Biology Curators Group Newsletter

Title: The renovation of the bird gallery at The Manchester Museum Conservation aspects

Author(s): Horie, C. V.

Source: Horie, C. V. (1983). The renovation of the bird gallery at The Manchester Museum Conservation aspects. *Biology Curators Group Newsletter*, *Vol 3 No 6*, 331 - 338.

URL: http://www.natsca.org/article/1391

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1. Introduction

The natural history galleries in The Manchester Museum were designed as part of the Victorian gothic buildings which form the nucleus of the University of Manchester (fig.1). The galleries form a long north-south rectangle with a main floor and two balconies around a central well. The middle layer of the galleries had been neglected over many years and the poor condition of the displays prompted a renovation in 1980/1 (1). This gallery housed, in display cases and in storage cabinets, collections of mounted birds, osteological specimens, specimens in fluid storage (the spirit collection) and other miscellaneous zoological items.

The conservation related work can be divided between improvements to environmental conditions of displays and storage and treatment of specimens.

2. Environmental control

2.1 Display area

The gallery was originally designed to be lit by natural light, supplemented by gas flares (fig.2). Accordingly the cases are set in bays between the windows along the gallery with skylights down the centre to illuminate the well. Obvious damage had occurred to the specimens by the action of daylight and sunlight which had streamed in over many years. Although in the late nineteenth century and early 1900's roller blinds were used on the windows to control the light, these had long since been removed. The skylights had in recent years been treated with a light reflecting film (Scotchtint) but this film is inadequate as it keeps falling off due to the action of water condensed on the glass. It is proposed to obscure the skylights completely in the near future. The use of solar control films on the windows of the gallery was investigated (3) but rejected as the achievable light reduction would not be deflected. Dark coloured vertical blinds (Permaglass) were chosen to deal with these problems. Unfortunately blinds are more vunerable to wear and vandalism so providing problems in long-term maintenance. The blinds, which have been placed over all the windows in the natural history galleries, have reduced the ambient light levels to be used to illuminate the specimens adequately. The iron-framed windows in the gallery were repaired and gasketted to reduce leakages of the outside air which carries pollution.

The gallery retains the original mahogany display cases which run from floor to ceiling. The redundant displays were stripped out and all cracks and holes filled with a non-setting mastic (Arbomast) or Polyfilla as appropriate. Access is gained to the cases by large glazed doors which, with the carcasses, can distort significantly with changes in relative humidity. The doors and frames had been provided with re-entrant mouldings along the edges to restrict the flow or air into the cases. These had been supplemented by velvet pasted onto some of the mating surfaces. Although this protection probably improved the conditions, dust settling in the cases had been a constant problem. Attempts were made during the renovation to improve the seal by running a strip of closed cell PVC foam around the gap. Unfortunately the width of the gap in some cases varied more than the foam could accommodate without interfering with the closing of the door. The air-tightness of the cases was improved by the gasket though other methods will be substituted in future developments.

The lighting in the gallery had been from a combination of daylight and fluorescent tubes hung outside the cases. In the renovated gallery the lighting had to be supplied from within the cases though of course

this causes problems of heating and thus exchange of air between the case and gallery. The fluorescent tube control units had also to be housed within the cases which added to the heat build-up. The new lighting was by a combination of fluorescent tubes to provide a background illumination with LOW wattage spot/flood lamps on light tracks for directional light. The fluorescent tubes finally used were Trucolor 38 (Philips) which require UV filters (Morden) to reduce the fading of specimens. The lamps on each light track are controlled by a dimmer. his combined with directing the main focus of light slightly away from a specimen gave flexibility in providing good quality light at relatively low light levels. The maximum on any one specimen is 400 lux, frequently well below 200 lux. These were the minimum illumination levels achievable within the constraints of the building and case construction, and the design of the exhibition, but are well above limits suggested by Thomson (4).

Dust levels are monitored by collection of the dust which will be examined microscopically. The rate of fading caused by the lighting is monitored by a series of blue wool ageing standards (5). Humidity levels in cases are monitored thrice weekly. No measures of humidity control were feasible in the gallery.

