# Natural History Collections Working Group Newsletter

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## Contents



## Coordinators Column

In October 2006 the Directory Board and the WG-Coordinators held their business meeting at the Getty Conservation Institute in LA. Also a delegation of the organizing committee, hosting the next Triennial conference in Delhi, was present. I want to thank our host for offering us their overwhelming hospitality. The meeting was very constructive, in which the challenging aims of promoting more interaction between the various disciplines as well as creating more awareness for the diversity in conservation issues throughout the world were the main topics.

One of the outcomes of the discussion was to create a more interactive website for the membership. Being also in line with our own WG programme, I proposed to set up a forum site that gives ICOM-CC members the unique opportunity to start discussions in their own Working Group as well as with members of other Working Groups on subjects that benefit from an interdisciplinary approach.
At the moment, a trial version of the forum site named WG-Interactions can be found on the web: http://icom-cc-wg.phpbb24.com/. Being for the moment the administrator of the forum site, please let me know if you have any constructive ideas, suggestions, comments, etc.

Finally, I hope you will all join the Delhi meeting in September 2008. As I have already mentioned before, this is my last term as coordinator, which means that in Delhi a new coordinator has to be installed. Please put forward possible candidates for election as soon as possible. Ideally, we want you to have the opportunity to choose between more candidates with various backgrounds in order to ensure that the future of our WG will be in good hands.

Dries van Dam

## Triennial Conferences (formerly called Triennial Meetings)

ICOM-CC organizes Triennial Conferences to bring together professionals from all over the world who are interested in conservation. The Meeting represents the apex of the triennial activity of the Committee and of its Working Groups.

Recent Triennial Conferences have been held in Copenhagen in 1984, Sydney in 1987, Dresden in 1990, Washington DC in 1993, Edinburgh in 1996, Lyon in 1999 and Rio de Janeiro in 2002. The last one was in The Hague in 2005.

### 15th Triennial Conference in New Delhi

The 15th Triennial Conference will be held from 22 - 26 September 2008 in New Delhi (India). Please see the ICOM-CC 2008 Triennial Conference website for more information: www.icom-cc2008.org.

Theme: Diversity in Heritage Conservation: Tradition, Innovation and Participation

The objective of the Triennial Conference is to present an overview of the current state of conservation research and practice through reports by the ICOM-CC Working Groups. Special attention will be given to papers and posters dealing with problems and progress in conservation in the region hosting the conference and to papers addressing the congress theme – "Diversity in Heritage Conservation: Tradition, Innovation and Participation".

### Getty Foundation For New Delhi 2008 Grants/bourses/becas ICOM-CC 2008- New Delhi - Sept 2008

(Full Text in English/ Texte en français/ Texto en Español)

"Grants for the ICOM-CC 15th Triennial Conference – New Delhi, India, 22-26 September 2008"

Thanks to The Getty Foundation, the International Council of Museums (ICOM) is able to offer a limited number of bursaries to museum and/or conservation professionals from low-income countries in Africa, Asia and the Pacific, Europe, and Latin America to attend the 15th Triennial Conference of ICOM's International Committee for Conservation (ICOM-CC).

## A Plea for More Friends

Dear participant,
Until now you have taken part in the activity of your working group through one or more of the following:

- Triennial conference of ICOM-CC
- Meeting of the working group at the conference
- Interim meeting
- Publication in the preprints
- Networking with other members of the working group
- Use of the ICOM-CC website
- Reading the newsletter

We would like to encourage you to join ICOM-CC. If you are not able to become a member of ICOM and support the organisation through your membership due to the regulations of ICOM or other circumstances, there are other options. In order to establish a better link between you and your colleagues of ICOM-CC, several years ago we created the special category, Friends of ICOM-CC. The annual contribution (1 January - 31 December), which is essential to support the operation of ICOM-CC, is 40 Euro and 25 Euro for low-income countries. We have also installed a Paypal system on our website to make payment easier (at www.ICOM-CC.org).

We hope that you will consider joining ICOM-CC by either becoming a member or an ICOM-CC Friend for the year 2008. Members and Friends of ICOM-CC will benefit from the reduced registration fee at our Triennial Conference, which will take place in New Delhi, India from 22-26 September 2008 and will certainly be an exciting event.

Thank you in advance for supporting ICOM-CC

Thea van Oosten

## Shipping and handling of Natural History Specimens in Dangerous Goods

Most collection holding natural history institutions, as part of their day to day operating procedures, deal with the shipping of specimens, through loans and gifts of material to other institutions as well as the accepting of incoming material. A large number of these contain flammable or hazardous solutions e.g. ethanol, isopropanol or formaldehyde in varying concentrations. Dangerous goods regulations, most in place long before September 11th, 2001, were brought sharply into focus after that tragic event.

Most specimen shipments, whether domestic or international, are sent by airmail to minimize the length of time specimens are exposed to the hazards of transport, thereby reducing the chances of damage and dehydration. Shipping dangerous goods by air presents particular problems. International shipments must comply with both the International Civil Aviation Organization (ICAO) technical instructions as well as national regulations. In order to meet commercial standards, shippers are also required to meet the International Air Transport Association (IATA) Dangerous Goods Regulations. Furthermore, some countries have added variations to many of these requirements.

**Regulating agencies**
The ICAO governs the implementation and adoption of standard aircraft shipping and packaging regulations by both the Department of Transportation (DOT) in the United States and IATA internationally. DOT regulations are unique to the United States. Other countries have similar domestically enforced regulations while a number rely on IATA for both domestic and international regulations. International (IATA) shipping regulations are followed by most countries. Domestic shipments sent through the mail within the United States must also conform to United States Postal Service (USPS) regulations while courier shipments (FedEx, UPS and DHL) must conform to the individual company's specific regulations (which for the most part follow IATA regulations) as well as recipient country's specific regulations. USPS and private courier regulations must meet or exceed the DOT or IATA regulations respectively; in many instances they are more restrictive.

