10 | Methods and Materials Used for Patination at the Fonderia Chiurazzi

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FIGURE 10.1. The Fonderia Chiurazzi at the Albergo dei Poveri, Naples, early 1900s

FIGURE 10.2. Molds stored at the Fonderia Chiurazzi

The Fonderia Chiurazzi was established by Gennaro Chiurazzi (1840–1906), who first opened a small foundry in Naples in 1870.[1] Rapidly successful, he created a workshop in the city's Albergo dei Poveri (fig. 10.1) and assembled a small army of *formatori* who produced casts of numerous statues. Over the years the foundry had the opportunity to take molds in the collections of the Museo Archeologico Nazionale in Naples; the Capitoline Museums, the Vatican, and the Borghese Gallery in Rome; and the Palazzo Pitti and the Uffizi Gallery in Florence. The result is more than fifteen hundred plaster piece molds (fig. 10.2), which represent the legacy of a century of exclusive work by the company, and one that cannot be re-created today. Examples of Chiurazzi bronzes are to be found throughout the world, and include the series of replicas of statues from the Villa dei Papiri that were commissioned for the Getty Villa in Malibu in the early 1970s (fig. 10.3).

Together with its extraordinary collection of molds, a key element in the foundry's success was its use of traditional techniques—above all, its employment of the lost-wax technique (rather than sand casting, which was more widespread at the time). This guaranteed that the replicas would be of very high fidelity. Sale catalogues published by the foundry during the twentieth century show that, besides marketing its products in different sizes, the company made them available with different patinas: Pompeii (green), Herculaneum (dark), and Renaissance (shiny bronze).[2] Patination is a highly specialized craft, and one that owes as much to tradition and training as it does to empirical knowledge. This essay offers a brief overview of the techniques and materials that have been used by the Fonderia Chiurazzi, and in doing so provides a practical analysis of the patinator's art in nineteenth- and twentieth-century Naples.

FIGURE 10.3. Chiurazzi replicas on view in the inner peristyle of the Getty Villa, Malibu

Natural and Artificial Patination

Patina on a copper alloy, also known as corrosion or mineralization, occurs naturally and automatically. Outdoors, bronzes commonly develop a dark greenish coloration (patina), which is chemically a basic copper carbonate formed from the reaction of the copper in the metal alloy with atmospheric carbon dioxide and ambient or atmospheric moisture. This common form of

corrosion is soluble (which is why marble bases on which bronze statues stand are often stained a bluish green). Excavated bronzes, on the other hand, typically display a patina of copper salts, both soluble and insoluble, that were formed through chemical reactions during centuries of burial. In volcanic soils, such deposits are usually a uniform matte green color. In instances of prolonged burial in acidic soils (or exposure to air pollution), bronze surfaces will react to form copper sulfates, copper nitrates, and copper chlorides. These are highly soluble and offer little protection to the metal surface, resulting in continuous corrosion that can be highly destructive.

Patinas—or the appearance of a patina—can also be brought about artificially. At its simplest, a false patina can be obtained by applying oils, glazes, or paints to the bronze. These do not provoke any chemical reactions, and simply mimic the look of a patinated surface. However, their artificiality is often easily recognizable and the color not very durable. Much more effective is chemical patination. This is the provocation, acceleration, and control of the natural process of corrosion using chemicals to produce the desired colors and textures—in other words, artificial aging. Such chemical patinas are typically obtained with sulfides, nitrates, oxides, acetates, and chlorides. These react with the bronze surface to produce colors ranging from a deep black through a warm reddish brown, to various shades of green and other unusual hues, and can be opaque, semiopaque, or transparent.

Preliminary Surface Treatment

Even after a bronze statue has been cast, assembled, and cleaned, and any cold-working refinements have been made, the statue still has a rather heterogeneous appearance, since some areas remain covered by a dark layer resultant from the casting, whereas at other areas the bare metal is exposed.[3] The statue is therefore put into a pickling bath of 10 percent nitric or sulfuric acid to eliminate the oxidized surface (that is, the dark layer that remains on the surface).[4] Once the bronze has been allowed to dry, it has a brownish color and can be rinsed with water.[5] It is rarely left in this state, however, as the uniform color tends to flatten the volume of the sculpture. It is thus passed to the specialist who will apply the patina.

