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ARCHEOLOGICAL CONSERVATION

by Barbara J. Hall
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At the end of May 1974 the new conservation laboratory for the Oriental Institute Museum was completed—with the help of a very generous $10,000 grant from the Women's Board of the University—and since that time approximately 300 objects have been cleaned or treated for different types of deterioration. I would like to explain to the Institute members some general aspects of archeological conservation.

Most of the objects in the Museum's collection come directly from excavations; because they have been buried in the ground for at least 2000 years, and in most cases considerably longer, they generally suffer some form of deterioration, the rate and degree of which depend on two factors: the nature of the material—metal, stone, wood, leather, ivory, bone, ceramic, or glass—and its interaction with its burial environment. This environment may be underwater (in the sea or in waterlogged conditions), an enclosed space such as a tomb or cave, or the soil. The soil may be a natural type taking its character from the parent bedrock and natural influences such as weathering, flooding, and vegetation; or it may be a man-modified soil, the character and chemicals of which have been altered by use of the site for habitation or industry or as a waste area.

In each type of burial environment, certain factors, chemical, physical, and biological, combine to destroy the object; and it is only when a delicate and favorable balance between an object and environmental conditions is achieved that an object will be preserved. Chemical destruction is caused by the presence of salts, the available oxygen and water, and the pH (acidity or alkalinity) of the area. Climatic conditions, temperature, relative humidity, and amount of rainfall, not only affect chemical changes—chemical reactions are accelerated at higher temperatures and slowed at lower ones—but also they place the object under great physical stress as it expands and contracts to adjust to such fluctuations. In assessing the destructive effects of climatic factors, the depth of burial, the level of the water table, and the porosity of the soil, which will permit or hinder the percolation of salts, water, and oxygen, must also be considered. In addition to chemical and physical deterioration, environmental conditions may be favorable to biological degradation by molds, bacteria, fungi, insects, and rodents which feed on organic material.

In an adverse environment the rate of deterioration at first will be rapid as an object reacts with the chemicals available in the immediate burial area. If the environment remains unchanging, the chemicals will be used up and the object will achieve a state of equilibrium with the environment; the chemical reactions causing deterioration will slow down greatly although they never cease entirely. If the supplies of salts, water, and oxygen are constantly renewed, deterioration will continue until the object is destroyed.

Problems are created when a buried object is excavated and brought into a new environment to which it must re-acclimatize itself. The object is exposed to new supplies of moisture and oxygen from the air, new corrosive chemicals in the form of air pollutants, especially sulfur dioxide, nitrogen oxides, and ozone, and the damaging effects of fluctuating temperature and humidity. For this reason an environmental control system within museum galleries and storage areas is important: temperature and humidity must be kept constant while dirt, dust, and chemical pollutants must be excluded. The Institute has just completed a study on the installation of such a system, but since its cost is estimated at $3,000,000, it may be many years before it can be installed.

I would like now to mention briefly just a few of the archeological materials that are dealt with in the conservation laboratory and the way they have been affected by environment.

Limestone reliefs. The problems with reliefs—pottery and cuneiform clay tablets are also affected—occur because the stone has absorbed salts dissolved in ground water during burial. Stone is hygroscopic and is able to absorb atmospheric moisture during humid days in the museum thereby putting the salts into solution. When the humidity falls, moisture evaporates from the stone bringing up the salts, which then crystallize on the surface of the stone. The constant movement of salts through the stone with fluctuations of humidity causes the surface, and eventually the whole relief, to powder and flake. Reliefs which are still in relatively solid condition may be soaked in changes of water over a period of several weeks until most of the salts have been dissolved out of the stone. For reliefs too powdery to soak, the only method of treatment at the moment is to consolidate the surface with a wax or plastic and to keep the relief in dry conditions.

Organic materials. Organic materials, especially those made of cellulose (wood, cotton and linen textiles, reed baskets, papyrus) and protein (leather), are vulnerable to biological attack, and many such objects in our collection show evidence of biological degradation suffered during burial. Occasionally, the presence of a copper object in the burial area will act as a toxin against bacteria and fungi and protect organic material. The copper statuette wrapped in textile of King Shulgi from Nippur in the Babylonian Hall is an excellent example of this.

