CONSERVATION OF ARCHAEOLOGICAL MATERIALS #1546

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Colorado Preservation Office
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INTRODUCTION

Field conservation is the science of treating or stabilizing archaeological materials to prevent further deterioration after the materials are removed from the ground. Because conservation techniques change as new techniques are studied and developed, trained archaeological conservators are becoming an essential part of many archaeological projects. Conservation advice should be considered for all archaeological projects.

Conservators should be consulted at early stages of project planning as they can anticipate many problems of artifact preservation that arise due to the shock of removing finds from the ground, and aggrevated by improper handling of material in both field and lab. Conservators can help the archaeologist:

1) remove fragile or deteriorating artifacts from a site with minimal damage;

2) develop a system of care for expected artifacts from field to lab;

3) aid in ordering supplies to adequately handle and store artifacts; and

4) determine the degree and type of conservation treatment needed for specific artifacts.

Several principles guide the work of a good conservator.

1) Conservators try to minimize the amount of treatment given so as to respect the original integrity of the artifact and to alter it as little as possible.

2) Treatments and processes should be reversible whenever possible.

3) Durable, stable materials should be used in the treatment of artifacts.

4) The conservator should be aware of his/her own limitations and should be prepared to consult with other conservators.

5) The treatment of a given artifact should be documented. This documentation should include photographs of the objects' conditions, in situ if possible, and written records on the examination and treatment of the piece.

6) Finally, the treatment chosen should not interfere with later analyses or dating techniques.

Conservators take into consideration three major factors when deciding on the form and extent of artifact stabilization. These factors are:

1) The condition of artifacts when they are retrieved from the field. For example, organic materials probably will be in the worst shape.

2) The significance of a particular specimen. Is the artifact unique? Is the artifact expendable in the long run or will it be used for comparative purposes?

3) The future use of the artifacts. Stabilization procedures may differ depending on whether the artifacts will be subject to analysis, permanent storage, extensive handling, or display.

CAUSES OF DETERIORATION

The causes of artifact deterioration are physical, chemical and biological in nature. Physical deterioration takes place both on and below the ground's surface. On the surface artifacts are subjected to wind and water erosion and abrasion. Below the ground's surface, both organic and inorganic materials are subjected to cracking, crushing, and distortion. The freeze-thaw cycle is especially hard on porous material.

Moisture and temperature fluctuation can effect chemical and biological deterioration. Moisture fluctuation can cause the movement of salts, and higher temperatures can cause faster chemical reactions. Humidity is a critical factor, since a drier climate results in slower chemical reactions while damp conditions often accelerate decomposition of organic materials.

Many dry cave materials are well-preserved because they have not been subjected to physical deterioration. Most of those materials, however, have become dehydrated and have lost their flexibility. When such artifacts are removed from their dry environment and subjected to a changed environment, chemical and biological deterioration may begin.

Chemical deterioration of an artifact is effected by oxygen, moisture, temperature, and the chemistry of the surrounding soil matrix. In areas where precipitation exceeds evaporation, the wetter conditions usually create a more acidic soil. In such soil conditions bone, shell, lime, limestone, and cellulose may be subject to serious deterioration.

In areas such as Colorado, where evaporation often exceeds precipitation, soils tend to be alkaline, although there can be local areas of acidity. Alkaline soils are characterized by high concentrations of salts. These salts, through crystallization processes, cause physical deterioration of porous artifacts. Salts also damage metals. Iron and copper artifacts are especially affected by chloride salts.

The concentration of salts can be effected by human activity. Substances such as flesh and urine create higher concentrations of chloride, while wood ash can build up sodium and potassium salts. Irrigation in arid areas can cause redeposition of salts in areas close to the ground's surface.

Salts cause deterioration of objects in the following manner. Soluble salts move in and out of buried, porous material with fluctuations in temperature and moisture. As an object is drying, salts will crystallize, forming encrustations and flaking or delamination of an object. If that object is subjected to moisture, the salts can go back into solution, and migrate towards a surface of evaporation where they recrystallize and disrupt or coat the surface. The weakening activity of salts will continue after an object is removed from the ground if the environment in which the object is placed is not stable or is inappropriately chosen.

