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strongly suggested that the general dry collection should act as a quick visual catalogue of the entire collection, by including in it empty boxes in their correct systematic position with labels indicating that large, wet or type specimens are stored elsewhere.

5. References

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The Conservation of Molluscan Collections

All Collections are open to the 'Nine Agents of Decay' (cited in MGC 1998). These have been defined by the Canadian Conservation Institute (CCI) as:

1: Direct Physical Forces e.g. dropping; wearing away.

2: Security e.g. risk of theft; vandalism; displacement through poor collection management.

3: Fire

4: Water e.g. flood; leaking building; fire suppression.

5: Pests e.g. insects; vermin; moulds; microbes; children!

6: Contaminants e.g. atmospheric pollutants; liquids; solids.

7: Light especially visible and UV.

8: Temperature

9: Relative Humidity

Ideally the Collection Environment will protect the specimens from these agents of decay. The environment can be usefully divided into two main compartments;

- The Storage area; the macro-environment.
- The Storage Units housing the collection; the micro-environment.

Mollusc Collections tend to fall into two broad categories. Either dry shell collections or fluid preserved 'wet' collections. Parts of the same specimen can be in both collection types. This is where the shell has been separated from the soft animal parts. It is also possible to dry the whole animal, rehydrating the soft body parts with Decon 90 if required, a practise used at the Natural History Museum.

Dry Collections

Dry Mollusc Collections can have a number of characteristic conservation problems such as Bynes Disease (a white crystalline growth on the surface of the shell), Cracking and Exfoliation. These problems can have a variety of causes, such as;

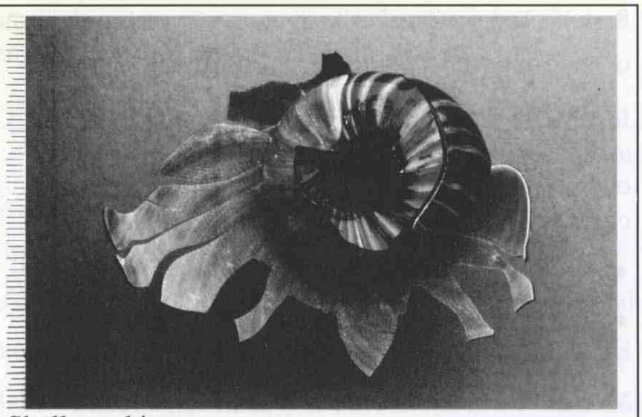
- Original preparation of the specimen.
- Subsequent remedial work.
- Neglect, poor custodial care.
- Environmental conditions; such as incorrect and/or fluctuating humidity and temperature; light – both visible and UV; Pollutants.
- Incorrect storage problems e.g. off-gassing from woods, MDF; decay of storage plastics; plasticisers in plastic clip bags migrating out and degrading.

Looking at some of the more specific problems associated with dry shell collections;

Bynes Disease (Tennant and Baird 1985; Von Endt et al 1996). Not a disease but a chemical reaction causing degradation of the shell;

- Characterised by a white or grey, water soluble crystalline efflorescence on the surface of the shell, which is usually a mix of calcium formate and calcium acetate.
- Affects mainly marine shells, but can be a problem in land shells (where its occurrence probably relates to the method of preparation).
- Caused by formic acid and acetic acid, off-gassing from storage furniture. The presence of hygroscopic salt residues in the shell is also considered to be contributory factor.

Shell cracking (Child and Buttler 1996)



Shell cracking

- Shells of some mollusca, mainly terrestrial and freshwater, have a tendency to crack and fragment in storage.

- Related to the physical and chemical shell structure. At its simplest level this consists of two main layers, the Periostracum (outer protein layer of conchiolin) and the inner mineral layer which is calcium carbonate based minerals such as calcite and aragonite. These two materials respond differently to changing temperatures and humidity

- Caused by a rapid drops in relative humidity which the elasticity of the shell cannot accommodate.

- Remember also that mechanical damage can occur from poor storage or handling.

Exfoliation; this is where the outer protein layer peels away from the mineral layer. Caused by low humidity levels from poor preparation or storage conditions (Child and Buttler 1996).

How do you reduce collection conservation problems?

Specimen Preparation; Ensure that the method of preparation is appropriate, and record any the processes and chemicals used with the specimen. Examples would be;

♦ Wash marine material in clean water to remove hygroscopic salts, and dry carefully.