**Training**
The first, and most important, requirement stipulated by all regulations is that all those who pack, handle or ship dangerous goods be properly trained. Training can be obtained from any number of commercial companies that specialize in Dangerous Goods or Hazardous Materials Training, and may range in price from $300-$500. For quantities above and beyond restricted quantities, more extensive training is required, which involves additional time and cost.

**Dangerous goods/Hazardous materials**
Dangerous goods/hazardous materials are classified according to Hazard Class and Packing Group. For example, most flammable liquids fall into Hazard Class 3. Within each Hazard Class, materials are classified into three Packing Groups. Of the four substances most commonly used in wet collections only ethanol, isopropanol and formaldehyde are covered under dangerous goods regulations. Glycerin (glycerol) used for cleared and stained specimens, is not regulated in any concentration.

Ethanol (ethyl alcohol), most commonly used in concentrations of 70% and above, is regulated for transport. Concentrations between 10% and 80% fall into Packing Group III while concentrations above this fall into Packing Group II.

Isopropanol (isopropyl alcohol), most commonly used at concentrations of 50% and above, falls into Packing Group III at concentrations of 10 to 30% while concentrations above this fall into Packing Group II.
Formaldehyde (formalin) in concentrations above 10% is a Class 9, packing group III substance and is regulated for transport. What is called "10% formalin" in natural history collections is, in fact, 3.7% or 4.0% formaldehyde (formaldehyde is a saturated solution of formaldehyde gas in water, measured by weight or volume concentration)

and as such is unregulated for transport.
The shipment of infectious substances, natural history specimens not containing dangerous goods (pinned insects, skins, skeletons etc.), biological materials other than natural history specimens and any material on dry ice is covered by a separate set of regulations while there may also be ancillary permitting requirements for the domestic or international transfer of biological specimens (US Fish and Wildlife, APHIS, CITES etc.).

**Regulations**
Domestic and international shipping and packing guidelines vary slightly in scope and limitations but both include special dispensations for smaller quantities of dangerous goods. The two sets of small quantity regulations are very similar in scope and content but have a number of limitations that must be adhered to. It is important to consult the original texts of both the DOT and IATA regulations before shipping. USPS and DOT regulations are available online[1,2] while IATA regulations must be purchased[3].

**Domestic Regulations**
In the United States, the shipment of dangerous goods (referred to as hazardous materials) is covered in DOT Title 49 CFR[1] (Parts 100 to 185) and USPS Publication 52[2]. An exception to the regulations is made for dangerous goods in restricted quantities termed "small quantity regulations" outlined in DOT 173.4 and USPS Publication 52 (334). These small quantities are considered exempt from regular DOT and USPS hazardous goods requirements. Most fluid preserved natural history specimens can be packed and shipped utilizing these small quantity regulations.

Small quantities may be sent through the United States Postal Service via air transportation (Express, Priority and First-Class mail) or surface transportation as Standard or Parcel Post, or by any of the three major courier companies (FedEx, UPS and DHL) that follow DOT 49 CFR 173.4 small quantity regulations.

- Class 3 dangerous goods (all packing groups) are acceptable (ethanol and isopropanol).
- The maximum quantity of dangerous goods per inner receptacle cannot exceed 30 ml for acceptable liquids (as above). This inner receptacle cannot be liquid full at 55°C (131°F) and is to be constructed of plastic (having a minimum thickness of 0.2mm) earthenware, glass, or metal. A removable closure on an inner receptacle must be held securely in place using wire, tape or other positive means.
- Each inner receptacle must be placed within a securely sealed secondary package.
- Sufficient cushioning and absorbent material (that will not react chemically with the dangerous goods) must surround each inner receptacle and be capable of absorbing the entire contents of the receptacle.
- The secondary packages must be securely packed in a strong outer package (box) which complies with DOT mandated drop and compressive load tests without breakage or leakage from any internal receptacle:
- Drop tests – free drop on top, bottom, long and short side and the junction of three sides of the package from 1.8m (5.9 feet) onto a solid unyielding surface.
- Compressive load test – stack packages of similar size and weight to a height of no less than 3m (10 feet) for 24 hours.
- The gross mass of the package must not exceed 29 kg (64 pounds).
- Labelling - The address side of each package must be clearly marked with "This package conforms to 49 CFR 173.4" and complete return address and delivery address must be furnished. There are no other labelling requirements.

**International Regulations**
International shipments of dangerous goods are covered in Section 2.7[3] of the IATA regulations. As above, restricted quantity regulations exist for international shipping,

contained in IATA Section 2.7.1 and referred to as “Dangerous Goods in Excepted Quantities”. Dangerous goods in excepted quantities, in contrast to DOT and USPS regulations, are considered dangerous goods under IATA regulations but are exempt from large portions of the dangerous goods regulations applicable to larger quantities.

- The United States Postal Service may not be used for international shipping of dangerous goods. All international shipments must be sent using a private courier service (FedEx, UPS or DHL) that follows IATA regulations. Class 3 dangerous goods (all packing groups) are acceptable.
- As above, each inner receptacle may not contain more than 30 ml while the same construction, liquid full and closure security regulations apply.
- Each inner receptacle must be placed within a securely sealed secondary package.
- Sufficient cushioning and absorbent material (that will not react chemically with the dangerous goods) must surround each inner receptacle and be capable of absorbing the entire contents of the receptacle.
- The same package drop and compressive load test regulations as above apply.
- IATA regulations state that each inner receptacle must be placed within a securely sealed secondary package, the total contents of which may not exceed 500 ml for Packing Group II liquids and 1 litre for Packing Group III liquids.
- Labelling – each package must be labelled with the label below, having minimum dimensions of 100mm x 100mm (4” x 4”). This label must be filled in and signed by the packer. The “Nature and Quantity of Goods” section of the air waybill must be completed with the words “Dangerous Goods in Excepted Quantities”.
- All three major courier services (FedEx,


Figure 1: Dangerous goods in excepted quantities label for international shipments.

