The Technique of Dendrochronology as Applied to Stringed Instruments of the Orpheon Foundation

by Dipl.-Holzwirt Micha Beuting and Prof. Dr. Peter Klein

University of Hamburg, Leuschnerstr. 91, D – 21031 Hamburg

Introduction

Dendrochronology is a biological discipline used to determine the age of wooden objects. LOTTERMOSER and MEYER introduced this method to date musical instruments as early as 1958 and since 1980 it has been generally well acknowledged in music-history (CORONA 1980, 1987; SCHWEINGRUBER 1983; KLEIN/MEHRINGER/BAUCH 1984, 1986; KLEIN 1995, 1996; TOPHAM/MC CORMICK 1998; BEUTING 2000).

The main aim of dendrochronology in the case of musical instruments is to provide a *terminus post quem* for the creation of the bellies of stringed instruments or of the resonance boards of keyboard instruments by determining the felling date of the tree.

Norway spruce (*Picea abies* L. Karsten) is generally employed in the making of these parts, a wood which is well-suited for dendrochronological investigation. It should be noted that neither sycamore (*Acer pseudoplatanus* L.) nor maple (*A. platanoides* L.), from which the other parts (e.g. bottom, bouts, neck, peg-box) are made, are suitable for dating purposes.

Method of Dendrochronology

From the tree's cambium layer (a growth layer located directly beneath the bark) one tree ring is built every year.

Each ring consists of two zones: the lighter colored earlywood and the darker latewood.

These growth rings mirror the conditions under which the tree grew. Growth is influenced by the amount of rain, the nutrients in the soil, the quantity of sunlight and the temperature to which the tree was subjected during the growing season.

Since the wood for musical instruments is obtained by radially sawing or splitting the trunk, the resulting radial structure permits measuring the ring widths on the surface of the instrument.

For this purpose a small 8X magnifier fitted with a contact reticle divided in tenths of a millimetre or a microscope is used.

These measurements yield an individual tree-ring pattern representing the relative increase and decrease in widths. This pattern is subsequently printed on a semi-logarithmic scale paper. Statistical computer programmes (ANIOL 1983; RINN 1988) suggest where the pattern could be positioned on the time axis of a so-called master chronology. Figure 1 shows how a master chronology is established.

