

**REVIEW: *Stradivari* by Stewart Pollens, Cambridge University Press (2010), 335 pp, £90.00**

Antonio Stradivari has been the iconic 'greatest' instrument maker for about two centuries. During that time, collectors and researchers have been searching for evidence and speculated about his life and how he made his instruments. Many books and articles have been written about Stradivari, and this book very splendidly brings us up to date on what we think we know about him and his methods.

Pollens opens with a brief summary of Cremona's political, commercial and musical history. He writes 'with no court orchestra, few concert venues, and only a small number of professional musicians residing in the city, there was no compelling reason for Cremona's preeminence in the field of violin making'. For me, the reputation of the Amati family for making most superior fiddles for a century before Stradivari started, and the tendency at the time of reputation being associated with the location of manufacture, is compelling enough.

Identification of the lira da braccio as 'the violin's closest ancestor' is not historically supportable. The ancestor for the tuning is the fiddle that Tinctoris (1487) wrote was 'the most usual' one which had 'three simple strings tuned to a pair of fifths', while the other one he mentioned (the ancestor of the lira da braccio) had 'five strings tuned unevenly in fifths and unisons'. The ancestor for the waist bracketed by sharp corners, and for a body construction of thin pieces of wood glued together, was the late 15<sup>th</sup> century Spanish vihuela. which was bowed as well as plucked. His understanding of the history of string usage led Pollens to correctly conclude that the three-stringed fiddles common in the 16<sup>th</sup> century lacked the lowest one of the later four-string ones. This contrasts with the conclusion of Boyden in his classic book that they lacked the highest one.

Up to the middle of the 17<sup>th</sup> century, the Amati family were the only significant makers of fiddle-family instruments in Cremona. At about that time, they were joined by the founder of the Ruggieri family, and in the next couple of decades, they were joined by the founders of the Guarneri and Stradivari families. Andrea Guarneri worked for Nicolas Amati for almost a decade, but Francesco Ruggieri, though he copied their work, had no apparent connection with the Amatis. Whether Antonio Stradivari had such a connection has been a matter of debate. The evidence for it is a label on one of his earliest violins (dated 1666) stating that he was a student of Nicolo Amati, and that his early violins showed strong Amati influence. Evidence against it is that Stradivari was never listed in the census as a resident of the Amati house (as was usual for apprentices or workshop assistants) and that his violins don't have the conical plug near the middle of the back that Amati and Guarneri ones do. It is surprising that Pollens is so strongly in the 'against' camp. Perhaps that is just an excuse for him to discuss (and also reject) alternative theories that Stradivari apprenticed as an architect or as a sculptor. It is odd that there is no known documentary evidence of the existence of Antonio Stradivari before his marriage, at the age of around 20, to Francesca, a 27 year old pregnant widow in 1667. They promptly rented a house, which was both a home and a workshop. Where could he have made the three or so surviving violins dated before then?

Stradivari appears to have been frugal, a workaholic and a good businessman, as well as an excellent craftsman, and his reputation grew. By 1680, he had saved enough to buy a house just doors away from that of the Amatis and that of the Guarneris. When Nicolo Amati died in 1684, Stradivari's reputation was so good that he apparently was considered the best remaining maker in Cremona. His eldest son Francesco was 13, old enough to be helpful to his father, and the output of violin-family instruments from the workshop increased considerably, as well as the income. Economically, the Stradivaris continued to flourish (and indulged in money lending), while their Cremonese competitors struggled.

Pollens tries to explain Stradivari's affluence by his sale of violin-family instruments, but I didn't

find it convincing for early in his career. One possibility was that he started his career and gained reputation as an instrument repair man. Another is that he made other instruments. Violin-family instruments were of high value, sold to rich customers for their musical establishments. It is courteous to offer such customers some choice on the design, so most of the work commences after the commission. Between such commissions, it would be appropriate to keep the workshop busy producing lower-value popular instruments in quantity, and guitars, mandoras and mandolins could have performed this function for Stradivari. It is possible that his initial training was in making these instruments, and that he learned about making violins while informally helping out the Amatis when needed. Later in his career, when his reputation as a violin maker was well established, it would have been worthwhile to make them for stock.

