The Biology Curator

The Publication of the Biology Curator's Group

ISSUE 16 **NOVEMBER 1999**

Diary Dates

GCG Meeting and AGM. Geology and the Local Museum

3-5 Dec 1999. Trinity College, Dublin.

Contact: Patrick Wyse Jackson, Trinity College, Dublin. Tel: +353 1608 1477 wysjcknp@tcd.ie

BCG: Mollusca training meeting: An Introduction to Molluscs: Collection, Curation and Display

31 Jan 2000 Oxford University Museum of Natural History

This meeting is aimed at non-conchologists who are responsible for mollusc collections.

Topics covered will include basic concepts of care and curation including storage, documentation, handling, preventative conservation and conservation problems, uses of molluscan collections and sources of information.

A mailing giving full details will be sent out in November.

Anyone wishing to present a paper, poster or demonstration please contact:

Nick Gordon, New Walk Museum, New Walk, Leicester, LE1 7EA

Tele. 0116 2554100 Fax. 0116 2553084.

GCG: Gemstone ID. Weston super Mare

7 March 2000

Contact: Dale Johnston, North Somerset Museums Service, Tel: 01934 621028

NHM: Insect Pests in Museums

14-15 March 2000

A two-day course by David Pinniger, of interest to all those with responsibilities for natural history, ethnographic, folk textile collections etc. Pests and damage, pest identification, pest environments, pest monitoring and control and pest management will be covered among other topics.

Further details: Phil Ackery, Dept. of Entomology, The Natural History Museum, Cromwell Road, London, SW7 5BD Tel. 0207 942 5612

BCG Conference and AGM: Access to Collections

3 / 4 Apr 2000 Scarborough

see inside for more information and Call for Papers

contact: Nick Gordon, New Walk Museum, New Walk, Leicester, LE1 7EA

Tele. 0116 2554100 Fax. 0116 2553084.

NHM: Millennium event; Nature's Treasure-houses

4-8 April 2000

An international conference on the role of natural history museums.

GCG: The Dynamic Earth

May 2000. RMS, Edinburgh

Contact: Steve McLean

BCG: Visit to Kew Gardens

June 2000.

A study trip is being arranged to visit the gardens and have a behind the scenes tour. Details will be circulated in the next issue.

Contents

Deadline: All items for next publication to reach Editors by 8th January 2000.

BCG: Study Trip to Eastern Europe. (Budapest or Prague)

Sept, Oct, or Nov 2000

GCG: Proposed Study trip to Southern Germany.

October, 2000

GCG Meeting and AGM

Dec 2000. Hancock Museum, Newcastle

Contact: Steve McLean

BCG: Documentation

Jan. 2001 Training meeting

This meeting will consider the state of biological documentation in museums, looking at MGC Registration requirements, documentation software, data standards and current initiatives.

Contact Nick Gordon, New Walk Museum, Leicester. 0116 247 3030

St. Petersburg Trip

On investigations, it looked like the trip was likely to cost in the region of £600 per head, with little or no possibility of bringing it down even as far as £500. We felt that this was far too expensive, and that there would be very few people who would take up the opportunity. IF THERE ARE PEOPLE WHO WOULD STILL CONSIDER SUCH A TRIP, EVEN AT THIS PRICE, PLEASE LET US KNOW. Instead of this, we are still hoping to go to Eastern Europe, and are looking into a trip to either Budapest or Prague, with Budapest looking the more likely. We believe this will work out considerably cheaper. Watch this space and please let us have any feedback, positive or negative. A trip to the States is intended for 2001.

BCG Conference and AGM: Access to Collections

3/4 Apr 2000 Scarborough

'Social inclusion' is one of the Government's new buzz-words and with the advent of 'Best Value' museums must show their commitment to providing access for all.

Within the scientific community there are calls for repatriation of type specimens and collections, particularly from countries to whom loans of material are sometimes refused and who cannot afford to send researchers to the holding institutions.

This two day conference will look at how we afford access to collections, to the scientific community, the public and other users. It will consider the issues raised by how we enable (or do not enable) access, examples of good practice, how museums can break down barriers and are reaching beyond their walls.

Call for Papers: Papers and posters on any aspect of collections access, community and outreach work, Best Value, joint working partnerships etc

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Skin and Bones

March 25-27, 1999

DAY 1: Bones

The following article was put together from the notes made for a talk at the 1999 Biology Curators Group Meeting on the 25th March 1999 at The Natural History Museum, London. The aim of the talk was to provide a brief overview of the structure and chemistry of bone, and then to explore how bone deteriorates with methods of preparation and conservation. The article describes these concerns with reference to modern bone.

What is bone?

Bone in common with other connective tissue consists of cells, fibres and ground substance, but unlike other tissues its extracellular components are calcified, making it a hard unyielding substance ideally suited for its supportive and protective function in the skeleton. In addition bone plays a physiological role in body functions, particularly as a storehouse of minerals. In life bone is a dynamic living material that is constantly being renewed and reconstructed. As a result it is surprisingly responsive to metabolic, nutritional and endocrine factors, to the extent that the skeleton of an animal can be used to piece together the history of the animal in life.

Bone has a distinct chemical and structural make up (Bloom and Fawcett 1968; Romer and Parsons 1977; von Endt 1979; Page 1982). Fundamentally the gross structure of bone has two forms;

- Spongy (substantia spongia) – a 3D lattice of branching bony spicules.
- Compact (substantia compacta) – a solid continuous mass.

At the microscopic level, uniformly spaced through the interstitial substance of bone, are lenticular cavities, or lacunae. Each is completely filled with a bone cell or osteocyte. From these, radiating in all directions, are very slender branching tubular passages or canaliculi, which penetrate the interstitial substance of the lamellae. These form a continuous network of cavities interconnected by an extensive network of minute canals.

