17

The role of the conservator in the preservation of megafaunal bone from the excavations at Cuddie Springs, NSW

Colin Macgregor

Materials Conservation Unit
Australian Museum
6 College Street
Sydney NSW 2010

Abstract

Including a conservator on an excavation team can provide benefits to the archaeologist in addition to the improved preservation of excavated materials. Additional information can also be obtained from the material through conservation processing and cleaning on site. The nature and conditions of the site should be considered when deciding if a conservator is required on a team. The work of the site conservator is illustrated by the functions carried out by the author as conservator on the excavations by Dr Judith Field (1997–2005) at Cuddie Springs, NSW. During these excavations, the conservator carried out the consolidation, lifting, packing and treatment of crushed megafauna bones which contributed to more effective long-term survival of the material.

Introduction

In the Australia/Pacific Region, it is less common for conservators to be actively employed in archaeological excavations than is the case in North America or Europe. This results from a combination of factors: the nature of the materials, the degree of preservation of material excavated in the region, and the availability of trained archaeological conservators. Most archaeological materials (particularly organics and metals) have reached an equilibrium state with their burial environment which is disturbed upon excavation. Taking appropriate measures on site to halt rapid deterioration immediately can be crucial in the prevention of major damage occurring before the finds reach the laboratory.

This paper will outline some of the conservation techniques that should be employed on site and the benefits to the archaeologist. It will also provide a case study showing the application of specific techniques at Cuddie Springs.

The contribution of a conservator to the outcomes of any excavation can be considerably more than simply increasing the prospects of the long-term survival of the excavated material (O'Connor 1996). Broadly the benefits for the excavation may be:

- successful lifting of fragile material for analysis
- increased amount of information accessed from excavated material
- easier post-excavation management
- long-term survival of trace materials for analysis.

Given these benefits, the principal aim of the conservator is to ensure the survival of the material in the best possible condition whilst assisting in unlocking the information that an object has to offer (Foley 1984).

Part 1: Benefits of on-site conservation

Slotting the conservator into the excavation

Is a conservator required at all on site? This question is best answered by assessing the nature of the site. When required, the conservator's role should be defined at the planning stage, in order to ensure that the conservator can deliver satisfactory outcomes and be effectively integrated into the excavation team (Cronyn 1990:10–11).

Planning conservation

The questions to consider when planning the conservation resources for an excavation are what materials may be found and what is their likely state of preservation.

Materials: The period, culture and function of the site should be considered, in order to anticipate the types materials that are likely to be excavated.

Condition: An appraisal of the likely physical nature and chemistry of the site before the excavation commences allows the archaeologist to anticipate the types of material that will survive and the expected condition of them.

The exact details of what will have survived on the site and the quality of preservation is impossible to predict with certainty. There are many variables relating to the post-depositional environment that may have affected the buried materials, such as changes in the moisture content of the sediment.

Examples of types of sites and influence on survival of finds:

- damp-acidic environment: poor survival of metals and bone
- damp-alkaline environment: good survival of metals and bone but little organic material
- waterlogged sites: good survival of organic materials and metals if conditions are anaerobic and not alkaline.

Identifying resources required

Using information about the nature of the site, a conservator can advise on the materials and equipment that may be required on site. These will be used for:

- stabilization and consolidation of finds
- lifting techniques for fragile materials
- storage systems for finds
- transportation from site

On-site conservation strategies

Armed with this information the archaeologist can decide, in consultation with a conservator, whether a trained conservator is required on site. If not, the finds co-ordinator may handle the first-aid for objects and storage (Leigh 1981: 3–7) and call in a conservator if unexpectedly difficult problems arise.

The work carried out by a conservator in the field can assist the archaeologist by both unlocking information about the finds and improving the prospects of the survival of the objects with the minimum of deterioration. Examples include:

Consolidation techniques

Fragile and crushed bones may require strengthening before lifting can be attempted by applying a reversible water-based polymer in situ.

