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We can address ourselves to the point of the status of iron objects in rather short order. What I propose to do, instead of painting pictures of gloom and rust for eight pages or so is to outline briefly what can be done to rectify the situation.

A local museum's metal conservator rather typified the attitude we often find toward iron objects. Iron objects were of concern but were on the bottom of the priority list unless it happened to be something of value as a firearm or edged weapon.

There are problems with iron objects. One is that iron conjures a mental image of indestructability, which simply is not true. Conservation in museums generally has an uphill fight for funds and staff allotment. Mainly, I suppose that, except in extreme cases, it produces a less than spectacular result with the expenditure of considerable resources. Unless the public is going to view and/or manipulate an iron object (like the machines in the Smithsonian) it is between difficult and impossible to get any sort of allotment to do more than minimal care, and usually not even that. Iron objects tend to be difficult to manage and are of little cash value. What resources are available go to paintings, paper, furniture, textiles, and the like. The great irony is that great reverence is placed on excavated wreckage, and elaborate techniques are devised to preserve it while superior specimens sit around deteriorating with no one apparently concerned enough to do something about it.

PRESERVING SOME CLASSES OF IRON ARTIFACTS:

A BRIEF SURVEY OF TECHNIQUES

For the purpose of this paper we will consider iron artifacts in two classes - excavated articles and all others. In this paper we will consider what to do with most of the other class, given the object is structurally sound.

The Problem: To preserve the surface of the object in the condition that we found it or a somewhat more attractive form and maintain wherever possible the original surface finish if it remains.

The Solution: Conceptually the solution is quite simple - thoroughly clean the obect and coat it with something that will protect the surface from whatever hazard that might be present. We should note that there is another solution which is building a case around the object and filling it with an inert gas (as was done with Ford's first car).

Implementation: Protection has to be a function of the hazard and use to which an object is subjected. For example, we would not load an object up with soft grease if it were to be handled by the public - not so much that the public would suffer some discomfiture, but the object would lose its protective coating in short order. We, therefore, have to consider the mechanical wear problem and the necessity for maintaining appearances. To be practical, we also have to consider costs. Ideally, we should be able to subject all artifacts in our custody to the best of care, but practically, in many cases we have to clean the object the best we can, coat it, and hope that in twenty or fifty years someone else will do the job better. For example, many of the cannons in the parks have fifteen to fifty coats of peeling paint, but at least they are still with us even though the job is almost invariably done wrong, and rusting is going on under the paint.

Cleaning: Obviously the first thing to do is to determine what material is on the surface of the object and how sound the object is structurally. If there is more rust than iron, one is ill advised to clean off the rust. The next thing to do is to consider how effective each method of cleaning is, and how it leaves the appearance of the surface. As an example, in at least two museums the gun collection was cleaned by some misguided soul with a wire wheel. The wire wheel did more damage to the surface than the couple hundred years of handling and use. Wire wheels can wear the surface to the point where markings

are obliterated. If an object is not structurally sound, disregard the following.

Mechanical Cleaning: On massive objects with much rusting but structurally sound we chip the scale off and then sand blast the surface. On massive but only dirty objects (like a steam engine) we steam clean the thing. Wire brushing is fine for removing quantities of dirt and corrosion if one is not too fussy about how the surface finish will appear (like a balcony that one is going to paint). On smaller objects the surface can be cleaned by steel wool, dental picks, sandpaper or jewelers rouge, etc., depending on the quality of the surface and the value of the object. One takes less pains with a cannon ball than with a clock movement.

Immersion in Caustic Soda: (in a water solution - 1 lb. per gallon). Besides being expensive, some sort of tank for immersion has to be provided like stainless steel which resists the action of the soda. Soda also is quite unpleasant when in contact with the skin. If one decides to elevate the operating temperature, thereby speeding up the process, one needs to add the cost of a heater. Soda is slow but fairly effective. On large objects caustic soda solutions can be painted on the object's surface.

Immersion in Acids: One can use a mild hydrochloric, phosphoric, or oxalic acid solution to loosen rust. In the same vein, vinegar is reasonably effective in removing rust. Of course the problem with acids is that one has to completely stop the reaction that one has started. This means that the acid has to be neutralized. Acid cleaned artifacts usually turn out a gray color which is not suitable for display but which will require some sort of cosmetic surface coating or polishing.

Electrolysis: This is also an immersion process which acts by reversing the rusting reaction. It can be done either by adding zinc to a caustic soda solution or installing electrodes in the soda tank and running a reverse type "plating" operation. Because one generates both oxygen and hydrogen in the reaction it is wise to have the facility well ventilated. This process can be both expensive and hazardous.

Cleaning With Acetone: On objects such as fine firearms where the finish is intact and all that is required is removing finger prints, wax, oil, etc., I use acetone. It evaporates leaving no film and is not likely to disturb finishes as plating, bluing, etc. It can, however, be murder on some paints.

