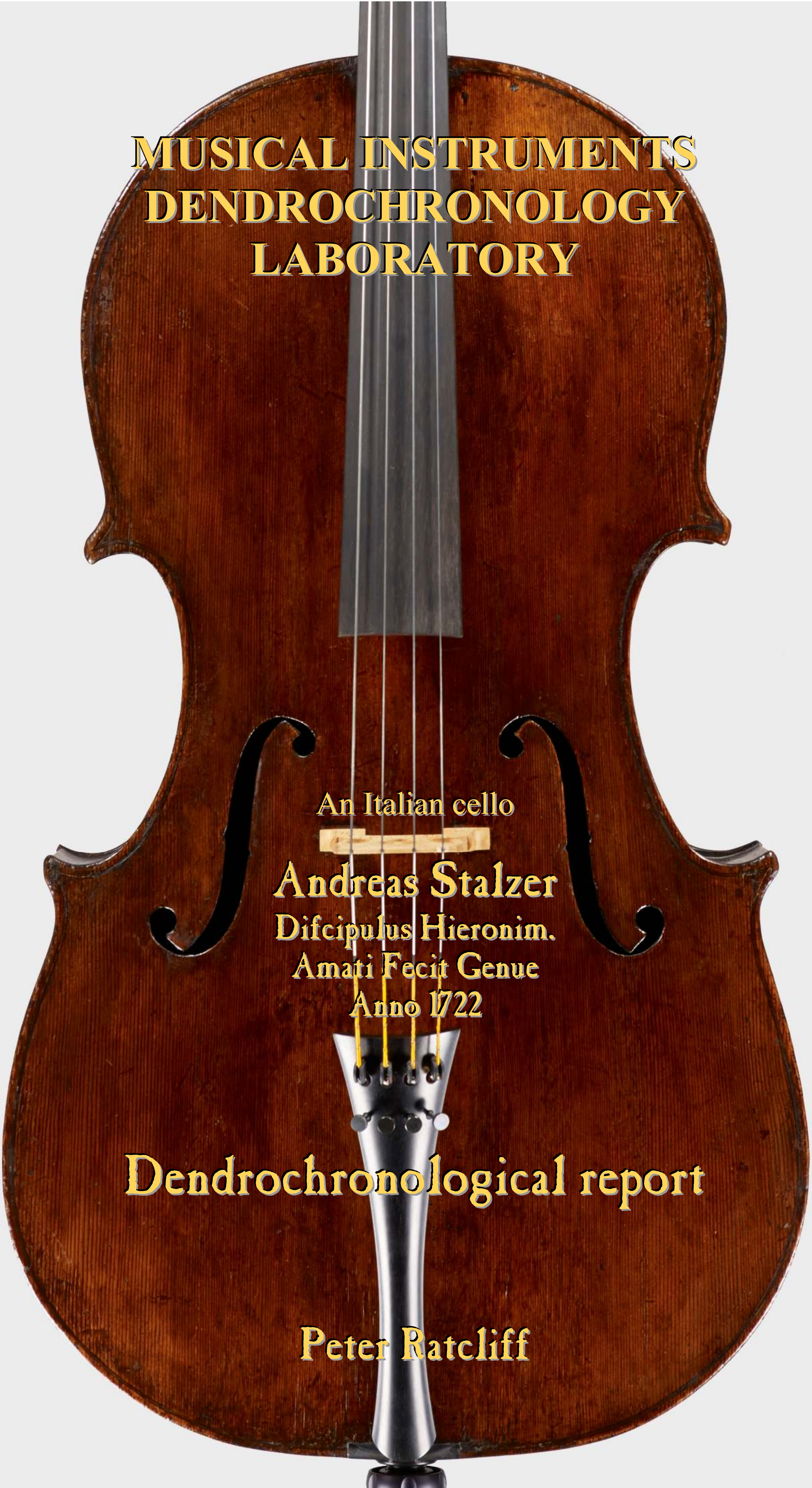


MUSICAL INSTRUMENTS DENDROCHRONOLOGY LABORATORY

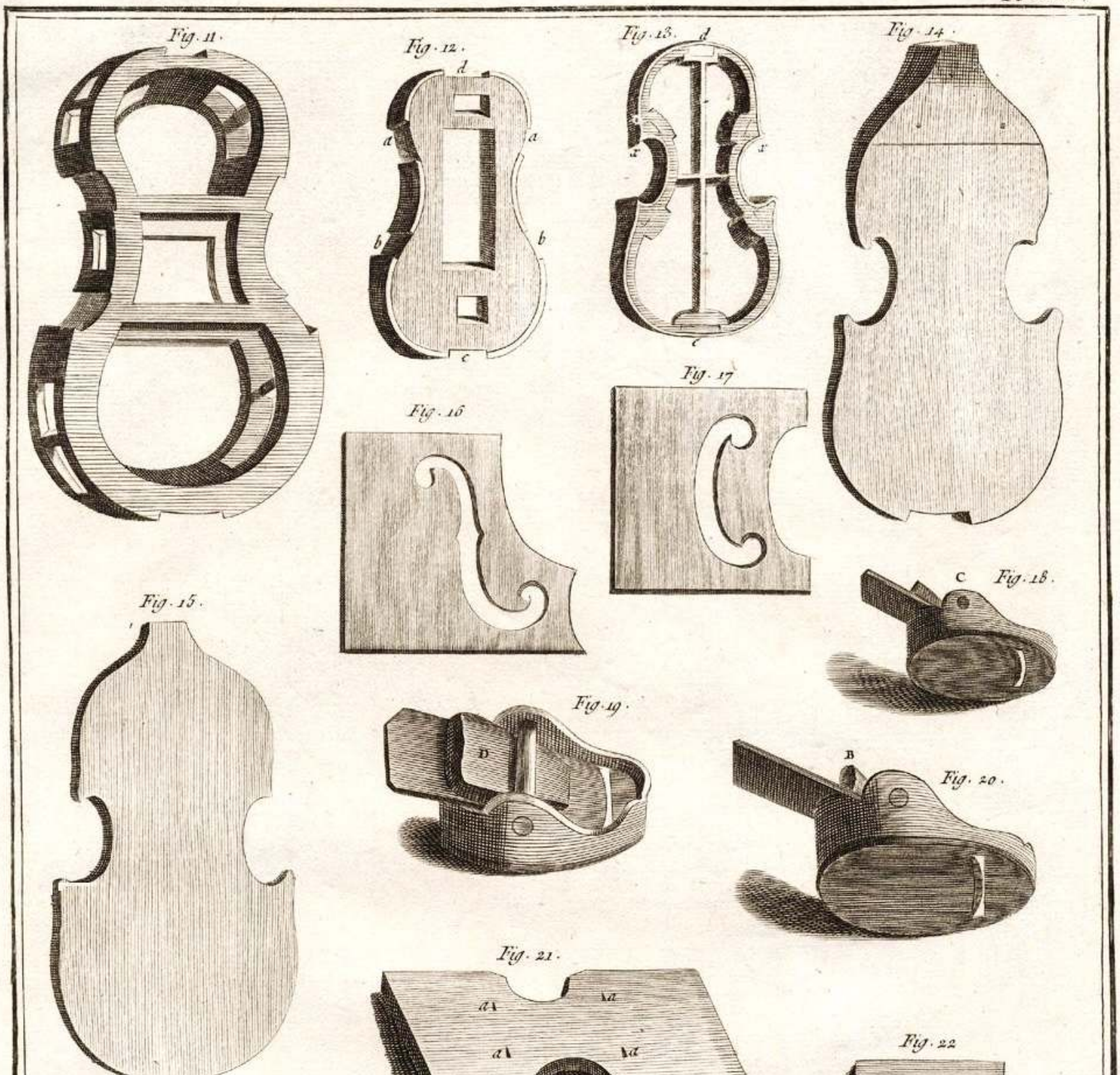
An Italian cello

Andreas Stalzer

Difcipulus Hieronim.
Amati Fecit Genue
Anno 1722

Dendrochronological report

Peter Ratcliff



Benard Direxit

Lutherie, Outils propres a la Facture des Instruments à Archet.