Lifting techniques

Soft waterlogged wood structures such as trackways can be supported by a semi-rigid sheet such as steel plate inserted through the soft matrix (Coles 1980).

Fragmentary materials such as bone or pottery may have to be encapsulated in a plaster or a foam jacket which will form a rigid cradle for the object after lifting.

Halting deterioration and storage

Metals can oxidize and deteriorate rapidly when exposed to the air so transfer to sealed containers with dry silica gel will remove the moisture and halt deterioration (Sease 1987:68).

Cleaning and stabilisation on site

Cleaning coins on site will reveal sufficient details to assist with the dating of contexts and interpretation of the site.

Reconstruction on site

During longer excavation seasons, reconstructions of profiles of pottery can enable the pottery to be drawn and recorded during excavation and facilitate the identification of pottery styles and chronologies (Figure 1).

Figure 1. Reconstruction of pottery in the field.

Packing of finds for transport

Preparing well-padded boxing systems for finds that limit movement and cushion shock and vibration will increase the chances of materials arriving in good condition, particularly from areas with unsealed roads. Creating appropriate micro-climates around unstable finds such as wood or metals will improve their chances of surviving the journey and storage until processed.

Planning the future of material

The long-term storage of the finds should also be considered before the excavation proceeds. Any site which produces a high volume of finds will require suitable storage space. Some materials will need an additional investment of funds to buy suitable storage units. For example, metals will require sealed polyethylene boxes and silica gel to keep the humidity low around the objects, whereas waterlogged wood requires tanks and biocides for storage prior to treatment. The cost of conserving large waterlogged objects is so great that reburial has often been the preferred option in recent years unless the cultural significance of the object can attract the necessary funding (Goodburn-Brown and Hughes 1996).

Part 2: A case study: Lifting and conservation of megafauna bones at Cuddie Springs, NSW

The site of Cuddie Springs is located in north west New South Wales (Field and Dodson 1999). It is a claypan that was formerly a lake, now silted up by drainage from the surrounding areas. It was recognised as a significant source of megafauna material during excavations by the Australian Museum in 1933 (Anderson and Fletcher 1934). The deposits containing bones are 10 metres deep. In 1991 further excavations (Furby et al. 1993) revealed the presence of stone tools in close proximity to the remains of *Genyornis* and *Diprotodon* in deposits dated at 28–35,000 years BP. The nature of these deposits makes the site significant to archaeologists interested in the causes of the demise of the megafauna.

The condition of the bones varied enormously between the oldest and most recent levels. In the lower levels the bone consisted of totally fossilised hard black material, whereas the upper archaeological levels contained delicate semi-mineralised dark-brown bones. The archaeological levels were 1.0–1.7 metres below the surface of the clay pan. In these levels, bones were more likely to have been encased in damp clay since deposition. The fine, even-grained silt formed an excellent support for the bones. The pH of the sediment was around 9. This alkalinity caused the organic components in the bone to deteriorate to the point beyond detection. The remaining inorganic structure had absorbed minerals from the surrounding soil, including manganese, resulting in a darkening of the material. Many of the bones were crushed, with multiple fractures but the nature of the clay had held the pieces together.

Preservation on site was generally only possible where the material was kept damp until it had been lifted and transported to the laboratory in Sydney. Rapid drying occurred in the surface layers and the clay shrank and hardened to a concrete consistency. The shrinkage caused physical disruption of the bone and the adhesion between the fragments was lost. Regular application of water using a hand-spray was required to keep the bones damp prior to lifting. Evaporation of moisture was also slowed by placing food-wrap (Glad® wrap) and aluminium foil over the bones, weighted down with miniature sandbags. Over night and during breaks the site was covered with polythene sheeting. This also aided the excavation by keeping the clay surface soft.

