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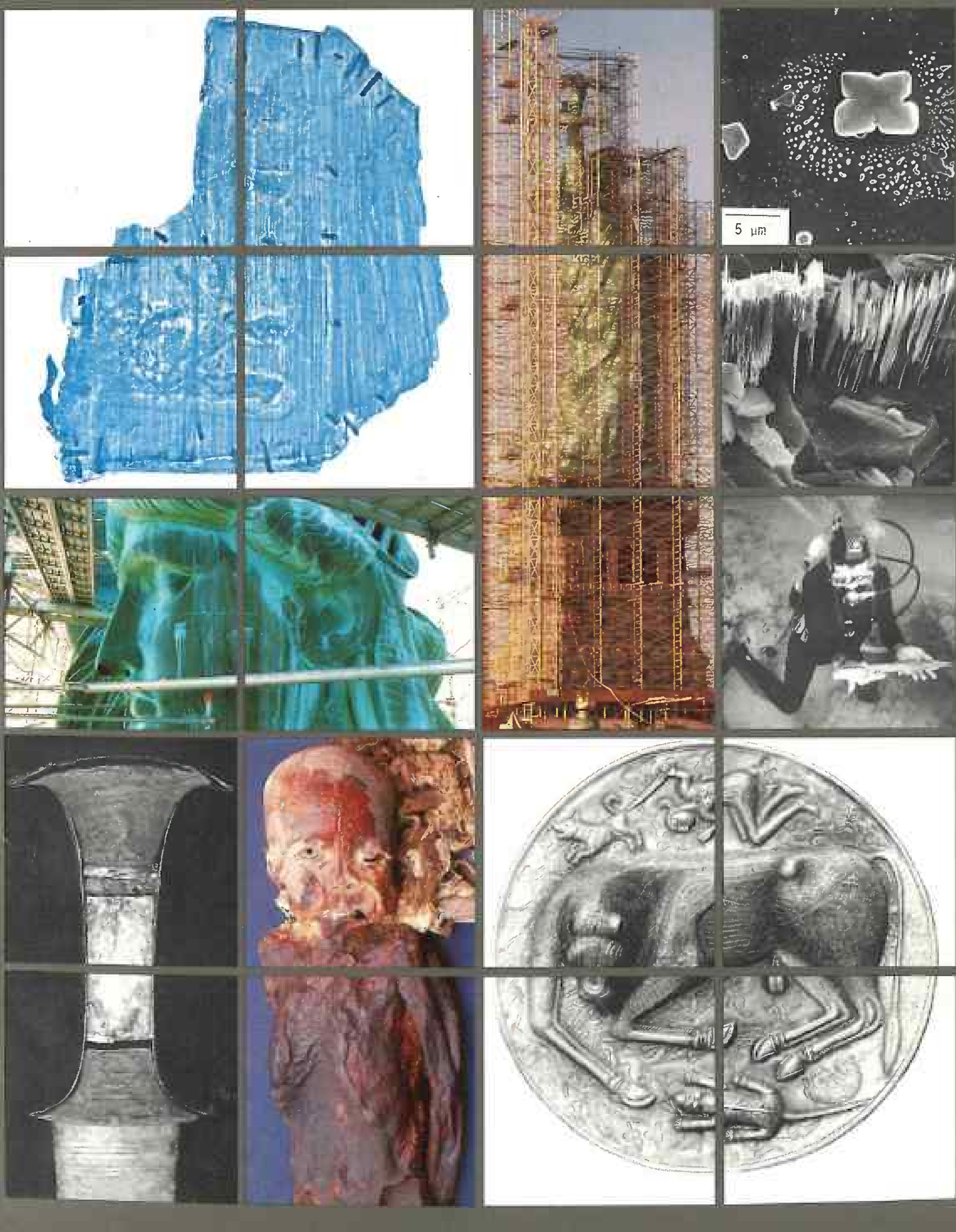
Recent Advances in the Conservation and Analysis of Artifacts



The Conservation of Artefacts from One of the World's Oldest Shipwrecks, The Ulu Burun, Kaş Shipwreck, Turkey

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Abstract: *The article discusses the problems encountered with the conservation of objects uncovered from a fourteenth century BC shipwreck found at Ulu Burun, (Kas) Turkey. After a brief description of the storage and recording methods on-site, the conservation considerations are given. The work of cleaning, desalting, drying and stabilising the artifacts is discussed in five cases where particular problems were encountered: an example of a composite material, a copper-alloy sword with wood and ivory inlays; a waterlogged metal, a silver bracelet; waterlogged elephant and hippopotamus tusk and tooth ivory; glass and amber beads; and finally, tin ingots and artifacts.*

The Ulu Burun (Kaş) shipwreck was discovered in 1982 by sponge diver Mehmet Çakar and was examined shortly thereafter by a team representing the Institute of Nautical Archaeology (INA) and the Bodrum Museum of Underwater Archaeology. Since 1984 the site has been systematically excavated by INA teams under the direction of G. F. Bass and Assistant Director Cemal Pulak. The shipwreck lies on a slope between 140 and 170 feet deep and artifacts recovered from it over the last three seasons (1984-6) point to the wreck being of the late Helladic III A:2 period, in the middle of the fourteenth century BC, making it one of the world's oldest shipwrecks to be properly excavated. Comprehensive reports of the excavation have been published elsewhere (Bass 1984; Pulak 1985; Bass 1986) (Fig. 1).

