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Editorial

With this second volume we remain committed to producing an annual journal highlighting recent achievements in music archaeology. The contributions, including congress papers from the 11th ISGMA 2021 in Berlin and the 12th ISGMA 2023 in Würzburg, exemplify the multifaceted approach the journal takes to music archaeology. Compared to our first volume, which focused heavily on the Palaeolithic, this one concentrates on more recent periods.

One of its focuses is on direct analysis of extant sound objects. Based on the study of a clay rattle from Szadek, Katarzyna Tatón und Ireneusz Czajka highlight the complex interplay between archaeology, acoustics, and material science in reconstructing the auditory characteristics of ancient artifacts. Adje Both's contribution is dedicated to liquid-filled whistling vessels from Teotihuacan, discussing both their acoustic properties and cultural significance in Central America. A team from Vienna investigated modern responses to the sounds of preserved and reconstructed bells and potential implications for the function of the objects. Huang Ruoxin revisits the small figures decorating ancient large bronze drums in Southern China with a view to their probable symbolic significance. Experimental music archaeology is represented by a study by Barnaby Brown and Marco Sciascia on the manufacture of reeds for Greco-Roman as well as Egyptian doublepipes, as guided by ancient Greek authors, especially Theophrastus. Other contributions explore the field of music iconography: From close examination of the representations of a turtleshell idiophone in Classic Maya culture, Monika Ciura infers a symbolic connection between the sound of the instrument and that of thunder. Angeliki Liveri examines various representations of music on gems from the Augustan period, encompassing both the portrayal of deities engaged in musical activities and the depiction of musical instruments. Following a comprehensive analysis of the available visual and written sources, Jutta Günther and Florian Leitmeir discuss potential approaches to the reconstruction of Roman soundscapes. Finally, Toivo Burlin takes us on an intriguing ethnological journey along the roads used by the mythical Vittra people of Scandinavia, often recognised by unusual sounds and music.

We would like to express our gratitude to the authors for their contributions and patient collaboration. We are also indebted to numerous reviewers, whose invaluable advice and meticulous comments were instrumental in shaping this volume. Finally, we would like to acknowledge the priceless support provided by Sarah Burgin in the copy-editing process.

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Doublepipe Reeds: *Phragmites*, Straw, and Data-Logging for Distributed Reed Research

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Abstract

This article focuses on some questions that fundamentally shape the revival of ancient doublepipes. These surround the choice of material used for reed-making, interrogating what ancient Greek sources, specifically Theophrastus, report in this regard. These testimonies are interpreted through the lens of our own experience as reed makers and performers of ancient doublepipes, comparing the results obtained from culms of different species, growing locations, and harvesting times. Issues that negatively influence the research aiming to develop reliable reconstructions of ancient reeds are discussed. These include *ad hoc* gathering of data, less than rigorous analysis, and knowledge silos prone to bias. This leads the authors to propose a method of cataloguing culm harvests and manufactured reeds that uses accessible technology to facilitate collaboration and build stronger data with an open science ethos.

Keywords

Double reeds – Reed making – Doublepipes – Aulos – Tibia – Phragmites – Avena

1 Introduction

Doublepipes were played all over the ancient Mediterranean and beyond. Some doublepipes used mouthpieces made from a flattened tube of straw or reed to produce sound. The flexibility of this 'embouchure' type of mouthpiece allows the player to tune the pipes while playing, altering pitch by adjusting lip compression, air pressure, and placement (the degree of insertion into the mouth).

It is also possible to articulate the sound using the tongue, separating musical notes with silence. Other doublepipes apparently used mouthpieces made from a tube of harder material into which a vibrating 'tongue' has been cut. This 'non-embouchure' type of mouthpiece – made by slitting rather than squeezing – cannot be tongued by the player or tuned by adjusting lip compression. It lends itself to a style of music constrained by a smaller range of dynamics, pitches, and playing techniques – but (as evidenced by the Sardinian launeddas tradition) these constraints in no way lower the levels of virtuosity or musical complexity possible on the instrument. The embouchure type mouthpiece predominates in archaeological evidence in the period 1500 BCE – 400 CE. The non-embouchure type mouthpiece, although having a wide diffusion in the present, is scarcely attested in antiquity.[1]

We intentionally avoid here the terms 'double reed' and 'single reed' in this binary division of doublepipe instruments in order to avert confusion with 'doublepipe' and 'singlepipe'. We will, however, follow convention by calling the mouthpieces of both types 'reeds' (without forgetting that the Ancient Greek term was *glôttai*, 'tongues'). Like other musical items (e.g. Latin *tibia*, English 'horn', etc.), the English term 'reed' is named after the material used to make it. To avoid ambiguity, reed makers conventionally call the stems from which reeds are made 'cane'. In the direction of the airstream, we call the parts of an ancient double reed as follows: tip, blades, bulge (or onion), waist, stem, and exit. Essential to form the blades, control their behaviour, and protect them when not in use are reed caps; these fit over the tips, press the blades together, and since at least the Hellenistic period were tied in twos, which helps to keep a good pair of reeds together. Reeds are made from internodes cut from culms that are harvested, dried, and prepared in ways that have changed significantly over time. All these technical terms are illustrated in Figure 1, which shows a half-made 'yoke' of reeds.

In this article, we will make frequent use of botanical terms: 'epidermis' for the outer skin, 'cortex' for the harder fibres below the epidermis, 'xylem' for the softer fibres below the cortex, 'internode' for the section between two nodes, 'leaf-sheath' for the tubular part of the leaf that encases the stem, and 'culm' for any stem with a jointed appearance and hollow internodes.[2] The term 'culm' is particularly useful in technical discussions of reed making because it includes oat, barley, and wheat – species excluded by the word 'cane' – and because 'stem' generally denotes the short tubular part of a reed below the waist binding.

We will use the term 'yoke' in a technical sense, specific to the field of doublepipes, for a working pair of reeds that is subjugated and conventionally tied together using a pair of reed caps.[3] Like

[1] A thorough examination of Hellenic evidence for both reed types concludes that non-embouchure reeds "did not belong to the cultural contexts typically represented in elite discourse" (Wysłucha and Hagel 2023: 398). We introduce the labels 'embouchure' and 'non-embouchure', shifting focus from how reeds are manufactured to how their sound can be manipulated (or not) by the lips of the player, to mitigate the problem of the 'single reed' category being unhelpfully diverse.

[2] We model our usage on Shtein et al. 2021: 3–4.

[3] Several fourth-century BC vases show a string linking the two pipes together, presumably tied to reed caps. Examples include Melbourne NVG D17-1972, Naples 80084, Naples 9015 (cf. Naples 111473), Taranto 28246, and Vienna IV 1009. See Wysłucha and Hagel 2023: 377.

Figure 1: Pair of reeds for a "Megara" aulos in mid-manufacture, 30 August 2019, made by Barnaby Brown using *Phragmites australis* harvested on Camí de Can Alegria, Palma de Mallorca, 4 July 2019. Top to bottom: Internode with leaf-sheath attached; internode with leaf-sheath removed and wrinkling (useless for reed making); root-end reed with unscraped stem, waist binding, bulge, and scraped blades (removing epidermis and cortex); tube partially scraped to make the partner reed, retaining the flower-end node at the reed exit; driftwood reed caps to 'educate' and protect the blades; offcut showing wall thickness of 1.1–1.2 mm. External tube diameter 13.0–13.5 mm; waist internal diameter 4.5 mm; length of scrape 23 mm; tip to top of waist binding 34 mm; total reed length 97 mm. For further details and images, see Brown 2019. © B. Brown.

'reed', this meaning of 'yoke' is derived by a shift from its basic field of reference and carries a connotation shared with the ancient term, *zeûgos*, which was used by Greek doublepipers in the fourth century BC and basically means 'a coupling'. The craft of reed-making was called *zeugopoiïá*, literally 'coupling-making'.[4]

In 2018, when the aulos revival was at an earlier stage, we wrote: "The value to society of Very Early music lies more in enriching the present than in illuminating the past".[5] Our view has changed. It is now clear that embedding practical experiments (or at least the insights of specialist practitioners) in the design and conduct of research does not necessarily lower the quality of the science when developing interpretations of instrument finds; on the contrary, it may help scholars interpret available evidence and find solutions that may not be obvious based on evidence alone.[6]

Obviously, the validity and effectiveness of any practical experiment aspiring to advance research in the field of doublepipes depends on the use of reeds that closely correspond to ancient evidence. Being very fragile, few reeds survive. Fortunately, those that do (or did before their loss

[4] Wysłucha and Hagel 2023: 391–2; cf. below, pp. 13 and 21. Reed makers were also called *glōttopoioí* (cf. Pollux 2.108; 4.71; 7.153).

[5] Brown and D'Angour 2018: 7.

[6] Historically, involving practitioners in research has been fraught with problems; for discussion and eight recommendations, see Brown and D'Angour 2018: 5–8.

in the modern era), are consistent with much of the available iconographic evidence (paintings, relief carvings, and mosaics) and with the singular outstanding item of literary evidence we have in Theophrastus' account of the procedures preparing cane for reed making. Although widely read, Theophrastus' *Historia Plantarum* ("Enquiry into Plants") poses interpretational difficulties in places, leading to competing readings and misapprehensions of crucial passages.[7] In many ways, the present article is fundamentally a report of what we learned in wanting to follow Theophrastus to the letter but realising, circling back to the text with the benefit of experience, that this is not so easy. In the following, we will begin with an analysis of the critical portions of Theophrastus' text, looking into some technical, botanical, and manufacturing details that previous translations failed to fully address. We do this by evaluating the results of fieldwork and practical experiments conducted between 2016 and 2024, and by integrating the sensitivities and concerns of linguists with those of a reed maker and a doublepipe teacher funded by patrons desirous of instruments that are rigorously evidence-based. We will then consider the materials from which doublepipe reeds are made, suggesting that straw merits more attention than it has hitherto received; and conclude with a mechanism designed to make this particular endeavour easier, raising the quality, accessibility, and trustworthiness of historically accurate doublepipe reeds.