Producing the Patinas

Chemical patinas can be classed as either "'hot" or "cold." For cold patination (*patinatura a freddo*), acids or other chemical solutions are applied directly by brushing or spraying and allowed sufficient time to react with the metal surface. For hot patination (*patinatura a caldo*), a heat source in the form of an open flame or torch is used (fig. 10.4) and the bronze is brushed with liquid salt solutions consisting of nitrates, acetates, or sulfides.

FIGURE 10.4. Hot patination using a blow torch

FIGURE 10.5. Pompeii patina

FIGURE 10.6. Pompeii patina (detail of the head)

Patinatura a freddo

Depending on the particular color intensity and texture that is sought, a variety of substances can be used to produce an array of greens. One simple technique is to brush the bronze with acetic acid and ammonium salts. This is done at daily intervals, and the metal is rubbed and rinsed until the desired hue is obtained. Another method is to apply a cold mixture of salt water, fresh water, ammonium salts, nitric acid, and a small piece of copper (which is used to convert the nitric acid to cupric nitrate). The resultant surface can then be used as a base on which to produce a Pompeii patina (figs. 10.5, 10.6). This is obtained by adding powdered ammonium salts to create the grainy effect that is traditionally associated with an excavated ancient statue. The bronze is then exposed to inclement weather and the patina fixed with shellac or a similar lacquer, mixed with colophony and pine resin in alcohol. This patina will age naturally over time, but the process can be accelerated by applying ash.

A third method requires cleaning the surface of the bronze with sulfuric acid, then applying a layer of the green patina and letting it sit for twenty-four to forty-eight hours. A second coat of green is then applied and allowed to dry. It is subsequently fixed with shellac or lacquer and alcohol. After twenty-four hours, the surface is sprinkled with beeswax diluted in benzine. After another twenty-four hours, a powdery mixture of talc, canary yellow, and Prussian blue is applied with a dry brush and then the surface is polished.

Another method to obtain greens is to use potassium sulfide (liver of sulfur) diluted with water,[6] then ammonium salts or ammonium chloride mixed with copper sulfate. By itself, diluted potassium sulfide will produce a natural light bronze color, and a range of hues can be obtained according to how long the solution has been applied (multiple applications are also possible). In its pure state, potassium sulfide will produce black (fig. 10.7), which can also be obtained with arsenic-based solutions. For reds, iron chlorides can be used, as can ferric sulfate or ferric nitrate. The addition of mercury chromium produces a bright red.

Patinatura a caldo

Given that time and labor are often key factors in the patination process, there is today a preference for hot patinas because of the rapidity of their action and their greater durability. Green can be obtained by applying diluted cupric nitrate a little at a time to a bronze surface that is heated with an open flame (fig. 10.8). The temperature of the metal and the number of applications adjust the color of the patina, as does varying the ratio of acid to water, with stronger concentrations producing more vivid results. Alternatively, the surface can initially be darkened with silver nitrate or potassium sulfide, and after drying with a flame, copper acetate is applied.