Most of the organic material which has survived, primarily from Egypt, has done so because of extremely dry burial conditions. Many artifacts when discovered appear in good condition, but in reality are very brittle and fragile; intense and prolonged heat plus the presence of oxygen breaks down many of the long-chain carbon molecules making up the structure of cellulose and protein so that the objects are liable to crumble at a touch unless strengthened with wax or plastic or handled with great care.

Other problems arise with organic materials because like stone they are hygroscopic and change dimension as they absorb or give up moisture with changes of humidity so that an already fragile object is subjected to physical stress that weakens it. If it is covered with gesso or paint, as are many of the Egyptian wooden statuettes and cartonnage mummy masks, expansion of the object will cause the paint or gesso layer to crack, while contraction will result in buckling of the layer. The best solution to this problem is to provide a suitably controlled environment for the object within the museum or storage area.

Metals. The type and extent of corrosion on a metal object depend first on certain properties of the metal, e.g. its purity (an alloy, a mixture of two or more metals, is more likely to corrode than a pure metal) or the stresses set up within the metal during its manufacture by casting, cold work, or annealing. The second contributing factor is the chemical nature of the burial environment: oxygen combines with the metal to form oxidation corrosion products; salts either react directly with metal to form corrosion compounds or combine with water to form corrosive acids. The most destructive group of salts for copper, bronze, iron, and silver are the chlorides such as sodium chloride, common table salt, which form hydrochloric acid with water.

The ore or mineral from which a metal is extracted represents a more stable state than the refined metal, and it is to this mineral state, in the form of corrosion, that the metal returns as the result of chemical reactions in the ground. The most common corrosion products found on copper or bronze (copper alloyed with a small amount of tin) are cuprite, a red copper oxide; malachite, a green basic copper carbonate; and azurite, also a basic copper carbonate mineral in blue. Intensive chloride contamination from the ground plus excessive moisture and oxygen from the air can produce paratacamite or "bronze disease," a light-green powdery mineral that may form indefinitely unless the object is stabilized.

In the laboratory corroded copper and bronze objects with a solid metal core are rarely chemically or mechanically cleaned down to the metal surface for several reasons: corrosion usually forms unevenly over the surface of an object, and because of this, a cleaned surface will often be pitted in areas where corrosion has been more severe; also, very often a cleaned object is left with an unpleasant, unnatural color as the result both of the chemicals used for cleaning and the removal of certain alloying metals during corrosion. In addition, chemical cleaning and subsequent soaking in distilled water to remove residue chemicals may leach out the more soluble alloying metals adversely affecting subsequent qualitative and quantitative analysis of the metal.

Only when decoration or constructional detail is likely to be revealed is an object cleaned; otherwise, just the surface dirt and loose corrosion are removed by hand, active corrosion is chemically stabilized, and a protective lacquer is applied.

Before any work is done to an object brought into the laboratory, it is photographed, with special attention paid to badly damaged areas. A workcard is kept recording any treatments given to the object. To obtain as much technical information as possible, it is important not to alter the object by unnecessary laboratory treatments that might interfere with future analytical techniques, especially now that they are becoming increasingly sophisticated and sensitive. With this in mind, the work done on museum objects—as long as their immediate survival is not endangered—is generally kept to a minimum.

The conservation laboratory has been extremely fortunate to have received within the past year a gift from Mr. William Boyd of Lake Wales, Florida, of a Nikon high power polarizing microscope that has a special eyepiece for photography. This will enable us to do many types of analysis including the identification of textile fibers and paint pigments and the analysis of metallographic sections. We are also fortunate to have analytical facilities available elsewhere on campus: Dr. John Fennessy of the Radiology Department of Billings Hospital has kindly x-rayed one of our Egyptian mummies and a series of metal objects (to check for joins or decoration that might have been hidden by corrosion); and, using x-ray diffraction, Professor Paul Moore in the Department of Geophysical Sciences has carried out important analysis on bronze corrosion products. This cooperation provides much valuable information to help a museum conservator and is much appreciated.