2 *Auletikos kalamos* according to Theophrastus

In the longest passage of ancient literature devoted to aulos reeds, Aristotle's student, Theophrastus of Eresos, describes a species of cane called *auletikos* (*Historia Plantarum* 4.11). Its identification with anything currently found in the Mediterranean is problematic. Until recently, makers of experimental ancient reed reconstructions have been using *Arundo donax* – a species widespread in the Mediterranean for millennia and commonly utilised in recent centuries by makers and players of bagpipes, oboes and clarinets.[8] The choice of *Arundo donax* was expedient as it can be acquired from suppliers in pre-processed forms, commercially grown, cured, and prepared to meet the requirements of woodwind instruments with large player communities. However, scholars have long noted that details in Theophrastus' passage speak against the identification of *Arundo donax* as the material of ancient reeds, leading to another species native to the region, *Phragmites australis* (=*communis*), to be suggested instead.[9] Although *Phragmites* is indeed a stronger candidate

[7] For instance, some researchers suggested that the passage describes the making of single reeds rather than double, see Becker 1966: 58; Steinmann 2021: 36–9.

[8] On the ancient distribution of *Arundo donax*, see Hardion 2014.

[9] The 1994 doctoral thesis of Stelios Psaroudakēs devotes a section to the surviving Greek terminology relating to aulos design and the interpretation of Theophrastus' account of auletic cane processing. Psaroudakēs (1994: 357–8; 500–501) was troubled by the assumption that the *auletikos* should be identified with *Arundo donax* (a position echoed by our reed-making mentor, Robin Howell, in personal communications from May 2016 – March 2018). He argued that, based on Theophrastus' text, the choice between *Arundo* and *Phragmites* is not straightforward, as both modern cane species display a combination of features that goes against the description of *auletikos kalamos*. On the whole, Psaroudakēs considered that the case for identification with *Phragmites australis (= communis)* would be superior, were it not for the assertion by Tutin (1980) that its culms do not overwinter.

than *Arundo*, its identification as Theophrastus' *auletikos* is complicated by the fact that the species exhibits significant genetic, morphological, and cytological variations.[10] We will evaluate the evidence for *Arundo* and *Phragmites* in the following section. But before we do so, it should be pointed out that it is possible that Theophrastus' report on the cane processing procedure comes from a specific reed maker informant who acquired his skills from his master as part of the craftsmanship transmission process. It cannot be ruled out that other reed-makers operating at that time may have used different techniques or plant species specific to their inherited schools of practice or as result of innovation. We should be cognizant of the fact that Theophrastus' account on processing reed cane is ultimately time and place specific, describing reed-making procedures presumably used by a specific, anonymous fourth-century Greek craftsman using local species and variants growing at that time around Lake Copais.

Figure 2: Reedbeds of *Phragmites australis* (foreground, with drooping panicles) and *Arundo donax* (background), growing near Lake Vadimone, Orte, Italy, September 2023. © M. Sciascia. Cf. Figure 6.

According to Theophrastus, there are two species of cane:[11]

> Τοῦ δὴ καλάμου δύο φασὶν εἶναι γένη, τόν τε αὐλητικὸν καὶ τὸν ἕτερον· ἓν γὰρ εἶναι τὸ γένος τοῦ ἑτέρου, διαφέρειν δὲ ἀλλήλων ἰσχύϊ ⟨καὶ παχύτητι⟩ καὶ λεπτότητι καὶ ἀσθενείᾳ· καλοῦσι δὲ τὸν μὲν ἰσχυρὸν καὶ παχὺν χαρακίαν τὸν δ᾽ ἕτερον πλόκιμον· (4.11.1)
>
> They say there are two kinds of cane [*kálamos*], the auletic [*aulētikón*] and the other; the other cane, they say, constitutes a single species internally differentiated by strength, ⟨thickness,⟩ tenuity and weakness. If strong and thick they call it stake-cane; but the other type they call weaving-cane.

Based on this passage, the "other cane" could perhaps be identified as *Arundo donax*, as it is described as strong and thick enough to be used as stake-cane. This certainly excludes *Phragmites*, which is too flexible and quick to rot to be useful as a stake. A *Phragmites* stem is characterised by a thin xylem tissue layer, which makes it more delicate and flexible, easier to squeeze flat and rendering a *Phragmites* reed more responsive to lip pressure and diaphragm support, which allows the

[10] On the variation among *Phragmites* subspecies, see Sturtevant et al. 2024; Kew 2024 (*Phragmites australis*); Lambertini et al. 2012; Hansen et al. 2007.

[11] For all the passages from Theophrastus, we use the edition by Hort (1916). The translations are a collaborative effort, building on those by Andrew Barker (1984), Stelios Psaroudakēs (1994), and Stefan Hagel (unpublished, kindly shared with us by the author).

Figure 3: Secondary growth either side of the tenth internode of a culm, green under the leaf-sheaths, cut from a stand of *Phragmites australis* on the banks of the river Gravina di Matera, Italy, 21 February 2024. © B. Brown. Cf. Video 1.

player to achieve a greater variety of pitch and timbre effects. An *Arundo* stem, on the other hand, is stiffer with a thicker xylem tissue layer, which certainly helps to maintain a stable pitch but also makes the tube more susceptible to cracking when it is squeezed flat to form the blades. Figure 2 and Figure 6 show the difference in the flower, or panicle, and Video 1 shows the difference in secondary growth habit, comparing stems of *Phragmites* and *Arundo* growing in Matera in February (see also Figure 3).

As with *Phragmites*, there is an enormous variety of strength and thickness to *Arundo donax*. The thinner culms that grow in the middle of an established stand, stretched by searching for light and as a result more flexible, are split and woven to make mats and baskets in many Mediterranean communities. Thicker-walled *Arundo donax* would lend itself to the manufacture of aulos *bombykes* (the body of the instrument with fingerholes), but although the species is widely used in living piping traditions throughout the Mediterranean, Theophrastus reports that *auletikos* was also used for the bodies, not the other cane (see the discussion of *bombykes* below).

Botanically, the description of Theophrastus presupposes a non-herbaceous perennial habit for *auletikos*, as may be seen in the description:

> γίνεται δὲ ὅταν ἐπομβρίας γενομένης ἐμμένῃ τὸ ὕδωρ δύ᾽ ἔτη τοὐλάχιστον, ἂν δὲ πλείω καὶ καλλίων. (4.11.2)
>
> It grows whenever there is an abundance of rain and the water remains for at least two years; if water remains longer [πλείω= more years], it grows even better.

According to this passage, in order to thrive, the *auletikos* species requires constant proximity of water. We have found usable *Phragmites* cane close to larger water bodies, for instance, rivers and lakes, while reedbeds with less access to water produce lower and thinner cane stems, unsuitable for reed making. *Arundo*, on the contrary, easily adapts to drier conditions, thriving in soil far from water sources, where its roots retain water for a longer period of time even when it vanishes from the ground surface. In such conditions it is able to grow very tall, in some cases reaching 5 metres.

Figure 4: Cross sections showing variability in the thickness of walls, peripheral cortex fibres, and inner xylem tissue of *Arundo donax* and *Phragmites australis* growing in different environmental conditions. Left to right: Sardinian *Arundo* selected for a pipe body; *Phragmites* harvested at Lago di Nemi, Rome, at Calore Irpino, Benevento, and at Lago Vadimone, Orte. © M. Sciascia.

This effectively excludes it from consideration, because in Theophrastus' account of the *auletikos* species, the depth of surface water makes a significant difference:

> φασὶ γὰρ καὶ δοκεῖ βαθυνομένης τῆς λίμνης αὐξάνεσθαι τὸν κάλαμον εἰς μῆκος, μείναντα δὲ τὸν ἐπιόντα ἐνιαυτὸν ἀδρύνεσθαι· (4.11.3)
>
> They say, rightly it seems, that the cane grows to the right length when the lake becomes deep, and if the cane remains, it matures in the following year.

We posit that the condition "if the cane remains" refers to the partial dieback of the aerial parts of *auletikos*. While both *Arundo* and *Phragmites* are rhizomatous perennials, *Arundo* culms overwinter much more successfully than *Phragmites* culms, which generally die back completely. Our field observations, however, show that this habit is not universal. Under certain environmental conditions, *Phragmites* culms can produce secondary growth and overwinter, growing thicker in the second year. [12] However, this habit is exceptional and has not been reported in the *Phragmites* literature that has come to our attention, but is evident in Figure 3 and Video 1.

For both *Arundo* and *Phragmites*, the longest stems can be found in the heart of a reedbed, where they grow the tallest in search of sunlight. The culms most suitable for reed-making are the ones without visible defects, perfectly round, with appropriate diameter and long internodal sections. Theophrastus goes on to note the following dimorphism of *auletikos*:

> καὶ γίνεσθαι τὸν μὲν ἀδρυθέντα ζευγίτην, ᾧ δ᾽ ἂν μὴ συμπαραμείνῃ τὸ ὕδωρ βομβυκίαν.
>
> In mature form it becomes reed-cane [*zeugítēs* – 'pair-cane', i.e. for pairs of aulos reeds], but those canes where the water does not stay become pipe-cane [*bombukías* – 'cane for tubes', i.e. the pipes with fingerholes into which the reeds are inserted].[13]

During our harvesting excursions, we were able to note differences in characteristics of culms, which apparently depended on water conditions during their growth. From our observations har-

[12] Cf. Wang et al. (2006).

[13] Psaroudakēs (1994: 349) believes the text means that the *bombykias* is produced when the lake withdraws at some stage during the growth.

Figure 5: Marco Sciascia and Barnaby Brown harvesting *Phragmites australis* near Lake Vadimone, Orte, September 2018. © B. Brown and M. Sciascia.

vesting *Phragmites* in Paphos, Athens, Palma de Mallorca, Orte, Rome, Benevento, and Matera, Theophrastus' text is most easily harmonised with botanical reality as follows: when there is little rain between May and October, potentially none at all, and the surface water of a lake or river bed recedes, leaving the culms dry at the base, the growth habit of *Phragmites* changes. Compared to culms growing where surface water remains for two summers in a row, these culms have a narrower diameter but greater wall thickness; this makes them less suitable for reeds, more suitable for pipes.

Figure 4 shows the cross sections of one *Arundo* and three *Phragmites* internodes. Second from the left is the first internode of a giant culm, four metres high, that grew 30 cm from the edge of lake Nemi near Rome.[14] It has a thick xylem layer and a diameter of 12 mm; reeds produced from this material require considerable embouchure stamina from players. The third tube was harvested in the riverbed of the Calore Irpino in central Benevento. It has a similar diameter but a much thinner xylem layer. The stand it comes from was growing in the riverbed among pebbles and sand deposits in close proximity to flowing water. Depending on the season of the year, the riverbed fills with water or partly dries out. The culms that grow in these changeable conditions reach medium height and provide material for the production of lighter reeds, well suited for beginner aulos players. The smaller tube of *Phragmites australis* was harvested from a stand growing around Lago Vadimone (see Figure 5), a small lake near Orte. The culms here reach only about 2 metres in height.

