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Conservation of Insect Specimens Affected by Verdigris

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Abstract

The problem of verdigris growth in entomological collections is well known. This paper suggests various methods for treatment, including the use of a controlled electric current machine designed and constructed at the Natural History Museum, London.

Introduction

This paper is the product of a demonstration at the Annual NatSCA conference held at the Great North Museum: Hancock, Newcastle upon Tyne, on 2-3 March 2011. A literature search showed that there is little published information on the conservation of insect specimens affected by verdigris. Various expertise held within the Natural History Museum (NHM) was brought together to produce an assessment of the options and curatorial practices available for treating verdigris affected specimens. This paper focuses on the treatment of Lepidoptera (butterflies and moths) and Coleoptera (beetles) however, these treatments could be applied to other insect orders at the conservator's discretion.

What is verdigris?

According to the English Oxford Dictionary 1989, the name verdigris originates from the Old French word *vert-de-Grèce* (c. 1170), literally 'green of Greece', since it was used by Greek artists as a pigment for painting and other artistic crafting. Entomological verdigris however is a waxy green substance which forms at the contact between an insect specimen and its pin, probably as a reaction between the breakdown products of lipids from the insect body with copper and other reactive metals in the pin. Other corrosion products form with ferrous pins and at the point where brass or ferrous pins are inserted into cork drawer linings. The compositions of these substances are unknown to the authors but given the different chemical environment of entomological collections are not necessarily the same as the traditional fine art verdigris pigments.

Verdigris and dry insect specimens

When mounting insect specimens (either pinning or gluing the specimen to a pinned card) good quality stainless steel pins are essential as they are generally resistant to the known degenerative factors in entomological collections (recommended suppliers can be found at the end of the paper). Non-stainless steel pins corrode with time. Moreover if the pin is made of brass or any other alloy containing copper, verdigris can appear following complex chemical reactions between the chemical elements of the pins and the organic compounds in the insect body or in the cork or wood of the drawer. Older pins (pre-1920s) are sometimes made from carbon steel which means they may produce rust (for removing specimens from rusted pins follow the same process as described below).

Verdigris and other kinds of pin corrosion are still a serious problem in entomology collections in many Museums which hold old specimens. The use of stainless steel pins for insect mounting is a relatively recent practice, and in the past many insect specimens were mounted with pins made of nickel-plated brass, or non -stainless steel pins. This has caused and continues to cause verdigris where brass pins are in contact with insects, rusting of non-stainless steel pins and the formation of various minerals where the pin is in contact with the cork drawer lining (Figs 1-3). Pins corroded or 'trapped' by cork in old cork-based entomology drawers are a common problem encountered by entomology curators and should be treated with care. These problems are long term; however in modern collections where relative humidity and temperature are controlled and stable, the deterioration of pins is considerably retarded. The Natural History Museum's dry invertebrate collections are ideally kept in environmental conditions between 45-55 RH & 16-20°C.

Fig. 1. Unidentified mineral formation on a non-stainless steel pin (for the purpose of the photo, the specimen was removed from the original cork-based drawer).

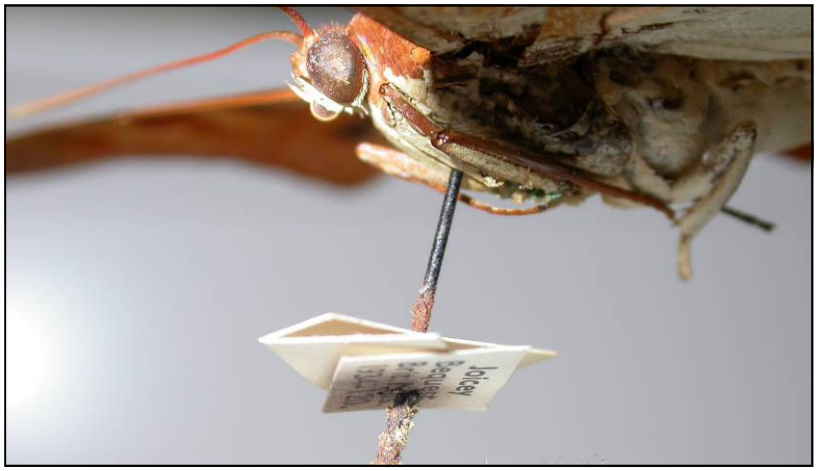

Fig. 2. Unidentified mineral formation on a non-stainless steel pin.

Fig. 3. Rust formation on non-stainless steel pins.

