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MUSICES

11

The use of CT scanning for bowed stringed instruments identification and identification

Gabriele Rossi Rognoni / Marco Fioravanti

THE USE OF CT SCANNING FOR BOWED STRINGED INSTRUMENT IDENTIFICATION AND COMPARISON

G. Rossi Rognoni,[1] P.Biagiotti,[3] P.Gallerini,[3] I.Menchi,[3] R.Ricci,[3] M. Fioravanti[2]

[1] Royal College of Music – London UK

[2] University of Florence – GESAAF Italy

[3] AOUC - Department Imaging diagnostic - Florence Italy

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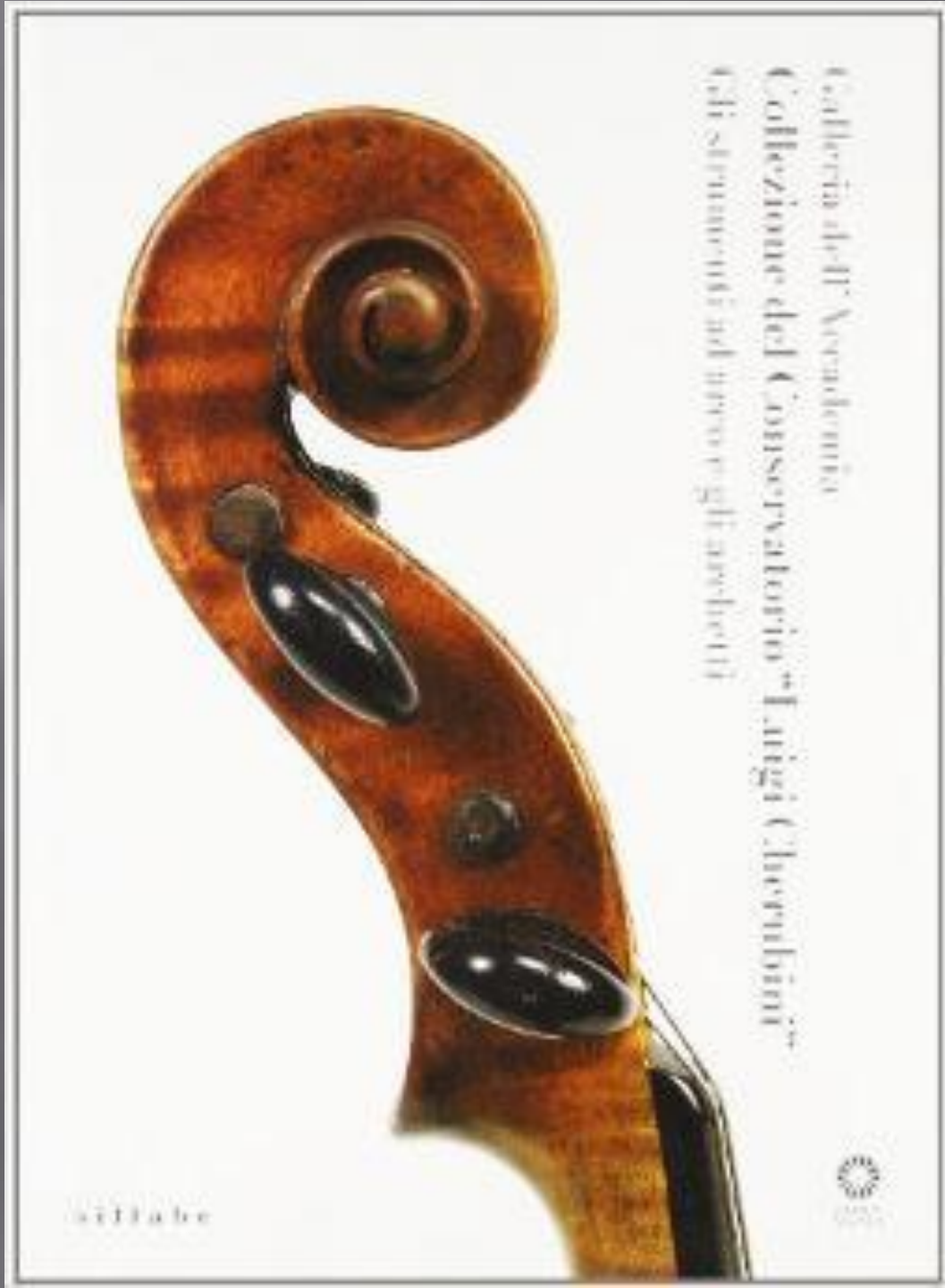
Galleria dell'Accademia, Dept. Of Musical Instruments, Florence

The bowed instrument collection

A.Stradivari, Viola tenore e violoncello ‘Medicei’, Cremona 1690

N.Amati, Violoncello ‘Medici’, Cremona ca.1650



Galleria dell'Accademia – Catalogue of the bowed instruments and bows, ed. G.RossiRognoni, Leghorn : Sillabe, 2009

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Galleria dell'Accademia – Catalogue of the bowed instruments and bows, ed. G.RossiRognoni, Leghorn : Sillabe, 2009

5. Violin

[Florence, 1770 ca.]

Giovanni Battista Gabbrielli (attr.)

(Florence, 1716–1771)

Inv. Cherubini no. 1988/9

Description

The BELLY is made of two quarter cut pieces of spruce (*Picea abies* Karst.) with hazel figure markings and medium-wide grain converging towards the joint (mean width 1.8 mm at the centre, 2.1 mm at the edges). The two pieces come from the same log although a 22.4 mm wide strip was cut from the centre of the piece on the right. The grain shows an anomaly in the wood growth near the edge of the left C-bout, but not on the right side. There are no positioning pins.

The arching is well-shaped with deep and wide fluting. It reaches its maximum height between the upper eyes of the F-holes.

The F-holes are short and vertical with small eyes, wings with diverging sides and no fluting. The notches are small, and those of the left F-hole are inverted, the outer one lower than the inner, while the notches on the right F-hole are quite slanted (63°).

The corners are elongated with similar openings on the lower and upper corners, defining very open C-bouts (83 mm). The thickness is only slightly greater than that of the edge.

The purfling consists of three lines: the middle line is beech wood (*Fagus sylvatica* L.) while the two outer rows are of stained, unidentified wood (total thickness 1.6 mm; white 0.5 mm). The purfling joint is very precise, centrally placed at the corners and reaches almost their end. The distance from the edge is 3.2 mm.

The ebony (*Diospyros* sp.) saddle is not original; it is very narrow and high on the belly. It protrudes beneath the belly and overlaps the rib. It also cuts into part of the brand mark on the belly.

The BACK comprises two pieces of quarter cut maple (*Acer* sp.). The right board has a slight flame pattern descending towards the edge, while there is no curl on the left piece. There are no positioning pins.

The arching reflects the style of the belly with deeper fluting that gives it more emphasis notwithstanding a slight deformation caused by the pressure of the sound-post. The maximum height just below the upper corners is higher than that of the belly.

The corners also reflect the style of the belly and are thicker than the rest of the edge.

The purfling is made of the same material as the purfling on the belly, but the black lines are narrower.

The original, intact BUTTON is rather wide at the base, semicircular, and is notably thicker at the top than at the base.

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The SIX RIBS are made of nearly quarter cut maple (*Acer* sp.) with a flame pattern that is barely visible on the lower ribs and perpendicular to the surface of the back. The bending of the wood near the corners caused wrinkling on the wood surface.
The BLOCKS are made of conifer wood with characteristics compatible with fir; except for the upper block made of walnut they are all original. The LININGS are original, made of broadleaved wood with features compatible with beech wood. The linings are not inserted into the blocks and in some cases are too short and do not reach them. The bassbar is very small, thin and may be original.
The maple (*Acer* sp.) NECK, without any flaming is original. Its angle was modified by the insertion of two wedges between the heel and the upper block and between the heel and the button creating an elevation of 4.5 mm and an angle of 7° with respect to the surface. The bone nut was moved upwards to lengthen the body stop, so now it is beyond the base of the pegbox.
The work is similar to what was done on instrument inv. no. 1988/6 (cat. no. 18) and can be attributed to the same hand.
The ebony (*Diospyros* sp.) fingerboard is not original.
The HEAD is of one piece with the neck. The pegbox is narrow, the base forms a 113° angle with the surface of the neck, and is coarsely dug out at the top. The pegbox flanks are slender and of the same width throughout the length.
The scroll is slightly twisted towards the left in relation to the pegbox. However, it is well-proportioned and develops evenly notwithstanding some asymmetry. The beginning of the spiral is anticipated at the eye by a slender scratch. The sides of the back of the scroll converge slightly and the heel of the scroll is deeply fluted and protrudes notably.
The VARNISH is golden brown.
The instrument has no LABEL. However, there are three BRAND MARKS with the initials 'G-B-G' within a rectangle made with the same punch used for violin inv. no. 1988/8 (cat. no. 4): they are on the button, at the joint of the lower ribs below the endbutton and on the belly near the saddle. There are no visible markings inside the instrument.
The modern pear wood (*Pyrus* sp.) pegs are decorated with a bone button on the sides.

Dendrochronological dating of the belly

Fifty-two and forty-eight rings were counted on the right and left boards respectively. The mean chronology of fifty-eight rings cross-matches with some Central European chronologies, including Wilson's that is applicable to Germany (Falkenstein). Dating of the last measured ring: 1768, T_{gp} 4,60, Glk 73,30***. The dating can be considered reliable.

State of conservation

Even though it shows some signs of wear the instrument is in fair condition.
The BELLY presents a significant fracture along the grain involving the entire lower right from the edge to the eye of the F-hole; it was reglued and consolidated with a single square reinforcement. There are some nicks, especially beneath the tailpiece. The edge, which is generally quite worn, was repaired at the upper and lower bouts, while the corners are very worn but original. A 20 mm long crack along the edge – from where the above mentioned crack begins, required doubling of the upper part of the edge and the replacement of the purfling in that section.
The BACK is in good condition even though it has some scratches and shows signs of moderate wear.
The RIBS are in fair condition: the upper right rib has a small crack near the block that was reglued from the inside. There is no other damage aside from a significant bulge on either side of the lower block.
The NECK and HEAD are in fair condition, but the right pegbox flank has some unrepaired cracks between the E and G pegs and above the A peg. The area around the D peg on the left flank was doubled on the outside. The neck shows a 9 mm crack on the right side just under the head.

Historical documentation

See preceding entry (cat. no. 4).
This instrument also comes from the Accademia del Regio Istituto Musicale. In an appraisal dated 1867 it is listed as 'ordinary' from the qualitative standpoint and was valued at only 50 lire, half the amount of the other Gabbrielli violin.[1]
The 1867 report by Castellani described this instrument as 'fairly well set up' and, because of its 'ordinary quality' advised against the work planned for the other instruments.[2]
In 1947 Alfredo Del Lungo submitted an invoice for the repair of the volute on the scroll and of a crack in the lower left part of the belly.[3]
Then in 1966, within the context of the restorations commissioned after the 1966 flood, he presented a bill for regluing the body, cleaning the inside, smoothing the fingerboard, touching-up the original varnish and polishing the neck, replacing the

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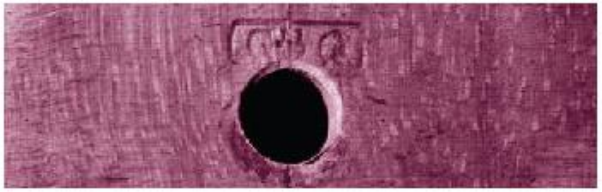

Dimensions	Length	Width	Depth
Total length	591	–	–
Vibrating string	330	–	–
Body stop	199	–	–
Belly	355	159-151-104-177-201	–
Back	357	161-153-105-179-201	–
Ribs	–	–	32-32-30.7-32.7-30.7
F-holes	73	45-74.3-126.5	–
Fingerboard	266	20.7-42.3	–
Head	109	–	–
Scroll	36.6	41.2	
Pegbox	–	7-17.4	–

Projection height of the fingerboard at the bridge position: 28

string and a general revision.[4]

Critical history

In 1911 Bargagna described the instrument as 'entirely identical to the preceding one and the label has the same information' this would suggest the existence of a label that was lost before 1969 when Gai stated that it was missing. However, it is strange that this was the only case in which Bargagna did not transcribe the text of the label, so it is possibly legitimate to assume that he was referring to the brand mark.

Stylistic notes

This violin is slightly narrower and longer than the preceding one. It does have the same stylistic features even though they are less carefully wrought, perhaps because of the maker's advanced age.
The out and placement of the F-holes and the purfling have the same characteristics. His choice of wood with a wider grain for the belly, however, led to greater thicknesses.
The workmanship on the scroll is highly asymmetrical especially when viewed from the front and back, and in particular the development of the second turn. The hollowing on the heel of the scroll is deeper on this violin than on the preceding instrument.
The inlay channels and the thickness of the black lines of the purfling are also less even than in the previous instrument. Furthermore the white purfling is further extended towards the end of the corners.
The beautiful golden brown varnish is lighter than that of the preceding violin, but its consistency is similar.

Exhibitions

Antichi strumenti, Florence, Palazzo Pitti 1980
Antichi strumenti, Florence, Palazzo Vecchio 1981

Bibliography

Bargagna 1911, p. 23
Gai 1969, p. 100
Antichi strumenti 1980, pp. 31, 39*
Corona 1980
Corona 1998

Notes

[1] ACF, *Biblioteca*, loose sheets.
[2] ACF, *Rendiconti*, 1957.
[3] ACF, *Rendiconti*, 1947 and *Biblioteca*, loose sheets.
[4] ACF, *Rendiconti*, 1968.