[14] Lotos Lab harvest ID H0004, co-ordinates 41.720609, 12.701255.

Harvesting in four Septembers (2019 and 2022–2024), we observed that its roots at that time of the year were entirely immersed in water, but the ground surface was basically dry. To find taller culms of larger diameter, we had to descend into a ditch where water was draining out of the lake, and cut stems growing in the rich silt beneath a few centimetres of running water. On the higher ground, where it was more convenient to harvest, the stems were thinner, not exceeding 9 mm in diameter, with a harder cortex. The fact that different environmental conditions produce culms of such differing characteristics, even at the same site, combined with its high genetic variability, promiscuity, and invasiveness, mean that further taxonomic work would be required to provide clarity across the biogeographic lineages of the *Phragmites* genus.[15]

Theophrastus provides us with further clues that may help to identify the *auletikos* cane:

> Διαφέρειν δὲ τῶν ἄλλων καλάμων ὡς καθ᾽ ὅλου λαβεῖν εὐτροφίᾳ τινὶ τῆς φύσεως· εὐπληθέστερον γὰρ εἶναι καὶ εὐσαρκότερον καὶ ὅλως δὲ θῆλυν τῇ προσόψει. καὶ γὰρ τὸ φύλλον πλατύτερον ἔχειν καὶ λευκότερον τὴν δὲ ἀνθήλην ἐλάττω τῶν ἄλλων, τινὰς δὲ ὅλως οὐκ ἔχειν, οὓς καὶ προσαγορεύουσιν εὐνουχίας· ἐξ ὧν ἄριστα μέν φασί τινες γίνεσθαι τὰ ζεύγη, κατορθοῦν δὲ ὀλίγα παρὰ τὴν ἐργασίαν. (4.11.4)
>
> They say it generally differs from other cane species by a kind of inherent thriving condition, being fuller [*euplēthēs*], more fleshy [*eúsarkos*], and overall having a feminine appearance. It also has a broader and brighter leaf [*phýllon*], but a smaller plume [*anthḗlē*] than that of the other kinds, some stems having no plume at all; they call these 'eunuch-reeds' [*eunoukhías*]. Some maintain that the best pairs [*zeúgē*] are produced from these stems, though few work out right during the process of manufacture.

Previous translators have rendered *zeúgē* as 'mouthpieces'. This is open to misinterpretation. The Greek word for the working frame that connects two oxen to a plough or carriage is slightly different: *zygón* or *zugós*. In order to convey in translation the sense of a connected pair, we would prefer to render the ancient term *zeûgos* or *zeugítēs* with the English word 'yoke' in its long-attested but now rare meaning of "any pair of people or things".[16] Although not a literal translation**,** this captures the sense of *zeûgos* more fully by invoking the idea of yoking two animals and gives modern players a one-syllable term with a richer meaning: a balanced pair of doublepipe reeds.

As well as documenting a technical term, this passage presents vital morphological information about the species. *Phragmites* and *Arundo* differ significantly in the size and shape of the blossom, or panicle. *Phragmites* has a shorter, fluffier plume, which droops to one side. Meanwhile, *Arundo* has a longer, erect plume that opens out evenly in all directions when mature (Figure 6). We have yet to investigate the properties of the flowerless stems which are mentioned in the last sentence of this passage. The flowerless culms stand out as taller and stronger in the wild, but become indistinguishable from the others as soon as the drooping panicles have been trimmed off,

[15] A helpful factsheet distinguishing native and introduced lineages in North America is Sturtevant et al. 2024, https://nas.er.usgs.gov/queries/greatlakes/FactSheet.aspx?Species_ID=2937.

[16] https://www.oed.com/dictionary/yoke_n, meaning II.7.b, with citations from 1425.

Figure 6: Left: panicles of *Phragmites australis*. Right: panicles of *Arundo donax*. Lago di San Liberato, Fiume Nera, Italy, April 2023. © M. Sciascia.

which is necessary to fit harvested bundles in a car. A scientific investigation requires that they be separated from the rest and carefully labelled before the panicles are cut off. Our research on this is in progress, as systematic harvesting only began in September 2023.

3 Preparing cane for reed-making

In this section we will report our experiments in preparing the cane for reed-making, in which we tried to follow the process described by Theophrastus as closely as possible. The first step is drying the cane without removing its protective leaf sheaths:

> ἡ δ᾽ ἐργασία γίνεται τοῦτον τὸν τρόπον· ὅταν συλλέξωσι τιθέασιν ὑπαίθριον τοῦ χειμῶνος ἐν τῷ λέμματι· τοῦ δ᾽ ἦρος περικαθάραντες καὶ ἐκτρίψαντες εἰς τὸν ἥλιον ἔθεσαν. (4.11.6)
>
> The manufacturing is done in the following manner: once they have harvested [the aulos cane], they put it in the open [ὑπαίθριον = under the sky] in its leaf sheaths (?) [λέμμα = husk, rind, bark] for the winter. In the spring, after thoroughly cleaning [περικαθαίρω = clean all around] and scraping it [ἐκτρίβω = rub out, destroy, wear out, polish], they place it in the sun.

The leaf sheaths and leaf blades provide a coating and cushioning that protect the culm from scratches, dents, dust, bird droppings, and other hazards of winter storage. The Greek ὑπαίθριον implies the open air, i.e., not under any kind of roof, so the leaf sheath also protects against rain. In the spring, the protective leaf casing is removed and the water-repellent outer layers of the stem are scraped away – at a minimum the shiny epidermis, and probably the outer cortex too – to reduce the risk of cracks when forming the blades. This leaves the softer internal fibres exposed to the sun. In our experiments, we have generally left the outer fibre ring immediately under the cortex, with its closely-packed vascular bundles, undisturbed in order to avoid exposing the paler ground tissue, which has larger vascular bundles spaced further apart. The extra effort involved in

removing the outer fibre ring does not appear to produce any advantage, only a loss of strength and degradation of the exterior finish. A possible exception to this may be made when scraping the lowest internodes, or an unusually hard culm. Removing more material will soften the reeds and may increase success rate.

We find that letting sunlight cure the xylem layer beneath the cortex is an efficient way of refining the evenness of the scrape and exposing defects, such as dead fibres, which are often darker in colour. Over time and under strain, these develop into cracks that can be catastrophic for the reed if they occur in the vibrating part of the blade. A crack at the tips will accelerate the reed's demise if not end its life immediately. A longer period in the sun allows lower-quality internodes to be discarded, saving time (and heartache) in the long run. The lost labour of manufacturing and breaking in reeds that develop cracks before reaching maturity is significantly more costly than curing scraped culms in the sun for six weeks.

At this point in the process, the culms are still intact. Theophrastus continues:

> τοῦ θέρους δὲ μετὰ ταῦτα συντεμόντες εἰς τὰ μεσογονάτια πάλιν ὑπαίθριον τιθέασι χρόνον τινά.
>
> In the following summer, they cut it into internodes [μεσογονάτια = between the joints] and place these once more outside in the open air for some time.

Following these instructions, we harvested stems of *Phragmites australis* in September 2022 and 2023, left them to dry in their leaf sheaths over the winter, and removed the leaves in March. We then removed the tough outer skin by vigorously scraping it away with a knife (Theophrastus uses the verb ἐκτρίβω to describe this process which may denote rubbing as well as perhaps sanding or polishing), then left the culms out in the sun. Exposure to ultraviolet and other rays has two noticeable effects on the xylem tissue. First, the contrast in colour between different depths of scrape increases, making it easier to finish consistently to the same depth. Secondly, the loss of moisture produces a slight shrinking of the xylem vessels, so that any remains of the outer fibre ring stand out, easier to see and to remove. If the scraping has gone deeper, sunlight will also expose the fibres surrounding the larger vascular bundles that increase in size and reduce in density towards the hollow interior. In other words, leaving scraped culms in the sunshine (presumably turning them occasionally so that all sides are evenly 'cooked') makes it easier to achieve a consistent wall thickness. This is crucial to achieve the desired response when the reeds are eventually broken in by the player, a process familiar to modern reed players.

After dividing the culms into internodes, leaving them outdoors allows warm summer air to penetrate the interiors of each tube, removing any residual moisture.

> προσλείπουσι δὲ τῷ μεσογονατίῳ τὸ πρὸς τοὺς βλαστοὺς γόνυ· τὰ δὲ μήκη τὰ τούτων οὐ γίνεται διπαλαίστων ἐλάττω.
>
> Each internode retains the node nearer the blossom [βλαστός = shoot, bud, blossom]; their lengths are no less than two palms [8 fingers, roughly 15 cm, or 6 inches].

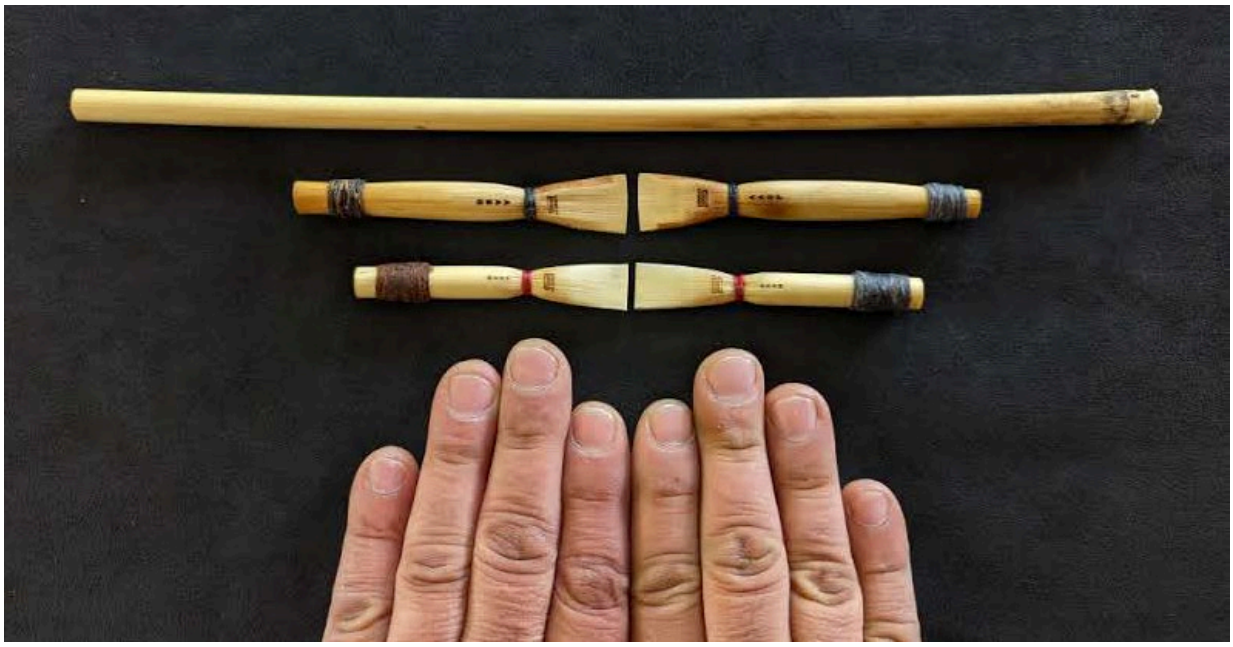


Figure 7: A *Phragmites australis* internode with two 'yokes' (pairs of reeds made from a single internode) suitable for 'Pydna' and 'Selinus' auloi. The 'yokes' are respectively ten fingers and two palms long. © B. Brown.

