Is Conservation Possible?

A Proposal for a Procedure and Method for Handling, Conserving, and Storing Iron Finds

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Abstract

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This article deals with an old method still in use for the conservation of iron, supplemented with a vapour phase inhibitor and vacuum packing. It also discusses the procedure for handling iron objects, from the moment when they are found and during the period of storage.

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Under certain conditions, iron shows a great tendency to corrode; it rusts in damp air, and rusts even faster in water with a high oxygen content. For the rusting process to begin, there must be an adsorbed layer of water on the surface of the metal. Together with soluble salts, acids, and bases, this layer of water forms an electrolyte; and if the relative humidity is over roughly 60%, corrosion begins. Rust substantially consists of hydrated iron (III) oxide with a varying water content.

When an iron object is deposited in a layer of earth, the speed of corrosion depends, among other things, on the quality of the metal, the composition of the electrolyte, and the amount of oxygen available for the process. These parameters, thus, determine how much of the object will consist of metal and how much of rust when it is found.

At the very moment when the archaeologist digs out the object and it is exposed to more oxygen, the speed of the decomposition process increases. Without analyses and careful calculations, it is unsuitable to try to quick-dry the object or apply chemicals in the field. Such measures may be saved for very special cases only.

The surest way to reduce the speed of decomposition in the field is to try, when packing to reproduce the climate that formerly surrounded the object. The simplest way to do this is to put the object in a plastic bag, along with earth from the layer where the object was found, and to store the package at an even temperature.

My colleagues and I have made comparisons between material packed in this way and material from the same excavation brought to Lund University Historical Museum (LUHM) in uncovered boxes. We have found that the packaged material, after preparation, gives much better surface information than unpacked material. This is true regardless of whether the preparation method is mechanical or chemical, or a combination of the two.

We have also performed experiments with packed and unpacked material that has been stored for some years, and found that the packed iron had decomposed much less than the unpacked iron. In this case, too, the packed material yielded the best surface information.

The processing methods can be blasting with glass beads or aluminium oxide in a gradation from 120 to 27 μm, or preparation with specially ground hand tools. Blasting is done in different devices, with both the pressure and flow of the blasting material adjustable. When necessary, work is done under stereo microscope. The most usual chemical method is treatment in ethylenediaminetetra-acetic acid (EDTA in disodium salt form) in a solution of water. X-rays are often used to assist in the process of restoring the appearance of the object. The museum's X-ray methods are such that it is possible to obtain a picture on film almost as quickly as by the use of fluorescence radioscopy.

The material exposed in this way is marked with acid-proof plates and is placed in airtight vessels containing a drying agent, while awaiting the next stage of the process. The person handling the material must wear cotton or rubber gloves to prevent contact with corrosion-promoting substances on the skin.

At LUHM we use, among other things, a mechanized dissolving method to conserve iron, followed by wax treatment. The apparatus consists of a distillation boiler with an inner vessel for the material under conservation and a thermostat-controlled wax bath. The boiler itself produces the distilled water, which is changed twice a day in the inner vessel. The equipment regulating the changes of water is set so that, when the used water runs out of the inner vessel, the new water is admitted within five seconds. The iron, thus, has very brief contact with oxygen.

The material, which usually contains between 500 and 1000 artefacts of normal size, is placed in wire baskets, which are immersed in distilled water in the inner vessel. The baskets are raised slightly over the bottom of the vessel so that the dissolved salts, which sink to the bottom, do not reach up to the iron. The dissolving time is approx. 6–8 weeks. The process is stopped when a water analysis to determine chlorine ions shows a low, even value. Using this method, the value can never be zero, but it approaches zero.

The baskets containing the material are then placed in a melt of microcrystalline wax maintaining a temperature of approximately 85°C. The temperature is then raised to just over 100°C so that the water evaporates, and it is then lowered so that a little surplus wax remains on the objects when they are taken out. The excess wax is removed with hot air and hand tools. All subsequent handling is done with cotton gloves.

At LUHM there are objects, both on exhibit and in storage, which were treated with this method 45 years ago and which are still in good condition. As a rule, this applies to material that has been kept in a suitable climate. There is also material which was not handled or stored properly; it is often rusty, sometimes completely destroyed.

Nowadays, the chain of treatment for iron, which is to be stored, has been supplemented with vacuum packing and a vapour phase inhibitor. The conserved and post-treated iron is put into a specially manufactured laminate plastic bag with an interior consisting of 120 µm polyethylene and an exterior of 30 µm nylon, which allows it to be welded. Both plastics lack softeners and maintain the highest food-storage quality. A vapour phase inhibitor in tablet form, intended for iron, steel, copper, brass, bronze, and other metals is also placed in the bag. The tablet, which is of food quality, is nitrite-free, and none of the chemical components are toxic or hazardous to health. Moreover, the vapour phase inhibitor has been on the market without any complaints for over ten years. One tablet can passivize corrosive substances in 20 litres of air.

The air is pumped out of the package, which is subsequently welded shut. Over this weld is placed a registration card, which is also welded to the bag. The object is then entered in the database, placed with its fellow objects in a standard cardboard box, and stored at 18°C in relative humidity of 45–50%.

With the correct climate in the place of storage, the iron should survive unharmed for at least 100 years with no need for further measures. Even if the bag should develop a hole, the vapour phase inhibitor will protect it for a very long time, since there will be little circulation of air in the bag. In addition, the material is very easy to handle. When the objects one wishes to examine have been selected in the database, they can be sorted by hand without touching the iron objects, which are moreover given the mechanical support of the packaging. If it is necessary to hand-le an object outside its package, the package is cut open, the observations are made, with cotton gloves of course, and the object is then repackaged according to the same method.

The only way to obtain source material of any value which can be used by researchers, museums, and the general public, is to ensure that everyone who handles our physical cultural heritage respects the working procedures that have been agreed upon. The material that we handle is, in fact, the only material there is. The chain must be unbroken from the moment of finding until final storage. It is difficult for museums to claim in their defence that they are not prepared for this handling; there is time both to reflect and to cooperate.

Translated by Alan Crozier