Sculptureworks, Inc.

A GUIDE TO THE FOUNDRY* PROCESS

HOW THE PLASTER IS TRANSLATED TO BRONZE

GEORGE R. ANTHONISEN

*All photographs taken at Tallix, Inc., Beacon, NY. Anthonisen has been making metal sculptures and working with artisans at Tallix for over thirty years, almost since the day it opened.

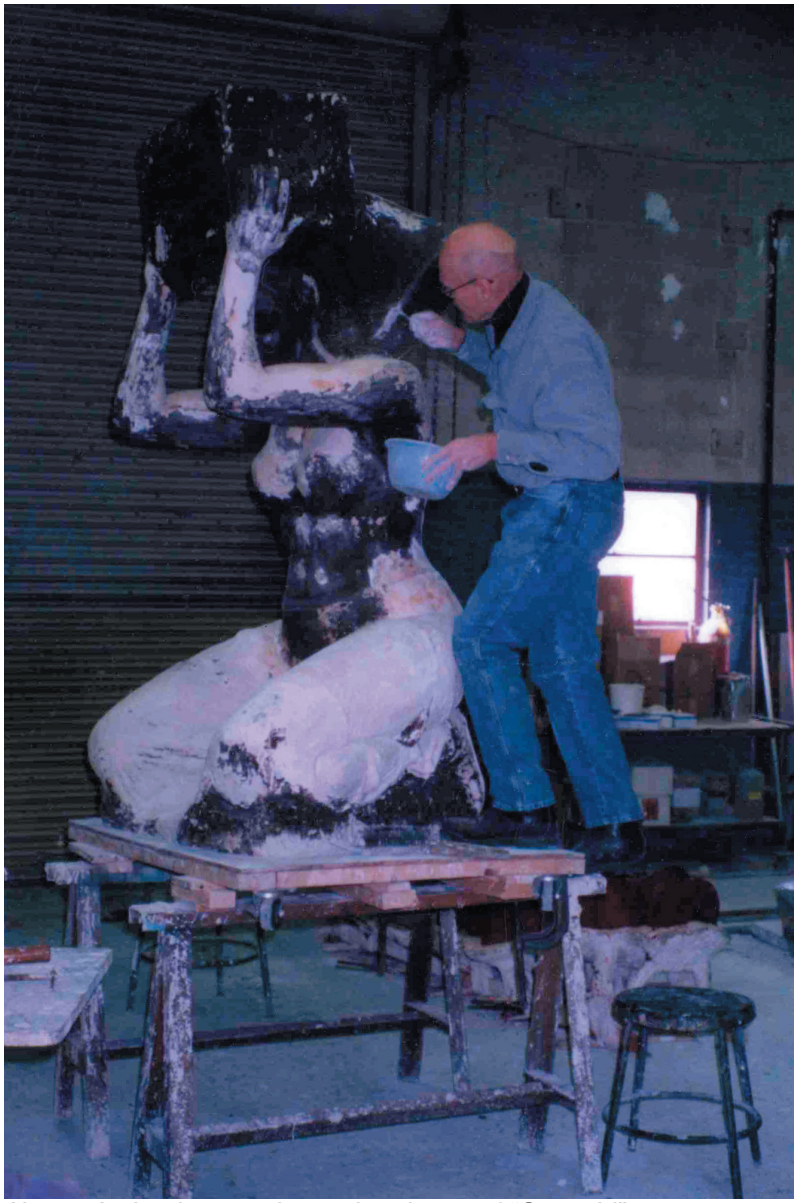
Benefiting Participating Libraries
*P.O. Box 54702 • Hurst, Texas 76054 • 1-800-551-6617 • 817-285-9488 • www.go*bronze*.org*

Sculptureworks, Inc.

A GUIDE TO THE FOUNDRY PROCESS

The relationship between foundry artisans and each artist varies according to the artist's attitude toward his or her role in the casting process. Some artists count on the foundry to make all of the technical and engineering decisions necessary to translate a piece into metal. Other artists work closely with a foundry to invent new ways of manipulating form and color. Most artists fall somewhere in between, wanting both interaction and control.

Above: Anthonisen works on the plaster of "Give Us Grace".



Above: Anthonisen works on the plaster of “Caryatid”.

The plaster is brought from Anthonisen’s studio to the foundry.
If needed, he works on it before mold making begins.

Sculptureworks, Inc.

Above: Foundry workers at Tallix, Inc., Beacon, NY.