The chemical matrix of bone consists of collagenous fibres embedded in an amorphous ground substance consisting of bone mineral and polysaccharides. The mineral phase consists of submicroscopic crystals of an apatite of calcium and phosphate, commonly called hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$). The mineralisation of bone is under the control of living bone cells. The mineral hydroxyapatite is deposited in the form of slender crystals within both the substance of the collagen fibres and the organic matrix. As a result these crystals are in close packed association with each other, the surface of the microfibrills, and within the microfibrils themselves. This strong association between mineral and protein provides the strong mechanical structure associated with the bone.

Collagen is an interesting molecule in itself – a three stranded thread that is wound about itself into a helix. Each strand consists of covalently linked amino acids, a third of which is glycine – the smallest amino acid. Of the rest about 20% will be alanine with 10% each of aspartic, glutamic and proline (figure 1). The amino acids form a regular repeating triplet in which every third amino acid is glycine (figure 2). This superhelix molecule is procollagen. Enzymatic action assembles the procollagen into microfibrills, which

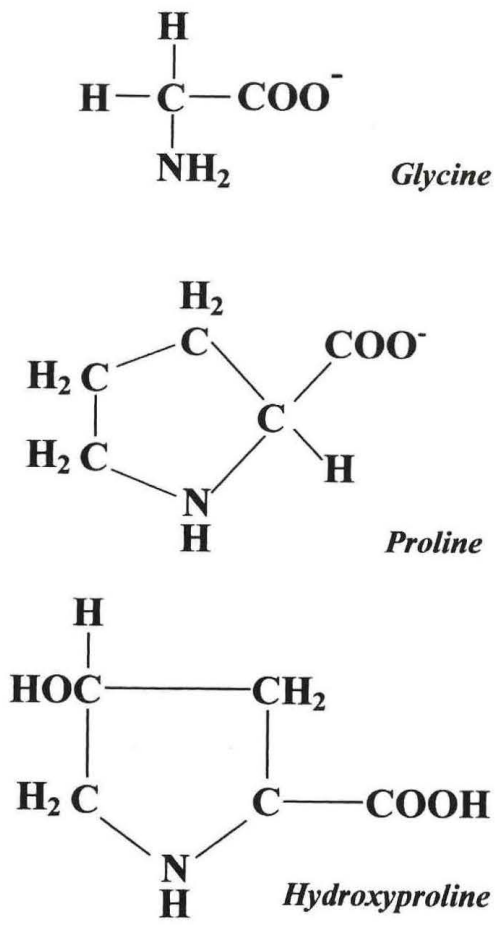


Figure 1: Some key amino acid structures that form Collagen

chemically cross-link in a regular fashion through specific amino acid residues to other microfibrills, thus strengthening the aggregate. Hydrogen bonding within the trimeric helix is probably the single most important factor in the stabilisation of collagen. Ultimately sheets of protein form, which overlay each other.

Non collagenous organic molecules, such as proteoglycans and glycoproteins, are in intimate association with the collagen molecules and these are thought to maintain the three dimensional, or steric, integrity of the collagen. It is also considered that these proteins also aid in the deposition of the mineral phase. Overall the weight of bone is approximately 25% protein and 75% hydroxyapatite mineral.

Living cells are also required to maintain the biochemical structure and relationship of the materials from which bone is composed. The presence of cells provides the presence of an important component in bone – DNA. The result is that bone has become an important resource for use in biomolecular studies (e.g. see Cooper 1994; Richards and Sykes 1995).

The deterioration of Bone

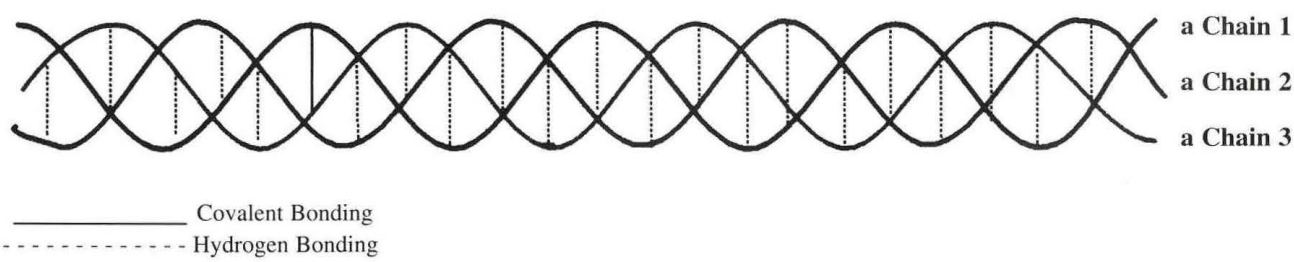
Despite its hard and solid appearance, bone is susceptible to deterioration because of its porous and microcrystalline structure. Moreover, bone must initially be extracted from the other body components of an animal, and therefore has undergone various types of chemical reactions in its removal and cleaning, making it more susceptible to further deterioration (von Endt 1979; Williams and Rogers 1989; Shelton and Buckley 1990; Williams 1992).

The composition of bone will start to alter as soon as the animal dies. On death, post mortem changes can cause the spontaneous re-ordering of the crystalline matrix and the presence of internal water can act on the bone proteins. Cellular metabolites and enzymes can also remain active and, once out of the control of the life processes, can cause degradation reactions. Overall two main events contribute significantly to the degradation of bone;

* Protein hydrolysis
* Crystal matrix modification

As the mineral-protein bonding becomes disrupted by these processes, the bone becomes softer and more friable. The degradation of the protein involves the unwinding of the helix in conjunction with the breaking of the polymer chains from the addition of water. This hydrolytic action breaks down the collagen into smaller polypeptide units and amino acids. The constituent amino acids are further open to steric changes such as racemization that will alter bonding relationships. If the disintegration of the protein goes far enough then the friable organic ghost of the bone will be all that remains. During the hydrolytic processes other reactions may proceed which can further accelerate the degradation of the bone. Oxidation (especially of lipids); decarboxylation (removal of the carboxyl group); deamination (removal of the amine group) and 3 dimensional changes such as

Figure 2: A simple representation of the collagen triple helix. Each collagen fibril is linked by hydrogen and covalent bonding



epimerization and racemization. Some amino acids resulting from the hydrolysis of bone proteins can undergo decomposition reactions that result in other organic chemicals and ammonia. These acid and amine products are themselves reactive and can further degrade bone.

