

# A VIOLA DA GAMBA TEMPERAMENT PRESERVED BY ANTONIO STRADIVARI

STEWART POLLENS



The problem of tempering keyboard and fretted instruments has occupied the attention of musicians and theorists for hundreds of years. Since the sixteenth century most fretted instruments such as the lute and viola da gamba have employed equal temperament (or an approximation of it based upon the 18:17 rule) or an adaptation of mean-tone tuning, but these systems suffered from ‘tempered’, or ‘impure’, intervals. In 1705 the music theorist Thomas Salmon (born London, 1648; died Mepsal [now Meppershall], Bedfordshire, 1706) proposed a system of intonation for the viola da gamba that employed divided frets (that is, the frets were not tied across the fingerboard in a straight line but were in effect cut apart and glued or inset beneath each string as required) as well as interchangeable fingerboards for different keys (much like the set of crooks for the later *Inventionshorn*). It was Salmon’s intention to overcome the lack of purity associated with fretting systems that ‘falsify the proportions’ and thus ‘deprive us of that satisfactory pleasure which arises from the exactness of sonorous numbers’.<sup>1</sup> In his system the C major scale was constructed of large and small whole tones having ratios of 9:8 for the intervals C–D, F–G and A–B, 10:9 for the intervals D–E and G–A, and 16:15 for the semitones E–F and B–C. The two sizes of whole tones were divided 18:17:16 and 20:19:18, resulting in the following scale<sup>2</sup>:

C 17/18 C# 16/17 D 19/20 D# 18/19 E 15/16 F 17/18 F# 16/17 G 19/20 G# 18/19 A 17/18/ A# 16/17 B 15/16 C

The idea of adapting such a system of intonation to a fretted instrument was not new (elements of Salmon’s tuning system can be found in that laid out in Silvestro Ganassi’s *Regula rubertina: Lettione seconda* of 1543;<sup>3</sup> see below), but unfortunately there are insurmountable problems associated with it – most notably the disposition of the syntonic comma.<sup>4</sup> As Mark Lindley has pointed out, with Salmon’s fingerboard fretted for the keys of C major and A minor, the fifth D–A would be a comma smaller than pure and would have a ratio of 40:27 rather than 3:2, while the thirds A–C# and Bb–D would have ratios of 108:85 and 51:40 respectively,<sup>5</sup> rather than that of a pure third, or 5:4. Salmon proposed to deal with the problem of changing keys by providing an interchangeable set of suitably fretted fingerboards, each arranged for a particular key and its relative minor. As he argued,

because the Composer begins upon any Key, and the series of Notes must take its *terminus à quo* from thence, the Instrument-maker can provide such movable Finger-boards as will serve exactly for every Key. They are taken out and put in upon the Neck of the Viol, with as much ease, as you

1 Thomas Salmon, ‘The Theory of Musick Reduced to Arithmetical and Geometric Proportions’, *Philosophical Transactions of the Royal Society of London* 24/302 (1705), 2076.

2 Salmon, ‘Theory of Musick,’ figure 1.

3 Silvestro Ganassi, *Regula rubertina: Lettione seconda pur della prattica di sonare il violone d’arco da tasti* (Venice, 1543), chapter 4.

4 The syntonic comma is a small pitch interval equal to 81:80. It is the difference between a pure major third (5:4) plus four pure fifths (3:2) less two octaves (2:1). It is also the difference between a pure major third and a Pythagorean third (81:64). Another comma that occurs in tuning is the Pythagorean (or ditonic) comma, which is the difference between twelve pure fifths and seven octaves (531441:524288).

5 Mark Lindley, *Lutes, Viols and Temperaments* (Cambridge: Cambridge University Press, 1984), 68.



pull out and thrust in the Drawer of a Table. Three, or at most five of them will be sufficient to accommodate all the Keys that are made use of.<sup>6</sup>