Because of the Spartan nature of the field camp, built on the cliffs overlooking the site, it would have been difficult to attempt anything but the basics of conservation on site. These included recording procedures such as photography, registering and basic drawing of artifacts when excavated, followed by storage of the objects in containers filled with a fresh water/sea water mix to avoid possible osmotic pressure damage to fragile objects which could occur if using pure water (Pearson 1977). The fresh water had to be brought laboriously by boat to the camp each day, but it meant that the desalination process could be started on site. The small objects were stored in polythene bags or sealed plastic containers of rectangular shape so that they could be stored efficiently in larger rectangular, stackable polythene crates. The labelling method which has been found to be the most satisfactory is a double labelling system: the first label is punched out on *Dymo* tape (plastic adhesive-backed tape) and the second is written with pencil on *Mylar* labels (plastic drawing film, cut into labels). Often the number is recorded for a third time on the polythene bag or container with indelible ink. Each artifact is then stored in a numbered crate, keeping artifacts of the same composition together where possible. The larger objects such as *amphoras*, ingots and wooden pieces were stored in concrete tanks constructed against the side of the cliff. Very large objects, for example *pithoi*, were left on the sea bottom until the end of the excavation when they were brought up and, with the rest of the objects, transported to the Bodrum Museum. The registering and storage procedures were carried out by experienced archaeologists and divers who have had conservation training.

Fig. 1. A diver on the wreck site at Ulu Burun lifting an artifact (sword KW 275).

At the Bodrum Museum the Institute has laboratories, workshops, and storage areas where the Kas artifacts can be conserved. The three main problems in conserving the Kaş artifacts can be summarised as follows:

- removal of the thick concretion on the surface of most artifacts;
- desalting of the artifacts; and
- stabilisation of the often extremely fragile objects, particularly from the wet to dry phase.

In addition three points had to be considered before beginning the treatment:

- Most of the objects were being sampled for analysis of their fabric or contents (of vessels). These should not be compromised by any treatment.
- No bulk treatment of objects could be undertaken because of the extreme variability of preservation of the artifacts, even of the same composition (for example the many copper ingots).
- The objects could not yet go into a climate controlled store room or display case. Objects would therefore have to be protected against high (but sometimes very low) humidities.

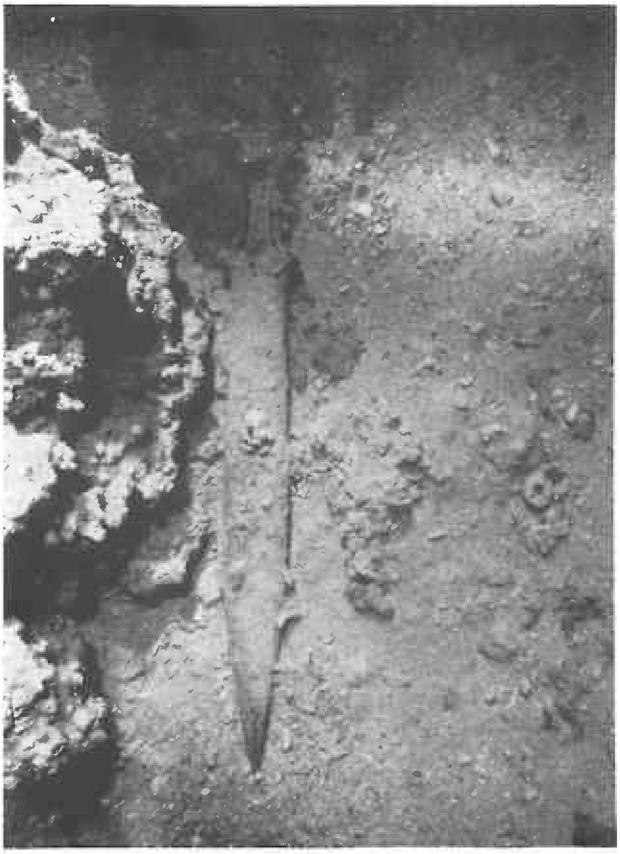

Fig. 2. Inlaid sword (KW 275) on the excavation before lifting.

Fig. 3. The handle of the sword being cleaned chemically with formic acid to reveal and release the inlays.

The conservation work and problems encountered are best illustrated by looking at the treatments of five organic and inorganic materials from the excavation:

1. The conservation of an object of composite materials is best illustrated by the treatment of a sword (KW 275). This was a copper-alloy sword with inlays of a dark dense wood, light soft wood and ivory in the handle recesses. The whole of the surface and particularly the handle was covered in a thick layer of calcareous concretion (Fig. 2). The sword blade was cleaned mechanically with a scalpel to reveal a beautiful patina. The sharp edges were particularly difficult to clean (the work was analogous to removing concrete from a brittle egg-shell), so these were strengthened by applying coats of *Paraloid B-72* in acetone to the underside of the edge; the use of a hydrophilic solvent acetone helped the *Paraloid* to adhere better to the damp metal than the use

