Protecting Sculpture

An art collection of any kind is an aesthetic statement that, if properly looked after, will give great pleasure, not only now, but also to future generations. Building up a collection is one thing, looking after it correctly, however, is an entirely another. Dr. Robert Faltermeier, *an expert conservator and restorer, looks at the problems one faces with different kinds of sculpture, gives some guidance on what takes place during deterioration of a work, and what one can do to take care of or restore it.*

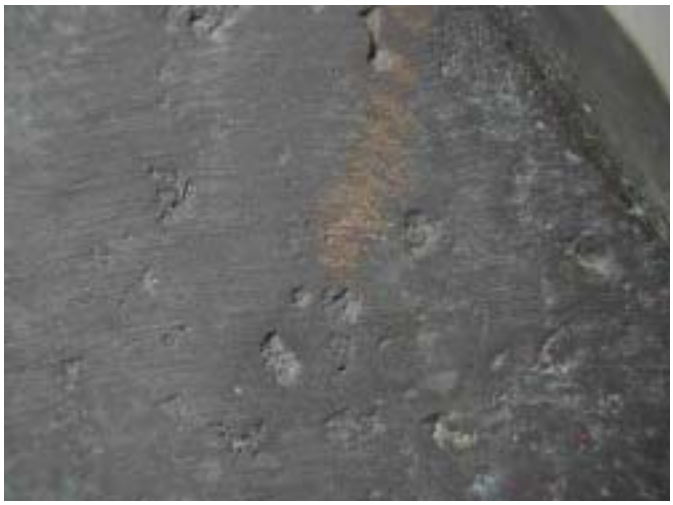
Bronze is usually a copper-tin-lead alloy although brass (a copper-tin-zinc alloy) sculptures are often referred to as bronzes as well. Artists and craftsmen have worked in bronze, for thousands of years. The Chinese, for example, began to smelt bronze as far back as in the Xia dynasty (21st–16th centuries BC). As excavated evidence from around the world has shown, this metal alloy is theoretically highly resistant to most environments for a prolonged period of time. Bronzes, thousands of years old, have been discovered in the snows of alpine regions, in deserts, in oceans, and in flowing rivers.

Modern sculptures made of bronze tend to have two kinds of surface finishes. Artists such as Constantin Brancusi (1876–1957) and Jean Arp (1886–1966) made numerous bronze sculptures in various sizes, for indoor and outdoor display, with highly shiny metallic finishes achieved by polishing the cast bronze or brass until even, with all scratches on the surfaces removed and a mirror finish was achieved. However, most artists, including Auguste Rodin (1840–1917), preferred a brown to black finish created by the foundry, according to the artist's specifications. This patina is very thin and is a chemically produced oxide layer. It has very little in common with beautifully colored patinas of antique bronze, where the patina often reaches deep into the metallic core of a bronze. The chemically produced patina is highly sensitive to outdoor exposure.

Hans Arp, Ptolemaee III. The sculpture after conservation - restoration. The damage and discolouration due to outdoor exposure was removed. All photographs: Courtesy of Dr. Robert Faltermeier.

In urban environments in the Asia-Pacific region, humidity ranges from 75 to 90 percent and the temperatures range from 20 to 34 degrees centigrade. Industrial pollution and salt aerosols in coastal regions in combination with such high humidity and temperatures speed up the corrosion process on almost all surfaces. The air surrounding urban sculptures contains a concoction of particles in an aqueous solution, which reacts with the surface constantly. The higher the daily temperature and the humidity, the faster the reaction processes occur and the more rapidly the surfaces deteriorate.

Most particles in urban air are organic chemicals; these are molecules containing carbon, hydrogen, and other elements. Most of these compounds are volatile organic compounds (VOCs), which are of an organic nature and readily evaporate. VOCs are a by-product of burning fossil fuels, such as oil and coal, resulting in hydrocarbons, partially oxidized hydrocarbons, and organic compounds containing chlorine, sulfur, or nitrogen. A typical reaction in a city environment would be a combination of sodium chloride (salt from the sea) with sulfuric acid (VOCs), resulting in hydrochloric acid and sodium sulfate. Hydrochloric acid is a very aggressive substance and readily eats into bronze surfaces, dissolving the alloy.



