Philadelphia Museum of Art

GILDING DIANA CONSERVATION PROJECT
Made possible by a grant from the Bank of America Art Conservation Project



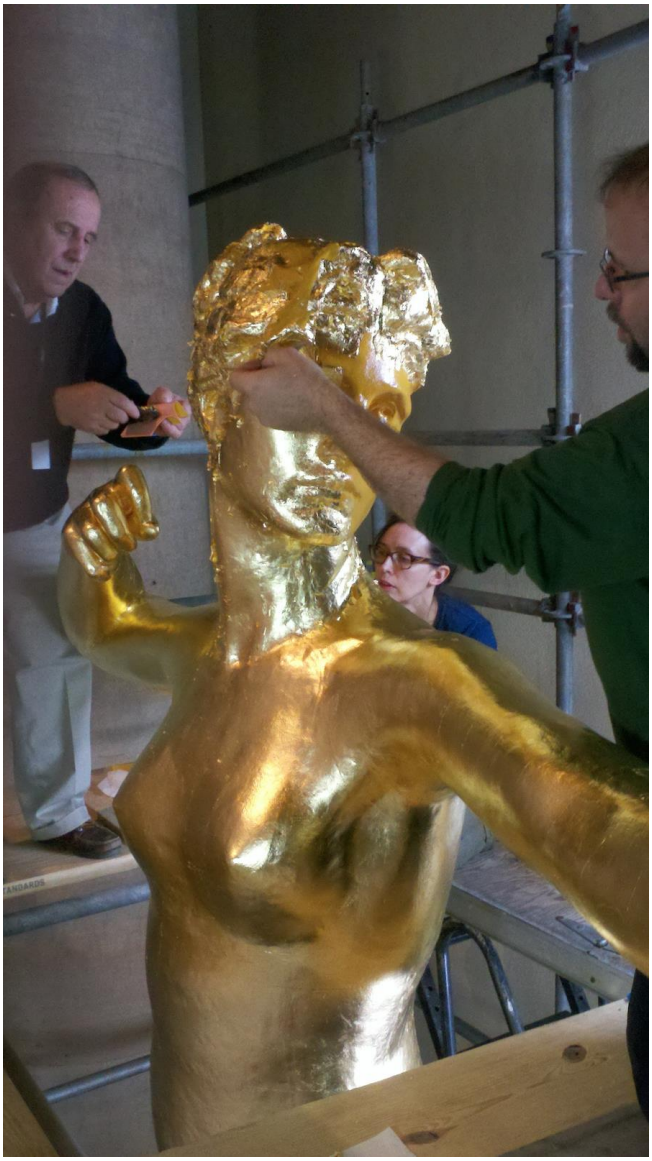


FOREWORD

This document presents an overview of the Philadelphia Museum of Art's 2013–14 conservation of *Diana*, a sculpture created by Augustus Saint-Gaudens in 1892–93.

The Museum's Conservation department—led by Andrew Lins, The Neubauer Family Chair of Conservation and Senior Conservator of Decorative Arts and Sculpture—conserved and regilded *Diana* in consultation with the department of American Art and with the collaboration of Adam Jenkins, conservator of decorative arts and sculpture, Adam Jenkins Conservation Services, LLC.

Visit the Museum's website for behind-the-scenes videos about the entire project.



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OVERVIEW

Augustus Saint-Gaudens's *Diana* has adorned the top of the Philadelphia Museum of Art's Great Stair Hall for more than eighty years. It was created in 1892–93 as a gilded weather vane for the tower of New York's Madison Square Garden, designed by Stanford White. The beloved sculpture underwent a remarkable transformation in 2013–14 when conservators repaired and preserved its copper structure and restored its original gold leaf finish. The project was completed in July 2014.

Diana is arguably the best-known work of Saint-Gaudens, the most celebrated sculptor of America's Gilded Age. It is his only nude female sculpture and one of only two gilded sculptures that he created for exterior sites, the other being the Sherman Memorial in New York. When installed on Madison Square Garden's tower, *Diana* turned and glittered 347 feet above the street at one of the highest points in Manhattan. Representing the grandeur and sophistication of the Gay Nineties, its brilliant gilded form caught the sun during the day and was illuminated at night by among the city's first electric floodlights. Although some were shocked by *Diana*'s brazen nudity, the goddess of the hunt made a fitting ornament for the sporting and entertainment arena below, a building conceived as "the most magnificent amusement palace in the world."

As the optimism of the Gilded Age faded into the twentieth century, Madison Square Garden fell into bankruptcy and deteriorated. Thirty years of weathering atop the tower had diminished *Diana*'s golden surface, and the sculpture was removed just prior to the building's demolition in 1925. When *Diana* was adopted by the Museum in 1932, it was cleaned and repaired—but not regilded—before it was installed in the grand staircase.

In 2013 the Museum's conservation staff began its restoration of *Diana* by analyzing and documenting her condition and performing tests to determine optimal cleaning and gilding techniques. They removed corrosion from the sculpture's copper surfaces and coated them with a paint containing a corrosion inhibitor. 180 square feet of gold leaf was then meticulously applied. Finally, as Saint-Gaudens did not like the look of bright gold at eye level, the conservators matted the gilding for interior display.

Sculptor Augustus Saint-Gaudens

The son of a French father and an Irish mother, Augustus Saint-Gaudens rose from working-class, immigrant origins to become "prince of sculptors" in America's Gilded Age. During his career, he forged his own distinctively American style of sculpture, a beautiful fusion of classicism, realism, and modernism, all celebrated in the graceful figure of *Diana*. The success of his public monuments, such as his moving commemoration of African American veterans of the Civil War (the Shaw Memorial in Boston), completed in 1896, and the spectacular Sherman Memorial in New York, completed in 1903, led to many public and private commissions.

Born in Dublin in 1848, Saint-Gaudens moved with his family to New York City before his first birthday. He was drawn to sculpting at an early age and left school before the age of thirteen to apprentice for a cameo cutter. While apprenticing, he attended night classes at Cooper Union and the National Academy of Design. In 1868 he enrolled at the École des Beaux-Arts in Paris, studying classical art and architecture and supporting himself by making cameos and copies of famous sculpture. Two years of travel and study in Italy immersed him in the idealism of the Renaissance and the classical past, which he combined with the naturalism he had learned from modern French masters.

In 1875 Saint-Gaudens returned to New York, where he rapidly proved himself to be the most versatile and imaginative American sculptor of his day. He established his own studio and began creating decorative art for Tiffany Studios. In 1886–87 he was part of a team of artists, led by John La Farge, who carried out H. H. Richardson's designs for the decoration of Trinity Church in Boston. His first major commission was the Farragut Monument (1881, with a base designed by architect Stanford White [1853–1906]) in Madison Square Park, New York City. The statue of Admiral Farragut set a new standard for American public monuments and launched the artist's reputation for portrait and monumental sculpture, making him one of the most prominent figures of his day.

By the 1890s, Saint-Gaudens had already created some of his greatest works, including the gilded copper statue of *Diana*. Like many of his peers, he participated in the 1893 World's Columbian Exposition in Chicago, serving as the sculpture consultant to the director. In 1901 he was a consultant for the city plan of Washington, DC, and in 1905 designed official United States coins at the request of President Theodore Roosevelt. Saint-Gaudens died in 1907 in Cornish, New Hampshire.

Diana and Madison Square Garden, 1891–1925

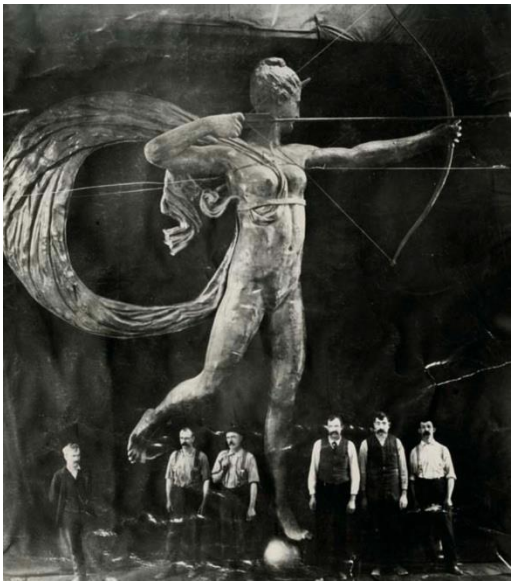
Stanford White, one of the most talented American architects of the late nineteenth century, invited his friend Saint-Gaudens to create a sculpture to crown the tower of the new Madison Square Garden building, designed by White's firm, McKim, Mead & White. Occupying an entire city block on the corner of Madison Avenue and 26th Street, this new "palace for the people" opened in June 1890 and hosted spectacles that included circuses, boxing, concerts, and fancy balls. The tower was not completed until 1891, and it was then that Saint-Gaudens's first *Diana* was installed on the pinnacle, above a bank of electric floodlights. A weather vane that turned and glittered 347 feet above the street—then the highest point in Manhattan—the gilded goddess was visible for miles.





Main tower for Madison Square Garden, designed by McKim, Mead & White

Not long after the sculpture was installed, White and Saint-Gaudens agreed that the eighteen-foot figure was too large for the tower. The first *Diana* was removed and refurbished for use in 1893 at the World's Fair in Chicago, where she ornamented another McKim, Mead & White building (and was later mostly destroyed by fire, along with the building itself, and then lost). Saint-Gaudens modeled a new thirteen-foot *Diana*, similar in pose but more graceful and attenuated, that was installed on Madison Square Garden's tower late in 1893. For more than thirty years, this second, smaller *Diana* reigned over Manhattan, representing the gaiety and sophistication of the city's Gilded Age.