Foundry artisans from Mold Making, Finishing, and Wax Casting meet to talk about each specific work. Decisions are made about where divisions will be made and the number of pieces in each mold. Photographs of the work are taken; exact measurements are noted.

MOLD MAKING

The first step in casting is making a plaster mother mold over the plaster that Anthonisen brings to the foundry. Mold makers cover the sculpture with a quarter-inch clay blanket. Then they splash plaster over the blanket to build up the mold. When necessary, the plaster mold is reinforced with burlap and it is left to harden. The plaster is removed from the clay, cleaned, smoothed, and coated with shellac to help plaster separate from the negative rubber mold that will be made next.

MAKING THE RUBBER MOLD

Foundry artisans make a rubber mold by reassembling the plaster mother mold like a mummy casting over the original plaster sculpture and fastening it with clamps. Pour spouts (through which the rubber will enter the mold) are placed at regular intervals along the sculpture. Then black polysulfide is poured into the space between the plaster original and the plaster mold and is left to cure overnight. In the morning the plaster shell is opened by mold makers who chip away at the fresh plaster seals. They cut registration lines into the rubber, making sure the edges of the rubber mold conform perfectly to those of the mother mold. Once they wash and trim the rubber mold and return it to the mother mold, the sculpture is ready for wax casting.

WAX CASTING

Wax casting is one of the most critical stages in casting: what you see in the wax positive, you'll see in the bronze, whether it's holes or cold flows or overpours. The wax is very weak and can sag, twist, or distort if not properly supported at all times.

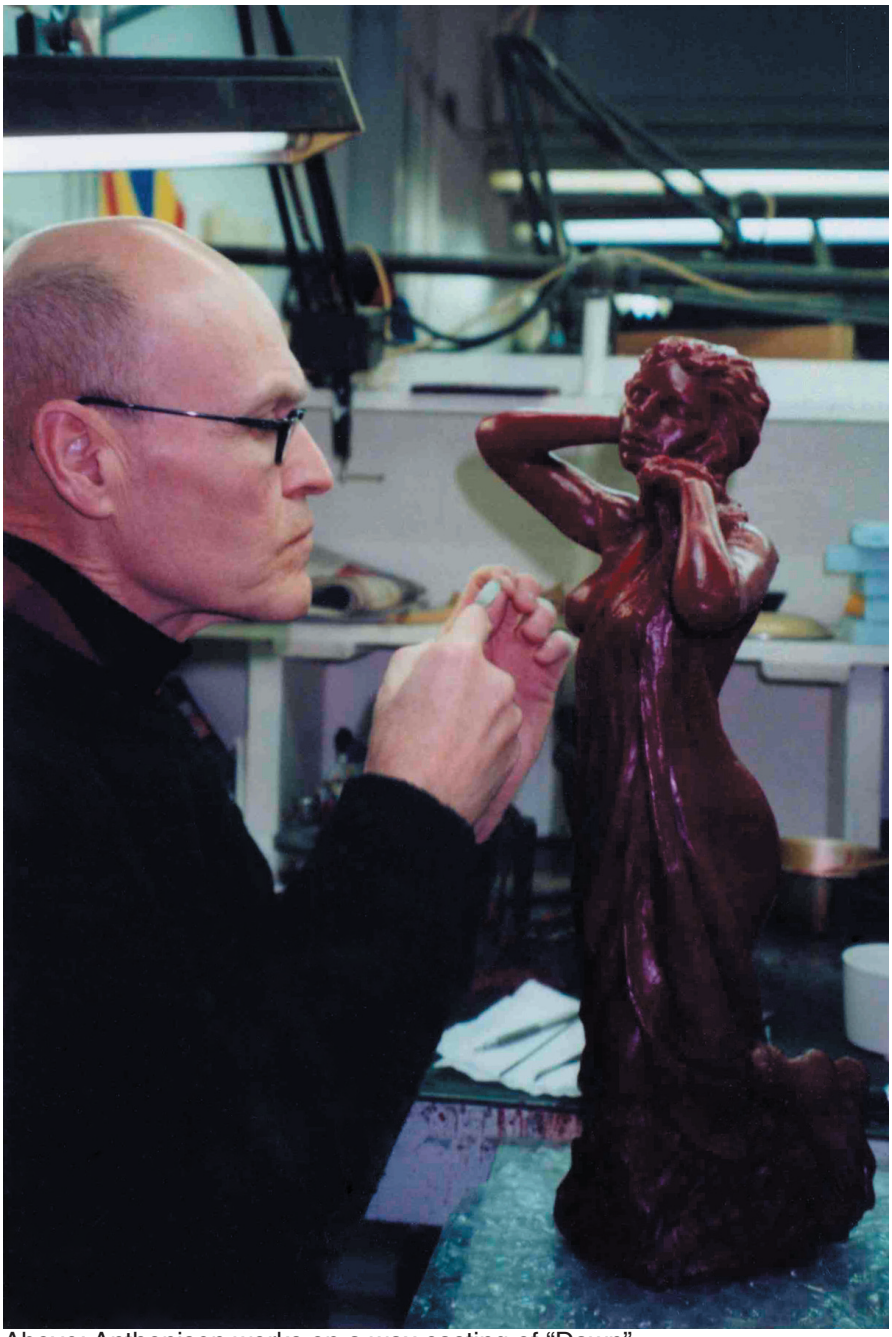
Wax casters begin by painting two coats of hot red wax directly into each section of the rubber mold. The wax's fluidity captures a maximum amount of detail and eliminates air bubbles as it fills the crevices. The artisans follow these two hot coats with a coat of cooler wax. The wax casters then close up the upper portion of the mold, add a pour spout, and cut a drainage hole in the top of the piece. A pin is inserted into the hole and is plastered over. They then hoist the mold upside down with chains and pour liner wax into the form using a slush technique. When the wax skin is thick enough, the pin is hit, the plaster fractures, and wax pours out of the mold into a pot positioned beneath it. The next day, wax casters prepare other sections of the sculpture in the same way. After they remove the rubber-lined mother mold from the wax, one section at a time, there stands a hollow red wax positive of the work with seams and lines and pour spouts.