2.2 Storage Area

As part of the renewal programme a store room for the large number of displaced mounted birds was prepared. A basement room carrying relatively few service pipes and wires but with some window openings along two sides was sealed by plastering over cracks, vents, window openings etc. This brought the rate of exchange with the outside air down from ca. 80 cu.m/hr. to ca. 6.5 cu.m/h. (6). The concentration of dust was reduced from ca. 64 ug/cu.m. to ca. 37 ug/cu.m. with the particle size remaining roughly the same at ca. 0.77 um. (7). A recirculating dust extractor installed to remove the fine dust unfortunately caused stirring of dust rather than removal. Dexion racking was erected to take the mounted bird specimens on open shelves. The provision of a storeroom with clean air was thought to be a far cheaper and less time-consuming option than boxing all the specimens individually.

A storeroom was prepared for the many spirit specimens displaced from the gallery combined with other zoological spirit specimens from around the museum - a total of 3771. These were provided with Dexion racking and arranged in order on the shelves. Other displaced collections, such as the osteological material, were put in a holding store for consideration at a later date.

3. Deinfestation

During the preparation of the mounted birds for display two dermestid beetles were discovered in the room being used temporarily for storing all the specimens. The risk of infestation running through the whole collection was felt to be sufficiently great to justify the deinfestation of all the specimens. Various possibilities were considered e.g. treating each specimen with insecticide, taking all the birds to a vacuum fumigation chamber, and sealing specimens into plastic bags with dichlorvos insecticide. The method chosen was fumigation of the entire room containing the specimens.

Fumigants are gases toxic to insects and humans and the time necessary for adequate penetration of the fumigant into the specimens is about 72 hours. Advantage was therefore taken of the closing of the Museum over the Christmas period (1980). The fumigation was carried out by an outside contractor (Rentokil) who recommended the use of phosphine, in preference to methyl bromide (possible adverse reaction with the specimens), hydrogen cyanide (too likely to diffuse into other parts of the Museum) and ethylene oxide

(at the levels of concentration required, too severe a fire risk). All ventilation holes, doors, windows and the gaps around wiring and pipes were sealed with brown paper and masking tape. The phosphine generator (calcium phosphide) was put in place and the room sealed for four days. By the end of this period the concentration of phosphine had already dropped by reaction with materials in the room and by diffusion out of the room. The room was ventilated by leaving the windows open for several hours and the Museum was opened the following day. At no time was phosphine detected by smell or Draeger tube in the museum galleries or other rooms of the building.

This fumigation will have killed any insects in or around the specimens but provides no long term protection. To achieve this vapour phase insecticide (dichlorvos) strips (Vapona) were hung in all the display cases when work in these had finished. As these had been moderately well sealed and were not opened, lethal concentrations of insecticide would be maintained over many months and would deal with any infestation arising from the specimens, mounts, display materials, cases or the gallery. The cases are opened only rarely to change lamps or filters with little chance of reinfestation. The dichlorvos strips will therefore not be renewed except when necessary.

4. Treatment of specimens

Most of the mounted birds required treatment of some sort. Approximately 1,250 birds were cleaned though some which had been boxed in glazed cases were sufficiently clean. Of the 786 birds that were used on the display about 50% required some minor repair work, about 25% required more major repair work and about 90% required some work in remounting. In addition to the mounted birds, 29 skeletal exhibits were repaired or prepared. 100 eggs were cleaned and 15 nests were cleaned and consolidated. Although not strictly part of the bird gallery, a whale skeleton which hangs in the well of the gallery and is viewed from this floor was also cleaned.

Each object dealt with had the details of the treatment recorded in a standard format. Unfortunately lack of money and time prevented the usual photographic recording.

4.1. Cleaning

Cleaning was carried out in various stages depending on the soiling, the more vigorous methods being used only if necessary.

1) Loose dust was removed using a soft brush aided by compressed air.
2) Greasy dirt, the result of city pollution, was removed by wiping down with cotton wool swabs moistened by a 1:1 mixture of Genklene 1,1,1-trichloroethane) and alcohol (IMS).
2a) Persistent stains were swabbed down with alcohol, Genklene or petroleum spirit (100/120).
2b) Stains insoluble in organic solvents were treated with water, a 1% solution of non-ionic detergent (Synperonic N) in water, or a 1-5% solution of .880 ammonia in water as necessary. The detergent or ammonia was removed by swabbing with water. Following the aqueous treatment the affected area was swabbed down with the alcohol/Genkelene mixture.
3) The mounted birds were then dried using a cool stream of air provided by a hair drier. The feathers were arranged using a brush or pin during the drying.
4) Birds that were badly stained overall or had heavily soiled white plumage were sometimes swabbed with a commercial biological detergent and then treated as 2b.

