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# WOOD IDENTIFICATION OF THE WOODEN COMPONENTS OF A 19TH CENTURY PIPE ORGAN

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***Abstract:***

*This work is aimed at showing the results of a work of identification of the wood species used for the construction of the mechanical components of a historic pipe organ. The instrument was built in 1895 in Pistoia (Tuscany, Italy) for a church of a small municipality in the north-west of Tuscany, the summer residence of a family of ancient European nobility; it is therefore a large monumental organ, still original. During the restoration operations, and consequently on the disassembly, it was possible to carry out a complete sampling of the wooden components that are normally not directly accessible. The sampling was performed under the supervision of the restorer, through the cut and drawing of very small samples and with minimally invasive criteria. The identification was performed by observing thin sections, manually cut, by means of an optical microscope.*

*The results of the identification carried out on the 25 samples are reported. The identified timbers are not very numerous and the most represented one is poplar (Populus sp.).*

***Key words***: *pipe organ, restoration, wood species identification, wood anatomy, cultural heritage*.

## INTRODUCTION

The pipe organ of the church of Our Lady of the Sacred Heart of Jesus in Capezzano Pianore is a large monumental pipe organ built in Pistoia (Tuscany) by the company Agati-Tronci in 1895 (opus number 1164, Figure 1). The Agati -Tronci was a pipe organ-making company founded in the 1880s by the union of the two competitors companies Agati and Tronci, both building large pipe organs in Pistoia from the first half of the eighteenth century. The presence of an organ of this size in the church of the small community of Capezzano-Pianore, not far from the north Tuscan coast, might seem strange, but in that municipality there was the summer residence of the Bourbon-Parma family and in Capezzano Pianore was born in 1892 Zita of Bourbon-Parma, wife of last emperor of Austria Charles of Habsburg. Precisely the noble family commissioned the construction of this organ, which is the largest still existing of the Agati-Tronci production.

The instrument is located in the elevated wooden choir of the church, enclosed in a wooden case leaning against the counter-façade wall and anchored to it by means of iron rods and bolts. Its appearance has an extraordinary majesty, confirmed by the imposing appearance of the 16-foot façade and with the neoclassical case that recalls the ancient sixteenth-century Tuscan pipe organs.

The mechanical components of a pipe organ have the function of managing and regulating the air flows, produced by the bellows, towards specific pipes, so as to produce the desired sounds (Shannon 2014). A pipe organ is a polymateric instrument, mostly constituted in its mechanical parts of different woods, but some metals (tin, iron and lead), frequently suffering for corrosion damages (Chiavari et al. 2008) and some types of animal skin, together with paper and woollen felt, are also important to seal the connections between elements constructed to regulate the flows of air towards the pipes.

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***Fig. 1.***
***The original label of the Capezzano Pianore pipe organ (left), the console before the restoration on the right.***

Due to the damage suffered by some pipes due to the splinter of a bomb during the last World War (1943), the organ of Capezzano Pianore had not played for several decades and at the time of the beginning of the restoration operations it was not able to play. The mechanical wooden parts were in good condition, showing few and limited holes from xylophagous insects dating back to old attacks no longer active (Figure 4, left). The parts in animal skin needed instead to be replaced, as well as numerous damaged and deformed tin pipes. The scientific literature on the restoration of pipe organs is not very numerous, so it is not easy to find examples that concern the identification of the wood normally used, because they are normally more concentrated on problems to metal components (Justo-Estebaranz et al. 2012), like the so-called “tin pest” (Eckert 2008) or on the deformations of wooden components due to heating (Schellen et al. 2003).

The first restoration operation consisted in the complete disassembly of the whole organ and in the cataloguing of all the components. The disassembled instrument was then transported to the organ building workshop of the Puccini company which required the identification of the wood species, in order to receive fundamental information for the subsequent restoration and consolidation operations of the wooden parts. The dismantling made it possible to evaluate that this pipe organ has never undergone restoration in the course of its history, therefore all the components must be considered those originally made by the manufacturer in 1895.

Aim of the work is the identification of the wood species used for the construction of the organ. The results are important to have a better knowledge about the use of wood into a peculiar field, but also both to inform the restoration and to find if it does exist a technological connection between the selected species and the specific use within the instrument.