Dendro-organological analysis of the belly of an Italian cello by
Andreas Stalzer, (Stanzer)
Genova, 1722

By Peter Ratcliff Higher Dip. Dist. Musical Instrument Technology

- Summary

- Methodology

- Results of the statistical cross-dating

- Individual and notable results

- Conclusion

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- Acknowledgments

General notes

This report has been commissioned by the owners of the instrument under study or their agent.

It is written following the evaluation of tree-ring data collected exclusively from the soundboard, or *belly* of the instrument. No other parts of the instrument are deemed suitable for dendrochronological testing and are therefore not tested and no dates can be attributed to back, ribs or neck by tree-ring analysis. This report does not guarantee the soundboard of the instrument to be an integral part of the original, nor whether the remainder of the instrument is contemporary to the belly or by the same author. Tree-ring data were gathered from high-resolution digital images supplied by the owner or their agent.
This report is not, and should not be considered in any way as a *certificate of authenticity* nor should the title and/or description be interpreted as evidence of authorship

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Front and back of the Andreas Stalzer cello, Genova 1722

Summary

Dendrochronology, the science of dating wood from the information contained in its tree rings, is now well established and widely used in the field of musical instruments. Information obtained following a successful test is second to none, and can yield very valuable and enlightening details, which can substantiate and strengthen traditional attributions, and equally, in some cases, demolish them.

Tree-growth is influenced by many environmental and geophysical factors. Tree-rings register environmental and climatic data, in multiple aspects of their growth. The rate at which wood cells multiply and the changes in physical attributes of those cells determine the rings' characteristics. Within one year's growth, variations of density can be observed. In spruce, the earlier spring growth, normally of lighter shade is characterized by lower density than the darker, late-Summer growth, which comprises of more compacted and thicker-walled cells. When cell growth stops at the end of the growing season, a concentric "ring" is formed below the bark, laying a visible and sharp boundary that becomes obvious when growth resumes in the following Spring. The varying distances between each ring are the results of the climatic and environmental conditions the growing tree found itself in, combined with its increasing development. These relative variations of year-to-year ring growth are the basis of dendrochronological cross-dating. Ring-growth from separate trees may react slightly differently within a specific area, due to individual circumstances, but their relative ring-width sequences will mostly follow a similar pattern. Cross-dating identifies the similarities followed by the tree-rings of the instrument under observation and a dated reference database of the same and related species, positioning the sample at its appropriate temporal placing.

Various species lend themselves to dendrochronological dating. Conifers, on the whole display grain structure suitable for this process and their annual ring growth responds correspondingly between trees in the same environment. On musical instruments, both of the bowed and plucked variety, including instruments of the violin family, guitars and keyboards, their harmonic tables are almost invariably manufactured with wood from conifers, mainly of spruce, fir or pine varieties. For strength, stability and acoustical reasons, the timber is processed in order to expose the radial plane. That way, tree-rings are positioned at an angle approaching 90 degrees from the main carved or flat surface. The resulting grain pattern of light growth interspaced by darker reed lines presents the ideal conditions for recording the tree-ring widths with minimal distortion. The varnish, usually applied to a highly finished wood surface, often highlights grain detail, allowing for enhanced accuracy in the measuring process.

Wood species used on other parts of musical instruments tend to be hardwoods. Traditionally, the use of maple, occasionally poplar and more infrequently beech forms the rest of the corpus for instruments of the violin family. These do not usually lend themselves to dendrochronological dating, although in the case of maple, grain similarity between backs of separate instruments, can sporadically be detected by statistical cross-matching or graphical comparison of their respective tree-ring patterns.

In the following report, we examine the results of cross-dating the wood from the belly of this instrument, in order to identify the most significant and likely date of the latest growth ring present on its belly. In turn, this date will shed light on the earliest possible manufacturing date for this instrument.

In addition to merely stating dendrochronological results, this report will examine possible relationships between the wood on the belly of this cello and that of other instruments, taking in consideration the whole of the results in the context of violin-making procedures revealed by cross-matching in general.

Unless otherwise specified, the dates arrived at after analysis are based on the most statistically significant results, with repeating frequency, corroborated by convincing graphical comparisons.

Methodology

In recent years, with the rapidly increasing quality and achievable resolution of digital equipment, a growing number of dendrochronological tests on musical instruments have been based on tree-ring measurements gathered from photographic or scanned images. In most instances, these methods are equally as accurate as collecting data microscopically. As a distinct advantage, a digital image can be filed and stored for later use or further assessment if required.

In order to carry out the present analysis, high-resolution digital images of the belly were supplied. The maximum number of rings available is situated at the widest part of the body. The tree-ring measurements were therefore collected along a horizontal axis across the lower bouts of the front. Cropped areas (*Fig.1*) of this lower half were enlarged further and on the whole, tree-ring boundaries remained clearly distinguishable without consequential loss of sharpness, across the width of the bass and treble sides. The digital images were loaded on a specially created software module (*Fig.2*) to measure and record the distances between each ring boundary.

Fig.1 *Cropped part of the older part of the belly, situated at the lower treble side, showing the direction from the centre of the tree outwards*

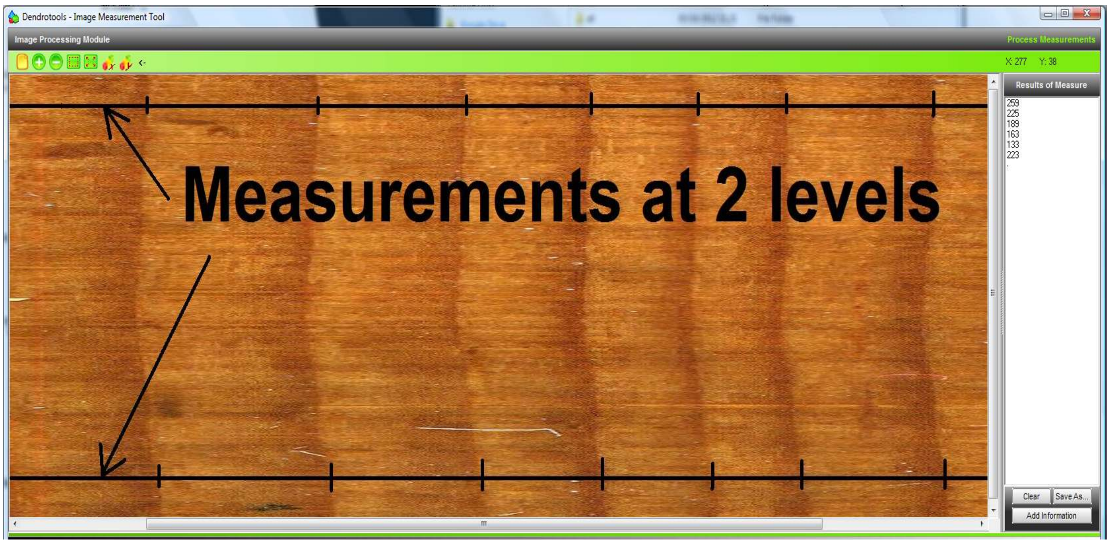


Fig.2 *Measurement processing module.*

Notes

Prior to onscreen measuring, careful visual inspection of the table was carried out, in order to identify and locate possible repairs, to ensure the continuity and the accuracy of the sequence of measurements. No repairs were identified on the table that were deemed to have disturbed the ring sequence in any significant way.

