

## MATERIALS USED IN MEDIEVAL PIPE MAKING -

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Historically metals, metal alloys and woods are the most commonly used materials for the manufacture of organ pipes. Paper pipes have a long if irregular history as a material used in medieval pipe making. Glass pipes were mentioned by Praetorius (17<sup>th</sup>c) in reference to a Venetian organ, and alabaster was reputedly used in a Neapolitan instrument of this era. Adlung lists possible pipe materials as gold, silver, tin, lead, copper, iron, metal, glass, earthenware, stone, wood, feathers, horn, the bark of trees and [paper](#). Ivory and similar rare and precious materials have occasionally been used, generally as a veneer (e.g. Bückeberg, 1615) or inlay (e.g. Gottfried Fritzsche). Bamboo was used in Japan in early 17<sup>th</sup>c, in Europe by late 17<sup>th</sup>c (Le ajsk 1680) then around the Manila area by Fr. Diego Cera in early 19<sup>th</sup>c, especially at Las Piñas, St. Joseph Church 1816-24 (RP:). It was also used for some dummy pipes in Uganda. Experiments have been made with plastics and a variety of other media, often with the objective of saving costs or enabling easier manufacturing, sometimes on account of market scarcities, and sometimes simply for novelty value or experimentation.

### *Metals*

The most common metals used for pipe resonators are copper, tin, lead, zinc and to a lesser degree, iron (as tinplate). Each of these, and their various alloys, has been used at some stage of organ history as a preferred medium for pipes. Some, like copper, have been abandoned for a time and then returned to limited favor for one reason or another, often economic. Occasionally precious metals, such as silver and gold, are mentioned, but distinguishing between fact and allegory, confusions between names of metals, or adjectives used for sheens or colors, and the fact that no organ survives with pipes actually made of some materials to any substantial degree, may be significant in this context (cf. Innsbruck, Silbernekapelle; Hillerød, Sølv Orglet etc..) One of the eight El Escorial organs in Madrid was supposedly made entirely of silver.

### *Metal Alloys and trace elements*

Very few metal pipes are not made from some alloy or other. Even “pure” tin, copper and lead have naturally, or need, traces of "impurities" left there or added back during the mining, refining or casting processes.

*Copper (also brass, bronze, alloys of copper and tin)*

Metal - copper, bronze - was the first to be used for pipes from and through hydraulis culture, virtually exclusively until about the 11<sup>th</sup> century. Either “pure,” or as a significant component of brass or bronze, copper was the first consistently used organ-pipe metal. The pipes found at Pompeii and Aquincum are of bronze. Julius Pollux attributed the “vigorous” sound of brass or copper pipes to their copper component. [Theophilus](#), in *De organis*, endorsed a contemporary anonymous text, *Cuprum purissimum*, in specifying very pure and thin copper. Its qualities were linked with Stentor’s “voice of bronze ... [equaling] the voice of fifty men”.

The first era of its application is impressive, lasting about one and a half millennia from the hydraulis until c13<sup>th</sup>c. Copper or bronze is noted in the organs of [Dunstan](#) (10<sup>th</sup>c) and [Baldric, Archbishop of Dol](#) (11<sup>th</sup>c.). Copper can give tonal and tuning problems: as early as 11<sup>th</sup>-13<sup>th</sup>cs it was reputed to “bother the ear.” Tests (Boner and Newman, USA 1940) showed that copper pipes can continue to sound, even for a second or two, after their wind supply has been stopped, with one of the lingering frequencies being slightly lower than the other; thus causing undesired beats. It also has malleability problems, so parts that need sensitive manipulation in the voicing processes, such as pipe mouths or languids, can also be made from softer metal or alloys e.g. of lead and tin.

Thus copper was almost exclusively used in early medieval organ building. It was then slowly abandoned for use in flue pipes after 13<sup>th</sup>c, although it continued to have limited use in alloys. From the 16<sup>th</sup>c, there was a gradual but limited revival in the use of copper, notably for reed resonators, where it could achieve “tonal penetration.” But with this we have left the domain of the medieval.