## MATERIALS AND METHODS

The applied methodologies follows the guidelines from the Italian technical standard UNI 11118. Sampling for wood identification was carried out by the staff of the anatomical wood characterisation laboratory, but the selection of the wood components to be sampled was by the restorer.

The samples, of the size of a few millimetres on each side, were taken by means of razor blades or scalpels, labelled according to the name given by the master organ and placed in plastic containers (Figure 2, Figure 3).


***Fig. 2.***
***Sampling from foot of wooden pipe quintatone 4p.***

***Fig. 3.***
***Sampling of the rollerboard.***

The 25 drawn samples were brought to the CNR - IVALSA wood anatomical characterization laboratory. Each sample was boiled in tap water to make it suitable for cutting into thin sections. The sections were obtained by cutting the sample blocked by a freezing plate, by hand cutting with a sharp blade. Thin sections were obtained along the three anatomical directions of wood: cross, longitudinal radial and longitudinal tangential.

The observations were carried out using an optical microscope (Leica DB2) equipped with a digital camera. Through the comparison between what has been observed and the descriptions reported in the sector technical literature (Grosser 1977, Schweingruber 1990) it was possible to reach the identifications listed in the results.

The results could reach in several cases the level of the species, while, eg for poplar, it is only possible to reach the genus, because all the poplar species produce wood having the same anatomical characteristics. Honestly, it should be declared that also for spruce wood it is possible only to state the level of *Picea* genus, but considering the historical period and the geographical context it is more probable (almost sure) *Picea abies* than any other possible spruce.

## RESULTS AND DISCUSSION

Table 1 reports the obtained results.

The most represented wood is poplar wood (*Populus* sp.), a widespread situation in Italy where poplar wood is the one that historically finds the greatest variety of uses. In fact it is known that Italian painting used poplar wood for some centuries to make paintings on wood. The most well-known case is that of Leonardo da Vinci's Mona Lisa, but other very famous names like Giotto or Raphael used to paint on poplar boards (Dunkerton and Roy 1996, Mazzanti et al. 2012).

Even the Italian wooden statues from the Renaissance to the late Baroque period were very often, but not almost exclusively, executed by carving poplar trunks (Macchioni et al. 2011, Macchioni et al. 2015).

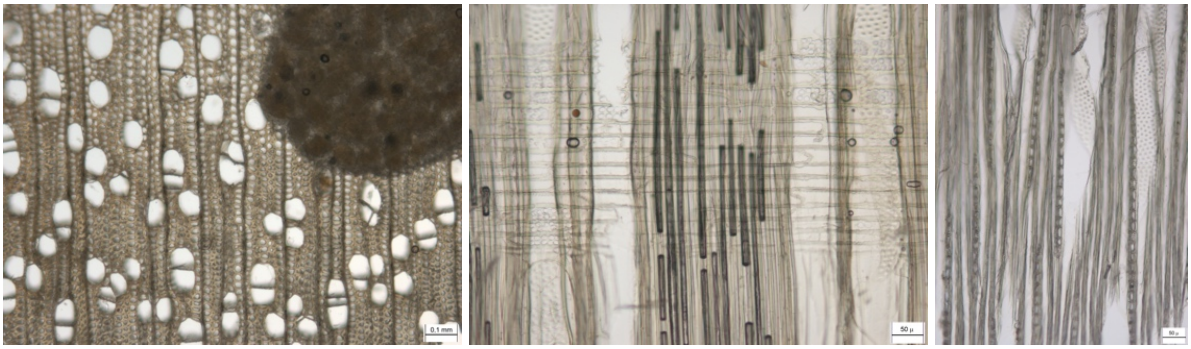

***Fig. 4.***
***From left to right, cross, longitudinal radiale and longitudinal tangential sections from the sample 4, poplar wood. Top right of the cross section: part of a tunnel by a furniture beetle.***

Poplar wood was also widely used in less noble end uses than the artistic ones mentioned before: in certain areas the wooden structures of rural buildings were often made of poplar, as well as the arches that supported the vaulted ceilings were made by nailing each other, to shape an arch, poplar boards (Macchioni and Diodato 2017).