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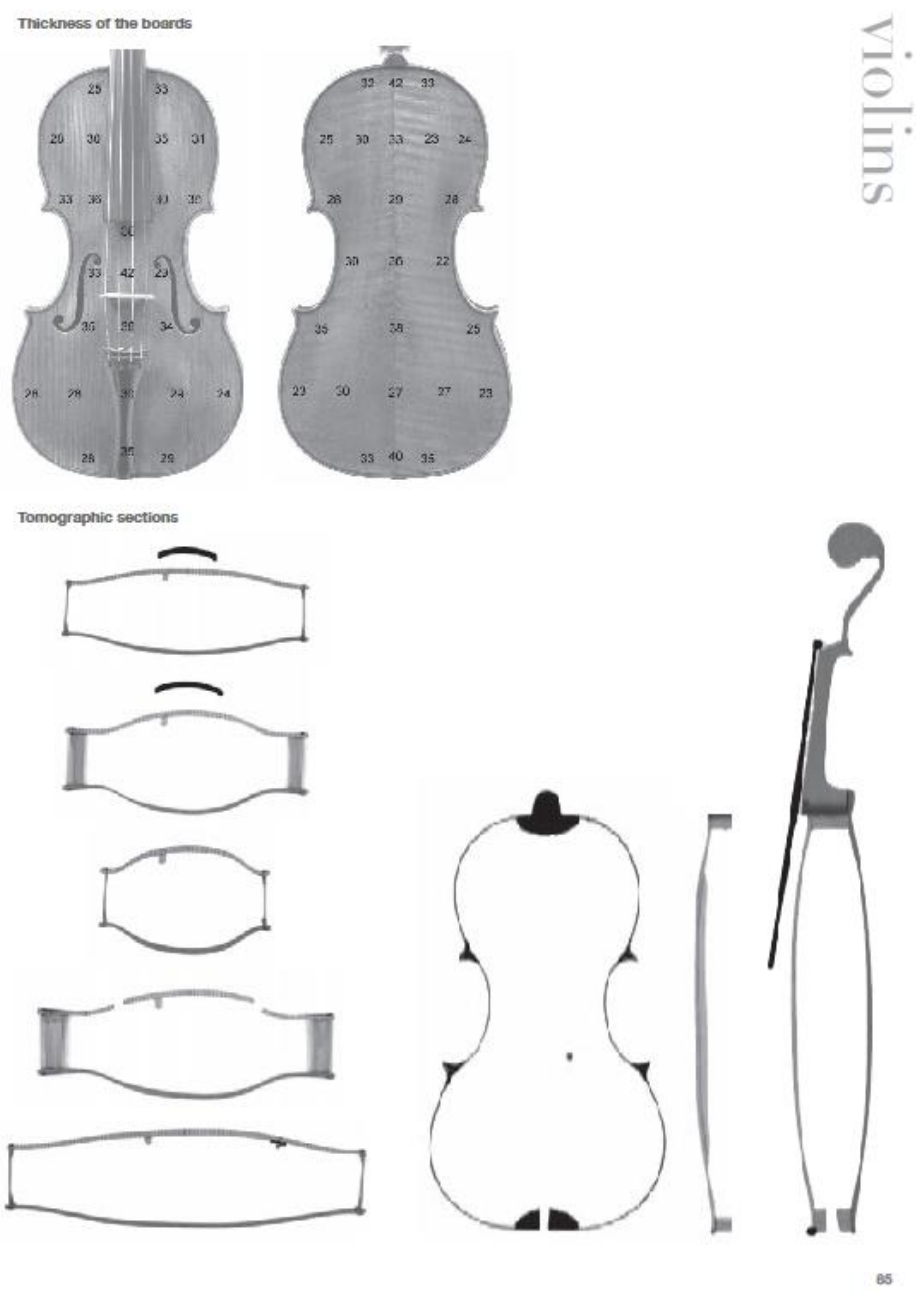

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Issues: cost and logistics

CT Scanner: General Electrics 'HighSpeed'

Step between 'slices': 0,7mm

80 or 100 KV

40-50 milliAmpère/sec.

Scan-time: 25-35 sec.

Hounsfield Units: 1000 HU (oscillation) and -600 HU (reading window)

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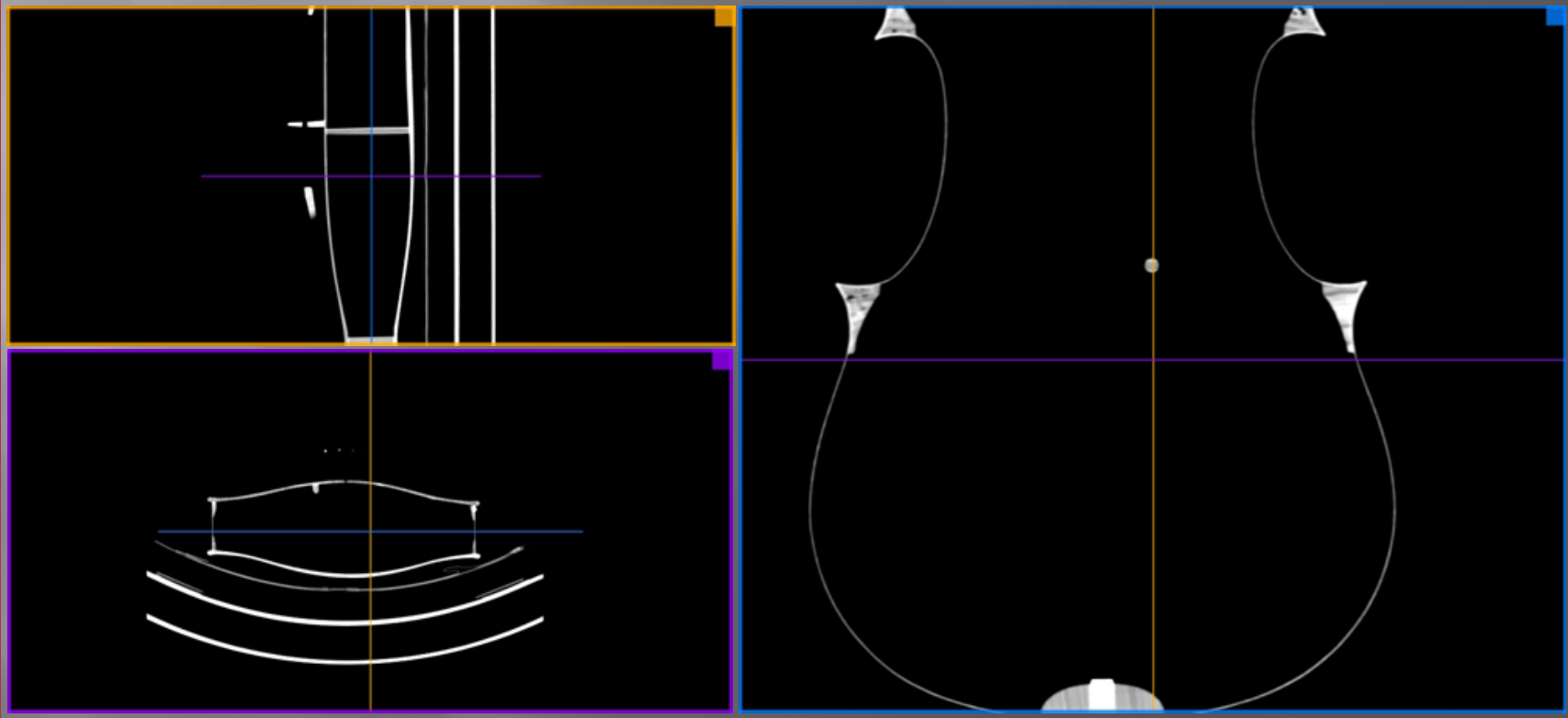
CT scan: 2D



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CT scan: 3D

A. Stradivari, Tenor viola ‘Medici’, Cremona 1690

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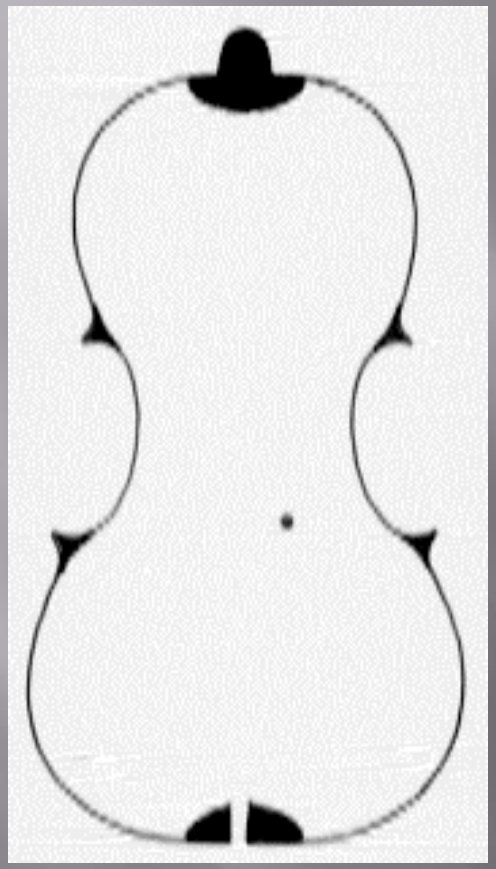
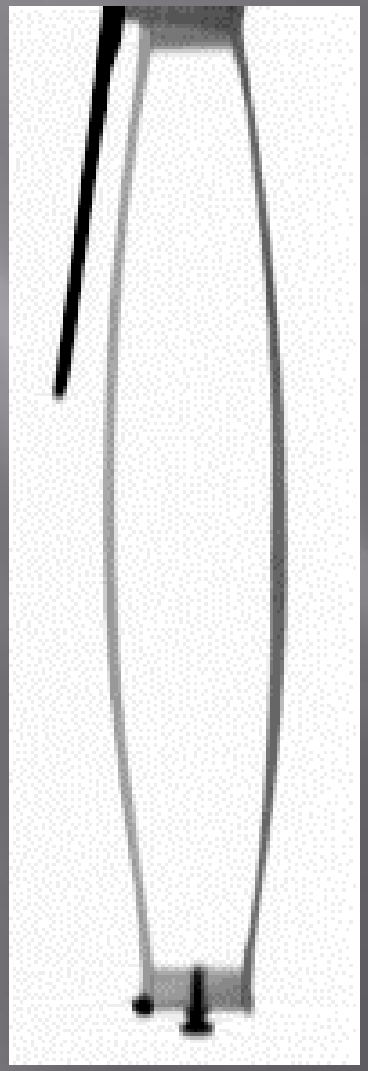
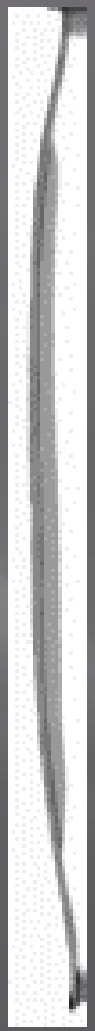
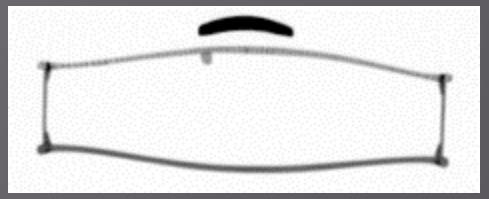
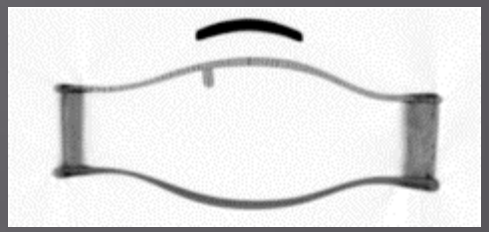
Selection of comparable data

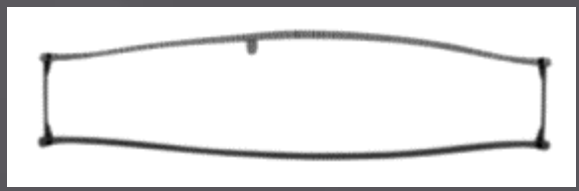






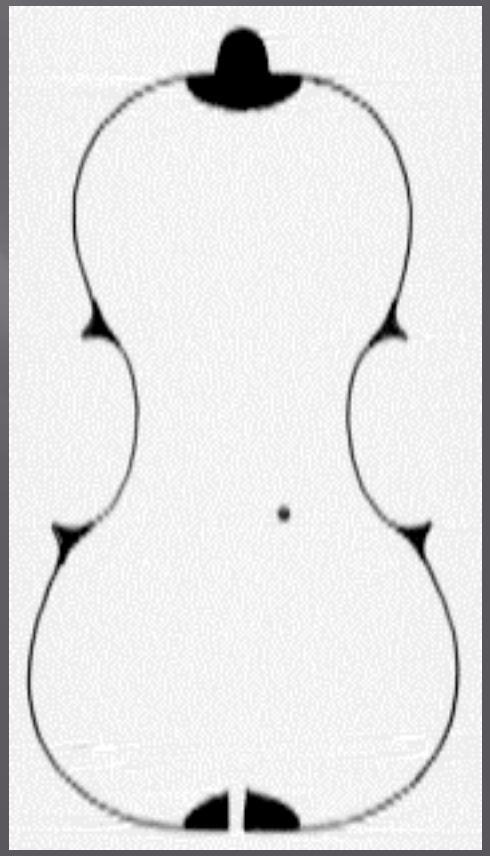






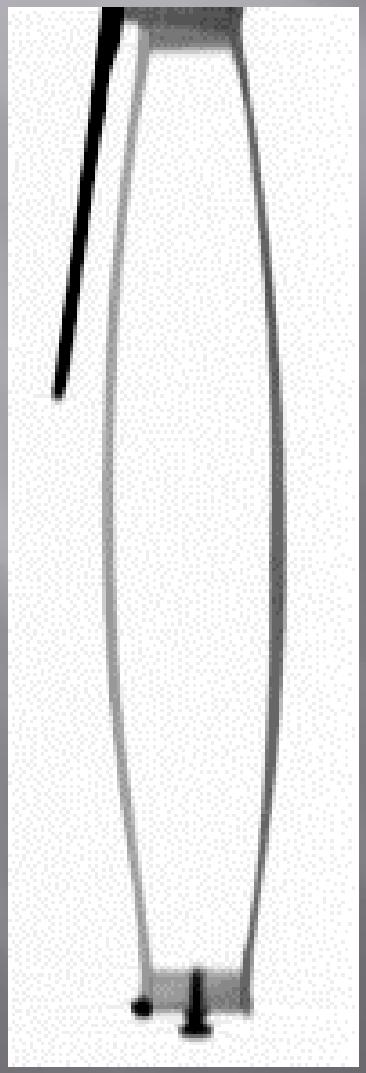
Elements towards identification

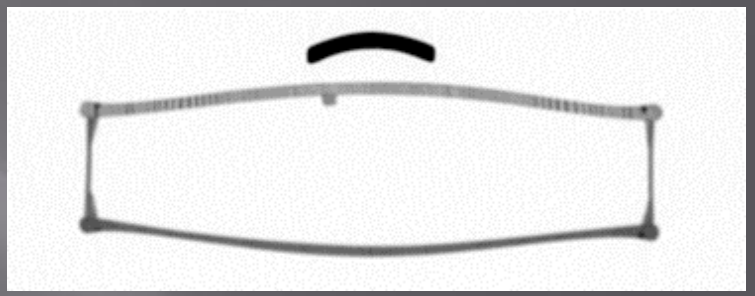
Variations in shape, thickness and position of parts that were built according to a template that was unique to a certain workshop