UPS and DHL) accept dangerous goods in excepted quantities for international delivery[4,5,6] and waive their normal dangerous goods surcharges for packages containing accepted quantities.

All three couriers do, however:

- Only accept dangerous goods on a contract or pre-approval basis.
- Only accept dangerous goods in boxes (no envelopes). FedEx has the added stipulation that the box must measure at least 7" x 4" x 4".
- Only ship dangerous goods to approved countries (there are various countries within which they are prohibited from shipping due in part to these countries not adopting IATA dangerous goods regulations for domestic transport). Packages can only be delivered to the designated international airport and no further. The list of countries to which this applies changes constantly therefore the courier should be contacted for an up-to-date list[4,5,6]. In some countries, additional customs, veterinary, or fish and wildlife fees may be incurred.

It has recently been noted that FedEx has regulations in place against the carrying of "dead animals" and that preserved, wet museum specimens fall into this category and are therefore prohibited in FedEx mail. There are various groups working with FedEx to institute exempt status for museum specimens and resolve this impasse.

**Transport in personal baggage as carry-on or checked luggage**

Due to the fact that DOT defines small quantities as non-hazardous, these quantities are allowed in hand and checked baggage on domestic flights but must be declared to the airline staff before boarding. The final decision as to whether or not to accept these packages is made by the pilot of the aircraft being boarded, thus you may be denied permission to carry the package on board at the last minute.

With the present heightened security measures in force at airports and the policy of no liquids or gels (or limited to 3 oz bottles in a clear quart zip-lock bag depending on which airport you fly through) no specimens in fluid would be allowed as carry-on baggage at all.

Internationally, dangerous goods in any quantity are prohibited as carry-on or checked baggage and cannot be carried on your person or checked onto any international flight (IATA Section 2.7.3).

**Natural history specimens**

In real world collection scenarios, the common practice of wrapping specimens in cheese cloth or gauze moistened with alcohol and sealed in plastic would keep the material from being dangerous goods as long as no more than 30 ml of 70% ethanol was used in each individual package and the heat sealed plastic bags were at least 0.2mm thick. Specimens preserved in 3.7% formaldehyde can be shipped in regular mail both domestically and internationally without any dangerous goods requirements.

Tissues can be placed in cryovials or glass vials in less than 30 ml of 99% ethanol if the caps are secured with tape or Parafilm, and the vials placed in a secondary heat sealed plastic bag with absorbent material and packed similar to the above.

It has also been suggested that fluid preserved specimens may be placed in water (or reduced concentrations of alcohol) for shipment. Although this may put specimens outside of the scope of dangerous goods regulations, the possibility of damage to specimens from swelling (and subsequent shrinkage upon reinsertion into alcohol), cell wall rupture, mold, and bacterial growth will severely endanger the specimens, particularly if the shipment is delayed.

It is important to remember that dangerous goods regulations are not written to specifically address the shipment of natural history specimens. There are various groups that are in the process of working with the various organizations to have regulations put in place that will address certain shortcomings of the existing regulations for natural history specimen shipments.

**References:**

1. Title 49 CFR, Subtitle B, Chapter 1, Subchapter C: Hazardous materials regulations. US Department of Transportation (DOT). http://www.access.gpo.gov/nara/cfr/waisidx_99/49cfrv2_99.html

2. USPS Publication 52: Hazardous, Restricted, and Perishable Mail. Part 3: Hazardous Materials. Pgs 15-60. July 1999. http://www.usps.com/cpim/ftp/pubs/pub52.pdf

3. IATA Dangerous Goods Regulations, 48th Edition. 2007. Section 2 - Limitations pgs 9-80. International Air Transport Association. Not online.

4. FedEx Dangerous goods shipping website:http://www.FedEx.com/us/services/options/express/dangerousgoods/hidden.html FedEx Dangerous Goods/Hazardous Materials Hotline: 1-800-463-3339.

5. UPS dangerous goods shipping website: http://www.ups.com/content/us/en/resources/prepare/idg/information/definition.html UPS Hazardous Materials Support Center: 1-800-554-9964.

6. DHL dangerous goods shipping website: http://www.dhl-usa.com/usgov/servopt DHL Hazardous Materials Hotline: 1-866-588-2002.

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## Project to investigate the environmental conditions required for the initiation of pyrite decay

Pyrite decay is a major problem within geological collections and can cause the total destruction of specimens. An experiment was set up to expose pyrite and marcasite to extremes of temperature and humidity, undisturbed for a year with the aim of determining the best possible storage conditions for pyritic material.

Fresh material was collected from two locations in Wales. Pyrite was collected from Maen Offeren Slate Quarry, Blaenau Ffestiniog, Gwynedd and marcasite from Bacheiddon Lead-Zinc Mine, Aberhosan, Machynlleth, Powys. The pyrite was known to be relatively stable whereas the marcasite was extremely unstable.

To represent actual collection material, the subjected samples were left in hand specimen and polished ore block form. They were then subjected to conditions of set temperatures of 7-8°C (Fridge), 22-27°C (Mineral Store) and 42-46°C (Oven). Within each of these temperature ranges, four humidity microclimates containing the samples were placed; RH 75% (to represent a high humidity environment), RH 35% (to represent recommended storage humidity), anoxic (to represent recommended packaged conditions) and ambient (the actual prevailing humidity of the fridge, mineral store and oven). The microclimates (Fig.1) were made from Escal™

**Fig.1** Microclimate packages

barrier film containing conditioned silica gel, temperature and humidity indicating strips, Ageless Eye™ indicators and for the anoxic environments Ageless RP-A System™ oxygen absorber was used. Each of the three storage areas contained a Tinytag™ data logger to keep an accurate record of the prevailing temperature and humidity.