High concentrations of salts can actually preserve objects through fossilization and by retarding biological deterioration. In such instances, desalination in a cleaning or stabilization process may destroy the object.

Biological agents include rodents, termites and other insects, plants, bacteria and fungi. Inorganic remains such as stone, and charred vegetal remains that have been reduced to elemental carbon are the least likely to be affected by biological agents. Inorganic remains can be stained by root or fungus activity.

In addition to physically damaging artifacts and features, biological agents cause chemical deterioration. Fungi and bacteria produce acids and enzymes that decay leather, feathers, wood, and other organics. Micro-organisms require a certain amount of moisture, relatively high temperatures, and a pH balance suitable to that particular organism. Most micro-organisms require oxygen, but there are some types of anaerobic bacteria that thrive under water without it. The presence of copper tends to reduce organic activity. Therefore, preservation of skin, textiles, or wood is more likely when an object has been in contact with copper.

FIELD TREATMENT OF ARTIFACTS

One of the most important facets of planning for artifact conservation is to establish written guidelines for handling unstable artifacts before going to the field. Artifacts handled on an unsystematic basis often can be damaged by the emergency method selected for their handling and transport. Methods used in the field will vary according to the distance from a laboratory, storage conditions, degree of preservation, types of artifacts encountered, and the amount of money available for artifact conservation.

The following are some general guidelines to consider when dealing with artifacts in the field.

1) Try to maintain the temperature and humidity to which the object has become adjusted. Generally, wet things should be kept wet and dry things dry. Some damp objects can be dried slowly, not in direct sunlight. Metals should be dried slowly and packed in a container with a desiccant such as indicating silica gel. Dry objects such as organics and ceramics should not be sealed in plastic bags or boxes because condensation can occur inside. Cushioning materials such as cotton batting also can serve to protect the artifact from the adverse effects of an environmental change inside a container by acting as an environmental buffering material.

2) Artifacts, both whole and fragmentary, should be photographed and mapped in situ before any consolidants are applied and before the object is cleaned and prepared for transport. The relationship of artifact pieces to one another in the ground is important to the accurate reconstruction and preservation of the artifact.

3) Exercise great caution when cleaning an artifact in the field. Some objects are held together by soil, and cleaning such pieces will destroy them. Organic remains on ceramic or stone artifacts may be destroyed by cleaning. Metal corrosion can form a protective coating. Sometimes there is little actual metal left, and the only shape left to the object is the corrosion. In addition, iron and copper corrosion can retain the impression of fabrics and other organics with which they were in contact.

4) Supports should be used under organic materials, even if they appear to be strong. A flat cookie sheet is a useful tool for support. Soil often can be used as a bed to support an object and hold it together during transport.

Lifting supports also may be necessary under objects such as pottery or fragmented stone. The original soil matrix should be considered as a possible lifting support. In extreme cases, plaster bandages (kept out of direct contact with the artifact) and polyurethane foam can be used to provide support for artifacts. Polyurethane foam is toxic and should be used with caution and the proper safety measures. It is helpful to use an easily removable material such as clear plastic wrap or aluminum foil between the artifact and the lifting support.

5) Care should be taken in choosing packing material. Sturdy brown paper bags are suitable for short-term storage of strong materials such as sherds and lithics. They offer no support for more delicate objects. Because brown paper bags are acidic, metals and other acid-sensitive materials should not be packed in them.

Plastic vials used for artifact storage should be padded with acid-free tissue paper or with cotton batting and an acid-free tissue paper liner. Plastic vials have a static build-up that pulls fibrous materials apart if the vial is not appropriately lined. Heavy polyethylene bags and plastic boxes have a similar problem with static build-up.

Prefabricated cardboard boxes in a variety of sizes, with lids, are preferable to containers made in the field. Common cardboard boxes, however, are not suitable for long-term storage of organic or metallic objects because they are acidic. Acid-free boxes or padding should be used in permanent contact with these sensitive materials. Fibrous or plastic padding materials should be combined with a covering material when used for packing organic and delicate inorganic materials. Cotton batting fibers can become enmeshed in a material to such an extent that the cotton batting and the artifact cannot be separated without damaging the artifact. Surgical wadding with a finished surface reduces the embedding problem, but does not eliminate it. It is best to combine padding material, such as cotton batting, with a smooth covering material, such as acid-free tissue paper.