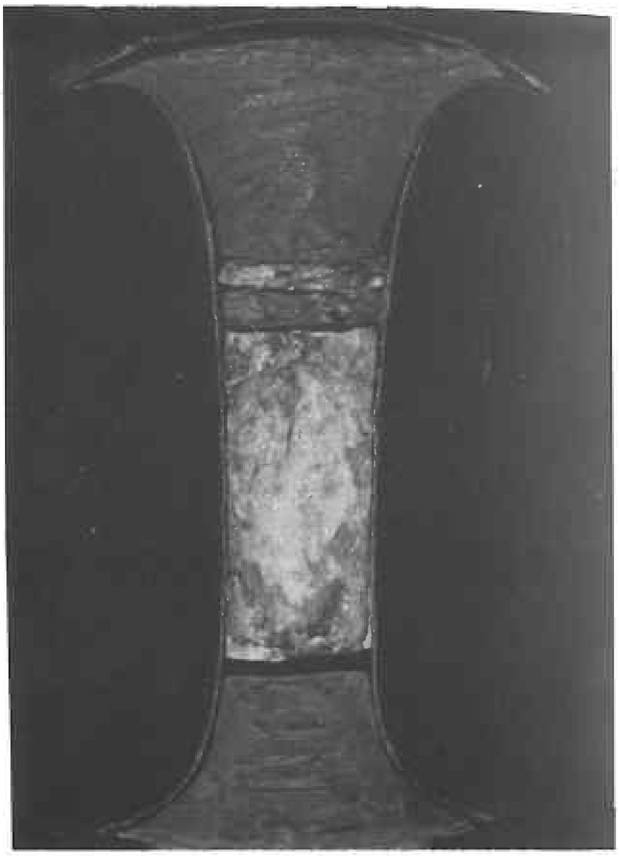

Fig. 4. The handle of the sword after conservation with, from bottom to top: dark hard wood, ivory, soft light wood, ivory and dark hard wood inlays.

of a hydrophobic solvent, e.g. toluene. In some areas the concretion was too hard to remove without damaging the edges, and swabs of cotton wool soaked in 10% formic acid were therefore applied and removed after all or most of the concretion had dissolved away.

Test cleaning of the inlaid areas showed that the inlays were embedded and encapsulated by hard concretion in their fragile copper-alloy recesses (the sides of the recesses were less than 0.5 mm thick at the top). Mechanical cleaning could not have been used. Instead it was decided to remove the concretion chemically with 10% formic acid. The acid was slowly dripped over the concretion and allowed to run off (Fig. 3). The inlays were frequently rinsed off with water and the cleaning progress inspected to prevent etching of the ivory surface by the acid. The acid did not affect the patina of the metal. When most of the concretion had been removed the inlays could be safely lifted out. They were then treated individually as follows:

Ivory pieces: These pieces (including a wedge of light-coloured wood adhering to the ivory) were dewatered in four acetone baths (of three volumes of acetone to one volume of object) of a day each. They were removed, excess acetone was allowed to evaporate, and they were then immersed in a consolidant, 5% *Paraloid B-72* in toluene. After a week of stirring the solution the ivory was removed and replaced in polythene bags to dry at a slow rate for two weeks. After removal from the bags the pieces were recoated, by brushing, with 10% *Paraloid B-72* in toluene to seal the surface and protect the ivory from fluctuating moisture conditions (see section 3).

Dark wood pieces: The three surviving pieces were impregnated with copper corrosion product stains. These were chemically removed by immersion in a chelating

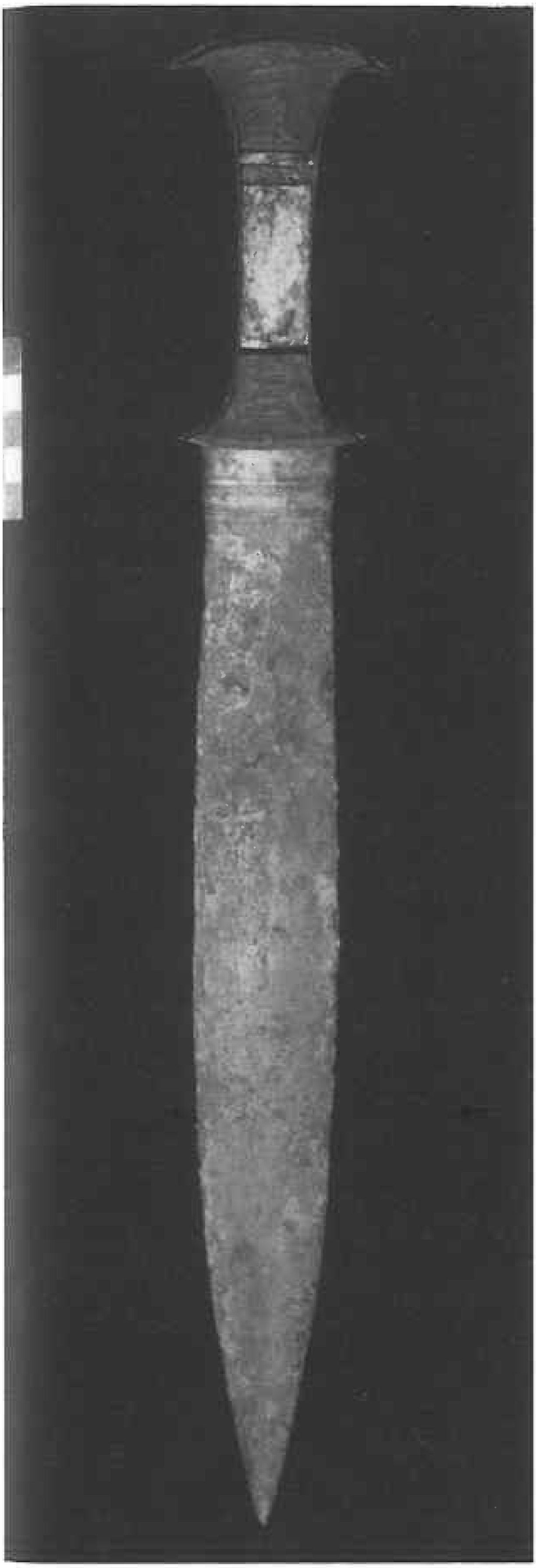

Fig. 5. Inlaid sword (KW 275) after conservation.

agent, 10% disodium EDTA (ethylenediaminetetra-acetic acid) for one day. The wood pieces were then washed in baths of distilled water to a level conductivity reading. In their waterlogged state the pieces were obviously swollen as they did not fit into their recesses properly and were also causing the other inlays to lift out. A method was chosen to stabilise the wood which would deliberately cause some dimensional shrinkage (about 5% was required) enabling the pieces to fit into their recesses. The acetone-rosin method was chosen as previous tests had shown that underwater archaeological wood treated by this method had shrunk by this amount. The wood pieces were dewatered in four acetone baths, then they were consolidated by immersing them in a warm saturated solution of rosin in acetone for one month (McKerrell 1972). After the treatment the pieces fitted correctly in their recesses, also enabling the other inlays to fit next to the wood.