FIGURE 10.7. Herculaneum patina

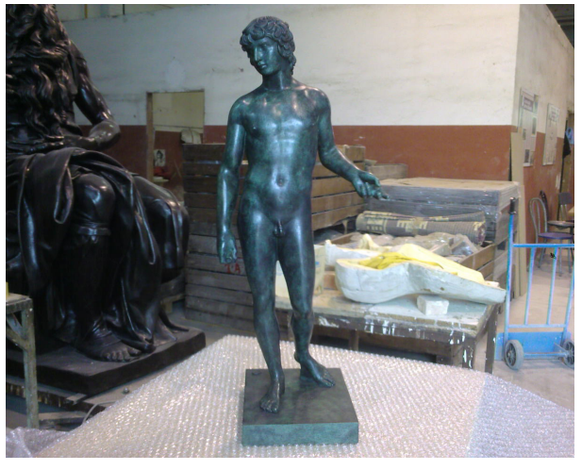

FIGURE 10.8. Green patina

FIGURE 10.9. Dark brown patina

To get a brown hue, the bronze is repeatedly coated with a liquid solution of ammonium sulfide and subjected to occasional gentle heating in association with the application of red ocher, chrome yellow, or carbon black pigments according to the desired tint. For a dark brown patina (fig. 10.9), sometimes known as a Florentine patina (*bronzo fiorentino*), one can use either pyrogallic acid (pyrogallol) or sulfuric acid to which iron oxide has been added. Gentle heating is employed together with yellow ocher and then the entire surface is coated with wax and buffed to the desired sheen. For a shiny Renaissance patina (fig. 10.10), ferric nitrate (obtained by dissolving small pieces of iron such as nails in nitric acid) is diluted with alcohol and water, and the solution brushed onto a heated surface, which is then polished with wax and alcohol.

Other Methods

Today the colors achieved through these various patination processes are sealed with shellac dissolved in alcohol. They can be further adjusted and made more intense with alcohol-based aniline dyes.[7] These are concentrated powdered colorants that are often used to color stains, oils, waxes, paints, and resins. They are easy to use and can be mixed together to produce an infinite variety of hues. If this extra layer is applied, it requires sealing with microcrystalline wax.

Two other methods of chemical patination are worth noting. One is done *a fumo* (by "smoking")—that is, by placing the metal in a reagent-rich environment. This gives rise to a color that is shiny and delicate on account of the very fine corrosion crystals that are formed on the surface of the metal. The object to be patinated is placed in a sealed container together with vessels holding the necessary chemical solutions. To produce a greenish blue, for example, the bronze is accompanied by a dish containing acetic acid, a second containing ammonia, and a saucer of water.[8] The process takes ten to thirty days. An ancient-looking green color is obtained in a similar way with a solution of one part nitric acid and one part water in the first dish, distilled water in the other, and four tablespoons of marble chips in the saucer.

Another type of chemical patina is that achieved by burying the object in the ground, in sand or in sawdust. The burial material is moistened frequently with uric acid or a solution of ammonia. This takes around twenty days. Such a patina is not very robust at first, but becomes so with the passing of time.

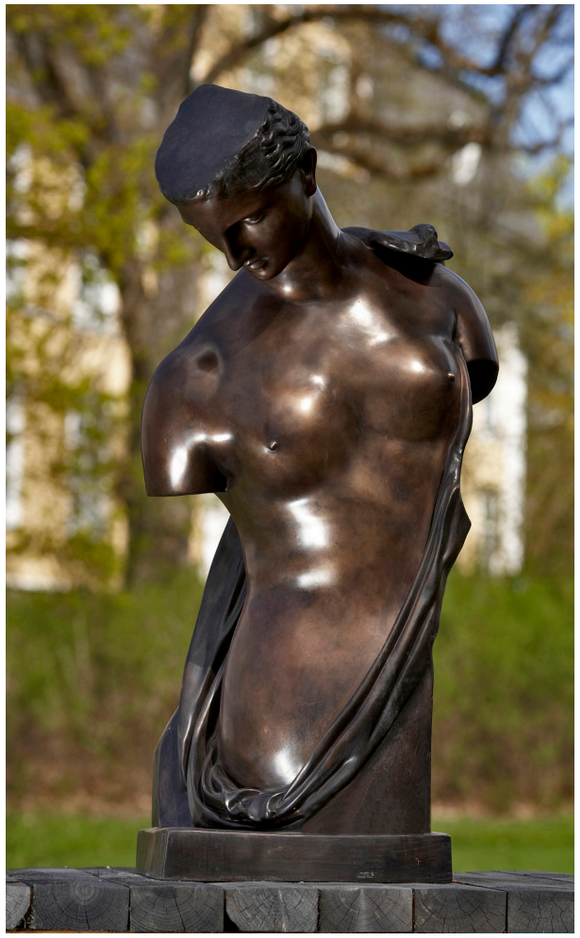

FIGURE 10.10. Renaissance patina

Protection

However it is produced, a chemically patinated surface that is placed outdoors will be affected by humidity and chemical substances present in the air, with the result that the color will vary according to where it is exposed.[9] It is therefore best to treat the patinated bronze with regular applications of a protective coating.

