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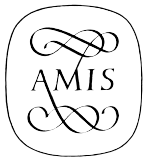

An Unfolding Tale: the Making and Transformation of the Decorative Elements of the Golden Harpsichord*

Pascale Patris and Adriana Rizzo

The seventeenth-century Baroque harpsichord in the collection of Musical Instruments at the Metropolitan Museum of Art in New York (MMA) (fig. 1) is commonly referred to as the Golden Harpsichord, due to its highly sculptured decorative surfaces covered in gold. It is a masterpiece of craftsmanship and one of the finest and most dramatic examples of Roman Baroque decorative art. The Golden Harpsichord is also the only surviving identified musical object from a long-defunct private museum in Rome known as the *Galleria Armonica*.[1] Situated in Via dell'Arco della Ciambella, this collection of musical instrument and automatons was conceived and created between 1650 and 1673 by Michele Todini, a trombonist and organist who held an administrative post in the Congregazione di Santa Cecilia, a highly respected music academy in Rome.

The composition of the Golden Harpsichord is dominated by the iconographic depiction of the myth of Polyphemus and Galatea as told by the Hellenistic and ancient-Rome tradition. The life-sized figures are beautifully carved, and the spirit that animates especially the two main figures of Polyphemus and Galatea, and their drapery, is reminiscent of works by some of the greatest sculptors of the period, such as Lorenzo Bernini (1598–1694), Domenico Guidi (1625–1701), and Alessandro Algardi (1598–1654).[2]

* We thank Mark T. Wypyski, Federico Carò, and James H. Frantz in the Department of Scientific Research, whose analytical work greatly contributed to this study. Thanks also to J. Kenneth Moore and Jayson Kerr Dobney in the Department of Musical Instruments. Thanks also to Susana Caldeira and Marijn Manuels in The Sherman Fairchild Center for Objects Conservation for their helpful assistance.

1. Patrizio Barbieri, "Michele Todini's Galleria Armonica: its hitherto unknown history," *Early Music* (November 2002): 572. See also Herbert Heyde, "Todini's Golden Harpsichord Revisited," *Journal of the American Musical Instrument Society*, this volume: 5.

2. Before the publication of a contract dated August 6, 1665 naming Jacomo Reiff as the carver (see note 3), Emanuel Winternitz, curator for musical instruments at The Metropolitan Museum of Art from 1941 to 1973, considered the carving to be the work

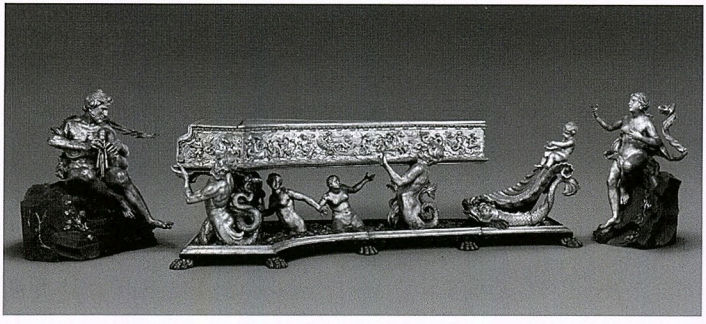

FIGURE 1. The Golden Harpsichord. Dimensions: case: L. 299.7 x W. 96.5 x D. 37.5 cm (118 x 38 x 14 ¾ in.); Polyphemus: H. 152.4 x W. 132.1 x D. 127cm (60 x 52 x 50 in.); Galatea: H. 144.8 x W. 119.4 x D. 88.9cm (57 x 47 x 35 in.). The Metropolitan Museum of Art, The Crosby Brown Collection of Musical Instruments, 1889 (89.4.2929 a–e). Reproduced with permission, The Metropolitan Museum of Art. See color photo p. 190.

According to a contract dated 1665,[3] the sculptor of the wooden figures and frieze was Jacomo Reiff (1627–1700),[4] a Swiss carver working in Rome, while the gilded surfaces were by Basilio Onofri.[5] In this contract Todini stipulated that the work be "completed in gold" except certain parts which had to remain ungilded. From the decorative standpoint,

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of Alessandro Algardi's workshop. Olga Raggio, former curator in the Department of European Sculpture and Decorative Arts from 1971 to 2001, suggested the circle of Algardi, perhaps his pupil Domenico Guidi (1625–1701) or Ercole Ferrata (1610–1686). Alessandro Angelini, *Baroque Sculpture in Rome.* Gallery of the Arts Series 5. Milan Five Continents, (2005). Sylvia Pressouyre, "Sur la sculpture a Rome autour de 1600," *Revue de l'Art,* no. 28 (1975): 22–75. The 1665 contract was first published by Patrizio Barbieri in 2002, cf. Patrizio Barbieri (2002).

3. The contract, dated August 6, 1665, was signed by Michele Todini, Jacob Reiff, and Basilio Onofri (file attached to 30 Not. Cap., uff. 2, vol. 255, 23 Dec 1669 Archivio di Stato, Rome); also cited in note 26 in Patrizio Barbieri (2002): 572, 581.

4. Patrizio Barbieri reports that Reiff was born in Salzburg, Austria. Patrizio Barbieri (2002): 572. However, an email dated June 15, 2011, addressed to the Department of Musical Instruments at The Metropolitan Museum of Art from Gerard de Reiff, his descendant, clarifies with supporting documents that Jacob Reiff was born in Fribourg, Switzerland, on May 14, 1627, and died in Rome in March 1700. Thanks to Gerard de Reiff and J. Kenneth Moore, Frederick P. Rose Curator in Charge, Department of Musical Instruments, for sharing this information.

5. Patrizio Barbieri (2002): 572.

the current ornamented elements of the Golden Harpsichord fit with Todini's description. However, all decorative surfaces have been extensively restored. The ensemble has long been a subject of controversy for both the iconography and the authenticity of some of its elements. Previous studies have focused on the harpsichord as a musical instrument and on its original installation in the Galleria Armonica. The present essay attempts to clarify some of the issues regarding the history and display of the ensemble, based on evidence gathered from a detailed investigation of its construction and decorative surfaces, and ultimately, attempts to elucidate how the Golden Harpsichord evolved from the time it was made as a musical instrument to its transformation over the centuries into a highly praised decorative object.

The opportunity to carry out a technical study came in 2009 when a condition assessment of the harpsichord was required by the Department of Musical Instruments at the MMA in connection to a loan request and for its subsequent re-installation in the Museum's gallery devoted to Western musical instruments. On this occasion, the installation of the Golden Harpsichord was disassembled for conservation and technical study. For the first time, visual observations were completed by X-ray radiography of the sculptural elements, along with material analysis of their decorative surfaces.