This book is awash with documentary details about Stradivari and his family, his homes/workshops and the history of what happened with his forms and patterns after his death, the remaining ones being now in museums in Cremona and Paris. Most of the rest of the book is concerned with those forms and patterns, and how they were used.

The chapter on violin forms and patterns provides measurements of a dozen forms for the violin, one for a violino piccolo, two for the (contralto) viola, one for a tenor viola, one for a cello, and one for either a small cello or a viol with a cello shape (Simpson's preferred type of division viol). The violin forms are compared and are often related to extant violins apparently made on them. Patterns for necks, scrolls and fingerboards, as well as f-hole positioning templates are discussed.

I am disappointed that Pollens calls the tenor viola 'unwieldy', though it seems to have been satisfactorily used in the Renaissance and baroque. His conclusion that the tenor viola was designed to be tuned to a lower pitch than the contralto is most probably untrue since all sources (except Hizler) indicate that all fiddle sizes between the treble and bass were tuned the same. Pollens was misled by the tenor being 18% larger than the contralto, apparently not considering that viola top strings of both sizes are much farther from breaking stress than violin top strings, so the relation between pitch and string length is less constrained (he justifiably suggested that smaller violins could be for use at higher local pitch standards). The purpose of different viola sizes was to focus greater resonance on different pitch regions within the same total range.

Hizler's *tenor geigen* was probably what elsewhere was considered to be a small bass violin tuned an octave below the violin. Stradivari's small cello could well have been tuned this way, and Bach's many bass parts written in treble clef could well have been for such an instrument played by a violinist. Such a small bass violin was measured in the Talbot ms, and its body dimensions are almost identical to those of his division viol. Its body length is intermediate between Stradivari's two cellos, but the string length is only 61 cm. Talbot called this size the 'usual' bass, and I have been suggesting that it was the usual Italian *basso da braccio* in the 16<sup>th</sup> and 17<sup>th</sup> centuries (later ones sometimes acquired a wire-wound 5<sup>th</sup> C string).

Pollens considers several popular claims of methods used in generating the designs. The scroll shape was apparently inspired by the Archimedean spiral, but doesn't follow it accurately, and there is no evidence for the construction marks needed to generate it. Though Andrea Amati violins were consistent in ratios of body dimensions, Stradivari's violins vary considerably from any such proportions (I wonder how the ratio of 2:3 for the neck stop to body stop in Amati's violins was determined when necks have been replaced and 16<sup>th</sup> century bridges were often lower). Where parts of the design are essentially circular arcs, centre points for the use of a compass are absent. There is no evidence of a formal system of design, and the designs appear to be freely sketched. From Stradivari's note on his harp design he used the Cremonese *braccio da fabbrica* for measurements, and when Pollens applied this measurement unit to the basic dimensions of the forms, he finds that they rarely fall on whole, half or quarter Cremonese *oncia*. There is also a discussion of how the f-hole placement templates were generated and used.

Listed are the major dimensions of surviving neck and neck patterns, fingerboard and fingerboard patterns, bridge patterns, tailpiece patterns, bass-bars and fingerboard alignment guides. Photos of some of these are shown.

The Museo Stradivariano (MS) catalogue nos. 222 and 309 are snippets of metal-wound strings for the contralto viola and the cello. Not mentioned is that Peruffo has measured these strings. That may be because there are great difficulties in interpreting these measurements according to any known stringing method, implying that they may be not what they are supposed to be.

