarded' birdwings is not that easy! L2S Lens tissue (9 gsm) was used to give support to any large tears in the wings. This very light paper has long fibres that give it extra strength. The nature of the paper is such that when torn it forms a jagged edge that not only 'blends in' better but produces a stronger joint than would be formed by a straight edge. The lens tissue was secured using Secottine glue that had been greatly thinned down with distilled water (approximately 1 part glue to 6 parts water). Using a diluted solution of glue enables the tissue paper to absorb it more readily, forming a thinner bond in contact with the wing. The glue soaked tissue paper is applied to the damaged area ensuring that all the edges of the tissue paper are smoothed out and are in contact with the wing. The lens tissue was placed on the surface facing the base of the drawer, even on those specimens that had been set ventral side uppermost. No effort was made to conceal the repairs other than by using the minimum quantities of materials needed.

Curation
The final task was to lay out and label the

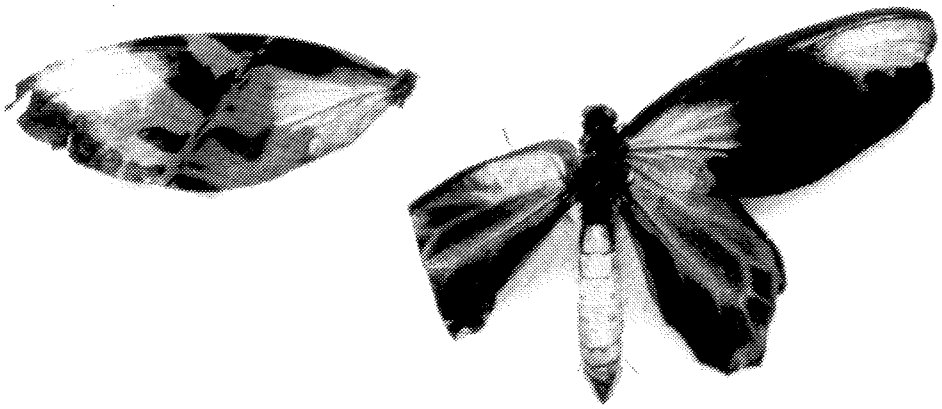
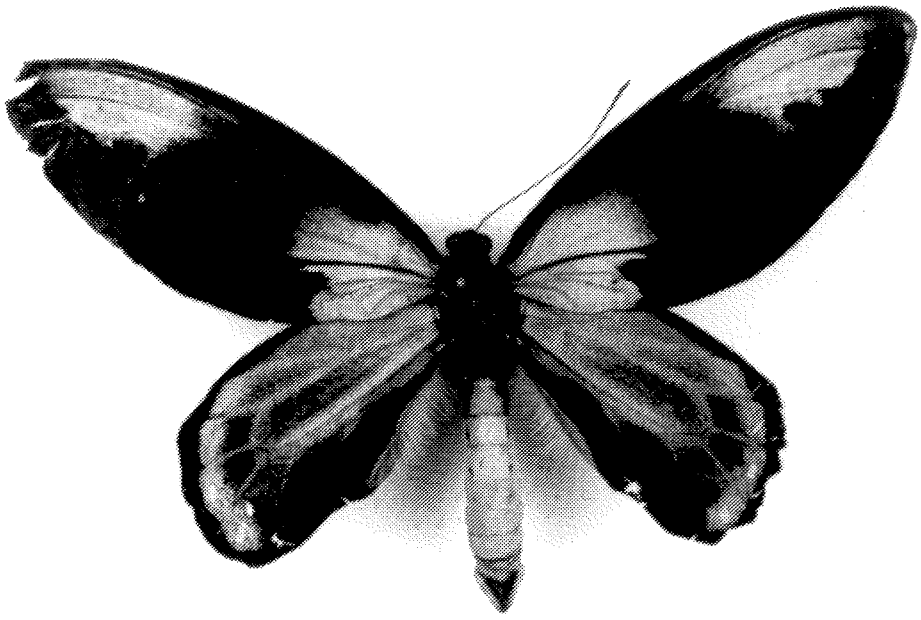


Figure 4. Specimen with damaged wings

Figure 5. Same specimen as in figure 4 after repairs



specimens following current nomenclature (d'Abrera 1990). This required determination of current names as many of the original labels within the drawers were out of date. Only a few of the specimens had locality data and most of that was insufficient to permit confident identification below species-level (Fig. 6).