Provenance / history

The only record of the original installation in situ of the Golden Harpsichord is described by Michele Todini in the 1676 publication of his *Dichiaratione della Galleria Armonica.*[6]

> In the second room is represented the story of Polyphemus with a number of statues covered in gold and among others is Galatea, who is shown passing through the sea carried by two dolphins harnessed by a cupid, while she sits in a seashell with sea nymphs paying court, and served by large, life size tritons who carry a harpsichord, the case of which is rich with carvings representing, in bas relief covered with gold, the triumph of the above mentioned Galatea with a marine procession that offers up in tribute diverse fruits of the sea. Polyphemus is seated on the slope of a mountain in which he lives, as the story relates, in the act of playing a sordellina or musetta in order to please Galatea; and within the said mountain is found the device to make the tones of

6. Michele Todini (1676) and Patrizio Barbieri (1988). Patrizio Barbieri, ed., *Dichiaratione della Galleria Armonica eretta in Roma da Michele Todini, per Francesco Tizzoni, 1676* (Rome: Libreria musicale italiana, 1988), 5–7.

the sordellina, which sounds with a keyboard placed under that of the already mentioned harpsichord. The statues are made by worthy men, as are also the other materials, which were used for either the sea, or the mountain or the air. The machine takes up the space from floor to ceiling.[7]

There are a number of speculations about the case and the instruments it contains. It has been reported that the case was modified to accommodate a longer instrument than that originally conceived.[8] The discussion of the changes related to the case and the harpsichord as an instrument requires a dedicated publication by specialists in the field of musicology and conservation of musical instruments.

The present paper deals with controversies to the configuration and decoration of the ensemble. In particular, one of the most significant controversies to the ensemble relates to the position and authenticity of Galatea, who is sitting on a rock as opposed to "in a sea-shell" as described by Todini, and the sculptor Jacomo Reiff. The 1672 payment record details Reiff's carving work, including the frieze and each sculptural element, and clearly mentioned: "Galatea herself, the shell she sits on."[9] The earliest documents describing Galatea on the rock rather than

7. "Nella seconda stanza si vede rappresentata la favola di Polifemo con molte statue messe á oro, e trá le altre Galatea, che mostra passeggiar per il mare portata da due Delfini da un Cupido, sedendo lei in una Conchiglia cortegiata da Ninfe marine, e servita da Tritoni grandi al natural, che li portano un Cimbalo; la cassa del quale è ricca d'intagli, rappresentante, in basso rilievo pur messo á oro, il Trionfo di detta Galatea, con Mostri marini, che li porgono per tributo diversi frutti di mare. Polifemo siede all falde d'un monte, nel quale há la sua habitazione, come dice la favola, in atto di sonare una Sordellina, ò Musetta per compiacere a Galatea; e dentro al detto monte stanno le Machine per far sonare la detta Sordellina, quale si suona con una tastatura posta sotto á quella del giá nominato Cimbalo. Le statue fono fatte da valét'huomini, come anche tutti gl'altri materiali, quali sono secondo richiede l'opportunitá di rappresentare, ò mare, ò monte, ò aria. Detta Machina occupa da terra sino al soffitto." Michele Todini (1676) (1988), 5–7. The English translation is by the authors, elaborated from that of Wendy Powers, "The Golden Harpsichord of Michele Todini (1616–1690)," *Heilbrunn Timeline of Art History* (New York: The Metropolitan Museum of Art, 2000). http://www.metmuseum.org /toah/hd/todi/hd_todi.htm (October 2003).

8. Pollens gives a detailed description of the case structure and alterations based on visual examination. Stewart Pollens, "Michele Todini's Golden Harpsichord: An examination of the machine of Galatea and Polyphemus," *The Metropolitan Museum Journal* (New York: The Metropolitan Museum of Art, 1990): 38–41.

9. This document, dated March 28, 1672, details Reiff's carving work, including the frieze and each sculptural element (30 Not. Cap. uff. 28 [not. succ. Rignani], vol. 331, Archivio di Stato, Rome). Patrizio Barbieri (2002): 573. It reads:

"[. . .] a conto delli lavori d'intaglio e statue, che servono per adornamento della machina della sordellina sopra tasti del cimbalo, et d'un orologio novamemte inventato dal medesimo Sr. Todini, qual adornamenti e statue sono Trionfo di Galatea fatto

on the shell in the installation of the Golden Harpsichord are archival letters dated 1825.[10] This same configuration is also reflected in the terra-cotta piece first juxtaposed with the Golden Harpsichord in 1878 (fig. 2). The date of the terra-cotta work has been subject of speculation; it is unclear whether it is a working model for a sculptor or a simplified reproduction.[11] The terra-cotta composition representing the Golden Harpsichord may reflect a new arrangement of the main figures on the rocks at a given time after 1676.

Another speculation concerns the possibility that the cavities inside the figure of Polyphemus and the rock, on which he is seated, once accommodated pipes and levers belonging to an organ mechanism imitating the sound of the sordellina.[12] This organ would have been hidden

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per la cassa del cimbalo, statua d'essa Galatea, conchiglia dove siede, delfini, amorino, come statue di tritoni, marina et la statua di Polifemo, che siede nel monte, et la statua del Pellegrino per l'orologio, il tutto posto, e consegnato dal detto Sr. Jacomo nella mia casa, che abito all'Arco della Ciambella." English translation, also in Barbieri (2002): 573: "[. . .] on account for the work of carving and for the statues needed to adorn the machine of the *sordellina* equipped with harpsichord keys and for a clock (that of the Pilgrim) newly invented by the same Signor Todini; such adornments and statues consist of the *Triumph of Galatea* made for the case of the harpsichord, the statue of Galatea herself, the shell she sits on, the dolphins, the Cupid, as well as statues of Tritons, the sea and the statue of Polyphemus who sits on the mountain, and the statue of the Pilgrim for the clock, all which assembled and delivered by the said Signor Jacomo to the house where I live at the Arco della Ciambella."

10. Details of the 1825 correspondence between Vanetti and Galeffi are in Patrizio Barbieri (2002): 580.

11. The *modello*, now at the Museo Nazionale del Palazzo di Venezia in Rome, was formerly part of the collection of terra-cotta "bozzetti" of Evangelista Gorga. Maria Giulia Barberini. *Sculture in Terracotta del Barocco Romano: Bozzetti e modelli del Museo di Palazzo Venezia* (Rome: Fratelli Palombi Editori, 1991), 14–20. In 1956 the *modello* was attributed to Ludovico Gimignani (1643–1697) by the scholar Antonino Santangelo. Its function as a preparatory model has been accepted by later scholars. Maria Giulia Barberini, Davide Fodaro, Alberto De Santis, Elisabetta Mattei, and Claudia Pelosi, "Model of the Todini Harpsichord," *Marvels of Sound and Beauty: Italian Baroque Musical Instruments*, Franca Faletti, Renato Meucci, and Gabriele Rossi-Rognoni, eds. (Florence: Firenze Musei, Galleria dell' Accademia, 2007), 122. Cristiano Giometti. *Museo Nazionale del Palazzo di Venezia: sculture in terracotta.* Vol IV (Rome: Gangemi, 2011), 62–3. On the contrary, Patrizio Barbieri hypothesized that the terra-cotta piece is a late eighteenth or early nineteenth century replica. Patrizio Barbieri (2002): 565–582. Patrizio Barbieri, "Michele Todini. Dichiaratione della Galleria armonica eretta in Roma [. . .] Roma, per Francesco Tizzoni, 1676." *Roma Barocca. Bernini, Borromini, Pietro da Cortona.* Marcello Fagiolo, Paolo Portoghesi, eds. (Milan: Electa, 2006), 304–5. A recent study of the polychrome surfaces did not provide clarification on the dating and nature of the terra-cotta work. Maria Giulia Barberini, Davide Fodaro, Alberto De Santis, Elisabetta Mattei, and Claudia Pelosi (2007), 121–126.