There are problems with Pollens's discussion of the strings that might have been used on Stradivari's violins. He accepts Fetis's report of Tartini measuring (in 1734) a total string tension of 63 pounds (about 30 kg), but considers Fetis's report of 80 pounds in the 1830s as excessive by today's standards (a set of modern Dominant strings is strung at 49 pounds or 22 kg). The latter report of 80 pounds also stated that the tensions of the different strings (22 pounds for the first and a little less for each of the others) were nearly equal. Pollens cites equal-tension prescriptions by Mersenne and Leopold Mozart, calculates the other string diameters from Mersenne's 0.75 mm ( $\frac{1}{3}$  ligne) E, and decides that a 2.5 mm G is 'much too thick'. What criterion is he using? Perhaps he can't imagine a hole in a peg that big. But early pegs have not been properly studied, so we don't know whether their shanks were thick enough to safely have such string holes (the bushes around peg holes in very old pegboxes are usually remarkably large). Pollens states 'many of today's violinists involved in period performance practice, as well as historians and makers of gut strings reject the idea of equal tension and advocate a system of so-called "progressive scaling" ' (as in modern violin stringing). The only one of these that I am aware of who has seriously studied the history of stringing is Peruffo, who presented his ideas in Comm 1804 (Q107-8), which I replied to in Comm 1829 (Q110). In support for this view, Pollens cites Peruffo's study of hole diameters in early lute bridges. My Comm 1807 (Q107-8) analysed that data by Peruffo, and my result agreed with Mersenne's equal-tension lute string diameters for all but the four (diatonically tuned) lowest basses. The possibility that might be the case is mentioned by Pollens.

Baroque musicians and instrument makers didn't have micrometers to measure string diameters, and relied only on visual comparisons. When an avid collector of design information on instruments he has made or repaired encounters one with unusual stringing, the simplest way to give an indication of string thickness is to draw it. So when Stradivari drew the long second neck of a theorboed guitar (MS no. 385), he drew the thicknesses of the strings at the nut. The lowest (and thickest) string measured from the reproduction in Sacconi's catalogue (Pollens does not reproduce it) is 2.9 mm. Inscribed next to this string on the drawing (which is mentioned without comment by Pollens) is that it is a violin fourth! That is even thicker than the equal-tension diameter of Mersenne, and is clearly not a wound string. Pollens insists that the G used by Tartini in 1734 (three years before Stradivari's death) would have been wound, following the fashionable expectations of the stringed-instrument community. The earliest documentary evidence of a wound 4<sup>th</sup> (and progressive scaling) in Italy is Ricatti (1767).

In an attempt to find evidence in favour of metal-wound strings before the middle of the 17<sup>th</sup> century, Pollens suggests that the mention of *gedrehere Messings-Seiten* by Praetorius for the sympathetic strings on the English viola bastarda (lyra viol) could possibly be interpreted as wound brass strings. This has usually been interpreted as twisted brass strings, which had been used on citterns since the middle of the 16<sup>th</sup> century. I can't think of any early evidence of metal-wound-on-metal strings, and then iron or steel would be a better choice of core, and brass would be an odd choice for the winding. An earlier example of winding of metal would be gold or silver foil covering thread for clothing and tapestries (from antiquity), and an example of a covered string would be the covering of metal strings with thin parchment in Praetorius's geigenwerck.

Pollens uses his experience with iron strings on keyboard instruments to speculate about the thinnest wire that could have been wound on a gut string. He rejects Peruffo's suggestion that it had

a diameter of 0.12 - 0.13 mm, claiming that such thin wire was not available in Stradivari's day. I suspect that this was the thinnest diameter that Peruffo actually measured on the string snippets in MS nos. 222 and 309. What Pollens has not considered is that the conditions of drawing the wire through the die for an iron wire string requires tensile strength, while those for a copper or silver winding wire requires annealed ductility. Winding wire can be drawn down to a diameter of 0.10 mm or even thinner.

Fully quoted are late 18<sup>th</sup> century documents that indicate that there was extensive re-graduation (thinning of the plates) of violins by Stradivari and others to make them louder. Pollens relates that one such Stradivari violin at the museum he worked at was fitted out with baroque fittings, but it was too powerful to balance against 17<sup>th</sup> century harpsichords and even late 18<sup>th</sup> century fortepianos. I suspect that the change of taste was related to violinists increasingly having to freelance and play in less intimate venues. Thinning would be attractive to makers worried about strength by the lower total tension of progressive scaling.

Photos of 20 bow frog patterns, a bow head pattern and two bow head models in the Museo Stradivariano are shown. Pollens suggests that it is likely that the frogs were moved by a screw adjuster because a bow stamped 1694 in the Ashmolean Museum has such an adjuster. I disagree, for reasons given in Comm 458 (Q 31).