The term βλαστός (*blastós*) almost certainly refers to the blossom (plume) at the top of the stem. Depending on environmental conditions, the mature stems we harvested have yielded between six and thirteen internodes that are at least two palms in length. This is sufficient for the sixth-century 'Giglio' and 'Selinus' *auloi*, but the 'Pydna', 'Elgin' and 'Megara'[17] *auloi* proved to require longer internodes of nine, ten, or eleven fingers (see Figure 7).[18]

We were initially curious as to why when cutting each culm into sections, it was important to cut above each node ('each internode retains the node nearer the blossom'). Why not cut below the node? Or above and below, removing the node? Is the node nearer the blossom retained permanently, left there throughout the life of the reed? What initially seemed an arbitrary detail to us was apparently important enough to be communicated to Theophrastus by his informant(s) and deemed worthy of transmission by him. To the best of our knowledge, the first practical experiments testing possible answers to these questions began in 2017, when Barnaby Brown commissioned Robin Howell to produce a stock of reeds for Hellenic *auloi*: a sufficient quantity to permit experimentation. At the time, no-one in the doublepipe revival apart from Chrēstos Terzēs and Stefan Hagel was making 'Theophrastian yokes' (ζεύγη): pairs of reeds squeezed from a single internode with the blades kissing at the midpoint. If made any other way, Theophrastus cautions, the reeds will not sound well together. He saves this nugget of cultural wisdom for the conclusion:

[17] On the 'Selinus' fragments, see Bellia 2015; the 'Pydna' aulos, see Psaroudakēs 2008; on the 'Elgin' aulos, see Schlesinger 1939: 411–13; Reichlin-Moser and Reichlin-Moser 2015; on the 'Megara' auloi, see Terzēs and Hagel 2022.

[18] There was a significant variation with regard to the length of διπαλαίστων (two palms). In Aegina, two palms was approximately 167 mm or 6.6 inches, whereas in Athens it was about 148 mm or 5.8 inches; cf. *Oxford Classical Dictionary*, 2015, *s.v.* Measures; Hagel 2021b: 428. Evidence that pre-Hellenistic auloi used reeds with long stems is overwhelming, cf. Hagel 2021b: 428–30; 433–35.

Figure 8 Seventeen uncut 'Theophrastian yokes' made by Valentina Grossi and Simone Mulazzani in March 2024, from *Phragmites australis* harvested by Marco Sciascia in Benevento, September 2022. The colour of the waist binding records which internode the 'yoke' is made from (see Table 2 below). © B. Brown.

> Τμηθέντος δὲ δίχα τοῦ μεσογονατίου τὸ στόμα τῆς γλώττης ἑκατέρας γίνεσθαι κατὰ τὴν τοῦ καλάμ τομήν· ἐὰν δὲ ἄλλον τρόπον ἐργασθῶσιν αἱ γλῶτται, ταύτας οὐ πάνυ συμφωνεῖν. (4.11.7)
>
> When the internode is cut in two, the mouth of each reed comes to be at the cut of the cane. If the reeds are manufactured in another way, they are not in good concord, it is said.

When we switched in 2024 to a manufacturing method where we no longer cut the internode before squeezing to form the blades, but rather squeezed while the two reeds were still connected, we found the process to be overwhelmingly advantageous for three reasons. First, it minimises the physical differences between the left and right reeds in the critical area manipulated by the player's lips. Secondly, it reduces the risk of cracks forming during moments of peak stress, such as when the blades fan out as they are flattened. During the days, weeks, or months prior to coming into service, reeds may be stored in a player's case travelling the world; as long as the yoke is left uncut, the longitudinal fibres and vascular bundles at the tips – where the fan is most splayed out, halfway between the waists – are held together laterally by the partner reed (as in Figure 8). And

thirdly, forming two blades simultaneously reduces production time significantly. Figure 8 shows a wide range of undivided 'yokes' made for different Hellenic and Roman-era *auloi*, in all cases retaining the node nearest the blossom.

However, the equality between the pairs of reeds produced by this method has a downside. If the pipes held in left and right hands were identical, there would be no problem, but the pitches of the fingerholes differ between the pipes of all surviving *auloi*. Notes of different pitches sounded with identical reeds produces an inequality in the relative loudness of the pipes, with the high pipe tending to overpower the low pipe. If ancient players, like the reconstructionist community, sought to amplify the bass and/or attenuate the shrillness of the treble, they would have ideally found a way to achieve this without compromising the perfect balance between the blades achieved by cutting them from the same internode. The site for adjustment least likely to upset this balance is the opposite end: the reed exit. In 2017, the reeds in our pipes were balanced at best for only a short window of time and perfect 'yokes', working well together, day in day out, were almost unknown. The first 'Theophrastian yokes' shipped from Robin Howell in Toronto and Marco Sciascia in Orte to Barnaby Brown in UK, had no clear markings to reveal which reed belonged in which pipe; this made it impossible to observe another tradition reported by Theophrastus:

> συμφωνεῖν δὲ τὰς γλώττας τὰς ἐκ τοῦ αὐτοῦ μεσογονατίου, τὰς δὲ ἄλλας οὐ συμφωνεῖν· καὶ τὴν μὲν πρὸς τῇ ῥίζῃ ἀριστερὰν εἶναι, τὴν δὲ πρὸς τοὺς βλαστοὺς δεξιάν. (4.11.7)
>
> Reeds [*glôttai*] from one and the same internode, they say, are in concord, but not others; and the one closer to the root is the left-hand, the one closer to the blossom the right-hand.

At the time, our decision on which reed to put in which pipe was made by ear and the wisdom accumulated over generations in a Panhellenic tradition was overlooked or undervalued. Initial progress was made by Howell, who observed that for equal voicing the high pipe always needed a reed that was slightly quieter, or darker in timbre, in order to achieve an optimal balance with the low pipe. For perceptual equality, it follows that the low pipe requires a slightly louder or brighter reed. In the case of an *aulos* 'yoke', visual and material equality does not produce acoustic equality. Reedmakers whose skills were shaped making embouchure reeds for singlepipes (piri, duduk, oboe, bassoon, etc.) attempted to achieve better voicing by making the blades of each reed slightly different, only to find that this threw other aspects of balance out of kilter, such as one reed speaking sooner on a crescendo, stopping earlier on a diminuendo, or (most distressingly) opening faster and becoming harder during a performance. These aspects of balance are unique to the doublepipe and the method of achieving balance reliably had to be rediscovered. The design of a 'yoke' reported by Theophrastus provides the answer as it ensures that the blades could not be more equal.

The process of learning between 2016 and 2024 was one of informal experimentation, exchanging results and evaluating each other's playing. Some of us were able to achieve virtuosic results, consistently in different venues and seasons, through intensive practice. The collective understanding that emerged from this process is that leaving the node on the high pipe reed only, thereby narrowing the exit bore of the reed, corrects the balance of the whole instrument; in other

words, neither left nor right pipe overpowers the other. But why should the reed made from the blossom end go in the right pipe, and the reed made from the root end go in the left pipe?[19] There is usually a subtle organic swelling in the lower region of an internode, resulting in a wider bore. Putting the reed with the wider bore in the lower pipe will make it slightly louder, increasing the vibrancy of the bass notes, just as putting the reed with the narrower bore in the high pipe will reduce the stridency of the top notes. But with internodes that are beautifully straight, the effect is slight. We conjecture that ancient players combined the two methods to increase the relative loudness of the low pipe. Neither method sacrifices equality of behaviour at the tips, and together they produce about the right correction, amplifying the bass somewhat, but not too much.

A final point is worth making here in order to save others from repeating our mistakes. Without some handmade mark, or a prominent organic feature like a node, it is difficult to distinguish the left reed from the right. There are therefore two compelling reasons for leaving the node permanently on one reed (rather than cutting it off). One is acoustic: the node quietens the reed by narrowing its bore at the exit. The other is visual: the node makes it easier for players to reliably distinguish which reed is which throughout a 'yoke's' lifetime. Unlike a mark or binding, it does not rub off, fall off, or fade away. We now have compelling answers to all of our questions: retaining the node is a musically effective and labour-saving solution to the balance problem created by putting perfectly equal reeds into pipes of differing pitches, a solution well worth transmitting to students. As with all investigations by practical experiment, however, other solutions are possible and we should remain curious until these findings have been tested by other teams of investigators who see the world differently, and who have the resources to design an experiment that is more rigorous. The most serious limitation to this investigation is the lack of consistent data logging over time, with reeds wandering between instruments and players. The problem of chaotic, inconsistent record keeping with no professional support, training, or leadership in research methodology is a limitation for which we present a low-cost way forward below.

> βέλτιστα μὲν οὖν εἶναι τῶν μεσογονατίων πρὸς τὴν ζευγοποιΐαν ὅλου τοῦ καλάμου τὰ μέσα·
>
> They say that the best internodia for reed-making [*zeugopoiïía*] come from the middle of the entire cane;

This statement accords with our own experience, finding that the best reeds tend to come from between the third and fifth internodes on shorter stems, or the fourth and seventh internodes on longer stems. Theophrastus then adds:

> μαλακώτατα δὲ ἴσχειν ζεύγη τὰ πρὸς τοὺς βλαστούς, σκληρότατα δὲ τὰ πρὸς τῇ ῥίζῃ·
>
> Those close to the blossom produce the softest reed-pairs [*zeúgē*], those near the roots make the hardest.