Sculptureworks, Inc.

Above: Anthonisen examines the wax of “Sunnyside Up”.

REWORKING

Foundry artisans rework the separate halves of the sculpture, smoothing parting lines with a tool heated to soften the wax, filling out contours with additional wax, repairing whatever was damaged during mold removal. They erase nicks, bubbles, and scratches by rubbing the wax with kerosene applied with a grit cloth. Reworking can take many days depending on the size of the work. When the workmen are finished, Anthonisen spends a day consulting with foundry experts and goes over the wax with his own hands before turning the form over for gating.

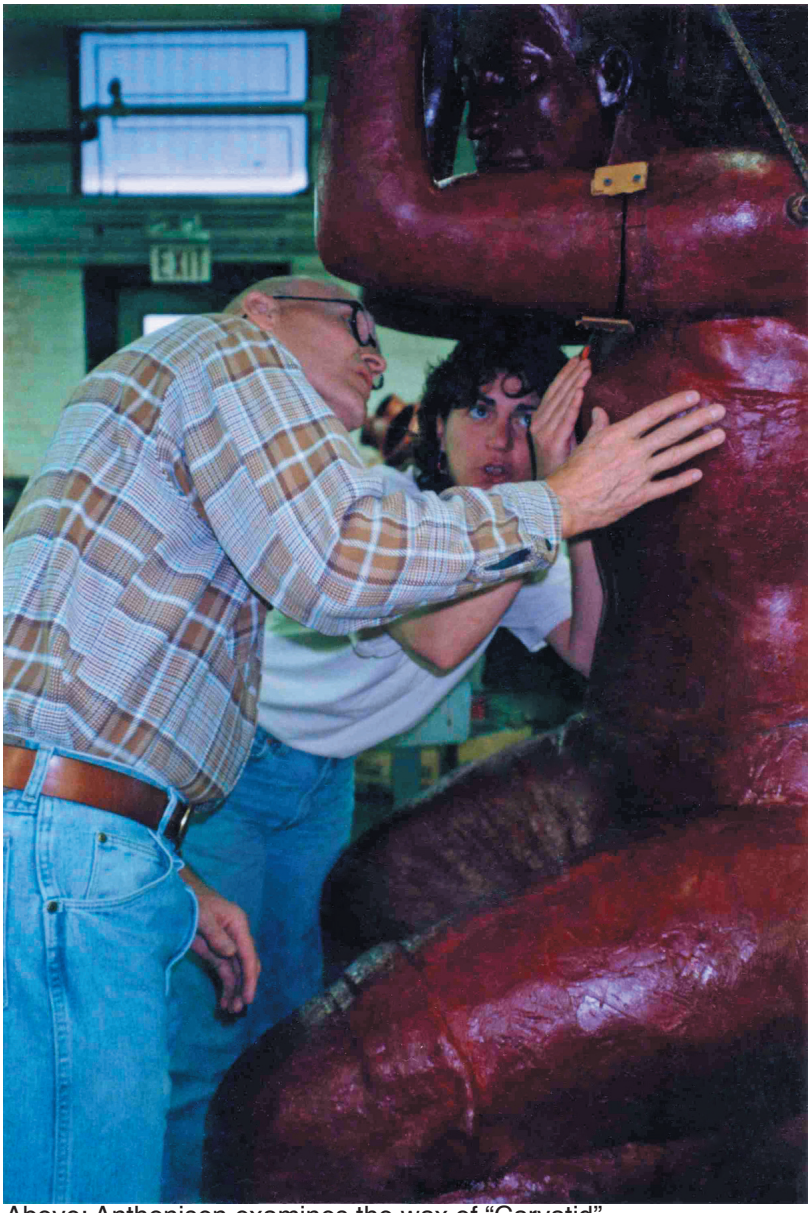


Above: Anthonisen works on a wax casting of “Dawn”.

Sculptureworks, Inc.

Above: “Contemplation” plaster and waxes.

The original plaster (left) with two of nine wax castings of “Contemplation”, a commissioned work. Each wax is worked on individually by artisans and the artist.



Above: Anthonisen examines the wax of “Caryatid”.

Tina Jeeter, head of Wax, helps Anthonisen line up the arm of “Caryatid” in preparation for Gating.

Above: The wax and original plaster of “Caryatid”.