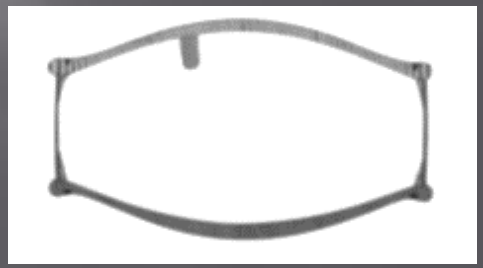


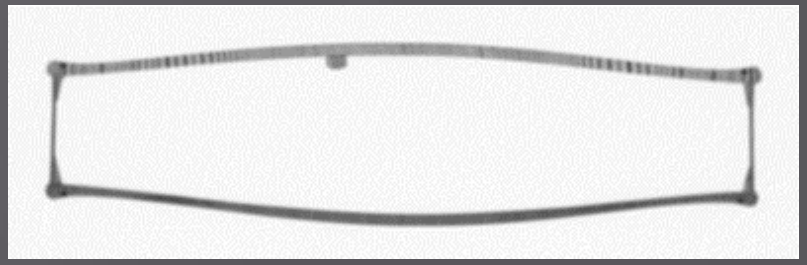
Elements towards identification

Variations of elements that, although entirely controlled by hand, have a strong impact on the sound quality of the instrument



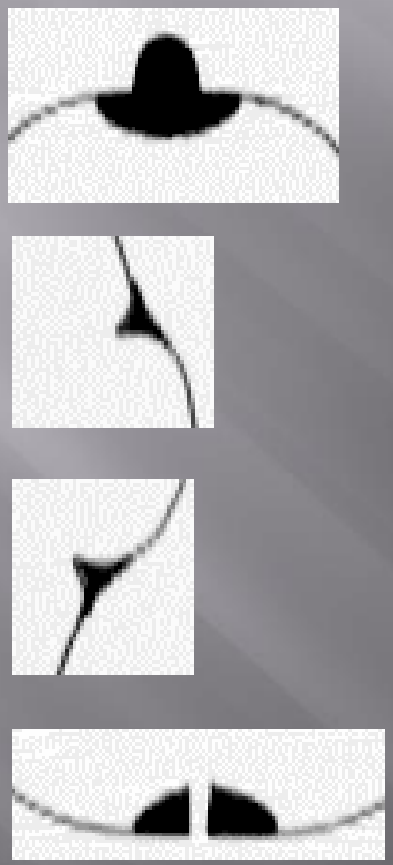




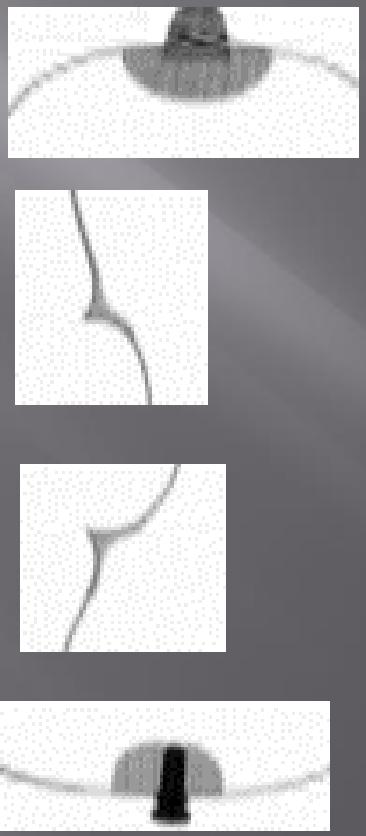


Elements towards identification

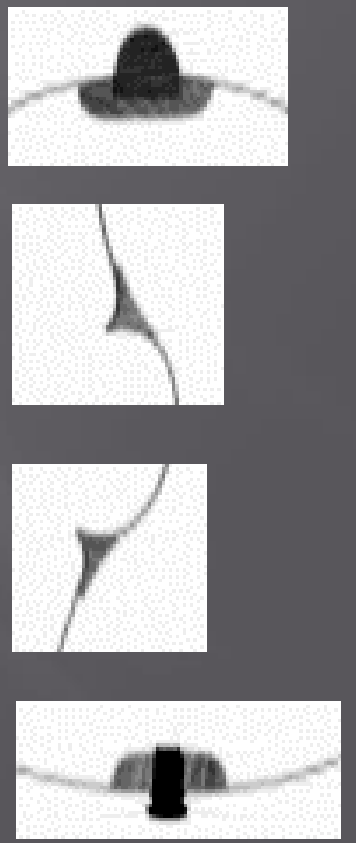
Variation in shape, size and position of structural and internal parts of the instruments



G.B. Gabbrielli, Florence, 1764



A.F. Mayr, Salzburg, 1764 ?



G. Scarampella, Florence, 1886

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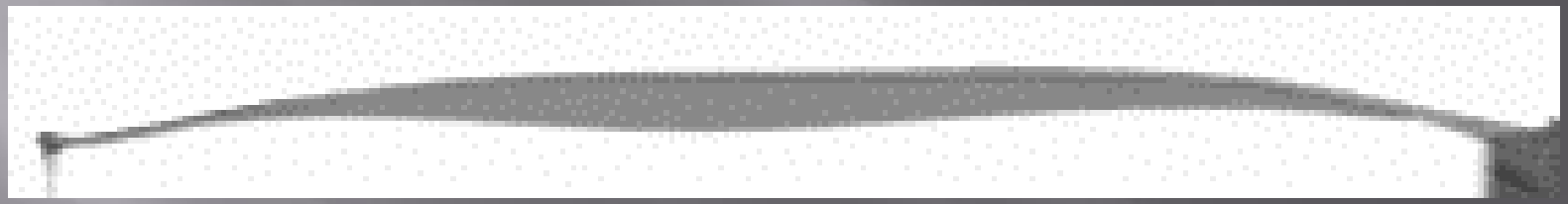
Elements towards identification



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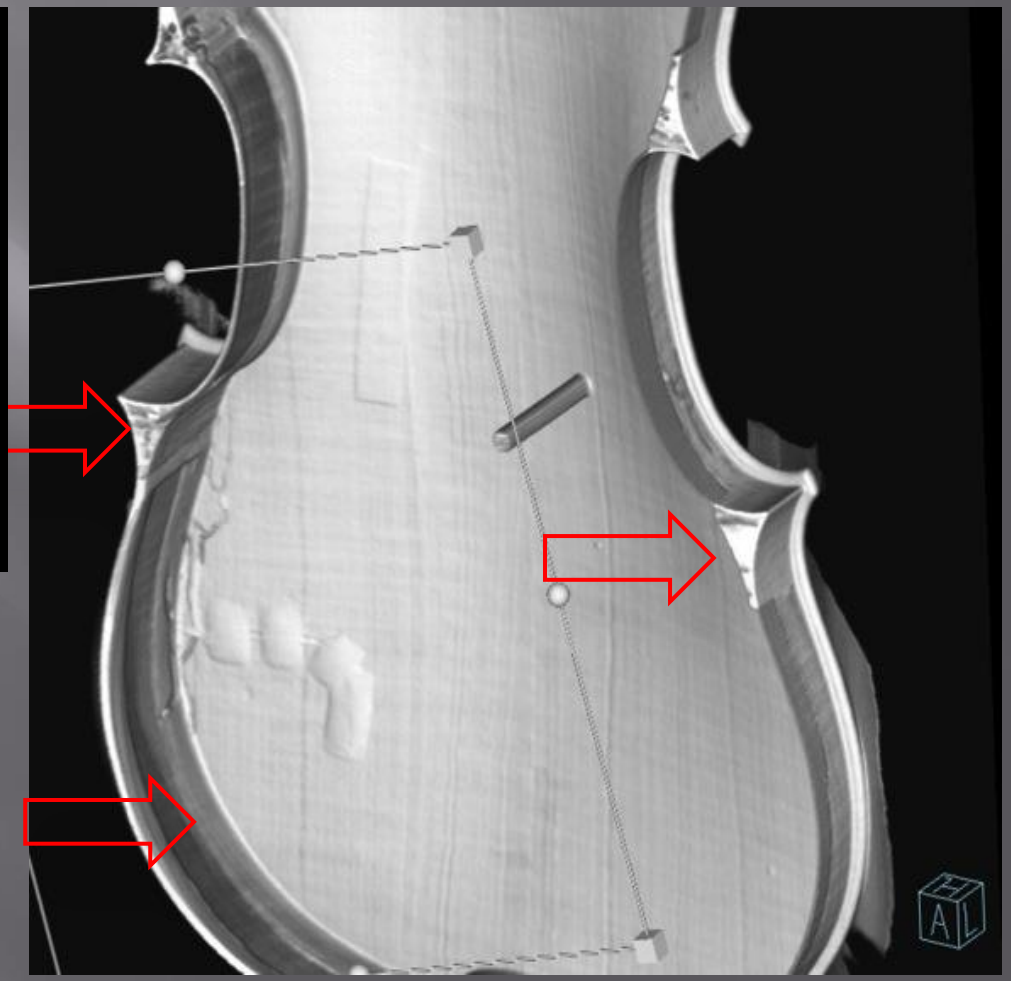
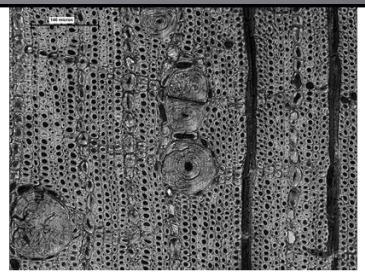
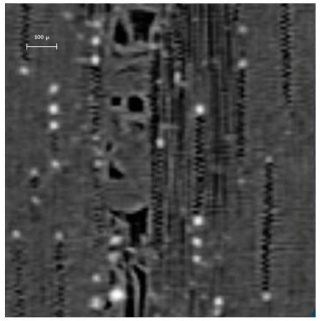
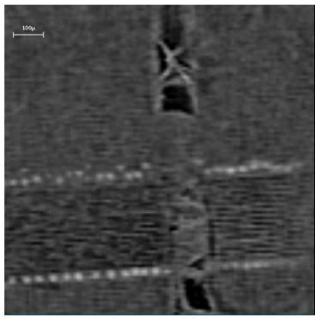
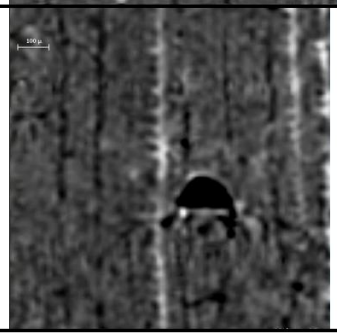
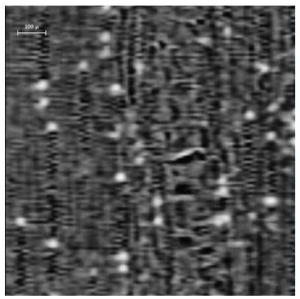
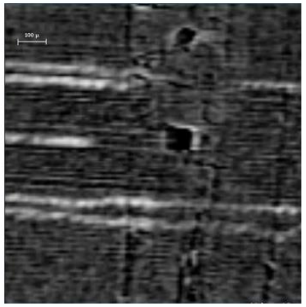


Elements towards identification

Control sample: Microscopic sections			
Control sample: Micro-TC in phase contrast (9µm/pixel)			
Bow n°52: Micro-TC in phase contrast (9µm/pixel). Same features In bows n° 53 and 56			

SNAKEWOOD

Brosimum guianensis (Aubl.) Huber

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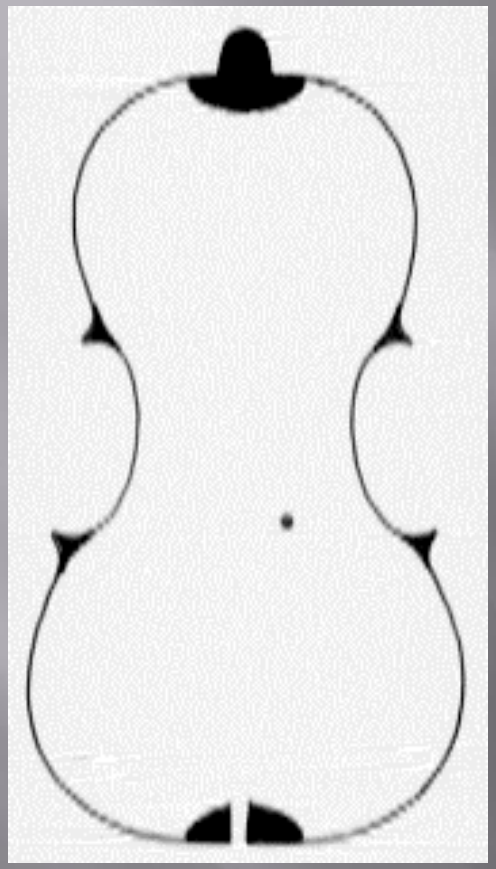
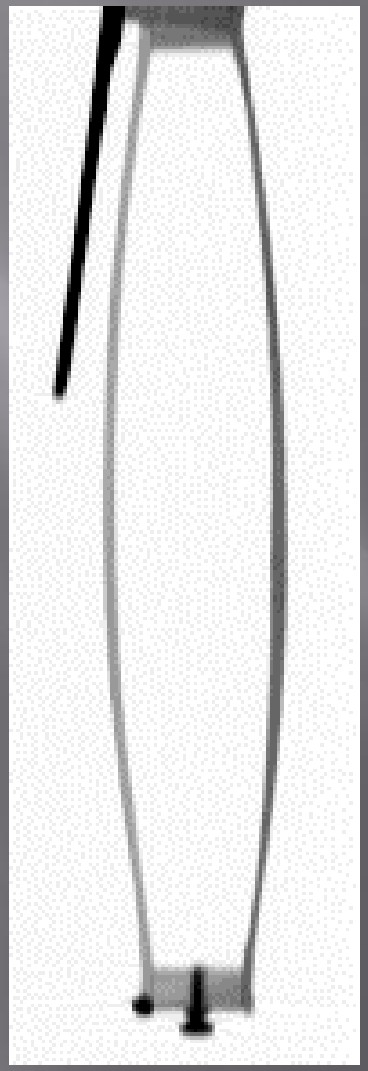
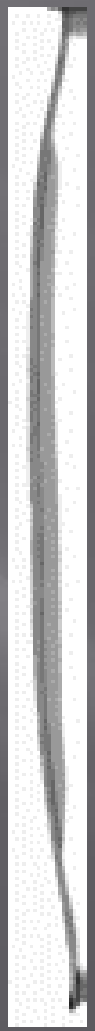
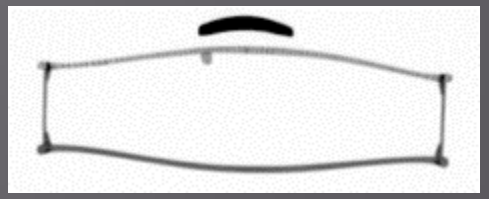
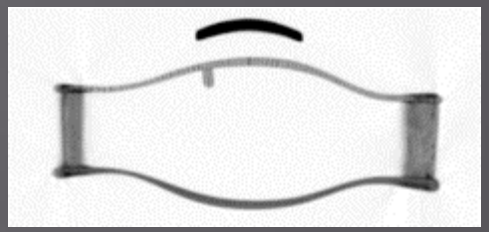
Selection of comparable data

