Chapter 16

Violin construction, dendro dates, and label dates

A violin is made of pieces of wood glued together; there are no bolts or screws. Indeed, on most violins the only pieces of metal are the fine-adjuster for the E-string and the mounting brackets for the chin rest.

The body of a violin is a hollow box with the front plate ('table', or 'belly') made out of two pieces of Norway spruce (*Picea abies*) which are glued together along a central longitudinal joint. The sides of a violin (the ribs) are made of maple, as is the back plate and the neck/peg-box/scroll. The back plate can be made from a single piece of maple (a two-piece back is more common) but it is very unusual to find a one-piece front plate.

Because of the internal cell structure of spruce the front plate of a violin displays its longitudinal grain – its growth rings – with great clarity. Conversely, the cell structure of maple tends to make its grain very much less noticeable and what one sees in the maple back-plate of most violins is a series of reflective bands, alternating light and dark underneath the varnish. In the case of a back plate made from two pieces of maple there can be a very obvious discontinuity in the reflective bands at the centre joint. The bands can be horizontal, angled upwards or downwards, and can be narrow, medium, or broad (or an irregular mixture of all of these). Traditionally, violin dealers have described the banded appearance of back plates, necks, and peg-box walls with the terms 'figure' and 'curl' – terms which, as in other niche areas of manufacture, are often meaningless to outsiders. David Boyden's 1969 description of the back plate of the *Messiah* violin is typical: 'The back in two pieces is made of handsomely figured curl, somewhat irregular in pattern.'[1]

In recent years the simpler, and more evocative, term of 'flames' has been used to describe the reflective maple-wood bands. Although most descriptions of the *Messiah* violin indicate that the two-piece back plate is made of maple it has alternatively been stated that the wood used is 'broad curled sycamore'.[2]

The longitudinal growth rings in the two-piece front plate of the *Messiah* violin are at their narrowest at the centre of the belly (there is a distinct width of pale wood running up the belly between the feet of the bridge) but these rings widen towards the left and right extremities of the front plate. The back-plate flames on the *Messiah* violin are varied in size, but all are very distinct and bright, and angled slightly downwards from the centre joint. The centre joint of the back is clear to see (because of the discontinuity in the flames) but the centre joint in the belly is all but invisible such is the precision with which the two pieces of spruce have been planed and then glued together.

A spruce tree which is judged suitable for conversion into string instruments will generally be felled when it is approximately 200 years of age (200 annual growth rings). If the growth rings, on average, are 1.2 millimetres wide then the trunk will have a radius of approximately 250mm. It is the lowest four or five metres of a spruce tree trunk – absolutely straight – which are sought by today's 'tonewood' suppliers, who then cross-cut the trunk into billets of approximately 400mm length followed by splitting the billets, longitudinally, into quarters. The quarters can then be split again to produce slim triangular wedges which, at their outer (bark-side) face, are approximately 35mm wide.

[1] Boyden (1979) p. 24.

[2] See the full-size working drawings of the *Messiah* violin drawn by John Pringle and published in 1980 by the Ashmolean Museum and W. E. Hill & Sons.

The bark is removed from the outside of the wedge and, after a period of seasoning (see below) some of the outermost growth rings (which were immediately underneath the bark) can be planed away to leave an outer surface of the wedge which is perfectly flat and true.[3] Two wedges are then reversed ('mirrored', 'butterfly'd', 'book-matched') so that the two planed surfaces are adjacent to each other and ready to be glued together. Each wedge needs only to have a radial dimension of 110mm since this dimension will encompass the half-width of a violin's front plate.

The same planing and glueing procedure is used when making a two-piece back plate out of maple. Alternatively, the back plate can be made from a single piece of maple which is obtained by cutting straight across the full diameter of the tree trunk; this is termed a 'slab-cut' back.