Penetrating Oils: On lightly rusted surfaces, soaking with penetrating oil or kerosene helps before mechanical removal techniques are applied. One should also remove the oil or kerosene film before coating.

Moisture Exclusion: By whatever manner the surface is cleaned we still have the problem of moisture. Chemical activity will continue under whatever surface coating is applied if moisture remains on the surface, or more likely in the pits. This is also true of chloride impregnation found in specimens excavated from salt water (as anyone from the northern states who drives an auto knows, when the salt they put on the roads gets into the joints, rusting is almost impossible to stop). Whatever coating is used - and I'll mention several - one needs to be sure that the surface is dry.

Coating With Oils, Greases, Cosmoline, Etc.: Let us dispense with cosmoline first. Although the government is fond of the stuff, other materials also conform to their specifications for preservatives and are not nearly as difficult to remove. Cosmoline is vile stuff, and one would be wise to avoid it.

Oils, greases and soft seals provide protection if the object is not subject to mechanical handling. However, they also seemingly act as a magnet for every bit of dirt within yards. When the oils and greases finally do evaporate, they leave a glue-like mess which can foul up delicate mechanisms. For example, I recently bought for my personal collection a revolver which had been cared for with religious fervor. However, the constant oilings had gummed up the parts so badly that when the previous owner tried to operate the thing the parts BENT instead of moved. Oils, greases, etc., do have their uses. On a large steam engine that we wanted to store for a few years and which was not subjected to visitor wear, we did the following which has proven effective. First, the engine was steam cleaned, a coating of CRC 336 was applied to seal the surface from moisture, and finally a coat of HEAVY FILM SOFT SEAL was used to protect the whole unit. Incidentally, we did build a plastic cocoon around the engine to protect the surface from mechanical wear - that is, from wandering staff and visitors touching it.

On interiors of machines that are going to be used (including firearms and clocks) oil is of course necessary as a lubricant. This should be a high quality pure oil (not 3-in-1 and the like). Periodically, the oil has to be cleaned and new oil applied.

We have used Penetrol on metal parts, but this does not prove satisfactory for exposed surfaces. Linseed oil is another poor preservative, which evaporates leaving a film which is extremely difficult to remove.

Silicone Oils: These are rather new, and should be used somewhat cautiously. About two years ago I corresponded with one of the makers of one of the wonder products. When I asked him how to get the stuff off of a surface, he replied that there was never any need to do it. Naturally this is less than satisfactory. A bad experience was reported by one of the major gun dealers who used a silicone spray on a gold wash gun, only to have the finish lift off. Until really good tests are made of silicone materials, it might be wise to use them only very cautiously.

Waxes: On fine objects not subject to great mechanical wear (like firearms), waxes are probably the best protection available. In fact, Colt now recommends waxing firearms between uses. A good coat of a clear wax both pleasingly increases the luster of the surfaces and provides protection to it without attracting dirt. One does, however, have to be careful to select the proper wax as some are artificially made by an acid process, and some natural waxes have a tendency to go rancid over the years. Waxes are vulnerable to handling, but not as much as oils and greases.

Vapor Phase Inhibitors: These come in a couple of forms; one is a pellet which one places in proximity to the iron object and the other is an oil with which one coats the object. I use the pellets in the cabinet with the firearms. Smith and Wesson uses paper impregnated with the stuff to wrap their new revolvers. Several exporters us the oil to cover machines to be sent on ocean trips. As the name implies, the material yields a vapor which retards the rusting process. Although V.P.I. has to be renewed periodically, it is most useful.

Paints: Properly applied paint gives the best long term protection available for iron objects. The paint does not attract dirt and does provide a measure of mechanical protection. Let us consider two painting procedures. The first was devised by Mr. Mulholland for us to be used on some of the massive iron artifacts we have in the collection. After sandblasting - the same day so that moisture does not get in - the piece is to be coated with a penetrant (Du Pont VQ 5465 or equivalent) after which it is painted with a metal protective finish paint (Dulux enamel or equivalent as Rustoleum).

William Henson published the following procedure in *Museum News*

(June, 1971). This procedure was used on machines exhibited at the Smithsonian. The pieces were cleaned with a caustic cleaner (Magnus 61-DRX) Pieces which were to be finished later were coated with CRC 336 to protect them until they could be worked on. The bright metal surface were wiped to remove the CRC 336 and then coated with a Magnus FF 111. The castings which he painted were filled with White Star filler, sanded, primed, and painted.

To sum up, the status of iron artifacts in American museums is pretty dismal, unless the piece happens to be either on display or of considerable cash value to warrant some attention, though frequently not in the artifact's best interest. There is slowly emerging a body of printed material devoted to preservation of iron artifacts, although except for Mr. Mulholland's study for the Hagley Museum, the literature is a result of empiricism as opposed to a scientifically based approach. The methods recommended are generally conservative but quite workable. I hope that this brief survey of techniques will assist the reader in his profession, his hobby, or at least in his household.

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SOURCES

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