♦ Avoid acids or alkalis, these will damage the protein layer of the shell.

♦ The use of ovens in drying is probably not a very good idea.....

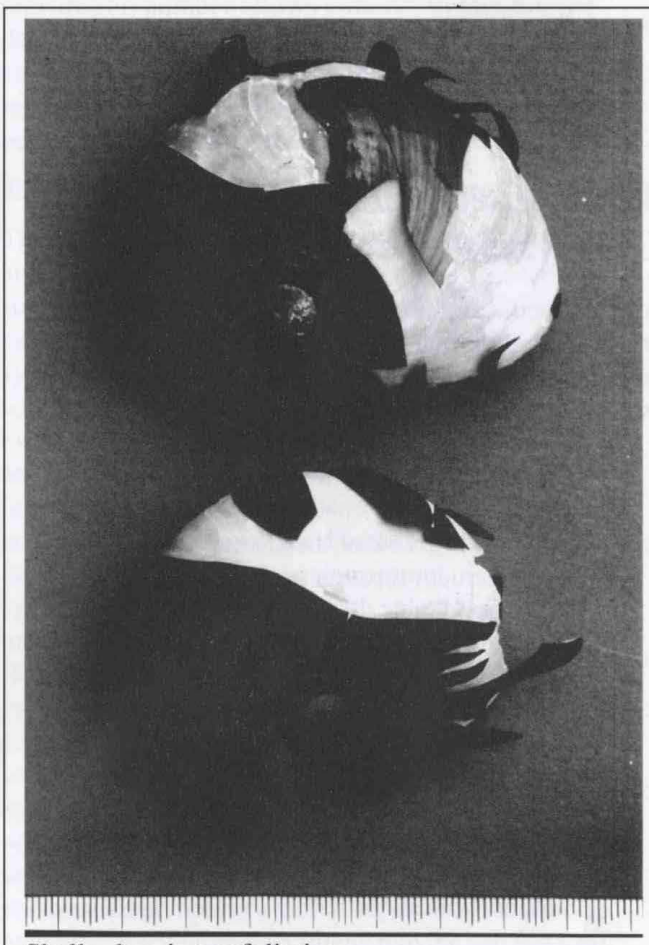
Control the Collection Environment; The macro-environment is usually the most difficult to control, requiring air conditioning systems, building work and lots of money! However on a smaller scale much practical work can be done e.g. draft sealing doors and windows; UV filters on lights and windows; pest monitoring controls. The micro-environment is more easy to control. Good storage will buffer humidity and temperature fluctuations; keep light and insects out; and secure valuable specimens.

Micro Climates and Anoxic Atmospheres. Specimens can be further protected at the storage level by the use of microclimates where the humidity is controlled through the use of conditioned silica gel (Buttler 1994). This can be further developed on by the use of anoxic atmospheres in which most of the oxygen is removed, preventing most chemical degradation reactions, as well providing a useful method of pest control (Burke, 1996).

Good collection environment should eradicate most of the potential conservation problems e.g. good storage furniture that does not off gas will prevent the occurrence of Byne's disease, and the prevention of sudden humidity drops should prevent cracking and exfoliation. Remember to take care when selecting new storage furniture and specimen housing materials. It is possible to assess the suitability of materials for display and storage. (e.g. see Lee and Thicket 1996).

However what if a specimen is decaying and needs conservation work?

♦ Bynes disease – brush off the surface salts. These are also water soluble and can be washed off, and some workers recommend washing the shell to remove hygroscopic salts. Subsequent care must be exhibited when drying the shell. Protective coatings should be only be considered as a last measure.



Shells showing exfoliation

♦ Cracking and exfoliation – broken pieces can be re-adhered if required. It is better to recommend using a weaker reversible consolidate such as Paraloid B72, rather than stronger glues such as epoxy resins. Badly exfoliating specimens can be protected with consolidates such as Paraloid B72 or Primal WS, although be aware these will alter the biochemistry of the specimen. It is not wise use materials such as Varnishes; Petroleum jellies; Linseed oil; Savlon.

Whilst these have been used with some success, these are variable compounds and alter the biochemistry of the material being treated. Think about a treatment before applying, and RECORD all treatments.