The particular species of conifer used for this belly has not been identified positively, but appears to be, as is the case for many harmonic tables, made of Norway spruce (*Picea abies (L).Karsten*). The exact nature of the species remains speculative without a thorough study of the structure of the wood at microscopic level.

Prior to the measuring of rings on screen, careful visual inspection of the lower table was carried out, in order to identify and locate possible repairs, to ensure the continuity and the accuracy of the sequence of measurements. No repairs were identified on the table that were deemed to have disturbed the ring sequence in any significant way.

The belly of this cello is carved out of two separate halves, glued together in the centre. Ring boundaries were carefully examined and the direction of tree-growth was determined to be from the outer edges towards the central joint on both pieces. As is customary in dendrochronological testing, measurements were carried out following the direction of the tree growth, from the oldest to the youngest available ring. In order to reduce measurement error and average natural tree-ring variation within the piece, two sets of tree-ring widths were measured on both bass and treble side at slightly different levels.

The latest growth ring present on the instrument is unlikely to have been formed in the same year as that of the felling of the tree. Unlike certain species, the sapwood in Norway spruce is often indistinguishable from that of the earlier tree growth in seasoned or old timber. Furthermore, the number of sapwood rings in spruce varies greatly depending on the tree's growing location and other geophysical factors. This makes it impossible to estimate the felling year accurately based on the wood structure alone, hence the quest for an earliest possible felling date, or *terminus post quem*. The short period between a dendrochronological date and manufacturing date occasionally witnessed, especially when Italian instruments are concerned, suggests expedient wood transportation and minimal seasoning.

It was possible to measure every ring present on the belly, starting from near the outer edges, right up to the last visible ones situated adjacent to the centre joint. Whilst there also may be some rings lost while preparing the surfaces prior to gluing, their actual number remains speculative.

The data resulting from the measurements series were statistically cross-dated and tested against a variety of master chronologies, both from published and private sources, including many generously supplied by the *International Tree Ring Databank* (ITRDB), together with a comprehensive database of measurements taken from musical instruments, both from individual instruments and *instrument chronologies*, compiled from data from well correlated examples. Some instrument chronologies are area specific, and are the result of the amalgamation of well-correlated instrument data from specific towns or countries, whilst others can be from instruments made in separate countries, but with wood displaying strong visual and statistical relationship, suggesting related growing locations. As an integral part of the analytical process the tree-ring series under study are plotted on a graph, and visually compared with a selecion of the instrument data leading to significant statistical results. The graphical analysis has to support the statistical findings, demonstrating contemporaneous growth between sample and reference. If such relationship is unconvincing, the results suggested by statistical cross-dating have to be considered unsafe, and the dating rejected.

Statistical cross-dating

The cross-dating and other statistical tests, including the *Gleichläufigkeit* or *Glk* (percentage of parallel agreement), and segmentation analysis when required are prepared using a specially written computer program (© P.Ratcliff) based on a statistical routine devised for the Belfast CROS program (Baillie and Pilcher 1973).
This procedure identifies possible temporal correlation between contemporary tree-ring series, and has been shown to be effective in the cross-dating of spruce for musical instruments. The formula originally proposed by Baillie and Pilcher (1973) is also used in cross-dating software such as the *TSAP Dendrochronological Software Suite* (RINNTECH®), an independent program in regular use by dendrochronologists. Indexation of data for graphical or other purposes is carried out with *CORINA* software (Cornell University), *COFECHA* (Grissino-Mayer) software suite or following *Baillie & Pilchers* (1973) formula.

For checking purposes, some series were also analysed with the independent TSAP program, showing identical dating results.

Results of the statistical cross dating tests

From the digital images were collected two separate sequences of tree-ring measurements for both sides, with additional measurements recorded on the upper bouts. These were initially cross-dated independently and compared to each other, to ensure that no mistakes or omissions had been made during measuring. The multiple series of ring measurements collected for each half were found to cross-date consistently at their relative dating position and were subsequently combined to form two complete sequences, or *curves*, representing the whole of the ring-width patterns of the bass and treble sides.

The resulting sequence for the bass side, of 154 measured rings, equivalent to **154** years of growth, most significantly cross-matched reference and instrument chronologies at year **A.D.1706.** That of the treble side, of 161 rings, cross-matched reference and instrument chronologies at year **A.D.1713.**

These dates correspond to the year of growth of the latest growth rings measured and present on the images. As previously mentioned, these rings are situated adjacent to the centre joint on the respective halves.

	Oldest ring	Youngest ring
Bass side	**1552**	**1706**
Treble side	**1652**	**1713**

Tree ring span of the two halves of the belly

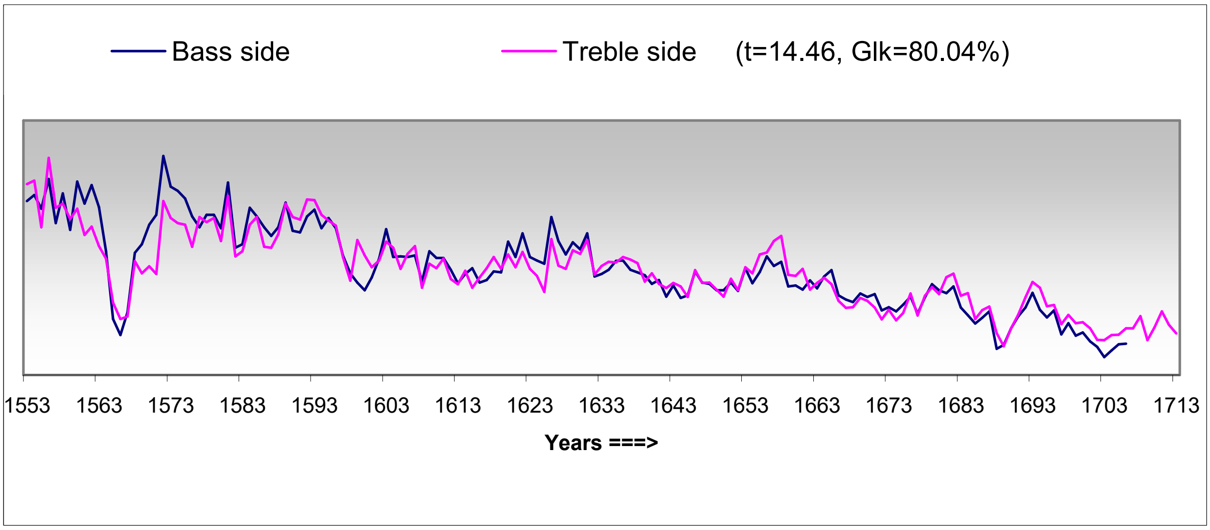


Fig.3 Comparative graph of the ring patterns from the bass and treble sides

As seen in the comparative graph above, the relationship between the two curves is evident. With a *t-value* of t=14.46 and the associated *Glk* score of just over 80% of parallel correspondence, as is the case here, it is obvious that the two halves originated within the same log, and may have been book-matched from a single wedge. When the halves are evidently from the same tree, it is customary and advisable to combine the data from the series, in order to achieve a more representative growth pattern of the tree. In such cases, a *mean chronology*, made out of the combined data from the two measurement series is created. The mean chronology will therefore be analysed in preference to the single series.