The copper-alloy sword was washed in baths of distilled water to remove any soluble salts and residual formic acid. Potential bronze disease was stabilised by immersing the desalted and air-dried sword in a bath of 3% Benzotriazole (BTA) in alcohol for one day. The BTA was sealed in and the surface lacquered by consolidating the surface with 50% *Incralac* in toluene (by immersion for one day). After removal and air-drying the surface was relacquered by brushing on more *Incralac* solution with a matting agent, *Cabosil*, added. The thin edges in particular were carefully laquered to strengthen them.

The inlays were replaced in their correct positions without an adhesive so that they could be easily removed for study, photography and drawing (Fig. 4).

Finally, as with all the fragile Kas objects, an expanded polystyrene foam mount was cut so that the sword could be observed without handling the actual object (Fig. 5).

The sword has been stored in a store room of unfortunately high relative humidity (average 70% RH) but the conservation treatment appears to have fully stabilised the complex object. Also we have had a 100% success rate to date in stabilising the other copper-alloy artifacts (with the exception of the copper ingots) with the distilled water baths, BTA and *Incralac* immersion and lacquering method, despite the adverse storage conditions.

2. Much of the Kas wreck metalwork is extremely fragile and has a soft, deteriorated surface. The conservation of a silver bracelet (KW 284) was a good example of the treatment of a waterlogged metal in this condition.

The object was covered in a layer of concretion below which was a thick layer of grey-black silver chloride and sulphide covering the surface of the actual object (Weier 1973). The object was no longer solid metal but was composed of a mixture of silver corrosion products and silver metal particles.

It is a general conservation rule that very deteriorated metal objects should not be chemically cleaned, but it has often been observed with the Kas material that mechanically cleaning such objects, even with great care, can cause more damage than by using a specific, controlled chemical treatment. However, before considering such a treatment a sample should be taken before the material is affected by the subsequent use of a chemical.

The hard calcareous concretion was partially removed by immersing the object in warm (50°C) 20% formic acid (Pearson *ibid.*). The reaction was closely

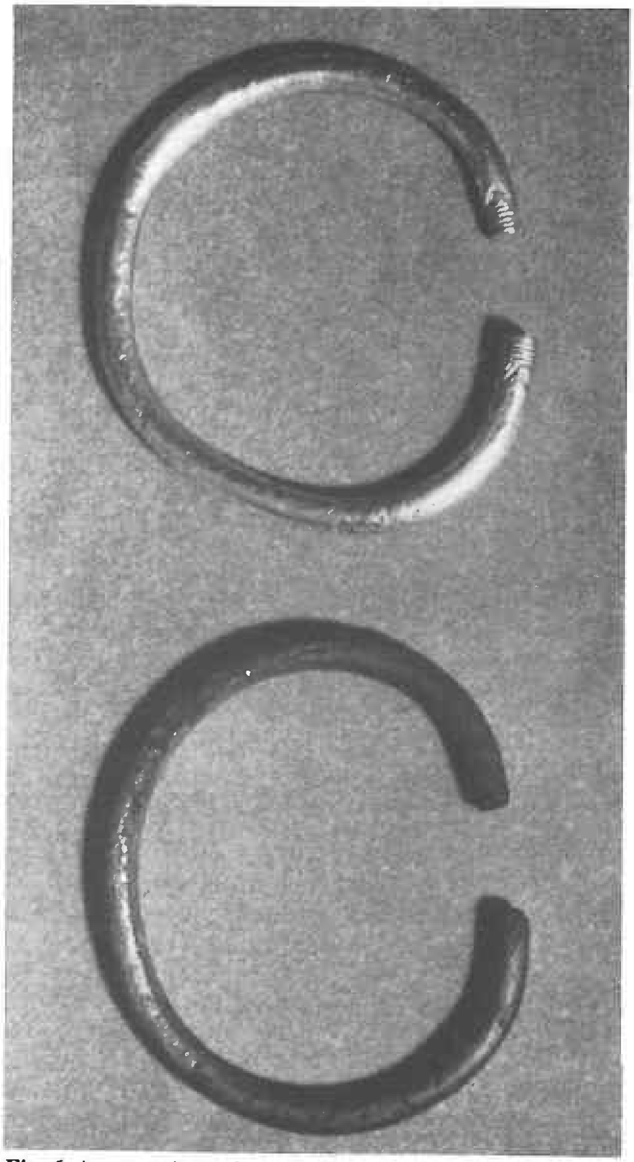

Fig. 6. A comparison of two similar silver bracelets from Ulu Burun: KW 92 at bottom still preserved as solid metal, after conservation; at top, KW 284 highly corroded and waterlogged metal after cleaning but before drying.

observed and when completed the acid was rinsed off the object in distilled water baths. Silver corrosion products remaining were removed with a scalpel; these flaked off very easily as a result of the previous chemical treatment. The bracelet was then fully desalted in baths of distilled water to a steady level of $24\mu S/cm^{-1}$, measured on a conductivity meter (Fig. 6).