12. The *sordellina* is a bagpipe playable through the action of a bellows, very similar to the eighteenth-century French *musette.* It was fashionable in Italian aristocratic

FIGURE 2. Terra-cotta *modello/* replica of the Golden Harpsichord, collection of the Museo Nazionale del Palazzo Venezia, Rome, Italy. Photo with permission.

within the mountain, as mentioned by Todini. It is also speculated that the current spine of the instrument's case may not be original.[13] In consideration of all these controversies and speculations, it is important to compare historical records with observation gathered during the study in order to understand the possible transformation of elements within the harpsichord.

The timeline of the most relevant facts in the history of the Golden Harpsichord is accurately described by Barbieri,[14] highlighted in figure 3. It starts with the creation of the Galleria Armonica in Rome in 1650, and the description of the Golden Harpsichord by Todini and Reiff. In 1690, following Todini's misfortune and ultimately his death, the Marchese Verospi, among his creditors, relocated the Galleria Armonica to Palazzo Verospi. It is probably as a consequence of this move that, for the first time, the original installation may have been modified to fit within the new space.

In the eighteenth century the content of Palazzo Verospi was moved to Palazzo Bolognetti, and was then sold from the last descendant of the Verospi family to Carlo Alessandro de Vaux of Brussels. Since the 1796 inventory, the Golden Harpsichord is the only musical instrument traced back to the Galleria Armonica. In 1859 the Golden Harpsichord was sold to the Count de Sartigues, who was French Ambassador in Rome from

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circles, especially in the first half of the seventeenth century. Patrizio Barbieri (2002): 569.

13. Stewart Pollens (1990): 36.

14. Patrizio Barbieri (2002): 565–582.

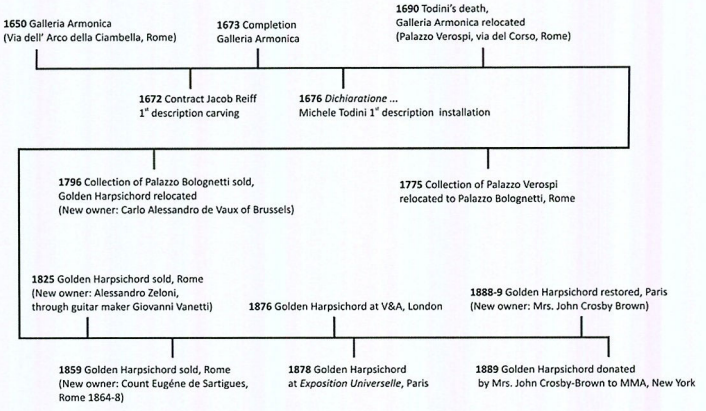

FIGURE 3. Timeline of history and provenance.

1864 to 1868. In 1876 the Golden Harpsichord is displayed first at the Victoria and Albert Museum in London and then in 1878 in Paris at the *Exposition universelle*. The ensemble was restored in Paris in 1888.[15] Under the new owner, Mrs. Crosby Brown, the harpsichord was then displayed at the 1900 *Exposition universelle* in Paris and ultimately entered the collection of the MMA in 1902 as a part of Mrs. Crosby Brown's donation of her entire collection of musical instruments.

These vicissitudes, which included much relocation with periodic disassembly, change of ownership, and requirements for display at exhibitions, have all contributed to the transformation of the harpsichord from a playable instrument to a decorative object.

Construction / Assembly

The Golden Harpsichord is constructed in the traditional Italian manner, with a thin-walled instrument case, housed inside a finely decorated

15. The year of restoration is supported by fragments of a Paris newspaper embedded in the plaster used to repair the carving of the base, discovered during a later restoration by Louis Saint-Lanne. Letter dated January 23, 1904, written by Mr. F. Edwin Elwell of the Department of Ancient and Modern Statuary to Mr. John Crosby Brown. Stewart Pollens (1990): 47.

outer case.[16] X-ray radiography confirmed a very simple assembly of the case and helped clarify the construction of the frieze and the lid. The frieze is made of three panels, carved separately, glued to the bent side and later further secured with nails. The lid is made of a solid wood panel with substantial woodworm damage, visible in radiographs. Presumably as a result, the weakened panel was reinforced on the underside with parallel thin planks, butt-joined together. This treatment also prevents the deformation of the gilded lid that can result from fluctuations in relative humidity. Despite the additional information obtained using X-ray radiography, assessment of the case is challenging because of the various restoration campaigns over the years. These are reflected in the structural alterations and the treatments of gilded surfaces. X-ray radiographs show that all sculptural elements have been affected by woodworm infestation, consistent with damage found throughout the ensemble, including the base.

Three large sections comprise the base, joined with wooden pegs (fig. 4). It is supported by lion's feet of cast metal, with the exception of one that is made of wood. The sea over which the figures carry the harpsichord is made of an assemblage of carved wood fixed to wooden supports, reinforced on each side by wooden rails. The condition of their assembly is fragile and vulnerable due to the poor construction of the base, which has been reinforced over time with additional wooden cleats and numerous nails. Transverse blocks of wood were added on the underside in 1904 to strengthen it and help support the weight of the harpsichord's elements.[17] The figures and the dolphins are inserted between the waves and fixed to the base with metal rods penetrating the wooden substrate and secured from below with hand-fastened wingnuts. On the basis of their close-fitting positions within the waves, the figures, and particularly the load-bearing Tritons, seem to have retained their original placement and orientation while the attachment of the shell to the dolphins with screws is clearly a later intervention (fig. 5). The shell is secured onto the base with a large flexible iron spring of unknown date that may have been used to give an impression of movement of the shell on the waves.

X-ray radiography reveals that all sculptural figures, including the dolphins and the shell, each have been carved from an assemblage of wood glued together. It also reveals a multitude of early square-section iron

16. Stewart Pollens (1990): 38–41.
17. Refer to note 15.

FIGURE 4. Cross-section detail of the base showing the assembly of wooden parts, including the waves and the figures. Visible is the hole for the wooden peg for joining another platform section of the base. Photograph by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art.

nails used for the joinery, which over time were supplemented with an assortment of fasteners of more modern manufacture. The torsos of Galatea, the tritons, and the sea-nymphs were also assembled from multiple blocks, with smaller pieces added to form the arms, hands, heads, tails, and draperies.

In the present study no compelling evidence was found to challenge the authenticity of the figure of Galatea. X-ray radiographs show consistent wood anatomy and nail typology in Galatea and the other sculptural elements (fig. 6); this includes the back triton and the cupid where the characteristic wood growth pattern is more obvious (fig. 7). Although not conclusive in itself, wood samples from Galatea's body were identified as limewood (*Tilia* spp.),[18] which is commonly used in Southern

18. Identification of the wood was carried out by microscopic analysis of thin sections by Paolo Dionisi Vici, Associate Research Scientist, Department of Scientific Research, The Metropolitan Museum of Art. Two samples were taken from exposed wood on Galatea's arm and shoulder.