Bone material that had been fully exposed and supported by a pedestal of clay sometimes required 'facing-up' to hold the fragmentary surface together during lifting and transport. This was achieved by adhering strips of nylon gossamer tissue across the breaks (Figure 2). The adhesive chosen for the job was Plextol B500, a water-based dispersion of an acrylic co-polymer that has sufficient strength for this work but is also easily removable in the laboratory (Horton-James et al. 1991). On bone that had

areas of soft or friable surfaces, especially the terminals of large bones, Primal WS24 was applied as an overall surface consolidant (Howie 1984). WS24 is an acrylic dispersion in water and on bone that is wet the polymer does not penetrate much beyond the surface. It is, however, an effective surface consolidant forming a skin that holds the surface together.

Figure 2. Consolidation of bone prior to lifting.

Lifting and Transport: The fragmentary nature of the bones embedded in a matrix of clay necessitated some form of block-lifting to ensure the pieces stayed together during lifting and transport. The jacket could have been formed from polyurethane foam or plaster of Paris. The first stage of the process was the same for both materials. A layer of food-wrap was spread across the bone. A layer of heavy-duty aluminium foil was then applied over this. Both were then stippled into the contours of the bones using a soft paint brush. The layer of food-wrap was an extra layer of protection to prevent leakage through pinholes in the foil. Polyurethane foam (Jones 1980) space filler, which can be purchased in aerosol cans at hardware stores, was sprayed onto the aluminium foil and allowed to expand and harden. It is not advisable to apply too much foam in any one application as foam trapped at the base will not set for days, causing dimensional movement in the support jacket.

Plaster of Paris and bandages are cheaper alternatives and faster setting materials, although more difficult to apply. In some cases the weight of the plaster makes it a preferred option. For example, the polyurethane foam will expand and push itself out of undercuts and narrow channels whereas plaster 'stays put' after application.

Once the jacket had set, the bone was removed by cutting through the clay beneath the pedestal. A selection of well-sharpened spatulae and knives with thin flexible blades were found to slice through the clay effectively (Figure 3). The jacket was then inverted with the spatula holding the bone in position.

Figure 3. Using a block of polyurethane foam to support the bone as it is lifted and inverted.

Treatment in the laboratory started with the removal of the remaining clay on the bones. This was carried out while the clay was still damp. Larger sections of clay were removed with a scalpel and dental tools. The smaller deposits that hid the fine detail in the surface were removed with a brush, hand-spray and dental aspirator. This drew a slurry of water and clay straight off the surface without allowing the water to penetrate and left a very clean surface (Figure 4).

The nylon gossamer applied on site to hold the fragments together was gently peeled off before consolidation. It was frequently detached from the surface manually. However, acetone was brushed under the edge to release the more stubborn pieces.

Figure 4. Cleaning bones using vacuum technique with water and dental aspirator.

The decision to consolidate the internal structure of the bone was made after assessing the strength of the remains. It was essential that all samples for analysis or dating were taken before treatment was carried out. Structural consolidation was best carried out with a polymer in an organic solvent solution. The high surface tension of the water made penetration by aqueous solutions problematic. It was therefore necessary to dry the bones slowly before consolidation. This resulted in a temporary weakening of the bones, as the adhesion of the damp clay was lost. Careful handling was crucial at this stage. The polymer chosen for consolidation was Paraloid B72, an acrylic co-polymer, that is recognized as one of the most stable resins available in conservation (Koob 1986). It also remains soluble over long periods, so that it can be removed again in the future, if required.

The three methods available for deep consolidation are:

- immersion in solution under vacuum
- immersion in solution without vacuum
- application of consolidant with pipette

Immersion under vacuum exerts considerable stress on a porous specimen as gas bubbles are drawn out by the reduction in pressure. This is particularly true with cancellous bone that will contain pockets of trapped air. For this reason vacuum was seldom used on the extremely fragile specimens from Cuddie Springs.

Immersion in solution without vacuum may also lead to collapse of some bones, as the bone and clay matrix softens and loses all structural strength in the solution. Where danger from this exists, specimens should be wrapped in gauze bandage or supported in a cradle of foil before immersion. These can be removed with acetone after drying.