The biggest problem in the treatment was encountered with drying the object. After slow air drying some areas of the very soft powdery surface crazed like drying mud. Other metal artifacts of both silver and copper-alloy (with and without chemical cleaning treatments) in a waterlogged condition have acted in a similar way, developing a fine system of hair-line cracks. As a result an improved drying technique has been developed to lessen this effect: the object is dewatered in three acetone baths; it is then stabilised, while still wet, by immersion in 3% BTA in alcohol; after which it is immersed, still in the wet phase, into 10% *Paraloid B-72* in acetone. Only then is the surface, which is now stabilised and consolidated, allowed to slowly air dry. The surface can then be re-strengthened and lacquered with a harder coating such as *Incralac* with a matting agent added if required.

In the case of the bracelet (before the above method was developed) the cracked surface was strengthened and restored by consolidating the object with many coats of 50% *Incralac* in toluene brushed onto the surface until no more was absorbed. After drying further coats were applied until the object could be safely handled. The hairline cracks were gap-filled as follows: the object was gently warmed under a lamp while *Araldite* epoxy resin was accurately mixed, then graphite powder was added to pigment the resin (HXTAL NYL-1 epoxy resin has also been successfully used on other objects). The resin was warmed to lower its viscosity, then it was dripped into the cracks (a cold object would have caused the resin to thicken on contact with the surface and retard the penetration of the resin deep into the cracks). Uncured excess resin was removed at this stage with a scalpel. After curing for three days the resin was trimmed to shape using files, scalpels and fine, grade 320 *Flex-i-grit* silicon carbide paper (Fig. 7).

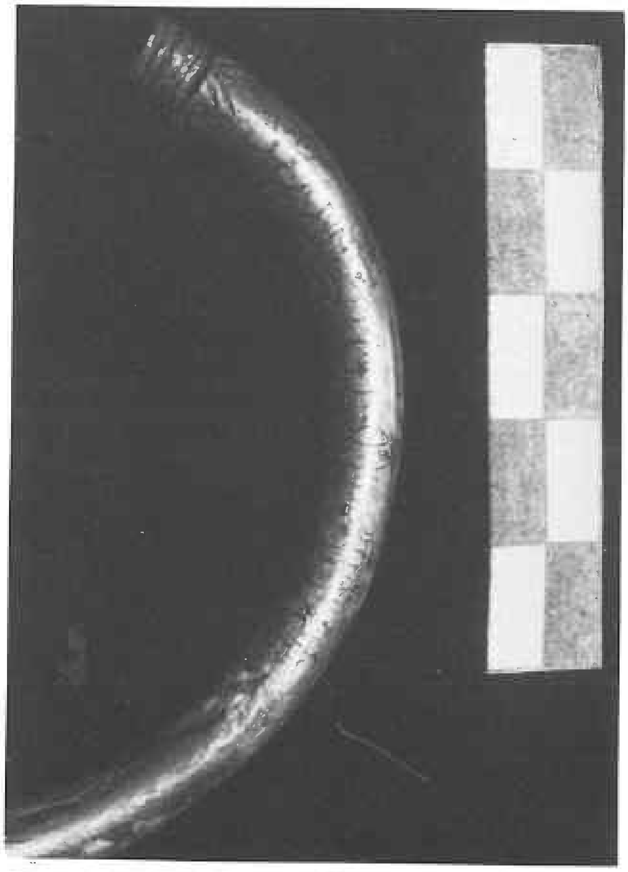

Fig. 7. A detail of the surface of KW 284 showing drying cracks filled and restored with epoxy resin.

The surface, which was now supported by the epoxy resin and the consolidant could be burnished and polished. The loose silver particles supported by the *Incralac* were burnished with a smooth glass rod and the rest of the metallic surface was polished with a fine polishing paste, *Solvol Autosol* applied on cotton wool swabs. The object was desalted again, after all the handling, with distilled water before thorough air-drying and a final application of a lacquer, 50% *Incralac* in toluene. The object has been repeatedly handled since its completion and it remains strong and untarnished (Fig. 8).

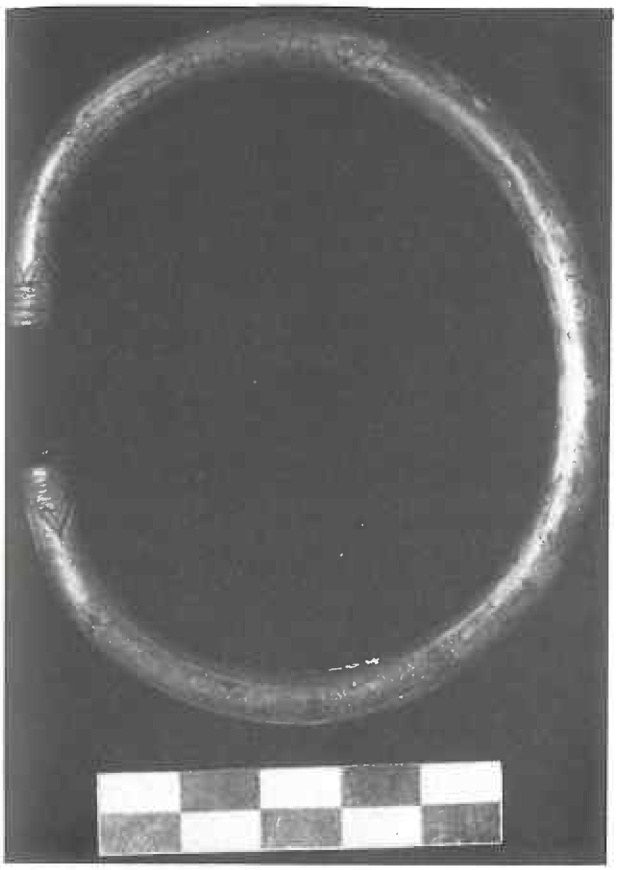

Fig. 8. The silver bracelet (KW 284) after conservation.