Despite the theoretical and practical problems inherent in this system, Salmon organized a demonstration before the Royal Society at Gresham College in 1705. He employed the services of the German viola da gamba players Frederick and Christian Stefkins and the Italian violinist Gaspar Visconti. The viola da gamba players prepared and tuned a set of instruments according to Salmon's instructions and Visconti accompanied them on the violin. In the same year Salmon published a summary of his tuning system in the *Philosophical Transactions of the Royal Society of London*. Of the musicians who assisted Salmon in this demonstration, Frederick and Christian Stefkins, both accomplished players, were the sons of Dietrich (Theodore) Stefkins (died Cologne, 1673), a noted viol player and composer who had served in the courts of Charles I and Charles II of England between 1635 and 1670. Dietrich in fact had collaborated with Salmon by transcribing a song into the new system of musical notation he proposed in 1672.<sup>7</sup> The Lord Chamberlain's records also indicate that Dietrich Stefkins sold viols to the court. Frederick and Christian began their service to the English court in 1662 and 1689 respectively, and they maintained their positions through the early eighteenth century.<sup>8</sup> The third musician, Gasparo Visconti (born Cremona, 1683; died in or after 1713), known as Gasparini (not to be confused with the noted composer Francesco Gasparini), was a prominent violinist who studied with Corelli sometime before 1702. Between 1702 and 1705 he was active in London, performing at court and in public halls and theatres. In 1704 he married Ebenezer Stefkins, a granddaughter of Dietrich Stefkins. Prior to her marriage, Ebenezer converted to Catholicism and was baptized Cristina. After leaving London, the couple settled in Gasparini's home town of Cremona, where the city's records note the birth of a daughter, Gaetana Francesca, in 1713.<sup>9</sup> It was at about this time that Antonio Stradivari used Cristina Visconti's viola da gamba as a guide in designing a cello neck and marked the positions of her viol's frets on a fingerboard pattern.

Antonio Stradivari left a number of patterns and forms for constructing the viola da gamba, including sets of patterns for seven-string basses in the French style dated 1701 and 1737, and several miscellaneous patterns for a viola da gamba dated 1684. An extant viola da gamba made by Stradivari in 1684, later converted into a cello, bears the arms of the Visconti family, but that particular instrument has no documented association with Gasparo Visconti (who was born one year before the instrument was made) or with Cristina Visconti. Of relevance, however, is one of Stradivari's paper patterns for a cello neck (Museo Stradivariano No. 308; see Figure 1) that is inscribed *A / Musura del manico del violoncello ordinari* (A / Measure of the neck of an ordinary violoncello), and on the heel *Manico della longezza della viola della Signa Christina Visconta fatta li 1707* (Neck the same length as that of Signora Christina Visconti's viol made in 1707). Also relevant in this connection are a wood fingerboard pattern (Museo Stradivariano No. 256; see Figure 2) inscribed *B / questi pontini ha la larghezza delli tasti della viola della Sig.na: Cristina Visconta* (B / these little points have the width of the frets of Signora Cristina Visconti's viol) and a small wood template indicating the curvature of the fingerboard (Museo Stradivariano No. 258) inscribed *Questo è il tondo della tappa della viola della Sig.na Cristina Visconta* (This is the roundness of the fingerboard of Signora Cristina Visconti's viol).<sup>10</sup> Ordinarily,

6 Salmon, 'The Theory of Musick,' caption for Salmon's figure 2.

7 Salmon, *An Essay to the Advancement of Musick* (London, 1672), 82.

8 Henry Cart De Lafontaine, *The King's Musick: A Transcript of Records Relating to Music and Musicians, 1460–1700* (London: Novello, 1909), 92, 94, 96, 98, 111, 121, 122, 134, 152, 157, 163, 205, 207, 209, 216, 230, 345, 394, 397, 399, 401, 402, 404, 406, 409, 411–414, 417, 421, 423, 424, 427, 428, 431, 433–435, 437.

9 Raffaello Monterosso, 'Gasparo Visconti, Violinista Cremonese del Secolo XVIII', *Studien zur Musikwissenschaft* 25 (1962), 378–390.

10 The syntax of Stradivari's inscriptions is often unclear, inviting a host of interpretations. On cello neck pattern No. 308, '1707' would appear to refer to the year Cristina Visconti's viol was made, though it may indicate when the cello neck pattern was designed or first used. From the inscription, we should not assume that Stradivari made Cristina Visconti's viol, though it is reasonable to conclude that he made a small cello for her.



Stradivari marked all of the patterns and templates for a particular model with an identifying letter (such as A, B, P, S, T, Q, etc.) or pair of letters (such as PG or MB). The fact that two letters, A and B, are found on the neck and fingerboard patterns of Cristina Visconti's cello is inexplicable.