Lepidoptera and verdigris

In Lepidoptera, the species whose larvae are plant stem-borers, and those which don't feed as adults, appear particularly at risk of developing verdigris (Fig. 4). The degree of damage varies depending on the environmental conditions where the specimens are kept. If left to develop, verdigris can seriously damage a specimen; in severe cases the verdigris can develop to the point of being the only thing holding the specimen together (Fig. 5); when the pin eventually breaks, the specimen can fall apart, and in many cases is rendered irreparable (Fig. 6).

Fig. 4. Verdigris formation on a non-stainless steel pin and cross-pins around a castniid moth.

Fig. 5. A carpenter moth (Cossidae) severely affected by verdigris.

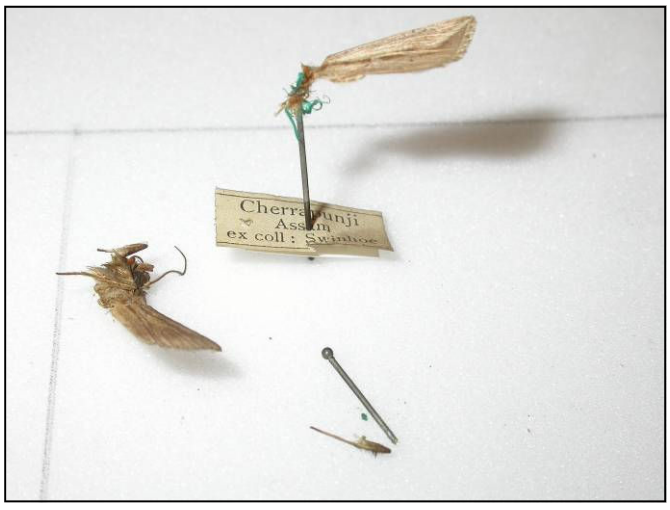

Fig. 6. Severely corroded pins can break, causing the specimen to fall apart.

For collections known to be in need of care

and maintenance, periodic inspections are advisable to evaluate the condition of the specimens. Pay particular attention to specimens housed in drawers with cork linings (Fig. 7-8). Specimens affected by verdigris can then be removed for an immediate or a future treatment; this depends on various factors, including the significance of the specimen (e.g. type specimens) the time available and the level of deterioration.

Fig. 7. Insect specimens housed in drawers with cork bases.

Fig. 8. Old entomology drawer with cork base.

When conservation of verdigris affected specimens is needed, the first conservation step is carefully to brush away the visible verdigris (using a fine soft brush) taking care not to detach any of the specimen's appendages. This is then followed by 'de-pinning' using a reliable and relatively simple method for removing the pin. By passing a low electric current through the pin, it will heat up just enough to soften the specimen's tissues where these have interacted with the brass core of the pin (see below). It is not advisable to 'relax' set Lepidoptera in order to de-pin them, as relaxation can damage a dry specimen further and cause DNA deterioration; besides this is a time consuming procedure given that one has to relax, re-pin and re-set each specimen.

SPECIMEN ASSESSMENT

Collections care

1. Is the specimen at immediate risk? If so, consider taking action as soon as practicable. For smaller entomological collections it may be possible to develop a spreadsheet of specimens at risk, assessed according to a scale of low to high priorities. (Fig. 9).
2. To comply with *SPECTRUM* documentation standards (Conservation & Collections Care http://