[19] Stelios Psaroudakēs (2008; 2020) proposes a 6L-Rule, which we would revise to a 7L-Rule: Longer sections of bone belong to the Longer pipe, which is held in the Left hand, has fingerholes Lower in pitch, has a Left thumbhole displacement, and uses a slightly Louder reed with a Larger internal diameter at the exit.

This is incontestably true: the cortex is invariably harder and thicker in the lower sections, becoming softer and thinner nearer the top. We would add that there is considerable variation between culms, even those growing from the same section of rhizome. The hardness of the first internode on one culm could, for example, match that of the fourth internode on its neighbour.

4 Straw reeds

While doublepipes with internal diameters of 7.5–10 mm, which were played in the Classical and Graeco-Roman periods, certainly used cane reeds made from stems of a matching diameter, other types of materials may have been utilised for the production of reeds for more slender instruments.[20] In the late 19th century, multiple discoveries of pipes in Egyptian tombs, often still equipped with reeds, led scholars to believe that the material generally used for smaller reeds had been straw.[21] In his 1889 catalogue of unearthed Egyptian pipes, Victor Loret reports three straw specimens – two fragments of finished mouthpieces, and one stem presumably stored by the player as raw material for making new reeds – all of which may still survive today (Table 1).[22] A fourth reed, apparently unknown to Loret, is perhaps the only surviving item of a collection of about ten Egyptian reeds held at the Museum of Musical Instruments in Brussels, the materials of which had been identified as cane and straw (Figure 9).[23] As no recent palaeobotanical studies have been conducted on any of these finds, the identification of the material as straw calls for verification, and without any seed-bearing spikes or panicles, it may be impossible to narrow down the species.

Since modern cereals, both domesticated and wild, differ greatly from their ancestors, selecting straw stems whose characteristics match the few fragments preserved in museums presents difficulties. Botanical taxonomies are fluid and may confer a specious tidiness on organic evolution that is not scientifically warranted, especially when chronological and geographical views are widened. In our harvesting experience, looking for suitable culms in the same stands, year after year, it is clear that environmental conditions are critical – nutrients, water, warmth, and sunlight at key growth stages. It appears that we are not hunting down a genetic mutation, or another variety or subspecies, because straw of sufficient diameter is much easier to find in some years than others. However, the cumulative effects of genetic mutations, cross-fertilization, changing climate, and human interference calls for an approach that resists singular solutions. We have conducted our experiments using *Avena sterilis* because it is convenient (growing all around Marco Sciascia's home), plausible (the progenitor of domesticated oat crops, indigenous to Southwest Asia), appears

[20] On reed and reed-seat diameters in the Graeco-Roman period, see Wysłucha and Hagel 2023: 383.

[21] Baines 1968: 199: "Among the fifty-odd cane pipes found in Egyptian tombs – nearly all of them double-pipe components with three or four holes – many had fragments of straw-like matter adhering to one end, thought to be remains of reeds." Cf. Chappell 1974: 261.

[22] Loret 1889: 197–206. The list was updated in a later study: Loret 1913: 17–20. It was incorporated in English into Kathleen Schlesinger's list of extant aulos pipes, see Schlesinger 1939: 419–56. Schlesinger built straw reeds for her facsimiles of Egyptian pipes.

[23] Cf. Baines 1968: 193.

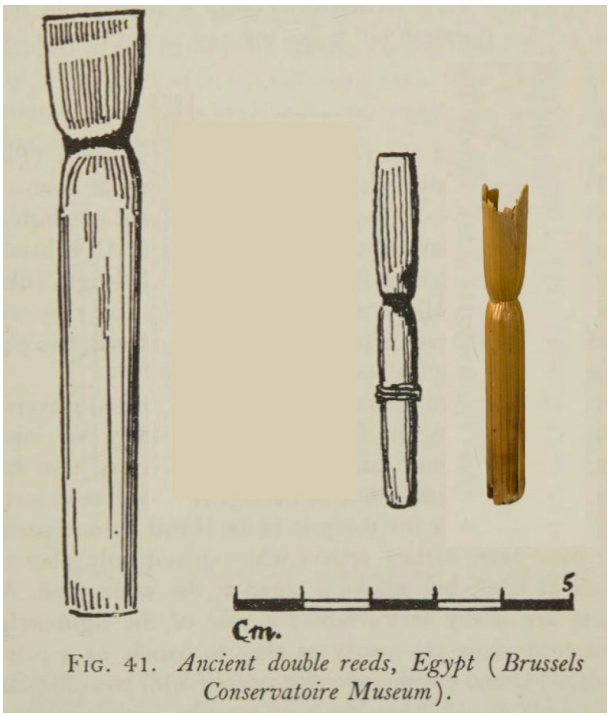


FIG. 41. *Ancient double reeds, Egypt (Brussels Conservatoire Museum).*

Figure 9: Left: *Avena sterilis* in Orte, Italy © M. Sciascia. Right: drawings of two reeds in the Brussels Museum of Musical Instruments (Baines 1968: 193) and a photo of the only surviving reed, inventory no. 3397. © MIM - Musical Instruments Museum.

museum	inventory number	Loret's 1913 cat. no.	dimensions
Turin, Museo Egizio	11 according to Loret; currently?	20	Diameter: 5 mm
London, British Museum	No number according to Loret; currently EA38166 and EA38168?[24]	33/35	Diameter: 4 mm Length: 31.9 mm
Leiden, Rijksmuseum van Oudheden	I. 476 according to Loret; currently 220?[25]	17	
Brussels, Musiekinstrumenten-museum	3397 (not mentioned in Loret)		[Diameter: 6mm Length: 53mm][26]

Table 1: Potentially surviving straw reeds in European museums.

[24] It is possible that the find survives with inventory numbers EA38166 and EA38168. Cf. https://www.britishmuseum.org/collection/object/Y_EA38166 [Accessed 23 November 2024].

[25] Schlesinger describes this item in the following way (1911, s.v. Mouthpiece): "A case excavated in Egypt was found to contain two pipes, and in addition five pieces of reed without bore or holes, and three pieces of straw suitable for making double-reed mouthpieces." This description matches a group of finds currently catalogued with inventory number 220.

[26] Dimensions estimated from the drawing reproduced in Figure 9 (far right).

Figure 10: 'Theophrastian yokes' made of *Avena sterilis* harvested in Orte, Italy, June 2023, with internodes of two giant culms (200 cm tall and 7–9 mm wide at the internodal midpoints), harvested a year later in the same location. Clockwise from centre: Reed caps made from birchwood tongue depressors. Five 'yokes' made from internodes of ⌀ 5–9 mm, one uncut, one unsqueezed. Six internodes cured in the shade, cut from a giant culm harvested when slightly green (17 June 2024), 7–8 mm in diameter at the midpoints. Six internodes cured in their leaf-sheaths in full sun for 6 hours (37°C), cut from a giant culm harvested when golden (8 July 2024), 8–9 mm in diameter at the midpoints. Seventeen uncut 'yokes' for 'Lady Maket' pipes, ⌀ 5 mm: six of internal waist ⌀ 2.7 mm (tied with white thread); five of ⌀ 2.3 mm (tied with brown thread); six ⌀ 2.0 mm (tied with black thread). © B. Brown.

to match what we have so far seen of the fragments in museums, and is supported by a literary tradition that we can trace back to Vergil.[27] More rigorous scrutiny of the archaeological evidence and experimentation with other species, circling back and forth between experiments and evidence, re-examining the museum fragments with more experienced eyes, is desirable but beyond the scope of this study.

We have found it best to harvest oat straw just before it turns completely golden, which in central Italy is in the second half of June. Like *Phragmites*, *Avena sterilis* culms have multiple nodes protected by leaf-sheaths, normally seven.[28] Straw of sufficient diameter for Egyptian doublepipes (5–8 mm) and Graeco-Roman auloi (7–9 mm) comes from stems that reach a height of 180–200 cm. This is unusual for any of *Avena*'s thirty accepted species.[29] Rather than curing harvested straw in direct sunlight, which makes it brittle, we have found it better to let the culms dry out more gently, in the shade and in their leaf-sheaths. This keeps it more pliant and, as with *Phragmites*, protects the walls of the internodes from dirt and damage. The results of our experiments show that *Avena sterilis* is a good candidate for making reeds for a wide variety of instruments (Figure 10). Compared

[27] *Avena* is the pipe of Vergil's bucolic, famously featuring in the opening verses of his first Eclogue.

[28] A video of ours (Brown 2024) shows culms of exceptional length and girth being processed, and the resulting reeds being played.

[29] Kew 2024, *Avena*.

Figure 11: Making 'Theophrastian yokes' in straw – tying a waist around a knitting needle of ⌀ 2.0 mm, using coloured thread to record different internal waist diameters. Cambridge, 19 May 2024. © B. Brown.

to *Arundo* and *Phragmites*, *Avena* 'yokes' are quick and easy to make, become playable in a fraction of the time, and as far as we can tell last just as long. The significant factors determining the life expectancy of a reed, in our experience, are care on the part of the reed owner (avoiding accidents and mould) and selection on the part of the reed maker (in the field and in the workshop).

The reeds we make for reconstructions of ancient Egyptian pipes, including the so-called Lady Maket pipes found in El Lahun, Egypt (now held in the Museum of Musical Instruments in Berlin), have provided an opportunity for iterative research (Figure 10, Figure 11, and Figure 12). Our current use of oat straw is provisional, building up expertise before a closer examination of original straw reed fragments, which we intend to accomplish by eye and electron microscopy, not just in one museum but by comparing fragments in Turin, Brussels, Berlin, Leiden, and London. The next step is to observe more closely the characteristics we are trying to match, and to assess the degree of diversity in antiquity. For now, all we can report is that *Avena sterilis* works, and the larger culms growing in central Italy have sufficient diameter and strength to produce compelling results not only in narrow-bore Egyptian doublepipes (such as the 'Maket' pipe) but in wider-bore Graeco-Roman doublepipes (such as the 'Louvre' *aulos*). As with *Phragmites*, we have verified experimentally that a pair of *Avena* reeds manufactured from a single internode, squeezed before cutting,

Figure 12: Reconstruction of the 'Lady Maket' doublepipe with an instrument case. © M. Sciascia.

greatly reduces the difficulty of getting the 3-hole and 4-hole pipes to sound well together and tends to encourage this balance to endure, rather than diverge over time. One early mistake we made was to scrape away the shiny epidermis at the tips of the blades. These scraped reeds did not last and lacked the reliability of those that preserve straw's water-repellent outer skin. We also learned that the 'onion' above the waist should be as rotund as possible, not flattened, otherwise the spring in the blades can be insufficient to re-open the tips, particularly when tonguing (a technique for which there is no positive evidence in antiquity but was eminently possible).