In a postscript to the third 1974-75 newsletter of the Joint Iranian Expedition inadvertently omitted from *News & Notes* No. 18, H. J. Kantor wrote that it was written by P. P. Delougaz himself and thus remains as a last poignant message from him just before his death.

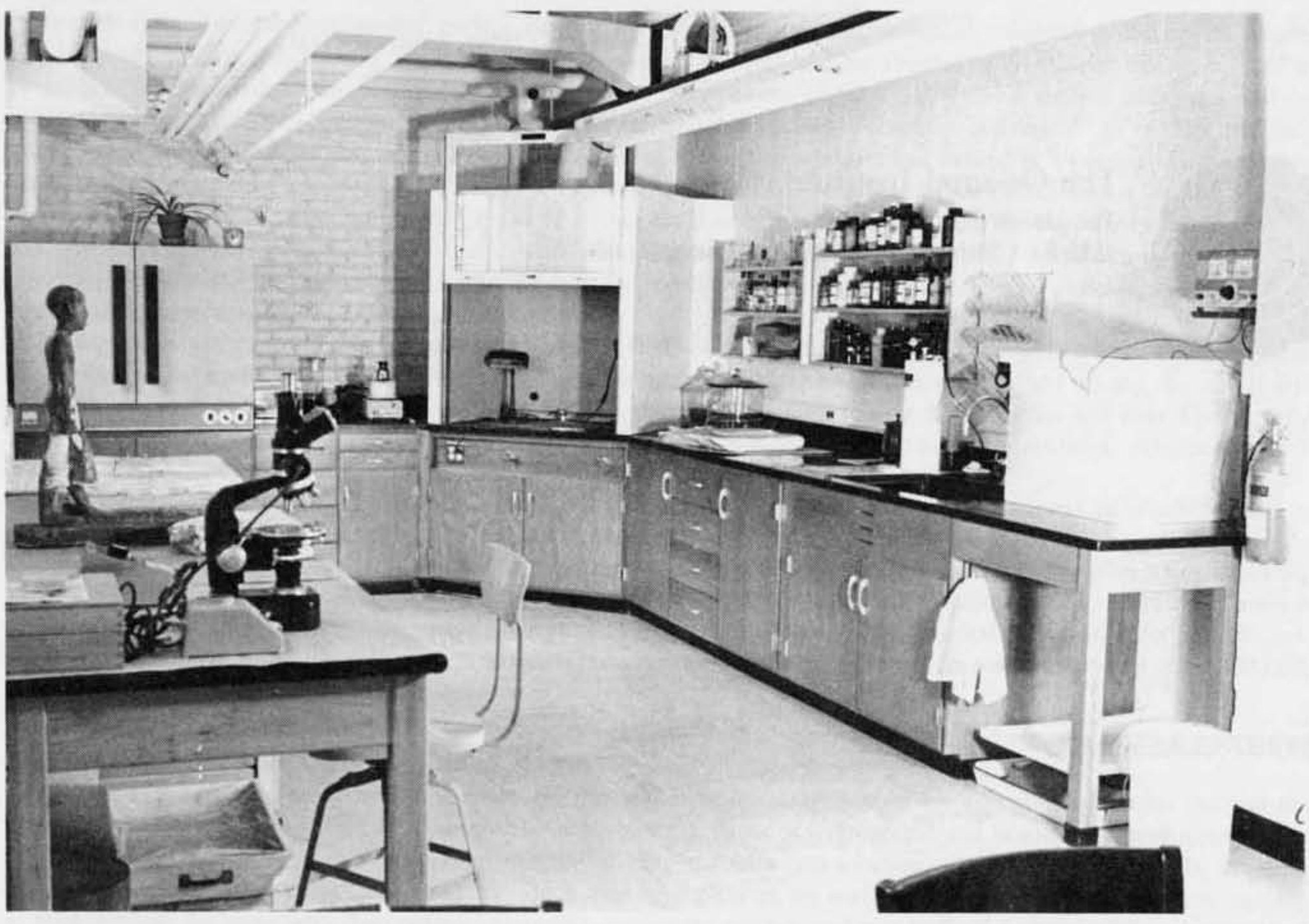
We take this occasion to add that an article by Mr. Lane T. Cubstead of the United States Information Service in Iran prepared on the basis of his March, 1975 visit to the Chogha Mish excavations and his discussions with P. P. Delougaz and Helene J. Kantor has now been published. ("Hafari dar Chogha Mish: yek karkhane sang-i chakhmaq pandj-hezar saleh," *Marzhaye Now [New Frontiers]*, Vol. 19, No. 6, June, 1975, pp. 15-20.)