Anthonisen checks the wax casting of “Caryatid” with the original plaster.

Sculptureworks, Inc.

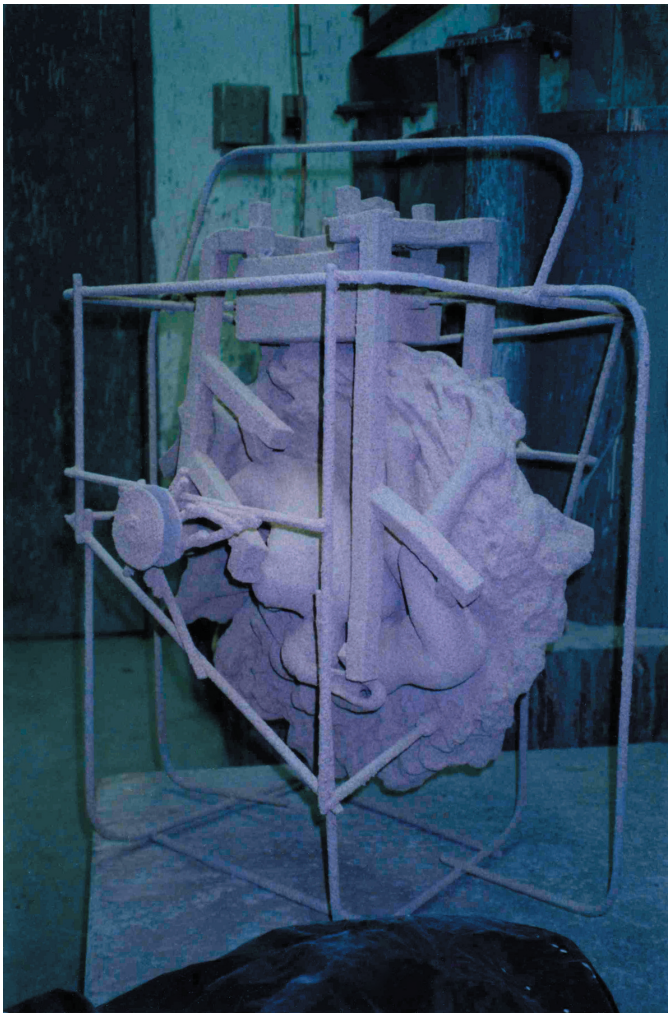
When a sculpture is ready to be cast, Anthonisen signs, numbers, and dates the piece. The next step is Gating.

GATING

The gating system is the circulatory system of the casting: gates and runners are the channels by which the wax will leave the mold during dewaxing and then by which, after burnout, the molten metal will enter the mold cavity. Getting the wax out of the ceramic shell mold is a fairly straightforward affair, its main constraint being the need to get the wax out fast, before the expanding, melting wax can crack the low-expansion ceramic shell. Getting the metal in the mold is another story: the density of the metal is so great that even slight differences in the height of a column of metal can cause substantial differences in pressure and in the flow of metal at a particular place in the mold. Thus the Gater's goal is to design a system that equalizes the pressure at all of the gates so that all flows are equal. With each individual work, artisans decide upon how many sections it takes to gate the particular piece.