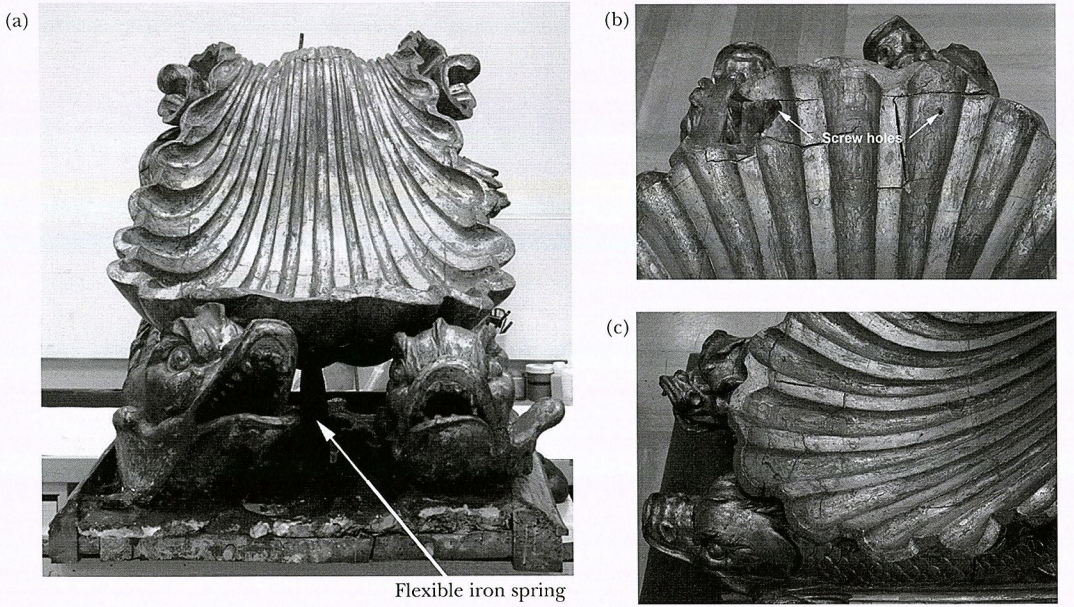

FIGURE 5. (a) Attachments of the shell to the sea with a flexible iron spring and (b) to the dolphins with screws. (c) Alteration to the front of shell. Photographs by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art.

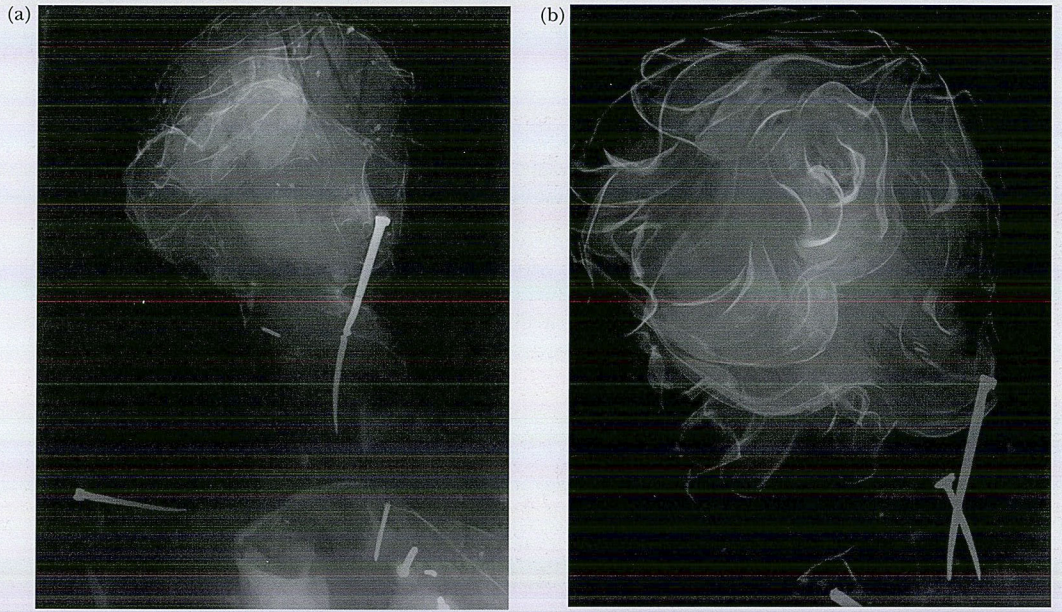

FIGURE 6. X-ray radiographs showing consistent wood anatomy and typology nails in (a) Galatea and (b) the Triton. Photographs by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art.

FIGURE 7. X-ray radiograph illustrating the characteristic wood growth pattern and the construction of the Cupid. Detail showing attachments of wooden fragments for arm, forearm, and legs to the main body, with early hand-wrought nails and nails of more recent manufacture. Photograph by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art.

European sculpture from the Middle Ages and is also the species from which the case is made.[19] Galatea's sculptural style is consistent with those of the other figures in the ensemble; details such as her facial features and hair are similar to those of the uncontested sea-nymphs on the base. Furthermore, the carving of Galatea's hands shows the characteristic attachment of the middle fingers that is found on the hands of the

19. Michael Baxandall. *The Limewood Sculptors of Renaissance Germany* (New Haven and London: Yale University Press, 1982).

sea-nymphs. In addition, the radiographs support the existing hypothesis that Galatea, based on the position of her hands and fingers, was never represented playing a musical instrument, such as a lute, as scholars had speculated. Stewart Pollens, conservator, noticed insufficient space for an instrument,[20] and Herbert Heyde, curator, argues that "the lute strings are plucked with the right hand and stopped with the left hand, just the opposite of that Galatea shows."[21] In Galatea, both hands suffered damage, and some fingers have been partially replaced or repositioned. Galatea's right forearm, including her hand, was carved from a single piece of wood. In contrast, the left hand was carved separately, as indicated by the direction of the wood grain, which is different from that of the forearm (fig. 8). The presence of a large wrought-nail suggests this joint is part of the original manufacture. Still, the left hand is re-attached with modern wire nails, and the joint is slightly out of alignment, suggesting that the hand position has been changed.[22] Despite these minor alterations to Galatea's gesture, the overall configuration of her arms and hands support Pollens' and Heyde's observations.

In this study, evidence of a previous attachment was found between the toes of Galatea's left foot: a tight opening for a wooden peg that could have been used to help secure her on a base, perhaps even sitting in or on the shell. Unfortunately, no corresponding evidence could be found on the shell itself, whose front edge is fragmentary and partially replaced, further obscured by extensive restoration to the finish.

Polyphemus, the largest figure of the whole ensemble, is comparable to the other figures except that his torso was hollowed from the back. Corresponding tool marks of rough carving are evident inside the back of the figure. Removal of the core for large solid wood sculptures has been common practice for centuries in order to prevent mechanical damage from environmental fluctuations.[23] The suggestion that the cavity accommodated pipes and levers for the organ that would have simulated the sound of Polyphemus' sordellina seems unlikely. However,

20. Personal communication to the authors. Thanks to Stewart Pollens for his comment.

21. Personal communication to the authors. Thanks to Herbert Heyde for sharing this observation.

22. The index finger and the little finger of her right hand have been replaced at the joint above the proximal phalanges; the index finger on the left hand and both middle fingers have been reattached, the latter two with nails (fig. 8).