5 Data Logging for Reed Research

Troubled by the spectre of beliefs setting in without scientific support, we started logging data more systematically in 2023. We are in the process of developing a system that we hope reed makers and players of every level will find easy and attractive to use, with a strong perpetuity plan so that a multi-lifetime, multi-regional, multi-perspective evidence base could be available to future researchers. One of the main issues with this sort of data collection is accuracy. Rather than recalling details weeks after the event, or storing information on scraps of paper that can become detached from bundles, we are currently using a Google sheet that enables collaborators in different regions to log information immediately, in the field and on the road. For example, capturing data for *Phragmites* harvested by the students we were training in Matera, Italy (Figure 13).

Figure 13: Bundles of *Phragmites australis*, harvested October 2023, labelled with locations of four harvest sites around Matera, Italy. Photographed 20 March 2024 after overwintering in the open air. © B. Brown.

An open-access catalogue records the location (places marked in our database are provided with GPS coordinates and a link that directs to Google Maps) and date the reed material was harvested; notes on curing, manufacturing, and parenting; and for *Phragmites* (not straw), the internodal section it was made from, recorded via the colour of the waist binding (see Table 2). Our aim is to make it easy for any reed maker to be systematic, contributing observations to a dataset that has an increased chance of being of scientific value down the line.

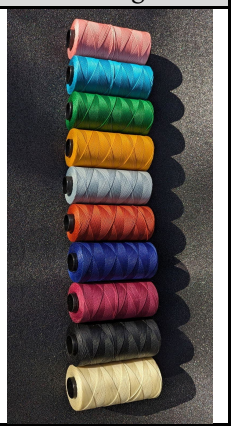
ancient colour	internode	waist binding thread
rose	10	
sky blue	9	
grass green	8	
gold	7	
silver	6	
cinnabar	5	
Ishtar Gate	4	
violet hematite	3	
bitumen	2	
whitewash	1	

Table 2: Colour system designed to foster public participation in longitudinal research, learning which internodes players prefer because the relevant information is enduringly visible in the reed's waist binding (see Figures 8 and 14).

In order for players to log observations throughout the lifetime of their reeds, there need to be unique IDs on every reed that remain legible for years. We found permanent ink wears off quickly, so switched to a laser engraver and initially burned IDs onto twenty-eight 'Theophrastian yokes' (twenty-three in *Phragmites*, four in *Avena*, and one in *Arundo*) and thirty singletons (twenty-one in *Phragmites*, eight in *Avena*, and one in *Arundo*): a total of eighty-six reeds for ancient pipes of every kind (Figure 14).

The use of Google sheets enables us to gather collective experience in this extremely niche sphere by increasing the number of investigators. This is our chosen starting point because it is an accessible platform that is robust and cheap to maintain, removing barriers for players who are not trained researchers to participate by logging observations and reed-treating procedures. Our ambition is to foster a multi-perspective, community-driven dataset that propels research forwards by systematically following hundreds of reeds, harvested in numerous locations, from their gathering to the end of their playable lives. We are still in the early stages of testing and development and would welcome feedback on how to refine the Lotos Lab data-logging system. We en-

Figure 14: Eighty-six reeds, laser-engraved with the unique IDs AAAA to AACF in January 2023. Pairs that make up 'Theophrastian yokes' have the same ID. In each 'yoke', the root-end reed and the blossom-end reed are distinguished by coloured thread: brown/red for the left/low pipe, blue/green for the right/high pipe. © B. Brown.

Figure 15: Forty-three 'Louvre yokes' and twenty-one 'Ur yokes' made by Marco Sciascia in September 2024, using *Phragmites australis* harvested in Benevento, September 2023, with waist bindings in colours that identify the internode (see Table 2) and birchwood reed caps; not yet laser engraved with unique IDs. © M. Sciascia.

courage players to record and share their experience with us by email or by using the forms at www.lotos-lab.com.

6 Conclusions

We hope to have demonstrated in this article the virtue of close collaboration between Classical philologists and aulos players in understanding Theophrastus' passage on reed-making. This not only brought us closer to identifying the cane species he describes, but also solved a technical problem of manufacturing reeds that produce a balanced sound from the left-hand and right-hand pipes through what we call 'Theophrastian yokes'. Our experiments with harvesting and processing *Arundo*, *Phragmites*, and *Avena* have begun to shed light on at least some aspects of ancient reed-making procedures, and bring us a step further in our quest of developing reconstructions of ancient instruments that follow available sources as faithfully as possible. Experiments are an important part of our work as they help us to fill in all the gaps where ancient testimonies are silent or insufficient. For this reason, our research will always have to rely on experimentation and collaboration, constituting a journey of trial, error, and teamwork, engaging with those who have different sensitivities and ideas.

Acknowledgements

We are tremendously grateful to colleagues of all hues who have gone through the discomfort of interaction between cocoons of expertise, forging out of the authors' obsessions, drafts, and diversions this end result. We could not have achieved this on our own. We particularly thank Kamila Wysłucha for innumerable suggestions; and for final-stage polishing, Michael Carroll and Sarah Burgin. For imperfections that remain, we accept sole responsibility. For aspects that prove solid starting points, credit is due not only to those named but a host of patrons and supporters who have encouraged our activities in multiple ways. We thank you all.

Video Example

1: A green culm of *Phragmites australis* with stems of secondary growth, one on either side of the tenth internode, compared to *Arundo donax* with multiple stems of secondary growth from many nodes, both growing beside the river Gravina di Matera, Italy, 21 February 2024. © B. Brown 2024: https://youtu.be/Jx4cfneSxEc

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Avena sterilis: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:391787-1;
Phragmites australis: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:30337627-2
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The Rattle from Szadek: Acoustic Research with the Use of Numerical Sound Reconstruction

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Abstract

Ceramic sound tools using clay as a raw material have been produced since the very beginning of human history. This was also the case for the cultures that inhabited the area comprised by present-day Poland. So far, over 1,200 ceramic rattles or their fragments have been discovered in this area. They are the subject of interdisciplinary research, using various methods from archaeology, musicology, acoustics, and even mechanical engineering. The state of preservation of the artefacts is often unsatisfactory, and thus important information about their original behavior has been lost. Traditional reconstructions of ceramic rattles restored their appearance only, without reconstructing the basic function of sound production. In order for the sound to be reliably reconstructed, the shape of the rattle, the material from which it was originally made, as well as the entire technological process must be precisely recreated. This is an extremely difficult task, especially in the case of poorly preserved objects. In these cases, reverse engineering methods using numerical modeling are often of use, because they allow the determination of the frequency structure of the rattle sound spectrum. Using reverse engineering techniques, it is possible to build a model that will allow us to recreate at least some of the sound characteristics of the reconstructed ceramic rattles.

Keywords

Archaeomusicology – Archaeoacoustics – Acoustic analysis – Clay rattles – Experimental sound reconstruction – Reverse engineering – Sound synthesis

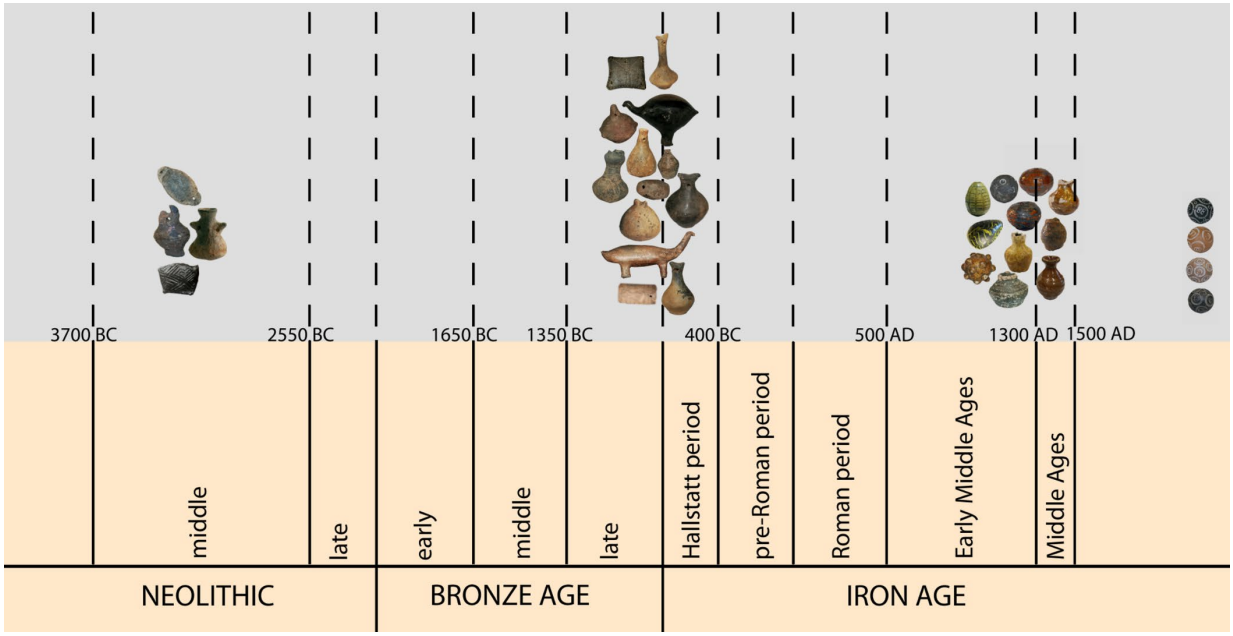

Figure 1: Chronology of the occurrence of rattles in Poland. Elaboration by K. Tatoń.

