GABRIELE ROSSI ROGNONI

The Virginals of Benedetto Floriani (Venice, *fl*1568–1572) and a Proposal for a New Attribution

The present study consists of a comparison and discussion of the works of Benedetto Floriani, one of several keyboard instrument makers known to have been active in Venice during the third quarter of the sixteenth century.[1] Three *spinette poligonali* inscribed with his name are currently known to survive, and these span the relatively short period 1568–1572. In addition, there are two unsigned instruments that may be attributed to him: a virginal (first attributed to Floriani in 1991) preserved at the Musikinstrumenten Museum Preußischer Kulturbesitz, Berlin; and one recently discovered in Florence. A comparative study of the decoration, dimensions, string scalings and case moulding has been carried out in order to assess the consistency in design of the five instruments, and to interpret the existing differences, in an attempt to combine methods mostly elaborated by keyboard instrument scholars in the past two decades towards an organic method of supporting the attribution of this model of instruments.[2] No archival evidence about Benedetto Floriani has been found in the Venetian archives, despite the extensive research carried out by Stefano Toffolo,[3] but three documents from the eighteenth century mention his name: two refer to a harpsichord – not surviving – dated 1568, that was modified by Bartolomeo Cristofori prior to 1708 by closing the second rose towards the end of the tail;[4] and one mid-eighteenth-century document mentions Benedetto, together with an otherwise unknown Domenico Floriani, in a list of 'li maestri più eccellenti nel far cembali' (most excellent masters

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[2] I am particularly indebted to the work and personal support of Herbert Heyde, Grant O'Brien, Denzil Wraight and John Koster. I also wish to thank Denzil Wraight, Grant O' Brien, Herbert Heyde, Eszter Fontana, Johnny Bell and Lance Whitehead for their comments, some of which led me to thoroughly revise my conclusions.

[3] See Stefano Toffolo, *Antichi strumenti veneziani, 1500–1800: quattro secoli di liuteria e cembalaria* (Venice: Arsenale, 1987); and Stefano Toffolo, *Strumenti musicali a Venezia nella storia e nell'arte dal 14. al 18. secolo* (Cremona: Turris, 1985).

[4] The earliest reference is found in the will of Federico Meccoli (1667–1710), court musician to Cosimo III de' Medici between 1664 and 1666; see Warren Kirkendale, *The court musicians in Florence during the principate of the Medici* (Florence: Olschki, 1993), pp.407–9. The instrument is later described in an anonymous manuscript dictionary found among the papers of Padre Martini in Bologna (I-Bc H62); see Giuliana Monatari, 'Bartolomeo Cristofori: A List and historical Survey of his Instruments', *Early Music* XIX/3 (August 1991), pp.383–96, at p.396, footnotes 32 and 43.

in harpsichord making).[5]

The earliest of the signed Floriani instruments, dated 1568, is now preserved in Florence, at the Collection of the Conservatory of Music, Musical Instrument Department of the Galleria dell'Accademia, inv. no.1988/101 (see Figure 1 in the colour section). It has been documented since 1911, when it was described in the first catalogue of the collection, unfortunately without reference to its provenance.[6] However, it was probably unknown in 1885, when Luigi Francesco Valdrighi, usually impressive in his documentation, published the earliest modern mention of this maker in his *Nomocheliurgografia antica e moderna*.[7] Here, the reference to an instrument by Benedetto Floriani made in Venice in 1571 probably refers to the instrument now in Leipzig, at the Museum für Musikinstrumente der Universität, inv. no.33 (see Figure 2 in the colour section). This instrument came from the collection of Wilhelm Heyer, who had purchased it from Alessandro Kraus in Florence. The latter had owned it at least since 1878, when the instrument appeared in the first catalogue of his collection.[8] The third and latest signed instrument is dated 1572, and is preserved at the Musée de la Musique, Paris, inv. no.D.AD.Pe.1803 (Figure 3, colour section). It was already known to Kinsky in 1910 who described it as 'Ein Cembalo mit der Inschrift "Benedict. Floreanus MDLXXII" (1572) besitzt das "Conservatoire des Arts et Metiers" zu Paris.'[9] Boalch suggests that this instrument could be the same as one sold at auction by Puttick and Simpson on 12 May 1909, whose date is mistakenly given in the auction catalogue as 1752 (probably an inversion of 1572),[10] but this may be rejected on the grounds that the Paris instrument was given to the Musée des Arts Decoratifs in 1904, five years before the auction, upon the death of the Belgian collector Emile Peyre who had previously owned it.[11]

A fourth instrument was attributed to Floriani by Horst Rase and Dagmar Droysen Reber in 1991. Currently owned by the Musikinstrumenten Museum Preußischer Kulturbesitz in Berlin, inv. no.5402 (see Figure 4, colour section), this instrument is neither signed nor dated and was bought from a private owner in 1985. The attribution, according to the 1991 catalogue of the museum, was based on:

> [...] seiner Konstruktion, den Maßen und im Dekor (u.a. Aunmaße, Stege, Profile, Klaviaturbacken, Bemalung von Klaviaturwand, Innenwänden und Springerleiste) weitgehende Übereinstimmung auf mit einem als Spinett bezeichneten signierten Instrument im Leipziger Musikinstrumenten-Museum der Karl-Marx-Universität [...] von Benedetto Floriano [sic], Venedig, 1571. Es ist sehr wahrscheinlich, daß auch unser Virginal vom gleichen Erbauer aus der Zeit um 1570 stammt.[12]

However, since the similarities between the two instruments in Berlin and Leipzig were not discussed in further details, in 1997 Denzil Wraight cautiously pointed out how

> [...] of this large list of comparisons, only the similarity of the style of decoration and the correspondence of three case measurements across the front of the instrument speak for Floriani. It may be confidently expected that the decoration of the case was done by professionals, who may have used similar designs in different instruments [...]. The keycheek outline is a good match in the curve but

[5] See the manuscript dated 1741 in the Vatican Library (Cod. Capponi Lat. 281, part II, vol.2, c. 269) identified by Oscar Mischiati, 'Un elenco romano di cembalari redatto nel 17412', *L'organo* X/1 (1972), pp.105–6.

[6] Leto Bargagna, *Gli strumenti musicali raccolti nel Museo del R. Istituto L. Cherubini a Firenze* (Florence: Ceccherini, [1911]), p.40. The instrument is further described in Vinicio Gai, *Gli strumenti musicali della corte medicea* (Florence: Licosa, 1969), pp.165–6.

[7] Luigi Francesco Valdrighi, *Nomocheliurgografia antica e moderna* (Modena: Società tipografica, 1885), p.32.

[8] Alessandro Kraus, *Catalogue des Instruments de Musique* (Florence: Arte della Stampa, 1878), p.14. The instrument is further described in Georg Kinsky, *Musikhistorisches Museum von Wilhelm Heyer in Cöln*, vol.1 (Cologne: Wilhlem Heyer, 1910), p.229 and Hubert Henkel, *Kielinstrumente*, Musikinstrumenten-Museum der Karl-Marx-Universität Leipzig, vol.2 (Leipzig: VEB deutscher Verlag für Musik, 1979), pp.12–13.

[9] Kinsky (1910), p.229.

[10] Donald H. Boalch, *Makers of the Harpsichord and Clavichord 1440–1840*, second edition (Oxford: Clarendon Press, 1974), p.44.

[11] I would like to thank Christine Laloue for this information, which does not appear in the on-line catalogue of the museum.

[12] *Kielklaviere*, ed. by Horst Rase and Dagmar Droysen-Reber (Berlin: Staatliches Institut für Musikforschung Preußischer Kulturbesitz, 1991), p.209.

other parts diverge too much that one can accept this as having been made with the same template.[13]

Furthermore the instrument is listed by Wraight among those tentatively attributed to Johannes Antonius Baffo, therefore challenging Droysen Reber's attribution.[14]

Two further instruments have been attributed to Floriani in the past. One, preserved at the Civic collection at the Castello sforzesco, Milan, inv. no.583, bears Floriani's name and the date 1567, but the model, mouldings and decoration are all very different from the other instruments by this maker, and the instrument has been re-attributed to Annibale de' Rossi by Denzil Wraight.[15] Similarly, an anonymous sixteenth-century virginal in the Victoria and Albert Museum, London, Mus. no.19–1887 (the 'Queen Elizabeth's Virginals')[16] was once attributed to Floriani on the basis of its decoration resembling that of the 1571 instrument in Leipzig; the new label in the recently renovated gallery still presents this attribution.[17] However, the instrument has now been re-attributed (with qualification) to Johannes Antonius Baffo by Denzil Wraight on the basis of its mouldings.[18] These two instruments are not discussed in the present article, since their measurements, scaling and design are distinct from those built by Floriani.

