Methods for Conserving Archaeological Material from Underwater Sites

Donny L. Hamilton
Conservation Research Laboratory
Center for Maritime Archaeology and Conservation
Texas A&M University

UA-116

Methods of Conserving Archaeological Material from Underwater Sites

by Donny L. Hamilton

Revision Number 1
January 1, 1999
Anthropology 605
Conservation of Archaeological Resources I
Nautical Archaeology Program
Department of Anthropology
Texas A&M University
College Station, Texas 77807

Conservation Files

The following conservation files were first posted on the World Wide Web during the 1998 spring semester for use by the students enrolled in ANTH 605, Conservation of Cultural Resources, at Texas A&M University in College Station, Texas. These files constitute the laboratory manual that is used in conjunction with the course. The emphasis of the course is on the conservation of material from underwater sites, especially marine sites, but the conservation of material from terrestrial sites is also discussed. While this laboratory manual is posted for use by students enrolled in the ANTH 605 class, others may download and use the manual; proper credit, however, must be given. (See the proper citation at the end of this page.)

This laboratory manual has been compiled from material gathered over the past 20 years. It consists of much of the data presented in a number of publications by the author, as well as class handouts. Particularly important resources include:

1973-1998: Numerous mimeographed class handouts compiled and distributed to the conservation classes taught by the author at the University of Texas at Austin and Texas A&M University.

1976: *Conservation of Metal Objects from Underwater Sites: A Study in Methods*. Texas Antiquities Committee Publication No. 1, Austin, Texas.

1996: *Basic Methods of Conserving Underwater Archaeological Material Culture*. Legacy Resource Management Program, U.S. Department of Defense, Washington, D.C.

The last publication is largely a compilation of the first two and is very similar in content to this on-line manual. The current manual does differ from the 1996 publication in that material has been added or updated in some sections. This conservation class manual changes each time it is used, and new changes and additions are being planned as preparations are made to post this version. Each time the manual is posted, it will be dated to reflect new changes, and a new revision number will be assigned. Consult the date and revision number to see if you have the most recent version. Revision 0, dated January 1, 1998, starts the series.

The general reference for the entire conservation manual is as follows:

Donny L. Hamilton

1998. Methods of Conserving Underwater Archaeological Material Culture. Conservation Files: ANTH 605, Conservation of Cultural Resources I. Nautical Archaeology Program, Texas A&M University, World Wide Web, http://nautarch.tamu.edu/class/ANTH605.

Donny L. Hamilton
Head, Nautical Archaeology Program
Texas A&M University
College Station, Texas 77843-4352

Overview of conservation in archaeology; basic archaeological conservation procedures

IN THIS FILE:

Artifact preservation is one of the most important considerations when planning or implementing any action that will result in the recovery of material from a marine archaeological site. It is the responsibility of the excavator or salvor to see that material recovered is properly conserved. The conservation phase is time consuming and expensive, often costing more than the original excavation. Without conservation, however, most artifacts will perish, and important historic data will be lost. The loss is not just to the excavator but also to future archaeologists, who may wish to reexamine the material.

Artifacts recovered from a salt water environment are often well preserved but of a very friable nature. In general, artifacts recovered from anaerobic marine environments (i.e., buried in sediment) are recovered in better condition than artifacts recovered from aerobic marine environments (i.e., the water column and surface sediment). Artifacts not properly conserved in a timely manner are apt to deteriorate at a very rapid rate and subsequently become useless as diagnostic or display specimens. Organic material, i.e., leather, wood, textile, rope, plant remains, etc., if allowed to dry without conservation treatment, can crumble and become little more than a pile of dust and debris in a matter of hours. Iron, on the other hand, can last for a few days to months according to the size and density of the artifact; however, it too will eventually deteriorate and become useless as a display or diagnostic specimen. Bone, glass, pottery, and similar material will, if not conserved, slowly devitrify and, in extreme cases, degenerate to a pile of worthless slivers. For these reasons, conservation must be of paramount concern when the excavation of a marine archaeological site is considered.