Before applying this, it is vital to eliminate any residual dampness, which can reside in the recesses or folds of a patinated surface, giving rise to the formation of chlorides or so-called bronze disease (identifiable by a distinctive light green powder). Dampness also favors the formation of sulfates, which contain copper compounds that corrode the surface—a situation that worsens further when the chemical components of the patina also react. The patinated surface must therefore be thoroughly dried by leaving it in a dry environment (for a day) or in an oven at a low temperature (for one to three hours).

Once the surface of the bronze has been lightly heated, a beeswax paste is applied, but it is necessary to take into account the various types of patina. The wax applied on a patina *a caldo* can be vigorously rubbed when cold and dry, in order to render the surface shinier. But a patina *a freddo* is delicate, and the wax ought to be applied lightly. A patina *a fumo* is even more vulnerable, and ought to be protected by shellac, lacquers, varnishes, or some other form of coating applied after lightly heating the surface. Today many waxes colored with aniline dyes are also used at this stage, in order to increase further the color intensity of the patina (or to create a false patina, though this is not particularly resilient or durable). Sprayable shellacs, varnishes, and other types of coatings have the tendency to render the patinated surfaces very shiny, whereas the waxes dampen such an effect.

METHODS AND MATERIALS USED FOR PATINATION AT THE FONDERIA CHIURAZZI | NOTES

1 For a full history of the Fonderia Chiurazzi, see L. Fucito, *Fonderia artistica Chiurazzi: La forma dell'arte* (Naples, 2001); C. C. Mattusch, *The Villa dei Papiri at Herculaneum: Life and Afterlife of a Sculpture Collection*, with H. Lie (Los Angeles, 2005), pp. 342–51.

2 See, for example, the catalogue *Chiurazzi: Fonderie–Ceramica–Marmeria* (Naples, 1929).

3 The bronze can be cleaned further with a file and rasps and then polished with cuttlefish bone or fine-grained stone such as pumice or emery. Until the nineteenth century, bronzes were cleaned in this fashion even when they were to be patinated.

4 Today, given widespread environmental awareness and greater responsibility regarding the use of toxic chemicals, many substitute citric acid for these acids.

5 To achieve a lustrous surface, a solution of nitric and sulfuric acids and water is used. After it has been brought to a boil, the bronze is immersed for a few seconds, or brushed with the solution and then rinsed. For a sateen surface, the same process is performed with diluted hydrofluoric acid.

6 To prepare a solution for coating metals, fifty grams of potassium sulfide are dissolved in one liter of deionized water (preferably hot), and one hundred milliliters of concentrated ammonia added. Once the solution has fully dissolved, it may be applied directly to the metal by brush, spray, or swab. It is then necessary to wait for the solution to react (on average, forty-eight hours). Once the patination process has been completed, it is advisable to protect the surface from successive oxidations with a layer of microcrystalline wax or with a coating or varnish such as Metacril that is specifically formulated for this purpose and contains oxidation and corrosion inhibitors such as benzotriazole.

7 Different-colored anilines are easily mixed to achieve a specific color and can be mixed into oils, waxes, paints, and resins. Some of the more common colors produced with aniline dyes are light reddish mahogany, dark brown mahogany, oak, light walnut, dark walnut, and ebony.

8 The object needs to be moistened with water before being placed in the container.

9 The color will be green near the sea, brown in the countryside, and brown, green, or black in the city.

ILLUSTRATION CREDITS
Fig. 10.1: Photo: Fonderia Chiurazzi
Fig. 10.2: Photo D. Saunders
Fig. 10.3: Photo: E. Rosenberry, J. Paul Getty Museum
Figs. 10.4–10.10: Photo: L. Fucito, Fonderia Chiurazzi