Finally, the attribution to Floriani of a fifth *spinetta poligonale*, hitherto unknown, will be put forward in this study. The instrument (Figure 5, colour section) bears a clearly fake signature 'Johannes Buffo [*sic*] 1579' and was identified in 2001 from among the some 30,000 objects of the legacy of the Florentine antique dealer Stefano Bardini (1836–1922) purchased by the Italian State in 1996 and stored in Palazzo de' Mozzi in Florence, nearby the present Bardini Museum, where the immense workshop of Bardini was located. The contents of the workshop, which included paintings, statues, furniture and medals, were intended for restoration and resale after undergoing the kind of modifications that is generally associated by organologists with Leopoldo Franciolini. In fact, according to the archival research recently carried out by Arianna Soldani on Bardini, this particular instrument is first recorded in the late 1880s, when it was inscribed 'Johannes Antonius Botto Venetus 1570'; the inscription was later changed to 'Antonio Buffo Venezia 1528', and finally to 'Johannes Buffo 1579'.[19] Apart from the signature, the instrument underwent only minor modifications, mostly due to the warping of the soundboard: some pins on the bridge and nut were added in order to displace some of the strings sideways, two screws were added through the baseboard to consolidate the structure, and finally the jacks were all replaced. The fact that the name of Baffo is frequently found in Franciolini's catalogues, while that of Floriani does not, as well as the similarity of the soundboard rose used by the two makers, probably explains the misspelled attribution. The possibility that the instrument should in fact be ascribed to Baffo may be rejected on the grounds that none of the measurements or string scaling corresponds with the instruments presently attributed to him.[20]

In the interest of clarity and brevity the five instruments discussed in this article will be

[13] Ralph Denzil Wraight, 'The stringing of Italian Keyboard Instruments c.1500–c.1650', PhD Dissertation, Queen's University of Belfast (Ann Arbor: UMI, 1997), vol.2, p.49.

[14] It should also be pointed out that Denzil Wraight was not able to study the 1568 instrument, which was at the time inaccessible, although a technical drawing made by Marco Tiella in 1969 exists and is still in circulation among makers.

[15] Wraight (1997), vol.2, p.254 (W129).

[16] See Howard Schott, *Victoria and Albert Museum, Catalogue of Musical Instruments, Volume 1: Keyboard Instruments* (London: Her Majesty's Stationery Office, 1985), pp.29–31. A date of 1594 has recently been found on the jackrail, although this is more likely to be the date when the instrument was decorated rather than constructed; see Nanke Schellmann, 'The Queen Elizabeth's Virginal. Scribbles, Scratches and Sgraffito', *V&A Conservation Journal* 42 (Autumn 2002), pp.9–11.

[17] The attribution to Floriani was first proposed in Philip James, *Early Keyboard Instruments* (London: Peter Davies, 1930), p.99.

[18] Wraight (1997), vol.2, p.50 (W299).

[19] See Arianna Soldani, 'Stefano Bardini e gli strumenti musicali', MA Dissertation, University of Florence, 2013, pp.210–12.

[20] Using Denzil Wraight's classification, these are Ecouen 1570 (W17); London, V&A, ante 1594 (W299); Stockholm, Stiftelsen Musikkulturens Främjande (W442); and New York, Metropolitan Museum of Art, 1540 (W279). Reference to instruments by other makers will be given, when possible, with the identification number assigned in Wraight (1997). These instruments were compared on the basis of the catalogues of the museums and with Wraight (1997), but were not examined directly.

indicated from now on as follows:[21]

1568 Florence: Florence, Collection of the Conservatory of Music, Musical Instrument Department of the Galleria dell'Accademia, inv. no.1988/101
1571 Leipzig: Leipzig, Museum für Musikinstrumente der Universität, inv. no.33
1572 Paris: Paris, Musée de la Musique, inv. no.D.AD.Pe.1803
Berlin 5402: Berlin, Staatliches Institut für Musikforschung Preußischer Kulturbesitz, inv. no.5402
Bardini 3385: Florence, Stefano Bardini Legacy at Palazzo de' Mozzi, inv. no.3385

DECORATION AND INSCRIPTIONS

All the instruments attributed to Floriani have painted case sides. As Berlin 5402 and the 'Queen Elizabeth's Virginals' at the V&A were once attributed to Floriani on the basis of their decoration, this aspect deserves special attention, particularly as this is an unusual feature of Floriani instruments, most Italian instruments having plain case sides and a painted outer case. While the outer case sides of 1571 Leipzig, 1572 Paris, and Berlin 5402 are all richly decorated in gold over a black background, that will be discussed in more detail later, 1568 Florence and Bardini 3385 do have the more usual undecorated case walls of bare cypress, according to the more common Italian tradition where the instrument was hidden in its outer case during performance. In both 1568 Florence and Bardini 3385, however, the front panel over the keyboard shows a geometrical decoration formed by sections of triple purfling – three layers of maple, the external ones stained black, similar to the purfling used in instruments of the violin family– crossing each other in order to form series of square diamonds (see Table 1 in the colour section, element 1) grouped in five elements, the largest and most complex one in the centre, the others progressively smaller and simpler at the sides. 1568 Florence is also decorated between these inlaid elements, and in the soundwell over the soundboard with ink and paint decorations in dark brown, red and silver/white: those on the front panel are barely visible and consist of intertwined twigs and leaves with little flowers (elements 7–8), while those on the inner sides of the case walls, are much better preserved and show large and elaborate flowers typical of the Islamic tradition (elements 9–10), surrounded by twigs and leaves (element 8), painted on all sides, apart from the front one that is invisible to the player. A composition of floral motifs in black ink is found on the inner side of the two cheeks (element 4), facing the keyboard, and similar elements are found on the namebatten both alternated to the syllables of the signature ('Benedicti Floriani Mdlxviii'), and decorating its capital letters (elements 3 and 5). Finally, an elaborate motif in gold with little flowers over a strip of ebony is painted on top of the jackrail (element 2). A similar decorative scheme may once have been present on Bardini 3385, although most of the paint has been washed away with acid, possibly to prepare the instrument for a new decoration or to remove one that was too damaged to be restored. Almost identical decorations, clearly based on the same template, if not by the same hand, survive on the panel above the keyboard (element 1), on the jackrail (element 2), and on both cheeks (element 4).

The confirmation of the authenticity of these decorations, and of their pertinence to the instruments of Benedetto Floriani, comes from a painting recently displayed at the Gallerie dell'Accademia in Venice (Figures 6 and 7, colour section). The unfinished painting portrays three men: an elderly male with a grey beard playing a five string viol; and two younger men, perhaps the viol player's sons, immediately behind, wearing identical clothes and both with their hands poised to play a keyboard instrument. The keyboard instrument for the right-hand player has not been completed, although there is a mysterious object at his feet: the stripes suggest it may be bellows, or perhaps the back of a gigantic lute in which the ribs are of alternating colours. Importantly, the left-hand keyboard player (distinguished from the other only by a rich gold and stone ring on his left little finger) is shown playing a polygonal virginal that is portrayed in such detail that it can be identified as an instrument by Floriani. The decoration matches the 1568 Florence and Bardini 3385 instruments described above, while the signature and decorative elements on the name batten (elements 3, 5 and 6) are identical to 1568 Florence, albeit dated one year later; the inlaid decoration on the panel above the keyboard (element 1) and the intertwined floral decoration on the top surface of the jackrail (element 2) also match. The painting has been dated

[21] The format 'year, present location' is used for dated instruments, while 'present location, inv. number' is used for undated instruments.

to the last third of the sixteenth century on the basis of the clothing,[22] and it is likely that the three men depicted are from a relatively wealthy family. It is tempting to suggest that the two brothers could be Benedetto and Domenico Floriani, although the young age of both, below the minimum age required for a master maker to sign his instruments, probably precludes this.