Before discussing the conservation of archaeological materials, it is helpful to examine and clarify the various definitions of the term 'artifact.' For the purposes of this manual, the definitions given in the United States Code of Federal Regulations 36, Part 79, section 4 are applicable (U.S. Department of Interior 1991):

1. Collection: material remains that are excavated or removed during a survey, excavation, or other study of a prehistoric or historic resource, and associated records that are prepared or assembled in connection with the survey, excavation, or other study.
    1. Material remains: artifacts, objects, specimens, and other physical evidence that is excavated or removed in connection with efforts to locate, evaluate, document, study, preserve, or recover a prehistoric or historic resource. Classes of material remains include, but are not limited to:
        1. Components of structures and features (such as houses, mills, piers, fortifications, raceways, earthworks, and mounds);
        2. Intact or fragmentary artifacts of human manufacture (such as tools, weapons, pottery, basketry, and textiles);
        3. Intact or fragmentary natural objects that are used by humans (such as rock crystals, feathers, and pigments);
        4. By-products, waste products or debris resulting from the manufacture or use of man-made or natural materials (such as slag, dumps, cores, and debitage);
        5. Organic material (such as coprolites, and vegetable and animal remains);
        6. Human remains (such as bones, teeth, mummified, flesh, burials, and cremations);
        7. Components of petroglyphs, pictographs, intaglios, or other works of artistic or symbolic representation;
        8. Components of shipwrecks (such as pieces of the ship's hull, rigging, armaments, apparel, tackle, contents, and cargo);
        9. Environmental and chronometric specimens (such as pollen, seeds, wood, shell, bone, charcoal, tree core samples, soil sediment cores, obsidian, volcanic ash, and baked clay); and
        10. Paleontological specimens that are found in direct physical relationship with a prehistoric or historic resource.

This section of definitions goes on to discuss what constitutes *associated records* resulting from an archaeological excavation. This manual is concerned only with cultural material or collections resulting from an archaeological excavation; it is does not consider archival or art collections for which there are established standards of conservation that are quite similar in many ways to the federal standards established for archaeological material. What is important is that all relevant documentation be recorded from the start, including all records pertaining to conservation treatment, and that a complete set of records accompany the collection or any artifact separated from the collection.

The following section discusses alternative methods for conserving archaeological artifacts recovered from marine sites. Techniques which may only be appropriate for the conservation of artifacts from terrestrial sites will not be discussed. The section is divided into eight major headings:(1) Introduction to Marine Conservation, (2) Synthetic Resins and Adhesives, (3) Ceramics, (4) Glass, (5) Bone and Ivory, (6) Wood, (7) Leather, and (8) Metals. Appropriate subdivisions will be found under each major heading. All the treatments discussed in this manual do not conflict with any known federal regulations and laws; from this perspective, therefore, there is no limitation on their use.

It is necessary to make a brief statement regarding the level of effort and resources necessary to perform each technique. As each treatment is discussed, the required chemicals are listed, and any necessary equipment is either listed or obvious. For example, if an object is to be rinsed in sodium carbonate, it is obvious that sodium carbonate, water, and a vat necessary to hold the object is required. If the solution and object must be heated during the rinsing process, then a metal vat and a source of heat (i.e., gas stove, electric hot plate, or oven) is required. There are too many variables involved in each treatment to arrive at any specific cost; the cost is dependent upon the size of the artifact and the length of time required for treatment, neither of which can be reliably estimated. How much does it cost to treat by a given treatment a spike from a ship as opposed to a cannon from the same ship? The exercise merely becomes a numbers game that serves no useful purpose.

Any discussion of both near-term and long-term conservation goals is equally meaningless. In conservation treatments, there are no near-term goals as opposed to long-term goals; the only ethical alternative is to treat the artifact so that is stable in the environment in which it is to be stored or displayed. There are some viable alternative conservation treatments for particular artifacts that can be performed by untrained personnel and with a minimum amount of specialized equipment; these treatments, however, are employed only when they will successfully preserve the artifact. For the purposes of this manual, near-term conservation goals will be considered those that deal with the proper storage of an artifact until the long-term goal of suitable treatment can be performed. Where possible, comments relevant to these two goals will be made. Near-term goals are also most relevant when it comes to making decisions such as whether an agency wants to contract out the conservation to existing laboratories or establish its own conservation capability in order to conserve all future artifacts that might be acquired.