The experiment produced many expected results from the various temperature and humidity microenvironments. For example, with a higher humidity and temperature, a rapid onset of decay occurred, particularly within marcasite samples. This agreed with general opinion that increased humidity and increased temperature cause decay. The marcasite samples were the first to decay and showed the most alteration with the development of efflorescence products, which were analysed and identified by X-Ray Diffraction (Figs. 2-6). The minerals that occurred as efflorescence products were chemically representative of the environment that they formed in.

Generally the pyrite in the most extreme environments showed some signs of decay and the majority of the pyrite showed signs of tarnishing, although the experiment also revealed some unexpected results for the pyrite samples within a cold and rapidly fluctuating humidity environment. As was expected the low temperature environment of the fridge

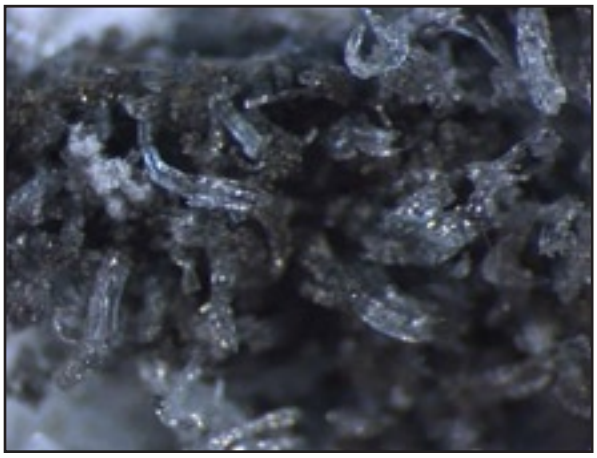

**Fig2.** Efflorescence analysed by XRD - melanterite $FeSO_4.7H_2O$, the earliest forming phase which is common across a wide range of temperatures and a high humidity and minor pickeringite $MgAl_2(SO_4)4.22H_2O$ which forms by an interaction with the host rock

**Fig.3** Efflorescence analysed by XRD - römerite $Fe^{2+}Fe^{3+}{}_2(SO_4)_4.14H_2O$, forms at higher temperatures and humidity

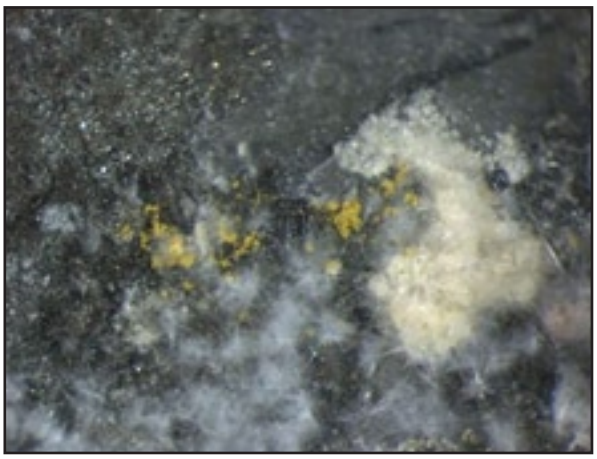

**Fig.4** Efflorescence analysed by XRD - akaganeite $Fe^{3+}O(OH)$, natural rust

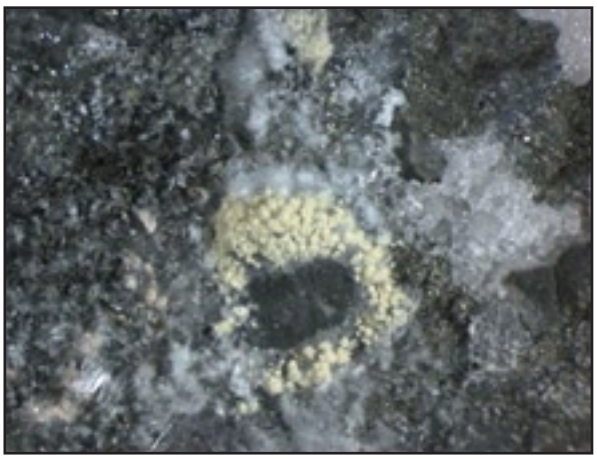

**Fig.5** Efflorescence analysed by XRD - magnesiocopiapate $MgFe^{3+}{}_4(SO_4)_6(OH)_2.2OH_2O$ formed in higher humidity with an interaction with the host rock

delayed the process of decay for both the pyrite and marcasite samples. However, an unexpected factor arose in that the fridge has a rapidly fluctuating humidity from around RH 18-74% whilst the temperature stays at a constant of 7-8°C. This resulted in the samples in the ambient environment of the fridge being subjected to fluctuating high and low humidity. Surprisingly, the pyrite samples in this rapidly fluctuating environment seemed to show very little sign of decay and the pyrite polished block came out at the end of the year as fresh as the day it went in. Even the marcasite polished block only showed a small amount of tarnishing. Further research is needed but this could possibly have some implications for future storage of pyritic material, particularly for samples in the form of polished blocks.

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**Fig.6** Post project decay showed the melanterite $FeSO_4.7H_2O$ when removed from its high humidity environment, dehydrated to rozenite $FeSO_4.4H_2O$

## Assessing Standards of Collection Care in a multi-discipline institution.

How do large institutions that care for a wide range of materials assess the standards their collections should be maintained at? How do they quantify the risk to those collections if they aren't cared for at an appropriate level? This talk looks at a project currently underway in the Natural History Museum (NHM), London to look across the diverse array of materials within a natural history collection and examine how we care for them, what areas we need to improve in and set out a plan to put in place those improvements. This work is leading us to examine not only our own attitudes to the standards of care but how we are perceived by users of our collections. We also have to consider the issues of undertaking a project that will highlight risks and potential problems in an institution with a high media profile.