The remaining three instruments – 1571 Leipzig, 1572 Paris and Berlin 5402 – bear a striking similarity to each other and are distinct from those of the first group due to the more elaborate decoration, characterized by a thick layer of black paint that entirely covers all the case walls, mouldings and cheeks, with geometric decorations in gold, red and silver/white. In particular, the case fronts of 1571 Leipzig and 1572 Paris are decorated with six rectangular panels, three smaller ones enclosed by the cheeks above the keyboard, the lower edge of the decoration extending without interruption over the namebatten, and three larger panels: one to the left and two to the right of the keyboard. Each panel contains a central golden ovoid with notched sides, surrounded by a thick silver/white line (element 13) and decorated with interlaced twigs and little red and possibly brown flowers on 1571 Leipzig, and simply scratched in the gold layer to show the black layer underneath, in 1572 Paris. These elements are connected by a straight gold line bearing crescents between the two smaller shields at the sides. They are similar in that they are made of a gold base, a thick silver-white edge with red on gold. The same technique and colours are also used to decorate the four corners of each panel (element 11). In addition, the remaining space around these elements is filled by six symmetrical golden garlands (elements 12) and punctuated by little dots all over the surface, in groups of three on 1571 Leipzig and singly on 1572 Paris. The two outer panels above the keyboard are smaller, but otherwise identical to the others. The central keywell panel includes a central golden shield encircled by silver/white, with the inscription, scratched in the gold of the maker's name and instrument's date: respectively 'BENEDICTI FLORIANI MDLXXI', and 'BENEDICTI FLORIANI MDLXXII', surrounded by either single dots (1571) or floral elements (1572). It should be stressed that the decoration of the case front extends over its entire length, including the spaces at the sides of the keyboard that are usually invisible when the instrument is in its outer case. Therefore, the instrument requires a special type of outer case which has its front side entirely on view: the original case is probably the one on display with the instrument in Paris; the original case of the Leipzig instrument may survive in storage.[23]

In all instruments except Bardini 3385 the walls of the soundwell above the soundboard, with the exception of the front one, are also painted in black, with floral decorations of Islamic origin (elements 9–10) in gold, red, silver/white, with the addition of green, and with two kind of alternating flowers. Further gold decoration is also found on both faces of the cheeks, on the jackrail supports, on all the mouldings along the front side (elements 14–15), on the cap moulding around the perimeter of the case, and in 1571 Leipzig also on the tops and front of the sharp keys. A careful comparison of the decoration of these instruments with those discussed earlier reveals many similarities with regards both the models and elements used. Although no chemical analyses were carried out, it is evident that not only do all the colours match, but they appear to have been made with the same components, since – particularly in the silver/white colour – they show the same degree of oxidation. Moreover, the elaborate capital letters of the signature of 1568 Florence, and those of the two later instruments are clearly based on the same model, while the lower case letters are also executed in a similar font. Furthermore, smaller elements such as the little flowers, are found, almost identically, on all instruments. In particular, more distinctive ones such as the small indented leaves (element 8), are shared by the three signed instruments with Berlin 5402. Likewise, as well as the large flowers over the soundboard that although they are slightly different, are clearly based on the same model as 1568 Florence.

All the most distinctive elements in 1571 Leipzig and 1572 Paris are also found on Berlin 5402, with the exception of the signature and a 'fish scale' pattern on the mouldings (element 15) that is absent in Berlin 5402. A notable difference, however, is that the decoration on the case front is limited to the keywell area above the keyboard, the faces either side of the cheeks being undecorated, suggesting

[22] I wish to thank Isabella Bigazzi, historian of Italian costume, for her insight in this matter. Moreover, according to Doretta Davanzo Poli, 1569 is a reliable date for the painting, because of white shoes without heel (heels arrive in early 1600s), mustache pointing down (later tips go up), the collar, the cuff of the shirts, the sleeves of the jacket, the shape of the jacket, the hairstyles. I wish to thank Joëlle Morton for sharing this information.

[23] I am grateful to Eszter Fontana for this information (personal communication).

that the instrument was intended for a more traditional outer case, similar to that which must have been used for 1568 Florence and Bardini 3385. Moreover, the central shields in the three panels above the keyboard, are replaced here by three heads that are positive casts – presumably in plaster painted black and roughly gilded – from medals, surrounded by an octagonal crown motif. The heads must be considered original, since the total width of the octagonal motive is notably smaller than that of the central shields in the other two instruments and the decoration around them, checked under UV light, does not show any sign of modification.

A discussion of the identification of the heads is necessary, since it bears upon the attribution of the decoration and instrument: the two side heads are those of Francesco I de' Medici (1541–1587) and Johanna of Austria (1548–1578), who married in late December 1565; the central head depicts Philip II of Spain (1527–1587), a distant relative of Francesco.[24] The two lateral heads, therefore, set a date *post quem* for the instrument of 1565 and a date *ante quem* of 1578, when Johanna died, and Francesco immediately married his mistress Bianca Cappello under rumour that he had poisoned his former wife. Moreover, in 1991 the two lateral heads were shown to be derived from a bronze medal cast in 1564 by Domenico Poggini,[25] while that of Philipp II can now be shown to derive from a medal made by Gianpaolo Poggini (elder brother of Domenico), to celebrate the third wedding of the King of Spain in 1559, to Elisabeth of Valois (see Figures 8a and 8b, colour section).

Importantly, an extremely similar decorative scheme is found on a polygonal virginal made in Venice by Marco Jadra, signed and dated 1565 (see Figure 9, colour section), which is presently on display at the Glinka Museum in Moscow.[26] Although the instrument is built to a totally different design, that matches the other two known instruments by Jadra,[27] it shares motifs, technique, colours, and organization of the decoration with the three instruments attributed to Floriani, and could be the 'twin' of the instrument in Berlin. However, while the two lateral heads of the Jadra instrument are casts from the same 1565 medal by Domenico Poggini, the central one depicts Charles IX of France, and is a cast of a medal made by Guillaume Martin (active from before 1558 to *c*1590. Charles IX was also connected to the Medici family through his mother, Catherine de' Medici (Figures 10a and 10b, colour section).

The presence of different effigies in the position usually reserved for the donor, and the overall quality of these reproductions – very poor quality gilded plaster casts – make it unlikely that the two instruments were originally created as gifts to the Medici family on the occasion of the wedding. It is more likely that they were aimed at general customers. Indeed, the resonance of the Medici wedding was such that it could well have justified such a commercial enterprise, and the presence of very similar decorations, certainly by the same workshop, on instruments by two different makers reinforces the hypothesis that these were outsourced, with the aim of 'improving' them for the market.[28] The presence of the same decoration on all five virginals attributed here to the workshop of Floriani lends weight to the authenticity of the decoration as well as the provenance of these instruments; virginals by other makers sharing the same decorative elements may be assigned to the same *milieu* and period.[29] This hypothesis might also be extended to the series of violins supposedly made by Andrea Amati for Charles IX of France, with similarly themed decorations on the back of the

[24] In 1559 he had married Elisabeth of Valois, daughter of Henry II of France and Catherine de' Medici, a descendant of a branch of the Medici that had been separate from that of Francesco since the fourteenth century. There were strong personal and political ties between Francesco and Philip, however, following Francesco's time at the court of Spain.

[25] *Kielklaviere* (1991), p.210. For a photo of the medal see Karla Langedijk, *The portraits of the Medici, 15th.–18th. centuries*, vol.2, (Firenze: S.P.E.S., 1983), p.992.

[26] An unpublished paper raising the question of the interpretation of these decorations was presented by myself at the 41st Annual meeting of the American Musical Instrument Society (New York, Metropolitan Museum of Art, 15–20 May 2012).

[27] A polygonal virginal dated 1552, not on display, is preserved at the Pitt Rivers Museum, Oxford, inv. no.1948.1.1.1.B, and one dated 1568 is on display at the Victoria and Albert Museum, inv. no.155:1, 2-1869.

[28] As already suggested in Wraight (1997), vol.2, p.49; see also Schellmann (2002), p.9.

[29] See for example the harpsichord by Alessandro Trasuntino, Venice 1531 (Royal College of Music, London, inv. n. 2), the *spinetta poligonale* by Giovanni Celestini, Venice 1593 (Royal College of Music, inv. n. 176) and the already mentioned 'Queen Elizabeth's virginal' attributed to Giovanni Antonio Baffo, Venice 1594 (Victoria & Albert Museum, London, inv. n. 19-1887).

instruments, but which seem to show differences in manufacture that makes it hard to ascribe them all to a single workshop.[30]

At any rate, the above features point to the following conclusions:

1. The decoration of the five instruments under scrutiny share colours, motif, and organization of the elements that ascribe all of them to the same workshop.
2. Since instruments by other makers survive with the same style of decoration, this workshop did not work exclusively for Floriani. This confirms the hypothesis that the decoration of the instruments was outsourced.
3. The decoration, however, is found exclusively on a group of instruments by makers who belonged to the same area (Venice) and period (at least 1531-1594), so that its authenticity – supported also by the quality of the painted work – is more than probable.
4. Features and patterns of the decorations were used by this workshop at least for the period 1531–1594. The instrument signed by Jadra and dated 1565 provides the best match with the decorations on Berlin 5402.

As a consequence, while the decoration doesn't enable us to attribute these instruments exclusively to Floriani, it does restrict the attribution both chronologically and geographically. Furthermore, the same conclusions may be drawn from other decorative elements, such as the roses. Preserved on 1568 Florence and the two unsigned instruments only, the roses are of a very elaborate tri-dimensional hexagonal pattern, with the bottom layer painted light blue. Interestingly, the same rose design is also found on instruments by Jadra and Baffo, suggesting that this was another element that was outsourced and therefore can't be used in isolation for the attribution to an individual maker.