1 Chronology

Ceramic rattles from the area of present-day Poland constitute a large collection of over a thousand identified archaeological objects, which makes them quite a numerous group of findings from this territory. The first specimens, of different shapes, appeared in the Neolithic, when clay became a widespread raw material for the production of objects for everyday use. Although the clay rattles have enjoyed varying degrees of popularity throughout history (Figure 1), they were present in this area until the beginning of the 20th century. The youngest rattles, which were spherical in form, were plowed out of the ground around 1918.[1] It was the last case of the occurrence of ceramic rattles in Poland. They are not present in today's folk instruments. The tradition of using the sound of these ceramic objects developed unevenly over the centuries. Its heyday came at the turn of the Late Bronze Age and the Early Iron Age and was associated with the Urnfield cultures, traditionally known as the Lusatian culture[2] or, as the authors of the latest research describe it, the Lusatian cultures.

Many of the preserved rattles are equipped with various types of holes. Some pierce the inner chamber, others are placed in protruding parts, e.g. in the cones or the shaft, thought by previous researchers to be handles. Some of the holes are interpreted as being used for threading the rattle onto a strap and suspending it. As for the holes that penetrate the inner chamber, some researchers think they were necessitated by technological reasons. In their opinion, without a hole in the corpus, during firing, the temperature and pressure difference would burst the rattle from the inside.

[1] Seweryn 1960: 41.
[2] Tatoń 2021: 68.

The hole was meant to ensure unrestrained air circulation during the firing of the rattle, and thus to prevent it from being destroyed.[3] However, this idea requires further investigation. Research conducted on clay rattles from the Numantine Museum of Soria, including replicas produced using a reconstruction of the original Hallstatt kiln, confirmed the possibility of firing rattles without holes.[4] In addition, it is contradicted by the excellently preserved Lusatian rattles from present-day Poland, which are devoid of any holes.

According to the Hornbostel-Sachs system revised by the MIMO consortium, all of them are classified as indirectly struck, shaken idiophones (112.1), vessel rattles (112.13), in which the rattling objects are enclosed in a ceramic vessel.[5] In archaeological typology there are several classification systems in use, because as research progressed, multiple systems were developed, however the most comprehensive is the systematics established by Jerzy Tomasz Nowiński. The general division is based on morphological features, such as the shape of the belly, and distinguishes between two classes: geometrized – characterized by a simple form and a belly with a cross-sectional or longitudinal cross-section similar to a geometrical figure, and figural – ornithomorphic, zoomorphic[6] and anthropomorphic.[7]

1.1 Lusatian rattles[8]

All Lusatian rattles differ in appearance (Figure 2). Although they are quite easily distinguishable from other rattles, each has an individual form, size, and shape. The smallest of them are no more than 3 cm in diameter, while the largest ones reach 12 cm or more. One individualizing feature is the composition of the ceramic mass and the firing method. They result in a different color of the surface of each rattle, as well as discolorations and darker spots resulting from uneven access to oxygen during firing.

They are all handmade, but have been formed in different ways: from a single piece of clay; or from several assembled parts, using coil pots or a mixed technique. The majority are devoid of any decoration. On those that do have ornamentation, it can take many different forms, from simple punctures and engravings to relief patterns. Rattles painted with red paint are the rarest and come from the youngest phases of the Lusatian culture (HaC).[9]

Sometimes, they are of the unsophisticated form, simply made, seemingly carelessly, as if in haste. Sometimes the quality of the firing was so poor that after being left in the ground for centuries, the walls delaminated and fell apart. At other times they are refined in every detail,

[3] Kontny et al. 2021: 97.
[4] Jiménez et al. 2014: 58–63.
[5] MIMO Consortium 2011: 5.
[6] Nowiński 2003: 16.
[7] Tatoń 2021: 73.
[8] Research done within the program of the Minister of Science and Higher Education 'National Program for the Development of Humanities' in 2014–2020, Project no. 11H 13 0382 82 Archaeological musical instruments in Polish museum collections, carried out at the Institute of Musicology of the University of Warsaw.
[9] Gediga 1991: 80.

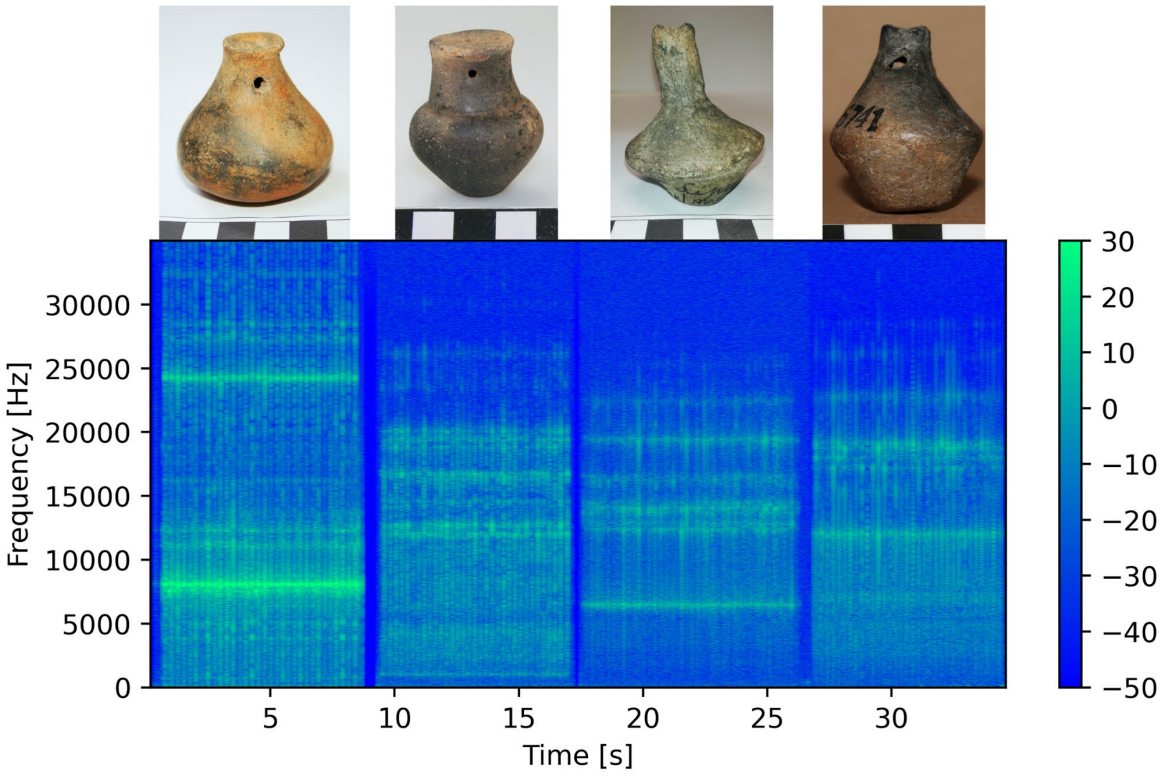

Figure 2: Spectrograms of sample Lusatian rattles: Zbrojewsko grave 1289 (courtesy of the Institute of Archaeology of the Jagiellonian University in Krakow); Dunino cat. no. W25/2015 (Museum of Copper in Legnica); Lipie cat. no. MAK/3267 rattle 1 (Archaeological Museum in Krakow); Laski cat. no. 6741 (Archaeological Museum in Poznań). Recording, photos graphic and elaboration by K. Tatoń.

elaborately decorated, and they are examples of very well fired ceramics. Although some of them are similar in form – at times very similar – they are all unique.

Also, the sounds of rattles each have a unique timbre, and are all differently tuned. Of course, the analysis of the rattle sounds cannot be made solely on the basis of auditory assessment. Spectrograms reveal time dependencies between the frequencies, which makes it possible to observe changes in the tonal structure of the signal, in other words, the features that cannot be detected by hearing alone. Acoustic analysis reveals the noise ranges, as well as the presence of amplified sound components and formant areas.

The tradition of using ceramic rattles did not cover the entire territory of Lusatian culture. They occurred only in certain areas and certain periods. They were absent in its oldest phases, emerged in the Late Bronze Age and were in use until the Early Iron Age. They first occurred in Dolny Śląsk, and then gradually expanded to Wielkopolska, Śląsk, part of Małopolska, the western part of central Poland and part of Pomorze Zachodnie.[10] The number of rattles discovered at individual sites varies. There are sites with several dozen, while on the other hand, in many locations only a few instruments or even a single one were discovered.

[10] Malinowski 1993: 23.

The Lusatian rattles occurred mainly in cemeteries, often deposited in children's graves. They constitute grave equipment, but were used for other purposes as well. They are also discovered above graves, in their stone casings or paving or even outside the grave complexes. Next to complete, undamaged rattles, we find single fragments and rattles that were deliberately defragmented or with a hole drilled into them.[11] According to Tadeusz Malinowski, many of the so-called loose finds of rattles do not come from destroyed graves, but may be evidence of various funeral rites. [12] This suggests the use of ceramic rattles by the Lusatian people, among others, during funeral ceremonies, in the final phase of laying graves, and during some later rituals performed at the places where the deceased were buried. Justyna Baron highlights another aspect of rattles that indicates that the sound of breaking pottery during rites of passage, such as funerals, had a symbolic meaning. Producing noise, as opposed to grave silence, was crucial in most of these rituals.[13]

2 Sound of rattles

Current methods for the musicological study of the sound of ceramic rattles allow for the detection of hitherto unknown features. The mere presence of distinct, amplified components, with well-marked rise and echoing phases (Figure 2), may be surprising, especially in the light of earlier results from studies of ceramic idiophones found in Poland. In the only work on ceramic sound tools found in this area (from the end of the 20th century), ethnomusicologist Alojzy Kopoczek described the sound produced by rattles as noise. He stated that it was impossible to isolate component tones with similar vibration frequencies. In his opinion, the only measures of this sound were the duration and intensity of the noise. [14] Based on observations, and probably partly intuitively, he described the features that influenced the differentiation of the sound of rattles: the size of the body, the thickness of the walls and the type of ceramic mass. Without appropriate acoustic analysis tools, and relying solely on auditory assessment, Kopoczek described the nature of the sound of the ceramic rattles as a timbre with significant expressive and imitative properties that could accompany ecstatic dances, putting participants into a trance.[15] Archaeologist Tadeusz Malinowski, while examining Lusatian rattles, noticed that their sounds, although quiet, varied greatly in pitch.[16] Recently, Anna Gruszczyńska-Ziółkowska turned to ceramic rattles. She was the first researcher who recorded their sound and then made an in-depth acoustic analysis,[17] giving rise to the current extensive interdisciplinary research.