Foam rubber is good for short-term padding around heavy items. However, foam rubber deteriorates after a time and produces contaminants in the process. Polystyrene and polyvinyl chloride foams can give off chloride and other gases in the process of deterioration, and so may not be suitable for long-term use. The most stable foam product on the market today is a compact polyethylene foam sheeting known as Microfoam, available from packing suppliers. It is good for both short- and long-term padding of objects.

6) In some cases, archaeological materials must be consolidated or stabilized before they can be transported. Materials should only be consolidated if they cannot be transported safely without treatment. Consolidation treatment should be reversible as it may have to be undone for future treatment. If in a damp environment, a water emulsion adhesive should be used. Emulsions include Jade and CM Bond M-3 which are suspensions of polyvinyl acetates (PVA) in other liquids. Because emulsions are suspensions of solids in liquids, they have larger molecules and tend to be less penetrating than solvent adhesives. Emulsions are also harder to remove than solvents. (Elmer's brand and similar white glues are not appropriate consolidants.)

Solvent-based resins should be used whenever possible. Solvents generally work the best in dry environments. Solvents commonly used include PVA dissolved in acetone, toluene or alcohol. Because solvents are toxic materials, masks should be worn during application and the area should be well ventilated.

Consolidants should be applied in dilute solutions of between five and ten percent resin in solution, and several applications of the consolidant should be used on an object. Once a solvent-based resin is applied, the object must be dried thoroughly before moving, or the object may be damaged. To avoid rapid drying, an object should be kept in the shade.

The best method of consolidant application is to drip the liquid onto an object with an eye-dropper or pipette. Spraying an object usually does not result in good penetration of the solvent, but is a practical method for large artifacts. An object that does not have a flaky or otherwise unstable surface can be brushed with solvent.

ARCHIVAL CLEANING AND CONSERVATION

Conservators question the need for total cleaning of objects, because sometimes extensive cleaning can cause damage to an artifact or remove historical evidence. Archaeologists should consider preserving untreated samples of all types of material (sherds and lithics included) for future analysis.

Low-fired prehistoric ceramics should be sorted before washing so that unusual or problematic pieces can be removed. Cool water is best for washing ceramics. Detergents and acids should not be used routinely since both can leave residues and acids that can alter ceramic components. If a detergent is required, it should be non-ionic. Orvus WA paste, available from Conservation Materials, is a recommended detergent. Immersion of ceramics in water prior to cleaning is advised when acids are used. Ceramics should be saturated with water before and after being dropped into a dilute (1-2 percent) acidic solution. Formic and acetic acids are preferable to hydrochloric acid. Ceramics should not be scrubbed with an abrasive instrument.

Bone and shell should not be cleaned with water. Mechanical cleaning of these objects is best, but if liquid is necessary a fifty-fifty mixture of alcohol and water should be used, and used locally on a swab.

Metals should be handled with gloves and should be mechanically cleaned. In many cases, the corrosive shell is all that is left of an object, and chemical cleaning will virtually destroy remnants of shape and size that otherwise can be discerned from the corrosion. The object should be examined for impressions of organic materials prior to cleaning. Copper and iron can preserve impressions of organic material. Cleaning of metals and delicate materials should be left to a professional conservator.

High quality, non-commercial glues should be used when reconstructing artifacts. Duco and Elmer's glue deteriorate, and become discolored and brittle with age.

One of the best glues for low-fire ceramics is a nitro-cellulose glue called HMG. Although not permanent, this treatment is reversible. HMG is available from Conservation Materials. Other high-quality synthetic resin glues such as PVA and Acryloid B-72 are preferable to inorganic, irreversible glues such as epoxies and "superglues".

When restoring an artifact, the restoration should be sympathetic to, but distinguishable from, the original. Plaster or putty used to fill holes in a ceramic piece, for instance, should be shaded to blend with, but not necessarily match, the background color of the piece. Surface designs or missing handles, etc. should not be restored if there is not clear evidence to support the restorations. The reversibility of the material used is of prime importance.