Finally, the two instruments 1568 Florence and 1571 Leipzig both show, on the top keylever, an inscription in black ink with a motto, written by the same hand, that connects the two instruments to a common origin. Unfortunately, only the inscription on 1568 Florence is legible: it reads 'È felice chi i suoi giorni ben dispensa' (Happy is the man who makes good use of his days); the inscription on 1571 Leipzig is too faded to read. Both Bardini 3385 and 1572 Paris bear inscriptions on the last keylever, but they are not by the same hand: the former seems to be a series of sigla, while the second is an inscription with the date of the instrument, followed by the note 'a schudi 50 fu venduto (sold for 50 scudi).

THE BASEBOARD

All five instruments considered for this study are built according to the Italian tradition, with the case sides glued around the baseboard. Moreover, they are all designed according to a rather unusual six-sided model instead of the more usual five-sided irregular polygon. This model is characteristic of instruments attributed to Floriani, and possibly Baffo;[31] it is also found on an instrument attributed to Joseph Salodiensis[32] (*fl* 1559–1574). The front and rear sides are parallel to each other, as usual, while the sixth side comes from cutting the angle between the right oblique side and the front. It is the mirror image of the other at the opposite end of the front side, but shorter, with the result of allowing space for longer bass strings in the bottom octave, while at the same time shortening the length of the front case wall to the right of the keyboard.

The baseboards of all five instruments are made from spruce. Those of 1568 Florence, Bardini 3385 and Berlin 5402 are all made from two planks: one for the body of the instrument, and an additional board for the keywell. The baseboard of 1571 Leipzig was originally made in the same manner, although a section has been replaced during a restoration. 1572 Paris is exceptional in having the entire baseboard cut from a single board.

Measurements of the five baseboards are given in Table 2. For comparative purposes, the standard deviation (SD) of these measurements is included. SD is defined as a measure of dispersion in a frequency distribution, equal to the square root of the deviations

[30] Ample and controversial literature is dedicated to these instruments. See, in particular, *Andrea Amati opera omnia: les violons du roi*, ed. by Fausto Cacciatori, (catalogue of the exhibition, Cremona, 2007) (Cremona: Ente triennale internazionale degli strumenti ad arco, 2007), whose contributions generally support the attribution of the instruments to Amati and the connection with Charles IX; and, on the opposite position, François Lesure, 'La commande à Andrea Amati : parcours d'une légende obstinée', *Musique Images Instruments*, vol.5 (2003), pp.61–70 and Karel Moens, 'Analyse des instruments conservés', in the same volume, pp.71–98.

[31] Wraight (1997), vol.2, p.162.

[32] Wraight (1997), vol.2, p.375.

Table 2. Baseboard measurements of the five instruments and standard deviations.

Measure	*1568 Florence*	*Bardini 3385*	*Berlin 5402*	*SD1*	*1571 Leipzig*	*SD2*	*1572 Paris*	*SD3*
(A) Front side. total length	1645	1645	1642	*1.73*	1646	*1.41*	1696	*36.77*
(a) Front side. left of the keywell	319	320	318	*1.00*	318	*0.71*	341	*15.56*
(b) Front of the keywell	715	712	714	*1.53*	713	*0.47*	711	*1.89*
(c) Front side. right of the keywell	611	613	610	*1.53*	615	*2.59*	644	*23.10*
(B) Angled left side	186	187	184	*1.53*	185	*0.47*	207	*15.08*
(C) Angled left back	799	794	802	*4.04*	818	*13.91*	809	*7.54*
(D) Back	328	314	307	*10.69*	279	*26.40*	309	*5.19*
(E) Angled right back	495	511	502	*8.02*	533	*21.45*	540	*26.40*
(F) Angled right side	104	106	117	*7.00*	98	*7.78*	102	*4.95*
(h) Projection of the keywell	115	117	117	*1.15*	116	*0.24*	115	*0.94*
Height of the ribs	158	154	160	*3.06*	161	*2.59*	162	*3.30*
(H) Perpendicular distance between the parallel sides	361	361	360	*0.58*	372	*8.01*	365	*3.06*
Angles (clockwise)								
(α) (between A and B)	64	64	65	*0.58*	64	*0.24*	64	*0.24*
(β) (between B and C)	130	129	130	*0.58*	130	*0.24*	129	*0.47*
(γ) (between C and D)	167	166	167	*0.58*	166	*0.47*	167	*0.24*
(δ) (between D and E)	147	148	150	*1.53*	148	*0.24*	149	*0.47*
(ε) (between E and F)	148	146	146	*1.15*	148	*0.94*	147	*0.24*
(ζ) (between F and A)	64	65	64	*0.58*	64	*0.24*	64	*0.24*

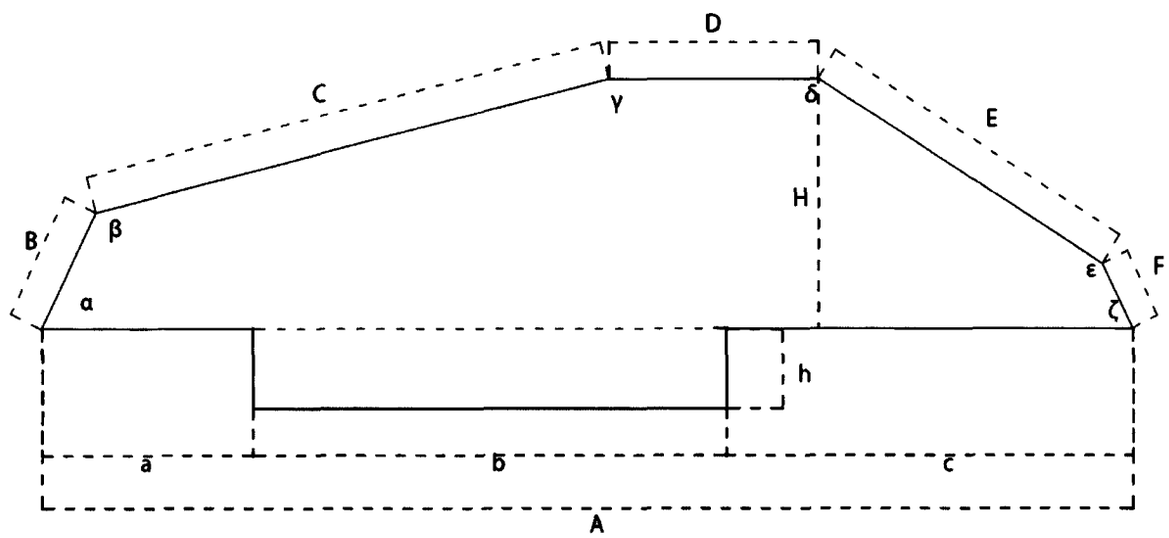

Figure 11. *The baseboard plan of Floriani virginals.*

from the arithmetic mean of the distribution; the smaller the value, the closer the correlation.[33] Since the instruments 1568 Florence, Bardini 3385, and Berlin 5402 show an extremely high correlation based on the average of their SD error hereafter, a single value is shown in column SD1 for all three.

[33] It must be stressed that this value does not take into account the value of the difference in proportion to the entire length. For example, a difference of 5mm leads to the same SD of 3.53 both if found on the long front sides, or on the very short right oblique side. A proportional use of SD was also tried in preliminary drafts of this article, but the results were less conclusive.

Table 3. Conversion of the linear measurements of the five instruments into Venetian *once* (1 *oncia* = 28.98mm).

Measure	*1568 Florence*	*Bardini 3385*	*Berlin 5402*	*1571 Leipzig*	*1572 Paris*
(A) Front side, total length	56.76	56.76	56.66	56.80	58.52
(a) Front side, left of the keywell	11.01	11.04	10.97	10.97	11.77
(b) Front of the keywell	24.67	24.57	24.64	24.60	24.53
(c) Front side, right of the keywell	21.08	21.15	21.05	21.22	22.22
(B) Angled left side	6.42	6.45	6.35	6.38	7.14
(C) Angled left back	27.57	27.40	27.67	28.23	27.92
(D) Back	11.32	10.84	10.59	9.63	10.66
(E) Angled right back	17.08	17.63	17.32	18.39	18.63
(F) Angled right side	3.59	3.66	4.04	3.38	3.52
(h) Projection of the keywell	3.97	4.04	4.04	4.00	3.97
Height of the ribs	5.45	5.31	5.52	5.56	5.59
(H) Perpendicular distance between the parallel sides	12.46	12.46	12.42	12.84	12.59

Conversely, some of the baseboard dimensions of 1571 Leipzig and 1572 Paris are significantly different, so their SD are given separately in columns SD2 and SD3. For ease of reference, various elements of the baseboard have been assigned a letter (see Figure 11) and these are used in the following discussion.[34]

The consistency of measurements (A), its components (a), (b), and (c), together with (B) and (H) within group 1 is high, with a maximum variation of ±1.5mm (in the case of A this is equal to less than 0.2% of the total length); the variation in the distance between the front and back parallel sides is just ±0.5mm, equivalent to 0.1%. Greater variation is found in the measurements of the back edge (D), with a considerable difference of 21mm between the largest and smallest value, reflected in smaller variations in all the oblique sides, and particularly on the right side of the construction (E, F), with the exception of (B), that shows a higher consistency (maximum variation of ±1.5mm, or 0.8%).