Diana I, 1891, 18 feet *Diana II,* 1893, 13 feet
Shown here are the two versions of *Diana* at the W. H. Mullins Co. in Salem, Ohio. In the first *Diana,* the right leg is more bent and the left foot is not centered on the sphere. In the second *Diana,* the left arm is straight and the drapery is entirely above the waist. (Left: Photo courtesy of Salem Historical Society, Ohio. Right: From W. H. Mullins Co. 1896 catalogue)

Diana Comes to Philadelphia, 1932

The optimism of the Gay Nineties faded in the twentieth century as Madison Square Garden fell into bankruptcy and deteriorated. Years of weathering abraded *Diana*'s golden surface; her drapery was torn in about 1905 and removed by c. 1915; the floodlights were shut off to save costs before 1912. The building was demolished in 1925, and the sculpture was placed in storage. After a plan to reinstall *Diana* on the campus of New York University fell through, the sculpture's owners, the New York Life Insurance Company, welcomed an invitation from Fiske Kimball, the director of the Philadelphia Museum of Art. Funds from the Fairmount Park Art Association (now the Association for Public Art) paid to have the sculpture cleaned, repaired, shipped to Philadelphia, and installed in the Museum's brand-new building on Fairmount, which opened in 1928. Placed at the top of the grand staircase in 1932, *Diana* became the elegant goddess of the park and the Museum, and an icon of her adopted city.

Philadelphians invited some of the finest examples of Saint-Gaudens's public sculpture. A monument to President James A. Garfield, installed in 1895, stands on Kelly Drive near Girard Avenue, not far from the artist's bronze *The Pilgrim,* completed in 1904 for City Hall Plaza and later moved near Boathouse Row. His marble masterpiece of 1902, the luminous *Angel of Purity,* commissioned for Saint Stephen's church in Philadelphia, is here in the Philadelphia Museum of Art, in gallery 120, on the first floor.



The Angel of Purity (Maria Mitchell Memorial), 1902, by Augustus Saint-Gaudens (Philadelphia Museum of Art: Purchased with the Annenberg Fund for Major Acquisitions and with the gifts of Mr. and Mrs. Wharton Sinkler and Mrs. T. Charlton Henry (by exchange), and with funds contributed by the Margaret Dorrance Strawbridge Foundation of Pennsylvania II, Inc., 2005-2-1)

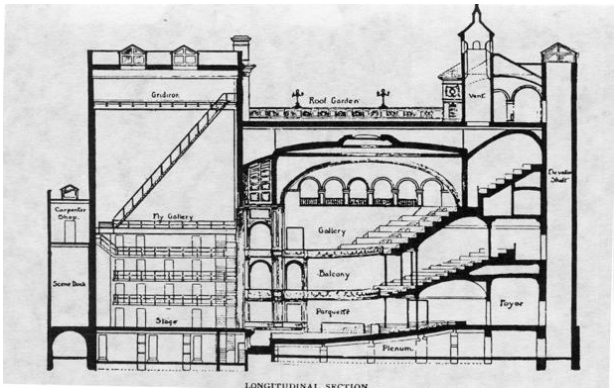
Madison Square Garden

In 1871 P. T. Barnum leased a plot of land formerly occupied by a New York City railway terminal from Cornelius Vanderbilt and converted it into Barnum's Great Roman Hippodrome. After the lease expired, Vanderbilt renamed the venue Madison Square Garden. The Garden I, as it is called today, stood at 26th Street and Madison Avenue. On Memorial Day in 1879, Madison Square Garden opened as an arena for activities such as boxing matches and circus acts. The Garden I also featured a cycling track as well as the first indoor hockey rink in the United States.

In 1890 the second Madison Square Garden was rebuilt by a syndicate that included J. P. Morgan, Andrew Carnegie, P. T. Barnum, Darius Mills, James Stillman, and W. W. Astor. The architectural firm McKim, Mead & White designed the Beaux-Arts structure with Moorish features, including a minaret-like tower modeled after the Giralda, the bell tower of the Cathedral of Seville. It soared 32 stories or about 347 feet, making it the city's second tallest building at the time, after the World Building of 1890. The structure occupied 200 feet (61 m) by 485 feet (148 m). The main hall, the largest in the world, measured 200 feet (61 m) by 350 feet (107 m), with permanent seating for 8,000 people and floor space for thousands more. It had a 1,200-seat theater, a concert hall with a capacity of 1,500, the largest restaurant in the city, and a roof garden cabaret. The final cost for the building, which the *New York Times* called "one of the great institutions of the town, to be mentioned along with Central Park, the bridge to Brooklyn, and the new aqueduct" was $3 million.

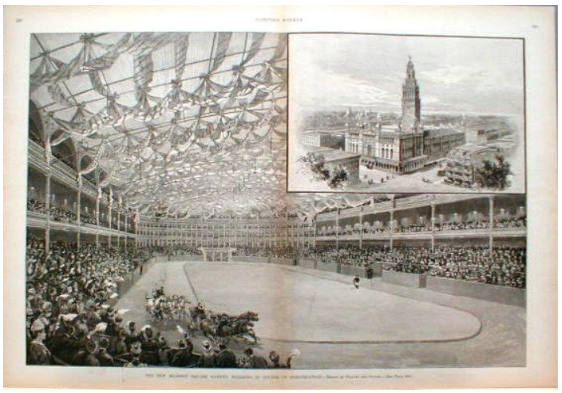


Street view of Madison Square Garden II



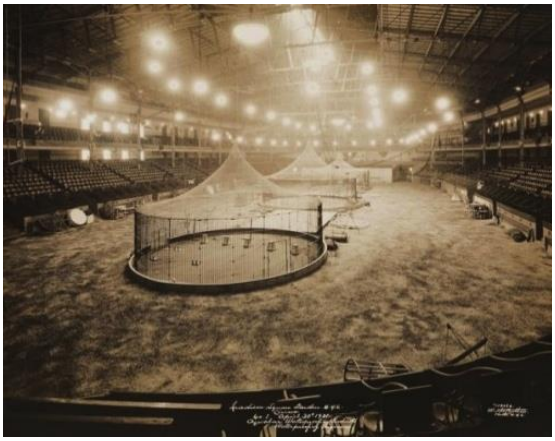


Elevation of Madison Square Garden II showing its public spaces, including the roof garden shown at right, c. 1900





Horse racing event and bicycle show, 1896, at Madison Square Garden II




Left: New York City Circus at Madison Square Garden II, 1921. Photograph by Wurts Brother. © Museum of the City of New York. Right: US Senator Pat Harrison giving the keynote speech at the 1924 Democratic National Convention at Madison Square Garden II

Architect Stanford White

Stanford White was not only the leading urban architect in the United States but also a notorious playboy. His name had been linked with many women, including Evelyn Nesbit, wife of Pittsburgh millionaire Harry Thaw. On the night of June 25, 1906, Thaw attended a dinner show with his wife at Madison Square Garden's roof theater. When he rose to leave the dining room, he suddenly turned on his heel, walked to White's table, drew a revolver, and fired three times at White's head, killing the architect in a building that he designed. After one hung jury, Thaw was found not guilty by reason of insanity. The story has been depicted in several movies, notably in *The Girl in the Red Velvet Swing* and *Ragtime.*

TWO *DIANAS*

The first studies for the head of *Diana* date to 1885–86, followed by a small plaster figure, no longer extant but possibly dating to 1886.[1] The first enlarged figure in plaster (18 feet high) was created in 1890–91, with a recently discovered image showing changes made to the scarf as the plaster figure was being constructed at the W. H. Mullins Co. in Salem, Ohio.

Shortly after *Diana*'s well-publicized unveiling on November 1, 1891, Saint-Gaudens and White decided the sculpture was too tall and heavy for its site. It was removed in early September 1892.

Diana I, 1891



Left: An early version of the drapery/scarf on *Diana I.* From W. H. Mullins Co. workbook, c. 1891. **Right:** The eighteen-foot *Diana I* at the W. H. Mullins Co. in Salem, Ohio, September 1891, before transport to New York City. Photos courtesy of Salem Historical Society, Ohio

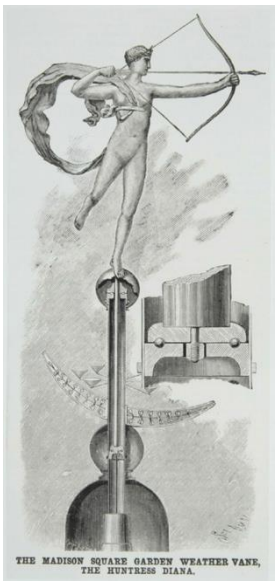
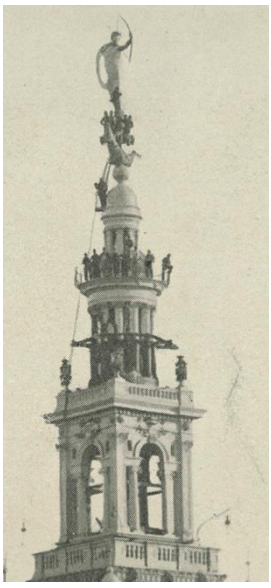
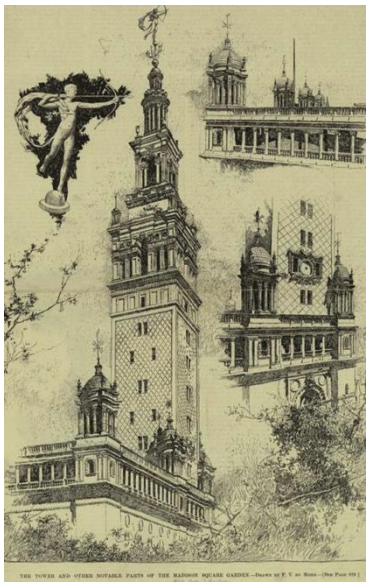


Illustration of double bearing system that allowed *Diana I* to rotate as a weather vane (*Scientific American*, December 26, 1891). Fabrication was in sheet copper to lessen the weight.