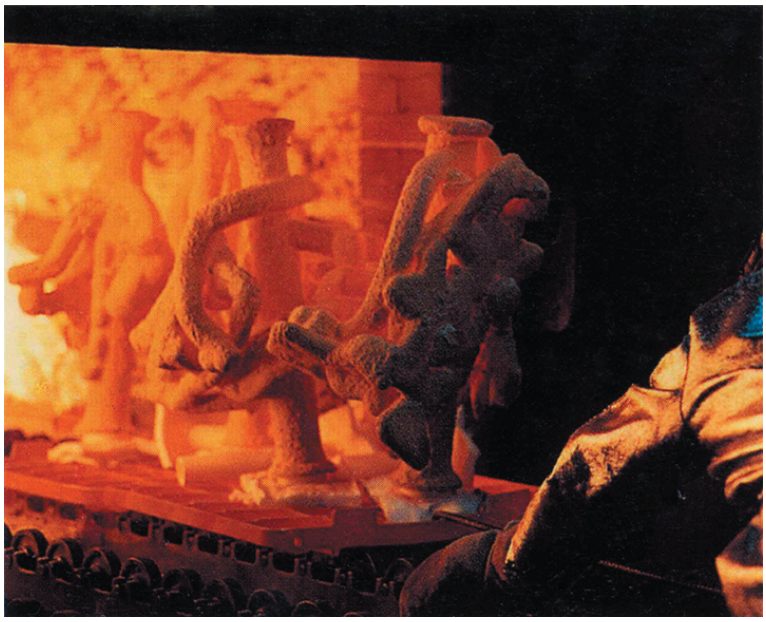
MAKING THE SHELL

During shell making, the wax sections are "invested" with a ceramic shell. Shell makers dip each form into a slurry tank containing a precoat of water-based silica solution mixed with powder-fine sand and then dip it into a fluidized bed of fine zircon sand to build layers of a craggy ceramic shell around the fragile wax. This stage is difficult: the shell must be placed in sand before it dries, and the fragile, uncured shells must not be bumped on the side of the tank or they may crack or their gates may come off. Shell makers continue putting additional coats of ceramic on the forms over the next several days. Ultimately, the ghostly forms are dipped into three grades of slurry, each progressively thicker, and into three grades of increasingly coarse sand. After the final coat, the shells cure for at least two days, hanging on racks like sides of meat. After the shells dry, foundry workers drill small vents into them so that the wax can expand without cracking the shells during dewaxing.



Ceramic shell of “Creation”, also showing gating system.

Sculptureworks, Inc.



Loading ceramic shells into the preheated oven.

THE FOUNDRY

After the ceramic shells are dry, the various sections of a sculpture move to the foundry area, where foundry workers melt out the wax, bake the shells, and pour in the metal. The foundry room is dark, but it pulsates with heat and noise. There is a quiet tension among the foundry workers: their concentration is intense. The danger of the white-hot molten metal forces them to carefully choreograph all of their movements.

The sculptor's wax melts out of the ceramic shells in an autoclave, a huge cylindrical tank that functions as a pressure cooker. Next, the shells bake in an oven whose glowing depths look like the inside of a volcano. Flames lick up along the edges of the furnace, dramatizing the white-hot glow of the skeletal silhouettes of the ceramic shells. After the first firing, foundry personnel cool the shells, wash the dirt out of them, and reinforce them with stainless steel wire and cement. They return the shells to the burnout oven, where they are baked again.

THE POUR

The climax of lost wax casting is the pouring of molten metal. This is done either by using gravity to force the metal through the gates and into the mold cavity or by the Chandley-Lamb Air Melted casting process, or CLA, which works with positive pressure.

The metal is poured into the sculpture's shells by foundry workers wearing silver aprons that reach nearly to the floor, flame resistant jackets, gloves, helmets, hoods, and special glasses. The pourers must achieve a critical balance between metal and shell temperature. When the correct temperatures are reached, the hooded workers hoist crucibles of molten metal and guide them over the sculpture's hot, empty shells, which have been positioned in sandbeds. They have only a few minutes to pour the molten metal. In a glowing white stream, the metal is poured, with both columns of metal synchronized carefully so the casts fill evenly.