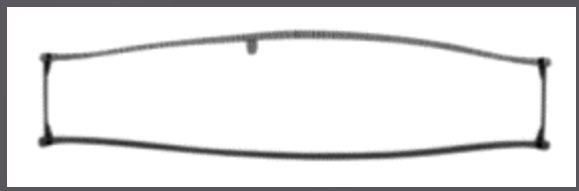












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Selection of comparable data

- Dimension of the object
- Cost and logistic
- Publication/dissemination of the results

Fraunhofer EZRT

DFG Deutsche Forschungsgemeinschaft

GERMANISCHES NATIONAL MUSEUM

WoodMusICK FPS COST Action FP1302

MUSICES

12

The use of CT scanning for other stringed instruments

Giovanni Paolo di Stefano / Marco Fioravanti

G. P. Di Stefano, M. Fioravanti, G. Rossi Rognoni

Part II
The use of CT scanning for other stringed instruments

UNIVERSITÀ DEGLI STUDI FIRENZE
Amici del museo degli strumenti musicali di Firenze
Azienda Ospedaliero Universitaria Careggi
RCM LONDON
RIJKS MUSEUM

Galleria dell'Accademia
The Conservatorio "Luigi Cherubini" Collection
Stringed Instruments - Part II
sillabe

Galleria dell'Accademia
The Conservatorio "Luigi Cherubini" Collection
Stringed Instruments - Part II
sillabe

FIRENZE MVSEI

56 stringed instruments that were not included in the previous publication:

- European plucked instruments
- European psalteries and zithers
- Keyboard instruments
- Non-European instruments

Donato Filano, Neapolitan mandolin, Naples, 1782. **Cat. no. 3**

Successors to Wendelio Venere (Christoforo or Wendelin Eberle), Lute transformed into a tenor mandola, Padua, 1607. **Cat. no. 5**

Anonymous, Mandola popolare (*Colascione*), [Pratola Peligna (L'Aquila), late 19th/early 20th century]. **Cat. no. 10**

Anonymous, Chitarra battente, [Bisignano (Cosenza), *post* 1764]. **Cat. no. 11**

Antonio Berti (attr.), Psaltery, [Florence, first quarter of the 18th century]. **Cat. no. 21**

Anonymous, Psaltery, [Florence, *c*. 1725]. **Cat. no. 22**

Anonymous, Virginal, [Venice], *post* 1525. **Cat. no. 27**

Bartolomeo Cristofori, Oval virginal, Florence, 1690. **Cat. no. 30**

Thomas Culliford, Harpsichord, London, 1785. **Cat. no. 31**

Domenico Del Mela, Upright pianoforte, Galliano (Florence), 1739. **Cat. no. 33**

Anonymous, *Sitar* (Plucked lute), [Northern India], *ante* 1939. **Cat. no. 47**

Anonymous, *Tā'ūs*, [India], *ante* 1939. **Cat. no. 48**

Milanese mandolin

n, 1764

seppe and Carlo Fiscer

ilan, 1748-1780)

Cherubini 1988/82

Description

The SOUNDBOARD is one piece of near quarter cut Norway spruce (*Picea abies*), with the growth direction from the bass towards the treble side, and grain that is particularly narrow towards the treble. There is one narrow strip of ebony (*Diospyros* sp.) purfling let into half the depth around the edge adjacent to the soundboard and a wider strip of bone purfling. The SOUNDHOLE is covered by a rosette consisting of two overlapping layers of wood (conifer beneath, broadleaved above) on paper; there is a hexagonal-base plant motif. It is supported by three BRACES that are more or less perpendicular to the bridge and six others placed horizontally: two above the soundhole, three adjacent to it, and one below. The soundboard is encircled by a single strip of dark wood purfling. Traces of a first, and abandoned, attempt at positioning the soundhole are clearly visible on the soundboard: it is slightly lower and to the right of the existing soundhole. The TIE-BRIDGE is walnut (*Juglans regia*), the flat front is decorated with two strips of purfling in bone and a strip of mother-of-pearl separated by ebony. It is probably not original and, by way of the glue's fluorescence, can be traced back to a restoration that included adding a large piece of protective ebony set at an angle and partially covering the lower part of the soundboard and capping strip.

The BOWL consists of fifteen ribs of cypress (*Cupressus sempervirens*), with shallow fluting that alternates with ebony spacers. The glue is reinforced with strips of white paper inside the bowl. The CAPPING STRIP is cypress, with short moustaches that have no decorative motifs.

Inside the bowl, there is a printed LABEL, the bottom faces the treble side, and reads: "Giuſeppe, e Carlo Fratelli Fiſcer/ Fabbricatori d'Iſtrumenti in/ Milano vicino alla Balla./ *1764*".

The NECK is black-stained maple (*Acer* sp.), and the fingerboard comprises six mother-of-pearl plaques, with sgraffito landscape motifs alternating with narrow bone (the first, third, sixth and seventh on the joint with the neck) and complanate ebony frets, marking the position of the gut frets. The last fret before the joint with the soundbox, between the sixth and seventh fret, is covered by the soundboard; there is one mother-of-pearl decoration at the centre, and two on the sides that extend onto the soundboard forming the moustaches. Two strips of bone purfling decorate the side edges. The finely modelled bone TOP NUT is original. The black-stained pear wood (*Pyrus* sp.) PEGBOX, is elongated and surmounted by a slightly trapezoidal mother-of-pearl shield with a sgraffito plant motif, with two sets of twelve similar lateral pegs: five are rosewood (*Dalbergia* sp.) and seven smaller ones are boxwood (*Buxus Sempervirens*). The front sides of the two pegbox flanks are decorated with mother-of-pearl plaques with a sgraffito geometric motif of alternating light and dark triangles.

Dendrochronological dating

Three different readings were taken on different parts of the soundboard to exclude sampling errors. The series of 64, 81 and 72 rings made it possible to construct a mean chronology of 89 rings dated to 1758 with the Reference chronology AMC01, T_{BP} 6,23, Glk 74,20***, and several others. The dating can be considered reliable.

State of conservation

The instrument is in fair condition. It was restored once, but neither the date nor restorer are known. At that time the tie-bridge was reconstructed, the bottom edge of the soundbox was reinforced with wood on the outside and some pegs were replaced. There is a crack along the entire length of the soundboard slightly to the left of the axis of symmetry. The bowl is in good condition but the capping strip has a long horizontal crack due to shrinkage. There are evident traces left by gut frets on the edges of the neck near the edge of the fingerboard.

Historical documentation

The first certain documentation of the instrument being in the collection is the 1911 catalogue.

Critical history

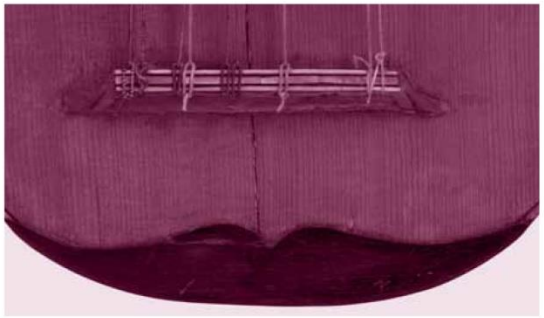
The first mention of this instrument, which was probably already in the Conservatorio Cherubini Collection, dates from 1884 when Valdrighi, immediately followed by De Piccolellis (1885), based the biographical information about the two Milanese makers on this label.

In 1911 Bargagna defined it as a "small, carefully made instrument" and transcribed – as De Piccolellis already had – the text of the label. However, he incorrectly gave the year of fabrication as 1763, an error that was repeated by Vannes (1979[2]). Gai (1969) corrected the date to 1764. In 1980, the mandolin was displayed in the exhibition held in Palazzo Vecchio and Palazzo Pitti; the catalogue highlighted the fine construction.

Stylistic notes

All the fundamental parts of the instrument are intact, and the restoration did not compromise its legibility. It presents all the features of Milanese mandolins made during the second half of the eighteenth century (six double courses, gut frets); the materials and decorations place it in the upper bracket of production.

The attribution to the Fiscer brothers, as per the label, can be fully confirmed on the basis of a stylistic comparison with



two other surviving instruments from their workshop: the one in Milan, Castello Sforzesco, inv. no. 212, from 1759; and the Eisenach instrument, Bach Haus, cat. 1976 I-11, from 1780. Comparing this instrument to the one in Milan, we see that the style is the same, as is the motif on the rosette (here supported by three rather than five braces), the sophisticated decorations on the fingerboard and the shield on the peghead and the way it is curved (however, there is a slight difference in the angle of the shield with respect to the fingerboard). The capping strip, though not identical, is similar.
The mandolin presented here is slightly bigger than the one in Milan (Overall + 23 mm; diapason + 16 mm) not because the neck is longer (the neck of the Milan instrument has been shortened, and now is identical in length to this mandolin's neck) because the bowl comprises two more ribs. These features are shared with the instrumented dated 1780 which also has the same number of braces under the rosette and is decorated with the same materials and motifs.

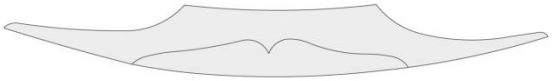
Exhibitions

Antichi strumenti, Florence, Palazzo Pitti, 1980
Antichi strumenti, Florence, Palazzo Vecchio, 1981

Dimensions	Length	Width	Depth
Overall	561	190	100
Vibrating string	311	–	–
Diapason on the soundboard	208	–	–
Soundboard	272	190	–
Ribs	3-18	–	1.4-1.8
Soundhole	Ø 71	–	–
Fingerboard	102	46-61	–
Head	210	40-23	–

Distance from the centre of the rosette to the where the neck meets the soundboard: 110
Distance of the frets (corresponding to their positions) from the from the top nut: 18, 33, 50, 65, 78, 91, 103
Inclination of the pegbox with respect to the fingerboard: c. 20°

Outline of the capping strip

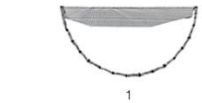


References

Valdrighi 1884, p. 31
De Piccolellis 1885, p. 29
Bargagna 1911, pp. 37-38
Lütgendorff 1922, p. 139
Gai 1969, p. 153 (with diagram)
Heyde 1976, pp. [34-35]
Vannes 1979², p. 107
Antichi strumenti 1980, p. 82 (with colour photograph)
Museo degli strumenti musicali 1997, pp. 217-218

T.R.

Tomographic scans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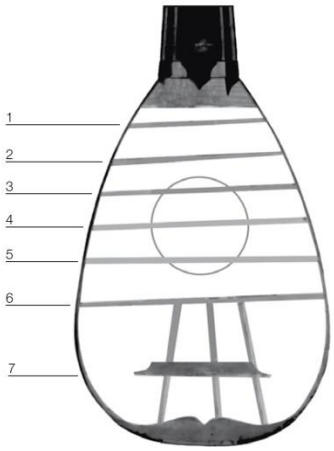


- Ilario Menchi (Unità Diagnostica per Immagini dell'Azienda Ospedaliera di Careggi)