Left: *Diana I* installed October 14, 1891. Note the workmen on the lighting fixtures below the sculpture. Photo from W. H. Mullins Co. 1896 catalogue. Right: Illustration of tower opening on November 1, 1891. Published 1891 in *Harper's Weekly*. Drawing by Frank Vincent Dumond

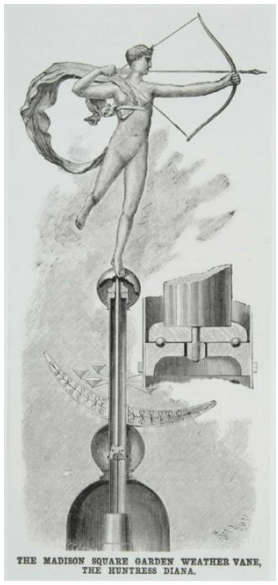
Diana II, 1892–93

A second version (*Diana II,* 13 feet high) was begun by 1892 and the plaster model completed by June 1893. In addition to reducing the sculpture's size, Saint-Gaudens refined the figure and pose and adjusted the drapery.





Left: *Diana II* in the process of being modeled in clay, n.d., in Saint-Gaudens's New York studio. The figure is half its final size. Note the protruding supports for the pipe armature over which the clay was formed. Under her left heel the pipe which provides the main support for the figure is visible. Right: *Diana II,* 13 feet tall, in W. H. Mullins Co. shop, November 1893. Photo from W. H. Mullins Co. 1896 catalogue





Left: *Diana I:* Note arrangement of lighting and mounting pole. Illustration from *Scientific American,* December 26, 1891. Right: *Diana II* was installed on Madison Square Garden's tower

on November 18–19, 1893. Note simplified lighting and reduced mounting. Photograph by Brown Brothers, New York

The original 18-foot and 13-foot plasters, used as the models for the copper sculptures, do not survive. A 6-foot plaster, used as the basis for the enlargement of the figure, is also no longer extant though copies were made from its mold, which no longer survives. The half-scale *Diana* at the Metropolitan Museum of Art (below) was cast in 1928 from a Portland cement version made from the artist's original mold in 1894 for Stanford White (cement cast now in the collection of the Amon Carter Museum of American Art, Fort Worth, Texas). Later 6-foot plasters and bronzes at the Augustus Saint-Gaudens National Historic Site in Corning, New Hampshire, and elsewhere were based on this figure or the mold taken from it, which was later destroyed.



Diana, 1892–93, cast 1928. Bronze, gilt, height: 101 3/4 inches (258.4 cm).
Marking: [foundry mark, base]: P.B. v. Co. MUNICH MADE IN GERMANY
Friessman Baur Foundry, Munich, ½ original size (Metropolitan Museum of Art: Rogers Fund, 1928, 28.101)

Other Versions

Diana was the most popular, most reproduced of Augustus Saint-Gaudens's works. There are at least thirty-two versions smaller than three feet high.





Left: *Diana,* 1889. Bronze, height: 25 inches (63.4 cm) (Smithsonian American Art Museum: Gift of John Gellatly, 1929.8.397) © Smithsonian Institution. Courtesy National Museum of American Art. **Center:** *Diana,* 1893–94, cast 1894 or after. Bronze, height: 28 1/4 inches (71.8 cm). Marking: [foundry mark, back of base]: GRUET Jne FONDEUR PARIS • (Metropolitan Museum of Art: Gift of Lincoln Kirstein, 1985.353). **Right:** *Diana of the Tower,* 1899. Bronze, height: 36 inches (91.44 cm). Inscribed on top of base platform, proper left rear: AUBRY BROS./FOUNDERS, N.Y. (Smith College Museum of Art: Purchased with the Winthrop Hillyer Fund, SC 1900:22-1)

Chronology

1886

Augustus Saint-Gaudens begins work on a marble bust (*Study for the Head of Diana,* Saint-Gaudens National Historic Site, Cornish, New Hampshire) of his model and mistress Davida Johnson Clark (1869–1910), mother of his son Louis P. Clark (nicknamed "Novy"), born 1889. This head would be used as the ideal head of *Diana.* Julia "Dudie" Baird (1872–1932) was the model for the body of *Diana.*





Left: *Study for the Head of Diana*, 1886, by Augustus Saint Gaudens (Saint-Gaudens National Historic Site). Center: Davida Johnson Clark, model for *Diana*'s head. Right: Julia "Dudie" Baird, model for *Diana's* body. Photos courtesy of Saint-Gaudens National Historic Site

c. 1886

Saint-Gaudens creates clay sketch of clothed female archer, possibly used later for *Diana.* [Not extant; photo in Papers of Augustus Saint-Gaudens; see Dryfhout]

1887

McKim, Mead & White receives commission for new Madison Square Garden, Madison Avenue and 26th Street.

1889

July: Old Madison Square Garden demolished; new building is constructed from fall 1889 to spring 1890.

n.d.: Pen-and-ink sketch of a fully clothed ideal female figure with billowing drapery, standing on an orb and blowing a horn. On same page with note from Augustus Saint-Gaudens to Stanford White: "I will start the figure for the tower today." [Stanford White Papers, folder dated 1891–94]

n.d.: Small plaster model for first *Diana* [not extant]. A drawing from it is used for large statue [per letter and photo to Saint-Gaudens's son Homer from architect Lionel Moses in 1909; see photo in Dryfhout]; variant scarf on this same (?) plaster model seen in photo from W. H. Mullins Co. archive [Salem Historical Society] of figure attached to supporting pole.

n.d.: Plaster sketch, no drapery or bow, crescent diadem, 20" (50.8 cm). [Not extant; unique bronze cast, ex coll Stanford White, now Smithsonian American Art Museum; [Dryfhout in 1975 says this is a sketch for the second *Diana* (1893)*;* in 1982 he revises to 1886 as sketch for the first *Diana* (1891).]

1890

June 6: Opening of Madison Square Garden, 17,000 in attendance; tower still not complete.

1891

June 25: First shipment of stamped copper cornices to New York City from W. H. Mullins Co., Salem, Ohio, for main tower. [*Salem Daily News*]

September 9: White writes to Saint-Gaudens that it is not a good idea to unpack *Diana* before she is hoisted above the tower, due to additional costs and labor. Saint-Gaudens wants to see her first.

Mid-September: *Diana* fabricated at W. H. Mullins Co. in Salem, Ohio. Photo of finished gilded sculpture is taken at the Mullins factory. "Diana on view at the cornice shop." [*Salem Daily News*, September 17, 1891]

September 19: "Colossal statue of *Diana*" is shipped from Salem. [*Salem Daily News*]

October 3: White writes that the sculpture's drapery is "stiff as a belt"; wants Philip Martiny to fix it. Expresses doubts about *Diana*'s large size.

October 14: Various newspapers report wrapped *Diana* installed. [Hardin, p. 301]

November 1: *Diana* unveiled at 5:00 p.m. with lights.

November 2: Madison Square Garden's tower is opened to the public. By this time, Saint-Gaudens and White realize that the statue needs to be smaller and lighter.

December 31: White writes to Saint-Gaudens that the Madison Square Garden executive committee has sanctioned the replacement of *Diana* with a smaller one. "New version" announced by *New York Post,* March 17, 1892 [Hardin, p. 324] and *New York Times,* March 18, 1892, p. 8, c. 3.

1892

September 7: Telegram from McKim, Mead & White (dated September 8) says, "*Diana* being taken down."

September 12: *Diana* removed from Madison Square Garden per *New York World* [Hardin, p. 324]. Sent to W. H. Mullins Co. in Ohio for corrections, then on to Chicago for Columbian Exposition. Subsequently destroyed by fires, except for torso and head, which was displayed but not catalogued at Augustus Saint-Gaudens retrospective, Chicago, 1909. [Current location unknown] The head and torso were attached and shown outdoors, on the steps of the Art Institute of Chicago.

October: White directs W. H. Mullins Co. on the engineering of *Diana* for Columbian Exposition, Chicago.

November 1: White wants the plaster of second *Diana* hoisted in the air before enlarging. [Letter to Walthausen]

December 30: White makes arrangements for the plaster to be delivered to the tower for hoisting.

1893

January 5
New York Daily Tribune reports test installation on tower of *Diana* plaster. [p. 7; *New York World* also notes; see Hardin pp. 301, 341]

January 6: Letter from White to W. H. Mullins says, "Mr. Saint-Gaudens is now having the figure enlarged to the original size of the contract."

March 21: From Augustus Saint-Gaudens letter dated March 21, 1893: "The whirl I am in, the concentration of thought necessary for the final emblematic figure in the Shaw monument, together with the indescribable confusion and haste of the completion of the 'Diana' and the 'Columbus' by ten assistants and a removal in the midst of it." [*The Reminiscences of Augustus Saint-Gaudens*, vol. 2, p. 98]

June 16: Discussion of how W. H. Mullins should ship the statue to Salem, Ohio. [Letter from Stanford White to Augustus Saint-Gaudens]

June 19: Stanford White says, "The *Diana* is now ready." Arranges shipment to Salem, Ohio, June 19–24. [*Salem Daily News*]

June 19–24: Shipment of plaster model/pattern of *Diana* to Salem, Ohio. [*Salem Daily News*]

June 26: White accepts Mullins's terms of $1,650 for casting *Diana* "either in aluminum or bronze."

August 23: Letter from White to Mullins regarding the gilding of the figure.

August 25: *Diana* ready to be crated in Salem. (*Salem Daily News*)

November 2: *Diana* "approved by the authorities" in New York. (*Salem Daily News*)

November 6: *Diana* being "gilded today." (*Salem Daily News*)

November 8: *Diana* to be "shipped by special express" to New York. (*Salem Daily News*)

White states to Saint-Gaudens that *Harper's* wants to take photos of *Diana.* About this time, an undated photo shows a gilded *Diana* in the Mullins foundry with twelve workmen and the plaster model in background.

November 13: Samuel West "left yesterday for New York to superintend the erection of *Diana.*" (*Salem Daily News*)

November 18: *Diana* was to be installed but too windy. [*New York Times, New York Daily Tribune*]

November 19: *Diana* is installed on Madison Square Garden's tower.