Scratches and abrasions of the surface of a bronze sculpture due to handling.

Example of a deep scratch due to handling.

The first indicator of an outdoor bronze deteriorating is a loss of gloss on the dark-brown to black-patinated surface. This can be due to several factors. Most patinated surfaces were originally waxed or lacquered by the foundry after the patina was applied. It is most likely that the wax or coating has started to deteriorate due to the temperature, humidity, and pollution. In circumstances where the patina has not been attacked, the damage can be easily reversed by a regular maintenance plan, including regular washing of the surface, removal and reapplication of protective coating with museum-grade materials by a trained professional.

Where the sculpture has been outdoors for several years, it is most likely that the original protective layer is completely gone. Initially the inadequate coatings tend to get sticky in hot temperatures. The sticky surface traps dirt and, if a museum-grade coating was not used, it can acidify and turn from a protective layer to a harmful substance. Constant urban rain with generally low pH removes most of this substance and remaining coating, and will eventually expose an already damaged and usually pitted surface. Further rain and humidity, together with pollutants, will result in further damage by washing off the recently formed corrosion products and eating further and further into the metal. What is left behind will be a variation in surface appearance and in the actual metallurgy in protected and non-protected areas.

Rain leaches out to various metallic components in the bronze, which is also known as preferential corrosion. Areas in recesses that are not in direct contact with rain accumulate dirt and dust, resulting in a thick black layer. In some cases there is still the original patina under these black crusts. However, restoration attempts by unqualified people to remove the black dirt layer and the secondary corrosion layer often result in the removal of the underlying original patina.

Graffiti is one of the oldest forms of defacing public buildings and sculptures. Even during classical antiquity, visitors left their marks on Egyptian and Roman monuments for posterity. These scribblings included names, poetry, or rude caricatures. Most frequently these days, vandals use water-resistant markers and spray paint. These can be removed with the appropriate solvents. It is not advisable to apply commercial paint or stain removers as these may contain chemicals, which will cause further corrosion and discoloration of the patina.

Other forms of defacement are the use of stickers; either plastic or paper-based. The adhesives on the back can be of varying composition and some of them can be very difficult to remove. The decomposition of most of these glues will cause a discoloration of the patina.

The most damaging forms of vandalism are scratches which penetrate any protective coating and patina, exposing the metallic copper alloy. A scratch will corrode preferentially in the surrounding patinated and coated surface, increasing the damage. Such scratches must be treated by a trained conservator to minimize the damage to the surrounding areas.

Humans are very tactile creatures

An example of a heavily corroded underside (above left). Original patina has been lost. It was repatinated and coated with a protective lacquer (above right).

by nature, and a smooth bronze surface is a very inviting material to stroke and caress. The abrasive and corrosive nature of the human touch is usually visible in metallic bronze patches on the easily accessible parts of a patinated sculpture. Sweat contains salts and amino acids, whihc attacks and dissolves the patina, causing the metal underneath to constantly expose a new surface.

For public safety and prevention of theft, all but the heaviest sculptures are secured to their bases. It is important to recognize the possible damage when planning the display site and how the sculpture will be fastened to the base or ground.

It is rarely a good idea to place sculptures on grass as grass, when cut with a trimmer or a lawnmower, can cause damage to the base of the artwork. Often fertilizers, which are obtained from ammonia and contain nitrogen, phosphorus sulphur, and potassium, are used. Ammonia is known to corrode copper easily, and can cause discoloration of the bronze surface. Since most bronze sculptures are produced in the lost-wax-casting technique, the underside is open and can be a humidity trap from wet ground, or may be used by animals as shelters or nesting grounds. To prevent such damage, it is recommended to place the artwork on a dense, solid material such as stone, with a protective plastic between the bronze and the stone as water is sucked up by capillary action into the stone base and this keeps the stone-bronze interface moist.