Both 1571 Leipzig and 1572 Paris have some notable differences with the other three instruments: the 1571 Leipzig has a remarkably short spine side (D, -37.3mm than the average of the first three, or 11.8%); 1572 Paris has a much longer front side (A, +52mm than the average of the first three, or 3.2%). However, these anomalies may be explained by the construction method adopted by Floriani. The inconsistent length of (D) suggests that this is a derivative measure, geometrically correlated to a variation of (H), where the longer the (H) side, the shorter becomes (D), due to the convergence of (C) and (E), providing that the angles remain, as is the case. Therefore an increase of some 11mm (or 3%) in H, as compared to the other three instruments, causes an increase in length of (C) and (E), with consequent reduction of (D).[35] In 1572 Paris, on the contrary, the measure of H matches closely that of the first three instruments, while the considerable variation in A is distributed on the two sides of the keyboard, causing the related modifications of (B), (C), (D), and (E), and (F). The size of the keyboard, both in width and projection, remains remarkably consistent for all five instruments, while the height of the casewalls, on the opposite side, shows considerable variation of up to 8mm (5%).

It is therefore evident that, notwithstanding the differences in absolute values, the five instruments derive from a common model – as also confirmed by the high accuracy of the angles – where discrepancies can be attributed to two different reasons: voluntary modification of one of the main dimensions (particularly in A, a, b, c, h, and H), and consequences of these modifications. Thus an attempt was made to interpret the measurements in terms of the local unit of measure. Since Floriani is only known to have been

[34] The values given for the angles are those actually measured on the instrument, without adjustment. Therefore, while the theoretical value of the sum of the inner angles of a five-sided polygon = 720°, the sum of the value of the instruments 'Bardini' and 'Berlin' ' = 718° and 722° respectively, with a relative error of measurement of ± 0.003, or 0.3%.

[35] It is remarkable, however, that the total perimeter of 1571 Leipzig is almost identical to 1568 Florence, Bardini 3385 and Berlin 5402: 3,556 ±3mm for all four instruments. I wish to thank Denzil Wraight for attracting my attention to this striking feature that he informs me is found in other makers, where variations in individual elements of the design of the baseboard compensate each other, leading to an almost identical perimeter.

registered in Venice, the Venetian *oncia* = 28.98mm was adopted.[36]

Concentrating on the measurements identified in Table 3 above, it can be seen that the width and projection of the keywell (b) and (h), correspond respectively to 24½[37] and 4 *once* respectively, with an average error of 0.1 and 0.004 *once* (or 2.9 and 0.1mm) well within error of manufacturing.[38] The length of the front side to the left of the keyboard (a) corresponds to 11 *once* in the first four instruments with an average error of 0.002 *once* (0.06mm), and to 11¾ *once* in 1572 Paris with an error of 0.02 *once* (0.6mm), while the section to the right of the keyboard (c) is equivalent to 21 *once* with errors spanning between 0.05 and 0.22 *once* (1.5–6.37mm), reflecting the smaller accuracy in the right side that was already noted above. 1572 Paris is exactly one *oncia* longer than the previous instrument. As a result, the total front length (A) corresponds very closely to 56¾ *once* in 1568 Florence and Bardini 3385, with minor variations in Berlin 5402 (-0.09 *once*, or 2.6mm) and 1571 Leipzig (+0.05 *once*, or 1.4mm), also small enough to be ascribed to error in design or measurement, while 1572 Paris measures exactly 58.5 once. Finally, the perpendicular distance between the parallel sides (H) is always very close to 12½ *once* (with an average error of 0.02 *once* or 0.6mm), or 12 *once* and 6 *pollici*, while 1571 Leipzig corresponds exactly to 12 *once* and 10 *pollici*.[39]

While a detailed interpretation of each instrument according to the unit of measurement falls outside the scope of this article, there is no doubt that all five instruments were designed using the Venetian *oncia*, and while in 1571 Leipzig and 1572 Paris differ from the other three instruments in some respects, these differences correspond to whole numbers of the local unit. In particular, the increased distance between the parallel sides in 1571 Leipzig may be expressed as an increase of 5 *pollici*, while the longer front side of 1572 Paris may be expressed as an overall increase of 1¾ *once* (with an additional 1 *oncia* to the right of the keyboard and 9 *pollici* to the left).

Some recurrent *ratios* among the proportions of the five virginals are also worthy of note, since they suggest that the maker may have used a proportional method when designing the instruments. However, it should be stressed that the proportions identified are not as consistent as the measurements, and so if this was the case, the method may have been in an evolutionary stage. Nevertheless, the main elements that have been identified are as follows:

1. The centre of the keyboard in all five instruments is approximately 41% of the total length of the front side, that is close to the proportion 2:3. This is true also with the increased length of (A) in 1572 Paris.[40]
2. The extension of the rear oblique sides to their meeting point in all five instruments defines the vertex of a triangle whose perpendicular projection on the front side of the instrument (HH) divides it in a ratio close to 2:1 (see Figure 12, colour section). Also the value of this measure (HH) remains almost constant in the five instruments.[41]
3. The ratio between the section of the front side on the left of the keyboard (a) and the adjacent left oblique side (B) is constant through four of the

[36] See Grant O' Brien, 'The use of simple geometry and the local unit of measurement in the design of Italian stringed keyboard instruments', *The Galpin Society Journal* LII (1999), pp.108–71.

[37] This same measure seems to have been used by other Venetian makers. See Denzil Wraight, 'A contribution to the analysis of local units of measurement in Italian keyboards', *Cembalo, Clavecin, Harpsichord, Regionale Traditionen des Cembalobaus. Symposium im Rahmen der 35. Tage Alter Musik in Herne 2010 Veranstalter und Herausgeber Stadt Herne*, ed. Christian Ahrens und Gregor Klinke, pp.72–94, at pp.93–94.

[38] Considering the accuracy of manufacture of some of the dimensions, differences of 3–8mm are considered in this article within reasonable error in layout, manufacture or measuring.

[39] Each *oncia* is divided into 12 *pollici*.

[40] The ratio between the two sides is calculated as [a+(b/2)]/[c+(b/2)] and gives the following result for the five instruments (in the same order as in Tab. 3): 0.699; 0.698; 0.698; 0.694; 0.697. The theoretical ratio of the two parts in exactly 2:3 proportion would be $0.\overline{6}\approx0.7$. However, the typical error of the actual measurements, compared with a theoretical division in 2:3, is approximately 18.5mm, well over what was defined as acceptable error in manufacture in note 38.

[41] The exact ratio in the five instruments is: 1.532; 1.520; 1.522; 1.534; 1.538. The theoretical ratio of the two parts in exactly 2:1 proportion would be 1.5. The measure of HH in the five instruments is: 415; 416; 416; 414; 420, therefore showing an error of over 14.5mm as compared to its theoretical position, too large to be considered as manufacture error as defined in note 38.

five instruments (where the two measures show a ratio approximately close to 5:3), but fails with 1572 Paris, where (B) is oversize.[42]

THE SCALING

All five instruments have the same range C/E–f³ with 50 keys (short octave without split keys), one 8ft register, with the first two notes (C and F) plucking towards the player and the others alternated with long f's (plucked towards the player) and short c's (in the opposite direction).[43] The use of single slots at the top and bottom of the compass is characteristic of all five instruments – possibly unique to Floriani – and leads to both the bottom strings C and F having a slightly longer vibrating length than they would have otherwise. Several pin holes, made during the laying out of the instrument to position the bridge, and usually corresponding with the f's, are visible

Table 4. Length, plucking point and ratio of the plucking point of the c's and f's in the five instruments.

	1568 Florence	**Bardini 3385**	**Berlin 5402**	**1571 Leipzig**	**1572 Paris**
	L Plucking point *ratio*	L P *ratio*	Length P *ratio*	L P *ratio*	L P *ratio*
C	1478 256 17%	1480 250 17%	1446 251 17%	1492 265 18%	1499 272 18%
F	1408 255 18%	1419 253 18%	1391 256 18%	1428 266 19%	1432 272 19%
c	1143 286 25%	1158 294 25%	1132 288 25%	1136 289 25%	1162 297 26%
f	942 256 27%	953 256 27%	933 245 26%	923 247 27%	935 248 27%
c^1	634 158 25%	634 156 25%	627 158 25%	630 162 26%	636 163 26%
f^1	**498** 124 25%	**500** 123 25%	**499** 131 26%	**509** 137 27%	**509** 134 26%
c^2	326 83 25%	324 80 25%	333 93 28%	342 95 28%	338 88 26%
f^2	253 81 32%	252 81 32%	256 83 32%	268 90 34%	261 82 31%
c^3	162 79 49%	159 77 48%	157 72 46%	173 78 45%	160 68 43%
f^3	129 94 73%	123 92 75%	133 81 61%	138 84 61%	130 82 63%

[42] The exact ratio in the five instruments is: 1.715; 1.711; 1.728; 1.719; 1.647. The theoretical ratio of the two parts in exactly 5:3 proportion would be $1.\overline{6}\approx1.7$.