The curvature – the arching – both widthways and lengthways, of a violin's front and back plates, will emerge from within the rising and falling double-wedge as all the unwanted wood is gouged and planed away. The thickness of a violin's front plate is usually 2 – 3mm across most of its area; back plates vary between approximately 4.5mm in the centre to 2.5mm at the extremities.[4]

The purfling comprises three extraordinarily thin strips of wood arranged in a sandwich pattern. Stradivari often used poplar and pear wood. A narrow groove is cut in the front (and back) plate, close to the outer edge, and the tripartite purfling is glued into the groove. The precision and elegance with which two lengths of purfling are brought together in a point (at any one of the eight C-bout corners) is one area of craftsmanship which differentiates the excellent from the ordinary. The purfling is decorative but also functional in that a crack started by a blow to the edge of the plate is sometimes prevented from entering the main wooden area of the front or back plate by the obstructive presence of the purfling.

The neck, peg-box, and scroll (sometimes referred to as the 'head') are carved from a single block of maple. The fingerboard is made of ebony; the tail-piece and pegs can be made of ebony, rosewood, or boxwood. All these components contribute to the tonal quality of the instrument despite their apparently secondary status.

The immense downward pressure of the tensioned strings is transferred through the bridge (made of a thin piece of maple) into the front plate. The vibrations of the front plate are coupled to the back plate of the violin by the sound-post which is a thin dowel of spruce positioned very slightly below[5] the point where the right-hand foot of the bridge bears down on the plate. Because the back plate of the violin is made of maple (a hardwood) it vibrates in a different, but complementary, manner to the vibrations of the spruce front plate. Simone Sacconi elegantly describes this difference as: 'the belly vibrates, the back pulsates'.[6] The *f*-holes are decorative but also have a strong acoustical function.

The underside of the front plate has a bass-bar glued to it, running most of the length from the top to the bottom of the plate. It is not known who discovered the tonal and acoustical benefit of fitting this thin wooden flange (which is partly visible by looking through the bass-side *f*-hole) but its length, thickness, depth, and positioning are all critical in achieving the optimum sound quality from the instrument.

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[3] Some makers will also cut, from one of the wedges, a width of spruce sufficient to create the instrument's internal bass-bar.
[4] See Chapter 12 for further information regarding plate thicknesses.
[5] 'below' when viewing the upright front of the violin face-on.
[6] Adapted from Sacconi (1972) p. 49.

Chris Johnson and Ray Courtnall have described the process of seasoning a piece of wood:

> Seasoning involves the wood undergoing a number of structural changes. First, a large amount of the water present in the structure will disappear. Over a period of time, the oils and resins present in the wood will alter and harden. The wood will shrink a great deal across its width. Seasoning has to be carried out at a controlled rate, otherwise areas of stress will develop in the structure of the wood, and when it is later re-sawn, it may split and buckle. The traditional method of 'air-drying' is still favoured by most makers as producing better wood. […] The wood is then left to season naturally, which will take a number of years.[7]

In a similar manner, Edward Heron-Allen advises:

> It is of the greatest importance that the wood used in fiddle-making should be thoroughly dry and well-seasoned, and for this purpose should be laid fully exposed to the sun and air (but not to rain) for some five or six years, at least, before it is used. If the wood is not thoroughly dry before it is used, the chances are that it will shrink or otherwise alter after the fiddle has been made some time […].[8]

A tree's outer wood, nearest to the underside of the bark, is termed 'sapwood'. A tree not only creates a new sapwood growth-ring each year (each new ring being formed under the bark) but also 'promotes' earlier rings (nearer to the centre of the tree) from sapwood (relatively weak) to 'heartwood' (stronger). With respect to the making of string instruments, it is known that sapwood tends to attract beetle infestations and discolouring fungi, and therefore, if a violin-maker harbours any suspicions about the structural integrity of the sapwood portion of the extracted wedge he can respond by planing away many – perhaps all – of the wedge's outer, narrow, weak, sapwood rings (the maker being sensitive to the fact that when two wedges are subsequently 'butterfly'd', and glued together, any remaining sapwood rings will coincide at the centre of the belly, in the area where the greatest strain will be generated both by the downward pressure of the strings through the bridge and by the asymmetrical upward pressure of the sound-post). The radial extent of sapwood within a spruce tree is variable; Klein, Mehringer and Bauch have stated that sapwood rings in spruce can number as many as sixty,[9] and whether a violin maker planes away five or forty-five sapwood rings from the outer, curved, face of a wedge cannot be known by anyone after the event.