5) Skeletal material used on the gallery was first cleaned with a 1% solution of Synperonic or a 5-10% solution of ammonia. Greasy osteological material was cleaned with ammonia solution, petroleum spirit, acetone or trichloroethylene. Small specimens were treated in a soxhlet extractor, larger ones were sometimes treated in an ultrasonic tank.
6) Dirty bird eggs were cleaned with Synperonic solution.
7) The whale skeleton posed greater logistical problems. Scaffolding was erected (fig.3) and the skeleton was vacuum cleaned then scrubbed down with a mixture of 1% Symperonic, 2% .880 ammonia and 10% IMS in water. The detergent mixture was rinsed out by spraying with water from a high pressure portable plant spray. The rinsing was repeated until the water ran out of the bone clear. After drying for two weeks the bone was coated with two coats of a 10% solution of poly vinyl butyral (Mowital) in IMS.

4.2 Repairs

1) Large broken feathers, i.e. with cracked rachis, were repaired with a cellulose nitrate adhesive (HMG). Sometimes a fine stainless steel wire was inserted into the rachis to give support.
2) Bent and distorted feathers could often be restored by moistening, rearranging and then drying in the new position. Others could only be restored to their natural position by gentle steaming. Brittle feathers which were often also badly faded, usually proved difficult, if not possible, to restore.
3) Split and torn skin was stitched back into place on the larger birds where the skin was not too brittle but in most cases the specimen had to be left unrepaired. Where the splitting produced a flap of loose skin and feathers it was sometimes possible to glue the flap down with HMG.
4) Broken or missing eyes were replaced with a matching one where possible. Otherwise both eyes were replaced by a matching pair.
5) Chipped beaks or claws were repaired by filling the hole with epoxy resin (Araldite AV100/HV100) or plaster of Paris and then grinding down to match the line of the original. The repair was then painted with oil paints.
6) Missing beaks and claws were usually replaced by taking a mould, usually in Plasticine, from a similar bird. A replacement was then cast in plaster, Araldite or an acrylic casting resin Acrulite). After shaping to the correct form the replacement was stuck in place and painted. An alternative method was to build up a shape in situ which was modelled and painted.
7) Loose heads and broken necks were secured with HMG. It was often necessary to insert a new reinforcing wire through the skull and into the body.
8) Broken legs were stuck back using HMG, sometimes with the addition of a new supporting rod. Large heavy birds required the use of a quick setting epoxy resin (Devcon 5 Minute) rather than HMG.
9) Loose or detached wings were secured with stitches of polyester/cotton sewing thread where it was practicable. Otherwise they were held in place with stainless steel pins.
10) Loose or detached tails were stuck in place with HMG and usually fitted with an extra supporting wire through into the body.
11) Broken bones were repaired with HMG where possible. In some cases it was necessary to use Deycon with steel wire plints inserted into the bone. The bones of one specimen which had been very greasy were repaired with anaerobic adhesive (Loctite 312). Chipped bones were filled with plaster.
12) Missing bones from skeletal mounts were prepared as in 6.
13) Broken eggs were repaired with HMG where possible. In some cases it was necessary to use Deycon to provide the required strengthening

behind the cracks. One specimen that could not be repaired successfully with any other adhesive was stuck with Loctite.

14) Several very fragile nests were consolidated with a dilute solution of poly vinyl butyral (Butvar B98) in alcohol sprayed onto the surface.

4.3 Display related treatment

Many birds were to be displayed in positions different from the original mount. Various methods were used to achieve a change of stance.

1) In several cases wires used for side mounting and which therefore passed through the side of the body and the wing were removed.
2) Side mounting wires were often replaced on the opposite (less degraded) side of the bird.
3) Some side mounting wires had to be lengthened by soldering on more wire to facilitate mounting on display panels.
4) Extra side mounting wires were frequently required to provide additional support or stability.
5) When the new mounting position was significantly different from the original, it was necessary to soften the legs and feet using steam in order to alter the stance of the bird. In two instances it was necessary to alter the position of the neck and head.
6) Large numbers of birds had broken leg-mounting wires. Fresh wires had to be inserted through the feet into the legs so that these birds could be displayed in the standing position.
7) Many birds were removed from old, painted, flat bases and fixed to new bases, perches or branches.
8) When birds were to be remounted on branches, great care was taken to match the branch shape to the original setting of the birds' feet.
9) Previously painted beaks, legs and feet were cleaned with Synperonic solution and, if necessary, repainted with oil colours.
10) Prior to use with specimens all newly acquired branches and trees were dried and treated with sodium pentachlorophenal and gamma benzene hexachloride.