[43] The position of the jacks in polygonal virginals causes the strings to be slightly displaced from their theoretical position, and therefore to be slightly shorter or longer than their theoretical length due to their position. Strings plucked 'toward the player' are relatively longer than those plucked in the opposite direction. For further details see Wraight (1997), vol.2, pp.187–188.

on 1568 Florence, Bardini 3385 and 1572 Paris instruments. Close observation of the positioning holes on the first two instruments revealed them to be situated on both sides of the bridge and nut, in corresponding positions, at all f-strings and one c-string: more precisely holes are found between e's and f's on the inner sides of the bridge and nut towards the vibrating length of the strings, while they are located between f's and f#'s on the other side. A further pin hole on the outer side of the nut is close to the c string on both instruments, although no other positioning holes were found at any other c. The exact position of the holes, on both sides of the bridge, the general correspondence of the scaling among the five instruments, together with the absence of any marks suggesting that the bridges were moved, strongly suggest that all pin holes are original.

A comparison of the measures of the string lengths, limited to C's and F's,[44] is given in Table 4, with the distance of the plucking point from the bridge and the percentage in brackets indicating the ratio of the plucking points in relation to the vibrating length of the string.[45] Figure 13 in the colour section shows a graph of the string lengths.

While the string lengths show a notable degree of inconsistency in the five instruments over the entire range, two notes stand out as possible design lengths. If the five instrument are taken as a single group, the best match is for the length of note c^1 (SD=4.77). However, if 1568 Florence, Bardini 3385 and Berlin 5402 are considered as a separate group, it would appear that the scalings of these three instruments were based on an f1 string length of 499mm (±1mm, SD=1) and that 1571 Leipzig and 1572 Paris were based on a slightly longer f^1 string length of 509mm (SD=0).[46] This could possibly be the reason for the longer (A) side of 1572 Paris, in an attempt to allow more vibrating space to the soundboard, particularly around the bass side of the bridges after the adoption of the longer scaling.[47] The reason for the variation in string length between the two groups, however, is not immediately clear, since its effect on the pitch of the instruments, assuming that they were all strung with the same material (iron, as the scaling strongly suggests), and that the tension and diameter of the strings remained the same, leads to a difference of slightly less than a tempered semitone between the two groups, and could therefore simply be ascribed to an attempt to improve the sound quality of the later instruments.[48]

A high level of consistency among all five instruments, notwithstanding the differences in absolute values, emerges from the analysis of the string shortening in the bass. Table 5 shows in percentage terms the coefficient of string shortening in relation to the theoretical Pythagorean length of the string, based on the length of f^1 (positive values indicate that the string is longer than the expected Pythagorean value), and the number on the right side of the column the f^1 equivalent string lengths.[49] The bottom line shows the F/f^1 ratio of the strings, a measure introduced by Denzil Wraight as the *ratio* among the scales of the bottom and central octave of the instrument, to show 'the amount of shortening which the scale has suffered in the bass compared with the treble'.[50] It is applied here to f^1, rather than to f^2 for the reasons discussed above, and derives therefore from the formula $(F/4)/f^1$.

All five instruments generally share strong similarities in the coefficient of string shortening, with the bass ones reduced by less than a half of their

[44] All strings were measured during the study of the instruments, but only C's and F's are given here.

[45] The percentage is obtained through the formula: string length : plucking point = 100 : x, or (plucking point * 100)/ string length.

[46] Although the adoption of a scaling based on f^1, rather than f^2, appears to be unusual in virginals, this feature has been identified by Denzil Wraight in some Venetian made harpsichords; see Denzil Wraight, 'A construction principle in Venetian harpsichords', paper read at the Edinburgh Early Keyboard Instrument Symposium, 25 October 2008. An attempt to analyse the scaling of the five instruments starting from f^2, rather than f^1, leads to far less consistent and satisfactory results, therefore the hypothesis that these five instruments were conceived on the basis of f^1, rather than f^2 is based here solely on the fact that it is only around this note that such an accurate match is found.

[47] I would like to thank Denzil Wraight for this suggestion. However, there is a general lack of correspondence between the variations in baseboard design and the different scalings and string spacing, apart from the element of string length. Therefore this hypothesis requires further investigation to be confirmed.

[48] The difference can be calculated with the application of Tylor's law using the formula: Frequency 1 : Frequency 2 = Length 2 : Length 1, so that the ratio between the two scalings is = 1.020, while the ratio of a tempered semitone is 1.059. I wish to thank Gabriele Bonamini for his help in this matter.

[49] The f^1 equivalent is defined as the length that the f^1 string would have applying a Pythagorean scaling to the measured string.

[50] Wraight (1997), vol.1, p.165.

Table 5. String shortening and f^1 equivalent of the f notes and bottom C in the five instruments.					
	1568 Florence	**Bardini 3385**	**Berlin 5402**	**1571 Leipzig**	**1572 Paris**
C	-44.46% 273	-45.48% 271	-45.63% 277	-45.04% 280	-44.78% 281
F	-28.81% 355	-28.95% 348	-30.17% 355	-29.86% 357	-29.67% 358
f	-5.51% 477	-4.70% 465	-6.63% 472	-9.33% 462	-8.15% 468
f^1	**0** **500**	**0** **498**	**0** **499**	**0** **509**	**0** **509**
f^2	+1.40% 502	+0.40% 510	+2.41% 489	+5.30% 536	+2.55% 522
f^3	+3.41% 492	-1.60% 528	+6.02% 486	+8.45% 552	+2.16% 520
F/f^1 ratio	0.71	0.71	0.70	0.70	0.70

theoretical length (about 45%), while the analysis of the same features on five-sided instruments of the same period shows shortenings of more than 50% in this area.[51] The coefficient is gradually reduced by a constant factor of about 2/3 in each octave (i.e.: C=44%, c=14%, c1=5%), and strings slightly longer than their theoretical values are used for f's above f^1.[52] Within this general framework, a closer correlation exists among 1568 Florence and Bardini 3385, as opposed to the two instruments dated after 1570: the former instruments show a slightly but consistently lower degree of shortening in the bass and middle range (particularly for the notes f and c^1). Moreover, the comparison of the f^1 equivalent of the scaling confirms a close correlation particularly among 1568 Florence and Berlin 5402.

A similar situation is also found for the plucking points: while their absolute values are as heterogeneous as the string lengths, their proportional position along the string is very consistent, although it still reflects small differences between the two groups: strings of 1568 Florence and the two undated instruments are plucked slightly more towards the bridge, while those dated after 1570 are plucked slightly more towards the centre by about 1% of the length of the string.

Finally, the lateral spacing of the strings and the total width of the string band is given in Table 6.[53] The figure on the left of each column shows the value of the lateral distance between a 'long' string and the next, or between a 'short' string and the next, while the value on the right is the total width of the string band between the first and the last strings ($F–f^3$).

Table 6. String spacing in the five instruments measured at the bridge, plucking point (jack slot) and nut.					
	1568 Florence	**Bardini 3385**	**Berlin 5402**	**1571 Leipzig**	**1572 Paris**
Bridge	12.37 313	12.00 298	12.12 304	12.21 307	12.18 308
Jack slots	11.57 289	10.82 268	11.31 283	10.76 269	10.82 271
Nut	11.44 288	10.47 266	10.92 278	10.39 264	10.44 264
Bridge/Nut	1.087	1.120	1.094	1.163	1.167

[51] See, for example, the instruments made by Jadra in 1552, 1565 and 1568.

[52] This is likely to be caused or emphasised by the alternation of 'short' and 'long' strings, where all f's are 'long' as described in the opening of the present paragraph. This element and the position of the pin holes already mentioned suggest that the theoretical values of the string lengths are calculated in a position between e's and f's, so that all f's – apart from f^1 – are bound to be slightly longer than their theoretical value.

[53] Lateral spacing of the strings was calculated through separate regression analyses of the measures of the short and long strings in each instrument, obtaining values that differed by a maximum of ±0.03mm. Therefore the average of the two values is given here, rather than the two separate figures.