**Background**

The Natural History Museum (NHM) must care for a wide range of collections ranging from art works on paper to fossils and from spirit preserved collections, to herbarium sheets. These are housed in a variety of storage areas and subject to differing levels of collections care and collections management practice, many of these of varying suitability. While state of the art collections' storage in Darwin I and II are high profile projects, the poor condition of other storage areas are not as widely known except to those who have to use and/or care for the specimens stored there.

The Collections Standards Project takes our understanding of standards in place worldwide to define what the NHM should consider the 'NHM standard for collections storage and care' and will then measure the current collections storage facilities and care practices against this standard. Through risk analysis, the project will show which areas of the NHM collections are most at risk to damage and loss. In a climate where competition for funding can be intense, such a study is a necessary precursor to setting priorities for

a comprehensive collection storage and care renovation plan and estimating the resources required for that plan's implementation.

**Methodology**

This project will identify worldwide best practice for collections storage and care standards. Using this information we will determine the NHM standard for collections storage and care, which in some cases might be aspirational. Using the SYNTHESYS NA C survey as an inspiration and starting point (Collins C, Cornish L, Huxley R and Owens S J. 2006. SYNTHESYS Network Activity C Assessing Standards Of Collections in European Museums. *Collection Forum* Volume 21 Vol. 1-2. ) we aim to develop the methodology to undertake an initial baseline survey at a store level to evaluate the general standard of the collections management status of the museum's collections within the scientific collections, libraries, archives and exhibits. The project will also outline a timetable for repeating the work to ensure progress is being made in areas that fall below an acceptable standard; that in other areas, standards are maintained and in certain instances continued improvement is achieved.

The survey will enable us to do the following:

- To identify which collections fall below the benchmark standard and are therefore at a higher risk of loss.

- To propose a long-range cross-museum plan to bring the collections that are below acceptable standards up to a recognised level of care, over the next 10 years.

- To propose a business plan showing the full costs of achieving the whole NHM collection reaching the benchmark standard.

Ultimately we believe this will enable us to produce:

- A long-range cross-museum report and plan that addresses collections management issues raised by the survey.

- A business plan providing costs for achieving the benchmark standard for the NHM collections as a whole.

**Conclusion**

This project is currently in progress, but by September 2008 we will have devised and completed the surveys and have the results of the assessments. We believe such a survey will inform not only our own decision making but enable us to articulate, with clearly quantified supporting evidence, to our funding body the implications for the long-term preservation of the collections in our care. It will also allow us to develop an informed, prioritised list of collections management projects.

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## Making a Three-quarter Cast of an Atlantic Tripletail Fish

An unusual fish, subsequently identified as an Atlantic tripletail (*Lobotes surinamensis*), was caught in September 2006 by fisherman Michael Roberts in a stake net off the estuary shore at Peterstone, between Cardiff and Newport. Normally found in tropical and sub-tropical waters around the world, it is believed to be the first recorded occurrence of this species in Britain.

The 2ft long mature adult specimen was brought to the zoological conservator Julian Carter at the Museum, where it was

photographed and stored in the deep freeze. After moulding, the specimen will be fluid preserved and exhibited alongside the replica at the Museum.

**Materials**

Tin-Sil 70-25 silicone rubber
Thixotropic agent
Fast catalyst
Araldite DBF epoxy resin
Aradur HY 956 EN Hardener
Fibreglass matting
Araldite colouring pastes
Fine dental plaster
Artist's pigments
Mineral fillers
Acrylic paints

**To Make the Mould**

A support was prepared from a sheet of corex (corrugated plastic) with several layers of thick plastazote underneath. An outline, slightly smaller than the actual fish, was drawn on the corex surface. A scalpel was used to cut along the outline through the layers to create a depression for the lower ¼ of the fish to rest in. This left enough of the underside visible to create a cast that looks like a whole fish viewed from the front.

The frozen fish was placed in a large plastic tub of warm water. The excess slime was rubbed away from the skin in the water using just the fingertips, to avoid any unnecessary damage to the scales. When the surface had thawed sufficiently, the fish was taken out of the water and placed in its hollowed support. The skin was dried with paper towels, and the pectoral and pelvic fins were cleanly removed from the upper side of the body with a scalpel. The dorsal and ventral fins were pressed down slightly into the clay and pinned in position with dressmaking pins. The pin heads were then cut off so they would be less noticeable when the mould was made. Rolls of soft modelling clay (similar to plastacine) were positioned around the sides of the fish, and pressed down firmly to make a smooth join between the specimen and the support. The mouth of the fish was left open and the inside cavity was blocked with polythene. Clay strips were positioned with a gap of 25mm around the perimeter of the fish to create a retaining wall. A modelling tool was used to press the outer edges of the wall to the corex base to make a good seal.

The two removed fins were cast in separate two part moulds. A small standard batch of silicone rubber was mixed with a little fast catalyst and poured over the entire fish. The silicone was brushed into delicate areas, very carefully, in order to avoid any air bubbles between the object and the mould. After about 30mins, when the first layer had set to touch dry, a second batch of silicone was mixed with fast catalyst and thixotropic agent. This second layer was spread on with a spatula and smoothed with water and detergent. When the rubber had set, a support jacket was made by pouring plaster over and around the silicone.

Once the plaster had dried sufficiently the clay walls were peeled away, and the support was removed and turned over. The silicone mould was peeled off carefully, washed, dried and placed in the support. The fish was immediately placed back in the freezer to be fluid preserved at a later date.

**To Make the Cast**

Using the real fish and photographs for reference, the primary colouring was painted in reverse on the inside of the mould. Dry artist's pigments were used and applied with a fine brush. An acetate palette was taped to a sheet of glass and the epoxy resin was mixed in a wax paper cup. Araldite colouring pastes and mineral fillers were set out and mixed on the palette with the epoxy resin, to create the colours and opacities needed. The coloured epoxy was then painted into the mould replicating the colours on the outside of the fish, then working inwards. The epoxy was built up in several layers, with the first setting in place before the next was applied. When the

whole of the silicone mould had been covered, layers of fine fibreglass were cut and set into the final epoxy mix.
The epoxy was left to dry completely then the cast was taken out of the plaster support and the silicone mould peeled off.