4.4 Outside contractors

A small number of new specimens were prepared outside the museum. Although the work appears to have been well carried out no record of the processes employed accompanied the specimens. This reinforces the need to ensure adequate documentation for specimens whose past history can so easily be lost.

5. Personnel

Although preliminary planning and some research was carried out from 20 months before the gallery opened in September 1981, work on the specimens did not start until October 1980. The bulk of the preparation of the specimens used in the gallery was undertaken by the three technicians in the Conservation Department, Don Ashton and Bill Hutchinson led by Roy Garner. A student who had experience of this sort of work was employed for two months.

Following the opening of the gallery a large programme of moving and recataloguing of the items and collecitons which had not been used for display was started. A three man team, A. Boyle, S. Barnes and M. Wilding funded by the Manpower Services Commission, worked for a year to clear the backlog of work arising from and exposed by the gallery renewal. This made a marked improvement to the relevant stores and museum records. Unfortunately they were unable, for reasons of space and finance, to

complete the clearing up operation which has been undertaken by following MSC funded team also based in the Conservation Department.

6. Conclusion

It is almost an axiom of museum life that there is not enough time available to carry out the tasks to the desired standards. In retrospect it was obvious that work on the objects should have started as soon as possible. As a result there was an unfortunate rush at the end.

Although the project was supposed to deal, at least in part, with the problems of storage thrown up by the gallery renewal, these problems turned out to be more time consuming than was appreciated in advance. Much of the storage had been inadequate and it was not considered proper simply to transfer the inadequacies from one store to another. The process of improving the stores and arranging the specimens occupied a large part of the time of the MSC team. The documentation of the collection mirrored the storage conditions. The recording of the specimens and the conservation work relating to them proved difficult in the time scale of the renewal. The MSC team worked hard to bring the records up to date.

Research into appropriate environmental control and conservation measures also proved more time consuming than expected.

The renewal of the gallery taught me a great deal about the organisation of such a project. Even more it demonstrated the skills and hardworking nature of those who worked on all aspects of the gallery.

References

1. A. G. Millward and S. Cross, forthcoming paper in Museums Journal.
2. C. V. Horie, Solar Control Films for reducing light levels in buildings with daylight, pp.49-54 in Conservation within Historic Buildings, ed. N.S. Bromelle, G. Thomson and P. Smith, IIC 1980.
3. R. L. Feller, Further Studies on the international blue wool standards for exposure to light, paper 78/10/2, ICOM Committee for Conservation, 1978.
4. R. Thompson, Museum Climatology, Butterworths, 1978
5. Measured using on IRGA 30, non-dispersive infra-red gas detector for nitrous oxide, kindly loaned by the Architecture Department of the University.
6. Dust measurements kindly carried out by Dr. F.F. Cinkotai, Department of Occupational Health of the University.

Materials used:

Scotchtint V30: 3M (UK) Ltd., 3M House, P O Box 1, Bracknell, Berks RG12 1JU.

Permaglass Raisin 113: Perma Blinds Ltd., Propect Row, Dudley, West Midlands DY2 8SE. A dark non-inflammable material.

Arbomast BR: Adshead Ratcliffe & Co. Ltd., Belper, Derby. A butyl mastic that is non-setting and has good ageing resistance.

PVC foam sealing strip: Inseal 5900 2.5mm thick, 5mm wide; DRG (UK) Ltd., Theobold St., Borehamwood, Herts. WD6 4SQ. Norseal V560. 3.2mm thick, 6.4mm wide: Norton Abrasives Ltd., Welwyn Garden City, Herts. AL7 1HZ. Inseal is a denser, stronger, PVC foam than the very light weight Norseal.

Trucolour 38: Philips Lighting, PO Box 298, City House, London Rd., Croydon CR9 3QR. Trucolour 37 giving a better colour rendering and UV emission was originally specified but became unavailable by the time of installation.