Fluid Preserved Collections

Important for the preservation of soft bodied molluscs, e.g. cephalopods, or the bodies of shelled specimens. The main methods used can be summarised as follows;

- Ethanol based preservation — flammability; high evaporation rate; tissue shrinkage. Addition of glycerol or propylene glycol can improve specimen flexibility and protect from evaporation.

- Formaldehyde preservation — needs to be buffered as acidity will dissolve shells if present; possible carcinogen; unpleasant to work with; aqueous based so less tissue shrinkage.

- Glycerol — used to protect shells prone to cracking etc. Messy to work with and difficult to remove.

For more information on fluid preservation the following references are of use – Horie 1989; Simmons 1995; Carter 1998; Moore 1999.

The container used to store a specimen, and the fluid preservative surrounding the specimen, constitute a micro-environment. Upon this will be the wider effects of the macro-environment – light; temperature; pollutants; handling. Key collection problems are a result of these external environmental interactions (e.g. see Horie 1994; van Dam 1997). These can cause problems such as fluid loss, loosening lids, warping of plastic storage jars and accelerated chemical degradation. Some key affects are:

- Temperature. Fluctuations in temperature can cause internal pressure changes in sealed jars. This can ultimately loosen the lid weakening the seal and allowing evaporation of the fluid.

- Relative humidity. Alcohol tends to evaporate from solutions faster than water causing a dilution of the fluid, although the lower the humidity the less this effect.

- Light and UV. Light damage is cumulative, and net exposure will determine the level of photochemical damage.

- Pollutants. Usually dust and grime although leaky jars will add to air pollution problems for workers in collection areas.

- Mechanical Stress. Brought about from environmental fluctuations, vibrations and poor handling.

- Oxygen. A well sealed container will act as an oxygen barrier. However if the seal is compromised oxidative degradation can occur.

The result is that fluid collections tend to require constant maintenance and monitoring to ensure the integrity of specimens. Some of the key requirements in maintaining and conserving fluid collections are;

- Identifying the preservative used, and monitoring the concentration levels. This is best done through monitoring density levels (see Moore 1994; Carter 1994; Simmons 1995).

- Topping up fluid levels and / or changing the preservative used. Care must be taken when deciding to change the preservative as the specimen and the fluid will have reached a chemical equilibrium . Changing the fluid will alter this equilibrium. The decision to change the fluid will be down to unsuitable preservative type or strength, or degradation of the specimen (usually indicated by condition of the specimen and unsuitable pH).

- Removal of deteriorated / dried out specimens for subsequent conservation work. Ensure that any work is correctly documented and that any labelling is stable in the fluid environment. (Pitkin 1995; Carter 1996).

- RECORD all treatments carried out on a specimen – you may know what you have done, but others in the future will not!

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"MOLLUSCA FOR THE MILLENNIUM"

LEEDS MUSEUM RESOURCE CENTRE MOLLUSCAN STORAGE AND DOCUMENTATION PROJECT.

The Leeds Museums and Galleries "Mollusca for the Millennium" project is funded by the Designation Challenge Fund, formally administered by the Museums and Galleries Commission M.G.C. now the Museum Libraries and Archives Council. This three-year project is designed to enable the service to develop the city's extensive world-wide shell collections.

The funding will enable us to:

- Install new roller racking to hold the shell collections
- Store the collection in scientific order
- Install a new networked computer system
- Upgrade the documentation of the collections from the present manual system
- Research and publish a series of papers on the collections, including

A catalogue of the type and figured material held in the collection

A register of the collection, range and content, by family, (or maybe even species).

- Help pay for extra staffing within the natural history department
- Help with travel and subsistence expenses
- Help research, develop and produce one or more exhibitions on mollusca

All of the above will help us to develop new, innovative methods, as well as alternative ways of using and displaying the shell collections in any future new museum development within the city.

MOLLUSCAN COLLECTIONS - LEEDS MUSEUM RESOURCE CENTRE

The Leeds Museums and Galleries hold a large number of shell collections, some of which are very well known and others not so well known. It is difficult to separate the more important collections as even the less well known collections have important material within them. Two major collections however, contain large numbers of type, figured and cited material. These are the collections of Sylvanus Charles Thorp Hanley (1819-1899) and Terence Eldon Crowley (1915-1999).

The collection of Sylvanus Charles Thorp Hanley, was originally housed in some 13 cabinets and over