BASIC REFERENCES

There is a considerable body of literature on the conservation of archaeological material recovered from all environments, including that from marine sites. However, in recent years, a significant amount of the available data has been compiled in several publications, and the majority of the knowledge that is required to conserve artifacts from marine sites can be obtained from a relatively small number of publications. In addition to this on-line manual, the following publications should be consulted for additional details. These are the most important publications in the field of marine archaeology conservation to date.

Cronyn, J. M. 1990. *The Elements of Archaeological Conservation*. Routledge, London.

Grattan, D. W., ed. 1982. *Proceedings of the ICOM Waterlogged Wood Working Group Conference*. Waterlogged Wood Working Group, Committee for Conservation, ICOM, Ottowa.

Hamilton, D. L. 1975. *Conservation of Metal Objects from Underwater Sites: A Study in Methods*. Texas Antiquities Committee Publication No. 1, Austin, Texas.

_____. 1996. *Basic Methods of Conserving Underwater Archaeological Material Culture*. US Department of Defense Legacy Resource Management Program, Washington, DC.

ICOM Waterlogged Wood Working Group Conference. 1985. *Waterlogged Wood: Study and Conservation*. Proceedings of the 2nd ICOM Waterlogged Wood Working Group Conference, Grenoble, France.

Pearson, C., ed. 1987. *Conservation of Marine Archaeological Objects*. Butterworths, London.

Plenderleith, H. J. and A. E. A. Werner. 1977. *The Conservation of Antiquities and Works of Art*. Oxford University Press, Oxford.

These basic references, combined with various articles and papers from the *Journal of the American Institute for Conservation*, the Canadian Conservation Institute, the Getty Conservation Institute, the International Council of Museum Papers, and the International Institute for Conservation and Artistic Works in London (which publishes *Studies in Conservation*, the major journal for conservation), form the core of the information on the conservation of material from marine sites (see bibliography). These are supplemented by various university theses, papers prepared by conservation laboratories that are not widely distributed, personal communications from conservators, and personal experiences.

The following discussion on conservation is condensed from a combination of the above sources. This discussion, however, cannot replace consulting these references for a more detailed presentation. A 'cookbook' approach to archaeological conservation should never be taken. A range of personal experience and a thorough knowledge of the alternative techniques available is required to contend with the array of material to be treated. Even with this knowledge and experience, there will always be artifacts that simply cannot be successfully conserved; furthermore, there will always be instances when, for any number of reasons, it is simply not practical to conserve an artifact.

CONSERVATION ETHICS

The following are some of the more pertinent conservation ethics adopted by the International Institute for Conservation (IIC) as guidelines for all conservators. These standards were developed for art conservation but are also generally applicable to archaeological conservation. The statements in maroon-colored font are taken directly from IIC. Additional comments follow some of these entries to help clarify them. A knowledge of these ethical considerations helps to understand the reasoning behind a conservator's decision and selection of a procedure for treating an artifact.

1. Respect for Integrity of Object.
   All professional actions of the conservator are governed by unswerving respect for the aesthetic, historic and physical integrity of the object.

   Regardless of an artifact's condition or value, its aesthetic, historic, archaeological, and physical integrity should be preserved. After conservation, an object should retain as many diagnostic attributes as possible. The preservation of the diagnostic attributes of the object being conserved is of utmost importance in selecting a conservation treatment.

2. Competence and Facilities
   It is the conservator's responsibility to undertake the investigation or treatment of an historic or artistic work only within the limits of his professional competence and facilities.
3. Single Standard
   With every historic or artistic work he undertakes to conserve, regardless of his opinion of its value or quality, the conservator should adhere to the highest and most exacting standard of treatment. Although circumstances may limit the extent of treatment, the quality of the treatment should never be governed by the quality or value of the object. While special techniques may be required during treatment of large groups of objects, such as archival and natural history material, these procedures should be consistent with the conservator's respect for the integrity of the objects.
4. Suitability of Treatment
   The conservator should not perform or recommend any treatment which is not appropriate to the preservation or best interests of the historic or artistic work. The necessity and quality of the treatment should be more important to the professional than his remuneration.