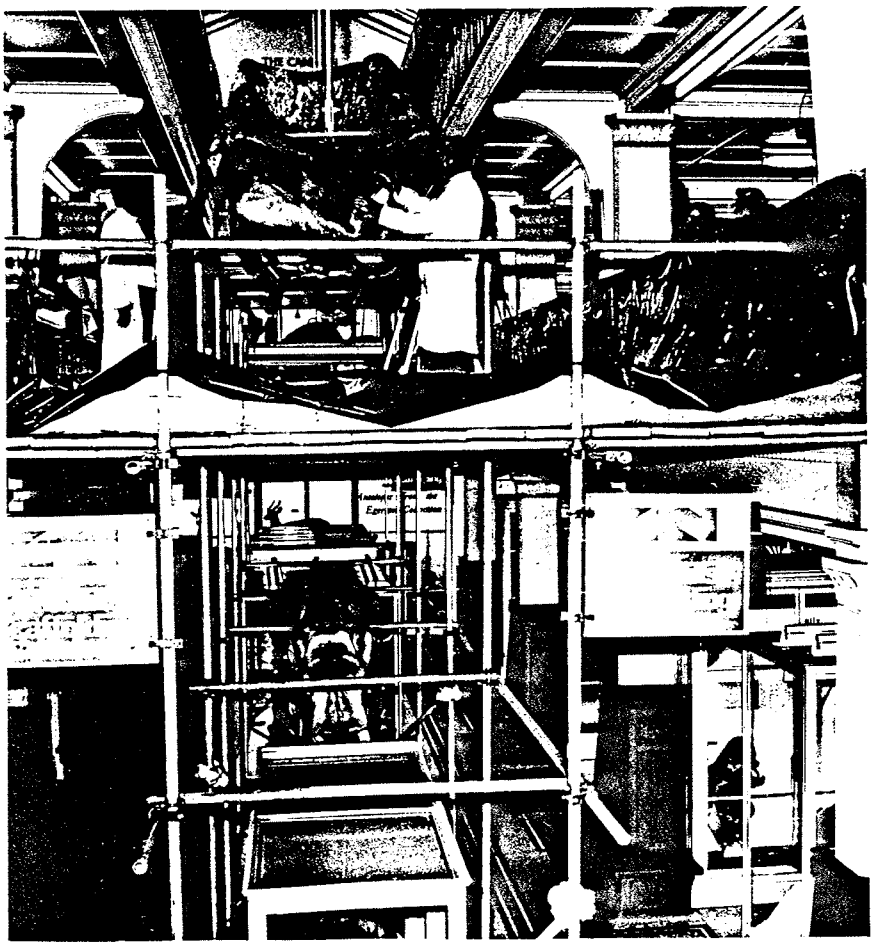
Morden T-12: The Morden Co., Lytham Rd., Heald Green, Cheshire SK8 3RG

Rentokil: Marine and Fumigation Division, Rentokil Ltd., Rentokil House, 248-252 Price Street, Birkenhead L41 3RA.

Draeger Safety, Draeger House, Sunnyside Rd., Chesham, Bucks HP5 2AR
Vapona: Temane Bees Ltd., Sealand, Chester CH1 6BA. Various sizes of strips were used depending on the size of case to be protected.
Genklene: ICI Ltd., Sunley Building, Piccadilly Plaza, Manchester M60 7JT.
IMS 74op: BP Chemicals Ltd., Devonshire House, Piccadilly, London W1X 6AY.
Synperonic N: ICI as above, supplied by F. W. Joel, Oldmedow Road, Hardwick Industrial Estate, King's Lynn, Norfolk PE30 4HH.
Cellofas B1500: Joel as above
Mowital B20H: Hoechst (UK) Ltd., Hoechst House, Salisbury Rd., Hounslow, Middx TW4 6JH.
HMG Waterproof Adhesive: Joel as above
Araldite AV100/HV100: Ciba-Geigy (UK) Ltd., Plastics Division, Cambridge CB2 6TA
Acrulite: Rubert & Co. Ltd., Station Rd, Theale, nr. Reading, Berks RG7 4AB
Devcon 5 Minute: Devcon Ltd., Station Road, Theale, nr. Reading, Berks BG7 4AB
Loctite 312, Loctite (UK) Ltd., Watchmead, Welwyn Garden City, Herts AL7 1JB
Butvar B98: Monsanto Ltd., 10-18 Victoria St., London SW1H ONG.

1:
External view of the natural science galleries after renovation. The three top floors make up the natural history galleries, the bird gallery being the middle of the three. The effects of the blinds are visible as is the obviously lower light level in the bird gallery.

2;
View of the galleries in the late nineteenth century showing arrangement of cases in bays between windows.



3;
Whale washing. Also visible is the fluorescent lighting used before the renovation.