November 20: Return of West after hoisting *Diana* "yesterday." (*Salem Daily News*)

1899

October 14: Letter to *New York Times* editor says no movement of the vane; possibly at this time *Diana* was fixed in place so she no longer moved with the wind.

1908

Madison Square Garden's *Diana* is shown in photo copyrighted 1908. The scarf is still attached. However, all photos in the source book are dated 1908, so this may be an older photo copyrighted for publication that year.

1925

May 5
Last event in Madison Square Garden. Demolition begins the next day. *Diana* is soon removed from the tower. A photo of her on the ground with rigging and New York University (NYU) dignitaries in *The American Architect,* June 3, 1925. The sculpture is moved to a Brooklyn warehouse for storage.



Diana after removal from the tower of Madison Square Garden during demolition, 1925

n.d.: New York Life Insurance Co. gifts *Diana* to NYU with a stipulation that they reerect the Madison Square Garden tower. By 1931 NYU is not able to raise the money. Other efforts to keep *Diana* in New York are not fruitful.

1932

January: New York Life offers *Diana* to the Philadelphia Museum of Art. The Museum's director Fiske Kimball suggests the possibility of placing the sculpture on the Museum's grounds in Fairmount Park.

February 8: Curator Henri Marceau views *Diana* at Franklin Warehouse in Brooklyn, New York. He reports favorably back to Fiske Kimball and urges prompt action by the Museum's board of trustees to accept the statue.

February 25: Fairmount Park Art Association trustees vote to approve the gift and underwrite its restoration and transportation to Philadelphia.

March 1: Kimball informs New York Life that the Museum's board has accepted the gift and that the Fairmount Park Art Association will underwrite *Diana*'s restoration and transportation to Philadelphia.

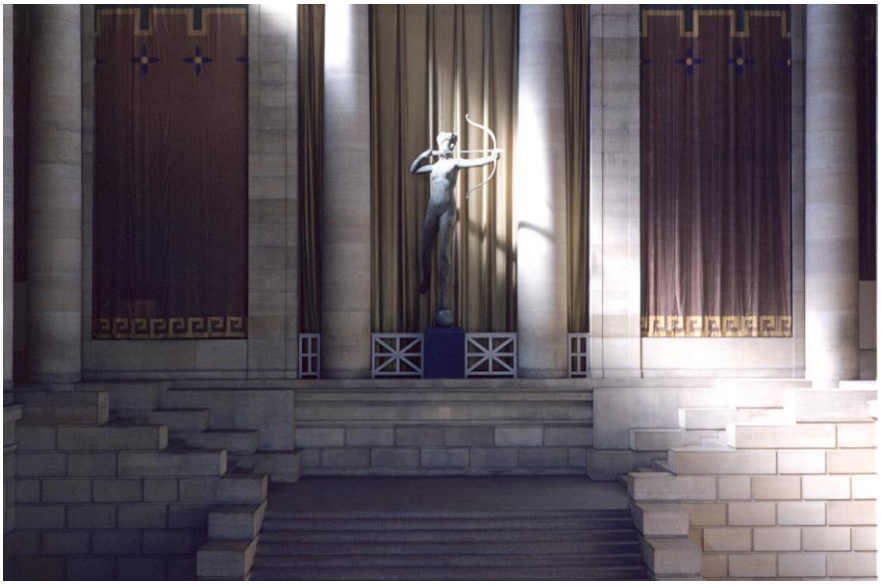
March: *Diana* is transferred to the Roman Bronze Works in Corona, New York, for repairs.



Diana at the Roman Bronze Works being repaired before installation at the Philadelphia Museum of Art, 1931

By April 21: *Diana* is delivered to the Museum. Press release says, "Pending the determination of a permanent site, it will be placed for the time being in the Art Museum on a pedestal at the head of the great staircase. Here it will be seen, as it was designed to be seen, from below, and against the light of a tall western window."

April 30: *Diana* is installed in the Museum's Great Stair Hall.



Initial installation of *Diana* at the Philadelphia Museum of Art, 1931

Notes on Timeline

Period articles and correspondence

Augustus Saint-Gaudens Papers at Rauner Special Collections Library, Dartmouth University, Hanover, New Hampshire

McKim, Mead, and White Papers at the New York Historical Society

Salem Daily News

Stanford White Papers at Avery Architectural and Fine Arts Library, Columbia University

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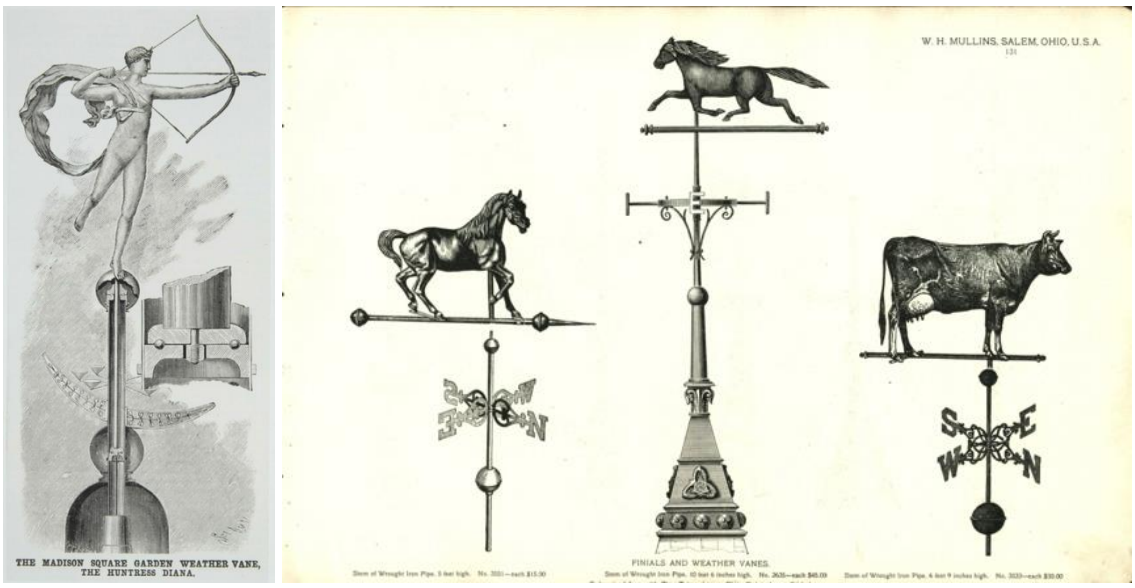
DIANA'S CONSTRUCTION

Design/Engineering as a Weather Vane

Stanford White's design of the clock tower for the second Madison Square Garden featured a functional weather vane at the apex. For this crowning detail, he relied on his friend Augustus Saint-Gaudens to develop and execute a unique and impressive figure that would act as a beacon for the many uses of building itself. How closely they consulted as the forms and gesture of the sculpture came together is not well recorded, but they had already shared a very strong working relationship in previous commissions. The *Diana* that emerged from their collaboration was exceptional in Saint-Gaudens's production: it was his only female nude and one of only two of his gilded sculptures intended for outside installation, the other being the Sherman Memorial in New York City.

To make a sculpture light but strong enough to be moved by wind required an evaluation of the latest metal technologies. The options included the beaten sheet-copper construction of the Statue of Liberty, which had been only recently been established on Bedloe's Island in 1886.



Diana compared with other vanes produced by the W. H. Mullins Co. in the 1890s. **Left:** Illustration from *Scientific American*, December 26, 1891. **Right:** Spread from the company's catalogue, 1896

The use of sheet metal in architecture and sculpture had been developing rapidly over the past decades in Europe and the United States, where the most competitive and innovative firms included: the J. L. Mott Iron Works and the J. W. Fiske Iron Works, both in New York City; the Friedley-Voshardt Co. in Chicago; and the W. H. Mullins Company in Salem, Ohio. The Mullins Company had grown from a relatively small enterprise in the early 1870s to a company with a widely published catalogue and product distribution across North America. For many years, they had produced weather vanes for buildings and barns.

Augustus Saint-Gaudens and Stanford White established contacts with W. H. Mullins and construction of the first *Diana* began, probably in 1890. When the sculpture was placed on Madison Square Garden's clock tower on November 1, 1891, both men almost immediately judged the first version too large and heavy for its site. A second *Diana* was proposed.

Steps in Making the Second *Diana*, 1892–93

In Saint-Gaudens's studio in New York City
1. Remodeling and refining the figure in clay to ½ life size
2. Enlarging the figure in clay to full size, 13 feet
3. Molding and casting the figure in plaster

In the W. H. Mullins Co. factory in Salem, Ohio
4. Creating a series of dies from the plaster in zinc, possibly lead
5. Cutting copper sheet to fit the dies
6. Annealing (heating and then slowly cooling metal to make it stronger) and stamping the sheet, hammering where necessary for joints
7. Fitting and joining the copper by soldering and riveting, attaching the joined sections to a supporting wrought iron armature using rivets
8. Finishing the seams and gilding the copper with gold leaf over an oil size.