### *Lead*

Lead was probably introduced by or during the 13<sup>th</sup>c and then adopted consistently, virtually entirely replacing copper by the 14<sup>th</sup>. The earliest use of lead in England specified in a contract is from 24 January 1338, for York Minster, by Adam of Darlington (cf. also [Rutland Psalter](#)). Italian records show lead used at [Firenze, SS Annunziata](#) 1379 by Domenico da Siena (tin was also used here); in 1396, at Ely, lead is mentioned although it is unclear whether it was for pipes, bellows’ weights or other purposes; lead was used at Fano (Duomo 1424); the old pipes for an organ at Siena were recorded as being of lead (the Duomo - a new organ of 1457 was to have pipes of tin which was then considered to be “progressive”).

Tonally lead gives a characteristic sound - “dark,” “hollow,” “ancient” - and is noted for “musical agility”. A relatively small Gothic organ with lead pipework could thus fill a large building. A [swallow’s-nest organ](#) installation helps the pipes speak fully into the room; galleries e.g. at Oosthuizen (15<sup>th</sup>c-), also assist lead principals to project their famous “brave sound” (a poignant expression of lead’s tonal qualities coined by E. Power Biggs). In Italy at this time a two-tier system could sometimes used with tin for the Principale facade pipes and lead for the rest (e.g. Cattaro, San Trifone 1488)

Some northern European builders, such as de Mare, Niehoff, Müller, the Scherers, Bockelmann and Hoyer are noted for their dedicated perpetuation of lead. Still in 1539, Niehoff pipes could be of 98% or more lead. Through the 16<sup>th</sup>c and until mid-17<sup>th</sup>c in most regions high lead content pipework was fairly universal.

English lead was preferred by some. North German builders developed sophisticated casting

techniques producing strong lead sheets with graduated thicknesses that were less prone to metal creep and eventual collapse.

Because lead needs high temperatures, casting is difficult, but the metal became highly desirable in organ building of the 14<sup>th</sup> to 16<sup>th</sup>cs and beyond. Its general availability, density, malleability and softness, dampen unwanted pipe wall resonances can thus favourably influence tonal outcomes.

Processes of casting - typically on sand - and hammering the metal before rolling it all had their influence on the final tonal results, especially dealing with any tendencies to porosity.

### *Tin*

Tin has mostly been a relatively costly metal, but highly valued in certain regions and eras. It was first introduced to organ building c11<sup>th</sup>-13<sup>th</sup>cs when it was regarded as having a “friendlier” sound than the “crude” sound of copper. It remains one of the most-used materials.

Provenance was a major issue:

- England/Cornwall - for centuries considered the best tin, although habitually alloyed at source with traces of lead. Consistently specified for its high quality and “lack of impurities” from c1150-, Cornish tin was the preferred source for virtually all organ builders, Europe-wide, over the succeeding c6cs. Italian builders used it from 1421 through to early 18<sup>th</sup>c.
- German mines also produced tin from early 13<sup>th</sup>c, but their metal was regarded as “soft” in reports from the 17<sup>th</sup>c-. Considered the worst available because of a high iron content, Dom Bedos much later (18<sup>th</sup>c) specifically advised against the use of German tin for facade pipes, since rusty surfaces could develop. In 1688 the Flemish builder Antonio Gehenni had to cover pipes with tin-foil which had rusted in this way (at Rome, S. Maria in Aracoeli).

Early references to the use of tin in Italy come from Florence, (S Annunziata 1332); Siena (Duomo 1372); Florence, (S Annunziata 1379 by Domenico da Siena - which used both tin and lead); Orvieto (Duomo 1441) where the tin was “clean and burnished so that it looked almost like silver.”

[Schlick](#) made a strong recommendation for tin in [Spiegel der Orgelmacher und Organisten](#) (1511), although there appears to have been little immediate response. In England the organ at Barking, All Hallows 1519 by A. Duddyngton, seems to have had high-content tin pipes. Tin was probably used, as well as wood, by John Howe II (Howe family ...) for the pipes of Coventry, Holy Trinity 1526.