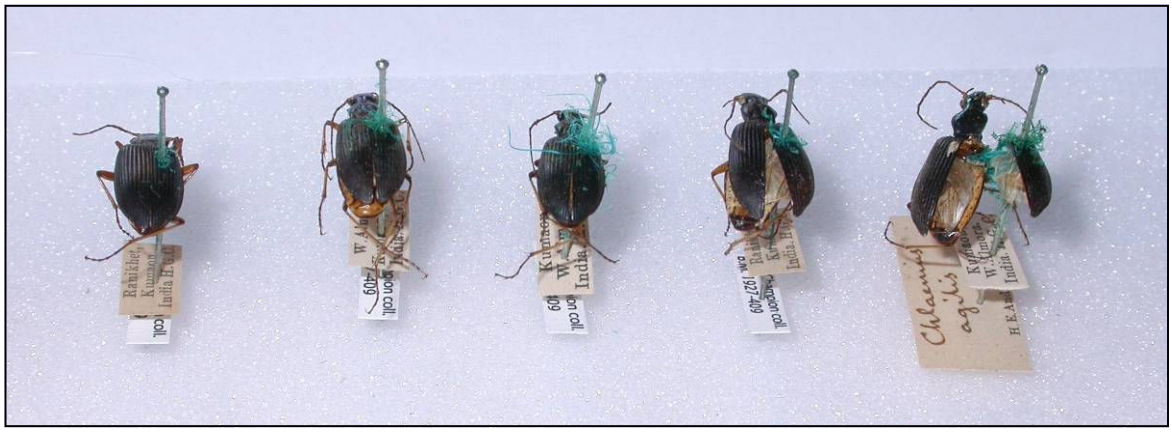

Fig. 9. Degrees of verdigris severity from left 1 – requires monitoring, to right 5 – requires immediate conservation.

www.collectionslink.org.uk/) it is recommended that conservation treatments are recorded on a database as a measure of collections enhancement as well as retaining relevant specimen level information. A specific time each year might be set aside to assess collections for verdigris.

3. For separate collections of historic or scientific value, consider carrying out a project to conserve the whole collection.

Assessment

Initial assessment of specimen:

1. How at risk of damage are the specimens or collection? Do they show the first signs of verdigris or is there the risk of complete disintegration of the specimen? Prioritise the work based on a risk factor: 1=low priority to 5=high priority (Fig. 9).
2. Pay particular attention to the non-stainless pins of carded specimens which need not be touching the specimen for verdigris to develop, because fats can seep from the body of the insect through the card, coming into contact with the pin (Fig. 10).
3. If a specimen is particularly fragile and positioned in a crowded or poorly curated drawer then it may be useful to remove some of the sound specimens around it to clear a 'way out' for your specimen (especially if it is likely to fall apart when moved).
4. Have a unit tray lined with high density expanded polyethylene foam (*Plastazote*) into which specimens may be pinned.
5. If specimens are moved from the original storage (drawer) indicate the location change with a data label and record specimen movement on a database (unless specimens are repaired immediately or one is working through an entire drawer). If there isn't time to take immediate action record the necessity for conservation on a database for future reference or mark the drawer or cabinet with a temporary label.
6. If the specimen is beyond repair and to attempt conservation would further damage it, then retain the pieces in a gelatine capsule, pinned through with the original data labels; or more preferably, glue component parts to a card in the general appearance of the original specimen (see dry method).
7. Add conservation data labels to repaired specimens for historical reference, particularly if the original pins are retained (and kept separately from the newly repaired specimen). This is particularly important for historical specimens where a new pin, while necessary, may appear incongruous.

N.B. Copper compounds can be poisonous and washing hands after dealing with verdigris is advisable.

Fig. 10. Verdigris creep resulting from lipids leached onto card mount, reaching the non-stainless steel pin base.

M E T H - ODS

The de-pinning machine

The de-pinning machine used at the NHM was designed and constructed many years ago, by Mr Deryck Jones, previously the Museum's electrical engineer. To our knowledge de-pinning machines of this kind are not available for purchase; however, with some electrical knowledge it would be possible to copy this design. The components of this specific de-pinning machine are: the electric element (rheostat) which is enclosed in a wooden box; a pair of forceps connected to the electric element and a small cylindrical metal post which completes the electric circuit via the pin; a switch found in the centre of the box regulates the amount of electrical current with two settings: high and low; the electrical current is turned on and off at the plug and indicated by a red light (Fig. 11). The de-pinning machine has successfully passed the recent (February 2011) portable appliance testing (PAT) and is consequently considered safe for use; however only trained curatorial staff is permitted to use the machine. The highest measure of electrical voltage and current that passes through the forceps connected to the electrical element is 7 V and 0.2 A respectively.

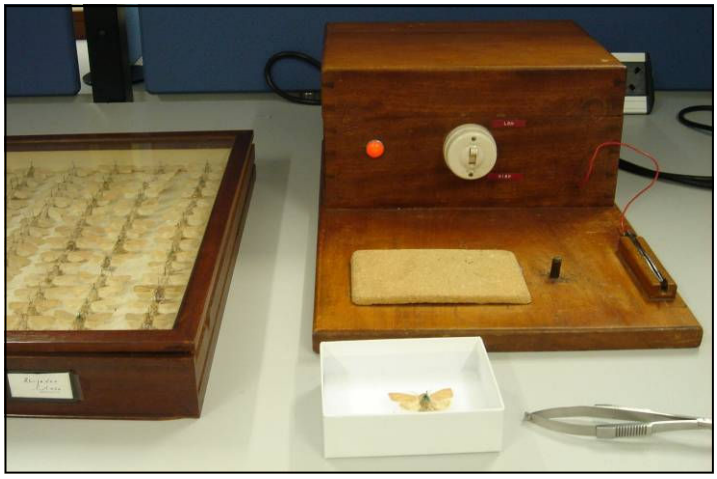

Fig. 11. The Natural History Museum de-pinning machine.