Patterns for the dancing master's kit (or pochette) are listed. They include 7 showing body and neck outlines, 6 of which have associated patterns for f- or C- hole placement. In addition, there are 6 independent body outlines and 8 neck outlines. The body and neck one illustrated is festooned, and the sequence of inward and outward curves and points appears to be traditional (it is the same as on the outline of the polyphont body shown in Comm 1821 Q 110). Also illustrated is an experimental tailpiece with a chin-operated mute attached.

Relating to viols, there are five groups of patterns in the Museo Stradivariano and three wood forms in the Musée de la Musique in Paris. All but one group are dated. The undated group is related to one of the Paris forms, with a body length of 64.5 cm. The statement of Pollens that it 'is considerably larger than the typical English division viol' is most probably untrue, being smaller than the body of the division viol measured in the Talbot ms and the body in Simpson's illustration. His idea of the size is probably influenced by the size names in the catalogues of some museum collections that follow the size names of Dolmetsch that are still accepted by the viol community, which rejects the measurements given by Talbot and Simpson as 'controversial'.

The 1684 group (without a body outline) is for a five-stringed viol with a scroll and a string length of about 80 cm, which I would suggest was a small violone. Pollens suggests that it was possibly converted to the 1684 "Visconti" cello. The neck appears to have been inset into the neck block. The 1701 group (also without a body outline) is for a 7-string viol in the French style, with a string length of about 70 cm. It had a tenon over an inch deep used in attaching the neck to the top block. It also had a finial on the pegbox rather than the usual scroll or carved head on French viols.

The 1737 group is for a French type of viol. It doesn't have a body outline but one of the Paris wooden forms is inscribed with the date 1737. The neck pattern shows a shield-shaped finial and a pegbox length that could fit a dozen pegs, suggesting that the instrument had sympathetic strings, like the English lyra viol mentioned by Praetorius. The neck is morticed into the neck block. There are fret positions marked on the fingerboard pattern which imply a string length of 74.3 cm. Pollens writes that this 'is somewhat long for a full-size bass viola da gamba'. This could well be true for 18<sup>th</sup> century viols with wire-wound basses, but not for the classic 17<sup>th</sup> century English sizes when (according to Talbot and Simpson), the string length was about 72 cm on the lyra viol (it was smaller early in the century), 76 cm on the division viol and 81 cm on the consort bass viol.

The 1707 group is comprised of a pattern of a cello neck, one of a fingerboard with markings for

frets, and one of the fingerboard curvature. The latter two were measured from the bass viol of Cristina Visconte, a woman from an English viol-playing family, recently married to a prominent Cremona violinist. The string length implied by the fret placings is 70 cm, indicating that her viol probably had a metal-wound lowest string, as mentioned by Talbot. To ease the transition when moving from a bass-viol country to a cello country, I suppose that she wanted a cello that felt like her own bass viol under her fingers.

Surviving Stradivari artifacts relating to the viola d'amore include a form for a small guitar converted to be for a cornerless viola d'amore, the traced body outline of a Germanic viola d'amore and two proper body-outline patterns. There are two neck patterns with equal numbers of bowed and sympathetic strings, one with 5 each and the other with 6 each. It is very unusual for a viola d'amore to have less than 6 bowed strings (inherited from its conversion from redundant treble viols), but the 6<sup>th</sup> would not be missed if the player who did not make full use of chords beneath the melody.

I had known that after early in the 17<sup>th</sup> century, the archlute had become so much more popular in Italy than any other kind of lute that the name 'lute' was understood to apply to it. But I was puzzled by the occasional instrument that looked like a Renaissance lute appearing in paintings from then. Stradivari's patterns for a lute in the 'French style' solves this problem. What Stradivari apparently considered a French style lute to be was that it had one pegbox. Of the five soundboard tracings, three are labelled as for a French style lute, and one of these, with 11 pairs of strings, is labelled for a 'true' French style lute. Another of these is for one with either 11 or 12 pairs of strings, while the other shows a bridge with a real French arrangement of 9 pairs plus 2 single courses. Of the other two tracings, one is similar in size to the others, and the other is much larger, for either a low bass lute or a theorbo. In addition, there is a fingerboard pattern for 12 pairs of strings and ten frets (implying a string length of 69 cm), patterns for two pegboxes (one for 12 pairs of strings and the other for a real French one with 19 pegs, and an actual lute bridge with 12 pairs of string holes.