In many cases bronzes are secured with ferrous screws. These screws corrode over a short period due to bimetallic or galvanic corrosion between these dissimilar metals. It is best to place a protective insulating material between the bronze and the iron and to ensure that the screws do not corrode. Iron corrosion leaves marks on the patinated surface, thus causing irreversible changes.

Sculptures are also frequently harmed by nature: this can be due to insects nesting in their recesses, or mammals and their body fluids. Metabolic waste contains an array of chemicals potentially damaging to an artwork. Urea, ammonia, and inorganic salts, to name only the main culprits, react readily with copper. They cause streaking of the bronze, actively eating into the surface and causing irreversible damage. Frequently in parks and public spaces, urine corrosion on the lower parts of sculptures is due to dogs urinating. Bird droppings on horizontal surfaces also react with the patina, and therefore need to be removed as soon as discovered. Trees and shrubs can also damage the surface. Branches may break off and scratch the surface. Tree sap and other organic matter can leave resinous deposits and cause a spotty appearance of the patina. It is therefore best to keep a sculpture in an open, well-aired space away from any trees or shrubs.

To keep a bronze in good health it is important to ensure a maintenance plan right from the start. Initially, whenever possible, it is important to find out the history of the sculpture: how it was made and what form of patina and/or coating the surface has received after casting or by the previous owner. When initially studying the sculpture, a qualified person has to seek out flaws in the cast or the making of the bronze, such as hairline cracks or pitting, since these are future trouble-spots and can—and should—be repaired before displaying outdoors. Most sculptures are produced by the lost-wax method and in this process a sand-core is used at one point to support the modeled wax layer, before the final sculpture is made in bronze. This sand-core is, in many cases, a source of future problems and corrosion. The sand used is hardly ever clean or pure and will retain ground water or rain. The water can enter through cracks and crevices in the bronze or through an opening in the base. The trapped humidity will evaporate through the same cracks and soluble salts from the sand-core will be carried through to the surface and be deposited around the cracks. So, whenever possible, all the sand-core should be removed when displaying outdoors so as to avoid future complications.

Alberto Giacometti s La jambe being handsoldered due to a massive fracture in the ankle.

It is not advisable sculptures with protective synthetic coatings such as polyester, epoxy, and polyurethane to be exposed to high temperatures or sunlight since these coatings age and crack and become insoluble. Any non-protected crack, hole, or void will accelerate during corrosion, also known as preferential corrosion, causing deep pits in the surface. These sculptures are better preserved indoors since the temperatures and humidity are more readily controllable and the deterioration of the plastic coating can be slowed down.

It is advised that any maintenance plan for a sculpture should be developed with a trained conservator who has experience in the preservation of outdoor sculpture. It is not advisable to use materials that have not been tested for their efficacy. Frequently untrained employees use highly acidic or alkaline commercial cleaning solutions as these cleaning agents are often the only readily available, off-the-shelf solutions that can shift or remove persistent stains. However, grout or tail cleaner is one onf the worst examples as it tends to contain either hydrochloric acid or hydrofluoric acid, both highly damaging as they remove all forms of corrosion and eat into the metal causing irreparable damage.

A normal maintenance plan would include the monthly rinsing of the sculpture using a hose. The water pressure should not be high, since it can force water into the core of the bronze sculpture, through voids and pores. Any rubbing or brushing, to remove dirt and grim, should be done with a soft brush or clean flannel since the surface is easily scratched.

At least once a year a trained conservator should wash the sculpture, using a tested museum-grade surfactant since any protective coating such as natural waxes attracts dirt and in most cases will be sublimated over prolonged outdoor exposure. Remains of these coatings need to be removed. The reapplication of these sacrificial coatings should only be done by a qualified person and with tested materials, since the wrong procedure can do irreparable damage. During the maintenance, the conservator will locate areas that need special attention to identify future trouble-spots. Δ

Dr. Robert B. Faltermeier is an expert on the conservation of sculpture. He works between Singapore and Basel.