De-pinning a dry specimen is a relatively simple method but is dependant on the degree of deterioration of the specimen. The following procedure refers to lepidopteran specimens which have begun to show signs of verdigris development (Fig. 12).

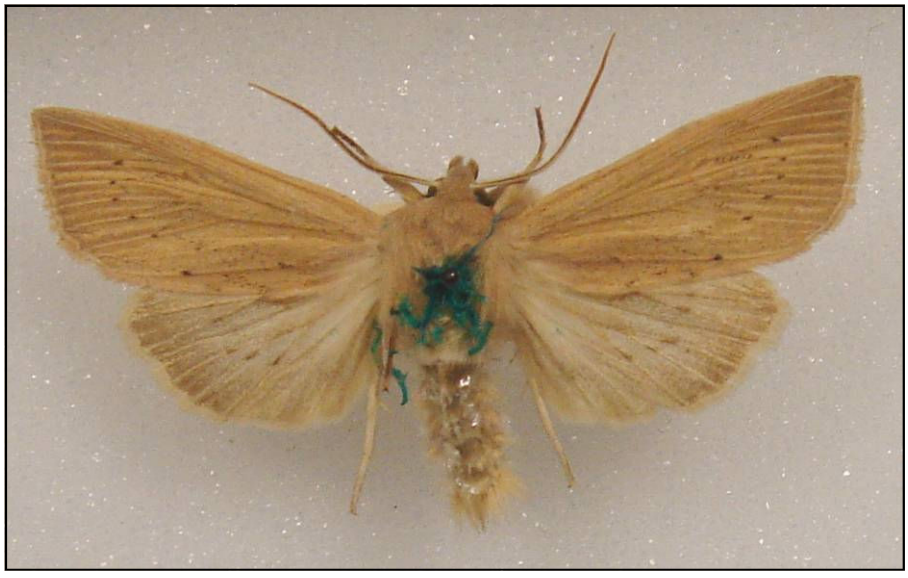

Fig. 12. Noctuid moth affected by verdigris. This specimen is about to be de-pinned.

1. Remove the labels from the specimen. With a fine brush carefully clean the verdigris from the specimen, taking care not to remove any scales or hairs (Fig. 13).

Fig. 13. Using a fine brush to carefully remove the verdigris from the specimen.

2. Using the forceps wired to the rheostat pick up the specimen and touch the point of the pin on the metal post (Fig. 14). The rheostat can regulate the amount of current passing through the pin; larger specimens may require a higher current whereas the lower setting is sufficient for smaller or more fragile specimens.

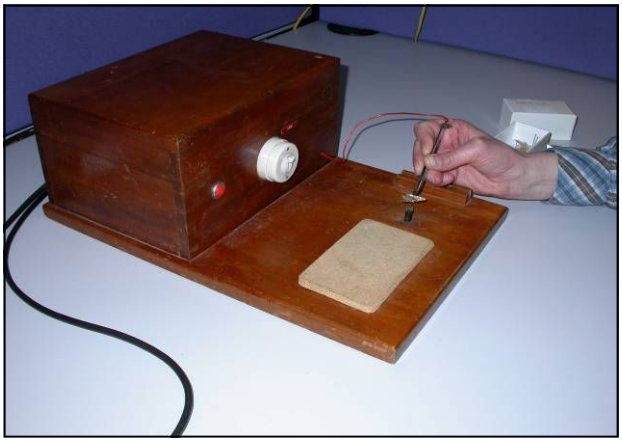

Fig. 14. Using the forceps to pick up the specimen and place the base of the pin onto the metal post.

3. Be aware that when the pin is in contact with the metal post some sparks may be seen at the contact between the pin and the post and smoke may come from the specimen where it touches the pin (due to heating of this part of the insect's body). This is a delicate process and the amount of heating should be regulated by closing and opening the electric circuit by alternately placing and withdrawing the pin from the metal post. There are reported cases of the specimen exploding at this stage, either because the electrical current may have been set too high or the pin was left too long in contact with the metal post. Gentle pressure should be applied to the specimen using fine forceps to test whether it is detaching from the pin. The specimen should slide down the pin after approximately 2-5 minutes depending on the specimen and degree of verdigris (Fig. 15).