   No treatment should be used that is not in the best interest of the object. Any treatment, even if less expensive, extensive, or time consuming should be avoided if there is a possibility of damaging the artifact. For these reasons, near-term and long-term goals are not pertinent when it comes to deciding the best treatment for an artifact.

5. Principal of Reversibility
   The conservator is guided by and endeavors to apply the 'principle of reversibility' in his treatments. He should avoid the use of materials which may become so intractable that their future removal could endanger the physical safety of the objects. He also should avoid the use of techniques, the results of which cannot be undone if that should become desirable.

   No treatment should be used that will result in damage to the object if it has to undergo further treatment. In general, all treatments should be reversible. This requirement recognizes that a conservation treatment may not last indefinitely nor remain superior to all future techniques. If the treatment is reversible, the option to re-treat is always open, and the continued preservation of the material is assured. However, in the conservation of material from archaeological sites and underwater marine sites in particular, this tenet often cannot be followed. The conservator has only one chance to preserve the artifact; in order to do this, non-reversible techniques may need to be used. The concept of reversibility vs. non-reversibility in archaeological conservation is currently undergoing close scrutiny, as it is a well-known fact the many so-called 'reversible processes' are *not* reversible. In fact, there is more potential for successful re-treatment of waterlogged wood previously treated with the 'non reversible' silicone oil process than there is for waterlogged wood treated by 'reversible' processes, such as polyethylene glycol.

6. Limitations on Aesthetic Reintegration
   In compensating for damage or loss, a conservator may supply little or much restoration, according to a firm previous understanding with the owner or custodian and the artist, if living. It is equally clear that he cannot ethically carry compensation to a point of modifying the known character of the original.
7. Continued Self-Education
   It is the responsibility of every conservator to remain abreast of current knowledge in his field and to continue to develop his skills so that he may give the best treatment circumstances permit.
8. Auxiliary Personnel
   The conservator has an obligation to protect and preserve the historic and artistic works under his care at all times by supervising and regulating the work of all auxiliary personnel, trainees and volunteers under his professional direction. A conservator should not contract or engage himself to clients as a supervisor of insufficiently trained personnel unless he can arrange to be present to direct the work.

   In marine archaeology, conservation is not simply a set of procedures and treatments. Often the conservator is the first and, in the case of some very fragile items, the only person to see the actual artifact. The conservator's responsibilities are that of archaeologist, mender, caretaker, and recorder of the artifacts that come into his or her care. Conservation, like archaeology, is a state of mind: a state of mind which holds a deep concern for the integrity of the artifacts and what they represent as remnants of history.

TENETS OF CONSERVATION

When treatment is accorded an object, it can include both conservation and restoration. Conservation refers to the process of documentation, analysis, cleaning, and stabilization of an object. The main objectives of the cleaning and stabilization are protection against, and prevention of, adverse reactions between the object and its environment. Restoration refers to the repair of damaged objects and the replacement of missing parts. A specimen may undergo both conservation and restoration, but in all cases, the former has priority over the latter. Restoration should never be initiated without conservation (Coremans 1969:16). Only the conservation aspect of artifact treatment is considered in this publication.

Because artifacts are a primary element of archaeological inquiry, artifact conservation should not detract from the natural appearance of the object nor alter any of its scientific attributes. The conservator should strive to process specimens so that they retain as much diagnostic data as possible and yet remain chemically stable. Every attempt should be made to preserve as much as possible of the original surfaces, form, and dimensions, i.e., the diagnostic attributes of the object. In addition, all treatments should, if feasible, be reversible when ever possible. This last requirement recognizes that a conservation treatment may not last indefinitely nor remain superior to all future techniques. If it is reversible, the option to re-treat is always open, and the continued preservation of the material is assured.