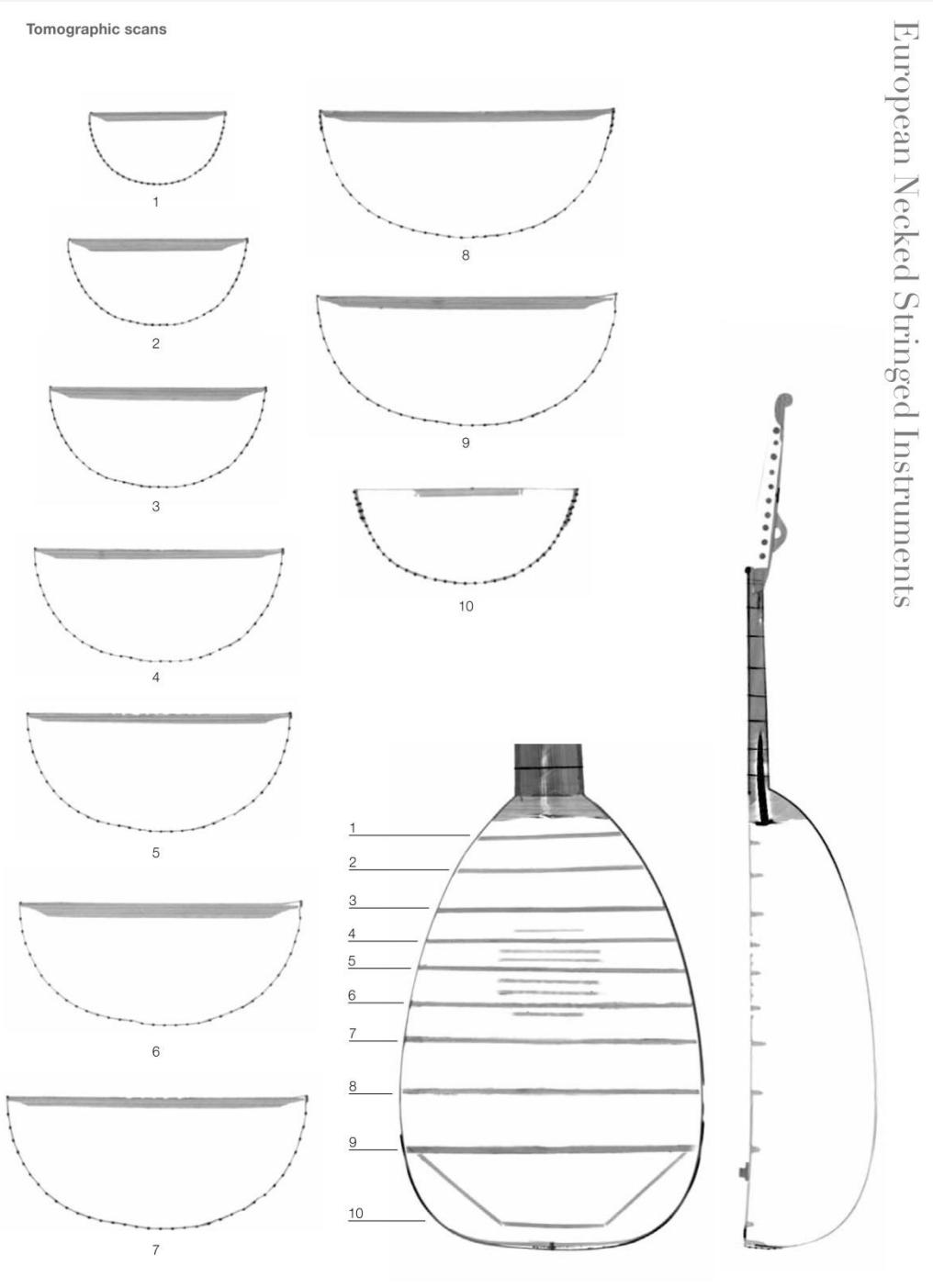
- Marco Fioravanti (Università di Firenze)

- Gabriele Rossi Rognoni (Università di Firenze/Royal College of Music)

- Giovanni Paolo Di Stefano (Università di Palermo/Rijksmuseum)

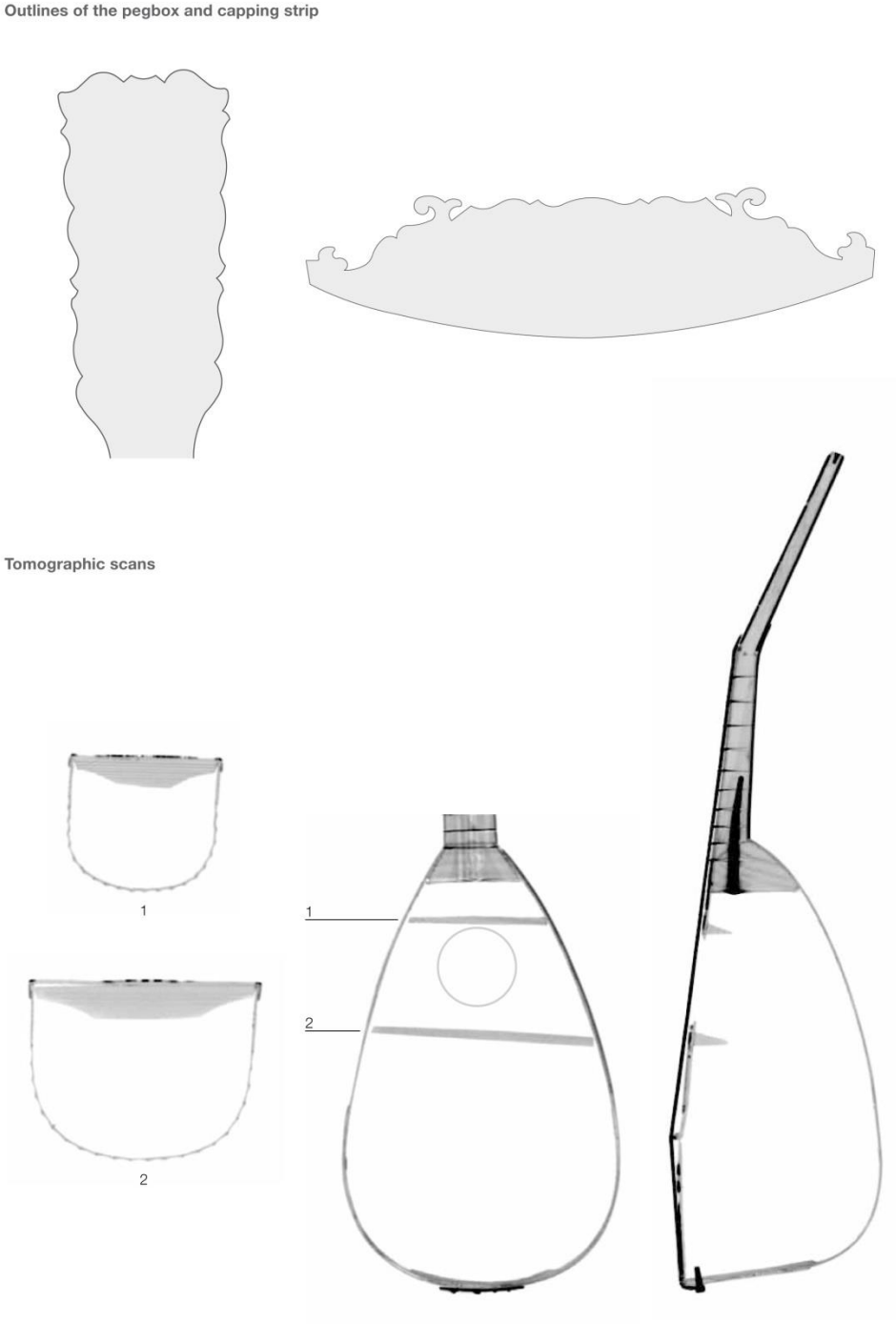
- Emanuele Marconi (Milano)

- **Plane view of the soundboard**
- **A longitudinal section along the centre-line of the instrument**
- **Transverse images of the soundbox at the soundboard ribs**

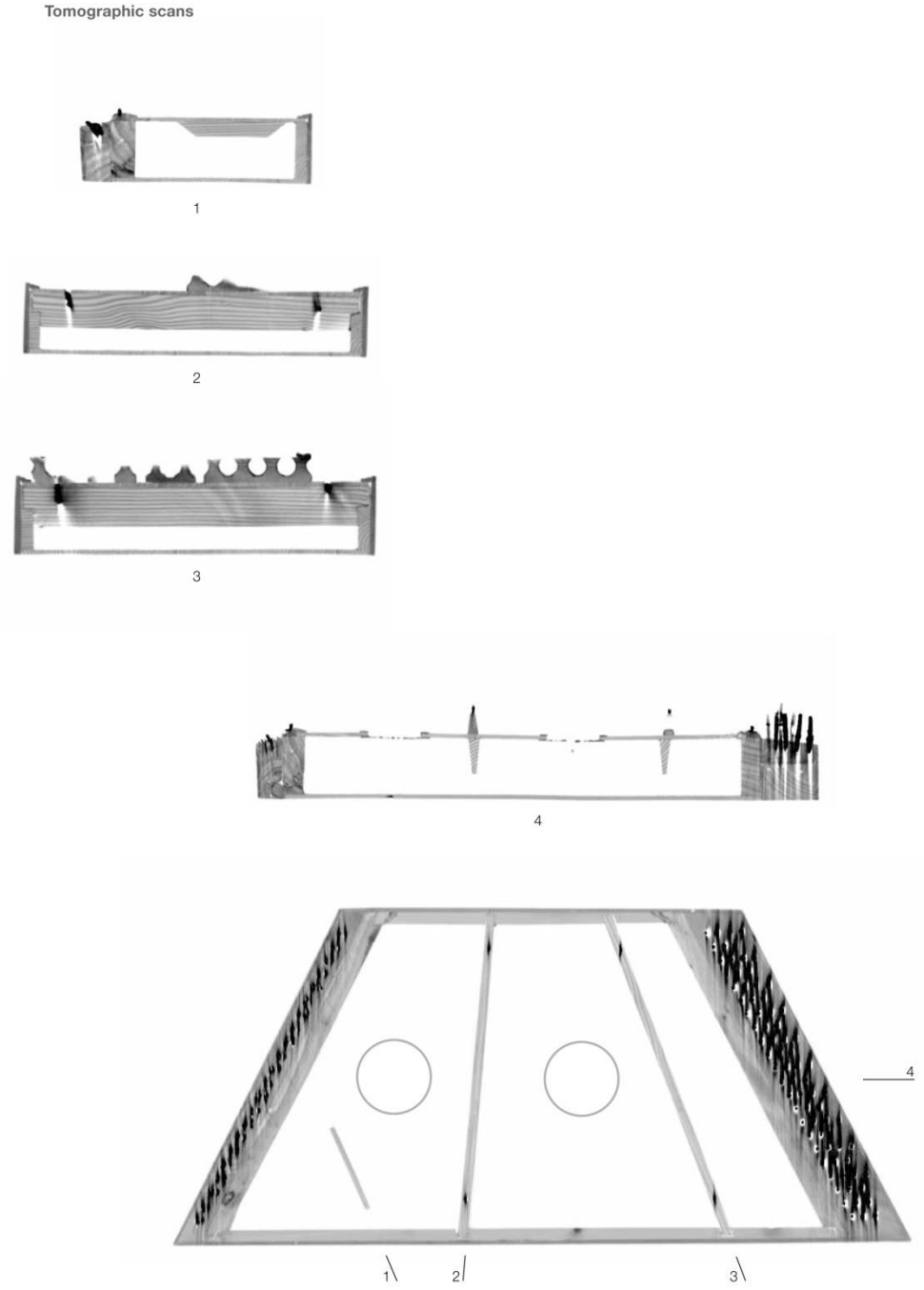


Necked stringed instruments

Neapolitan mandolin
Naples, 1782
Donato Filano
(*fl.* Naples, 1763-*post* 1783)

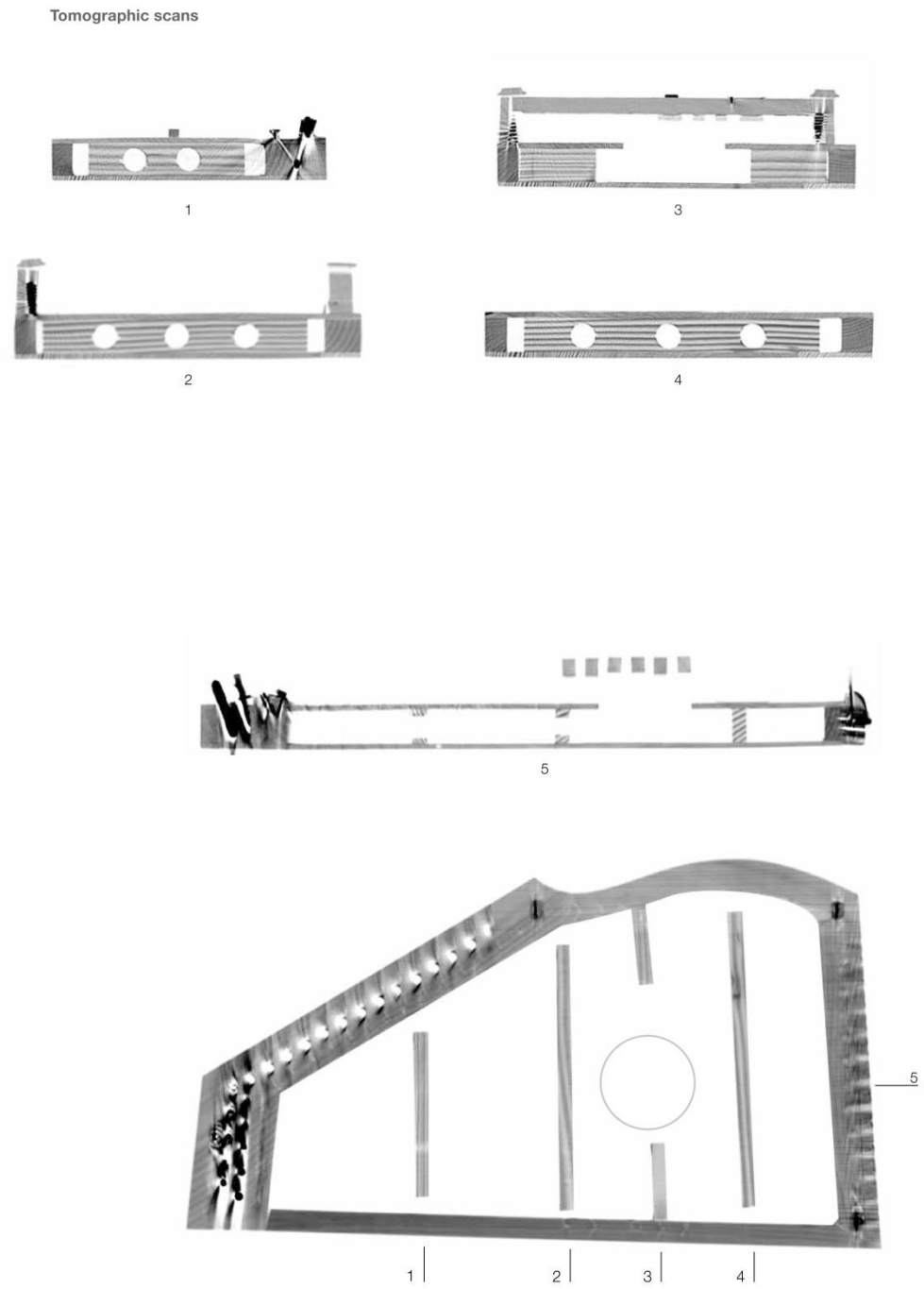


Psalteries



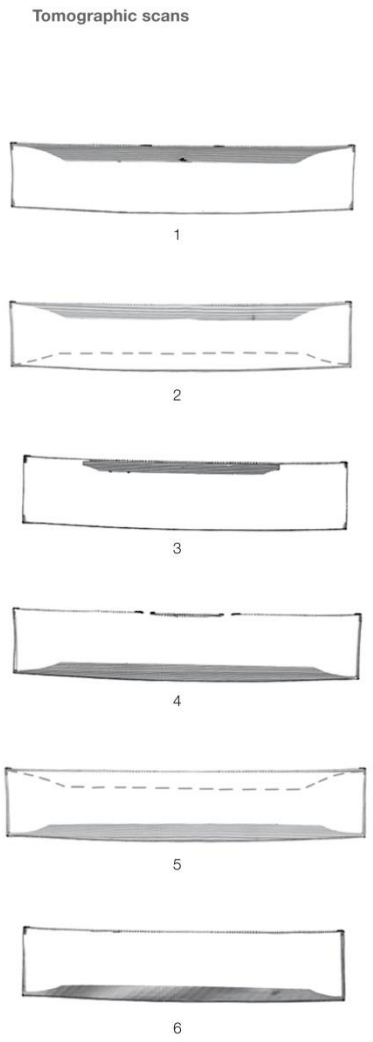
Psaltery
[North-Central Italy, first quarter of the 18th century]
Anonymous