It is the unknown period of seasoning, followed by the unknown extent of planing of the spruce tree-trunk's outermost/BS rings, which undermine attempts to relate the dendrochronologically-established date of a front-plate's outermost/CJ ring with a specific violin maker. It is possible that the tree which was the source for the *Messiah* violin was felled in 1710 and the billets left to season for six years, until 1716; approximately thirty sapwood rings were then planed off the outermost/BS face of each front-plate wedge before the instrument was made. It is equally possible for the source tree to have been felled in 1710 and left untouched for 140 years before approximately thirty rings were planed off and the instrument made. These two scenarios would reveal the same dendrochronological 'youngest ring' (outermost/CJ) date.

Intervals of just a few years between the dendrochronologically-calculated 'youngest' date and the instrument's label date – no more than seven or eight years – are particularly difficult to explain with respect to the necessity for a period of seasoning and the removal of at least some of the sapwood rings.

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[7] Johnson and Courtnall p. 61.

[8] Heron-Allen p. 129.

[9] Klein, P., Mehringer, H., Bauch, J., *Dendrochronological and Wood Biological Investigations on String Instruments*, Holzforschung, 1986, Vol. 40, Part 4, pp. 197-203.

In the August 2001 issue of *The Strad*, John Topham and Derek McCormick presented a listing, for thirteen Stradivari violins, of year-intervals between the outermost/CJ ring-dates (determined through dendrochronological investigation) and the instruments' label-dates (which fall between 1699 and 1718). The year-intervals are 7, 9, 10, 10, 10, 11, 12, 16, 17, 17, 28, 31, and 34 years (the *Messiah* violin is 34 years following Topham and McCormick's dating of the bass-side outermost/CJ ring to 1682).[10]

Subsequently, in 2003, John Topham published the dendro-dates and the label-dates (and thus the year-intervals) for both bass and treble sides of more than sixty Stradivari violins, the violins being label-dated between 1666 and 1736.[11] This 2003 listing includes the data from all thirteen violins which had been itemised in *The Strad* in August 2001. The 2003 data reveals that fifty treble or bass half-widths exhibit year-intervals of between 9 and 14 years.[12] This concentration suggests a Stradivarian 'standard' procedure whereby the spruce wedges, having been extracted from the tree-trunk log, were left to season for five or six years, followed by the removal, through planing, of five or six outermost/BS rings. Thus, a spruce tree might be felled in 1690 and the wedges left to season for five years, until 1695; six outermost/BS rings were planed off the wedges, thus resulting in the finished instrument having an outermost/CJ ring which dates (after dendrochronological testing and date-allocation) to 1684; the instrument's label-date of 1695 identifies an 11-year interval.

Topham's 2003 data also reveals eleven front-plate half widths for which the interval between the dendro-date and the instrument's label-date is less than 9 years. Such short intervals can only be achieved by minimal seasoning, or by planing only one or two rings from the convex outer face of the wedge, or by a combination of both procedures; the further possibility that the instrument's label-date, and/or the dendro-date, are incorrect, cannot be ignored.

Topham's November 2000 presentation to the Violin Society of America[13] referred to five Stradivari violins with front-plate half widths which 'probably came from the same tree':[14] the 1711 *Parke*, an un-named 1711 instrument, the 1714 *Dolphin*, the 1715 *Marsick*, and the 1716 *Provigny*. Topham's specification of the 'youngest' dendro-date (outermost/CJ) for each front-plate half width on these five violins is:

Parke (1711)	1704 (bass) and 1694 (treble)
Un-named (1711)	1698 and 1703
Dolphin (1714)	1702 and 1704
Marsick (1715)	1697 and 1703
Provigny (1716)	1699 and 1693[15]

If the spruce tree which probably supplied the wood for all five violins was felled in 1706, and the extracted wedges were then seasoned for five years, until 1711, then the bass-side wedge of the *Parke* (and the treble-side wedge of the *Dolphin*) required just two sapwood rings, likely amounting to no more than 0.5mm in depth, to be planed off the convex face in order to produce an absolutely flat and

[10] 'The dating game', *The Strad*, August 2001, p. 851. Topham and McCormick's year-intervals are defined from either the treble or the bass side of each violin's front plate – whichever side has the outermost/CJ growth ring with a dendro date which is closest, chronologically, to the label date of the instrument.