When objects are treated, the basic attitude and approach should be cautionary and similar to that outlined by Plenderleith and Werner (1971:16-17), who state that the past history of an artifact may impart features of significance pertaining to age and provenience, which can validate the authenticity of the artifact. Therefore, a preliminary examination of the object must be made in order to determine a course of action that will preserve the integrity of the specimen and maintain any significant attributes or any features relating to its manufacture or microstructure. In some cases, a corrosion layer may contain valuable archaeological data, in which case it should be preserved and not indiscriminately removed. Only in those instances where the corrosion is unstable, conceals underlying details, or is aesthetically displeasing should it be removed. Above all, one should heed the cautionary advice offered by Plenderleith and Werner (1971:17): "This work calls not only for knowledge, foresight, ingenuity, and dexterity, but for infinite patience. It should never be hurried."

The recording and preservation of the basic data derived from any given artifact is essential and must be of utmost concern to all laboratories which process archaeological material. In archaeological conservation there is often more to consider than simply the preservation of individual artifacts. One duty of the conservator is to stabilize the artifact so that it retains its form and diagnostic data. When treating archaeological material that requires documentation of context, as well as preservation, the documentation demands equal emphasis and first priority. The interaction between marine archaeology and conservation is a perfect example of the intimate relationship that can exist between archaeology and conservation in general.

It is important to continually stress that the proper conservation of artifacts is critical not only because it preserves the material remains of the past that are recovered, but also because it is capable of providing almost as much archaeological data as do field excavations and archival research. This is possible if the problems of conservation are approached with an archaeologically oriented view of material culture. This view contributes a sensitivity to the nature and potential value of the archaeological record and the importance of various types of association. An underlying premise of archaeology is that the distribution of cultural material, as well as its form, has cultural significance and is indicative of past cultural activities. By studying the material remains of a culture, considerable insight into its workings can be derived.

THE ROLE OF CONSERVATION IN MARINE ARCHAEOLOGY

The development of underwater archaeology is almost entirely a post World War II phenomenon resulting from the development of scuba, which made submerged sites, especially those in shallow water, accessible. Technological progress now allows archaeologists access to even deeper wrecks, such as the CSS *Alabama* and the USS *Monitor*. Nonetheless, underwater archaeology shares common techniques and standards with its terrestrial counterpart. Goggin (1964:302) describes underwater archaeology as " the recovery and interpretation of human remains and cultural materials of the past from underwater by archaeologists"; this definition is acceptable only if it is qualified by a more explicit definition, such as "archaeology can be defined minimally as the study of the interrelationship of form, temporal locus, and spatial locus exhibited by artifacts. In other words, archaeologists are always concerned with these interrelationships whatever broader interests they may have, and these interrelationships are the special business of archaeology" (Spaulding 1960:439). These definitions serve to differentiate archaeology, which is a scientific investigation, from uncontrolled salvage and 'treasure hunting,' which are oriented toward relic or object collecting.

Categories of underwater archaeological sites, in salt or fresh water, include (1) submerged refuse sites; (2) inundated settlements or harbors; (3) shrines or sacred localities, such as the cenote at Chichen Itza; and (4) shipwrecks (Goggin 1964:299). While the conservation of shipwreck material is the topic of this manual, the techniques reviewed here are applicable to metal objects from any underwater site and most terrestrial sites.

Shipwrecks are a special kind of archaeological site which have been compared to time capsules: "The very suddenness of such disasters has made these underwater wreck sites, in effect, accidental time capsules. Thus there is deposited in the waters of the world a mass of materials--dating from the earliest historical times to the present--capable of being located, recovered, identified, and preserved" (Peterson 1969: xiii-xiv). While all of this is true, but it is a very artifact-oriented view. There are much more data available in these 'time capsules' than simply collections of objects and an index to material remains. To an anthropologist or a historian, human activities are of more interest than the ship itself or its contents. It is only through viewing the ship as a component of a cultural system and by structuring the interrelationships of the material remains within the shipwreck site that the story of a social group may be revealed.

When a ship sets sail, it is a self-sufficient, self-contained segment of its culture with samples of what are considered essential commodities for periods of isolated life at a given time. The crew, the officers, and the passengers often represent a cross section of different social classes with class-distinctive quarters and selected material goods. Their distribution in the ship may be represented even after wrecking. It is also possible that data concerning technology, trade, personal belongings of the crew and passengers, armaments, armament policy, monetary systems, navigation, ship construction, shipboard life, and possibly societal and functional implications, as indicated by the distribution of certain kinds of remains, can be obtained. Tax, ownership, mining, shipping, or other types of identification, often stamped or marked on individual artifacts, provide additional leads. This potential wealth of information can often be checked and compared with archival documents for corroboration and reinterpretation.