Epoxy putty was used to strengthen the inner edges of the cast and to attach the two separately cast pectoral and pelvic fins. The surface detail was finished off with acrylic paints. Finally the whole fish was coated with a layer of glossy varnish to make it appear lifelike.

**Acknowledgements for help and advice**
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**Fig.1** Showing the removal of the pectoral fin with a scalpel

**Fig.2** Showing entire fish within perimeter wall of clay.

**Fig.3** Completed epoxy cast of fish

**Natural History Abstracts Submitted for the 15th Triennial General Meeting, New Delhi, India . September 22-26, 2008**

## Study of natural history specimens using X-ray fluorescence spectrometry

### Introduction

Natural history specimens have always been associated with preservatives to prevent them from decaying or from insect damage. Arsenic or mercuric compounds have been commonly found and recorded in taxidermy literature.

A non-destructive method using X-ray fluorescence spectrometry ( XRF) was used to investigate whether the natural history collections pertaining to the Hong Kong History Museum and the Hong Kong Science Museum contained any inorganic compounds as a kind of preservative which may lead to occupational health concerns with the museum personnel.

### Methods and Sampling

The analysis on the natural history specimens was conducted in two phases. A preliminary study was done on four bird specimens to investigate if any inorganic preservatives could be detected on various parts of the specimens by using X- ray fluorescence spectrometry. The results were positive from the preliminary study. A further analysis was done on another 147 natural history specimens including birds, mammals and reptiles.

***First Phase***

**Four bird specimens**

The SII SEA 200 X-ray fluorescence spectrometer was used to analyse the specimens. The specimens were placed on the edge of the table and the measurement head of the SEA 200 was tilted to irradiate the X-rays on different positions of the specimens. The measurement condition for this analysis was 200 seconds (for owl and black bird ) and 60 seconds (for two Egretta garzetta**)** using the 5mm collimator at 15 KV and 50 KV.

Fig 1 XRF set up for the analysis of an owl specimen

***Second Phase***

The second phase of XRF analysis was conducted on 147 natural history specimens including birds, mammals (Chinese Pangolin, Chinese porcupine, squirrel), reptiles (snake, lizard, crocodile), etc. The SII SEA 200 X-ray fluorescence spectrometer was used to analyze

Fig 2 Natural history specimens - birds

The results were summarized in the following tables:

**Results**

***First Phase***

## Owl specimen

| | Position | Elements Identified 15kV | Elements Identified 50kV |
|---|---|---|---|
| **A** | Left Chest | S, Ca, Fe, As | S, Ca, Fe, Zn, As |
| **B** | Left Eye | S, Ca, Fe, Zn, As | S, Ca, Fe, Zn, As |
| **C** | Tail Feather | S, Ca, Fe, As | S, Ca, Fe, Zn, As |
| **D** | Lower Abdomen | S, Ca, Fe, Zn, As | S, Ca, Fe, Zn, As |
| **E** | Near the Right Leg | Not analyzed | S, Ca, Fe, Zn, As |
| **F** | Back (between the wings) | Not analyzed | S, Ca, Fe, Zn, As |
| **G** | Left Claw | Not analyzed | S, Ca, Fe, Zn, As |
| **H** | Right Claw | Not analyzed | No elements identified |

## Black Bird

| | Position | Elements Identified 50kV |
|---|---|---|
| **A** | Left Wing | S, Ca, Fe, Zn, As |
| **B** | Head | S, Ca, Fe, Zn, As |
| **C** | Right Wing | S, Ca, Fe, Zn, As, |
| **D** | Tail Feather | S, Ca, Fe, Zn, As |
| **E** | Leg | S, Ca, Fe, Zn, As, Sr, |
| **F** | Left Leg | S, Ca, Fe, Zn, As, Sr (also with 15kV) |

## Egretta garzetta A

| | Position | Elements Identified 15kV | Elements Identified 50kV |
|---|---|---|---|
| **A** | Left Wing | S, Ca, As | S, Ca, Fe, As |
| **B** | Right Leg | S, Zn, Fe, As, Ca | Fe, Zn, As |
| **C** | Chest | S, Ca, As | S, As, Ca |

## Egretta garzetta B

| | Position | Elements Identified 50kV |
|---|---|---|
| **A** | Left Wing | As |
| **B** | Right Leg | Nil |
| **C** | Chest | S, As |

| Description | Birds | Mammals | Reptiles | Others |
|---|---|---|---|---|
| Number of specimens analyzed | 101 | 30 | 15 | 1 |
| Number of specimens As detected | 97 | 23 | 2 | 0 |
| Number of specimens Hg detected | 0 | 2 | 0 | 0 |

Fig 3 Natural history specimens-birds and mammals

SEA 200 was tilted to irradiate on different positions of the specimens. The measurement condition for this analysis was 60 seconds using the 5mm collimator at 50 KV.

***Second Phase***

For the second phase, 129 specimens from the natural history collections of the Museum of History and 18 specimens from the Science Museum were analyzed . The natural history specimens include mammals, reptiles, birds of which the majority were birds. Arsenic was detected on over 83% of the specimens. Iron, zinc and calcium were also commonly detected to be contained in the specimens. Only a few of the specimens were detected to have mercury.

**Discussion**

From the preliminary study it was deduced that arsenic was detected on most areas of the natural history specimens. This analysis was therefore extended to the majority of the natural history collections within the two museums. The results indicated that over 83 % of the natural specimens contained arsenic and that most of them were animals with hair or birds with feathers.