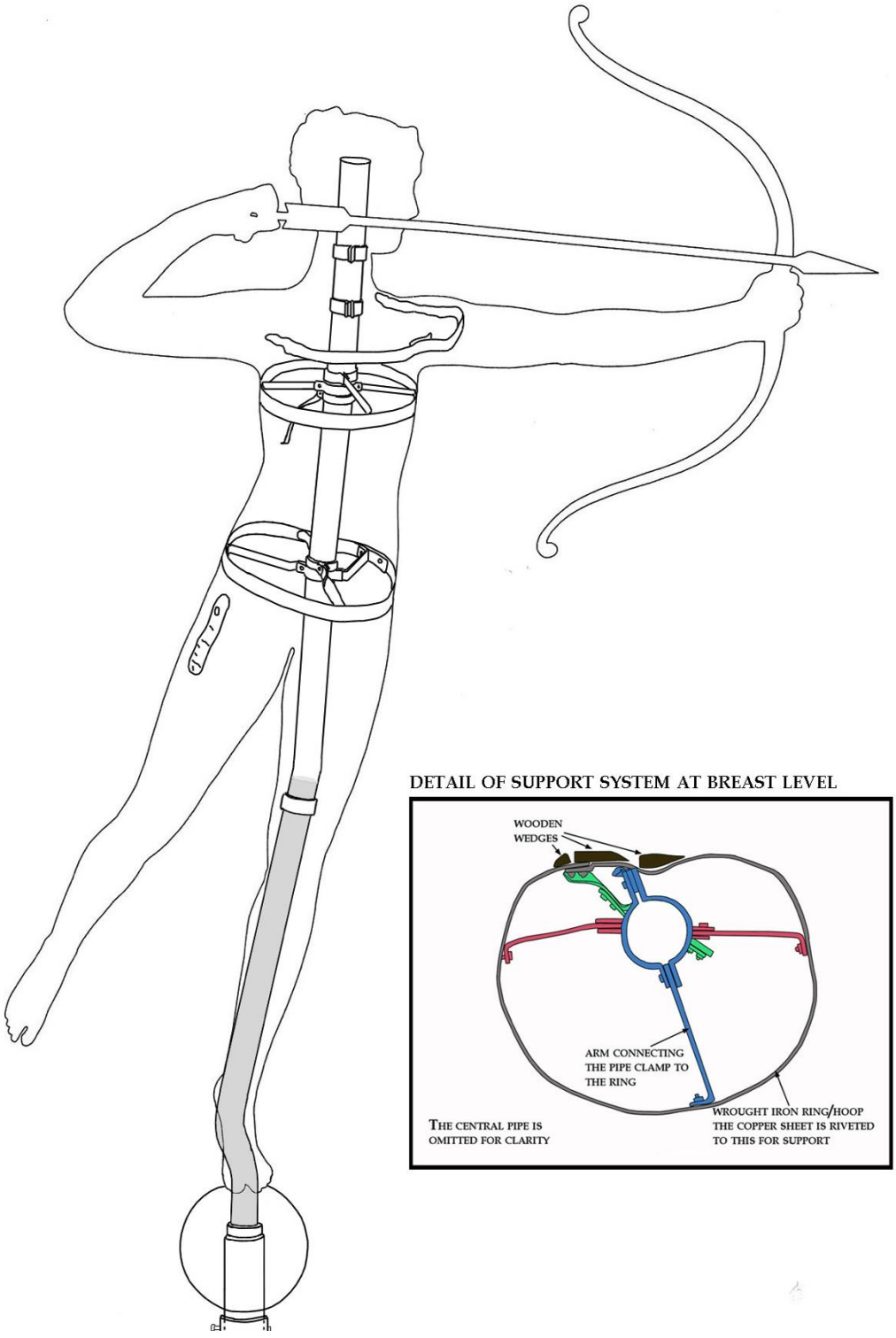
Left: *Diana II* in the process of being modeled in clay, n.d. The figure is half its final size. Note the protruding supports for the pipe armature over which the clay was formed. Under her left heel, the pipe that provides the main support for the figure is visible. This photograph from W. H. Mullins 1896 catalogue shows an interior view of the company's modeling shop. The finished sheet metal sculpture (center) and the plaster model (right) of the second version of *Diana,* 1892–93, are juxtaposed.

Diana's Sheet Copper Construction over an Armature

Made of copper sheet, which is typically 0.020–0.025" thick after forming, large figures required additional support to make them sufficiently strong. Typically an interior armature provided the support. In the case of *Diana*, the armature consisted of a wrought iron pipe that was joined by means of pipe clamps, attached arms, and wrought iron rings to the copper skin. The wrought iron rings were riveted to adjacent copper sheets. The figure itself was composed of 77 copper sheets.



Typical modern pipe clamp



DETAIL OF SUPPORT SYSTEM AT BREAST LEVEL

Structural Investigation with Borescope

Conservators used a borescope to examine inside the sculpture. Interior support structures were found at regular intervals along the height of the central pipe. The maximum depth obtainable within the sculpture was 9′ 2″ (measuring from the top of the head), where there is a solid floor within the leg of the sculpture. This point, 9′ 2″ from the top of the head, corresponds to 4′ above the figure's proper left big toe—the lowest point on the interior of the sculpture. Measuring from this point, there are interior structures located at regular intervals along the height of the central pipe:

• At the bottom, 4′ above the big toe and 9′ 2″ from the top of the head, there is a lot of debris. There is ferrous metal corrosion against the pipe that is suggestive of wrought iron.

• Approximately 5′ above the big toe (1′ above the interior floor) there is another ferrous metal ring around the pipe. Its function is unclear. There is a white fluffy material against the walls that appears also to be nearly opaque to X-rays.

• At approximately 7′, the borescope is just above the crotch of the figure.

• At a few inches above the 8′ mark, the spokes from the lower support hoop attach to the central pipe. They clamp to the pipe in the same manner as riser clamps attach to large-diameter water pipes. The lower riser clamp is at exactly the 8′ mark, the second riser is just slightly above it.

• 9′ above the toe there is a rusted end of ferrous metal arm visible on the lower proper right of the back of the figure. This location is just below the upper ring and is a single support that probably penetrated the back of the figure, roughly in the location of her right kidney, to provide support for the drapery. This is the arm attached to the third ring indicated in the next bullet point.

• A few inches below the 10′ point, the spokes for the upper support hoop are attached. There are three clamps in this location. The upper two clamps support the upper ring, which attaches to the interior of the sculpture just below the bust on the front and, slightly higher, just below the shoulder blades on the back. The lowest clamp has a single strap that extends out toward the region of her proper right kidney, where there is a patch on the copper skin of the sculpture. It is likely that this was another attachment point for the drapery armature. The patch was not removed in this area during the structural investigation.

• 11′ above the toe another riser clamp structure is attached to the pipe; the ends have been cut off. This is oriented such that the ends point front to back and the ends on the front side at the base of her throat. There is a lead patch on the surface at the base of her throat that upon excavation revealed the presence of a washer and rivet (of the sort associated with armature attachment points at the waist and beneath the bust). There is a copper patch on the proper left shoulder blade at the point where the ferrous metal structure previously penetrated the skin of the sculpture. There is a ferrous metal strap against the interior wall of the sculpture that does not appear to tie into the rest of the armature and appears to be severely weathered on one end. The rivet at the base of the throat and the short weathered section of strap are evidence of a third support ring at the height of the shoulders. The ring crossed her back just below the neck, crossed her chest beneath the collarbones, and had squared ends that penetrated slightly

into the arms (the proper left end is mostly intact and extends approximately 6" into the proper left shoulder).

• 12' above the toe, another riser clamp is attached to the pipe and again oriented front to back. This one corresponds to several large repairs in the back of the neck of the figure and appears to correspond to some of the original attachment points for the drapery structure. This was probably one of the locations where the armature penetrated through the back of the neck to support the drapery.

Joining *Diana*'s Copper Sheets

In 1890 there were four common means of joining large sections with lead tin solder. Wires, metal clamps, and clips held the sections together as they were being soldered.

1. Heat the sections to be joined over a fire until the sections reach a temperature where solder would begin to flow at 180–200° C, aided by the use of a blowpipe or blowtorch.



Vintage blowpipes, a blowtorch, and a Turner (US) double nozzle unit for large brazing work

2. Apply a heated soldering iron locally to the seam to be soldered.

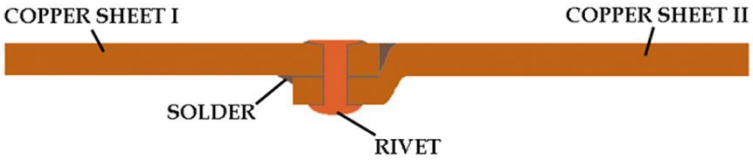


Soldering irons

3. Heat the surfaces to be soldered with a blowtorch or blowpipe.

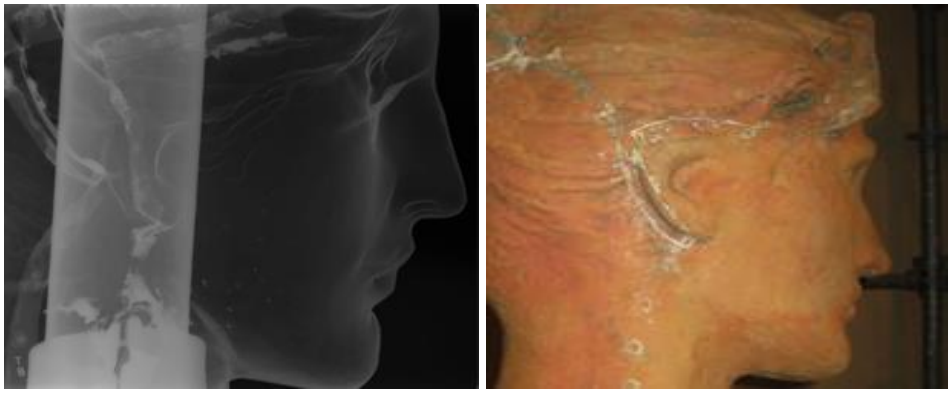
4. First apply solder (pre-tin) to each side of the joint, clamp the pieces together, then warm the sections until the solder flows.

In the Mullins workshops, sheets of copper were soldered and riveted together at the edges. Most of *Diana*'s seams are offset lap joints, which create a continuous surface on the exterior. The rivets sit nearly flush on the surface so as to be as invisible as possible. After the copper was gilded, these seams would be very difficult to see.





Diana: Detail of thin solder seam with rivets
The skill of the Mullins copper workers in fashioning and joining the sections of the sculpture is evident. These joints were only made visible after corrosion was removed. Originally, these joints would have been hidden under gold leaf.



This radiographic image shows thin sheets of copper (light gray) that have been assembled around a wrought iron armature. The whiter portion shows the wrought iron pipe inside the thin copper skin of the sculpture. On the right, joints where sheets of copper are soldered together are evident after cleaning at the top and left edges.