It is possible to retrieve these data only if well-organized, problem-oriented excavations are conducted. Borhegyi (1964:5), in reference to underwater archaeology, states that "no one today would be forgiven if he employed the nineteenth century excavation techniques." At present, any well-planned underwater excavation should include properly planned conservation prior to the excavation and no one should be forgiven if conservation is cursory or slighted. If conservation plans are not included, more data may be lost than gained.

The recovery of artifacts from archaeological sites destroys the archaeological context, which remains preserved only in the notes, drawings, and photographs made by the archaeologist in the field. Careful recording is a necessity, otherwise the operation is not an archaeological excavation but rather an uncontrolled salvage operation producing a simple inventory of artifacts. Even the limited knowledge derived from uncontrolled excavations can be significant and valuable because it usually can be determined that the materials were associated with a single ship of a certain nation within a certain time span. All associations are not culturally significant, but if one approaches each archaeological excavation with the basic assumption that many associations are meaningful, and excavates accordingly, additional systemic and intra-site problems can be considered.

The conservation of metal artifacts from a marine site, and to a lesser degree metal artifacts from fresh water sites, is only remotely analogous to the conservation problems presented by other fields of archaeology. When artifacts of every variety, but particularly metals, are recovered from the sea (especially warm-water environments, such as the Caribbean and the Mediterranean), they are commonly encrusted with thick layers of calcium carbonate, magnesium hydroxide, metal corrosion products, sand, clay, and various forms of marine life, such as shells, coral, barnacles, and plant life. The term 'encrustation' refers to the conglomerations that may contain one or more artifacts. Such conglomerations may range from the size of a single coin to huge masses weighing several thousand pounds and which contain hundreds of individual objects made of many different materials.

The proper conservation of encrustation with their concealed contents is analogous to an excavation square within a site. Any laboratory that processes encrustation has the responsibility to (1) preserve and stabilize the artifacts as well as conservation technology permits, and (2) recover as much useful data as possible. Considerable information exists in the form of associations recoverable only by in situ observations made by the conservator. Extensive records must be maintained, including notes on the encrustation, the objects it contains, and the preservation techniques used, as well as color, black-and-white, and X-ray photographs. Casts must be made of disintegrated objects and of significant impressions left in the encrustations. Care must be taken with common items, such as potsherds, cloth fragments, spikes, straps, and animal bones. Even less obvious remains like impressions of seeds and insects (such as impressions of cockroaches found in an encrustation from the 1554 Spanish Plate Fleet excavation) must be detected and recorded. In other words, the conservator is in a unique position to supply the archaeologist with valuable evidence and to provide the laboratory with basic conservation data for research. As will be stated again: the investigation of large encrustation with their concealed contents is analogous to the excavation of a structure within a site; the location and orientation of each encrustation must be accurately plotted before it is raised from the seabed so that the data recovered in the conservation laboratory can be related back to the site.