Many of these degradation processes can be driven from the existing biological components of the bone. However, if water is introduced, the bonding between the mineral and protein portions of the bone is further weakened. This can cause the interior portions of the bone to become more accessible to these chemical processes increasing degradation. Steric changes and substitution can also occur within the crystals, further weakening the bonding between the mineral and protein portions of the bone.

Environmental factors can further affect the bone in a numbers of ways. Temperature will alter the rate of reaction, the higher the temperature, the faster the rates of hydrolysis and other chemical reactions. The relative humidity can have both a gross structural affect as well as a chemical effect through the introduction of water at high humidities.

Atmospheric pollutants can also have an effect, particularly acids that can combine with water to form hydronium ions. These can promote hydrolysis and increase the degradation of bone, through both the destruction of the protein and by dissolving the apatite mineral. The same can occur with bases such as hydroxide, which can also increase the rate of protein hydrolysis. The more porous the bone the greater the surface area, the greater the reaction rates.

The long-term degradation of modern bone is not clearly understood. Work by von Endt and Hare (1996) has looked at the degradation products from modern bone at high temperature and relative humidity. Their work found significant degradation in the amino acid pattern in the bone, and the production of the major deterioration product of the organic component of bone, ammonia. At low humidities, but high temperatures volatile oxygen containing hydrocarbons were found to be released, probably from heat activated reactions from the lipid portion of the bone. These were followed by cyclic organic molecules containing nitrogen, pyrrolidines and their derivatives, which are formed from the amino acid precursors that make up the organic component of bone.

With all these factors acting on the bone, it is surprising that bone is as durable a material as it is. It is thought that the presence of the mineral phase retards denaturation of the collagen (Collins at al 1995). This could be due to mineral-collagen bonding via calcium bridges. Also, despite the porous structure of the bone, the collagen still forms dense bundles which can help resist the effect of enzymatic dissolution, especially into the mineral-protein composite where it is difficult for molecules larger than water to penetrate. The result is that the collagen in mineralised tissue is more resilient to degradation than non-mineralised collagen tissues such as the skin.

Biochemical changes with the preparation of bone

When preparing bone it will be important to consider the potential uses of the specimen, and this may influence the choice of preparation method. Ideally we are aiming to maintain the bone in as natural a condition as possible for technical research; biochemistry; genetics; environmental chemicals. Introduction of reactive substances will alter natural components, leave chemical residues or reaction by-products (Matienzo and Snow 1986; Shelton and Buckley 1990; Williams 1991; Williams 1992). The introduction of oestological materials to adverse environments (e.g. solutions, fumigants) will compromise structural and material stability, conflicting with current museum conservation ideals. However if the specimen has limited data and is required for teaching or display then the ethics of preparation could be considered more 'flexible'.

The previous brief review of the deterioration of bone now puts us in a position to consider the effects of preparation methods on bone. Skeletal preparations can be prepared from the whole animal in a number of ways (Wagstaffe and Fidler 1968; Hounsome 1988; Davis and Payne 1992; Hendry 1998);

- Cold water maceration – possibly with the addition of enzymatic detergent.
- Warm water maceration – again with possible addition of enzymatic detergent
- Hot water maceration
- Chemical – sodium and potassium hydroxide; ammonia solution, sodium perborate (also consider final degreasing treatments).
- Scavenging organisms e.g. *Dermestes* spp
- Burying in sand

Generally the most commonly used method is some form of maceration with the addition of some enzyme activity by using a biological washing powder. This is due to basic maceration methods being easier to maintain and run than less invasive methods such as using *Dermestes* beetles.

However as has been previously discussed, the important aspect in maintaining the structure of the bone is the state of the protein – mineral interaction. Degradation of this will deteriorate the bone. Bone is a porous material open to the introduction of water and other aqueous borne compounds. Thus any process involving water and indeed heat must be considered destructive (Williams 1992). Combined with this bone is hygroscopic and anisotrophic in nature, and essentially such methods as maceration (with or without enzymes) can considerably alter the chemistry of the bone for biochemical and genetic investigations as well as promoting the rates of deterioration. Also the use of enzymes can also have a long term damaging effect on the bone, causing gradual and continual degradation of the bone protein. If using enzymes it is very important to consider a neutralising step.

Many institutions use methods that employ scavenging organisms such as Dermestes beetles, which overall damages the bone very little, although the subsequent washing procedures or treatments (bleaching, alkaline solutions, chemicals for pest control) can be detrimental. Alkaline solutions are particularly damaging to collagenous material, especially >pH9. Broadly it can be considered that cleaning solutions will be deleterious to proteinaceous materials, acidic solutions can dissolve the mineral component, and fumigants or pest control chemicals have the potential to degrade collagen and lipids. Combined with this will be the

effects of environmental factors, specifically through excessive temperature and RH. Essentially the elimination (as much as possible) of fumigants and aqueous solutions should improve the long-term stability of the bone, as well as promote a healthier work environment.

How the specimen has been previously stored prior to preparation of the bone material may also have effects that require consideration (e.g. Williams and Rogers 1989);

- Freezing – may promote desiccation.
- Alcohol – desiccant, may promote mobilisation of lipids and possibly cause material reactions with the ultrastructure of bone. The result is a whitening of the bone, which may cause later problems with desiccation and embrittlement or be beneficial through the removal of these substances, as they will not contribute to the deterioration through oxidation or the formation of acid by-products.
- Formaldehyde – can cause a staining of the bone probably through the fixation effect on the protein component.