I've noticed that Italian paintings of lutes from late in the 16<sup>th</sup> century onwards tended to have doubled first courses. This practice was apparently copied in England for a while since the methods of Dowland and Robinson imply it. French stringing later in the 17<sup>th</sup> century had one or two highest courses single, often with a rider attached to the pegbox for tuning the highest string. Stradivari's patterns include one for a fingerboard (on a body outline) and one for a pegbox that is for a proper French lute. They were probably drawn in the process of a repair or a rebuild for a French customer. The other patterns with all courses paired were probably for Italian customers. As Italian lutenists generally retained Renaissance tuning, and the two octaves and a fifth range of 10 courses fill the limits of all-gut strings, the question arises as to where the extra one or two courses went in the tuning. For all-gut stringing, the most likely place is between the fifth and sixth courses, and if wire-wound strings were used, it would be below the other strings.

When comparing Stradivari's lutes with those measured by Talbot, Pollens states 'In referring to Talbot's measurements, one should also consider the French foot for interpreting them' since 'non-French writers sometimes employed the French system because it was more generally accepted as an international standard of measurement'. This is most highly unlikely. Talbot clearly intended to write an English encyclopaedia of musical instruments similar to those of Praetorius and Mersenne, and like them, the main audience would be domestic, so the unit of measurement would be local. The possibility that the *ligne* in the measurement was the French one of one twelfth of an inch (*pouce*) instead of the English one of an eighth of an inch is rendered extremely unlikely by the observation that, of the hundreds of measurements Talbot recorded, all have the number of *lignes* in each less than eight. Has Pollens been influenced by the viol community who need to insist that the measurements by Talbot and Simpson are controversial to justify the convenient sizes they use?

A mandolin, in the time of Stradivarius was just a small mandola, and a mandola was just a small

lute with fewer courses a different tuning and a pegbox more like a viol than a lute. The bent soundboard at the bridge of mandolins that allowed unglued bridges appeared later in the 18<sup>th</sup> century, so two of the four mandolin bridges in the workshop artifacts, which are moveable, most probably were added later. Other artifacts include patterns for 5 bodies without attached necks, 5 bodies with attached necks, 7 necks with pegboxes and 5 pegboxes.

Pollens does a good job of trying to estimate string lengths. The string length of a large (*granda*) mandora is 56 cm, and that of other mandoras without a size qualifier is about 54 and 41 cm. That of a somewhat large (*piu grande*) mandolin is about 35 cm, of a *mandolino coristo* is about 32 cm, and of mandolins without a size qualifier are about 31, 32, 33 and 34 cm. There is also a body pattern considerably smaller than that of other mandolins. One of the mandoras has 5 double courses, one has 4 double courses plus a single first one, and one has 4 double courses. One of the mandolins (the *corista* one) has 4 double courses plus a single first one and three have just 4 double courses. The tuning of the 5-course instruments was probably *b e' a' d'' g''* at the player's personal pitch standard, and that of the 4-course instruments omitted the *b*. It is likely that violinists sometimes acquired 4-course mandolins and tuned them like a violin (*g d' a' e''*).

I applaud Pollens's view concerning the *mandolino coristo* that this 'singular reference to pitch ... is extremely important'. I also agree with his view that Haynes's conclusion about Cremona pitch is misleading (see Comm 1489, Q 86). To estimate the highest safe pitch of a gut string for *g''*, Pollens used Peruffo's formula for the average breaking point  $\text{Hz}=240000/L$  (where *L* is the string length in mm) and dropped a full tone, making  $\text{Hz}=190500/L$ . My work on Praetorius indicates that what his musicians considered safe was about  $\text{Hz}=210000/L$ , leading to a frequency about 10% higher. My work on pitch standards led me to estimate that *coristo* was like Roman pitch, about  $a'=380$  Hz, making *g''*=667 Hz. The *coristo* standard was used by stringed instruments all over Italy. Using my Praetorius formula, the calculated highest safe pitch for the string length Pollens measured is 662.5 Hz, within about a tenth of a semitone of my estimate of *coristo*. I am sure that conformity to the standard had a much wider range of variation than this.