W. H. Mullins Co., Salem, Ohio

The W. H. Mullins Company was established in 1890, when William Mullins bought out his partner in the metal-working business of Bakewell and Mullins. Bakewell and Mullins was, in turn, the successor to the firm of Kittredge, Clark and Co., which had supplied pressed metalwork and architectural components to the Centennial Fair in Philadelphia in 1876.

The pressed-metal decoration for Stanford White's tower at Madison Square Garden (1890–91) were made by the Mullins Company. The Mullins Manufacturing Co. (established 1927) merged with Youngstown Pressed Steel (YPS) in 1937. YPS filed for bankruptcy in 1974; it was purchased by American Standard in 1975, when any extant YPS records were destroyed.

Company Timeline

1872
Kittredge, Clark and Co.
First decorative cornices, sculpture, etc., in Salem, Ohio

January 1, 1875–April 1878
Kittredge Cornice & Ornament Co. absorbed entire plant of the National Ornament Co. of Toledo, Ohio

April 1878
Thompson, Boyle & Co. begun

February 1882
Thompson & Bakewell ended

February 1882–1890
Bakewell and Mullins
"Sheet Metal Statuary and Cornicework"

1890–1904
W. H. Mullins Company
Very much extended plant capacity

December 8, 1904
W. H. Mullins Incorporated

1926
Mullins Body Corporation

—Timeline from Harold Barth History of Columbiana County, 1926



W. H. Mullins Co.'s soldering room. Note charcoal pit in foreground. Photo from W. H. Mullins Co.'s 1896 catalogue





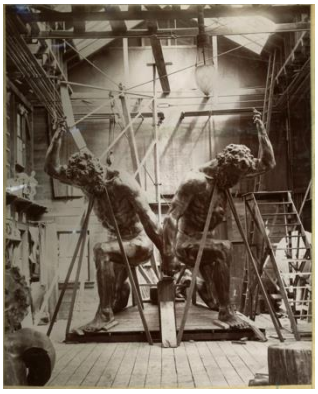
Workers at W. H. Mullins Co. assembling sections (left) and then fitting them together (right). On picture on the right, a joint is being closed. Note hammer in hand of the man on the far right. Photos courtesy of Salem Historical Society





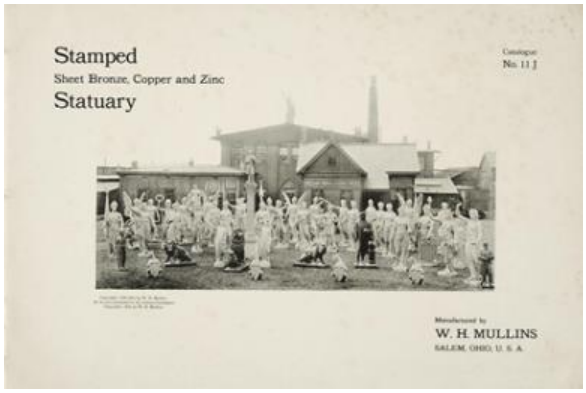
Prior to soldering and riveting (left), and after soldering and riveting (right). Photos courtesy of Salem Historical Society



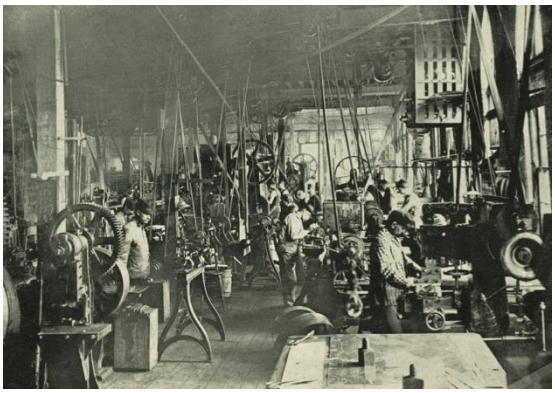
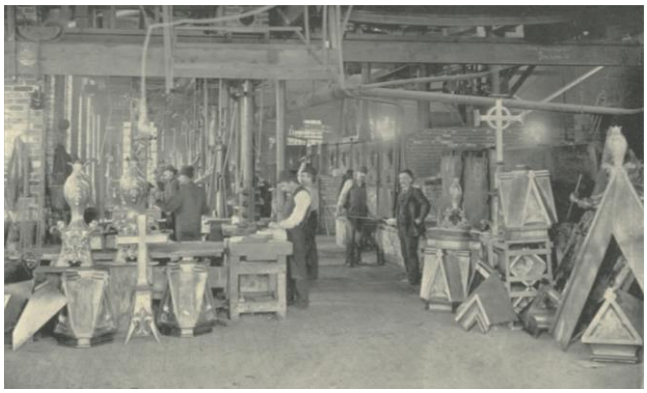


Filing joints after soldering (left, photo courtesy of Salem Historical Society), and joints being finished (center, photo from Mullins Archive). Large multisection figures required support during assembly (far right, photo from Mullins Archive).





1896 catalogue for W. H. Mullins Co. and a page showing sculpture that the company produced for the 1895 Cotton Exposition in Atlanta

Left: View of Mullins shop where sheet copper was cut prior to being formed. Right: This view of the Mullins stamping room shows stamping presses on the left and annealing furnaces on the right. In this shop the copper sheet was formed with zinc dies. Both images From W. H. Mullins Co. 1896 catalogue



Kittredge Cornice Works, fall 1875. Kittredge was the predecessor of the W. H. Mullins Co. This 1875 photo shows the owners and employees at the plant on South Ellsworth Ave., displaying stamped metal work for the buildings at the Centennial Exposition held in Philadelphia in 1876. Photo courtesy of Salem Historical Society, Ohio



A small selection of sculptures made by W. H. Mullins Co. for the Columbian Exposition, Chicago, 1893. From W. H. Mullins Co. 1896 catalogue

W. H Mullins manufactured other gilded sculptures for tops of buildings around the time *Diana* was made, including *The Angel Moroni* by Cyrus E. Dallin and *Progress Lighting the Way for Commerce* by John Massey Rhind.







Left and center: *The Angel Moroni,* completed April 6, 1892, by Cyrus E. Dallin. 12.5 feet high. Installed on the Salt Lake Temple, Utah. Right: *Progress Lighting the Way for Commerce,* 1898, by John Massey Rhind. Installed atop the Ward Building, Chicago, on October 10, 1900

Colossi

In the nineteenth century, there were a number of gigantic sculptures (colossi) erected to demonstrate the engineering power and skill of the makers. Among these monumental structures are: the Statue of Liberty (hammered sheet metal over a wrought iron frame) by Frédéric Auguste Bartholdi, the Hermann Monument (cast bronze) by Ernst von Bandel, *Bavaria* (cast bronze) by Ludwig Michael Schwanthaler, *William Penn* (cast bronze) by Alexander Milne Calder, and *Hermann the Cheruscan* (sheet copper over a wrought iron frame), manufactured by the W. H. Mullins Co. sculptor Alphonse Pelzer, architectural design by Julius Berndt, Sr. Installed at New Ulm, Minnesota, the last on this abbreviated list of colossal sculpture was constructed in 1889 and installed in 1897. 32 feet high, it was not gilded.





Colossi (Gigantic Sculptures)
Top row: Statue of Liberty by Frédéric Auguste Bartholdi, the Hermann Monument by Ernst von Bandel, and *Bavaria* by Ludwig Michael Schwanthaler
Bottom row: *William Penn* by Alexander Milne Calder and *Hermann the Cheruscan* by Julius Berndt, Sr.

DIANA'S 2013 CONDITION AND STRUCTURAL EVALUATION



Diana prior to 2013–14 conservation

Prior to the Museum's 2013–14 conservation treatment of *Diana,* there were open cracks along seams in her left hand and under her chin. Copper was torn along the edge of an early twentieth-century patch in the back of her neck and in three places near her left shoulder and shoulder blade, all of which appear to be metal fatigue. The bottom of the right foot was missing, and the sheet comprising the top of the head was found at the base of the sculpture during examination.

In a number of areas, the copper skin had been disrupted, probably in 1932 to make repairs at a foundry prior to being shipped to Philadelphia. Several of the disruptions have been intentionally obscured with overpainting. The most visible examples were in the back of the neck, in the region encompassing the entire center of the back, left shoulder, and left shoulder blade. These areas had cracks in the metal and obvious solder repairs that have been subsequently covered with matte green material and/or a powdery black material. In the case of the patches in the back of the neck and proper left shoulder blade, these had been added to cover locations where the armature penetrated through the skin of the sculpture and connected to the scarf/drapery. In both locations there is ferrous metal armature that has been cut off just below the surface. These areas were also quite evident from the interior during the borescopic examination.

Two other areas where the surface appears to have been disrupted are on the front of the proper left shoulder (and continuing to the underarm), across the top of her rib cage on the front, and across the middle of her lower back below the shoulder blades where a portion of the scarf was once attached. On her lower back, there are two rectangular patches in the general location of her kidneys. The one on the proper left is either part of the original construction or a very early repair, evident in a photograph dating to c. 1910. The patch on the proper right is probably a later addition. On the proper right side of her torso, from just below her right breast straight down to her hip, the surface has had the same treatment where gold leaf and then

black and green colors were added. It is possible that this seam opened up and had to be resoldered during the 1932 restoration.

Most of the gold that was originally on the surface of the sculpture had eroded off. A few remnants of original gold persisted, primarily on the proper right thigh where overlaps from adjacent sheets are evident. The coating over most of the torso appeared to have also eroded off, leaving corroded copper on the bulk of the surface of the upper half of the sculpture.

A considerable portion of intact coating (ground) used to bond the gold leaf to the copper metal was found over the lower half of the sculpture, including the lower abdomen and legs. On first examination, this coating appeared to be heavy corrosion, but it is, in fact, composed of two layers of matte yellow colored coating that has taken on the green color of the corrosion at the surface.