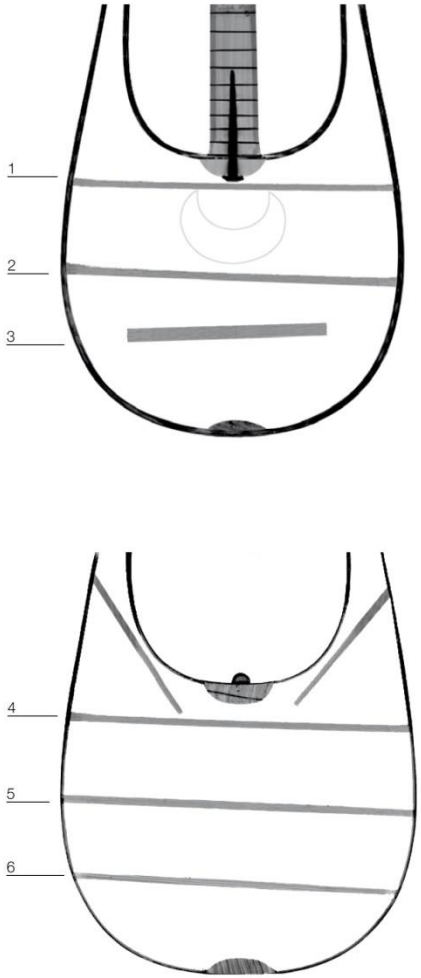
Zithers



Accord-zither (Auto harp)
Dresden, [*c*. 1900]
Julius T. Müller
(*fl.* Dresden, late 19th - early 20th century)

Number, type, shape, size and positions of the ribs





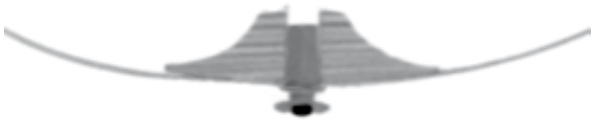
Lyre guitar
Naples, 1811
Gennaro Fabricatore
(*fl.* 1790-1832)

Details of internal reinforcement elements

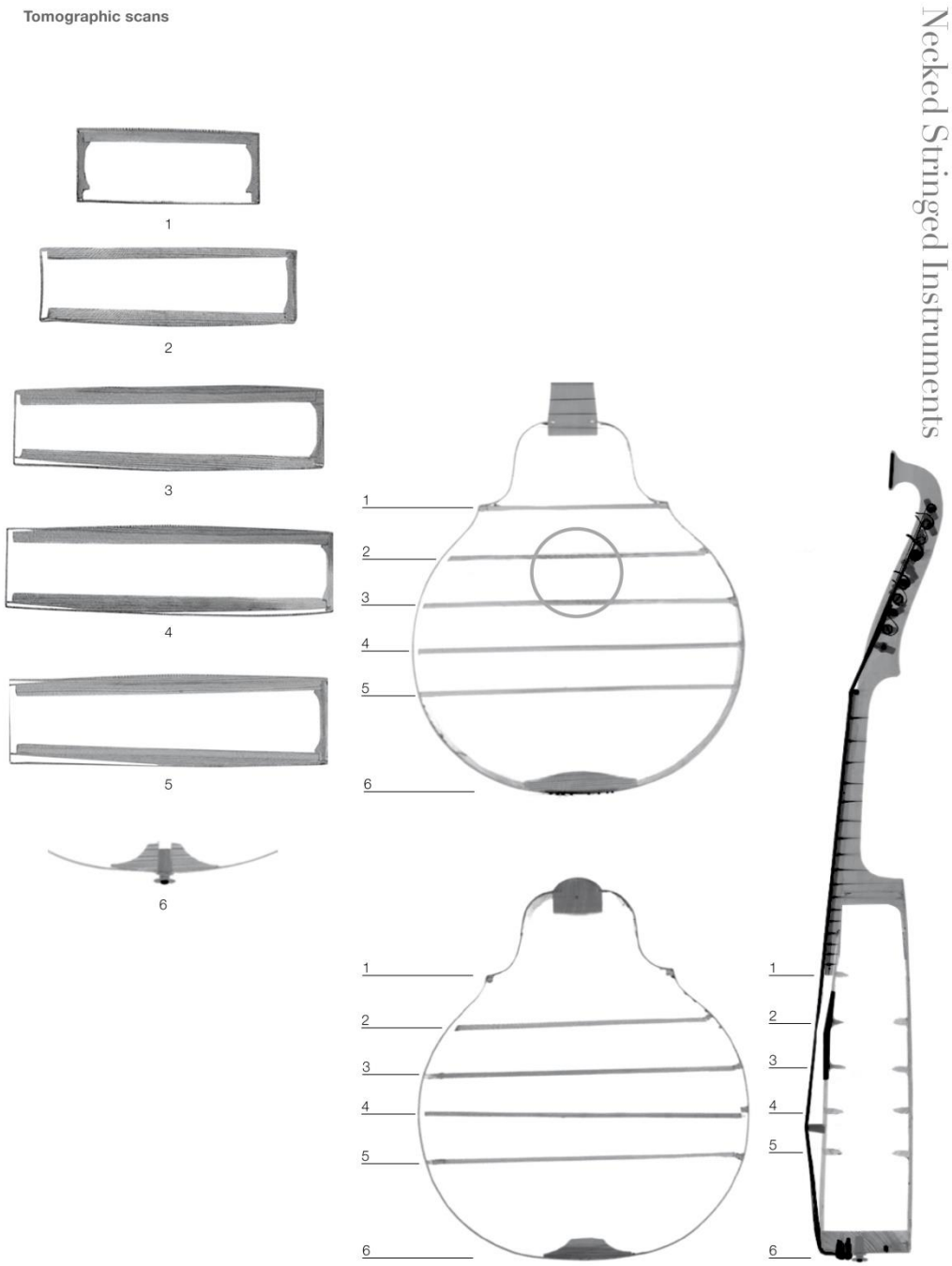
Mandola popolare (*Colascione*)
Pratola Peligna, late 19th century
Anonymous

Milanese mandolin
Milan, 1764
Giuseppe and Carlo Fiscer
(*fl*. Milan, 1748-1780)

English guitar
[London, mid-18th century]
John Frederick Hintz
(Greifenhagen, Moravia 1711-London 1772



State of conservation and restorations



English guitar
[London, mid-18th century]
John Frederick Hintz
(Greifenhagen, Moravia 1711-London 1772)

Traditional X-ray analysis

description is an exact match to our instrument. Furthermore, the document states that the machine stop made it possible to achieve dynamic changes gradually or suddenly, creating sounds much like those of the pianoforte that was already popular in England during the period.
As to the authenticity of the machine stop on the instrument described here, the qualitative difference between some mechanical parts (such as the main and the three secondary springs) and the obvious modifications such as the hand-widened slots on the plates of the 8' and lute registers – factors that led Mobbs and Mackenzie to maintain that the harpsichord is not in its original state (Mobbs - Mackenzie 1994, pp. 39-40) – could be due to the use of parts made in series for two-manual instruments. By making a few modifications and adding some parts, it was possible to adapt the same components to making one-manual harpsichords for which there was a smaller market, potentially making production less expensive because they were built with series-made parts.

Exhibitions

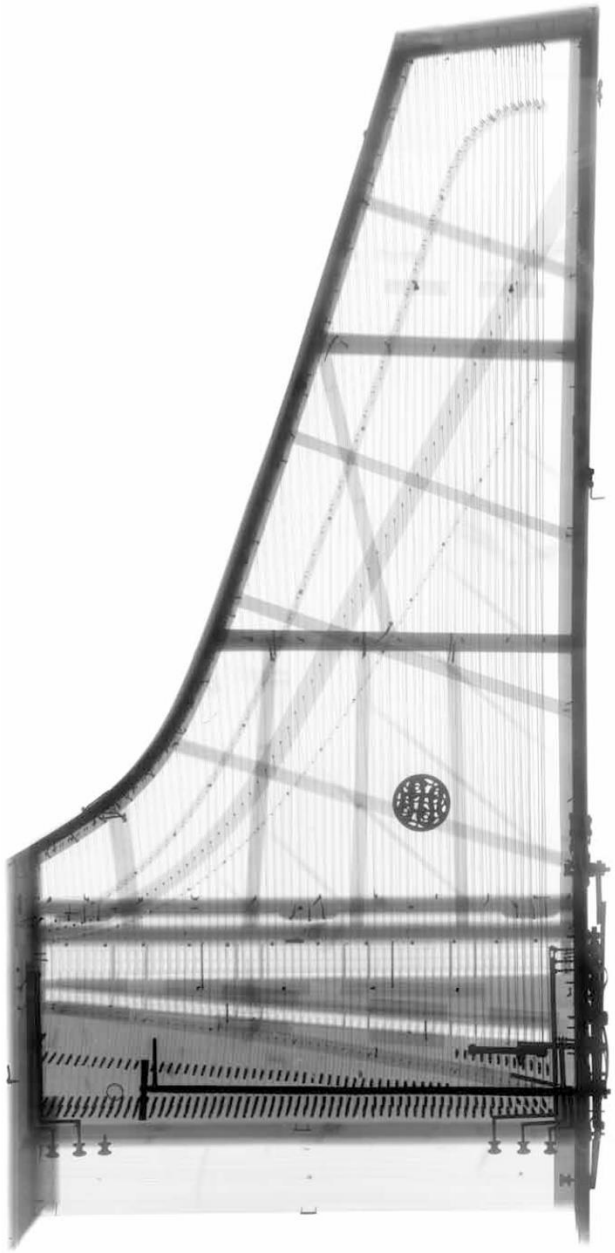
Antichi strumenti, Florence, Palazzo Pitti, 1980
Antichi strumenti, Florence, Palazzo Vecchio, 1981

References

Bargagna 1911, p. 42
Gai 1969, pp. 163-154
Antichi strumenti 1980, p. 93
Mobbs - Mackenzie 1994
Mobbs - Mackenzie 2002
Nex 2004
O'Brien 2009

G.R.R.

X-ray



31. Harpsichord
London, 1785
Thomas Culliford
(Penzance, 1747-London?, 1821)

15

Details in woodwind instruments deserving special attention for imaging

Tom Lerch

Details in **Woodwind** Instruments

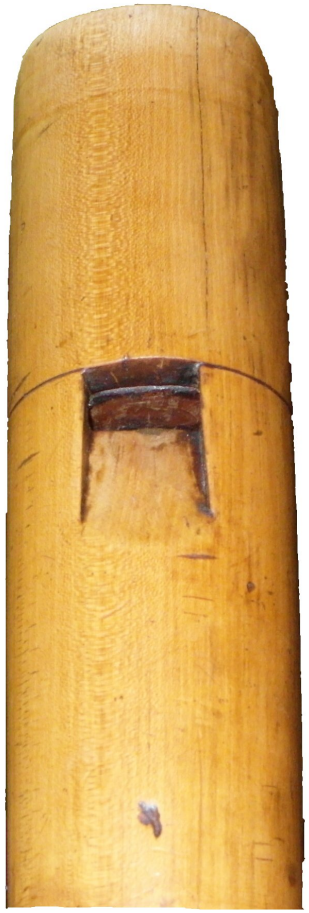
deserving special attention for imaging

Tom Lerch

Musikinstrumenten-Museum
Staatliches Institut für
Musikforschung

21. Mai 2015

Acoustics



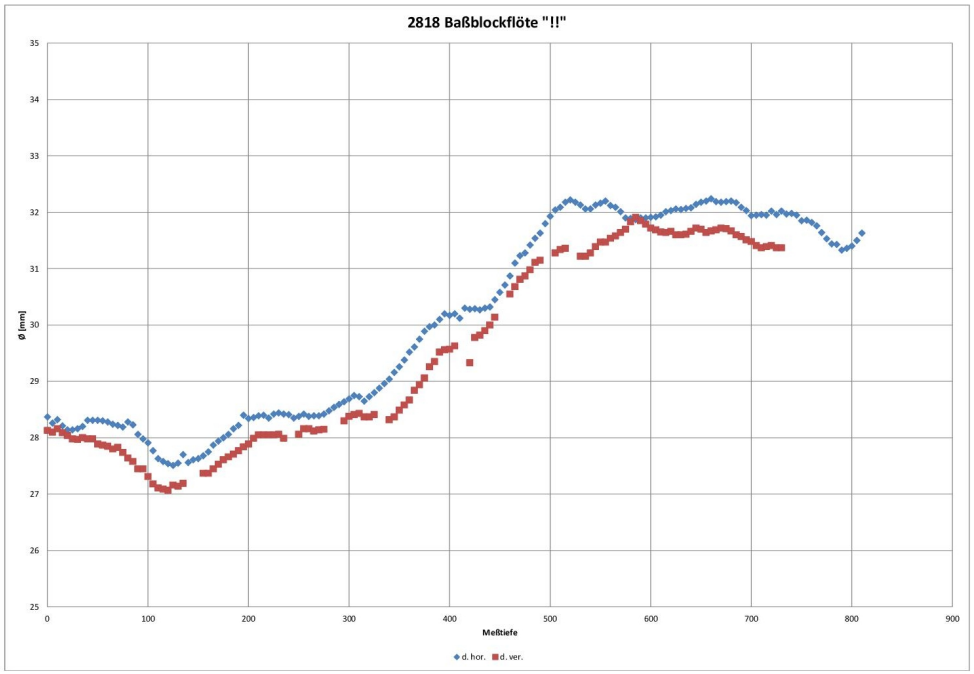
The acoustic of woodwind instruments is i. a. defined by:

- 3D-shape of bore
- position of mouth- and toneholes
- 3D-shape of mouth- and toneholes
- position and size of window and labium
- 3D-shape of windway
- mouthpiece (single or double reeds)

Measuring

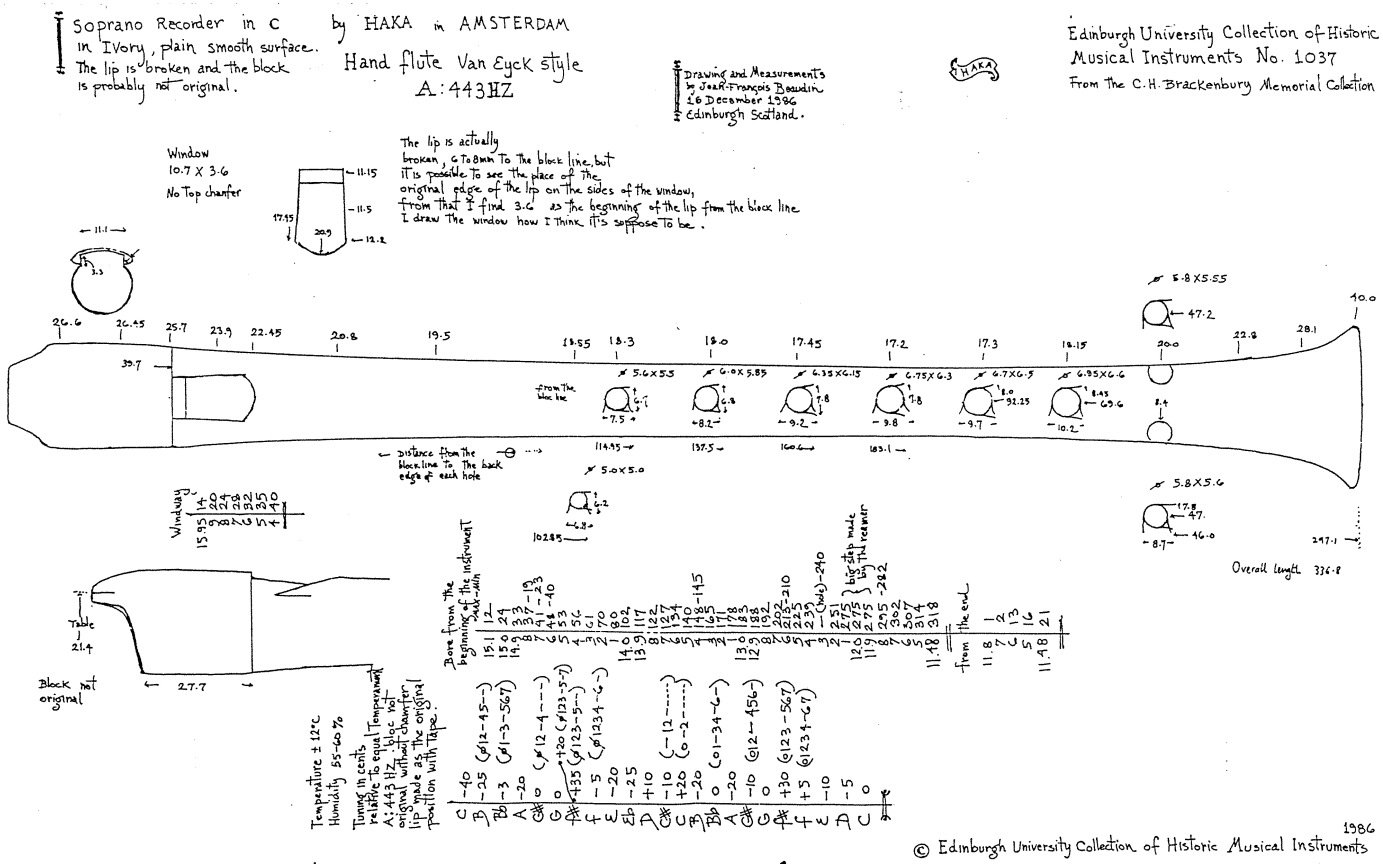
Measuring and evaluating these parameters is not trivial:

- bores are relatively narrow and deep
- bores are deformed in longitudinal and transverse section
- bore shapes may be convex or curved
- corpus material may be susceptible or damaged



MIM 581 *Oboe da caccia* by Johann Gottfried Bauer

EUCHMI 1037 *Soprano Recorder* by Richard Haka



©J.-F. Beaudin 1986

further objects

- bassoons
- *Rankette*
- double reed mouthpieces
- restorations and damages
- zink mouthpieces

Details in **Woodwind** Instruments

deserving special attention for imaging

Tom Lerch

Musikinstrumenten-Museum
Staatliches Institut für
Musikforschung

21. Mai 2015

Fraunhofer EZRT

DFG Deutsche Forschungsgemeinschaft

GERMANISCHES NATIONAL MUSEUM

WoodMusICK FPS COST Action FP1302

MUSICES

16

CT scanning: the uses for museums and makers

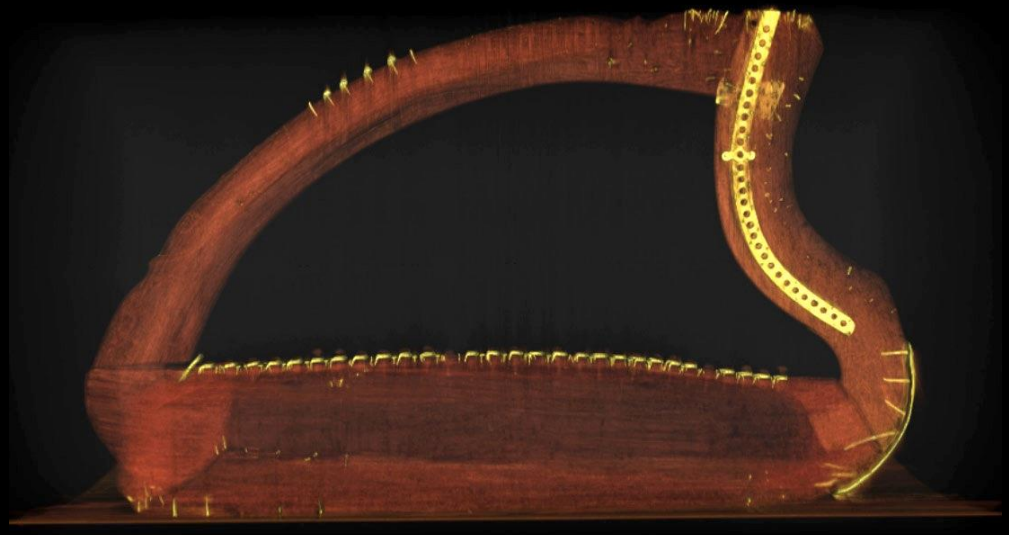
Darryl Martin

The Queen Mary and Lamont harps
National Museums Scotland

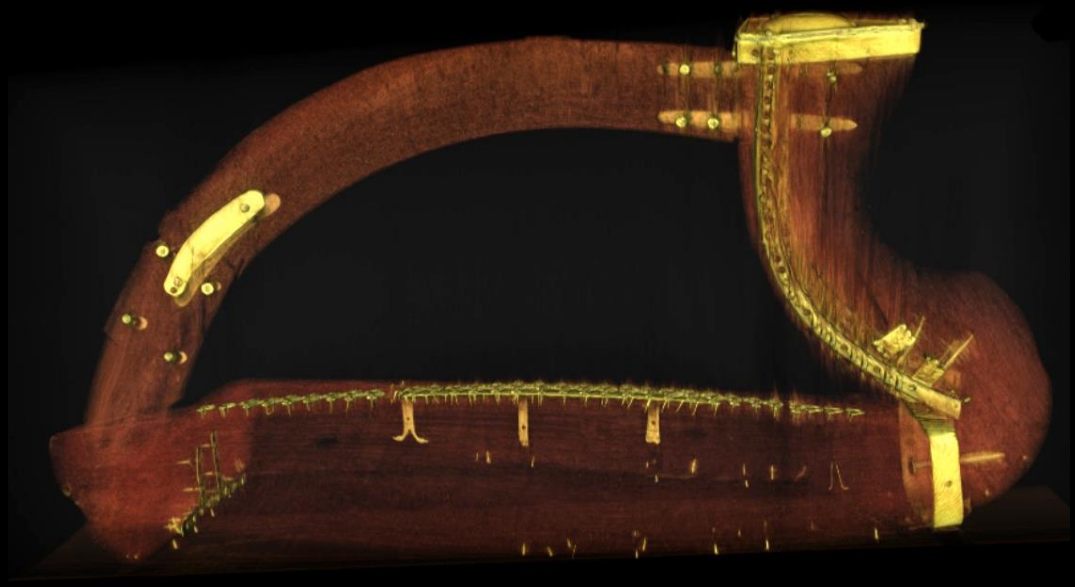
CT scanning the Lamont harp at CRIC

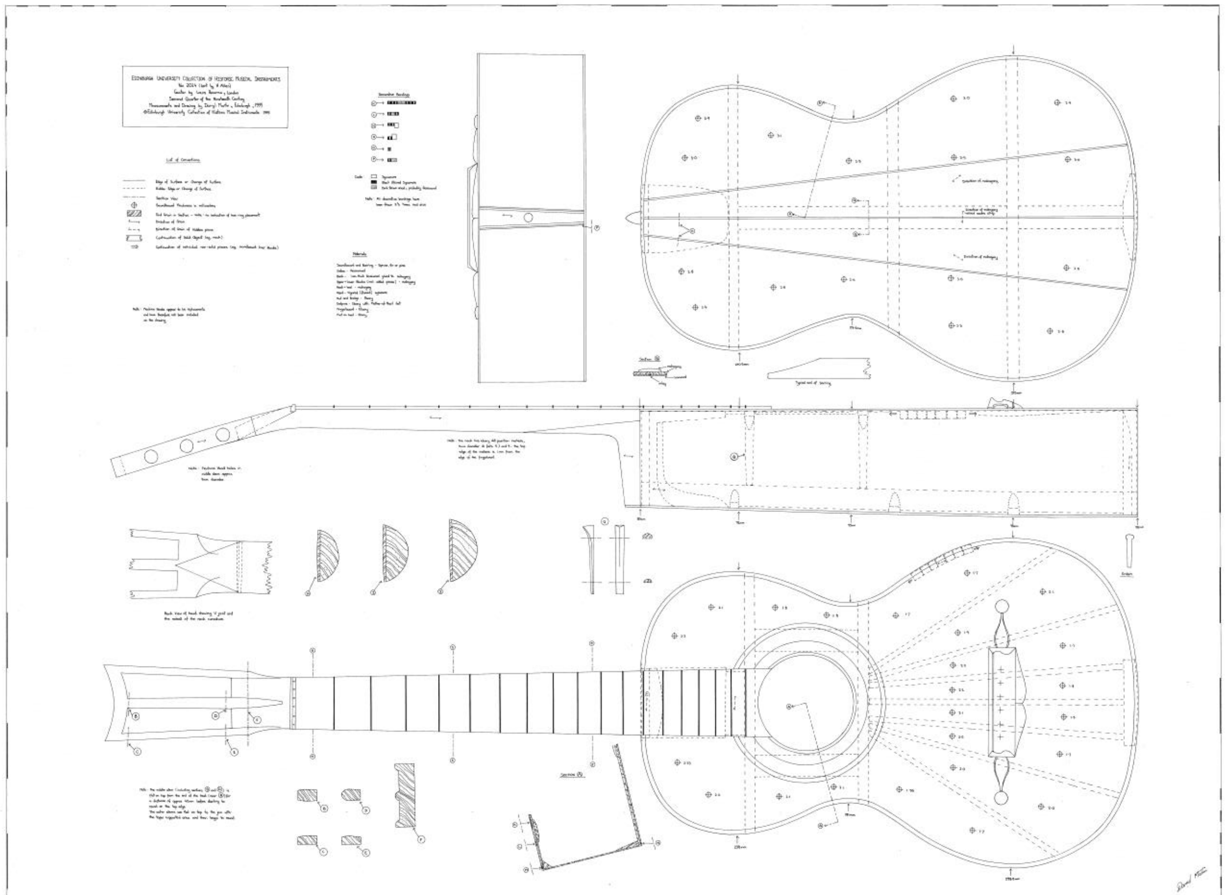
(l – r) Martin Connell, Tessa Smith, Jim Tate, Karen Loomis