Here in the pipe organ poplar wood is used mostly for lathe-worked elements, but also for less refined joined elements, like supporting boards (Figure 4), reflecting its role as a widespread and economic timber, useful for different purposes and selected according to quality and available dimensions in the storage. For sure the lathe-working of small elements needed an accurate selection of the material, in terms of wood orientation and absence of defects. Giordano (1997 Vol. I) reports the use of *Populus tremula* for inner parts of pipe organs.

The second represented timber is that of the Norway spruce (*Picea abies* Karst.). It is a wood that is neither typical nor traditionally used in the organ production area. Despite this, it is widely used within this organ. In the previous decades it was probably used European fir (*Abies alba* Mill.) wood instead of the spruce, completely similar, but normally without resin production and coming from the Tuscan mountains. Instead, Norway spruce wood was most likely originating in the Alpine regions and its use throughout the peninsula had certainly been encouraged by the political unification of Italy which, at the time of the organ's making, had taken place a few decades earlier, while up to the middle of the 60s of the nineteenth century the Alps and Tuscany belonged to different states. The presence of spruce wood is connected to the structural elements of the organ.

It must be underlined that spruce wood is typical for the production of resonance boards within string instruments, including pianos (Giordano 1997 Vol. I). But this is not the case in this pipe organ, where resonance boards are not present.

A similar structural function is given by the chestnut (*Castanea sativa* Mill.) elements: this wood is represented within the organ by the jalousie of the swell box, a use of chestnut wood that is among the most representative in the Tuscan tradition (Becagli et al. 2009).

The apparently casual presence of a single specimen of Douglas fir (*Pseudotsuga douglasii* Franco) and Swiss stone pine (*Pinus cembra* L.) is probably due to the presence of small elements in the joinery storage that allowed the adequate realization of small components to be placed inside the organ. The Douglas fir sample was probably of American origin (the so-called "first growth") given the small rings, therefore suitable for carving, while Swiss stone pine is well known as one of the few among softwoods suitable for carving (Macchioni et al. 2015).

Walnut wood (*Juglans regia* L.) is present in the organ in small components of fine joinery, as frequently happens in the tradition of Italian carpentry. The walnut wood makes it possible to carry out accurate work in a simple manner given its anatomical and physical-mechanical characteristics (Giordano 1997 Vol. II).

*Table 1*

***Results of the identifications***

| Sample | Position | Timber | Scientific name |
|---|---|---|---|
| 1 | frame of windchest | Norway spruce | *Picea abies* |
| 2 | lock valve of windchest | Walnut | *Juglans regia* |
| 3 | frame of springs stops | Walnut | *Juglans regia* |
| 4 | bottom part of windchest | Poplar | *Populus sp.* |
| 5 | wind trunk | Norway spruce | *Picea abies* |
| 6 | rack board | Poplar | *Populus sp.* |
| 7 | long part of tracker | Poplar | *Populus sp.* |
| 7b | spherical part of tracker | Poplar | *Populus sp.* |
| 8 | pallet | Norway spruce | *Picea abies* |
| 9 | wooden pipe quintatone 4p | Norway spruce | *Picea abies* |
| 10 | foot of wooden pipe quintatone 4p | Douglas fir | *Pseudotsuga douglasii* |
| 11 | Foot of contrabass pipe | Poplar | *Populus sp.* |
| 12 | rollerboard | Poplar | *Populus sp.* |
| 13 | fold of bellow | Beech | *Fagus sylvatica* |
| 14 | valve of bellow | Poplar | *Populus sp.* |
| 15 | bourdon 8P | Swiss pine | *Pinus cembra* |
| 16 | foot of bourdon 8p | Walnut | *Juglans regia* |
| 17 | label of the stops | Holly | *Ilex aquifolium* |
| 18 | tracker | Walnut | *Juglans regia* |
| 19 | curtain's wooden pole | Norway spruce | *Picea abies* |
| 20 | jalousies of swell box | Chestnut | *Castanea sativa* |
| 21 | case bottom | Norway spruce (r.w.) | *Picea abies* |
| 22 | case | Poplar | *Populus sp.* |
| 23 | internal part of case (behind the column) | Norway spruce | *Picea abies* |
| 24 | choir wooden floor | Maritime pine | *Pinus pinaster* |
| 25 | pipe oboe soprano | Maple (prob. Sycamore) | *Acer* cfr. *pseudoplatanus* |