Fig. 9. A diver recovering the elephant tusk section (KW 162) from the wreck site. Note the dark staining of the ivory surface.

3. The conservation of waterlogged ivory from the shipwreck presented many problems. An elephant tusk section (KW 162) (Fig. 9) and a hippopotamus tooth (KW 162) have been conserved and three hippopotamus teeth are undergoing treatment. The problems can be summarised as: salt and stain removal; water removal; and strengthening the objects. The problems are complicated by the anisotropic nature of ivory, especially deteriorated archaeological ivory which is very vulnerable to exfoliation and collapse of its growth ring structure if too great a stress is applied. Such stresses could result from a fast desalination process, a vigorous dewatering treatment and finally, inadequate consolidation of all the objects. The treatment and a discussion of the problems follows.

Salt removal: Fast salt removal from the ivory could have caused damage and exfoliation of the layers of ivory by osmotic pressure damage (where a large salt concentration in the ivory is diffusing outward to an area of low salt concentration in the surrounding water). It was therefore decided to desalinate the ivory over a long period using, initially, only moderately pure water, then as the salt level dropped towards the end of the treatment, using very pure water. In the case of the hippopotamus tooth the ivory was relatively thin (about 3-4 mm, except for the solid tip) and during storage was desalinated over a period of fourteen months of which only in the last two months was the salt level steadily reduced with distilled water. The elephant tusk section was much thicker (10.7 x 12.6 cm at one end and 12.4 x 14.6 cm at the other oval end of the 20.1 cm high piece) and out of the fourteen month period, seven months were required to reduce the salt level in the ivory.

The sea water level (approximately 33-34,000 $\mu S/cm^{-1}$) in both cases was brought down to the local tap water level (around 3,000 $\mu s/cm^{-1}$) by slowly introducing the tap water into the sea water baths. Then local clean well water (around 200 $\mu s/cm^{-1}$) was gradually introduced into the tap water and finally distilled water (5 $\mu s/cm^{-1}$) was used to replace the well water. The baths were changed approximately every week, but with the introduction of the distilled water the baths were changed every one or two days until a steady level was reached on a graph of conductivity of the soak solution against time. The final reading for the hippopotamus tooth was 60 $\mu s/cm^{-1}$ and 45 $\mu s/cm^{-1}$ for the elephant tusk section.

The stains in the tusk were not removed by the prolonged soaking in the pure water baths, so it was decided to try and bleach out some of the staining. The tusk was placed in a bath of 5% (V/V) hydrogen peroxide for four days until no more bubbles were given off. A lot of organic stains were removed but the deep copper stains remained. It was found in tests that the bleaching was best accomplished by use of a dilute solution of hydrogen peroxide over a long period rather than a more concentrated solution over a short period. After the bleaching treatment, the tusk was again washed in distilled water baths. Bleaching of other ivory pieces, for example hippopotamus tooth KW 744, had had considerable success too, with most of the dark brown staining being removed leaving the original colour of the white ivory.

Water removal: Air drying the pieces could have resulted in differential drying rates of the exterior to the interior: the fast drying of the exterior surface, with the resultant small amount of shrinkage, would have caused the outside growth ring layers to split and exfoliate. Therefore it was necessary to devise a method of removing the water thoroughly, but slowly, to retard this effect. Dewatering with a water miscible solvent presented the obvious choice, carrying out the process on a gradual scale to prevent over-dehydration and stress formation of the outer layers. (Hippopotamus tooth KW 744, however, which was in a relatively good condition, was successfully air-dried over a three week period in a partially covered container in a high humidity (90% RH) atmosphere). The solvent acetone was chosen in a ratio of one volume of object to three volumes of acetone, in the following method:

First bath	50/50 acetone:water	3 day bath
Second bath	75/25 acetone:water	3 day bath
Third bath	100 acetone	one week
Fourth bath	100 acetone	one week

A test of the final bath with a conductivity meter indicated that there was a negligible amount of water extracted and the process was completed.

Consolidation: The acetone-soaked ivory pieces were consolidated by immersion in a 5% solution of *Paraloid B-72* in toluene/acetone (80:20 mix). This mixture was chosen because a solution made with toluene alone would have been fairly immiscible with the solvent, acetone, already in the ivory. By utilising a higher percentage of a slower evaporating solvent, toluene, in the mix the drying rate of the consolidant in the ivory could be slowed down, reducing the likelihood of the consolidant being brought back to the evaporating front at the surface of the object (reverse migration).

Fig. 10. One end of the elephant tusk showing the cracked surface and interfaces between the growth rings which enabled the penetration of the consolidant into the ivory. Note also the characteristic end grain markings of the elephant ivory.

Paraloid B-72 was used because of its good strengthening properties, stability, low discolouration of the ivory (Snow 1984), and its reasonably good impermeability to water vapour (Feller 1985), the latter a necessary factor in a climate of fluctuating humidity conditions. The fine hairline cracks already in the ivory and the interfaces of the growth rings undoubtably allowed better penetration of the consolidant deep down into the ivory (Fig. 10). After two weeks the ivory was taken out and placed in two layers of polythene bags so that the consolidant could dry through the polythene membranes at a slow rate.

After two weeks the ivory was removed (into an atmosphere of moderate humidity, 55% RH) and more of the consolidant was brushed onto the surfaces each day, allowing it to soak in and dry overnight (in polythene bags). After five days the ivory would not absorb any more consolidant. Excess drips of the *Paraloid B-72* were removed with acetone soaked swabs.