Descriptions such as “Flanders tin” and “Venice tin” refer to the locations of traders, not mines. “Provence,” “Mallorcan” and “Marseilles” tin also appears in the late 18<sup>th</sup>c. In Italy “rake” tin (*del rastrello/rastrello*) was imported, and had a brand name imprinted with the sign of a rake. It was especially available around Venice, and used e.g. by Graziano Antegnati at Bergamo, 1566.

All early sources of tin contained impurities, either present from its mining, or added later, e.g. lead, antimony, bismuth, copper and iron. Iron was never intentionally added: it was an impurity and considered damaging. Typically, a minimum of 3% lead might be added,

improving malleability, especially when casting.

### *Iron (Tinplate)*

Manufacture of tinplate - iron sheets with a coating of tin (“galvanized iron”) - may have started in Wundiedel, Fichtelgebirge (D:). As early as 1428, it is recorded that “28 short tons” of it were delivered to the Netherlands from Nürnberg. France had production plants by 1665 and England became the major producer during the 18<sup>th</sup>c. Tinplate was effectively never used for medieval pipes, the main instances being found in France and the Netherlands in 16<sup>th</sup> and 17<sup>th</sup>c. In 1686 Lana-Terzi became the first published reference to include an acoustic assessment of iron, post-dating the known introduction of the practice by well over a century (Nick Waanders).

The first reed resonators known to have been made from tinplate were by Peter Breisger at Koblenz in 1534 and Jehan Crinon at Leuven in 1554 (Vente). The Langheduls continued to use tinplate for reed resonators in France through the late 16<sup>th</sup>c, but with influential Parisian builders, tin eventually supplanted it. The earliest use in Italy has been attributed to Willem Hermans (17<sup>th</sup>c). Once again, as with reeds, we have left the medieval era and arrived at the Renaissance or later.

### *Zinc*

Zinc is first documented only as an alloy. In 1657 Johann Rudolph Glauber suggested adding zinc to tin to increase tonal clarity and structural hardness. Its use in organ pipes only fully developed in the 19<sup>th</sup> and early 20<sup>th</sup> centuries.

### *Spotted Metal*

Since the 19<sup>th</sup>c spotted metal is one of the most common alloys used in pipe-making.

### *Wood*

Wood began to be used for organ building generally during metal shortages in the medieval era (Markovits 2003). Truly clear references to wood as a pipe material only occur in the 15<sup>th</sup>c from Arezzo Cathedral 1454 (a complete rank?) and Bologna Cathedral (limited to four pipes). It is possible these were not the first instances, but much earlier dating is unlikely. It was only after the 16<sup>th</sup>c that we can be certain from the chronicles that pipes were regularly being manufactured from wood. Thus [Schlick](#) in his 1511 publication, [Spiegel der Orgelmacher und Organisten](#), recommends it for a Rückpositiv Principal register (“or tin pipes made to sound like wood” and in England, Worcester, Cathedral 1613 had some wooden pipes. Organs with all wood pipes are rare and have only existed from about the 17<sup>th</sup>c, e.g. Hillerød, Frederiksborg Slotskirke in 1610.

A great variety of woods have been chosen for the manufacture of organ pipes, both for flue and reed ranks. Wood’s use was encouraged when solutions to structural problems with large metal pipes (e.g. metal creep) needed resolutions. Obviously once its use had commenced, new tonal palettes were offered and development was further encouraged. Most of this was never part of the normal aesthetic of medieval organs.

### *Summation*

While disputed in some arenas - with counter-arguments usually based on shaky iconographical interpretations - it seems that portatives, positives and blockwerks from the Gothic-Medieval era used only metal pipes. If this is so, then metal was the exclusive option for pipe material from the hydraulis through to the mid-15<sup>th</sup> century (isolated earliest uses of [paper](#) and wood). A consistent exploitation of the properties of wood for organ tone thus probably only developed from the 16<sup>th</sup> century.

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