The neck pattern (Museo Stradivariano No. 308) has a nut-to-heel length of 269 mm and a scroll height (measured from the nut) of 195 mm. The pattern has a cello-shaped heel (rather than the truncated type used in viols with canted backs) and a cello-style pegbox that would appear to accommodate four pegs. Thus this is clearly a cello neck pattern (as the inscription indicates) rather than one used to construct a viola da gamba neck.<sup>11</sup> The fingerboard pattern (Museo Stradivariano No. 256) has a length of 449 mm, with widths of 29.5 mm at the nut and 61.5 mm at the lower end. There is also a score line that would appear to mark the position of the characteristic 'baroque notch' (the point where the fingerboard is cut back so that it can overhang the upper edge of the instrument's belly). This line is 280.5 mm from the top of the pattern, which would appear to be somewhat too far down from the nut for neck pattern No. 308 and more in keeping with neck pattern No. 276, which, like the fingerboard pattern, is marked with the letter B.<sup>12</sup> Two opposing arcs spaced at 30 mm presumably indicate the thickness of the fingerboard at its stoutest point, which is just above the notch. Though the length and upper and lower widths are consistent with those of a cello fingerboard (as opposed to that of a viol), the fingerboard has seven fret positions marked on it.<sup>13</sup> These fret positions do not run across the pattern like tied frets but are represented by short inked marks made along one edge.<sup>14</sup> The little pattern indicating the curvature of the fingerboard (Museo Stradivariano No. 258) has a radius of approximately 80 mm – somewhat flatter than the modern cello fingerboard.

From the wording of the inscription on the cello neck pattern, it would appear that Stradivari used the length of the neck of Cristina Visconti's viol as a guide to construct a cello neck. It is difficult to understand how or why he would have done this, as there are essential structural and proportional distinctions between viols and cellos. If one assumes that the seventh fret on Museo Stradivariano No. 256 marks a perfect fifth (see Table 1), then the overall string length would be 697.5 mm (tempering the fifth would not alter this dimension significantly). In classically proportioned viols, string length is approximately equal to body length, and thus the body of Cristina Visconti's viol was approximately 700 mm in length. However, if a cello of standard baroque proportions were constructed with a neck the length of her viol, it would have a string length of 672.5 mm (assuming the baroque cello *mensur* of 2:3) and a body length of approximately 726 mm.<sup>15</sup> A cello of this size would have been somewhat shorter than the standard full-sized instruments made by Stradivari, though an undated Stradivari cello form with a length of 724 mm is preserved in the Musée de la

11 Myrna Herzog asserts that the pegbox of this pattern is on the short side; however, it is virtually identical in length to the pegboxes of cello neck patterns MS 276 and MS 311; Myrna Herzog, 'Stradivari's Viols', *The Galpin Society Journal* 57 (2004), 190.

12 Neck patterns Nos 276 and 308 are both reinforced with a glued strip of paper just below the pegbox. These may be repairs or evidence that sections of the neck patterns were removed to shorten them, which would be consistent with Stradivari's tendency to reduce the body size and string lengths of his full-sized cellos as his career progressed. For example, the body length of the 1690 'Medici' cello is approximately 792 mm, whereas that of the 'De Munck' cello made in about 1730 is 745 mm. In any case, it will be shown that the present length of neck pattern No. 308 is proportionally consistent with a small cello body form used by Stradivari that is now in the collection of the Musée de la Musique in Paris.

13 Herzog misidentifies this as a viola da gamba fingerboard; Herzog, 'Stradivari's Viols', 190.

14 Herzog states that this fingerboard pattern has been dimensionally altered. There is, however, no evidence that such is the case. She mistakenly concludes that the marks along the edge of the pattern are not fret positions (despite Stradivari's inscription 'questi pontini ha la larghezza delli tasti') but indications of the neck's width at different points. Her count of the number of marks is incorrect, as is her general characterization of their appearance and spacing. It would appear that she has conflated descriptions of fingerboard pattern No. 256 with a template for the back of a scroll, either No. 276 or No. 277. The patterns shown in her figure 8 are also incorrectly identified. Herzog, 'Stradivari's Viols', 190–191.