Chemical effects on other skeletal elements

The skeleton consists of more than bone;

* Teeth – enamel; dentine; cementum
* Cartilage – connective tissue
* Ivory.

This results in a complex mix of materials that potentially respond differently to chemical treatments and environmental influences. e.g. with the dentine in teeth. This is hygroscopic and, as it absorbs water, internal stresses develop that cause internal stresses (Williams, 1991). As the crack develops the surface area increases, subsequently increasing the rate of deterioration. Connective tissue can be damaged by bleach where the pH is above 12. Ivory has been found to be extensively altered by treatments such as HCl due to formation of amino acid salts. Such ionizable residues make the material more hygroscopic (Matienzo and Snow 1986).

Conservation treatments – cleaning and consolidation

When considering the role of consolidation and cleaning treatments it must be questioned whether the work is necessary. The role of cleaning must be carefully considered as the addition of water can be particularly damaging to the protein-mineral interactions in the bone. Treatments with other standard organic solvents can also bring more organic matter to the surface of the bone.

However bone will need cleaning, whether for display, teaching or to remove the grime of time which in itself could be damaging the bone. The main recommendation is not to overtreat the bone whatever method is chosen. If using aqueous solutions do not over wet the bone surface and remove the solution as quickly as is possible. Some general recommendations can be:

- 10% sodium bicarbonate solution – can be very good (Photo 1). Has also be used to help degrease bone (Horie 1988).
- Synperionic N – non-ionic detergent, with the addition of very small amounts of EDTA and PVP to help chelate and remove dirt (Horie 1988; Jaeschke and Jaeschke 1992).
- Decon 90 – can be useful with very greasy material but is a very alkaline solution and must be used with caution.
- Organic solvents, e.g. Acetone. Consider their use with care and in relation to health and safety practice in your work environment (Horie 1988; Jaeschke and Jaeschke 1992).

But what if the bone requires repair or consolidation?

This is a tricky area. Past treatments with consolidants have caused problems in museum collections. The consolidant has started to degrade over time causing damage to the specimen. Often the consolidant has become chemically changed and the treatment becomes difficult to reverse. Materials such as shellac have caused particular problems. Whenever considering using a consolidant, take time to research the material and to assess its possible long-term stability and potential reversibility. There are a number of consolidants around with a proven history, and some are mentioned below. However it must be remembered that such polymers used in conservation are commercial compounds, and their properties can vary between batches.

- Paraloid B72 – an acrylic polymer miscible with solvents such as toluene or acetone (e.g. Koob 1984; Horie 1987; Jaeschke and Jaeschke 1992). This is useful as a surface consolidant, or for basic repairs of breaks, although the strength of the repair will not be very high. B72 is also useful as a filler (photo 2) when mixed with glass micro-balloons (for further details on fill materials in conservation see Craft and Loew 1998). The advantage of B72 is that it is very stable and reversible. It is however difficult to mix and tends to work best with fast evaporating solvents such as acetone which can make it difficult to work with. To reduce the rate of solvent evaporation and increase the penetration of the polymer a 50:50 mix of acetone to ethanol is useful.

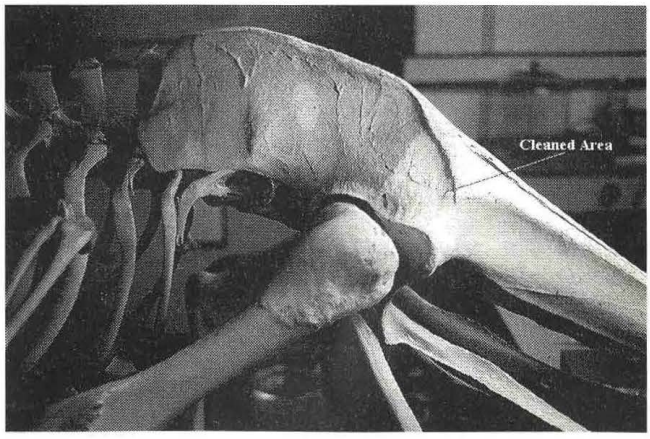


Photo 1: Ostrich skeleton, partially cleaned with IOY sodium bi-carbonate solution

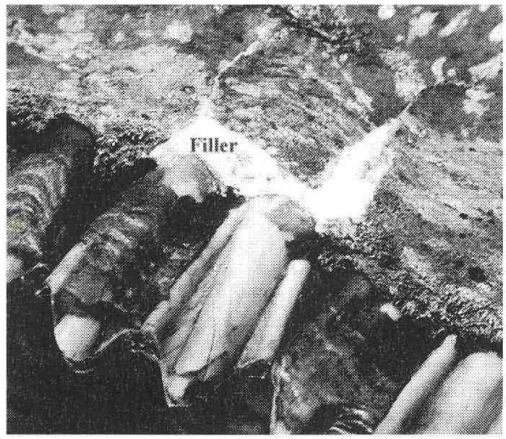


Photo 2: Repair using Paraloid B72 mixed with glass micro balloons

- Primal WS24 – this is a short chain acrylic dispersion miscible with water (Koob 1984; Horie 1987). This is very useful in the consolidation of weak friable bone as it is readily absorbed, and appears to be stable. However due to its ease of absorption it is not reversible, and it will introduce water to the bone with some degree of biochemical change.
- PVA's – Polyvinyl acetate (Horie 1987). Popular with paleontological material but tend to have a high degree of plasticer added, although plasticer free PVA is apparently becoming available.

If a strong repair is required then epoxy resins will need to be considered. However these are not reversible, and often stronger than the repair surface (it is recommended to coat the repair surfaces with a polymer such as B72 prior to epoxy repair). They are also non-reversible, can shrink a lot on drying pulling the bone surface with it and can have acidic off-gassing products on curing.