Tables of statistical cross-dating results

The following correlations table illustrates the statistical results obtained with the data recovered from the bass and treble sides, combined into a mean chronology of the belly of the instrument under investigation at the attributed dates. These data are compared to a mixed and comprehensive database of tree-ring patterns from instruments. Due to an overwhelming number of results, only the ones associated with an overlap of rings exceeding 60, and achieving *t-values* of about 5 and above feature in these tables. The correlations were calculated using Baillie & Pilcher's (1973) formula, at every point of overlap between the cello data and data from our reference. This means that correlations where identified not only with full overlapping series, covering the total 154 rings, but also for shorter series. As mentioned, ring overlaps of about 60 and under, although significant, were not listed.

The following results are therefore limited to the most significant ones, which there were a great number of. It is important to stress that the instruments in the results are not *chosen*, but are those directly appearing in the output of the statistical cross-dating tests, in decreasing order of statistical significance, ie. according to their *levels of t-value*. Our database contains data from thousands of ring patterns from instruments from all available countries and periods. These data are not grouped according to instrument origin within the database, therefore *any* of the correlating datasets, ***irrespective of the country of origin of the instrument they refer to***, will feature in the tables. This procedure exposes unbiased evidence of shared timber provenance between instruments. Generally, the higher the corresponding *t-value*, the closer the geographical location of the tree-growth,

Correlations with the Mean chronology at 1552-1713

Correlations with the Mean chronology	T-value	Dates	Overlap	Glk%
Andrea Stanzer 1722 violin (1pf) t63295	14.84	1552-1713	115	76.3
Roman cello attributed t D.Tecchler kw001	7.79	1552-1713	156	70.6
Composite violin, table attrib. To M.Deconet ram2002-387	7.44	1552-1713	124	65.0
David Tecchler violin aa/jb	7.26	1552-1713	86	57.1
1725 Carlo Bergonzi violin wt/t	6.98	1552-1713	83	63.4
G.Guarneri del Gesu' violin lc/b	6.89	1552-1713	96	66.8
G.Cappa cello pb/m	6.88	1552-1713	143	61.6
1767 Jose Contreras violin AP/b	6.86	1552-1713	105	60.6
J.G. Hamm Mittenwald violin NMM5204	6.86	1552-1713	131	64.6
violin attributed to Antonio Guadagnini ga/t	6.79	1552-1713	103	68.6
Gioffredo Cappa violin b6904	6.72	1552-1713	130	59.7
Violin attributed to the G.Cappa school t72032	6.55	1552-1713	123	66.0
Carlo Tononi violin aw13	6.5	1552-1713	111	63.6
Jose Contreras violin 1767 ap/b	6.49	1552-1713	100	65.7
1731 G. Guarneri Del Gesu' 'Baltic'	6.42	1552-1713	107	65.1
1717 A.Stradivari (same tree match to Messiah) fl013	6.4	1552-1713	111	67.3
1732 Guarneri Del Gesu' "Prosselt" edb/b	6.36	1552-1713	118	67.9
1711 A.Stradivari violin l/l/b	6.32	1552-1713	126	58.8
G.Guarneri DelGesu' m BC/ou	6.31	1552-1713	109	67.1
Tommaso Balestrieri 1750 violin ga/b	6.29	1552-1713	110	67.4
Violin Cremona ca 1735 nik/t	6.25	1552-1713	126	66.0
G.Cappa violin t64400/t	6.23	1552-1713	96	74.2
1708 A. Stradivari violin Ad/b	6.21	1552-1713	99	62.8
P.G.Rogeri violin (same tree match to Messiah AS	6.2	1552-1713	74	63.7
Vincenzo Ruggieri Attributed pb/i3849	6.11	1552-1713	91	63.9
1776 G.B. Guadagnini violin ls/b	6.1	1552-1713	79	75.6
1770 Jose Contreras cello ex Tortellier	6.08	1552-1713	88	66.7
G.B Ruggieri cello (Hill cert) aw/m	6.06	1552-1713	106	67.1
Violin attributed to E. Catenari b6473-4/1pf	6.05	1552-1713	137	63.2
1709 A.Stradivari "Wieniavski" b/pt	6.04	1552-1713	135	59.7
Gennaro Gagliano violin s33	6.02	1552-1713	73	66.7
Attributed to Pieter Rombouts violin b7209	5.99	1552-1713	64	68.3
Testore school cello b003	5.95	1552-1713	68	67.2
Violin Italy, circa 1755/60 b6053	5.9	1552-1713	75	64.2
1737 G. Guarneri Del Gesu' l&H/s032	5.9	1552-1713	92	67.6
Michele Deconet 1777 violin eb07	5.85	1552-1713	62	70.5
G.B Guadagnini cello udk/m	5.8	1552-1713	65	60.9
1732 G.B. Guadagnini violin cr/h/b	5.79	1552-1713	73	66.7
1710 Antonio Stradivari violin jab	5.79	1552-1713	102	64.4
1878 H.Derazey violin s1457	5.78	1552-1713	112	62.2
L&T Carcassi cello bs	5.76	1552-1713	72	64.8
1716 A. Stradivari "The Messiah" hgm/m	5.75	1552-1713	109	61.6
Attributed to Homolka t72571	5.72	1552-1713	124	61.0
mid 19th century viola Caussin school p811	5.71	1552-1713	134	57.9
Vincenzo Ruggieri cello dg/b	5.7	1552-1713	89	71.0
Louis Panormo Guitar 1PF LP1751	5.65	1552-1713	161	67.5
Carlo Bergonzi violin arw/07	5.59	1552-1713	140	60.4
Nicolo Gagliano violin H380/b	5.59	1552-1713	94	67.2
1734 Antoni Stradivari violin hab/b	5.59	1552-1713	78	64.3
ca.1718 A.Stradivari violin ih/lt130/b	5.55	1552-1713	87	62.8
1734 G.Guarneri Del Gesu' 'ex-Haddock'	5.5	1552-1713	99	70.4
1708 A. Stradivari violin Ad/t	5.48	1552-1713	103	61.3
Domenico Busan cello ac/m	5.48	1552-1713	138	58.4
G.B Lolio cello Bergamo jw/cr/b	5.48	1552-1713	103	61.3