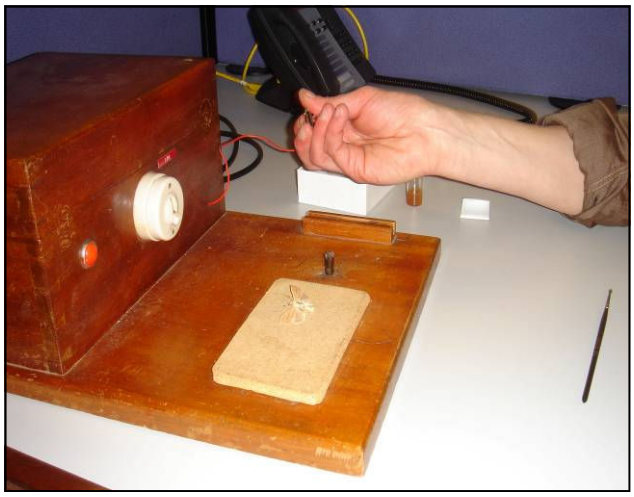

Fig. 15. Specimen successfully removed from the pin.

4. Place the de-pinned specimen into a unit tray lined with *Plastazote* and insert a new stainless steel pin into the existing hole. The pin should be a size or so bigger than the original to gain a secure grip between the specimen and the pin (Fig. 16). Avoid cleaning of the hole as this could further damage the specimen; moreover it is likely the hole is already rather large given that parts of the body are often corroded or displaced by the chemical reaction which formed the verdigris. Often it is necessary to place a drop of glue on the pin, underneath the specimen, to prevent it from slipping down. Once the specimen is re-pinned, replace its labels using a pinning stage and return to the drawer. Record the specimen conservation on a database.

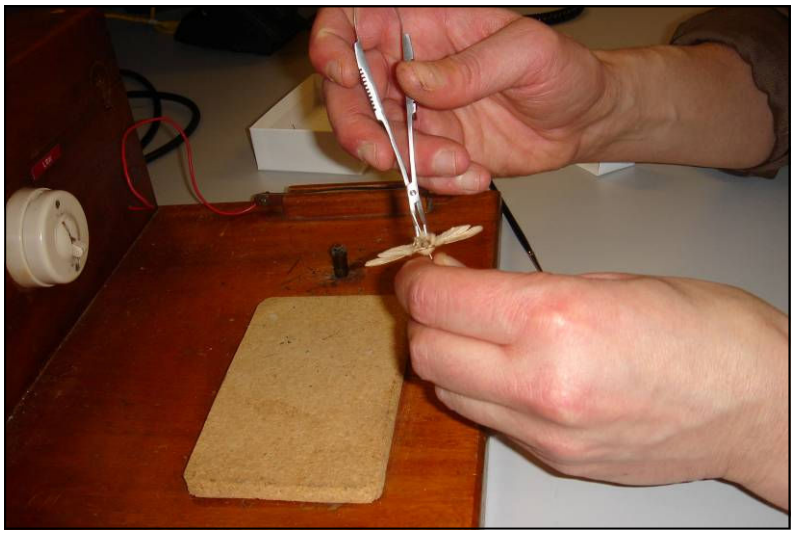

Fig. 16. Re-pinning the specimen with a stainless steel pin.

Wet method for pinned specimens (Not suitable for Lepidopteran specimens) (Fig. 17)

1. Following initial assessment remove the specimen from the drawer and place into a suitable receptacle. We recommend *Plastazote* lined unit trays.
2. Prepare a beaker of warm (c. 60-70°C) distilled water preferably using a hot-plate and *Pyrex* beaker.
3. Remove all data labels and retain in the original order for re-pinning later.
4. Pin the specimen to a cube of *Plastazote* and immerse it upside down in the beaker. The *Plastazote* acts as a float.
5. Check the specimen after a few minutes for any softening (the time will vary from specimen to specimen and from species to species). The softer bodied insects should be quicker (check after two minutes for progress using the technique described in the dry method).
6. Check the purchase of the specimen against the pin; if there is some looseness then the specimen should be carefully moved down the pin and placed onto absorbent tissue to mop up any excess moisture.
7. Assess whether re-pinning or carding is suitable once the specimen has been removed from its original pin. Some more delicate and softer bodied specimens such as Cantharidae (the Soldier beetles) are better carded even though they were originally pinned.
8. For re-pinning use a slightly thicker pin than the original pin to provide a better grip between the pin and the insect. If needed put a small drop of organic glue underneath between the pin and the insect for extra security.
9. For sticking the specimen to a card mount (if the specimen was originally pinned unsuitably) choose a card slightly bigger than the specimen and glue the specimen directly onto the card. Pin the card once the specimen is secure. If the specimen is not in a suitable position for gluing it must be relaxed. To do this, put the specimen in hot distilled water (up to 70°C) or a humidifying chamber with suitable antifungal chemical. The time taken depends on the age and size of the insect. Once the specimen is relaxed its appendages can be moved into a suitable position using a mounted needle and fine forceps.
10. When the specimen is dry and secure, re-pin the labels.