Storage Effects

We may think that our collections are safe once stored away in our collection areas. But think again. Many potential problems await. Some notable concerns are;

- Acidic offgasing products from storage units. Many materials will release corrosive chemicals that can react with stored object. Thus the storage environment of the collection must be evaluated (see von Endt et al, 1995).
- Temperature and humidity fluctuations. Inappropriate storage temperatures and humidities levels can significantly aid the deterioration of an object (Mathias 1994) More importantly if these factors are allowed to fluctuate then this can cause continual structural alterations in the object as it responds to the environmental changes. The result is the degradation of the object as cracks open up and increases the surface area for degradation reactions.
- Insect pest damage. A subject which now has a great deal of information, especially in relation to Integrated Pest Management (e.g. Pinniger 1994; Linnie 1996). Bone is open to insect damage (e.g. Carter 1995), especially if there is available moisture.

These problems can often be dealt with quite simply e.g. if you keep the doors on a storage cupboard closed, the humidity and temperature fluctuations that occur in the room as a whole are markedly reduced within the storage unit. This can be further improved with good enclosed storage boxes for the specimen. Secure storage units can also help deter insect visitors, although always keep a monitoring programme going, a good storage unit can also keep insect visitors in. Good hygiene will also greatly deter any insects, as will regular disturbance. If your existing storage furniture has an off-gassing problem, and replacement costs are prohibitive then some form of barrier lining may be possible (Thicket, 1998; Ganiaris and Sully, 1998). For a good review on aspects of preventative conservation see Rose et al 1995.

Bone is an important element in many areas of museum collection; natural history, ethnographic; art; archaeology; palaeontology. How we prepare, store and subsequently conserve our specimens will all have an effect on the biochemistry of the bone. It is important that we continue to care and research our collections, thus gradually improving our knowledge and understanding for this remarkable material.

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Moving Large Articulated Skeletons

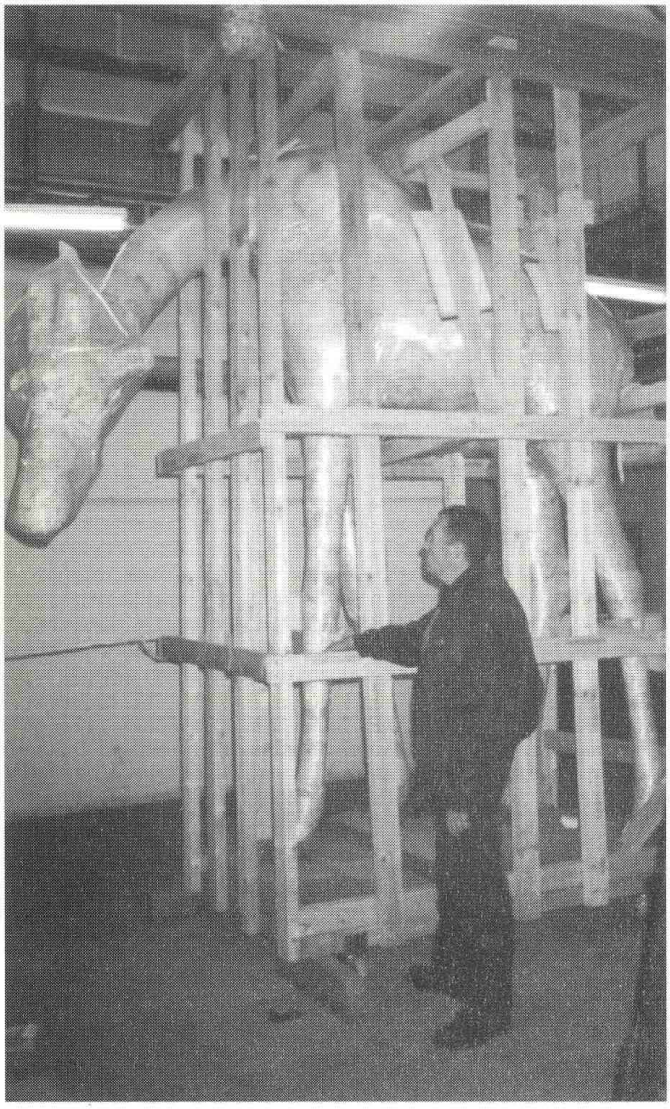
In the current climate of building projects and ever-changing gallery displays, all museums eventually have the problem of moving collections, either internally or to off-site storage facilities. The skills required to move collections, whether large in numbers of specimens or large in terms of the size of individual objects, is rarely present in-house. External contractors will be required in many cases.

We have a Museum Services Division with a dedicated team of operatives experienced in the handling and transport of museum collections. We understand the museum ethos and we believe in solving problems in conjunction with curators and conservators, to ensure the safety of collections. The need to protect specimens and provide a sealed environment to minimise changes during movement, are central to the way we work.

I'd like to talk to you today about how we move specimens, the problems that occur and some of the ways we have developed to overcome them I will be concentrating on a number of moves which we have undertaken here in the Natural History Museum.

When faced with moving specimens like the articulated skeletons of fully-grown elephant and giraffe, the first question to be asked is 'can this be moved complete or does it need to be sectioned?' The answer to this question is always 'is there enough room to physically and safely move the specimen from A to B?' Assuming a complete physical move cannot be achieved, the next stage is to stay the construction of the specimen from the point of view of its constructor. If you study the method of securing the joints, it becomes apparent which parts can be easily separated and which, if possible, should be left intact. Our policy has been to section a specimen as little as possible to minimise disruption to the specimen.

We were recently tasked to relocate six articulated elephant skeletons from this museum to a new storage facility. These specimens have been in store for many years and building work, principally ducting and fire-door systems, had severely reduced the available headroom. Therefore, the specimens needed to be sectioned prior to removal.



Most large land mammal skeletons section in three major areas – skull, rib cage and limbs. Our experience has taught us to section along these lines. Our first step is always to remove the vulnerable scapulae. These are almost always connected with steel pins and just require lifting off. Using a genie lift, we then remove the skull. This is usually bolted to the steel bar which runs through the vertebrae. The next stage is to secure the skeleton to the lifting tackle via this central supporting bar. The weight of the specimen is then held by the lifting mechanism and the limbs can be detached. These are usually secured by steel pins which are easily removed.