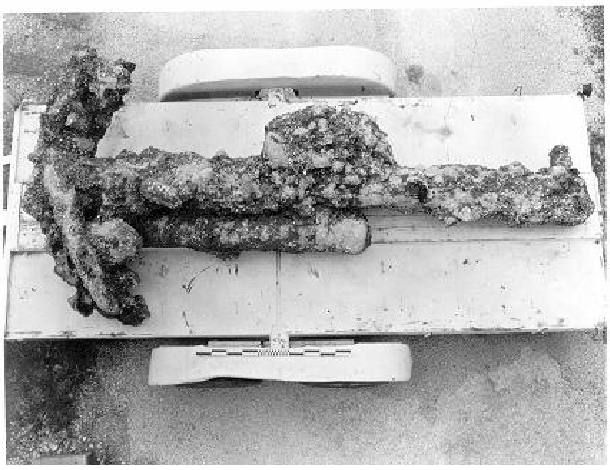

Figure 1.1

Figure 1.1 illustrates one of the several large encrustation recovered from the site of the *San Esteban*, one of the three ships of the 1554 Spanish Plate Fleet wrecked off Padre Island, Texas. This single encrustation, which contained two anchors, a bombardetta gun with its wooden undercarriage, breech blocks, and a multitude of smaller objects, was over 4 m long and weighed over 2 tons. A laboratory must have sufficient space and equipment to accommodate such a large object, mechanically clean it, properly conserve recovered specimens, and, possibly, cast a number of natural molds of disintegrated objects. Furthermore, it may be necessary to prepare the encased artifacts for display. The laboratory must have forklifts, chain hoists, large vats, specialized DC power supplies, hundreds of kilograms of chemicals, and thousands of liters of de-ionized water, among other resources, to perform the job. The conservation laboratory has to take an encrustation such as that depicted in Figure 1 and turn out an array of stabilized artifacts.

The degree and extent of artifact encrustation is dependent upon the local sea environment. Encrustation does not form in fresh water and is extensive in tropical sea water. In the cold sea water of the north, for example, encrustation formation is minimal. In environments where the encrustation is thin, the role of casting is less important, and the number of artifacts associated with any encrustation decreases.

It is often maintained by some treasure hunters that no artifact provenience other than site designation is necessary, since associated relationships are not significant. It is assumed that any patterned distribution of the ship's parts and contents will have been destroyed through years of wave action and shifting sand. This may be true for some wrecks, but such an arbitrary attitude has surely been responsible for the destruction of considerable archaeological data. What is important to remember is that careful documentation, both in the field and in the laboratory, conscientious conservation, and good laboratory records provide data that can be manipulated to solve a variety of problems and conceptual schemes, be they anthropologically or historically oriented. Conservation approached in this manner contributes considerable data to the understanding of any shipwreck.

BASIC CONSERVATION PROCEDURES

Conservation must be a part of any archaeological project; this is especially true for wet sites, i.e., archaeological sites located in bogs, rivers, and oceans. Of the wet sites, those found in salt water present the greatest challenge to the conservator. Artifacts from a marine environment are saturated with salts that must be removed when an artifact is recovered. In addition, the salt water environment accelerates the corrosion processes of many metal artifacts. If the salts are not removed and the artifacts treated in a timely manner, they will, over time, deteriorate and become useless as a diagnostic or museum display specimen.

Prior to any excavation, the archaeological project director should take the following factors into consideration:

1. Anticipate what may be encountered in the archaeological project, be it a survey, testing or a full-scale excavation.
2. Be aware of the types of breakdown, corrosion, and degradation that the recovered material may undergo.
3. Have a person with conservation experience in the field to help with the excavation to ensure that the recovered objects are properly treated.
4. Make arrangements for conservation before initiating any operation where artifacts may be recovered. This may mean contracting with an existing laboratory or establishing special facilities for the project. If the latter, ensure that the laboratory is properly equipped and is headed by a conservator with experience in the field of underwater archaeological conservation. All the artifacts recovered from an excavation should be under the direct control of an experienced conservator until they are stabilized.
5. Always keep in mind that it is an archaeological project, and that an archaeological project does not stop in the field, it continues in the lab. As much basic archaeological data are recovered in the laboratory as in the field. The information and records from both the field and the conservation lab have to be synthesized in order for the archaeological record to be properly interpreted.

FIELD RECOMMENDATIONS

Many projects set up a field conservation laboratory near the excavation site. This is often true for sites far removed from the main laboratory. However, in most cases the field lab cannot compare to the main lab and its capabilities. For this reason, aside from general cataloging, acquisition, and documentation, the minimal use of field conservation facilities is recommended. Proper field conservation procedures can be anticipated by referring to various articles, such as Pearson (1977;1987c), Dowman (1970), and Lawson (1978). During any marine excavation, the following field procedures are suggested (Hamilton 1976):