The yellow "ground" coating was brush applied and in thin areas, where the coating has eroded completely away, corrosion has etched the brush pattern into the metal. Further, spherical voids in the coating have translated into circular pits in the surface of the copper.

There is an open plain weave pattern (resembling burlap) etched into the proper left hip, suggesting that the ground had not yet hardened before the sculpture was wrapped for shipment from Ohio to New York City in 1893.

Disguise of 1932 Foundry Repairs and Overpainting



Square cutout for inspection of proper left ankle and internal support system in 1932. The opening was repaired with lead tin solder, then colored/patinated black, followed by green.



Left: There was damage in an area of the neck, one of several points of attachment for the cape to the internal armature (pipe, pipe clamps, and rings/"hoops"). The 1932 repair consisted largely of lead tin solder. The copper sheet was badly deformed in this area. Center: The same area of damage in the neck (showing extensive solder repairs) after corrosion removal with EDTA (ethylenediaminetetraacetic acid) solution.

Corrosion and Structural Changes



Corrosion and etching patterns from size, textile imprint, Au/Cu couple, before cleaning. The depressions in the surface are due to corrosion attack where gold was lost/did not cover/protect the copper skin. The attack is particularly severe at the edge of losses where the galvanic couple between copper and gold causes rapid corrosion of the exposed copper.



Left: After removal of corrosion and coating, the underlying copper oxide (cuprite, Cu_2O) shows the etched pattern of a fabric that probably pressed into the freshly coated and gilt surface during shipment from Ohio. Right: Very deep etching is observed where names or initials were incised into the copper, probably during installation and after.

Analysis of Original Gold

Twenty-three samples from areas that appear to be original surfaces have been analyzed by SEM-EDS (Scanning Electron Microscopy/Energy Dispersive X-ray Spectroscopy). There is good correlation between the samples. The original gold appears to have been a gold and copper alloy (no or negligible silver) and appears to have been close to 23.25 karats. The most intact portion of the original ground on the surface can be seen on the legs of the figure, and particularly on the proper right thigh, beneath the pattern created by the overlaps in the most intact area of original gilding.

Sample 29	% Au	% Cu		Sample 30	% Au	% Cu
From the outer proper right thigh near the hip				From the proper left thigh between knee and hip		
29a	96.39	3.67		30a	96.46	3.54
29b	96.43	3.57		30b	97.20	2.80
29c	97.14	2.86		30c	97.43	2.57
29d	97.19	2.81				
29e	96.54	3.46				
Avg. Karat: 23.2	96.73	3.27		Avg. Karat: 23.3	97.03	2.97
Sample 31	% Au	% Cu		Sample 32	% Au	% Cu
From the proper left inner leg just above the knee				From the upper proper right thigh on the front		
31.a	96.80	3.20		32.a	97.21	2.79
31.b	97.36	2.64		32.b	96.74	3.26
31.c	96.38	3.62		32.c	97.96	2.04
31.d	96.10	3.90				
Avg. Karat: 23.2	96.65	3.35		Avg. Karat: 23.3	97.30	2.70
Sample 33	% Au	% Cu		Sample 34	% Au	% Cu
From the front of the proper right thigh 1/3 of the way from knee to hip				High on the proper right inner thigh		
33.a	96.46	3.54		34.a	95.02	4.98
33.b	96.43	3.57		34.b	97.24	2.76
33.c	96.55	3.45		34.c	98.16	1.84
Avg. Karat: 23.2	96.48	3.52		34.d	97.65	2.35
				34.e	96.93	3.67
				Avg. Karat: 23.3	96.89	3.11

Loss of *Diana*'s Cape: Legend vs. Photo Record

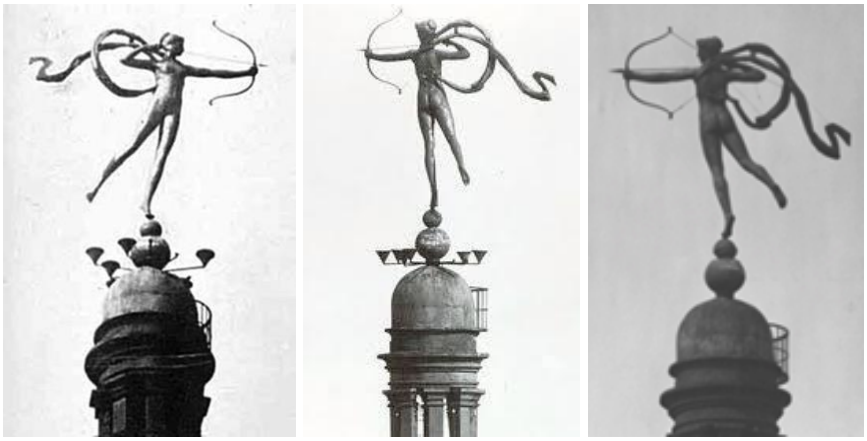
Diana's cape was fabricated at the Mullins factory with instructions and review by Saint-Gaudens, White, and others. It was a necessary component of the weather vane, providing a sail to rotate the sculpture in relatively low winds. Rivet and solder attachments of the copper sheet from the cape to the surface of the sculpture and to the internal armature were stressed by the wind forces atop the building. A letter to the editor of the *New York Times* dated October 11, 1899, complains that the figure is no longer turning, creating greater stress of the cape and leading to localized fatigue and slumping of the cape structure.

As the enlarged image below shows, sections of the cape were guy-wired together at one point, suggesting that if the cape did pull away from the sculpture, it is probable that at least some of the pieces would have remained tied together by the wire, again making the loss easier to see. It is the author's contention that the evidence of wiring—just as the careful and stepwise removal of the lighting fixtures under *Diana*—indicates that regular maintenance was being carried out on the tower. This makes the legend of the cape blowing off in a storm a hard one to accept. When the cape reached the point where it could not sustain the ambient winds, the damaged cape would have been removed, rather than allowed to fail and cause damage or injury. Certainly the loss of such a structure would have been easily observed, as would its impact on adjacent roofs, streets, etc.

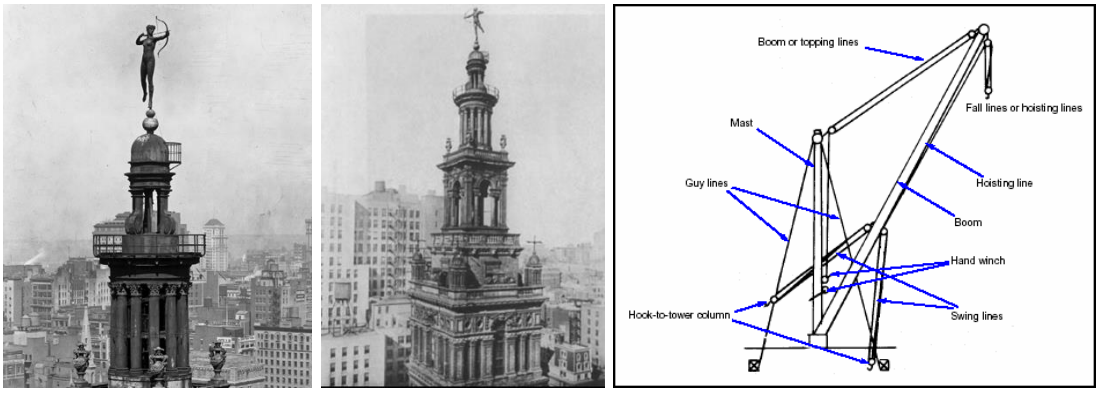


Close inspection of this image indicates that *Diana*'s cape was held together with guy wires.

Photos show an obvious band of modeled drapery below the breasts and a loop over the left shoulder, indicating the remnants of the original anchoring draperies. This detailing was removed or diminished by staff at Roman Bronze Works when they cleaned and restored the sculpture in March 1932. In smaller versions of the sculpture modeled by Saint-Gaudens, all references to drapery were omitted, suggesting that he preferred the piece without the scarf. Stored in a Brooklyn warehouse from 1925 until 1932 when it was sent to the Philadelphia Museum of Art, the drapery was certainly lost by the time the sculpture was examined by Henri Marceau in February 1932. Marceau comments on the loss, but concludes (from seeing the Metropolitan Museum of Art's six-foot version, sans drapery) that "the figure is quite complete without it and I do not think its absence will mar its beauty greatly." [In a letter to A. L. Aiken, February 11, 1932]



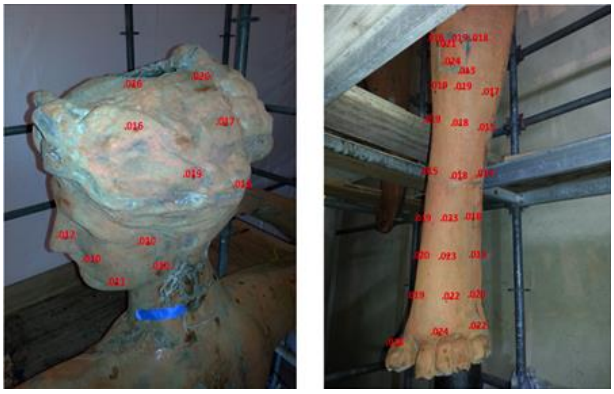
Diana late 1890s. Far right: Diana after removal of lighting



Left: *Diana* after the cape was removed, c. 1915
Center: *Diana* before the demolition of Madison Square Garden in 1925. Note the presence of a derrick crane on the tower.
Right: Derrick crane

Use of Ultrasonic Thickness Gauge to Assess *Diana*'s Condition

An ultrasonic thickness gauge (UTG) was used to measure changes in the thickness of the copper sheet during forming/stamping/hammering. While part of this effort was to document the working of the metal, the measurements were used to ensure that repairs during this project were not carried out on torn or fatigued metal too thin to sustain soldering. Visit http://www.philamuseum.org/conservation/21.html for a behind-the-scenes video on investigation and cleaning tests.