Interviews with the museum's registrars disclosed that most of the specimen collections were acquired (and probably produced) in China. Literature review indicated that arsenic trioxide was commonly used as the preservative for the skin in production of the specimens in China. Other ingredients such as alum and camphor were also reported to be added as a kind of preservative for specimens produced in China.[5,6,7]

Some literature sources cited that powder form preservative was prepared in the ratio of arsenic trioxide : alum : camphor 2: 7 : 1 [6,7]. Boric acid was recommended to replace arsenic trioxide in view of health and safety, particularly for specimens prepared in schools [5, 7]. However, it was remarked that boric acid was not as effective as arsenic trioxide.

Besides arsenic, iron (Fe), zinc (Zn) and calcium (Ca) were also detected in the natural history specimens by XRF. The presence of Ca was probably due to the bones while iron and zinc were detected because of the presence of the internal framework (wires) for supporting the specimens.

**Conclusion**

Given that natural history specimens (without preservatives) were susceptible to insect/ mould attack, it is fully understandable why arsenic or mercuric compounds have been added to the specimen collections. Whilst these poisonous compounds have become an integral part of the objects themselves, there is no easy way that these poisonous compounds can be separated out. As a result, it is necessary to collect such information and to inform all museum personnel (in particular those who would be handling the collections) so that the health and safety of individuals

Fig 4 XRF set up for the analysis of eagle in the Science Museum

is not threatened when these objects are permanently kept as collection items within the museum premises.

XRF was found to be a useful tool in detecting the presence of inorganic preservatives in the natural history specimens. The arsenic compound inside the specimens could be in the form of arsenic soaps, arsenic trioxide and lead arsenate ($Pb_3(AsO_4)_2$). Mercury compounds would be in the form of mercuric chloride. All these compounds are toxic and hazardous to the people who are exposed or handle the objects.

**Precautions and Recommendations**

The items identified to contain arsenic or mercury should be labelled with "Arsenic contaminated" or "Mercury contaminated" and stored separately, if possible. Museum personnel that handle the specimens should wear gloves, protective smocks and respirators. After handling, all personnel should wash hands at once and avoid contamination with other objects.

## References


1.Goldberg. L. 1996 A history of pest control measures in the anthropology collections, National Museum of Natural History, Smithsonian Institution Journal of American Institute for Conservation Vol 35 no 1 p 23-43

2.Horie. C V. 1998 Conservation of natural history specimens vertebrates Proceedings of the short course at Manchester University

3. Johnson. J S . Heald. S. and Chang L. 2005 Case studies in pesticide identification at the National Museum of the American Indian *in Verger, I. (ed.),ICOM-CC 14th Triennial Meeting Preprints*, p89-95 London: James and James

4. Siroris. P J. and Sansoucy. G 2001 Analysis of museum objects for hazardous pesticide residues : A Guide to Techniques Collection Forum ; 17 (1-2) 49-66

5. http://www.biox.cn/content/20050603/14741.htm

6. http://www.tzltbb.com/prolore.aspx

7. http://www.zhounan.com/ShengWu/ShowArticle.asp?ArticleID=1930

8. http://www.cr.nps.gov/museum/publications/conserveogram/02-03.pdf



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## Using Anoxia to Kill Insect Pests. Methodologies and Methods

This paper will examine the research on the effect of anoxia on different insects and different life stages. It will also look at the way anoxic and low oxygen atmospheres can be achieved. It will provide guidelines on the most effective ways to provide anoxic environments that will kill particular species of insect pests.

Anoxia is a particularly useful treatment for fragile, historically valuable specimens. However, even though there have been many successful treatments which have eliminated live pests, there have also been some failures. One of the factors contributing to some of the failures has been a lack of understanding of the physiological differences between insect species and life stages.

A number of different treatment systems have been introduced in the last ten years to produce anoxic conditions. Some of these have shown to be useful, while others have been demonstrable failures.

This paper will review the data generated on the effect of anoxia on a number of insect species in different life stages at various low oxygen levels. It will also assess the different

ways low oxygen conditions can be achieved and which are the most appropriate for insect pest control.

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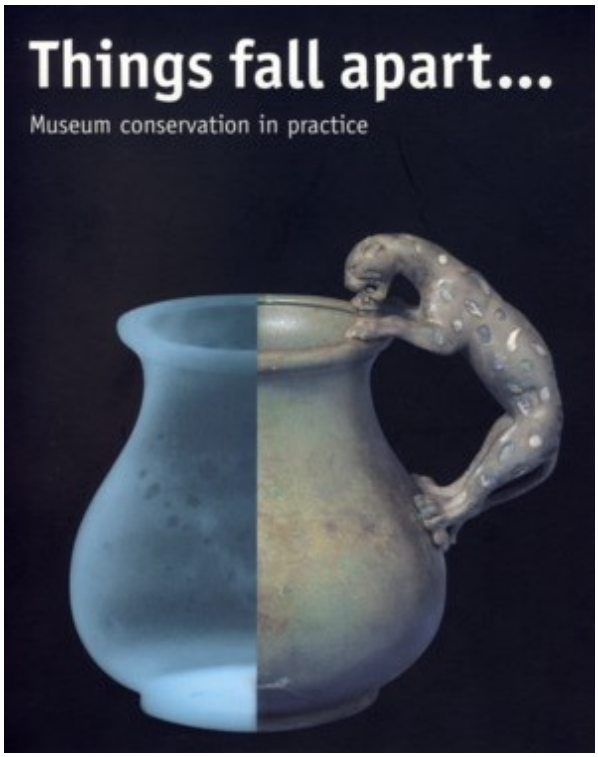
## New from Amgueddfa Cymru - National Museum Wales:

### Things fall apart… Museum conservation in practice




**Edited by Caroline Buttler and Mary Davis.**

This book examines the work undertaken by conservators today. The articles cover a wide range of conservation disciplines including natural sciences, social and industrial history, archaeology and art. It is divided into four sections: preventative conservation, interventive conservation, re-conservation and replication. The projects are very diverse, and deal with objects ranging from the preservation of a coal mine to a prehistoric pot. All reveal various practical and ethical dilemmas that confront conservators every day.