1. Record the precise position and orientation of every object, i.e., ship timbers, encrustations, individual artifacts, and number each item. Numbering is important so that there will be no confusion as to how each object related to the site after the material has been delivered to the laboratory for processing.
2. Do not remove any encrustation or layers covering the artifacts in the field, since they provide a protective corrosion-resistant layer around the material and preserve associations. Furthermore, considerable data may exist in the form of impressions and natural molds of objects which have completely disintegrated.
3. When dealing with large objects, such as kegs, chests, boxes, etc., it is strongly recommended that they be jacketed or otherwise brought up intact with minimum excavation in the field. This will protect the material while it is being shipped to the laboratory where it can be more effectively excavated. This will save valuable and costly field time, which is always much more expensive than conservation laboratory time. The bottom line is that features such as these are best excavated in the controlled environment of the conservation laboratory.
4. Keep all material wet at all times, either in sea water or, preferably, in fresh water with a sodium hydroxide-adjusted pH of 10 to 12. This will inhibit further corrosion. Keeping the storage vats covered to restrict light will inhibit any algae growth.

LABORATORY CONSERVATION

The laboratory operations from the time a specimen is delivered to its ultimate place of storage or exhibition can be separated into six basic stages:

1. Storage prior to treatment.
2. Evaluation of conservation process.
3. Mechanical cleaning.
4. Treatment to stabilize.
5. Restoration (optional).
6. Storage or exhibition after cleaning.

Only numbers 1-4 will be discussed in this manual.

STORAGE PRIOR TO TREATMENT

Generally speaking, all metal objects should be kept submerged in tap water with an inhibitor added to prevent further corrosion. For long-term storage, excellent results have been achieved using a 1 percent oxidizing solution of potassium dichromate with sufficient sodium hydroxide added to create a pH of 9 to 9.5. Alkaline inhibitive solutions, such as a 5 percent solution of sodium carbonate or a 2 percent solution of sodium hydroxide, can also be used, but they are not satisfactory for long-term storage (Hamilton 1976:21-25). As mentioned above, any adhering encrustation or corrosion layers should be left intact until the objects are treated, since they form a protective coating which retards corrosion. A more thorough discussion of pre-treatment storage techniques can be found under each material-specific chapter in this manual.

EVALUATION OF CONSERVATION PROCESS

Prior to treatment, any artifact, particularly if encrusted with marine carbonates, must be critically evaluated in order to ascertain the possible presence and condition of metal, associated organic material, and/ or other material, such as ceramic and glass. Only after each artifact is evaluated and all options considered is a course of action decided upon.

MECHANICAL CLEANING

X rays are indispensable for determining the content of each encrustation and the condition of any object. They also serve as a guide in extracting the artifacts from the encrustation. The use of chemicals to remove the encrustation is generally a very slow, ineffective process, which may possibly damage the artifact. The use of well-directed hammer blows and assorted chisels are generally the most utilized and effective means of removing encrustation. However, for many objects encrusted together with metal artifacts, especially fragile objects and ceramics, small pneumatic tools are indispensable. Larger pneumatic weld-flux chisels are particularly useful for the removal of large amounts of encrustation. Chisels can be easily fabricated in the laboratory for specific jobs, and their use is often desirable and quite effective in freeing movable parts on artifacts. Sandblasting can sometimes be used for cleaning the bores of cannons or guns but should never be used on the surface of any piece.

TREATMENT TO STABILIZE

First, it must be emphasized that conservation is not an exact science, and in many cases two different conservators may treat the same object in completely different ways. The objective is to treat any given object so that it is stable and does not lose any of its diagnostic attributes. There are often options and some leeway on any conservation procedure that will result in a well-conserved artifact. Therefore, much of what follows is based upon the personal experience and personal preference of the author. Other conservators may not agree completely with everything presented here, but all treatments discussed are within the scope of alternative conservation procedures. When possible, the advantages and disadvantages of each treatment will be presented

Before discussing specific treatments of any given category of material, it is necessary to present a short discussion of adhesives and consolidants. In archaeological conservation, various synthetic resins are used extensively, and they play an important role in the conservation of materials, especially organic and siliceous materials, from marine sites. It is, therefore, important that any conservator working on archaeological artifacts has not only a variety of resins at his or her disposal for use as glues and consolidants but also has a good understanding of their physical characteristics.