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SOME BASIC SUPPLIES FOR THE CONSERVATION AND CARE OF ARTIFACTS IN THE FIELD AND LAB

TOOLS AND PACKING MATERIALS	SUPPLIER
Soft and stiff brushes of various sizes	Art Supplier
Dental tools, dissecting needle or pin vise and needle	Scientific Co.
Fine pointed tweezers	Conservation Materials or Scientific Co.
Rubber squeeze bulb blower	Drug Store
Magnifying head loop, magnifier lamp or microscope	Scientific Co.
Hand-held water mister	Garden Supplier, Hardware
Eye-dropper or pipette with squeeze top	Scientific Co.
Q-tip swabs or wood swab stick and cotton wool	Drug Store
Acid-free tissue paper	Talas, University Products, etc.
Microfoam, compact polyethylene foam sheeting	Packing Suppliers
Cotton or synthetic batting	Drug Store, Scientific Co.
Polyethlyene plastic sheeting and bags	Hardward, etc.
Various size cardboard and plastic containers, some with lids	Packing Supplier
Sturdy, flat metal cooky sheet	Household Supplier

CHEMICALS AND ADHESIVES	
Polyvinyl acetate resin, grade AYAC or AYAF	Conservation Materials
Polyvinyl acetate emulsion, Jade 403 or Gelva TS100	Talas, Monsanto
Acryloid B72 resin	Conservation Materials
HMG nitrocellulose glue	Frank Joel Ltd.
Orvus WA paste (non-ionic detergent)	Conservation Materials
Lysol spray (non-foaming fungicide or Dowicide A or Quaternary Ammonia	Hardware, Dow Chemical
Silica Gel, indicating kind 6-16 mesh	Scientific Co.
Distilled water	Drug Store, small amounts
Acetone, laboratory grade	Scientific Co.
Toluene, laboratory grade	Scientific Co.
Ethyl Alcohol	Scientific Co.
Thymol crystals, fungicide	Talas

MAJOR SUPPLIERS OF CONSERVATION-GRADE MATERIALS

Associated Bag Co.
400 W. Boden St.
Milwaukee, WI 53207-7120
1-800-926-6100
(various zipper top bags, et al.; catalogue & samples available)

Conservation Materials, Ltd.
1165 Marietta Way
Box 2884
Sparks, NV 89431
1-702-331-0582
(offer a variety of tools, resins, etc.; catalogue & price list available)

Fisher Scientific
5475 Peoria St.
Building 2, Univ J
Denver, CO 80239
303-371-0888
(gloves & other safety equipment; catalogue available)

Highsmith Co. Inc.
W 5527 Highway 106
P.O. Box 800
Ft. Atkinson, WI 53538
1-800-558-2110 (orders)
1-800-558-3899 (service)

Hollinger Corp.
P.O. Box 8360
Fredericksburg, VA 22404
1-800-634-0491
(acid-free boxes and papers; catalogue & price list available)

Frank W. Joel, Ltd.
Oldmeadow Road
Hardwick Industrial Estate
King's Lynn, Norfolk
England PE30 4HH
(good range of items, e.g. adhesives, hard to get in USA; catalogue and price list available)

Light Impressions Corp.
439 Monroe Ave.
P.O. Box 940
Rochester, NY 14603-0940
1-800-828-6216 (orders)
1-800-828-9859 (service)
(various conservation and storage supplies; catalogue & price list)

Process Materials Corp.
301 Veterans Blvd.
Rutherford, NJ 07070
1-201-935-2900
(acid-free papers, adhesives, etc.; catalogue & paper samples available)

TALAS - Technical Library Service
213 W. 35th St.
New York City, NY 10011
1-212-736-7744

(catalogue & price list available)

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P.O. Box 101
Holyoke, MA 01041-0101
1-800-628-1912 (orders)
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(range of paper products; catalogue and paper samples available)

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1544 S. Emerson St.
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303-777-2513

WAAC Resource File (Western Association for Art Conservation)
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5905 Wilshire Blvd.
Los Angeles, CA 90036
[sells an updated reference file on conservation resources & suppliers]

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