National Museum Wales is well known for its promotion of natural science conservation, and the book reflects this with articles on DNA preservation, Blaschka glass models, botanical wax models, casting dinosaur footprints and the re-conservation of a mounted Victorian fossil.
The book is fully illustrated in colour and includes a glossary. As well as articles there are text-boxes that cover some information in greater detail, for example: polymerase chain reaction (PCR), freeze drying, anoxic storage, shale, SEM, XRD and pyrite decay. This book will be of great interest to practising conservators, students and many other museum professionals.

Things fall apart… Museum conservation in practice
Eds Caroline Buttler & Mary Davies
ISBN: 0 7200 0559 0
198 pages
Available from Amgueddfa Cymru - National Museum Wales
http://www.museumwales.ac.uk/en/759/

## Useful web/email addresses

| | |
|---|---|
| ACGIH | American Conference of Governmental Industrial Hygienists http://www.acgih.org/home.htm |
| ACS | American Chemical Society http://www.chemistry.org/portal/a/c/s/1/home.html |
| AIC | American Institute for Conservation of Historic and Artistic Works http://aic.stanford.edu/ |
| ALCA | American Leather Chemists Association http://www.leatherchemists.org/ |
| ANSI | American National Standards Institute http://www.ansi.org/ |
| ARCC | Association of Regional Conservation Centers http://www.rap-arcc.org/index.php |
| CDC | Centre for Disease Control www.cdc.gov/ |
| CHIN | Canadian Heritage Information Network http://www.chin.gc.ca/English/ |
| | Conservation distribution list consdist-request+consdist@lindy.stanford.edu |
| Cool | Conservation on Line http://palimpsest.stanford.edu/ |
| DHHS | Department of Health and Human Services www.hhs.gov/ |
| | English Heritage http://www.english-heritage.org.uk/ |
| EPA | Environmental Protection Agency www.epa.gov/ |
| | Federal Historic Preservation Tax Incentives http://www2.cr.nps.gov/tps/tax/index.htm |
| GCG | Geological Curator's Group http://www.hmag.gla.ac.uk/gcg/ |
| HSDB | Hazardous Substances Data Book www.nlm.nih.gov/pubs/factsheets/hsdbfs.html |
| HPF | Historic Preservation Fund http://www.cr.nps.gov/hps/hpf/hpf_t.htm |
| ICCROM | International Centre for the Study of the Preservation and the Restoration of Cultural Property http://www.iccrom.org/ |
| ICOM | International Council of Museums http://icom.museum/ |
| ICOM-CC | International Council of Museums Committee for Conservation http://icom-cc.icom.museum/Home/ |

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| ICON | Institute of Conservation. This institute was created in 2005 by the merging of the following organisations: the Care of Collections Forum, the Institute of Paper Conservation (IPC), the Photographic Materials Conservation Group, the Scottish Society for Conservation and Restoration (SSCR) and the United Kingdom Institute for Conservation of Historic and Artistic Works (UKIC). Convergence was fostered by the National Council for Conservation-Restoration (NCCR), which has now been disbanded. http://www.icon.org.uk/ |
| ICS | Institute of Conservation science http://www.instituteofconservationscience.org.uk/ |
| IIC | International Institute for Conservation of historic and artistic works of art http://www.iiconservation.org/ |
| IMLS | Institute of Museum and Library Services http://www.imls.gov/ |
| IRUG | The international Infrared and Raman Users' Group http://www.irug.org/ |
| ISO | International Organization for Standardization http://www.iso.org/iso/en/ISOOnline.frontpage |
| MRS | Materials Research Society http://www.mrs.org/s_mrs/index.asp |
| NAERG | North American Emergency Response Guidebook 1996, www.accesskansas.org/firemarshal/azmat/manuals/NAERGMan.pdf |
| NatSCA | Natural Sciences Collections Association formerly BCG (Biological Curator's Group) and NSCG (Natural Sciences Conservation Group) http://www.nhm.ac.uk/hosted_sites/natSCA |
| NCCR | National Council for Conservation and Restoration (See ICON) |
| NCPTT | National Center for Preservation Technology and Training. http://www.ncptt.nps.gov/ |
| NHCOLL | The Natural History Collections List Server http://www.spnhc.org/nhcoll.htm |
| NIOSH | National Institute for Occupational Safety and Health www.niosh.com.my/ |
| NISO | National Information Standards Organization http://www.niso.org/ |
| NPO | The National Preservation Office (British Library) http://www.bl.uk/services/npo/npo.html |
| NSCG | Natural Sciences Conservation Group (see NatSCA) |
| OEHHA | Office of Environmental Health Hazard Assessment www.oehha.ca.gov/ |
| OSHA | The Occupational Safety and Health Administration www.osha.gov/ |
| RTECS® | Registry of Toxic Effects of Chemical Substances. www.cdc.gov/niosh/rtecs.html |

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| SHNH | The Society for the History of Natural History www.shnh.org |
| SPNHC | The Society for the Preservation of Natural History Specimens. http://www.spnhc.org/ |
| TCC | The Textile Conservation Centre http://www.wsa.soton.ac.uk/ttccontent.htm |
| TPP | Tribal Preservation Program http://www.wsa.soton.ac.uk/ttccontent.htm |
| UKIC | United Kingdom Institute for Conservation of Historic and Artistic Works (see ICON) |
| UNESCO | United Nations Educational, Scientific and Cultural Organization. http://www.unesco.org/culture/heritage/ |
| USEPA | United States Environmental Protection Agency www.epa.gov/ |
| WHO | World Health Organisation www.who.int/en/ |