It is evident that the measurements of 1571 Leipzig and 1572 Paris, once again overlap very accurately, while the string bands of the other three instruments show more notable differences: 1568 Florence shows the maximum spacing, leading to a considerably larger string band, followed by Berlin 5402 and Bardini 3385. This observation is correlated with the variation in the string angles: in all instruments the strings fan out, such that they are more widely spaced at the bridge than they are at the nut, with the lateral distance between the jack slots being a consequence of the other two. This situation, also found in harpsichords, improves the resonance of the bass strings, by running the strings at an angle to the front side of the soundboard, rather than being close to the soundboard edge for their entire length.[54] The ratio of the two values (string band at the bridge / string band at the nut) gives an index of the angle of the strings independent from the absolute width of the string band: the higher the value, the more divergent are the strings towards the bridge (or convergent towards the nut). This index is shown in the last column of Table 6: the smallest index of divergence of the strings is that of 1568 Florence, where strings are closest to being parallel, followed, in order, by higher values in Berlin 5402 and Bardini 3385, and finally by the almost identical two latest instruments. It is therefore clear that in all five instruments the closer the strings are to being parallel, the more widely spaced they are at the nut. In other words, strings that are more widely spaced at the nut end (as in 1568 Florence), are closest to being parallel. However, the decrease in lateral spacing is more than proportional to the increase in the angle, so that there is no point along the length of the strings of the five instruments where an identical value can be found.[55]

THE MOULDINGS

As is common in Italian polygonal virginals, all five instruments have the following mouldings applied to the case sides: case cap moulding (/1),[56] case upper edge moulding (outside) (/2), case lower edge (/4), soundboard (/20), jackrail back and front (/23 and /24), nut and bridge (/29 and /30). Impressions of all of them were taken using a dental product named EliteHD+ produced by Zhermac clinical, a bi-component paste based on vinylpolisiloxane (addition silicone) that hardens in an elastic, but shape retaining mould in about 60 seconds after the two components are mixed together. Painted surfaces were protected with ultra-thin aluminium foil, so that the edges of their impressions are less sharp than the others. However, physical comparison of slices of the resulting mould, with positive models obtained from them, shows similarities and helps identify the tools used, that are not immediately obvious from the scanned image of the slices themselves (see Table 7).

In order to compare the five instruments, four of the most complex mouldings were selected: the case cap moulding (/1), the case upper edge moulding (/2), the case lower edge moulding (/4), and the moulding at the front edge of the jackrail towards the player (/23). Table 7 gives a synopsis of the results obtained by comparing each instrument with the others. Plain numbers show a very good match, or a match among mouldings whose minor differences are explicable with the wearing of the tool, of the moulding, or with slight defects caused by the impression process; numbers in brackets indicate mouldings whose shape and series of curves match, but do not seem to have been produced with the same tool, and could therefore possibly derive from different periods in the production of the same workshop; barred numbers show mouldings that do not match.[57]

It can be seen that the only moulding that appears almost identical in all five instruments is that found on the edge of the jack rail (this moulding also matches that running around the edge of the soundboard). However, since this is the smallest and simplest of the four mouldings that have been

[54] I am indebted to Grant O'Brien for the explanation of the reason of this feature, common in all instruments I have measured until the eighteenth century.

[55] This also causes the fact that the distance of the strings at the bridge end of 1571 Leipzig and 1572 Paris is not the highest, as would have been expected if the increase of the angle of the strings were at least in the same proportion of the decrease in lateral spacing at the nut.

[56] The numbering system that is used is taken from Friedemann Hellwig, *Atlas der Profile an Tasteninstrumenten vom 16. bis zum frühen 19. Jahrhundert* (Frankfurt a/M: Bochinsky, 1985), p.35. The method used to take impressions and compare them is based on Denzil Wraight, 'The identification and authentication of string keyboard instruments', *The Historical Harpsichord*, vol.3 (1992), pp.59–161, at pp.151–57.

[57] This conclusion matches the evidence offered by the mouldings and the conclusions reached in the previous paragraphs. However, it is not possible to rule out completely the possibility that two similar, but not identical tools, were in use at the same time in the workshop.

Table 7. Comparison of the case cap moulding (1), case upper edge moulding (outside) (2), case lower edge (4), and jackrail back (23) in the five instruments.

	Berlin 5402	1568 Florence	Bardini 3385	1571 Leipzig	1572 Paris
Berlin 5402	-	1, ~~2~~, ~~4~~, 23	~~1~~, (2), ~~4~~, 23	1, (2), ~~4~~, 23	1, (2), ~~4~~, 23
1568 Florence	1, ~~2~~, ~~4~~, 23	-	~~1~~, ~~2~~, 4, 23	1, ~~2~~, 4, 23	1, ~~2~~, 4, 23
Bardini 3385	~~1~~, (2), ~~4~~, 23	~~1~~, ~~2~~, 4, 23	-	~~1~~, (2), 4, 23	~~1~~, (2), 4, 23
1571 Leipzig	1, (2), ~~4~~, 23	1, ~~2~~, 4, 23	~~1~~, (2), 4, 23	-	1, 2, 4, 23
1572 Paris	1, (2), ~~4~~, 23	1, ~~2~~, 4, 23	~~1~~, (2), 4, 23	1, 2, 4, 23	-

compared, it is also the less reliable to identify small differences. The comparison of the cap moulding (/1) along the top of the case sides also gives a good match, particularly amongst the three signed instruments and Berlin 5402. However, while the match is excellent when the two sides of the moulding are compared separately (and the profile appears to be obtained with the same tool of the sides of the jackrail, and moulding surrounding the soundboard), it is less accurate if the moulding is considered in its entirety: the central ridge of 1568 Florence is narrower, particularly than that in the two later signed instruments; and there are differences in the angles of the lateral cuts in relation to the central ridge in all mouldings, except those among 1571 Leipzig and 1572 Paris which are identical. The comparison suggests that the moulding was made by two separate cuts on the two sides, using the same tool, although the exact correspondence also of the central ridge width among the two latest instruments remains surprising, if it were carried out using this technique. Conversely, the top cap moulding of Berlin 5402 appears to be an imitation of the others (the series of the curves is similar), but obtained with a different tool, used at a very different angle (about 45°, rather than the approximate 25° of the other instruments, so that the moulding has a distinctive 'roof shaped' appearance that is not found in the others), with sharp angled lower corners, rather than the rounded ones found in the other four instruments. The upper edge case mouldings (/2) show a similar series of curves in all instruments with the exception of 1568 Florence. Nevertheless, they are obtained by three different tools: one and the same for 1571 Leipzig and 1572 Paris, and two different ones for Bardini 3385 and Berlin 5402. The (/2) profile of 1568 Florence, conversely, shows the same set of curves of the upper section of the lower edge moulding (/4) of all five instruments, although it does not seem to have been cut by the same tool. The lower edge moulding (/4) also connects accurately four of the five instruments, with the exclusion of Berlin 5402.

In conclusion, notwithstanding a certain degree of variability, at least one profile cut with the same tool is found in all five instruments, in the two sides of the case cap moulding, and/or the moulding around the edge of the soundboard, and the two sides of the jackrail. More complex sets of curves, such as the case upper edge moulding, and the case lower edge moulding, also relate the two latest dated instruments 1571 Leipzig and 1572 Paris to each other, and them with 1568 Florence (through /4), Bardini 3385 (through /4), and more loosely to Berlin 5402 that only shows a similarity in the curves of /2. The consistency of the curves, also within variations due to the use of different albeit similar tools, in a period of at least five years seems to support the idea that the mouldings were made by the workshop itself, rather than purchased from an external supplier.

CONCLUSIONS

All approaches to the comparison of the five instruments confirm their provenance from the same workshop, so that the production of Benedetto Floriani can now be extended confidently to five surviving instruments. The analysis of the decoration confirms their provenance from the same historical and commercial *milieu*, although the decorations must be ascribed to a different, albeit contemporary, workshop active in Venice at least between the 1530s and 1590s. While Berlin 5402 would at first sight look much more similar to the two instruments made after 1570, the historical event to which its decoration relates, and the even closer similarity with the instrument by Marco Jadra now in Moscow and dated 1565, both point to an earlier date for this instrument. Therefore, the different decoration of 1568 Florence and Bardini 3385 on the one hand, and 1571 Leipzig, 1572 Paris and Berlin 5402 on the other, would not point to a different date in the production, but to the existence of two different decorative schemes applied to Floriani instruments during the same period. The analysis of the baseboard measurements shows as well a high degree of conformity among the five instruments, where variations can be attributed

to modifications in the basic design, always corresponding to whole numbers – or their main divisions – through their conversion to the local unit of measurement used in Venice in that period. An impressive accuracy in the reproduction of the main measurements is found particularly in three of them – the 1568 Florence, Bardini 3385 and Berlin 5402 – therefore reinforcing the attribution of the two undated instruments to the earlier period of production, *ante* 1570, of the workshop. Differences identified in the design of 1571 Leipzig and 1572 Paris are always clearly related to the variation of one main dimension of the instrument, showing that a process of experimentation was going on in the workshop in these years, although the basic features of the model were being retained. The comparison of the scalings of the five instruments also leads to a closer correlation, based on the length of the f^1 string, among 1568 Florence and the two undated instruments Bardini 3385 and Berlin 5402 on one side, and among the two instruments dated after 1570 on the other. An accurate consistency is found, however, in the *ratios* of string shortening adopted in all five instruments, independently from the length of the f^1 string. On the other hand, the spacing of the strings appears surprisingly inconsistent in the five instruments, and it was not possible, at this stage, to interpret it according to divisions of the local unit of measurement, or any recurrent pattern. Finally, the comparison of the mouldings shows sufficient consistency to connect several of them with the use of the same tool, therefore not only supporting the attribution of the five instruments to the same workshop, but also suggesting that the mouldings themselves were produced in the same workshop as well.

nineteenth century and has contributed 25 articles to musical publications as well as reviews of books and music. He is currently studying 'Octave flutes in England 1660–1800' at the University of Oxford.