23. Gerhard Schneider, "Zur Holzbearbeitung der Kölner Skulptur vom 11. Bis zum Ende des 14. Jahrhunderts," *Die Holzskulpturen des Mittelalters (1000–1400)*, Ulrike Bergmann and Anton Legner, eds. (Köln : Schnütgen-Museum, 1989), 65–83.

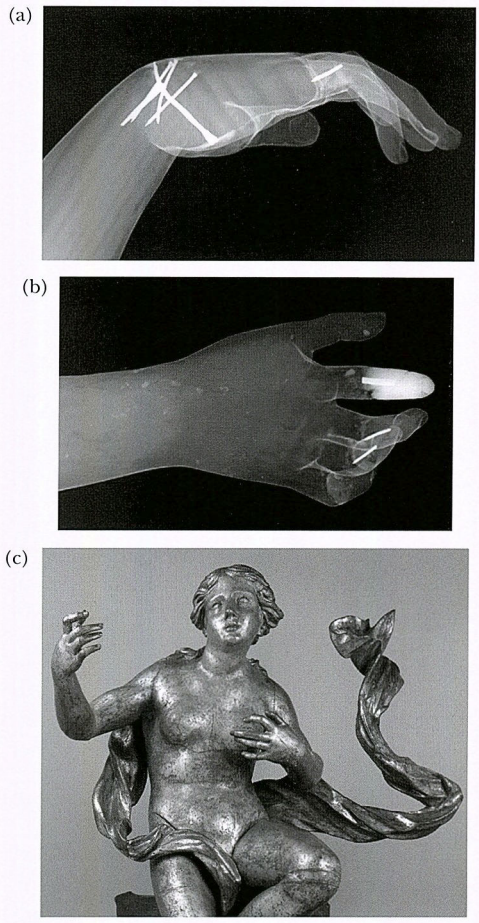

FIGURE 8. (a) X-radiograph of Galatea's left hand. Detail showing the attachment of the hand to the wrist and an alteration to finger attachment. (b) X-radiograph of Galatea's right hand. Detail showing the hand carved of one piece with the forearm, attachments of the fingers and later alteration, with replacement of the index finger with a composite material. (c) Full Galatea figure. Photographs by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art.

based on the size of the cavity, it could have held a small part of the mechanisms; the majority would have been hidden inside the mountain on which the cyclops was seated according to Todini's description in his *Dichiaratione*.[24] Also, a carved opening in the drapery at Polyphemus' neck shows evidence of linear abrasion corresponding to the inner wood substrate, maybe from a cord, suggesting that the figure might have been fastened from the back to accommodate an earlier attachment. This could also indicate the location of a device for an operational mechanism.

It is unclear whether the existing rocks, to which Galatea and Polyphemus are fixed with a wooden peg, were modified from the original mountains. What is clear is that both rocks were extensively restored in the nineteenth century, including the introduction of internal wooden frames. One still later intervention is the insertion of a section of plywood to create a secure seat for Galatea. In the back, both rocks were closed with rigid, brown-painted canvas nailed to the outer wooden frame.

Decoration

The condition of the decorative surfaces was evaluated under the stereo-microscope, and representative samples were prepared as cross-sections so that the stratigraphy of the original and later finishes could be studied.[25] Cross-sections were examined under high magnification using visible and ultraviolet illumination[26] and analyzed with a complement of instrumental techniques to provide detailed information on the materials. Attenuated total reflection-Fourier transform infrared micro-spectroscopy (ATR-FTIR) was used for characterization of pigments, binders, and coatings observed in the cross-sections.[27] Raman micro-

24. Michele Todini (1676), Patrizio Barbieri (1988), 5–7.

25. The samples were embedded in acrylic resin (Technovit 2000LC: Heraeus Kulzer, Germany) and dry-polished using polishing cloths (Micromesh, Micro-Surface Finishing Products, USA).

26. Ultraviolet illumination is used for improving visualization of organic layers, including coatings, adhesives, and sealing layers (e.g., proteins, oils, and resins). Samples were examined using a Zeiss Axioplan II microscope featuring tungsten and mercury lamps for illumination with visible light and ultraviolet light, respectively. Digital images were taken with a Diagnostics Instruments Spot Pursuit camera attached to the microscope and acquired using Spot Advanced software.

27. ATR-FTIR micro-spectroscopy was performed with a Hyperion 1000 FTIR microscope, equipped with a MCT (mercury cadmium telluride) detector, liquid-nitrogen cooled, interfaced to a Vertex 70 spectrometer (all by Bruker Optics). For

spectroscopy,[28] scanning electron microscopy with energy dispersive X-ray spectrometry (SEM-EDS),[29] and micro X-ray diffraction were used for further pigment characterization.[30] SEM-EDS also provided information on the composition of various metal leafs.

All decorative surfaces of the Golden Harpsichord had been extensively restored. The carved figures had been frequently refreshed with new applications of gold leaf and areas touched up with metal powder and bronze paint. Silver leaf coated with a yellow tinted varnish to simulate gold was used in several places. The wave and the rocks had also been re-finished many times.

Sampling of the full stratigraphy of the decoration of waves was challenging, in part due to delamination at the interface between some layers. Therefore, the full stratigraphy could be understood only through the combination of cross sections of samples from neighboring areas. These revealed a complex sequence of bluish and greenish paint layers, sometimes applied over new grounds and culminating in more recent superimpositions of paints, varnishes, glazes, and metal leafs (fig. 9). All campaigns reflect changes in preference over time in the interest of creating new finishes and visual effects. Despite extensive sampling, no trace of original paint was found on the waves. The oldest pigmented

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analysis of cross sections, an ATR 20× objective with an 80 micrometer germanium tip was used. For analysis of scrapings, a 15× FTIR objective was used. For ATR-FTIR analysis the germanium crystal is placed in contact with the cross section, the area of interest irradiated, and a spectrum recorded. Spectra were acquired as a sum of 125 scans, in the range of 4000 to 600–550 cm^{-1} at 4 cm^{-1} resolution.

28. Raman micro-spectroscopy was performed using a 50 or 100× objective on single particles in the cross sections and scraping samples with a Bruker Senterra dispersive Raman microscope system. A 785 nm laser beam and 30 second acquisition time were used; resolution was in the range of 3-5 micrometers and laser power at sample ranging between 1 and 25 mW.

29. Elemental analysis was performed using SEM-EDS on carbon-coated cross sections and micro-samples removed under high magnification using a tungsten needle and attached to stubs with carbon paint. The samples were examined using an Oxford Instruments INCA Energy 300 Microanalysis System (EDS) equipped with a Link Pentafet high resolution Si(Li) SATW energy dispersive X-ray detected attached to a LEO Electron Microscopy model 1455VP variable pressure scanning electron microscope, operated under high-vacuum conditions and accelerating voltages of 20 and 5kV. Analyses were conducted by Mark T. Wypyski, Research Scientist, Department of Scientific Research, MMA.

30. Micro X-ray diffraction analysis was carried out on clay-based ground filler with a Rigaku Dmax/Rapid instrument at the American Museum of Natural History in New York by Tony H. Frantz, formerly Research Scientist in the Department of Scientific Research, MMA.