Joseph Guarneri Filus Andrea violin s27	5.46	1552-1713	107	71.2
Nicolo Gagliano violin H380/b	5.46	1552-1713	92	63.2
Cremonese violin Bergonzi workshop erb/b	5.45	1552-1713	86	64.7
ca1709 Stradivari violin ref 33875	5.45	1552-1713	124	57.3
ca.1735/40 J.B.Vuillaume violin p333	5.44	1552-1713	78	64.9
Violin probably Mittenwald, ca 1820 sal/t	5.41	1552-1713	125	61.3
1718 A.Stradivari violin "Szcekely"	5.4	1552-1713	89	69.3
Santo Serafin violin b58/m	5.4	1552-1713	100	60.6
Gioffredo Cappa violin y261113/b	5.39	1552-1713	101	61.5
Giovanni Grancino cello fl00/b	5.38	1552-1713	104	61.7
Gennaro Gagliano vln s33 mean	5.37	1552-1713	73	66.0
GB Guadagnini violin la/ch/b	5.35	1552-1713	65	68.0
1773 G.B. Guadagnini violin ga/t	5.34	1552-1713	89	69.9
Gioffredo Cappa violin 1pf/ jabAP6443	5.32	1552-1713	131	61.2
Attrib Alessandro Mezzadri 6236-2 bss	5.28	1552-1713	101	63.0
Violin, central Italy first half of 18th century gb754	5.26	1552-1713	102	62.9
1703 G.B. Rogeri violin b6528-1/b	5.24	1552-1713	106	64.8
1715 A.Stradivari "Il Cremonese" t/mv	5.23	1552-1713	86	58.8
1717 Stradivari cello "Batta Piatigorsky"	5.23	1552-1713	93	68.5
GB Celoniatus violin gm/t	5.22	1552-1713	101	64.0
1768 Nicola Gagliano violin t67796/t	5.16	1552-1713	83	61.0
G.Guarneri Del Gesu' BC/ou	5.15	1552-1713	105	65.4
G.Cappa violin mb3309946	5.15	1552-1713	136	64.1
Attributed to Giovanni Tononi violin bchr/b	5.15	1552-1713	84	57.8
G Grancino cello bss ref s26	5.15	1552-1713	104	64.1
1769 Nicolo Gagliano ggk/t	5.14	1552-1713	62	63.9
1709 A.Stradivari y/KK	5.14	1552-1713	102	62.9
ca.1728/30 Michael Platner cello jjr	5.14	1552-1713	107	63.2
1709 A Stradivari violin HA/b	5.13	1552-1713	97	62.0
1735 Carlo Bergonzi violin be/ra/b	5.12	1552-1713	74	66.4
violin Italian circa 1730 eb/915	5.12	1552-1713	64	67.5
G.Cappa violin s/20	5.11	1552-1713	122	62.4
c173/35 Omobono Stradivari violin	5.09	1552-1713	82	66.0
1715 A.Stradivari Viola ru/cr15/b	5.08	1552-1713	86	70.0
1709 A.Stradivari violin "La Pucelle"	5.07	1552-1713	109	65.3

Observations on the crossdating results and comparative graphs

We observe from the previous table that the majority of correlating data was gathered from instruments of Italian origin. It is important to stress that the database used contains data from instruments from all over Europe, and all periods, from about 1550 to the present day. The fact that most correlating instruments were made in Italy within the period spanning from the late 1600's to the mid 1700's clearly suggests a shared and common geographical source for the spruce used on these instruments.

Interestingly, out of the total of the most significant correlations listed, 89 in number, 33 refer to instruments made in Cremona during the 1st half of the 18th century. Instruments from other Italian provenances also feature in the output of the crossdating tests.

Andreas Stalzer violin, 1722

One result in particular, stands out from the others. The most significant correlation is equivalent to a *t-value* approaching t=15, a result that almost always identifies, in conjunction with other parameters, a "same-tree match". This level of statistical correlation between individual tree-ring series is rarely come across, even when a same tree match is suspected. Graphical plotting of the data normally confirms whether the "same tree relationship" is likely or not. It is also significant that the t-value is slightly superior to the one obtained between the two halves of the cello (14.84 versus 14.46).

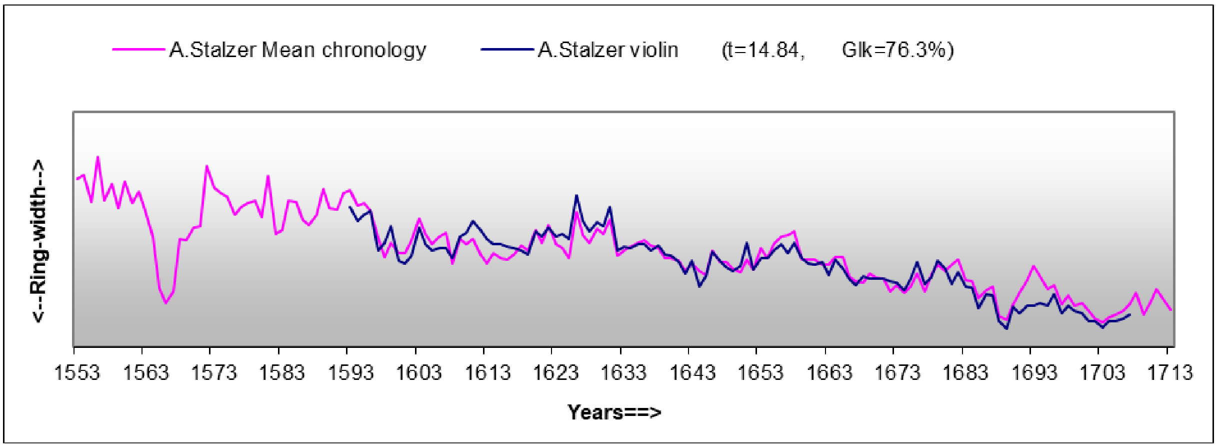


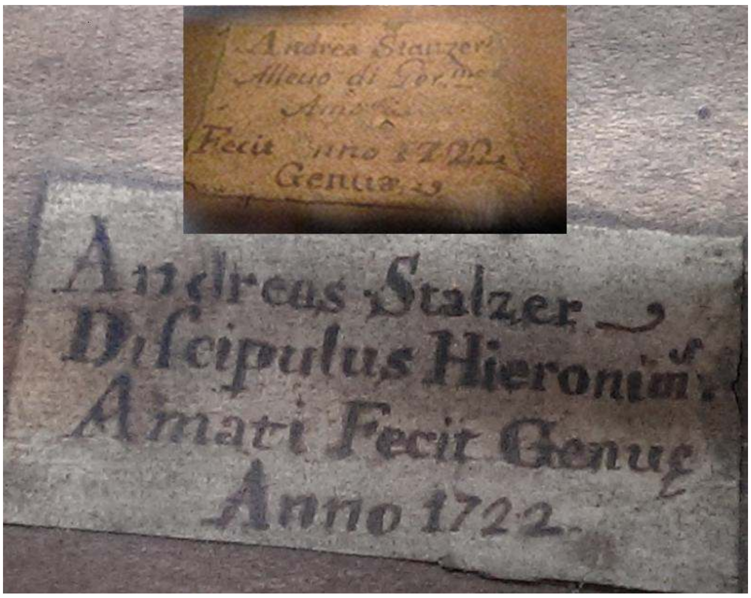
Fig.4 Comparative graph of the ring patterns from the 2 Stalzer instruments showing very close relationship

In the above graph, showing the overlapping part of the growth ring-width pattern of the cello and that of the *Andrea Stalzer* violin, it is highly likely that the pieces that produced the cello front originated from the same tree as the single piece from the violin belly. We have to bear in mind that the correlation identified between the wood of these 2 instruments, is *by far* the most significant obtained from the correlation tests carried out with a number of ring patterns well in excess of 12,000, and therefore hardly constitutes a statistical fluke.

For the soundboard of the violin, naturally of narrower width that half the belly of the cello at its widest point, the maker discarded the earlier (oldest) growth extending about 40 years, keeping the gradually narrowing grain, often deemed more suitable acoustically.