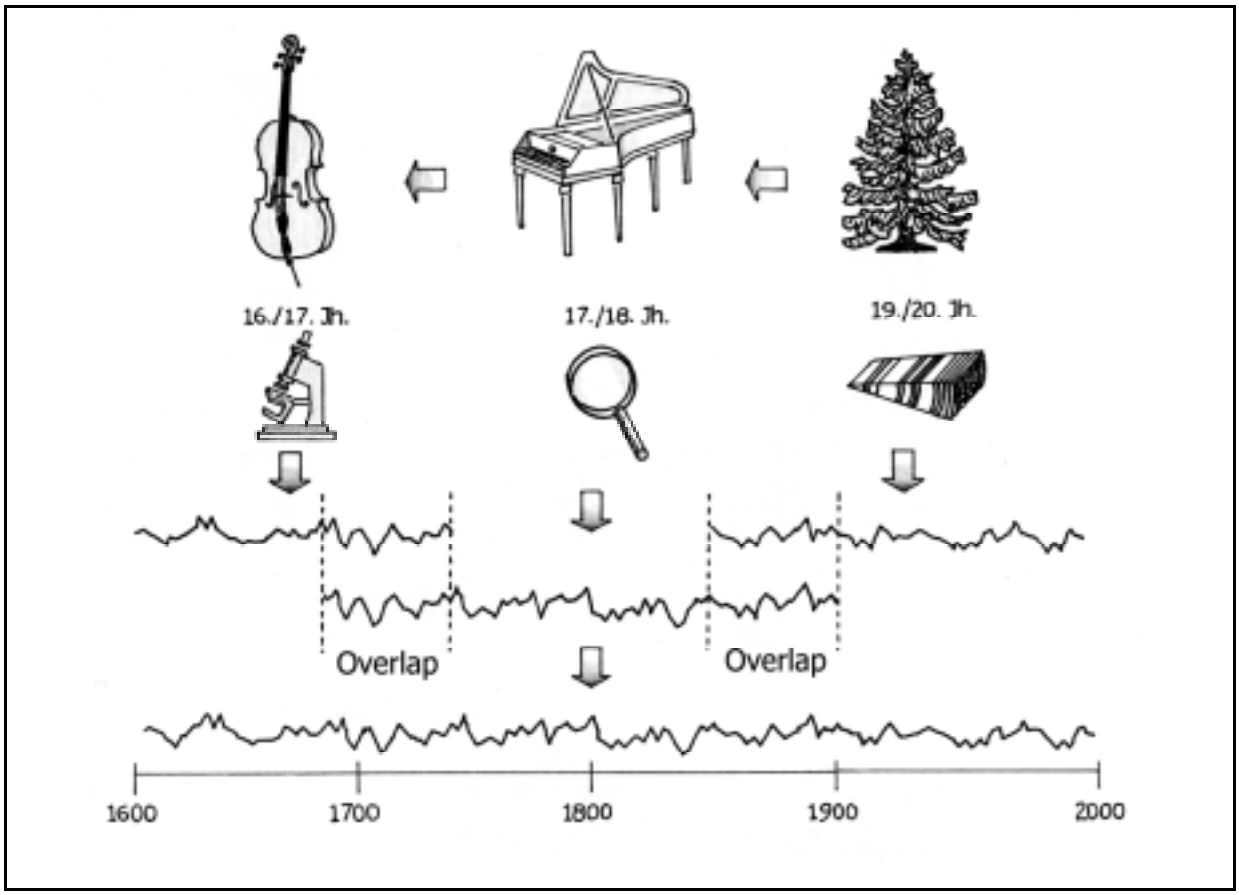

Fig. 1: System of superposition for establishing a master chronology. To build a chronology for the purpose of dating instruments one starts with cores from living trees or cross sections taken from cut spruces. From this material the initial chronology is built. In a next step the tree-ring pattern of older material, for example wood from keyboard instruments from the 17th and 18th centuries, is overlapped with the inner rings of the living trees to extend the chronology. By repeated application of this same procedure the chronology is gradually extended into the past.

In order to determine the earliest date when the instrument could have been built, it is necessary to carefully examine the difference between the historical attribution and the dendrochronological dating; this discrepancy may be due to the following two possibilities: on the one hand, the seasoning time of the wood, on the other hand, the removal of the outer tree rings during the instrument's construction. The belly consists of two halves, which are generally split from the same quarter-cut slice from the tree-trunk and then glued together; to put them together precisely they have to be plained. Plaining off only one millimetre may mean a removal of up to ten rings. In view of this fact a seasoning time of from 5 to 25 years was estimated (KLEIN/MEHRINGER/BAUCH 1986; KLEIN/ECKSTEIN 1988; KLEIN 1995). Investigations on instruments by Giuseppe Guarneri del Gesù demonstrated an even shorter storage time (KLEIN/POLLENS 1998). Apparently this depends entirely on the individual working habits of each luthier.

In the reports done by the University of Hamburg a minimal seasoning time of one year has been assumed. This is the time which would be sufficient for drying a piece of wood of ten millimetres thickness in a standard climate (20°C, 65% air humidity).

Over 100 spruce chronologies for various regions in Europe are consulted to make precise datings possible. New chronologies - established from the measurements derived from different instruments

by the cluster method (LEUSCHNER/RIEMER 1989; LEUSCHNER 1992 - allow a regional correlation of the instruments. A work concerning on this topic is under preparation (BEUTING 2003).
In many cases the historical attribution is confirmed by dendrochronology, in some cases an inaccurate attribution needs to be corrected.