To avoid completely dismantling the skeleton, we then cut through the two one inch thick bars that provide the upright supports. The risen section of the specimen, witch includes the rib cage, can then be secured in a purpose-built crate. A specimen may be reduced to six manageable sections, which can be easily and safely moved.

This method was used to section the six elephant skeletons. On arrival at the store, the specimens were reassembled, The only destructive part of the operation, cutting the steel supports, was repaired using inch and a half tubular-steel sleeving.

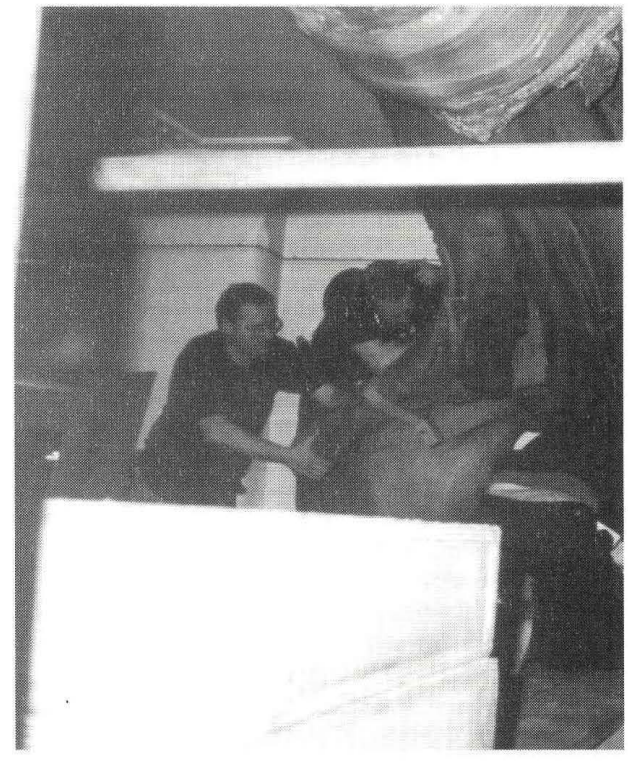
At the same time, it was also necessary to move an articulated giraffe skeleton which stands approximately 16 feet high. The specimen is in excellent condition but, unfortunately, the framework supporting it had begun to deteriorate, to the extent that it needed temporary supplementary supports.

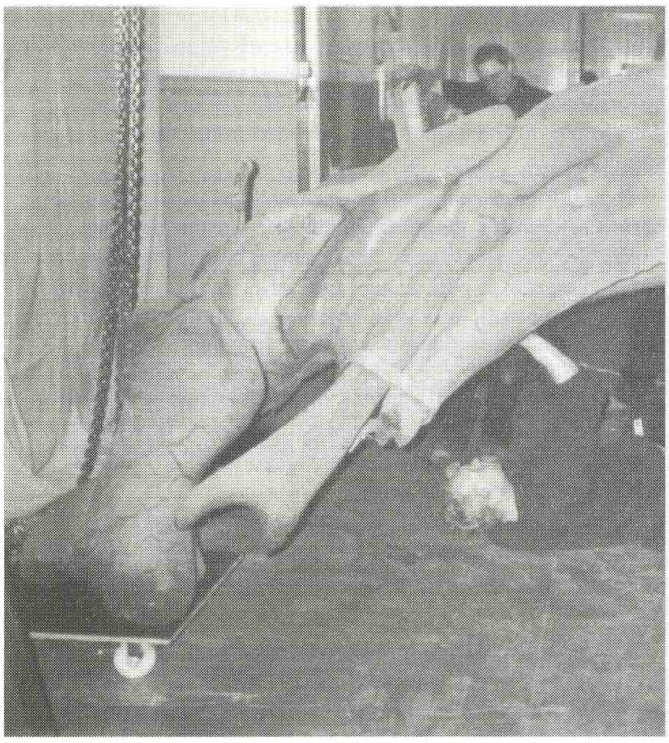
The skull and neck of the giraffe had to be detached to permit removal from the museum. We cut through the supporting rod, low down, at a point which allowed us to repair the section with a steel tube after relocation. A long timber framework was then built-up around the remainder of the skeleton. The skeleton was then attached to this frame, principally using it's legs which had been protected in advance. We were then able to turn the specimen over onto it's front and place it on movement skates. A 16-foot high specimen had effectively been reduced to a very manageable 6'8" high, 10-foot long case.

After relocation and rebuilding of the specimen, we prepared and fitted new lateral and rear supports, in addition to a head support, which allowed the specimen to stand freely.

Articulated sea mammal skeletons present unique problems in storage and movement. Due of their shape, they are usually suspended for display or storage purposes. A dolphin is relatively easy to move but when we were contracted to move an18-foot elephant seal, a longer-term solution was required. An inexpensive open wooden frame on wheels proved a good solution to the problem.

The skeleton was sealed with acid-free tissue and bubble-wrap and then braced within the frame with tape. In the new facility the skeleton was unwrapped and left suspended in it's frame. This could be easily moved within the store and made the specimen readily available for curatorial and study purposes.





A recent challenge involved a long-time resident in this museum's osteology department – the skull from a bowhead whale which weighed approximately 2 tonnes. Deterioration in the, supporting framework necessitated it's removal to a safer area. Initial problems related to the space beneath the specimens. This space contained storage cupboards and a partition. The partition was easily removed but unfortunately, the cabinets could not be moved at this time. Our task, therefore, was to move the specimen forward 2 feet and then lower it to the floor prior to removal.

Our first task was to remove the mandibles. We then erected a staging underneath the specimen. This staging was designed to allow us to move the specimen forward the required 2 feet. The rear of the specimen was raised 6 inches and landed on movement skates.