CLA casting is less dramatic to watch, but is ideally suited for casting where delicate detail is all important. Foundry workers place the ceramic shell of a particular piece in the CLA chamber, seal the chamber, and remove all air pressure. A snorkel that protrudes below the chamber is lowered beneath the surface of the molten metal. Atmospheric pressure forces the bronze directly into the casting. The metal, entering the mold under positive pressure, is forced tight against the surface of the mold. There is little turbulence in this counter-gravity procedure, and it produces a crisp, lean casting with half the usual number of gates.

Sculptureworks, Inc.

Hot ceramic shells ready for casting (above). A foundry worker pours the liquid metal into the waiting shells (below).

Benefiting Participating Libraries
*P.O. Box 54702 • Hurst, Texas 76054 • 1-800-551-6617 • 817-285-9488 • www.go*bronze*.org*

KNOCK OUT

The sculpture is then taken to the knock out room where foundry workers break the ceramic shell away from the metal casts with a pneumatic hammer. They cut off the gating system, grind off gate stubs, and weld the remaining holes. In a soundproof room, a worker, wearing an air-conditioned hood, sandblasts the sculpture's surface inside and out, clearing the metal of all ceramic material and metal oxides.

FINISHING

Up to this point, a sculpture's transformation has involved a series of tasks that broke the sculpture into smaller parts. During the finishing stage, welders fit each bronze section of the work back together, and the artist's image becomes a whole. Finishing is extremely noisy: air tools buzz, as metal surfaces are ground, sanded, hammered, and welded. Amidst the cacophony there is also a quiet concentration, as finishers hand work the surfaces with a variety of old-fashioned chasing tools. The finishers are carefully attentive to the forms and lights that characterize each artist's sculpture. Toward the end of the finishing process, the sculpture is turned over to the artist for approval again.

The artist inspects the sculpture, indicating where corrections need to be made. Artisans make final adjustments; the artist checks the piece once again before it moves on for patination.

Sculptureworks, Inc.

Above: The unfinished metal of “Caryatid”.

The ceramic shell has been taken off the metal with a pneumatic hammer. Foundry workers cut off the gating system, grind off gate stubs, and weld remaining holes, sandblasting the surface of the sculpture inside and out, clearing the metal of all ceramic material and metal oxides. The sculpture is then brought to finishing.

Above: Anthonisen inspects “Sunnyside Up” with foundry workers.

Anthonisen inspects the sculpture “Sunnyside Up”, indicating where corrections need to be made. Head of Finishing, Insun Cafarelli, and his assistant offer suggestions and expertise.

Above: The unfinished metal of “Caryatid”.

Above: Anthonisen views the metal of “Meditation”.

PATINATION

Forty-three samples of patinas line the wall in the patination area's entrance. These plates are individually colored and textured to give sculptors a wide range of options to consider for coloring their sculpture.

Over the years, Anthonisen and the foundry have developed a personal palette for his sculpture and the majority of his pieces are colored in the same way.

Most colors are made through a skillful blend of three water-soluble compounds: copper nitrate (which produces a green color), ferric nitrate (for reddish brown), and potassium sulfide (for black). On larger work, these compounds are applied in several layers of weak dilutions. The patinists build up a good base of black by using potassium sulfide and then apply copper or ferric nitrate to contribute to the sculpture's warmth.

The length of time for Patination depends on the size of the work but can take many days. Then, the sculpture is ready for waxing. Waxers apply beeswax to the figure, brushing on one coat, then buffing it, brushing on another coat, and then buffing it again. The piece is left to dry for several hours, and then finally, after three to five months at the foundry, it is ready to go out into the world.

Sculptureworks, Inc.

Above: The metal of “Give Us Grace” getting ready for the patina.

As soon as the sculpture is OK’d by Anthonisen, it is moved from Finishing to Patination. Rosemary Rednour (left), Head of Patination, Anthonisen (kneeling in center), and patinist Mike McNeel (right) move “Give Us Grace” in place to start on the patina. Patina samples are on the wall (background far right).

Sculptureworks, Inc.

Above: “Meditation” receives its patina by Mike McNeel.

Patinist Mike McNeel applies color in several layers.

Sculptureworks, Inc.

Above: The patina of “Meditation”.

Above: “Creation” receives its patina.

Sculptureworks, Inc.

Anthonisen (left), Rosemary Rednour (center), and Mike McNeel (right) apply wax to "Give Us Grace" (far left and below).

Sculptureworks, Inc.