It is interesting and highly significant that out of our *entire database*, and that of two colleagues consulted over this matter, the *only* apparent same-tree match was obtained with an instrument bearing the name (albeit spelled differently) of the same maker.
Literature about this maker is very scarce but mentions the use of different spelling for the same person, *Stanzer*, and *Stalzer* being the two spelling referred to. Having personally tested the only other genuine instrument to come on the market in recent years, and bearing the maker's label, we note that they both claim that *Stalzer* was a pupil of *Girolamo (Hieronymus) Amati*, and are *both* dated 1722.

The label from the violin (uppermost in the picture below), written in Italian, states: **"*Andrea Stanzer Allievo di Ger.mo Amati Fecit Anno 1722 Genuae*",** whereas the label of the cello, this time in Latin, reads: ***Andreas Stalzer Discipulus Hieronim. Amati Fecit Genue Anna 1722***. From close examination, it would also appear that the writing on this label has been written over to accentuate a faded print.



Dendrochronology *per se*, as well as declaring a *terminus post quem* for the wood.or earliest possible felling date, identifies the similarities between the sample and other dated reference. In the present case, the correlation together with the very convincing similarities between the growth patterns, has identified a convincing "same tree match". This relationship obviously refers to the wood, and in itself does not prove that both instruments have been made by the same maker. However, in conjunction with the similarity of labelling, and the extreme rarity of labelled instruments by this maker, the probability of randomly choosing this particular name on a previously unlabelled instrument, made with wood from the same tree is, to say the least, extremely remote.

Research suggests that many makers in Italy during the seventeenth and eighteenth centuries often bought logs, or part of, and processed the timber by splitting it into useable wedges prior to manufacture. As a result, identifying "same tree matches" is becoming more common, and these often relate to instruments attributed to the same maker or workshop. Several instruments by Antonio Stradivari, made within specific periods, sometime extending over a whole decade, have been identified as having originated within the same tree. This is the case for 17 instruments made during the period 1695-1705. Equally, the belly of 5 instruments, violins and violas, out of Andrea Amati's remaining 13 known instruments, over a century earlier were made with spruce from the same log. Many other such examples have been recognized, with instruments from makers such as *Giuseppe Guarneri Del Gesu', Giofreddo Cappa,* and *Giovanni Battista Guadagnini*.

However, although less common, other examples show that wood from the same tree also reached different workshops. A violin, made during the early working period of *G.B. Rogeri*, while still in Cremona, proved to have been made with wood akin to that of an early Stradivari, whilst a Venetian violin, by *Sanctus Serafin* fitted that of a *Guarneri Del Gesu'*, and surprisingly, the one also found of a Spanish violin, made 30 years later by *Jose Contreras*.

Comparative graphs with wood used by other Italian makers

Roman cello attributed to David Tecchler

The next most significant correlation was identified against data from a Roman cello attributed to *David Tecchler*. Their ring patterns demonstrates a good relationship, evidence of a common tree-ring growth response and a likely close proximity of the geographical location pertaining to the growth of the two respective trees.

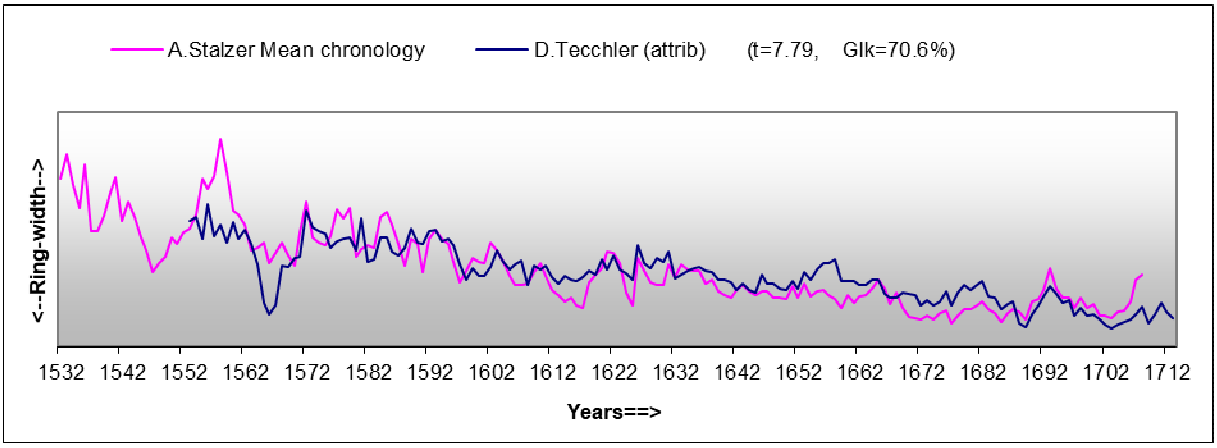


Fig.5 The ring pattern of the Stalzer cello against that of a Roman cello attributed to David Tecchler

Venetian composite violin, the belly attributed to Michele Deconet

Although the relationship is not so obvious in the following graph, representing the comparison of the cello *mean* data with that of a composite violin from the collection of the Royal School of Music in London, whose belly is currently attributed to the Venetian maker *Michele Deconet*, the significant *t-value*, reaching *t*=7.44 still identifies a strong similarity in year-to-year ring growth variation.

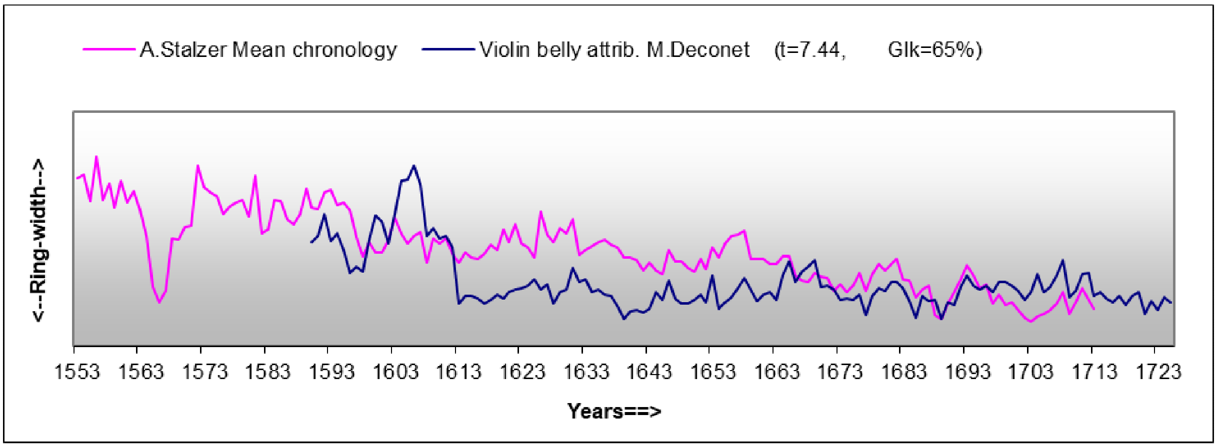


Fig.6 The mean ring pattern of the Stalzer cello against that of a Venetian belly attributed to Michele Deconet

Gioffredo Cappa cello, Saluzzo

The next correlation over a substantial overlap of 143 out of the total of 161 data-points of the cello Mean chronology was calculated against data from an Italian cello by *Gioffredo Cappa* of Saluzzo. We note that the ring pattern from the *Cappa* cello initiates about 90 years prior to that of the tree used for the *Stalzer* cello, and their overlap shows a good degree of similarity.