15 The modern cello *mensur* is often set at 7:10, which is the result of a slight lengthening of the neck.



Figure 1 Stradivari cello neck pattern. The inscription on the heel indicates that its length derives from Cristina Visconti's viola da gamba. Museo Stradivariano No. 308



Figure 2 Stradivari cell fingerboard pattern with fret markings taken from Cristina Visconti's viola da gamba. Museo Stradivariano No. 256



Musique in Paris (formerly catalogue no. E901c; now E901.1).<sup>16</sup> It is possible that this form was used in conjunction with the neck and fingerboard pattern bearing Cristina Visconti's name. From the cello's diminutive size we can conclude that its prospective owner was of small stature. The idea of fretting a cello neck may seem odd to us, but cello tutors written as late as 1765 advocate that beginners employ frets to develop their sense of pitch,<sup>17</sup> and today some violin teachers use a similar system of markers. If intended for a viola da gamba player (such as Cristina Visconti), it is possible that this small-sized cello would have been fitted with frets, at least initially.

**Table 1** Fret markings on Cristina Visconti's fingerboard

Top of fingerboard to fret 1	37.5 mm
Top of fingerboard to fret 2	74.0 mm
Top of fingerboard to fret 3	106.5 mm
Top of fingerboard to fret 4	142.5 mm
Top of fingerboard to fret 5	172.5 mm
Top of fingerboard to fret 6	207.5 mm
Top of fingerboard to fret 7	232.5 mm

The fret positions transferred by Stradivari from Cristina Visconti's viol fingerboard are rare bits of early eighteenth-century ephemera (Table 1), and they can tell us whether she employed Thomas Salmon's fretting system.

As indicated above, the fret markings made by Stradivari are not drawn completely across the fingerboard like a tied fret, but are simply indicated along one edge. Do they coincide with any of the string divisions proposed by Salmon? If we consider how the fret positions were transferred onto the pattern from Cristina Visconti's viol, they might have been taken from either edge of the neck of her instrument, which would have corresponded to the frets used for either of the D strings. Alternatively, they could have been taken from the fretting of the C or A strings, which would have been in direct accord with the bottom and top strings of the cello. In Table 2 the fret spacings for each of the strings of Salmon's proposed viola da gamba fingerboard (see Figure 3) have been recalculated using his interval ratios applied to a string length of 697.5 mm. (Note that Salmon's treatise originally called for a string length of thirty inches, or 762 mm – considerably longer than the strings of Cristina Visconti's instrument.) The fret spacings found on Stradivari's fingerboard pattern (Museo Stradivariano No. 256) are also given.

**Table 2** Fret spacings derived from Salmon's 1705 *Theory of Musick* applied to a 697.5 mm string length

	Salmon D string	Salmon G string	Salmon C string	Salmon E string	Salmon A string	Stradivari No. 256
Fret 1	19/20; 34.9	19/20; 34.9	17/18; 38.8	15/16; 43.6	17/18; 38.8	37.5
Fret 2	18/19; 34.9	18/19; 34.9	16/17; 38.8	17/18; 36.3	16/17; 38.8	36.5
Fret 3	15/16; 39.2	17/18; 34.9	19/20; 31.0	16/17; 36.3	15/16; 38.8	32.5
Fret 4	17/18; 32.7	16/17; 34.9	18/19; 31.0	19/20; 20.1	17/18; 32.3	36.0
Fret 5	16/17; 32.7	15/16; 34.9	15/16; 34.9	18/19; 29.1	16/17; 32.3	30.0
Fret 6	19/20; 26.1	17/18; 29.1	17/18; 29.1	17/18; 29.1	19/20; 25.8	35.0
Fret 7	18/19; 26.1	16/17; 29.1	16/17; 29.1	16/17; 29.1	18/19; 25.8	35.0

<sup>16</sup> Stewart Pollens, *The Violin Forms of Antonio Stradivari* (London: Peter Biddulph, 1992), 11, plate 20. Herzog misidentifies this as a viola da gamba form. Though it has been altered, its general shape and proportions indicate that it is a cello form. Herzog, 'Stradivari's Viols', 191.

<sup>17</sup> Robert Crome, *The Complete Tutor for the Violoncello* (London, 1765).