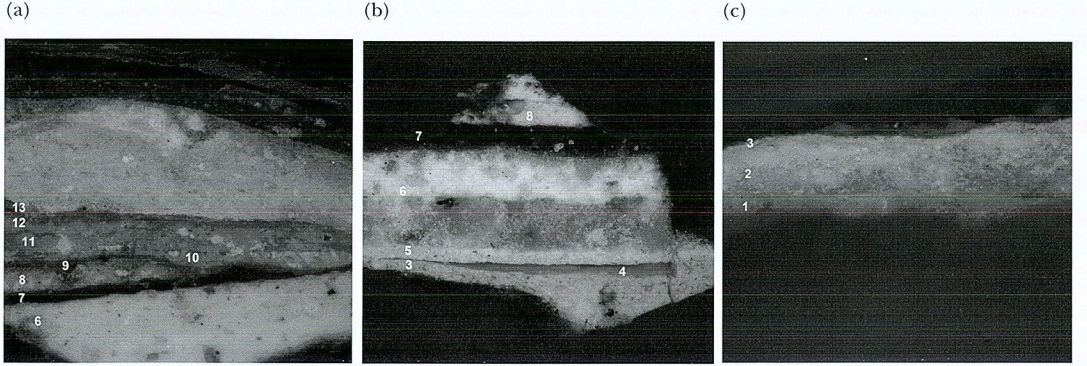

FIGURE 9. Stratigraphy of the sea viewed through the combination of three complementary cross sections obtained from adjacent areas. (a) upper and middle layers; (b) middle layers; (c) bottom layers. Paint cross-sections: 100x original magnification. Reflected visible light. See color photos p. 191.

(d)

(e)

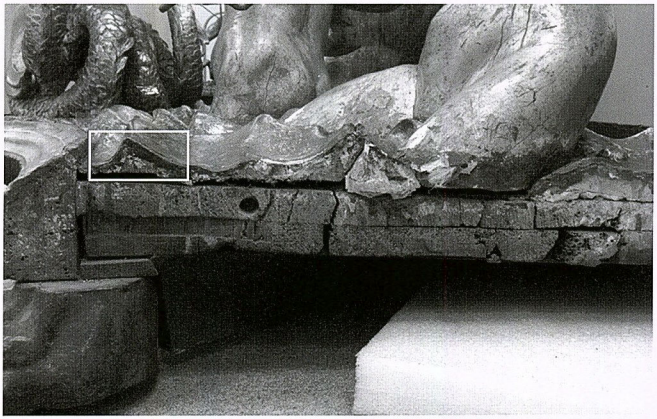

FIGURE 9 (*continued*). (d) and (e) show the stratigraphy locations (see white boxes). Photographs by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art. See color photos p. 192.

layer (layer 3, see fig. 9) is a light-green oil-paint coated with an oil-resin varnish for a glossy finish: a restoration campaign that may date to around 1825 when the piece was prepared for sale by the guitar maker Giovanni Vannetti. This light-green oil-paint is made up of lead white and very fine particles of Prussian blue which can be distinguished better in bluish-green areas around white translucent crystals of barium sulfate ($BaSO_4$),[31] inside which chromium was also detected. The presence of a chromium-based pigment, such as lead chromate, indicates that this paint dates from the first quarter of the nineteenth century.[32] Beneath this oil paint are two distinct preparatory ground layers of gypsum (calcium sulfate dihydrate $CaSO_4 \cdot 2H_2O$) (layers 1 and 2, see fig. 9), each dating from a different time. The bottommost ground (layer 1) may be the earliest preparation layer applied to the carved wooden waves, while the second gypsum ground is part of a major nineteenth-century restoration finished with the light-green oil-paint layer. The use of gypsum also suggests that the ensemble was restored in Italy, where calcium sulfate grounds are traditionally used.[33]

The sea was repainted and/or retouched several times. Notable is its re-finishing with what looks now a brown layer applied over a thick new gypsum ground (layers 6 and 7, see fig. 9). When it was first applied, this paint layer may have been evocative of the translucency of a bluish green sea, as it is an oil paint pigmented with smalt (ground cobalt-containing glass) and green earth.[34] Its discoloration to brown is a known phenomenon to smalt pigment bound in oil.

31. Jo Kirby and David Saunders, "Fading and colour changes of Prussian blue: methods of manufacture and influence of extenders," *National Gallery Technical Bulletin 25* (2004): 92. Noel Heaton, *Outlines of Paint Technology* (London: Charles Griffin & Company Limited, 1948): 9.

32. Rosamund D. Harley, *Artist's Pigments c. 1600–1835: A Study in English Documentary Sources* (London: Archetype Publications, 1982): 101. Noel Heaton (1948): 9. Lead (II) chromate was first synthesized between 1804 and 1809 by the French chemist Louis Nicolas Vauquelin, and became available as an artists' pigment around 1814 Chrome green, prepared from Prussian blue and lead chromate, dates from the same period. This green paint also contains calcium sulfate hemihydrate ($CaSO_4 \cdot 0.5H_2O$). Since their refractive indexes are close to those of oil painting media, fillers such as gypsum, barium sulfate, and calcium sulfate hemihydrate could be added to paints without altering their color.

33. David Bomford, Jill Dunkerton, Dillian Gordon, Ashok Roy, with contributions from Jo Kirby. *Art in the Making – Italian Painting before 1400* (London: National Gallery, 1989): 17.

34. Carol A. Grissom, "Green earth," *Artist's Pigments: a Handbook of their History and Characteristics,* vol. 1, Robert. L. Feller, ed. (Washington, DC: National Gallery of Art,

Other bluish-green oil paints followed until they were covered by a thick ground of calcium carbonate (layer 14, see fig. 10). The use of calcium carbonate ($CaCO_3$) as a ground is more common in Northern painting practice, rather than in Italy. Therefore, it is possible that this restoration campaign was carried out in France, perhaps around the time of Count Sartigues's return after 1868. This ground was used as a base for a greenish oil paint of ultramarine and chrome yellow pigments in a lead white and calcium carbonate matrix.

A more drastic restoration turned the sea into a deep green finish with a metallic effect, using a sequence of oil-based green paints (layers 17–19, see fig. 10 and 11) followed by the application of silver leaf, green glazes, and varnishes (layers 23, 25, 28, 29, see fig. 10 and 11).[35] The superposition of pigmented base-paint, with highlights of metal powder and leaf, could suggest the use of *vert antique* finishes, nineteenth-century surface treatments inspired by patinas of excavated ancient bronze.[36]

A similar finish for the sea was achieved with two subsequent restoration campaigns in which green glazes first were applied over aluminum flakes (layer 26) and later, aluminum leaf (layer 30). In this major restoration, the aluminum leaf was applied over the whole surface of the waves and acted as a reflective background for a thin dark-green glaze (layer 31). Using aluminum foil in the sea may be connected to the presentation of the Golden Harpsichord at the 1900 *Exposition universelle.* Aluminum metal became very fashionable in France after 1855, benefiting from both the interest and financial support of Napoleon III.[37]

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distributed by Oxford University Press, 1986): 141–167. Green earth refers to green clay traditionally used as pigment, also commonly called green earth pigment. The mineral composition varies according to its source. The major component is either celadonite, or glauconite, both blue-green silicates of variable composition (Grissom 1986). In this particular paint layer, blue-green round particles observed were identified as celadonite using ATR-FTIR.