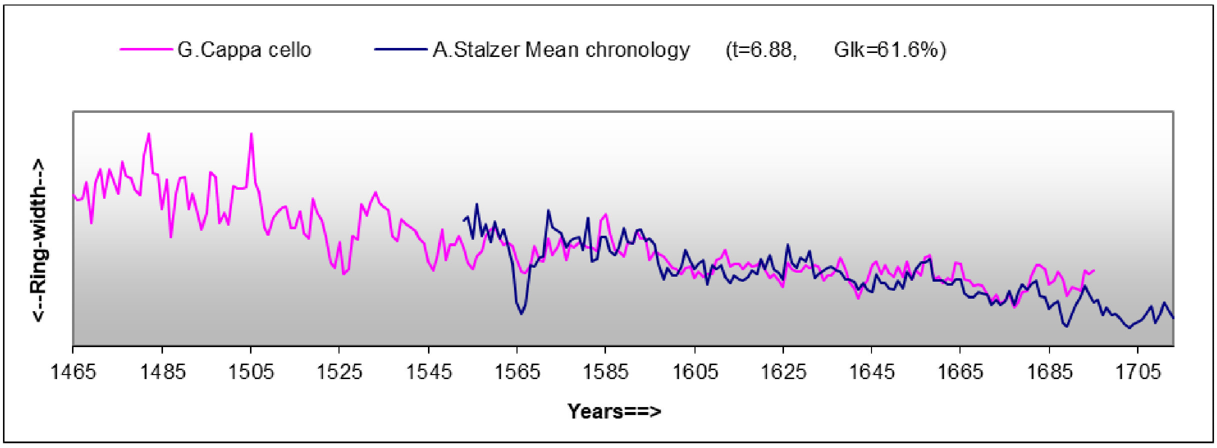


Fig.7 The mean ring pattern of the Stalzer cello against that of a cello by Gioffredo Cappa

As seen in the list, many more Italian instruments responded very significantly to cross-dating, strongly suggesting a shared location for the supply of the trees, spanning most of the length of the Italian Peninsula.

We note that a large number of correlating data listed refer to instruments by Antonio Stradivari. In fact data from 18 separate instruments from the Stradivari workshop were found to cross-match over our *t-value* threshold of just over *t*=5.

We can't help but notice that these include the data from the famous violin by *A.Stradivari* known as the *Messiah* from 1716, those of a *1717 Stradivari (ref fl013)*, and data from a violin by *Pietro Giacomo Rogeri* from 1710. Data from these three instruments, during separate research, have been found to correlate significantly together, and all show great similarity in grain pattern, strongly suggesting a same tree origin. These may well indicate a relative proximity for the growth of the trees used for the *Messiah* and the *Stalzer* cello

It is interesting to note at this stage, that wood from the specific Alpine locations supplying Italian violin-makers from about 1700, later gradually stops reaching these workshops. Very soon after the 1750's , it no longer, or only sporadically appears on the bellies of Cremonese instruments. The demise of this source of timber also occurs in other towns such as Venice and Naples, but not until later. These other cities appear to have had access to this wood for a further 30 to 40 years, which eventually disappears almost totally after 1800. Only very rarely do we detect *any relationship* on the soundboards of nineteenth century *Italian* instruments, with the wood from the *'Golden Age' which* was predominantly used there in the previous century.

Correlations with instruments by non-Italian makers

One notable exception observed in the table of cross-dating results, of instruments made outside Italy, are several separate examples of violins by the Spanish violin-maker *Jose Contreras (1710-1775).* Recent personal research based on dendrochronological results, published as part of the book "*The Golden Age of Violin-Making in Spain"*, by Jorge Pozas *(Trito Edicion 2015)*, has concluded that Jose Contreras used wood from the same geographical sources that supplied the majority of the Italian market during the eighteenth century. What sets him apart from other occasional non-Italian makers in the lists, is that he did so right throughout the whole of his career. Jose Contreras is, as far as current dendrochronological research goes, the *only non-Italian* maker to appear to have used that wood on a consistent basis. This explains the presence in the tables of several instruments by this maker. In fact, several same tree associations between Contreras' and Italian instruments have been identified or strongly suggested by statistical results and supported by graphical ring-data comparisons, including one with one half of the *Guarneri Del Gesù* violin known as the *Ole Bull*.

Jose Contreras volin, Madrid, 1767

The most significant crossmatch with an instrument by Jose Contreras was identified with data from a violin made in 1767, reaching a *t-value* of t=6.86.

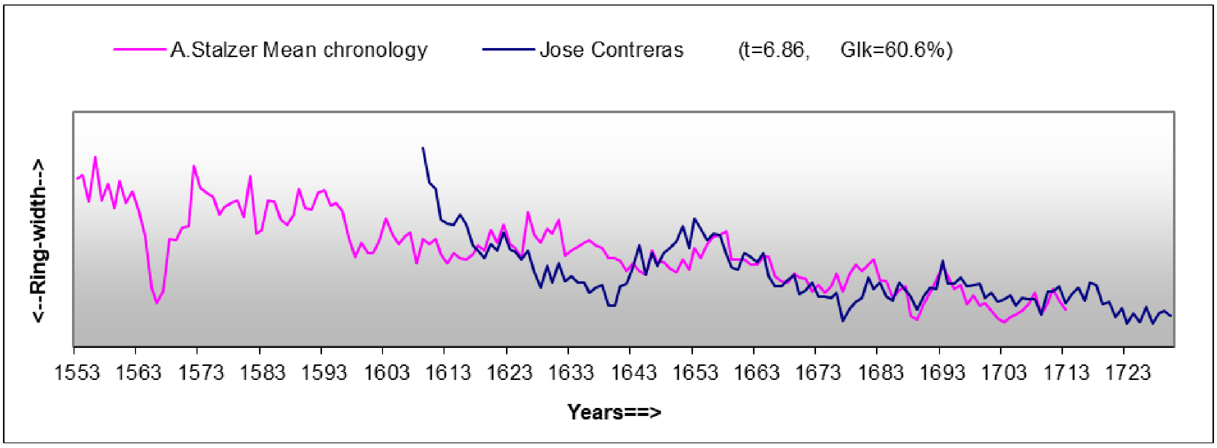


Fig.8 The mean ring pattern of the Stalzer cello against that of a violin by Jose Contreras

Correlations with data from other non-Italian instruments

The few data from other instruments made outside Italy include those from a Mittenwald violin by *Johann Gottried Hamm*, housed in the National Music Museum in South Dakota, a French instruments from the mid 1800's made in the *Honoré Derazey* workshops, It may appear surprising to see correlations between wood from the cello, built in the early 1700's, and the wood found on instruments made well over a century later, such as this French *Derazey* violins as well as another from the same workshop. The following graph, where the plotted data of the cello overlaps the early part of the series of the Derazey violin, shows that the two trees lived contemporaneously for the period spanning from about 1600 to 1713, but the tree used in the making of the violin was allowed to grow for a further 135 years after the one used to make the *Stalzer* cello. Therefore, in this case, the correlation is between the 112 overlapping rings from the two series. Although statistically significant, this correlation, upon examination of the graphed data, does not however appear to indicate closely related growing locations of the two trees.