Diana's head and face and left foot



Diana's left arm and right leg

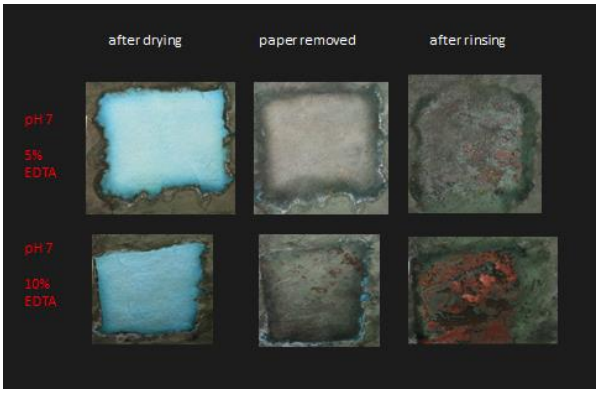
CONSERVATION TREATMENT OF *DIANA*

Tests for Removal of Gold Coating and Corrosion

The complexity, risk, and cost of moving the sculpture argued against taking the sculpture to an off-site location for treatment. Fortunately, procedures required to remove the deteriorated gold size and corrosion from the surface were implemented with very low toxicity. Rather than organic solvents being used to strip the gold size/coating from the copper substrate, it was found that solutions containing ethylenediaminetetraacetic acid (EDTA) were effective at removing both the coating and the corrosion. Solutions of varying concentration (3%, 5%, and 10%) and pH (6.5, 7, 8, and 9) were compared. The tests were repeated at different parts of the sculpture to ensure that the cleaning rate and net result were similar and controllable.

An initial treatment with 10% EDTA at pH 9 proved most controllable, followed by a 10% solution at pH 7 as needed until the desired level of cleaning was attained. The reaction products on the copper surface were removed with soft paper toweling, rinsed with a wet synthetic sponge, wiped dry with soft cloth toweling, then cleaned with low pressure steam, wiped, and dried in advance of coating.

Visit http://www.philamuseum.org/conservation/21.html for a behind-the-scenes video on *Diana*'s physical and chemical analysis.





Treatment method: EDTA, steam, scrub; reapply as needed, thoroughly steam clean at conclusion.




Left: Application of solution, covered by soft (white) paper to retain EDTA solution
Right: Paper being stripped after EDTA solution has reacted on surface



Before initial rinsing, this image shows residual ground layer.

Desoldering and Resoldering of Old Repairs

There were three locations where the armature was attached through the skin the cape: in the back of the neck, at the top of her left shoulder blade, and in the approximate location of her right kidney. For the neck and shoulder locations, it is likely that when the cape was removed, pieces of copper were soldered over the openings. Rather than having been patched with a single piece of formed copper sheet, the neck repair was made from three overlapping pieces of copper with rough, broken edges. Given the nature of these old repairs, it seems likely that they might be field repairs undertaken at the time of the removal of the cape.

The patch in the lower right of her back is a carefully cut square, located beneath where the copper sheet of the scarf was soldered to the surface of the sculpture. It is likely that this patch was installed in 1932, when Roman Bronze Works removed the remains of the scarf.

The patches on the back of the neck and at the top of the left shoulder blade were reversed and resoldered for both structural and aesthetic reasons. In addition, there were three areas that had to be soldered on the back of the left shoulder, where the copper had cracked owing to metal fatigue.

The patches on the back of the neck were removed with a small butane torch and a wire brush. The area was first prepared by coating it with a slurry of yellow ocher to prevent solder from

sticking to the adjacent metal surface. The metal was then heated and the solder was removed with a wire brush as it softened.

Once the patches and the excess solder had been removed, the interior of the sculpture in the immediate vicinity was examined and photographed. The metal around the hole was then straightened using pliers, hammers, and purpose-built dollies.

The stress cracks in the back of the shoulder were then repaired because the removal of patches in the back of the neck provided access to the interior. Dollies were inserted through the neck to support the interior metal surface so that creases on the shoulder could be reshaped with hammers. Once the cracks were properly aligned, they were soldered together with lead-tin solder.

The interior surface of the copper was then cleaned mechanically around the perimeter of the neck opening, fluxed, and pre-tinned with lead tin solder. A new piece of copper was cut to size, shaped, and pre-tinned with lead tin solder. It was then fit into the opening and soldered to the interior surface of the sculpture, providing a support on which to place the original patch pieces. The original patches were trimmed down so that they fit together without overlap and soldered back in place. Seams were slightly overfilled with solder and smoothed mechanically.

When the patch was removed in the region of the left shoulder blade, it became evident that the copper had been folded back rather than removed when the armature had originally been passed through this location during fabrication. Once the patch and excess of solder had been removed, it was possible to anneal this metal and use it to cover the hole rather than reapplying the patch in this area. The seam was again slightly overfilled with solder and the surface was finished mechanically as above.



The left image shows the back of the neck before treatment. Note the horizontal crack. The middle image is after EDTA cleaning and reveals that the cracks are more extensive than was initially visible and that they follow the solder joints. The image on the right shows the opening in the back of the neck after the patches had been removed and excess solder cleared away. The metal pieces inside the hole are the cut-off ends of the pipe clamp that attaches to the central pipe in the armature. The yellow around the perimeter is yellow ocher, applied to keep solder from re-adhering to adjacent metal when it was heated.

REGILDING *DIANA*

Aesthetic Considerations: Interior vs. Exterior Gilding

Saint-Gaudens made smaller versions of *Diana* almost immediately after completing the 13-foot sculpture, several sizes with both "bronze" and gilded surfaces and on different mounts. As an example, the medium-size (28") *Diana* at the Metropolitan Museum of Art was cast in bronze in Paris. "The matte gold-colored patination, composed of gold, copper, and zinc, was applied by the electroplating process. The rich tone alone is a testament to Saint-Gaudens' concern with the finishing and patination of his pieces." [Thayer Tolles, the Metropolitan Museum of Art's website, and similar comments in 1999 catalogue] Toning is absent from this interior piece.

Examples of intact exterior gilding treatments by Saint-Gaudens are not known, but gilded works of his that remain in interior collections all have had some amount of toning applied to the gold surfaces. The Victory bronze in the Met's collection, although a posthumous production, was ordered through the efforts of Daniel Chester French and created under the direction of Saint-Gaudens's widow, and one assumes the toning reflected their understanding of his wishes. In correspondence with French, Saint-Gaudens expressed a preference for dark toning on gilded sculpture. Examination of several posthumous gilded interior bronzes at the *Met* revealed brownish toning layers, sometimes heavily applied.

Saint-Gaudens on Gilding

In Homer Saint-Gaudens's biography of his father, he states that Augustus was "sick of seeing statues look like old stove pipes." This certainly informed his decision to gild the Sherman sculpture, which was double-gilded at the sculptor's own expense to prevent darkening and surface deterioration of the bronze casting. Saint-Gaudens "had always spent a lot of time over the color of his productions, struggling to obtain the proper 'mat' upon their surfaces either by paint or acids or gold leaf" [cf. Homer Saint- Gaudens, *The Reminiscences of Augustus Saint-Gaudens,* p. 294). In an 1899 letter to Stanford White, Saint-Gaudens noted that his small, gilded *Diana* could be "improved by using a little burnt sienna paint mixed with turpentine," rubbed on the surface, and then partially wiped off.

General Procedure for Regilding *Diana*: Priming Layers, Gold Size, and Gold Leaf

Green corrosion developed in the immediate regions of the new solder joints as a result of residual chlorides from flux applications. These areas were laser cleaned using a Cleanlaser CL20Q 20Watt ytterbium fiber laser with a scanning optic. The laser was used at full power and a focal distance of 250mm. Scan rate, pulse rate, and scan width were all varied during the cleaning.

The sculpture was then brush coated overall with Randolph Products MIL-C-8514C yellow wash primer, allowed to dry, then touched up. [This coating is primarily PVB, and is mixed 4:1:1 with a phosphoric acid diluent and an isopropanol containing denatured alcohol.] Next Randolph Products TT-P-1757B yellow zinc-chromate primer was brush-coated and allowed to dry and touched up. Surface dents and defects that had not been visually distracting before the primer application became obvious after this step. Many of these on the back, neck, abdomen, and legs were filled with Milliput epoxy putty and allowed to harden. The surface was sanded smooth and the primer touched up in these areas. The zinc chromate paint was then tinted with

ProLine Universal Colorants color PL-14 RED to make an orange that more closely resembles the original red gold leaf identified on the surface of the sculpture. This was brush applied overall, allowed to dry, and touched up. The sculpture was then gilt overall using LeFranc Mixtion twelve-hour gold size and 22 gram 23.4K red gold (there is no silver in this alloy), which is the closest available custom alloy to the 23.2 or 23.3K identified in SEM analysis.



Left: *Diana*'s neck after it received its second coat (of three) of primer. It was then repatched using the original's copper patches, the seams filled and chased, and any small cavities filled with epoxy putty before receiving a final layer of primer. Right: Gilt surface prior to receiving its final matting.

Several additional surface defects were identified after gilding, particularly on the legs. These areas were filled with Milliput, sanded smooth, reprimed with Zn-Cr primer, resized, and regilt. Several solutions were prepared and tested to matte down the surface. Binders tested included Aquazol 200, Klucel GF, and gum Arabic. Matting was done using fumed silica. Colorants tested included gouache paint in lamp black and burnt sienna, and black fabric dye. All colorants were rejected for aesthetic reasons. Gum Arabic was chosen as the binder as it is readily reversible with minimal damage to the gold leaf.

The surface was spray coated with fumed silica in gum Arabic. The concentrations varied but range from approximately 2–4% gum Arabic and as much as 3% fumed silica (w/v). The ideal solution is 2% fumed silica in a 2% solution of gum Arabic in 90:10 water:ethanol.

As a final step, lighting was adjusted and new fixtures installed to provide more illumination for the sculpture. Visit http://www.philamuseum.org/conservation/21.html for behind-the-scenes videos about *Diana*'s transformation.

Before and After Photographs

Changes in *Diana*'s appearance are illustrated in the following before and after images.