There are a half-dozen surviving unaltered forms or paper patterns for Stradivarius's guitar bodies, half of which have fingerboard outlines, allowing calculation of string lengths. Those string lengths are about 33, 57 and 77 cm. At *coristo* and using the Praetorius criterion, I find that the highest safe pitches for the first strings are *g<sup>b</sup>'*, *a<sup>b</sup>'* and *e<sup>b</sup>'* respectively. Since no guitar source indicated that the highest string should be tuned as high as it could safely go, I suggest that the last two would have been tuned to *g'* and either *d'* or *c'*, quite standard pitches for a small and large Italian guitar of the time, and the first would have been tuned to *f''* or *e''*, an octave guitar not a standard member of a set as defined by Foscarini or Calvi.

Though the baroque guitar usually had ten tuning pegs, we have come to expect that only one string was used on the first course. The stringing at the nut of the theorboed guitar shows a doubled first course, which I suspect could have very common in Italy. Incidentally, none of the three surviving guitars (dated 1681, 1688 and 1700) that he made match any of the forms or patterns.

In 1681, Stradivari made a 27-string diatonic harp with the soundboard strongly arched and purfled around the edges, like a violin. The Cremona museum has very rough drawings of the harmonic curve and pillar with their decoration. Pollens lists the lengths of each string and deduces the tuning assuming that the string with the same length of a violin (the 14<sup>th</sup> from the top) was tuned to *e''*, not noticing that the string an octave higher (the 7<sup>th</sup> from the top) was about 20% longer than half its length. The 6th string from the top is the one at the greatest stress, and its highest safe pitch, using the Praetorius criterion, is *e'''* at *corista* or *d'''* at Lombardy pitch (a tone higher). So the range is no higher than *e - c''''* at *corista* or *d - b''''* at Lombardy pitch.

The last chapter discusses factors involved with the design and making of instruments. Reviewed are geometry and proportion, acoustical science in Stradivari's time and the violin-making process

(using the tools, templates and alignment guides from his workshop). Pollens obtained 5 samples of Stradivari's varnish and had them analysed in 2008-9 by Fourier transform infrared spectroscopy, pyrolysis gas chromatography/mass spectroscopy and Raman spectroscopy, and gives the results for each (pine resin and a drying oil were the most common components). He did not mention any of the numerous similar previous studies, except for mentioning that no mineral ground was found. Stradivari lived next door to a chemist, upon whose death, the stock inventory included about 800 items. Thus, if Stradivari had wanted to add exotic components to his varnish, there is no question of its availability. In 1775, Guadagnini asked Paulo Stradivari, Antonio's only surviving son, about the supplier of wood to make violin tops, and was told that the supplier in Brescia was no longer in that business. Finally, Pollens discusses Stradivari's decorated instruments and a source of their designs.

There are three Appendixes. The first lists 50 bass bars of the 17<sup>th</sup> and 18<sup>th</sup> centuries in the Hill collection, giving their dimensions and weights, and showing photographs of them. The second discusses the partial fretting system for viols proposed by Thomas Salmon in 1705. The third presents his arguments for concluding that the "Messiah" violin is not what it seems to be, including a dendrochronological analysis of its soundboard that he commissioned. That analysis by Peter Klein concluded that it could not have been made before 1739, two years after Stradivari's death and 23 years after the label date, and Pollens cited a confirmation of that analysis by another dendrochronologist. In the notes at the end of the book, he mentions challenges to that analysis by two groups of dendrochronologists, leading to a date for the last year-ring of 1686, and challenges to those challenges by another group leading to a date of 1788, and later, of 1844. In the Autumn 2010 issue of the Newsletter of the British Violin Making Association, J. Topham wrote of this book, 'Stradivari: Evidence in new book refuted'. The issue seems to be the validity of different statistical methodologies used, which can only be settled by the specialists (not me or Pollens).

Despite the gripes expressed above, this is a marvelously good book. Pollens does his research meticulously, doggedly following up all leads. He tries to be objective and is usually successful. The coverage is truly comprehensive, refreshingly not from the narrow prospective of a violin specialist. This book should be an essential reference for some time on Stradivari's life and work, and of stringed instruments in northern Italy in his time.