What is surprising is the very reduced presence of beech wood (*Fagus sylvatica* L.), used only as an element of union of the components of the bellow, where the joiner looked for a stable and dense wood. The use of holly wood (*Ilex aquifolium* L., Figure 5) is reserved for the production of cartouches for organ stops. It is a hard wood with a very fine structure, suitable for making small, flat, dimensionally very stable components. Normally, in other pipe organs this role is given to boxwood (*Buxus sempervirens*), a timber

very similar to holly. Most probably the producer didn't have at the moment the availability of boxwood in his storage and choose the most similar one: holly wood.

Among the 25 analysed samples, only one was made to produce and diffuse the sound directly, ie the pipe of the soprano oboe, which turned out to be made of sycamore maple wood (*Acer pseudoplatanus* L.) and not, as expected by the restorer of boxwood. It is an anatomically very uniform wood, quite hard and compact, which allows for an excellent finish with any turning and carving work.

Finally, a sample was also taken from the balcony deck on which the organ is housed (upper choir, *cantoria* in Italian. The wood of maritime pine (*Pinus pinaster* Aiton.) Has been identified, a wood widespread in the area, suitable for uses such as the one found. Currently the maritime pine wood from the same area is mostly reduced in chips for the production of energy or wood panels, given the low quality shape of the local logs.

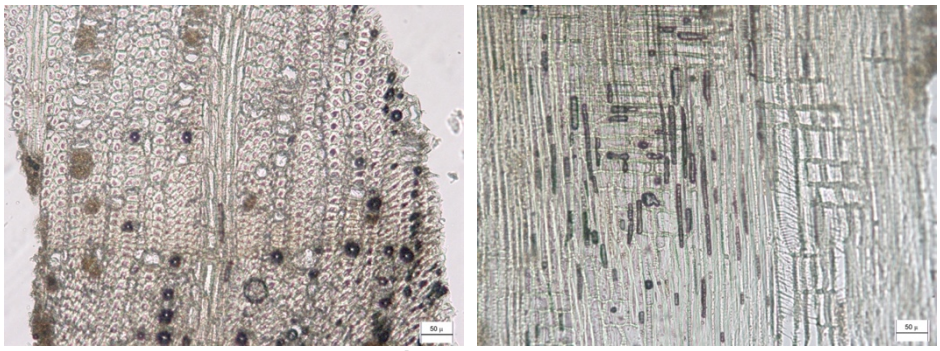

***Fig. 5.***
***Left cross and, right, longitudinal radial section from sample 17, holly wood.***

**CONCLUSIONS**

The identification of the wood species was an analytical phase which, together with the analysis of the metals and that of the surface finishes, informed the restorer in view of the restoration operations.

Given the good general state of preservation of the instrument, the restoration focused mainly on the cleaning of materials, the replacement of the few too damaged parts and the verification of all air seals. This phase necessitated the replacement of almost all elements made of animal skin. The most deformed metal pipes have not been replaced, but put back into shape and reinforced where necessary.

Finally, an extremely delicate phase, the instrument was tuned to its individual components and in general (Angster and Miklòs 1995). The final restoration phase ended on May 20018.

***Fig. 6.***
***After the restoration: the organ from the church and its console.***

The timbers used to make the mechanical components made of wood inside a large pipe organ of the late nineteenth century were identified. The woods used for the construction of the mechanical components made of wood were identified in a large pipe organ of the late nineteenth century. The followed methodology involved the observation by optical microscope of thin sections cut from small samples, obtained in a micro-invasive way with the support of the restorer.

The two most common woods were found to be poplar and spruce. Apparently the specific use of a certain timber for certain wooden parts was guided primarily by availability in storage and, secondarily, by adaptability to specific processes, necessary for obtaining the desired piece.

Once the restoration was completed, the pipe organ of Capezzano Pianore was reassembled in its original location during summer 2018 and was again inaugurated during a special concert, when the instrument played again for the public (Figure 6).

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