35. The silver leaf was analyzed using SEM-EDS, and found to contain 34 weight percent gold and 1.1 percent copper. The leaf (layer 22) was applied with a mordant (layer 21) directly on top of a varnished green paint (layers 19 and 20). The lack of dirt particles at the interface between the mordant and the paint suggests that the green paint was used as a colored base for the metal leaf.

36. G. Debonliez and François Malepeyre, *Nouveau manuel complet du bronzage des métaux et du plâtre* (Paris: Roret, 1837). Reprint Paris: MS Lacombe (1979).

37. Joseph Williams Richard, *Aluminium: Its History, Occurrence, Properties, Metallurgy and Applications Including its Alloys* (Philadelphia: Henry Cary Baird, Joseph W. Richard, 1890): 368–69.

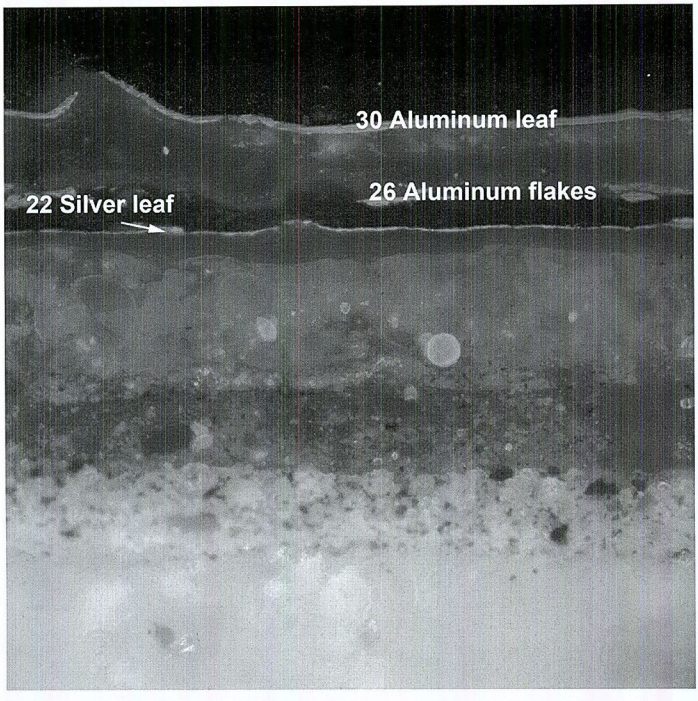

FIGURE 10. Stratigraphy of the upper layers of the sea, as from top layers in Fig. 9, with metal leafs and flakes marked. Paint cross section: 500x original magnification. Reflected visible light. Photograph by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art. See color photo p. 193.

However, at that time, the metal was still rare, and due to the difficulty of its extraction, more expensive than gold. It is not before 1886 that aluminum leaf became affordable and could be used more extensively for decorative purposes.[38]

38. Joseph W. Richard reported that aluminum was presented in Paris at the *Exposition universelle* of 1855, 1867, and 1878. In 1878 the price of aluminum was still high, but from 1889 the implementation of a new electrolytic process resulted in the lowering of its price. Joseph W. Richard (1890): 27–34.

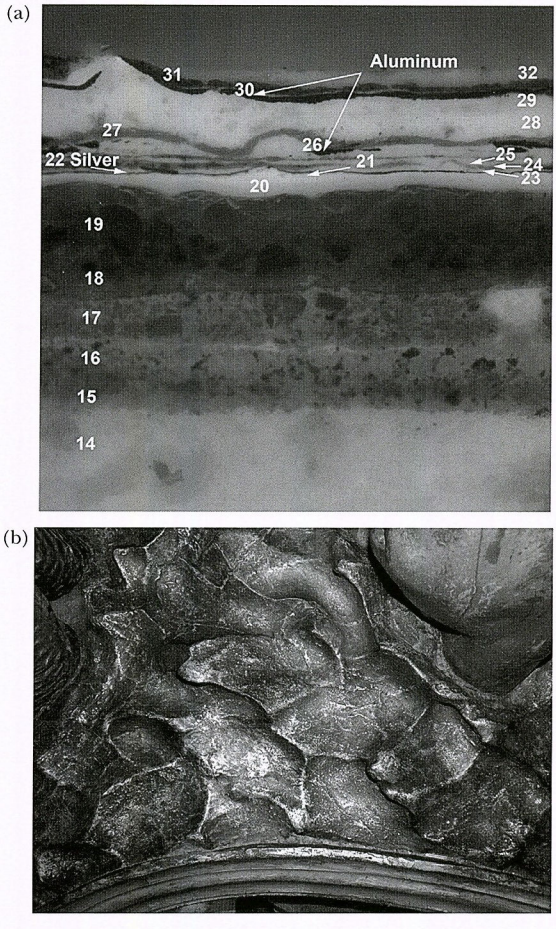

FIGURE 11. (a) Stratigraphy of the upper layers of the sea, as from top layers in Fig. 9, showing the superimposition of varnishes and glazes. Paint cross section: 500x original magnification. Ultraviolet illumination. (b) Detail of the carved waves showing the reflective aluminum leaf below the upper green glaze. Photographs by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art. See color photos p. 194.

A chronology for the various decoration campaigns can be established through a comparative study of the ground layers on the base of the Golden Harpsichord and on the other elements.[39] On the base, as mentioned earlier, are two distinct gypsum ground layers (layers 1 and 2, see fig. 9) below the earliest-found light-green oil paint layer (layer 3, see fig. 9). The homogeneous and translucent bottommost ground (layer 1) is similar to the lowest ground layer on Galatea's inner thigh (fig. 12), Polyphemus's sordellina, and the outer case's front molding. It is probably the earliest layer applied and may be original to the Golden Harpsichord's manufacture. Visible in cross-section (fig. 12) on top of this first ground preparatory layer, metal flakes indicate a possible later retouch for losses into the gilded surface. Applied over the homogeneous and translucent gypsum layer (layer 1, see fig. 9), the second gypsum ground is found on these same elements, and may relate to an early restoration. It is also relatively translucent and is characterized by the presence of air bubbles and occasional crystals of gypsum. The presence of these two early grounds on different elements and particularly the concomitant presence of both grounds on Galatea support the authenticity of Galatea within the ensemble.

On selected areas a clay-based fill has been used for woodworms' damage. Over these fills, and on the majority of the carved gilded elements including the frieze and the case instrument, a very distinctive gypsum ground containing clay minerals and some large crystals of gypsum is present. Because this ground is also evident in cross-sections from the carved waves as the preparation layer for the paint containing smalt and green earth, it is clearly a major overall nineteenth-century restoration.

The interpretation of the gilding campaigns is complicated. New boles[40] and gold leafs seem applied over existing grounds.[41] Where gold leafs could be analyzed, their composition was too similar to provide information on the chronology of gilding applications. The later use of

39. Thanks to Federico Carò, Associate Research Scientist, Department of Scientific Research, MMA, for his analysis of the grounds by SEM-EDS and image analysis.