Raw bronze of “Contemplation” (above left). In order to see how the patina looks in natural light, Anthonisen takes the sculpture “Contemplation” outside for viewing (above right).

Sculptureworks, Inc.

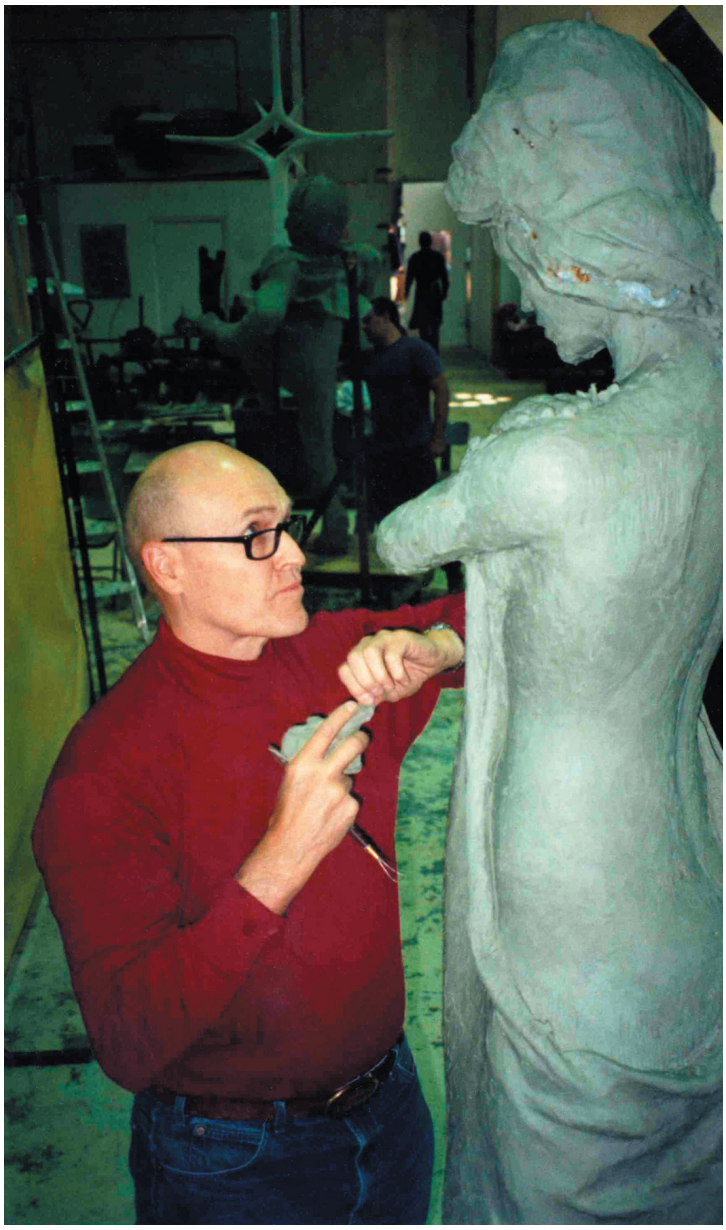
ENLARGING

Using the plaster maquette (model), foundry artisans enlarge the sculpture by skillfully manipulating a pantograph scraping technique.

Above: “Meditation” is enlarged.

An iron skeleton of welded iron work forms the armature. Before the clay is put on, the armature is covered with a styrofoam copy of the model. Using the pantograph, clay is applied with a scraping motion. The process is a skillful blend of technique and artistry.

Above: The enlarged “Meditation”.



When the enlargement is roughed out, Anthonisen refines the clay (above and right show the enlargement of “Meditation”). Depending on the size of the work, this process can take several days, weeks, or even months.

Sculptureworks, Inc.

Anthonisen (left) discusses drape for "Meditation" with Enlargers Jerry Tobin (middle) and Mike Keropian (right). The plaster maquette of "Meditation" is seen to the right of the enlargement (image at left).

Anthonisen puts the finishing touches on the clay prior to making a wax model (image at right).

THE ARTIST'S FOUNDRY*

I have been a foundryman for forty years. No one who has had work done at Tallix, the foundry I began and have run for twenty-two years, will question my interest, affection, and involvement with artists who make metal sculpture. The problems of these artists, how their problems are solved, and the nature of solutions both successful and unsuccessful, have absorbed my attention and energy and led to these musings on the relationship between artist and foundry.