Conclusion

These large birdwing butterflies withstood water damage quite well. Smaller, more delicate specimens would probably have disintegrated before any action could have been taken. The fact that they were fairly robust specimens also meant that handling and remedial work was relatively straightforward.

Freezing, once the specimens have dried out to reduce the risk of ice crystals forming, will kill hydrated or germinating conidia and vegetative growth but may not kill all dormant conidia. Removal of the visible mycelia helps to reduce the conidia population, it is impossible to remove them all and the dormant conidia can be easily activated by increases in humidity (60 - 70 %) and temperature (Florian 1997). The effects of fumigation usually only lasts about a month and many of the chemicals used are toxic and have to be used with care.

During the conservation work, the specimens were monitored regularly to check for re-growth of any mould. At the end of conservation, which was carried over a period of about 2 months there was no sign of any germination or vegetative growth. To prevent activation of the conidia in the future the specimens need to be kept in an environment that has a low RH and low temperature.

Materials used.

Glassine envelopes - BioQuip Products, Inc.

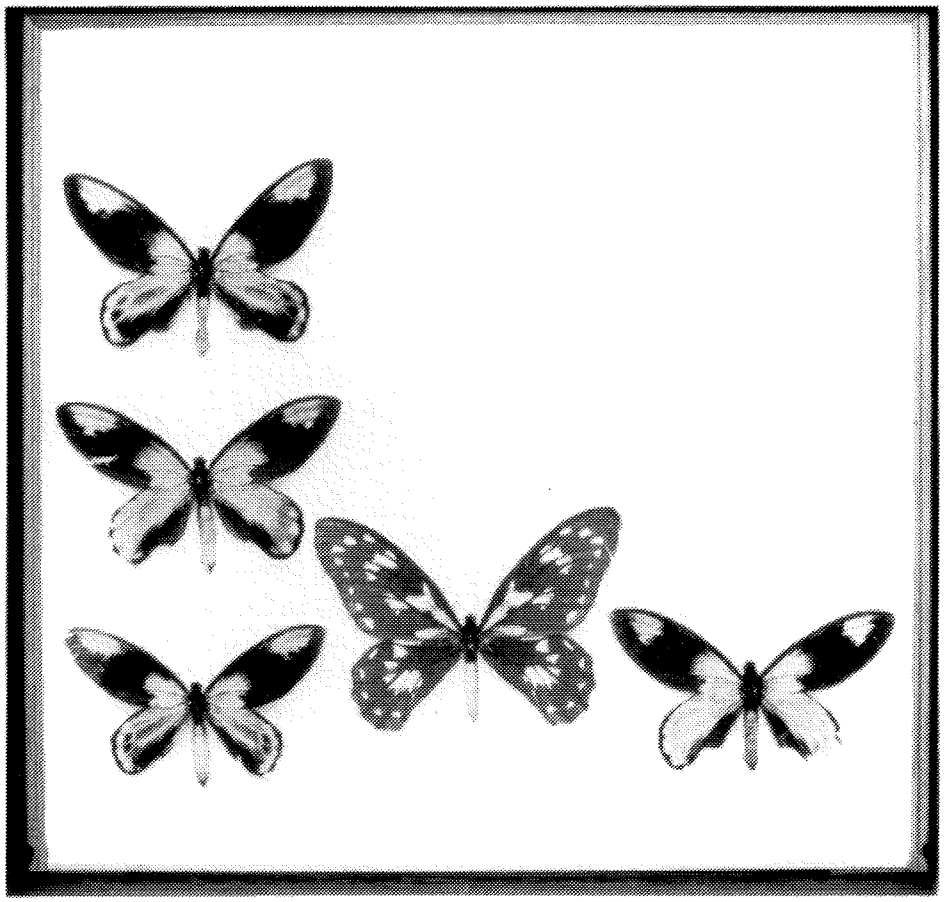


Figure 6. Drawer after conservation work completed