ARNOLD MYERS

Arnold Myers completed his doctorate at the University of Edinburgh with research into acoustically based techniques for taxonomic classification of brass instruments. He has contributed articles to the *New Grove Dictionary of Musical Instruments* and chapters for the books *The Cambridge Companion to Brass Instruments* and *The British Brass Band: a Musical and Social History.* He is a Professor Emeritus in the University of Edinburgh and is a Research Fellow at the Royal Conservatoire of Scotland. He serves as Vice-President of the Galpin Society and as Vice-President of Association RIdIM (Répertoire International d'Iconographie Musicale). He was the recipient of the 1991 Jason Farradane Award of the Institute of Information Scientists 'in recognition of services to information science', the 2007 Curt Sachs Award of the American Musical Instrument Society, and the 2014 Frances Densmore Prize of the American Musical Instrument Society.

ALBERT R. RICE

Dr. Albert R. Rice is a clarinetist, author, appraiser of musical instruments, president of the American Musical Instrument Society, and review editor for the AMIS Journal and Newsletter. He is a retired librarian and musical instrument curator. Rice's three books published by Oxford University Press are: *The Baroque Clarinet* (1992), *The Clarinet in the Classical Period* (2003), and *From the Clarinet D'Amour to the Contra Bass: A History of the Large Size Clarinets, 1740–1860* (2009). *Four Centuries of Musical Instruments: The Marlowe A. Sigal Collection* will be published in March 2015; and *Notes for Clarinetists: A Guide to Selected Works* (Oxford University Press) is in process. His awards include the Galpin Society's 1999 Anthony Baines Memorial Prize; the American Musical Instrument Society's 2011 Nicholas Bessaraboff Prize for the most distinguished book length publication written in English in 2009; and the American Musical Instrument Society's 2011 Curt Sachs Prize honouring lifetime devotion to scholarship related to musical instruments.

P. ALLEN RODA

Dr. Roda earned a PhD from New York University in Ethnomusicology in 2013. His dissertation was titled 'Resounding Objects: Musical Materialities and the Making of Banarasi Tabla.' Having completed a post-doctoral curatorial fellowship at The Metropolitan Museum of Art, Dr. Roda currently teaches at New York University and at Eugene Lang College, The New School for Liberal Arts. His scholarly interests include music and material culture, South Asia, actor-network theory, ecomusicology, object-oriented ontology, and organology.

ROSSI-ROGNONI

Gabriele Rossi Rognoni is Curator of the RCM Museum of Music at the Royal College of Music, London. Between 1998 and 2013 he was Curator of the Department of Musical Instruments of the Galleria dell'Accademia in Florence, and researcher in History of Music at the University of Florence. He has also been Andrew W. Mellon Fellow in Conservation and C. Coleman and Pamela Coleman Curatorial Fellow of the Metropolitan Museum of Art, and Wissenschaftliches Mitarbeiter at the Institut für Musikwissenschaft Preußischer Kulturbesitz in Berlin. Gabriele is vice president of the International Council of Musical Instrument Museums and Collections, and a board member of the American Musical Instrument Society and the Galpin Society. His publications focus mainly on stringed and keyboard instrument making in Italy during the sixteenth, seventeenth and eighteenth centuries, and also include several museum and exhibition catalogues.

ELEANOR SMITH

Eleanor Smith is a recent graduate of the University of Edinburgh where she was awarded a PhD in 2013 for her thesis *The History and Use of the Claviorgan.* As a former employee of the Edinburgh University Collection of Historic Musical Instrument and the Russell Collection, her research interests have largely focussed on keyboard instruments and their use in musical performance. As a performer she specialises in early baroque and post-restoration English vocal music, and this ties in with the accompaniment practices of the period, and continuo instruments. Currently, teaching music history at Edinburgh Napier University, she intends to expand her PhD research on the claviorgan further into the performance practice sphere.

STEFAAN VERDEGEM

Stefaan Verdegem is a researcher and cor anglais teacher at the Koninklijk Conservatorium Brussel. Being an all-round musician, for several years he has combined a freelance career as a baroque

Hawkes, through its period as Rivière & Hawkes, up to its merger with Boosey & Co. The production of the firm is described and the firm's innovations are discussed and evaluated.

Author: Douglas MacMillan

Title: Baroque Recorders in the Nineteenth Century

Abstract: It is commonly thought that the recorder ceased to exist in the nineteenth century but research by Barnes, MacMillan, Tarasov, Thalheimer and others has shown this to be incorrect. A paper published by the present author in the *Galpin Society Journal* in 2007 contained a checklist of 122 recorders of nineteenth-century manufacture but failed to distinguish between different types of recorder such as the *Berchtesgadener Fleitl, flûte douce* and baroque-style recorders. The present article concentrates on nineteenth-century baroque-style recorders emanating either from a continuing manufacturing tradition from the eighteenth century or in association with the recorder revival. 15 baroque-style recorders whose makers are identified are described, together with five anonymous instruments. It is proposed that the *csakan* and flageolet—whilst being closely related to and derived from the recorder—are separate instruments, rather than being the forms which the recorder took in the nineteenth century. A simple classification of the recorder and its derivatives in the nineteenth century is presented and it is concluded that baroque-style recorders continued to be made, albeit in very small numbers, during the nineteenth century.

Authors: Albert R. Rice

Title: A Two-Key C Clarinet attributed to Johann Scherer II, Butzbach

Abstract: A two-key C clarinet stamped 'I. SCHERER' was purchased in 2007 from an Italian dealer by the clarinetist and collector, Rocco Carbonara; the author was able to study the instrument in 2010. This article focuses on the makers of all known two-key clarinets made between 1700 and 1810 and three-key clarinets, clarinets d'amour, and alto clarinets made between 1730 and 1790. It describes the activities and instruments produced in the woodwind shops headed by Johann Scherer II (1664–1722) and his son, Georg Heinrich Scherer (1703–1778) in Butzbach, Germany, and gives a detailed description and photographs of the only clarinet known by Johann Scherer II.

The Johann Scherer II clarinet and the Jacob Denner clarinet in Brussels (no. 912) are compared, as are the eight extant clarinets by Georg Heinrich Scherer. The author concludes that the Johann Scherer II clarinet in Rocco Carbonara's collection has turning and dimensions that are very similar to Jacob Denner's clarinet. The comparison with the eight surviving Scherer clarinets suggests that the Johann Scherer II clarinet was made about 1720. It is one of the earliest extant two-key clarinets and an important example from this early period.

Author: P. Allen Roda

Title: The Tabla Past and Present: Analysis of Materials in India's Most Iconic Drums.

Abstract: The tabla is a set of harmonically complex, tonally rich, pitched drums from North India often recognized by the black circle of tuning paste applied to the head of each of the two drums in the set, or *joṛā*. Based on years of ethnographic work in Uttar Pradesh, India and analysis of historical instruments in museum collections in Europe and the United States, this article provides analysis of the materials used in the manufacture of tabla, both in the past and present, with emphasis placed on the production and impact of the tuning paste, known as *syāhī*. Much has been written about tabla performance and pedagogy, and some research has been undertaken into the structure and acoustics of the instruments. The article opens by briefly reviewing some of these published sources and commonly held opinions about the instrument to provide context for new research findings.

Authors: J Gabriele Rossi Rognoni

Title: The Virginals of Benedetto Floriani (Venice, *fl*1568–1572) and a Proposal for a New Attribution.

Abstract: This article discusses and compares five late sixteenth-century Venetian polygonal virginals attributable to the workshop of Benedetto Floriani. Three dated instruments survive with the name of this maker inscribed on the namebatten; one was attributed to this maker in 1991, since when the attribution has been questioned; and a recently discovered virginal in Florence is presented here and attributed to Floriani for the first time. The analysis of the decoration, baseboard measurements, scaling, string spacing, and mouldings are carried out with the aim of identifying the distinctive features of the work of this maker. It is also hoped that this will provide a paradigmatic method for the attribution of unsigned keyboard instruments.

Author: Eleanor Smith

Title: The English Claviorgan in the Sixteenth and Seventeenth Centuries.

Abstract: The claviorgan has been a rather neglected subject in keyboard instrument history, often relegated to a side note in the history of those