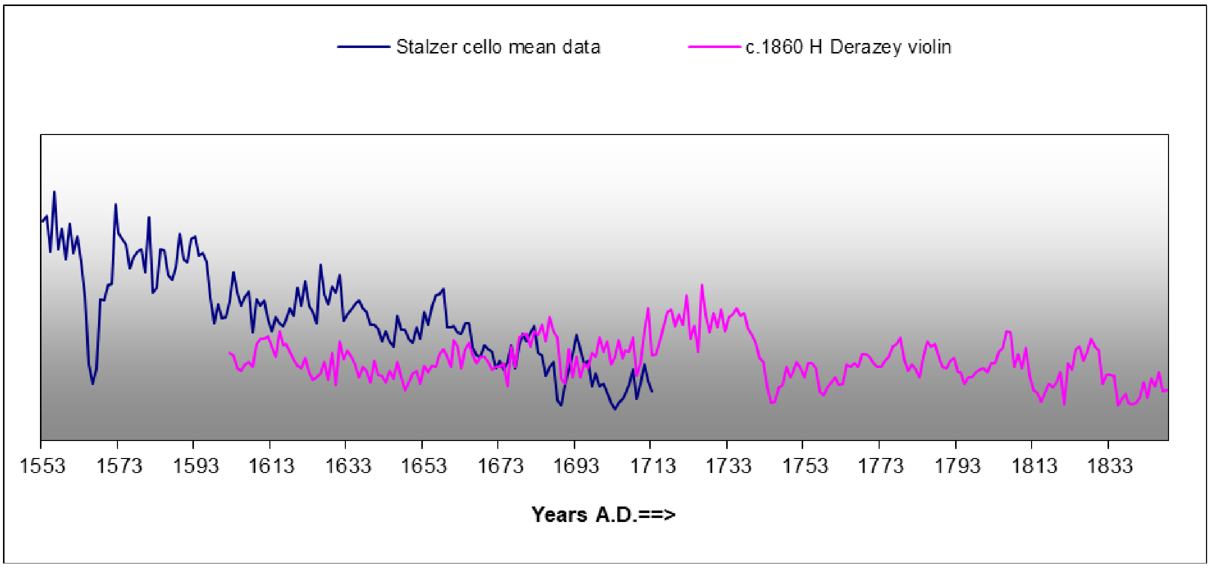


Fig.9 The plotted cello data is shown overlapping the ca.1860 Derazey violin tree-ring data

Dendrochronological research suggests that the area of the Alps, mostly the central part, along the borders between Italy, Austria, parts of Switzerland and Germany were favoured for *tonewood* production. However, it is unclear as to whether any specific areas were solely engaged in the growing and processing of *tonewood* in the eighteenth century. It is more likely that this activity was a sub-trade, although probably a fairly lucrative one, to a larger, more general timber production. What is sure, and witnessed by general dendrochronological results, is that makers throughout Europe, as far as the British Isles, favoured and made use of Alpine spruce, or related conifer species in the making of soundboards for many musical instruments, including keyboards, plucked and bowed stringed instruments, as far back as the seventeenth century. However, as witnessed in this analysis, the response obtained between data from Italian instruments always tends to be much more significant and specific than with those of non-Italian origin, apart from results with instruments by *Jose Contreras*.

Correlations with regional references

As well as correlating with numerous data from instruments, the data from the mean chronology of the soundboard of the *Stalzer* cello were found to cross-date with a couple of published *Master* reference chronologies available through the *International Tree-Ring Data-Bank.* (I.T.R.D.B).

The table below lists the correlations identified against the various geographical references.

Correlations with regional references (Mean chronology)	T-value	Overlap	Glk%
Italian ref.Cortina d'Ampezzo (ITRDB ITAL007)	4.72	54	67.92
Mixed Alpine Master references	4.69	161	62.81
Swiss Reference Chalet "Lapé"	4.54	161	65.62
Austrian ref. Obergurgl Spruce (ITRDB AUST003)	4.44	161	60.62

The most significant correlation, albeit identified over a short overlap of 54 rings, was calculated with a Master *Spruce (Picea abies)* chronology from Cortina d'Ampezzo in the northern Dolomites (ITRDB/ITAL007, *F.Schweingruber*). This was followed by a mixed Alpine reference, made up with the combined data from several Alpine regional chronologies and a further *Spruce* reference from *Obergurgl* in southern Austria (ITRDB/AUST003, *V.Siebenlist*)

As well as the correlations identified against published Master references, a private reference chronology from central Switzerland, archived in our database as "*Chalet Lapé"* features in the cross-matching data for the mean chronology, achieving a moderate *t-value* results of *t*=4.54. This valuable reference was gathered from structural and architectural timbers from an old building situated in the *Petit Mont* region of the central Swiss Alps, in the southern part of the Gruyere Canton. The Swiss dendrochronologist Heinz Egger, of *Egger Dendrolabor*, collected data from the spruce logs from that building several years ago and kindly made them available to us. This reference has proven extremely useful in the dating and occasionally establishing likely provenance of wood used on a variety of instruments, both in the eighteenth and nineteenth centuries.
The levels of correlation obtained with any regional chronologies, although statistically significant, are not high enough to suggest a credible specific geographical location for the tree-growth, but does indicate a likely Alpine provenance.

Conclusion

All the statistical tests, combined with the evaluation of many comparative graphs, have together determined that the *terminus post quem*, or the earliest possible felling date in the case of the tree used to make the front of this cello, is very soon after **1713.**

The difference between the "latest ring date" (1713) and the possible date of manufacture is naturally a matter of conjecture, and this instrument could indeed have been made at anytime after about **1717.**
Following many dendrochronological tests on the spruce wood used by Italian makers in general, it has been found that the period between the latest ring date and the attributed date of manufacture varies greatly. In a few cases we encountered, this time period was occasionally shorter than 5 years, in most, a period 15 to 25 years elapsed between the dendrochronological date and the year of manufacture.
The results of this dendrochronological analysis therefore fully support the label date of **1722** of this interesting and rare Genoese instrument.

In addition, the scarcity of instruments by *Andreas Stalzer* of Genoa, makes the faking of a label by this maker exceedingly unlikely, as no example of the label exist in print, and bearing in mind that we have identified a potential same-tree match with an instrument acknowledged by leading experts as one of the very few examples of this maker's work, and bearing a very similar label to that of the cello, even the boundaries of coincidence are stretched.

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ITRDB International Tree Ring Data Bank

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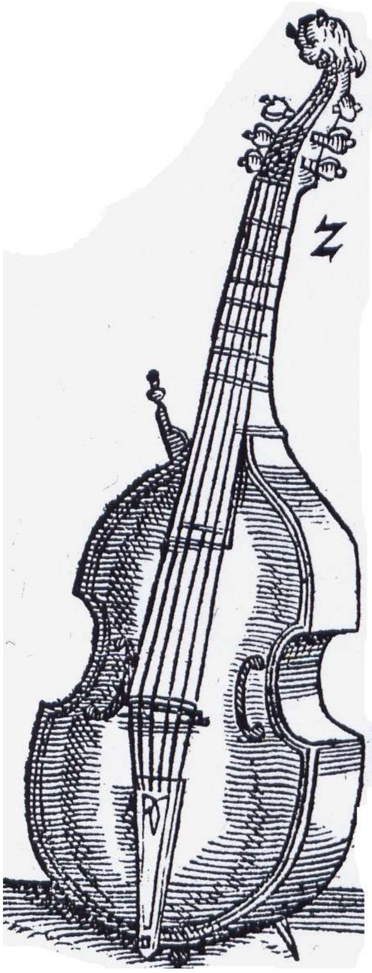
Veronika Siebenlist-Kerner

For individual tree and instrument data, Master Reference chronologies and cross-dating software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