The Queen Mary Harp
rendering from CT scan



The Lamont Harp
rendering from CT scan

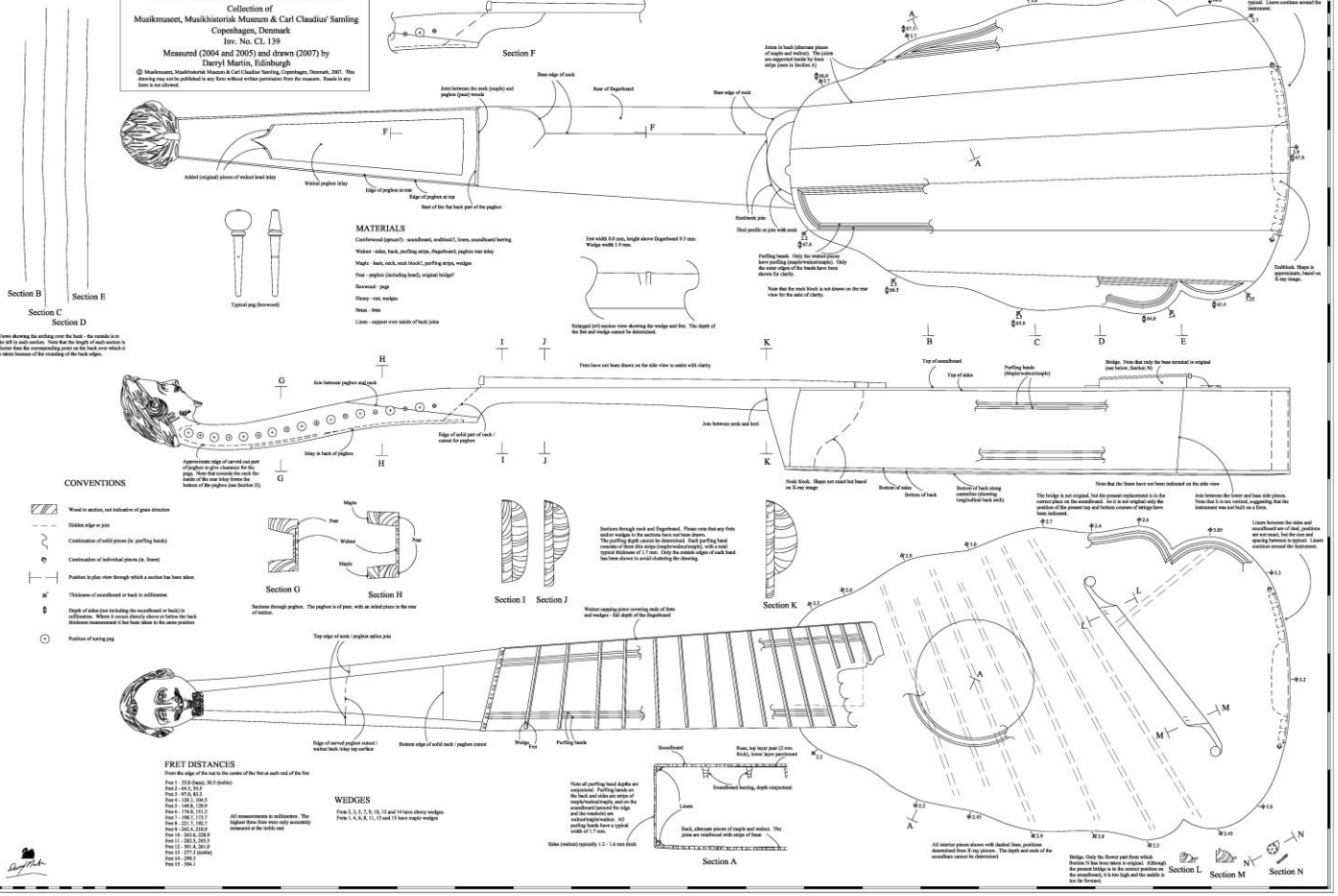



Edinburgh University Collection of Historic Musical Instruments
List of Conventions

ORPHARION

FRANCIS PALMER, LONDON, 1617

Collection of
Musikmuseet, Musikhistorisk Museum & Carl Claudius' Samling
Copenhagen, Denmark
Inv. No. CL 139
Measured (2004 and 2005) and drawn (2007) by
Darryl Martin, Edinburgh



Queen Mary harp
volume rendering video clip

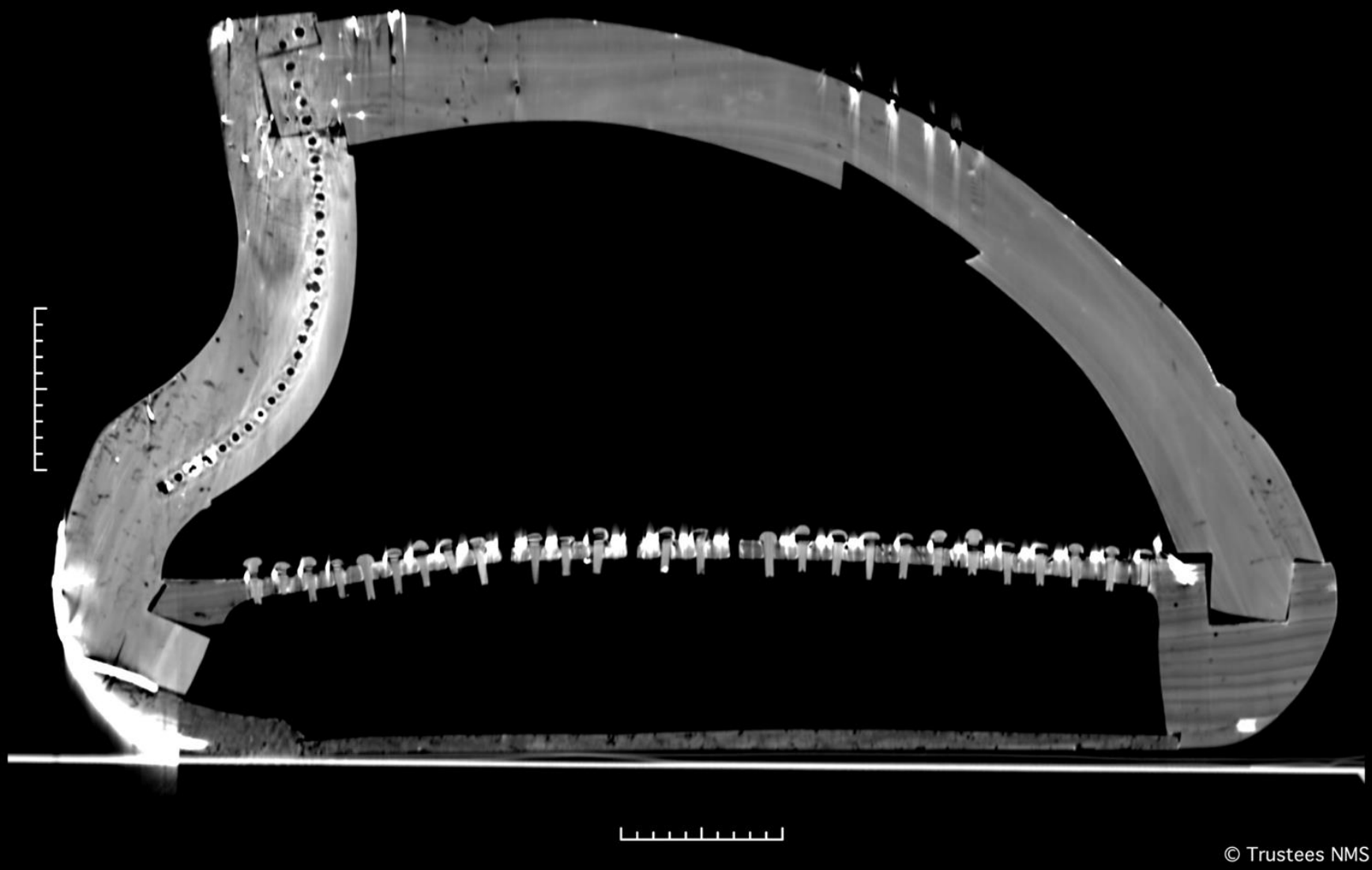
AI

IL

SR

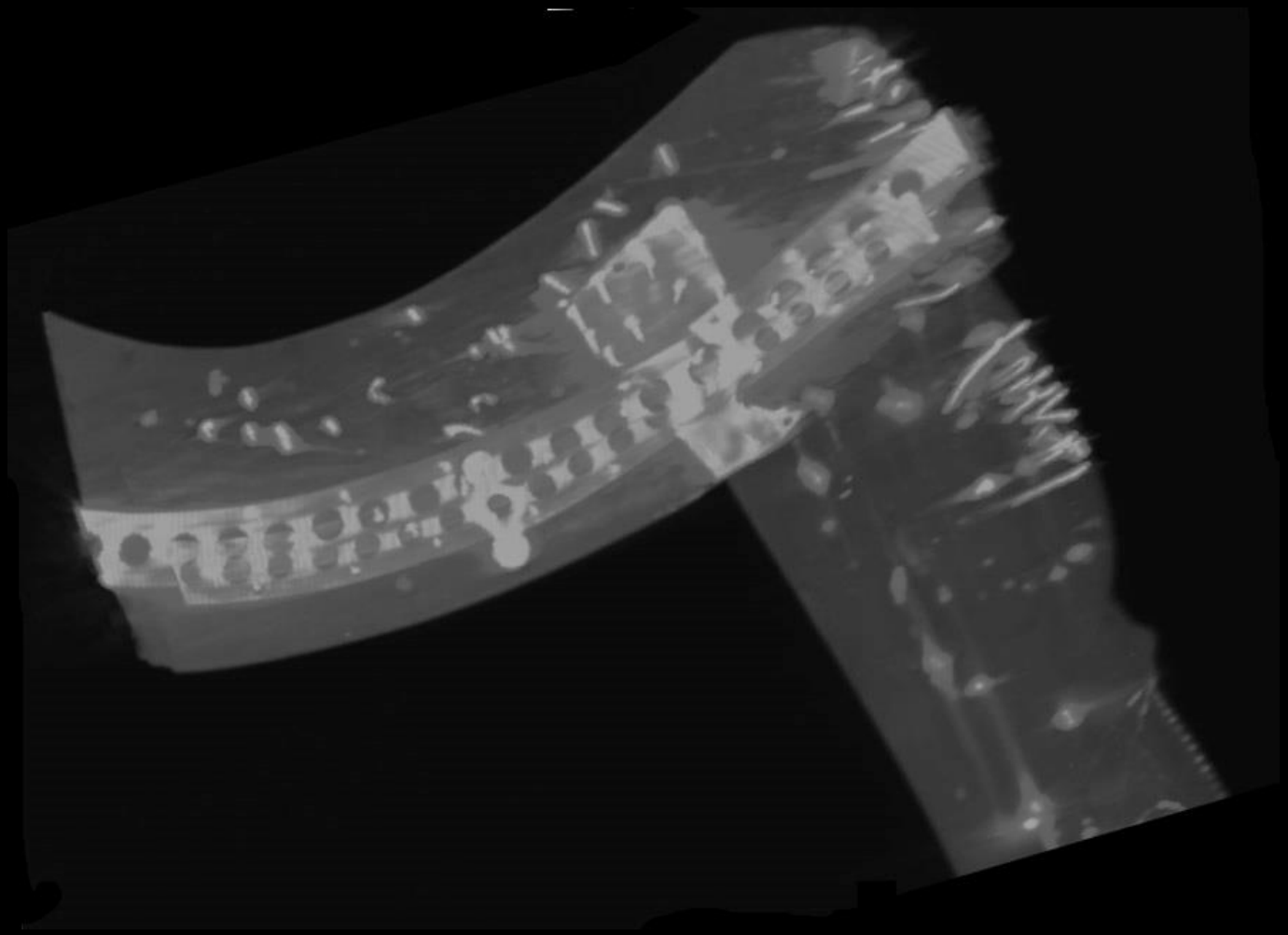
PS

OSIRIX

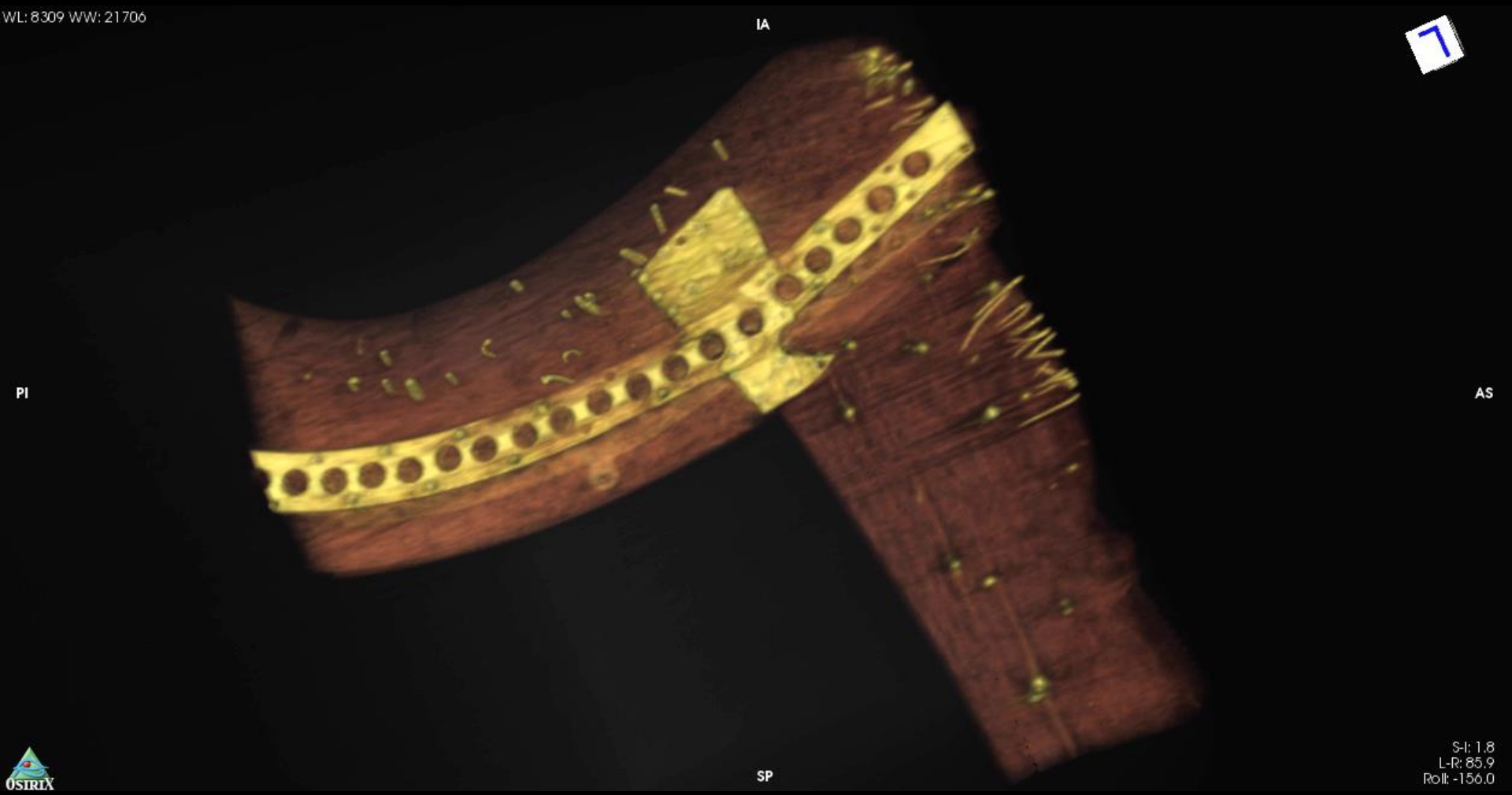


The scan of the object can be sliced along any plane to show a cross-sectional view

historical repair to the neck of the Queen Mary harp
as it appears to the unaided eye



A rendering from the CT scan,
revealing damage hidden under the metal patch



A different rendering,
highlighting metal embedded in the wood