Almost from the day Tallix opened, George Anthonisen and I have worked together making metal sculpture. He is, in fact, very much the model for the hypothetical artist in my essay. Together we have grown in experience and capability -- George as a sculptor, I as a foundryman.

The commissions that George has won are celebrations of our work together. At the same time, because of the importance of the subjects in George's work and the sites where the sculpture is installed, these monuments are testimony to our individual development: for George, that he won the commissions, for Tallix that we could do work requiring the highest skill and craftsmanship.

I remember many of George's projects, particularly "Death and Starvation" for the World Health Organization and, for the state of Alaska, the portrait of "Senator Gruening" that stands in the Capitol Building in Washington, D.C. In "Death and Starvation", George captures the true horror of starvation, while in the portrait of "Senator Gruening", he presented a man of great strength and dignity.

But what I most remember is the sculpture "I Set Before You This Day", George's newest major work. The sculpture has a force that grabs observers and compels them to ruminate on what is happening to the figures in the sculpture. The response of the people who work in the foundry was intense and lasting. Many people have had this response, but this is the foundry that does George's work. We are George's foundry. When the power of the art unites with the collaborative effort between artist and foundry, something special, something extra appears in the sculpture.

The artist who comes to the foundry to make sculpture needs to find at least four things: space, tools, technology, and craft.

> *Space:* The artist needs space to see his work, of course, but more importantly, he needs a place to do work, to touch up a wax, to help with a patina. Space, in its minimal form, is physical. When the artist is familiar with foundry and staff, when he and his work are both known, space can have a spiritual component and be supportive and generous.
>
> *Tools:* He needs tools and equipment: cranes, melting furnaces, shears, press brakes: all the stuff necessary to cast, cut, and join metal. Here, too, there is an upside to the chosen foundry, for while the quality and effectiveness of the tools will not keep the artist from making sculpture, it will affect how the sculpture is made and how it looks. In other words, the foundry is incidental to the artist making art, but once a foundry is chosen, the outcome is affected by that choice of people, equipment, and technology.
>
> *Technology:* The technology by which a sculpture is made marks the work and sets it in a particular time. For the contemporary artist, it is meaningful that the sculpture be made using the best methods and technology of his era.

> *Craft:* This, the last of the four needs, is of great importance, for when artisan and artist work together with materials, they create a pool of knowledge about things and substances. The craftsman must be familiar with these techniques to understand how certain things were done. Then he can repeat them. There is no way for the inexperienced person, no matter how committed, to proceed without that understanding. These inherent components of craft experience and technical knowledge . . . enable the craftsman to read the information about how the sculpture was made from the sculpture itself. Thus, the craftsman's knowledge ensures continuity and consistency in the forms, textures, and colors of the artist's work.

The expectation is always that these ingredients will combine to produce sculpture of the highest quality, on time, and at a fair price. But when an artist comes to *his* foundry -- that is, a foundry he has used for years -- he comes with the same needs, but he has a different expectation. The artist who works with a particular foundry for some continuous period of time establishes an empathy and rapport with the craftsman who works on his sculpture. Craftsmen have always worked for and with artists. But this rapport is more potent than that tradition. When a craftsman works for an artist, trying to do the work as the artist wants it done, he must suspend his ego, a psychologically difficult thing to do, and put himself at the command of the artist. This is always easier when artist and craftsman have worked together and know each other.

Working together gives the artist the trust that enables him to come to the foundry with the expectation that the technical details of making the sculpture will be taken care of. The foundry thus frees the artist to use his imagination for other than technical purposes. This gives both the artist and the foundry a great challenge to expand and improve: the foundry is challenged to improve its craft and technology of making sculpture; the artist has the time to explore and create. The foundry sets forth possibilities, the artist adapts, modifies, and takes. And for both, the force of the collaborative relationship kindled and released by their joint efforts produces a multiplying effect.

This, then, is the potential outcome of collaboration for foundry and artist. It involves faith, trust, and hope, and it is anchored by the aesthetic and practical observations involved in the long history of artists' and craftsmen's work with materials as they make art. And when the outcome is successful, it gives meaning to work and produces sculpture that maximizes the artist's intent.

Richard Polich
September, 1992

* *Anthonisen*, 1992 catalogue of Anthonisen's work, Woodmere Art Museum, Philadelphia, PA.
Richard Polich, founder of Tallix, is now president and founder of *Polich Art Works*, Rock Tavern, NY.

Adapted from *The Fine Art of Casting* by Miranda McClintic, Sculpture, November/December 1988.