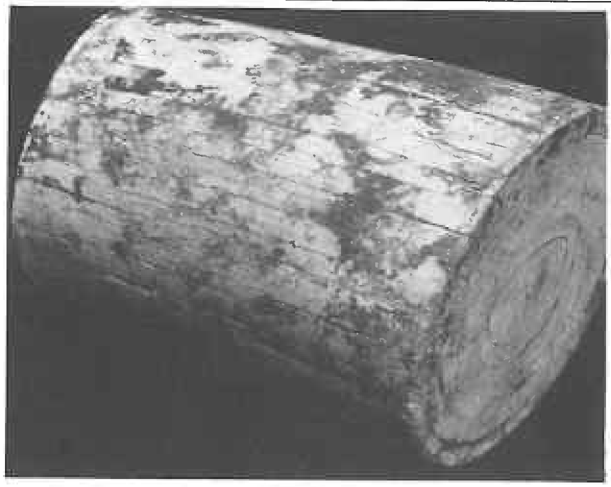

Fig. 11. The elephant tusk (KW 162) after conservation. Note the colour of the ivory compared to Figure 9.

The laboratory in which it was being treated had a fluctuating climate and in a particularly dry period (25% RH) a few new small cracks appeared in the ivory. However on application of more consolidant into the cracks and storage in a higher humidity store room (average 70% RH), wrapped in two polythene bags to maintain a non-fluctuating microclimate, the pieces have stabilised.

The ivory pieces have been inspected regularly and are still stable after over a year's storage (Fig. 11).

4. From the excavation many glass ingots and beads have survived, as well as a number of amber beads. In a deteriorated waterlogged condition the glass and amber behave in a similar way in that on air drying they first develop a network of fine cracks (most of which are already present but are invisible in their wet state), then collapse completely to a gritty powder. A variety of tests was carried out on a number of samples of glass beads (from an *amphora* full of glass beads, KW 8) by Jane Pannell and the author to assess various conservation treatments for the glass and amber.

Treatment	Results
A. Control: air drying	Total disintegration of the sample
B. Acetone dewatering then air drying	Some disintegration but less than above
C. Acetone dewatering then consolidation with 10% PEG 4000 wax in ethanol	Total disintegration of the sample
D. 5% *Paraloid B-72* in acetone applied to the bead by pipette	Strengthening of the sample but also some damp disintegration
E. Acetone dewatering then consolidation in 5% *Paraloid B-72* in toluene for three days followed by drying in a polythene bag.	Sample strong. No disintegation.

Because method (E) proved successful, the glass and amber beads were treated with this technique. On drying there was some cracking of the amber, but many of these cracks could have been present in the pieces before the treatment. The beads treated by this method are now strong and handleable and have shown no adverse effects as a result of storage in the high humidity store room.

5. The Kaş excavation is unique in the number of tin objects that have survived including tin ingots and tin (alloy?) vessels. This metal is rarely found in archaeological contexts and is usually badly corroded. Further research is necessary in this field, but the following are observations on the treatment of tin objects from the excavation.

The tin has presumably survived by the preserving action of the thick, relatively stable tin II sulphide patina on the surface, formed from the great organic activity next to the ingots. However, where the ingots are badly preserved this could be attributed to three factors: firstly, to the galvanic coupling with more noble copper ingots found in abundance on the wreck; secondly, to the disruption of the patina by outgrowing tin IV oxide crystals breaking through defects in the patina; and thirdly, to the disruption of the patina and metallic tin by grey tin brought about by temperature-induced allotropism (grey tin forms at low temperatures, below 13.2^{o}C such as are found at the bottom of the sea, 150 feet down at the wreck site) (Stambolov 1969).

The high purity tin ingots vary in preservation from a metallic tin dendritic structure to areas of massive white crystalline networks, (composed of tin IV oxide, SnO_2) often interspersed with particles of metallic tin. In both these areas grey tin is present in large, often 1 cm or more diameter deep spherical pits; but sometimes in considerable amounts causing the almost complete disintegration of the object, since grey tin contributes no structural support, being but a fine blue-grey microcrystalline powder. The ingots that have survived intact are covered by a dark brown sulphide patina that is extremely hard and thick. This patina overlies the 'warts' which disfigure the original surface. The contents of the warts, which can sometimes be very large (up to 15 cm diameter) appear to be outgrowths of the crystalline tin oxide network, or more rarely grey tin.

In the tin (alloy?) vessels the surviving walls are thin and exist only as two layers of brown-black patina with little in between. The surfaces are heavily disrupted by tin warts, grey tin and cavities where the grey tin has disintegrated (Fig. 12). With these and the ingots the patina is coated with a considerable layer of concretion.

Tests were carried out on tin ingot fragments to observe various cleaning techniques to assess their suitability for :

1. Chemical cleaning methods
or 2. Mechanical cleaning methods

1. Chemical cleaning techniques

Treatment	*Results*
10% Disodium EDTA	Extremely slow removal of the concretion. No observable action on the tin patina.
10% formic acid	Removal of the concretion but no observable effect on the tin patina.
10% Hydrochloric acid	Removal of the concretion. Some reaction with the surface.
10% Nitric acid	Removal of the concretion. No observable effect on the tin patina.

2. Mechanical cleaning techniques

Treatment	*Results*
Scalpel	Very laborious and ineffective against hard concretions and the tin patina.
Air scribe (compressed air percussion tip)	Effective but often shattered the brittle crystalline areas and chipped off fragile parts.
Hammer and assortment of chisel sizes.	Effective and controllable.