Fig. 17. Wet method of immersing a beetle in hot distilled water.

Dry method for pinned specimens

If the specimen is robust enough (e.g. scarab beetles such as chafers) it is possible to remove the pin and clean the specimen without immersing it in water.

1. Use a seeker or mounted needle along with a fine sable brush to carefully remove any verdigris.
2. Grasp the top of the pin with entomological forceps, carefully place fine forceps at the top of the specimen and push gently to see if the specimen will move down the pin. Carefully slide the specimen from its pin and gently remove the remaining verdigris from the specimen before re-pinning (this method is usually only suitable for the earliest stages of verdigris and for robust specimens). If the specimen cannot be removed this way, use the wet method above.
3. If the specimen has remained intact, re-pin it using a pin a size larger than the original (recommended insect pins come in many sizes, though 1-6 is preferred depending on the size of the specimen; source information can be found at the end of the paper). Replace data labels in the original order, using a pinning stage. It is best to keep the amount of pin holes in the labels to a minimum. If a label is too loose on the pin, then the hole can be closed up by turning the label over and rubbing the area immediately around the hole with a smooth polished metal object, such as the end of a pair of forceps.
4. If the specimen has broken into two or more pieces, where their orientation is certain, these can be glued together before re-pinning. If the specimen is in too many pieces to be consolidated, it can be glued to a card mount (maintaining the general habitus of the original specimen) or put in a gelatine capsule, retaining any data labels with the specimen.

Occasionally the pin will break inside the specimen. It is advisable to remove the remaining pin by pushing at it gently with another pin or mounted needle. At this stage it may be necessary to wet the specimen; this is particularly applicable to larger more chitinous specimens with very hard wing-cases.

For carded specimens

1. The brass pins of carded specimens can be subject to verdigris; the pin need not be touching the specimen for verdigris to develop, because fats can seep from the body of the insect through the card, coming into contact with the pin (Fig. 10). The resulting verdigris can damage the insect in the same manner as if it were pinned.

2. Remove the card from the pin with forceps and place the card on a *Plastazote* surface or pinning block (if suitable).
3. Clean away any remaining verdigris using a seeker needle and / or fine sable brush and re-pin the card using a suitable stainless steel pin, remembering to replace the data labels in the original order.

The pins of historic specimens and types should be retained as these can often tell us more about a collection.

Tools

- *Plastazote* for pinning specimens and as a float
- Watchmaker's forceps
- Spring-form forceps
- Fine blunt forceps
- Archival quality card for making data labels
- Water soluble glue such as *Seccotine* or PVA
- Stainless steel pins size 1-6 *Austerlitz* insect pins with nylon heads
- Unit trays lined with *Plastazote*
- *Excel* spreadsheet or database for recording conservation results
- Fine sable hair paintbrush
- *Pyrex* beaker, approx 250 ml capacity
- Distilled water
- Mounted needle
- Seeker needle
- Pinning block
- Bristol board or archival grade paper
- Pre-cut card mounts

Suppliers

- Entomoravia, http://entomoravia.eu/: *Austerlitz* insect pins size 1-6
- Entosphinx, http://www.entosphinx.cz/: General entomological supplies
- Druchema – Czech Republic, http://www.druchema.cz/cz/katalog/hobby/disperzni-lepidla/herkules-130g.html: *Erkules* Glue (water soluble)
- Watkins & Doncaster, http://www.watdon.co.uk: General entomological supplies
- Agar Scientific, http://www.agarscientific.com/catalogue/action_catalogue.asp?sat=2&saa=3: Gelatine capsules size 1-00
- Shepherds Falkiners archival supplies, http://store.falkiners.com/store/product/3563/Seccotine---150g/: *Seccotine* fish glue

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