Results of dendrochronological dating

To date, ten instruments of the Orpheon Foundation have been analysed dendrochronologically. The results are shown in Table 1.

The historical attributions of the instruments were taken over from the online-catalogue of the Orpheon Foundation (VÁZQUEZ 2003).

For the Instruments Nr. 1 – 4 (Bass viola da gamba, F. Linarolo, 1585; Bass viola da gamba, J. Stainer, 1671; Violin, N. Amati, 1669 and Bass viola da gamba, J. Seelos, 1691) the dendrochronological dating matches closely the makers' labels and can give an indication to the seasoning times of these masters' workshops.
Evidently the instruments Nr. 5 (Treble viola da gamba, Label: Gianbattista Grancino, ca. 1730/1740) and Nr. 6 (Treble viola da gamba, Anonymous, ca. 1730/1740) are made from the same tree. As the last growth ring of instrument Nr. 6 dates from 1729, both bellies could have been made at the earliest in 1730.
For instrument Nr. 7 (Violoncello, Label: Ramon Fernandez 1640, Catalogue: North Italian, ca. 1760 (?)) there is a difference of 115 years between the dating of the belly's wood and the label of the instrument.
Three instruments (Bass viola da gamba, G. Grancino, 1697; Violin, L. Widhalm and Bass viola da gamba, G. P. Maggini) could not be dated due to the small number of rings available or to the many repairs on the belly which impede a reliable measurement.

Table 1: String instruments of the Orpheon collection which were dendrochronologically investigated.
The date for the youngest measured growth ring is printed in bold. The same exponent number in the column *Dating* stands for the same tree.

Nr.	Instrument	Label	Historical attribution	Measured growth rings		Dendrochronological dating	
				Bass	Treble	Bass	Treble
1	Bass viola da gamba	Francesco Linarolo, 1585	Francesco Linarolo	213	209	1352 – **1564**[1]	1353 – 1561[1]
2	Bass viola da gamba	Jacob Stainer, 1671	Jacob Stainer	123	125	1511 – **1633**[2]	1504 – 1628[2]
3	Violin	Nicolaus Amatus…1669	Nicolò Amati	141	126	1518 – **1658**[3]	1489 – 1614[3]
4	Bass viola a da gamba	Johan Seeloßs…1691	Johann Seeloß	198	205	1465 – 1662[4]	1464 – **1668**[4]

5	Treble viola da gamba	Gianbattista Grancino	Anon. ca. 1730/1740	302		1411 – **1712**[5]	
6	Treble viola da gamba	No label	Anon. ca. 1730/1740	311		1419 – **1729**[5]	
7	Violoncello	Ramon Fernandez. Oviedo 1640	North Italian, ca. 1760	128	181	1628 – **1755**	1572 – 1752
8	Bass viola da gamba	Gianbattista Grancino…1697	Gianbattista Grancino	94	41 72	No dating[6]	No dating[6] No dating[6]
9	Violin	L (imperial eagle) W (branded)	Leopold Widhalm	69	72	No dating[7]	No dating[7]
10	Bass Viola da gamba	Gio: Paolo Maggini in Brescia	G. P. Maggini	70	74	No dating[8]	No dating[8]

Do you wish to see these instruments?

1. Bass viola da gamba by Ventura Linarolo, 1585
2. Bass viola da gamba by Jakob Stainer, Absam, 1671
3. Violin by Nicolò Amati, Cremona, 1669
4. Bass viola da gamba by Johann Seeloss, Linz, 1691
5. Treble viola da gamba in festoon form I, ca. 1730-40
6. Treble viola da gamba in festoon form II, ca. 1730-40
7. Violoncello, North Italy, ca. 1760
8. Bass viola da gamba by Gianbattista Grancino, Milano, 1697
9. Violin by Leopold Widhalm
10. Bass viola da gamba by Gio: Paolo Maggini, Brescia ca. 1600

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