The front of the skull was then raised and landed on its movement skate. The specimen was, at this point, secured to two block and tackles, front and rear, as a safety measure. The skull was then moved slowly forward until it was clear of the storage cabinets.

The specimen was then raised slightly on the two tackles and inspected for any structural weaknesses before proceeding When we were satisfied that the skull was stable, the staging was removed. The skull was then gently lowered to the ground.

The front of the skull was secured on a mobile frame and an inspection was made to decide, in conjunction with the curators, where the skull could be sectioned to facilitate removal. A previous break along the line of a suture was identified and agreed as the best option.

Using the blocks and tackles, the skull was successfully sectioned, removed from the museum and transported to the new storage facility.

When the decision was made to relocate two type-specimen mounted giraffe skins, one mounted in an upright position, the other mounted with it's head and neck bent forward, my assertion some months earlier that they could be, moved complete focused my mind on the accompanying problems.

The problems were immense. Physical removal, physical protection, environmental protection, time-frame problems, the list was growing. We set about formulating a plan, stage by stage.

After thoroughly measuring the specimens, we studied all possible exit routes. The specimens were stored in the basement, so we started there. Construction work over a period of years, consisting of trunking, fire-doors etc., ruled out any route from the basement to the rear of the building. This left us one option – through the trapdoor into the main hall and then out through the main entrance.

Having established our route, we undertook to protect and secure the specimens for removal. Firstly we completely covered the specimens in acid-free tissue because they were travelling on an open vehicle we needed to protect them from pollution and possible infestation. A covering of bubble-wrap afforded some protection against temperature and humidity changes. Finally, the specimens were completely shrink-wrapped. This effectively sealed them against inclement weather and infestation.

The specimens were then encased in strong timber frames. This allowed us to move and turn them without fear of damage. Finally, because of our exit route, the removal timings had to revolve around museum opening times. Our plan was to bring the two specimens into the main hall starting at 19-00 one evening. We then planned to remove and deliver the upright specimen that night. We planned to remove the smaller specimen the next morning, starting at 6.00 with completion by 9.30 to allow the museum to open at 10.00 as usual.

The upright giraffe was moved up from the basement via the trapdoor using an overhead hoist. Once the specimen was clear of the trapdoor we manoeuvred it over onto hardstanding in the main hall. The second giraffe was then brought up into the hallway. Using the overhead crane, we then turned the largest specimen onto its back, manoeuvred it to the doorway and then with the assistance of a crane we slowly cantilevered it out of the building. The larger specimen was then loaded onto the vehicle. It needed to be loaded in such a way that the overall height of the vehicle and specimen was less than 16'2" to avoid low bridges on the journey.

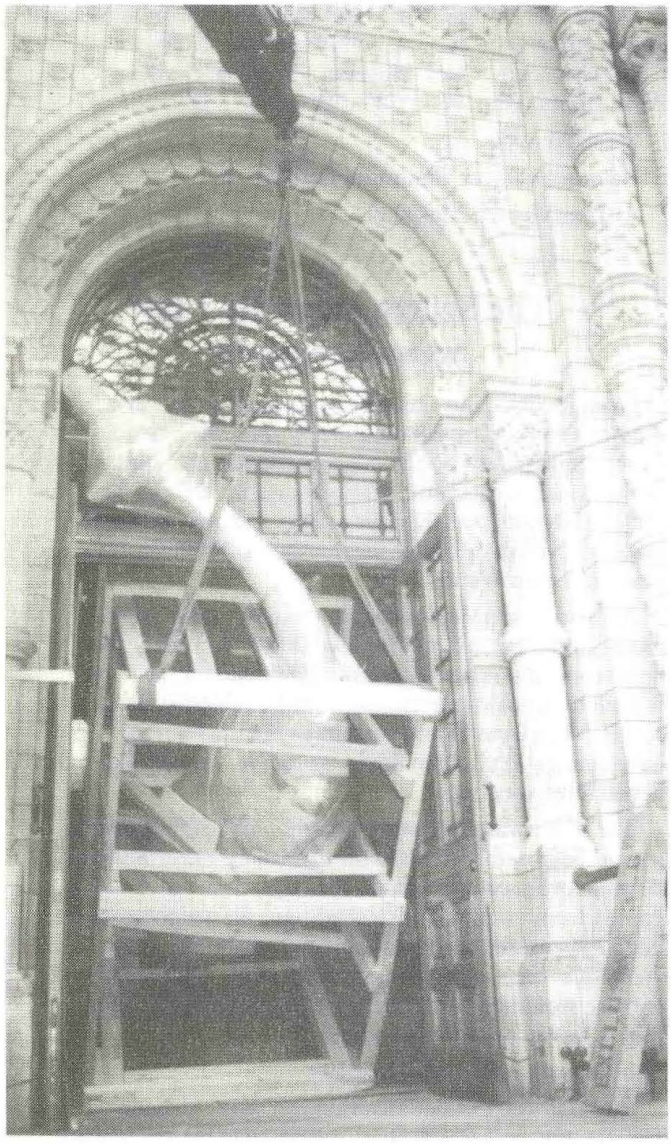
The next morning, we began the most difficult part of the operation. This was to remove the smaller giraffe, which had its head and neck mounted bending forward. We needed to turn this specimen 180 degrees to allow us to feed the head through the doorway, connect our crane to the framework and then slowly inch the specimen out of the doorway. We elected to do this difficult task last because it could be completed in daylight. Long sighs of relief all round when it was successfully loaded onto the vehicle.

George Orchard

Senior Manager

Industrial Moving Divison

Exclusive Group PLC



Postcard from Margate

After close of business at Bones II in the Natural History Museum, on 25 March 1999, the remaining delegates departed by coach and car to Margate for the next part of the Skin & Bones BCG meeting.