The aim of the cleaning treatments was to remove the concretion, while preserving the stable patina where possible. After the above tests it was decided to use the hammer and chisel cleaning technique (the method also used, with the air scribe, to clean the copper ingots). This had the advantage of avoiding chemicals which would have to be washed out of the porous object and also preserving the tin for metal analysis in the future. The mechanical cleaning technique allowed the controlled cleaning necessary in two cases: where the patina was so thick that it obscured the inscriptions sometimes found in the surface, it was deliberately thinned downand secondly, where 'warts' altered the original shape or obliterated manufacturing marks then these were removed by chipping them flush with the surface (some of these were later gap-filled with *Araldite* epoxy resin).

The small vessels could not be cleaned by mechanical technques because they were too brittle and fragile. The concretion was removed instead by pipetting onto the pieces 5% Nitric acid followed only then by careful cleaning with a scalpel.

After cleaning, the tin objects were desalted in baths of distilled water. However, following the cleaning and disturbance of the patina on the ingots, the exposed crystalline areas of tin oxide became very reactive towards water in the soak baths with fresh white tin oxide forming at a very fast rate. For this reason it was necessary to desalt the tin at as rapid a rate as was possible and then quickly but effectively air-dry them.

When thoroughly dry the ingots were lacquered by immersion in a 10% solution of *Paraloid B-67* in acetone. This grade of *Paraloid* was chosen because it gave a strong hard coating to the surface enabling it to resist abrasions and knocks (the tin ingots were extremely heavy and the surfaces would in all probability be abraded by handling). After three to six months storage in high humidity conditions 60-80% RH) some of these lacquered ingots had started to re-oxidise on exposed oxide crystals, actually through the lacquer, indicating inadequate moisture protection by the lacquer. It was therefore decided to solve this problem by using a two-layered lacquering system. The first layer is *Paraloid B-72* which has a relatively good impermeability to oxygen and moisture, and the second layer is *Paraloid B-67* which protects the B-72 and provides a harder coating. (*Paraloid B-72* has an ultimate Tukon hardness of 10-11, whereas *Paraloid B-67* is harder, 11-12 (Rohm and Haas 1983). Also *B-72* has a Knoop hardness of 0.34 against the *B-67*'s 57 (Grattan 1980). For the vessels, *Paraloid B-72* and *Incralac* (a *Paraloid B-44* composition; *B-44* has an ultimate Tukon hardness of 15-16) have been used to good effect. The tests have proved successful so far in the high humidity conditions of the store rooms, though if these fail a hard wax coating may have to be considered.

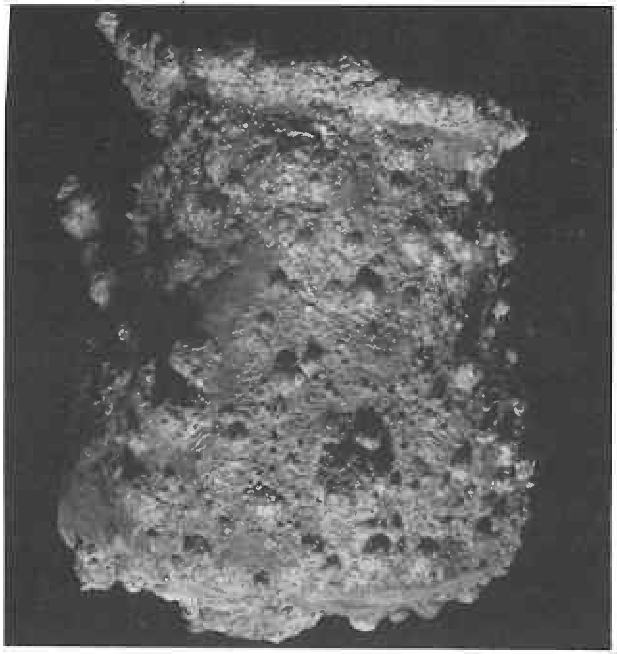

Fig. 12. Tin jug (KW 313) after conservation and restoration taken with a raking light to show the tin 'warts' covering the surface.

Conclusion

Although many hundreds of artifacts have so far been conserved, the work was best illustrated by choosing those objects and materials rarely found on archaeological excavations and in such a condition. Even after extensive testing (where materials and equipment allowed) not all the treatments were immediately successful; some had to be modified either during the initial treatments or afterwards. Although there is still much research needed in certain fields, such as tin conservation, it is hoped that this paper will supply such information that will further aid our knowledge of these objects and their conservation.

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Suppliers:

F. W. J. = Frank W. Joel Ltd.
Oldmedow Road
Hardwick Industrial Estate
King's Lynn PE30 4HH
England

C.M. = Conservation Materials Ltd.
240 Freeport Blvd.
Sparks, Nevada 89431
U.S.A.

Paraloid B-72: Ethyl Methacrylate Copolymer
F.W.J. and C.M. (see addresses above)

Paraloid B-67: Isobutyl Methacrylate Polymer
F.W.J. and C.M.

Incralac: (*Paraloid B-44* solution containing BTA and a UV absorber). *B-44 :* Butyl Methacrylate Copolymer
F.W.J. and C.M.

Cabosil: fumed silica
C.M.

Solvol Autosol: Spirit soap and fine abrasive paste
Hardware stores in England and C.M.

Mylar : Synthetic Polyester Resin Film
C.M.

BTA: Benzotriazole
F.W.J. and C.M.

Rosin: Colophony: Oleoresin from pine trees
Locally in Turkey and F.W.J. and C.M.

2Na EDTA: Disodium salt of ethylene diaminetetra acetic acid
F.W.J. and C.M.

Flex-i-grit : Abrasive powder coated onto Mylar sheets
F.W.J. and C.M.

Araldite: General purpose epoxy resin
Hardware stores in England

Acetone, Toluene, Formic acid, Nitric Acid
Locally in Turkey (cannot be sent parcel post)