The Oriental Institute's gift and book shop, The Suq, is staffed by volunteer workers. We need people to serve three hours a week as salespersons. Suq volunteers have the opportunity to take the Museum Docents' Training Course in the spring. If you are interested in this challenging job, please call Mrs. Jill Maher at 753-2573 or 753-2471.

We would like to remind you of Mr. David Nasgowitz's Members' Course in the Archeology and History of Syria-Palestine, being given Monday mornings and/or Tuesday evenings, beginning September 29th and 30th, at a fee of $30.00 for members. Please call Mrs. Maher for details or to register.

With the initial efforts of Mrs. A. A. Imberman of Hinsdale, members who live in the western suburbs of Chicago are forming an affiliate group to promote interest in the Oriental Institute. For a small membership fee, it is planned to offer lectures in addition to the regular membership program and to engage locally in other activities of an archeological interest. Any interested western suburban member is invited to call Mrs. Linn Buss, 354-4285.

REMINDER: "The Sumerian Woman: Wife, Mother, Priestess, Goddess," lecture by Prof. S. N. Kramer, Thursday, October 16, 1975, 8:30 P.M., Mandel Hall (57th & University); reception afterwards; R.S.V.P. 753-2389.



Conservation Lab showing oven, fume hood, large soaking tank set up for electrolytic treatment of iron, and Nikon polarizing microscope in left foreground.

MUSEUM NOTES

We would like to call your attention to a small special exhibit in Alcove M of the Assyrian Hall—"New Acquisitions from Chogha Mami, Iraq—a village of the 6th millennium, B.C." This exhibit features a case of objects from the excavations in 1967-68 of this early site in Iraq by Joan and David Oates, an excavation sponsored by the British School of Archaeology, the Oriental Institute, and the American Philosophical Society.

Chogha Mami is an early agricultural village of the Samarran culture, which existed in the Tigris-Euphrates area of central Iraq. Although slightly earlier agricultural villages of the Hassuna culture are known from Northern Iraq, the Samarran villages are the first to be established in an area where rainfall agriculture is not possible. Simple irrigation techniques were probably used to produce the crops of wheat, barley, lentils, linseed, and peas which are attested from seed remains. Pistachios, fish and mussels were utilized. Domesticated goats, sheep, pigs, and dogs were kept; and deer, aurochs, gazelle, and onager were hunted.

Houses at the Samarran sites were regularly built rectilinear structures of mud-brick with exterior buttresses. The Samarran site of Tell Es-Sawwan was fortified with a wall and a ditch and was especially noteworthy for the large number of small stone statuettes found in infant burials below the floors of the houses, which constitute the earliest Mesopotamian 'sculpture' known. Clay figurines from Chogha Mami are also remarkable in that these females with broad shoulders and slanted eyes are quite similar in style to the figurines of the Ubaid culture of Southern Iraq of almost a thousand years later.

Materials in the exhibit include a number of painted pottery vessels, many nearly complete, as well as a selection of painted pottery sherds. Depicted on the sherds are scorpions(?), a goat or gazelle, and a rabbit. A group of female figurine fragments are exhibited with photos of other fragments from the same site. Also included are several enigmatic painted clay objects, and a selection of flint and ground-stone tools, as well as a necklace of clay beads.

Included in the exhibit are photographs of an animal figurine and house plans from Chogha Mami, and photographs of stone figurines from Tell Es-Sawwan, as well as a plan of that site.

The pottery in the exhibit was restored by Robert Hanson and Mrs. Theodore D. Tieken.

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