[11] Topham (2003) pp. 78-81.

[12] There are eleven half-widths which exhibit year-intervals of less than 9 years, and twenty-nine half-widths exhibiting year-intervals of between 15 and 20 years. The remainder exhibit mostly single examples of ever-increasing year-intervals stretching as far as 60 years.

[13] *The Dendrochronology of Stradivari's violins*, JoVSA (XVII, 3) pp. 133-157.

[14] JoVSA (XVII, 3) p. 145.

[15] Topham (2003) pp. 79-80.

true surface (and the treble-side wedge of both the *Marsick* violin and the un-named violin required just one further ring to be removed). Such minimal removal of rings, to achieve absolute flatness, seems unlikely. Alternatively, if the tree was felled in 1709, the wedges seasoned for just two years, and then five sapwood rings planed away to leave the *Parke* bass side (and the *Dolphin* treble side) with a subsequently-defined (outermost/CJ) dendro date of 1704, it is likely (according to Johnson and Courtnall) that the wedges would still have contained water, oils, and resins, and be prone to shrinkage and distortion – thus unsuitable for making a violin.

Two further examples:

1. With respect to Stradivari's 1681 *Reynier* violin – treble-side dendro date of 1674, bass-side dendro date of 1675[16] – if the bass-side dendro date of 1675 was the outcome of five rings being planed off an extracted wedge then the source tree must have been felled in 1680. The extracted wedge, therefore, can have had only one year of seasoning before being used in 1681 to make the violin. Reversing the procedure – the tree felled in 1676, the wedge seasoned for five years, and then just one ring planed off the convex face – seems equally unlikely.

2. For the 1683 *Cipriani Potter* violin the bass side has been dendro-dated to 1671, the treble side to 1677.[17] An extremely brief period of seasoning for the treble wedge (the tree felled in 1681, just two years of seasoning, and then four of the outermost/BS rings planed off) seems unlikely given that the violin was possibly commissioned by the important and powerful Este family, perhaps for one of the Este children, and the extraordinary level of decoration – tiny dots and lozenges of ivory set within two rows of purfling, together with an inlaid flower design over the ribs – indicates a commission of such significance that Stradivari would surely never have risked subsequent deformation of the front plate through using unstable wood. Henri Grissino-Mayer and his colleagues have suggested that the (outermost/CJ) dendro date for this violin 'was most likely 1673 […] I consider the dating tentative for this particular instrument until we obtain more conclusive evidence.'[18] Grissino-Mayer's dendro date of 1673 suggests that the tree was felled, perhaps, in 1678, the wood seasoned for five years, until 1683, then five outermost/BS rings planed off the wedge.

The year-interval results from Dr Peter Klein's dendrochronological study of the twenty-five violins by Giuseppe Guarneri *del Gesù* which were exhibited at the Metropolitan Museum (New York) in 1994 were published in 1998.[19] Of these violins, seven were of uncertain label date; the remaining eighteen violins revealed year-intervals of 3, 3, 4, 4, 5, 6, 6, 8, 8, 11, 11, 12, 13, 14, 16, 17, 19, and 29 years. The collection of exceedingly short year-intervals perhaps raises the same concerns as outlined above.

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In considering any possible relationship between the dendro-dates of the *Messiah* violin (outermost/CJ) and the date written on the violin's label, four facts cannot be known:

1. the year when the source tree was felled
2. the number of sapwood rings within the outer portion of the tree's trunk when it was felled
3. the number of years of seasoning which were allowed for the extracted wedges
4. the number of sapwood rings which were planed off each wedge by the maker of the violin.

[16] Topham (2003) p. 78.
[17] Topham (2003) p. 78. An incorrect dendro date for the bass side, namely '1677', is given in MIAM/Milnes, p. 12.
[18] Grissino-Mayer *et al*. (2001/2003), pp. 159 and 163 (illustrations lie inbetween). It is not stated whether the date of 1673 applies to the treble or bass side of the *Cipriani Potter* violin.
[19] Chiesa *et al.*, Volume Two, p. 161.