40. Fine natural clay used as under-layer for water-based gilding, and burnishing.

41. A red-orange bole was found on most of the figures, whereas a red-brown was encountered mostly on the Galatea and Polyphemus's draperies, on the triton tails and on the frieze of the case. A light-colored orange bole was found in the latest restored areas on the case including the lid and the spine, as well as on selected minor restoration areas on the figures.

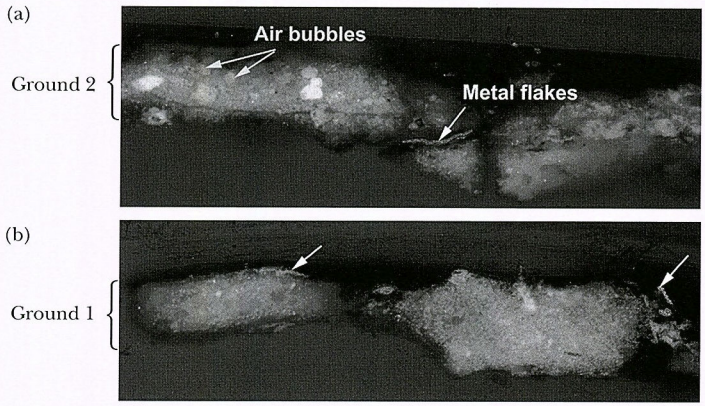

FIGURE 12. Cross sections of one sample delaminated in two parts (top and bottom), from Galatea's inner thigh. (a) upper gypsum ground (two layers) with residue of lowest ground layer; (b) lowest gypsum ground layer: 100x original magnification. Reflected visible light. Photographs by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art. See color photos p. 195.

silver leaf,[42] coated with a tinted shellac varnish as to imitate gold, was found on the back surfaces of several sculptural elements that had been previously completely gilded, including the shell, dolphins, and the tritons. On the spine of the case, the tinted silver leaf was applied over a light-color bole which is different to any other elements. It is likely that the spine was decorated and finished in the nineteenth century, as indicated by the distinctive gypsum ground containing clay minerals. As previously speculated, the spine might be a later addition, perhaps added when the Golden Harpsichord was used as a freestanding instrument, or later, when it became increasingly more of a decorative object.

42. The purity of the silver leaf was determined by SEM-EDS to be in the range of 99.9% Ag. The leaf found on the spine and the figures therefore has a much higher silver content than the silver leaf used on the waves. See note 35 above.

Conservation treatment

Due to the fragile condition and numerous alterations, a significant conservation treatment was required. The ensemble's heavy restoration history led to critical decisions on the treatment strategy, which focused on the use of minimally invasive and reversible conservation techniques. Re-integration of harmony and balance to the sculptural elements and their decorative finishes was a lengthy process.

Selective cleaning to the gilt surfaces of the figures restored the reflective nature of gold finish that had been largely obscured with excessive retouches with metal powders and bronze paint. These unsightly retouchings had darkened over time and hid damages and repairs as well as covered original details. Poor repairs and unstable filler materials from previous restorations were replaced using only non-traditional and reversible materials to keep the piece's integrity and avoid further intrusive restorations to the ensemble elements. The case and the base including the carved waves and the figures were stabilized using a step-by-step method to ensure strength and reversibility. A specially-designed light filler based on a polyvinyl butyral resin mixed with cellulose fibers and micro-balloons (microscopic hollow glass spheres) was used, which was both physically compatible with the surrounding materials and desirable as a base for the reintegration of the surface finish using gold powder and gold leaf, pigments, and watercolor.

As mentioned earlier, due to their vulnerable position hands and fingers had suffered extensive damage. As illustrated in the example in figure 13, the following steps were taken for their restoration: removing previous finger replacements and corresponding fills was unavoidable, as they were visually disrupting; subsequently, uncovering the original carved design revealed the intentional movement of hands and fingers, and the unveiled carved details guided the reconstruction of what was lost.

Conclusion

The appeal that the Golden Harpsichord generated through the centuries as a decorative work of art is reflected in its complex history of restoration, which contributed to preserving it in its entirety and splendor to this day. For the most part, the original concept of the decorative scheme with a combination of painted and gilded surfaces seems to have been maintained over the years. However, despite the extensive sampling

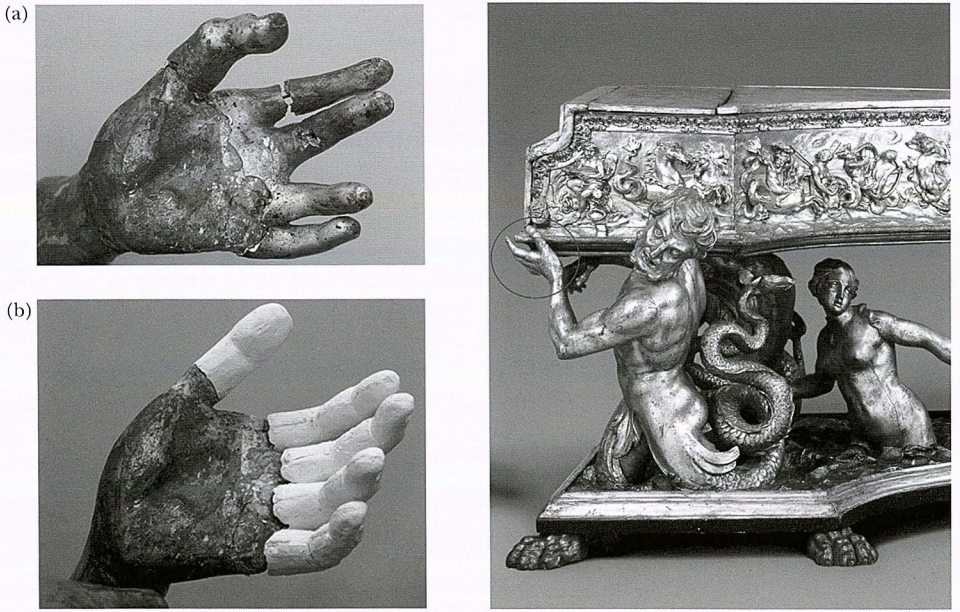

FIGURE 13. Front Triton with newly restored hand. (a) Detail: left hand of Triton with disruptive fingers replacement and removal of fills in progress. (b) Detail: left hand of Triton during restoration. Photographs by The Sherman Fairchild Center for Objects Conservation. Reproduced with permission, The Metropolitan Museum of Art. See color photos p. 196.

and examination, no remaining original finishes could be found from the number of areas that were both accessible and representative. This limitation made it difficult to justify additional sampling, and it is because of the great respect for this rare example of Baroque art, both functional and decorative, that evidence of the "worthy" materials of its creation may still be waiting to be uncovered. As for now, this technical study and the new conservation treatment allow us to appreciate once more such a masterpiece of craftsmanship and understand the transformations it has undergone. These thorough investigations are of great value for the awareness and interpretation of the restoration history of musical instruments in collections and are crucial to their conservation. The combination of the historical documentation and technical research conducted on the decorative elements of the Golden Harpsichord provides an essential base for the future investigation and interpretation of the case and its original content, in relation to the current instrument.