Application by pipette allows the consolidant solution to be drawn into the bone by capillary action. It is preferable to apply as much solution as possible with each application as the dried polymer resin will inhibit subsequent applications. This was the safest option and was used on the majority of the bones treated, although it did not necessarily result in as thorough consolidation as the immersion techniques.

Contoured supports for storage and handling the most fragile bones are made by adapting the polyurethane foam jackets that were applied for lifting on site, or sculpted from closed-cell polyethylene foam. The PE foam lasts a great deal longer than polyurethane foam, as it is more chemically stable.

Summary

In order to achieve the most effective conservation for excavation material and to support the research goals of the project it was necessary to:

- anticipate the likely materials that would be found
- consider the nature of the burial environment
- halt chemical and physical changes of finds immediately after excavation
- ensure treatments did not compromise analytical and dating goals of project
- consider the possible impact of treatment on future analytical techniques
- plan the destination of material for long-term storage.

Acknowledgements

Dr Judith Field and Dr Joe Dortch, University of Sydney, and the Australian Museum for photographs.

References

- Anderson, C. and H. O. Fletcher. 1934. The Cuddie Springs bone. *The Australian Museum Magazine* 5:152–158.
- Coles, J. 1980. Archaeology in the Somerset Levels 1979. In J. Coles (ed), *Somerset Levels Papers* 6:52–56.
- Cronyn, J. 1990. *The Elements of archaeological conservation*. London: Routledge.
- Field, J. H., and J. Dodson. 1999. Late Pleistocene megafauna and archaeology from Cuddie Springs, South-eastern Australia. *Proceedings of the Prehistoric Society* 65:275–301.
- Foley, K. 1984. The role of the objects conservator in field archaeology. In N. P. Stanley-Price (ed.), *Conservation on archaeological excavations : Proceedings of the ICCROM Conference*, pp. 11–19. Rome: ICCROM.
- Furby, J. H., R. Fullagar, J. R. Dodson and I. Prosser. 1993. The Cuddie Springs bone bed revisited 1991. In M. Smith, M. Spriggs and B. Frankhauser (eds), *Sahul in review: Pleistocene archaeology in Australia, New Guinea and Island Melanesia*, pp 204–210. *Occasional Papers in Prehistory* 24. Canberra: Department of Prehistory, RSPacS, ANU.
- Goodburn-Brown, D. and R. Hughes. 1996. A review of some conservation procedures for the reburial of archaeological sites in London. In A. Roy and P. Smith (eds), *Archaeological conservation and its consequences: Proceedings of the IIC Copenhagen Congress 1996*, pp 65–69. London: International Institute for Conservation.
- Horton-James, D., S. Walston and S. Zounis. 1991. Evaluation of the stability, appearance and performance of resins for the adhesion of flaking paint on ethnographic objects. *Studies in Conservation* 36:203–221.
- Howie, F. 1984. Materials used for conserving fossil specimens since 1930: A review. In N. S. Brommelle, E. M. Pye, P. Smith and G. Thomson (eds), *IIC Preprints of the Contributions to the Paris Congress*, pp 92–97. London: International Institute for Conservation.
- Jones, J. 1980. The use of polyurethane foam in lifting large, fragile objects on site. *The Conservator* 4:31–33.
- Koob, S. 1986. The use of Paraloid B-72 as an adhesive: Its application for archaeological ceramics and other materials. *Studies in Conservation* 31:7–14.
- Leigh, D. 1981. First aid for finds. *A practical guide for archaeologists*. Hertford: Rescue.
- O'Connor, S. 1996. Developing a Conservation Strategy in a Rescue Archaeology Environment. In A. Roy, and P. Smith (eds), *Archaeological Conservation and Its Consequences: Proceedings of the IIC Copenhagen Congress 1996*, pp. 133–136. London, IIC
- Sease, C. 1987. *A conservation manual for the field archaeologist*. *Archaeological Research Tools* 4. Los Angeles: Institute of Archaeology, UCLA.