I am glad to report that the social side of the meeting was as lively as ever. After arrival and unpacking at our sea side hotels the group met for drinks and a very reasonably priced and tasty Indian meal. The venue for the second night of our festivities was an unsuspecting Italian restaurant.

We were collected from our hotels by coach for a short trip to the Powell-Cotton Museum. After coffee and biscuits, the group dispersed to view the stunning taxidermy dioramas in the museum. The gasps of amazement were audible! The dioramas are stunning in their quality, scale and the range of animals from Africa and Asia that are displayed. The museum also houses galleries devoted to the ethnographic objects, porcelain and local archaeology collected by Major P.H.G. Powell-Cotton.

A packed day of talks followed a warm welcome from John Harrison, Curator of the Powell-Cotton Museum, and an introduction from David Carter, Chairman, BCG. The BCG AGM was held at lunch time.

DAY 2: Skin – The Future of Taxidermy.

Summary of the meeting held on the 26th March at The Powell-Cotton Museum.

Presentation about the Powell-Cotton Museum

Malcolm Harman, Assistant Curator (Natural History), took us through the life of Major P.H.G. Powell-Cotton and the history of the museum. Major Powell-Cotton travelled extensively in the 19th century, mounting 28 expeditions to explore Asia and Africa. He hunted big game and worked with a network of natural history traders to form his collection of natural history specimens, that includes important collections of the giant Angolan sable and primates. Photographs and data on latitude, longitude, weight and horn measurements were collected with the specimens. Roland Ward Ltd undertook the taxidermy of the mounts. The dioramas were constructed at the end of the 19th century to illustrate the wildlife of Africa and Asia. They contain 500 animals in settings that represent savannah, forest and swamp habitats.

There is a cleaning programme for the specimens on display and the importance of stable relative humidity and temperature for taxidermy was discussed. There was an opportunity to view a display of photographs, letters and other documents relating to the expeditions of Major Powell-Cotton and to the taxidermy by Roland Ward Ltd in the museum.

Victorian attitudes to animals and taxidermy

Dr Pat Morris reminded us not to judge 19th century taxidermy by the standards of society today and that museums should preserve the specimens, attitudes and ideas of the past. Characteristic Victorian taxidermy includes anthropomorphic taxidermy, mounted pets, hunting trophies, the use of animals to make furniture and comparative studies of birds and mammals that may be rare and protected under the law today.

A working taxidermist's view of the profession today

Kim McDonald spoke about modern taxidermy and the future for the profession. In 1976 the Guild of Taxidermists was formed to promote and teach the art of taxidermy, support the legal acquisition and handling of specimens and guide the professional conduct of taxidermists. The future of taxidermy rests upon educating members of the public about taxidermy and the productive use of legally acquired specimens, for instance, for educational purposes.

The educational value of taxidermy in museums

Carol Leverick, Schools Operations Manager, Natural History Museum, told us how the real objects in museums can engage people and how education using taxidermy can be based upon observation of specimens, practical tasks and national curriculum topics. However, people need a context for what they are seeing. For example, children often ask "Is

it real ?" – they could mean "Is it alive ?" – a very different question. It is also important to remember what these objects may not be telling us – for instance, information about the behaviour or movement of animals.

The real natural history

Dr James Brock, Keeper of Natural History, Horniman Museum, talked about the real natural history – our natural history collections in museums. Natural history museums and their curators have a poor public image. To improve this image museums need to explain why they have such collections and what curators do with them. People often do not realise that real natural history specimens are used in education, supporting conservation initiatives, and in research that leads to the understanding of systematics, biodiversity and evolution.

Taxidermy – an outsiders view

Maurice Davies, Assistant Director, Museums Association, felt that taxidermy in museums was a wonderful and popular resource. He urged museums to do that resource justice by improving the presentation and interpretation of such material.

A lively debate followed the presentations. The subjects discussed included attitudes to taxidermy, zoological material and past collecting; interpretation of natural history collections, access to collections and research in natural history museums.

DAY 3: Tour of the Powell-Cotton Museum Stores

On day three of the meeting the remaining BCG delegates and members of the Taxidermy Guild viewed the storage areas behind the scenes at the Powell-Cotton Museum. The museum has large collections of animal skins and osteology, including important collections of skull material. This material is invaluable for research purposes because of the data collected with the specimens. Malcolm Harman, Assistant Curator (Natural History), told the group about ongoing initiatives to improve storage of the collections. As with most museums, there is a perennial lack of space for storage. The tour ended with a visit to Quex House.

For further information about the Powell-Cotton Museum please contact the curator, John Harrison, at The Powell-Cotton Museum, Quex Museum, House & Gardens, Quex Park, Birchington, Kent CT7 0BH. 01843 842168.

Sarah Kenyon

Natural Sciences Curatorial Officer

Saffron Walden Museum.

The Scarce Hook-tip Moth *Sabra harpagula*

From its discovery in 1837 to its apparent demise in 1938, the Scarce Hook-tip Moth *Sabra harpagula* was only known from Leigh Woods on the edge of Bristol, the southern side of the Avon Gorge. Until it was found in 1962 in the Wye Valley the moth was thought to have become extinct, happily it still thrives at the latter locality but it has never been seen again in Leigh Woods.

As part of a project mapping the past and present status of moths in the Bristol region, I would be extremely pleased to hear from any museum or individual who has specimens of this moth in their collections. I am particularly keen to receive data from Bristol specimens but even if you do not have time to extract the data I would very much like to know if you have specimens.

The moth was never very common at Leigh Woods and it should be possible to build up a database of virtually every Bristol specimen still extant. It is hoped the information gained from them will also shed light on which years were good seasons for the moth and how successful the old collectors were in breeding them. Details of the method of capture would be particularly useful as would knowing of blown larvae or other life stages.

If you can help please contact:

Ray Barnett, Collections Manager, City Museum & Art Gallery, Queen's Road, Bristol BS8 1RL Tel.: 0117-922 3600 E-mail: ray_barnett@bristol-city.gov.uk

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