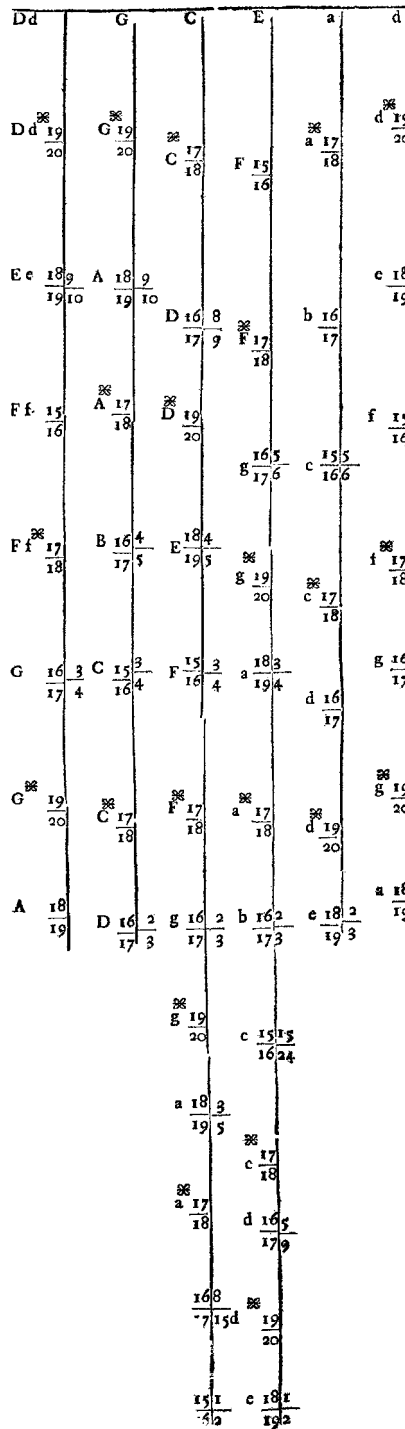


Figure 3 Thomas Salmon's system of divided frets for a viola da gamba fingerboard from 'The Theory of Musick reduced to Arithmetical and Geometric Proportions', *Philosophical Transactions of the Royal Society of London* 24/302 (1705)



As one can see, there is no agreement between the fret positions advocated by Salmon and the fret markings on Stradivari's fingerboard pattern. One of the curious aspects of Salmon's system is the equal spacing of frets for the sequence of intervals 19/20, 18/19, 17/18, 16/17 and 15/16. (This sequence is also found in Silvestro Ganassi's instructions for fretting the viola da gamba published in 1543.<sup>18</sup>) Salmon provides no directions for fretting the fingerboards for other keys, but this would have been a simple process of transposition, and thus none of the fret sequences for the alternative fingerboards would have matched the fret positions transferred from Cristina Visconti's viol.

For the purposes of this study fret positions were also calculated for the following tunings: equal temperament, the 18:17 rule from Vincenzo Galilei's *Dialogo della musica antica e moderna* (Florence, 1581); quarter- and fifth-comma mean-tone, Pythagorean fretting instructions from Juan Bermudo's *Declaración de instrumentos musicales* (Osuna, 1555) and Ganassi's system derived from his *Regula rubertina*. Again, no precise match could be found between any of them and the markings derived from Cristina Visconti's viol. Carlo Chiesa has remarked that 'the frets [on Stradivari's fingerboard pattern] seem too imprecise to be of any practical use', but this is perhaps an unfair assessment.<sup>19</sup> The markings on Cristina Visconti's viol are in fact fairly close to the 18:17 system, with the exception of frets 3 and 6, which are a few millimetres off. It should be noted that tied frets have a habit of loosening and moving around all on their own, and it is possible that Cristina Visconti's frets were simply out of position when Stradivari measured them.

In conclusion, as disappointing as it is to announce that research has led to a negative result, Cristina Visconti née Stefkins seems not to have been a convert to the fretting system that Thomas Salmon demonstrated before the Royal Society with the aid of the Stefkins brothers and her husband in London in 1705 and published in the *Philosophical Transactions of the Royal Society of London*. It remains a mystery why Stradivari used dimensions derived from a viola da gamba to construct a cello neck and fabricated a wood pattern that preserves an unusual system of fret placement.

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<sup>18</sup> Ganassi, *Regula rubertina*, chapter 4.

<sup>19</sup> Carlo Chiesa, 'The Viola da Gamba in Cremona', in *The Italian Viola da Gamba: Proceedings of the International Symposium on the Italian Viola da Gamba, Magnano, 2000*, ed. Christophe Coin and Susan Orlando (Turin: Manzoni, 2002), 87–95.