Today's sound analysis tools allow us to base our research on objective physical characteristics – excited frequencies, amplitude, and thorough spectrum observation. Unlike auditory sensations,

[11] Baron 2005: 9.
[12] Malinowski 1993: 29.
[13] Baron 2005: 9.
[14] Kopoczek 1989: 35.
[15] Kopoczek 1989: 35.
[16] Malinowski 1993: 26.
[17] Gruszczyńska-Ziółkowska 2018: 121–2.

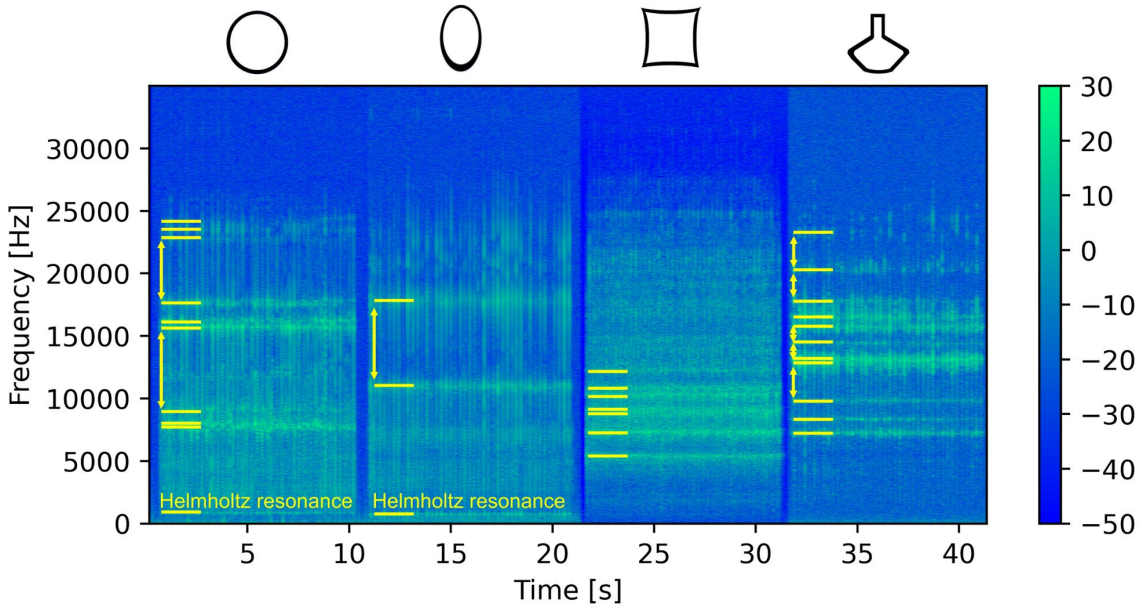

Figure 3: Four groups-types with the examples of rattle sound spectrograms; from left to right: Kalisz Zawodzie, the knobbed rattle (District Museum of the Kalisz Land in Kalisz), the easter-egg rattle from the Opole Ostrówek, cat. no. MSO/235/61 (Opole Silesia Museum in Opole), Dunino, cat. no. W/214/2015 (Museum of Copper in Legnica), Czarnków, cat. no. 1935:697 (Archaeological Museum in Poznań). Recording: Kalisz Zawodzie – P. Ziółkowski and K. Tatoń, the remaining ones – K. Tatoń. Graphic and elaboration by K. Tatoń.

visual representations of the time relationships between frequencies provide detailed insight into changes in the tonal structure of the signal. The use of frequency analysis, called Fourier after its creator Joseph Fourier (1768-1830), allows the signal to be decomposed into sinusoidal components, and then for the precise determination of such features as the number of component tones, their pitch, and relative loudness.[18]

The sound spectra of all the rattles examined, as well as the sound tools that produce them, are characterized by great diversity. Most well-preserved rattles produce a sound, the spectrum of which contains an element of noise, but above all it contains amplified frequency bands clearly separated from the background. The sound spectra of some rattles include only broad bands of noise. Each rattle has its own individual range of excited frequencies; they all are differently tuned. The spectra differ in the width of the amplified frequency bands, the number of these bands, and their distribution. Most of them are inharmonic components. However, the acoustic analysis of the full structure of the sound allows us to observe some analogies within several group-types of sound. Analogies often apply to similarly shaped rattles, but this may not always be the case. The similarities sometimes reveal different shapes and a different provenance in the spectra of sounds of rattles. They relate to the excited frequency range, the formant area, the number of essential components, and their distribution in the spectrum. The order of this distribution forms a kind of

[18] Szabatin 2007: 225.

pattern. This made it possible to initially distinguish four 'types' of sounds that do not necessarily coincide with the rattle categories resulting from archaeological systematics (Figure 3).

The first clearly distinguishable group is that of spherical rattles. The spectra of their sounds contain only a few amplified components, most often arranged in groups of two or three, loosely distributed, which are also in the ultrasonic frequency range. Sometimes, as can be seen in Figure 3, there is a component in the spectrum at an unusually low level of several hundred Hz. This is the Helmholtz resonance, not related to the shape of the tool, but rather to the presence of a hole of an appropriate diameter in its body, passing into the internal chamber.[19]

The most coherent and best-studied group of sounds so far is the egg-shaped type. It is possible to establish the features that are characteristic for this type:

- a flattened noise envelope with a fairly high intensity level of up to approximately 10 kHz, and reduction in the noise level in favour of the appearance of peaks of amplified sound components in the higher register.
- a small number of narrow bands of amplified sound components (from two to four in the analysed range of up to 27 kHz).
- loose distribution of these single bands in the sound spectrum.
- a generally high tuning, namely, the dominant band of amplified components is usually above 9 kHz, which makes the egg-shaped the highest-tuned ceramic rattles from Polish sites.[20]

It should be added that in the egg-shaped type of sound all these features occur simultaneously. As can be seen from the above, when we consider the sound of egg-shaped rattles, we must bear in mind that it borders on the edge of the human auditory range. There are three factors that limit how these sounds are perceived: the pitch, the volume, and the individual's sensitivity and hearing range. Gruszczyńska-Ziółkowska points out that the sound range of the egg rattle available to the human ear is its least attractive part – a flat noise envelope with a relatively high intensity level. In fact, it is only in the very high frequency range that it 'resounds'. The boundary between these two zones is usually distinct, and in the spectrum it takes two forms: a peak of the amplified component or, on the contrary, a deep gap preceding the hills that form further away.[21] The composition of the sound produced by egg-shaped rattles demonstrates dual inclinations. Despite the small number of important component frequencies, it is not always easy to indicate those that could be indisputably considered the strongest, constituting the formant area. It is often easier to identify two such oscillating and competing dominants, which humans can only partially perceive.[22]

The next group of rattles, the sounds of which have similar spectra, is the least coherent and most difficult to describe by indicating the external features of the artifacts. This category includes, but is not limited to pillow-shaped. The features of the sounds produced by this group are

[19] Gruszczyńska-Ziółkowska and Tatoń 2021: 117–18.
[20] Gruszczyńska-Ziółkowska and Tatoń 2021: 116.
[21] Gruszczyńska-Ziółkowska and Tatoń 2021: 119.
[22] Gruszczyńska-Ziółkowska and Tatoń 2021: 123.

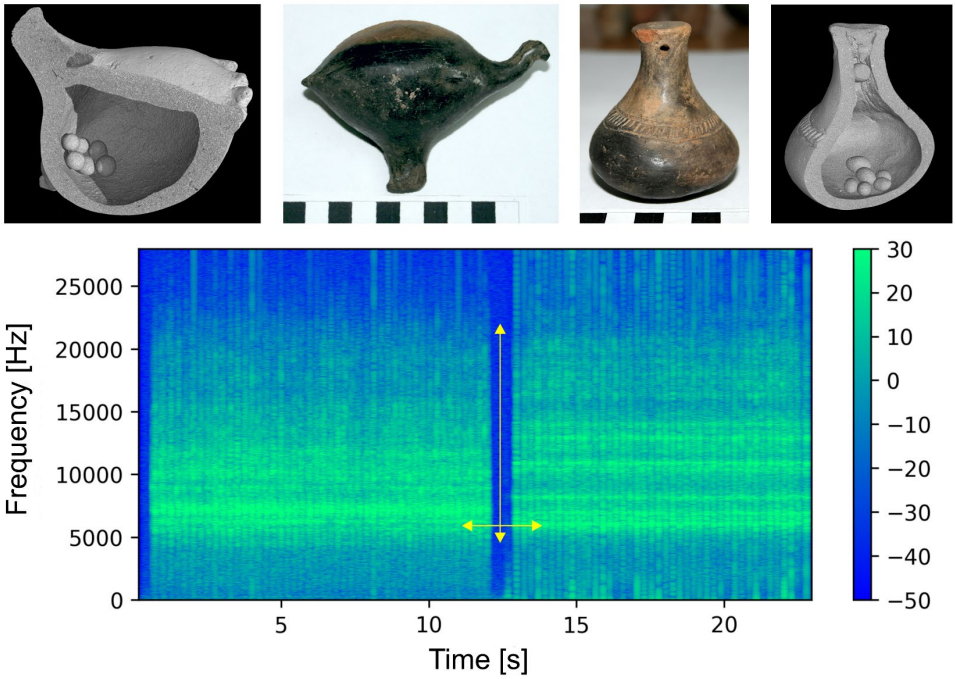

Figure 4: Comparison of similar spectrograms of rattle sounds: Lusatian rattles from the Brzezie site, on the left, cat. no. 1922, on the right, cat. no. 3287 (District Museum of the Kalisz Land in Kalisz). Recording by P. Ziółkowski and K. Tatoń; tomographic imaging by NANOTOM S device at the AGH Laboratory of Micro and Nano Tomography in Kraków. Photos, graphic and elaboration by K. Tatoń.[23]

shown in the sound spectrograms of rattles with other shapes, for instance a lens-like shape. The common features of these sounds can be described as follows: a large number of amplified important components and closely spaced bands, most often in the 5–10 kHz range. Sometimes the enhanced bands are located so close to each other that they seem to form one wide band with a significantly increased amplitude.

The last distinctive group of rattles, the sound spectrum of which can be described as characteristic, is the biconical. This is the largest group of rattles, with a wide variety of forms. In addition to corpus forms composed of two cones, there are also rattles equipped with the so-called handle, i.e. in the form of cones pulled directly from the body. Sometimes there is a wide, short cylinder, hollow inside, which enlarges the internal chamber, or a slightly longer, full cylinder, that sometimes ends with cones or a disc, etc. The spectra in this group contain quite a large number of essential components that are closely distributed in several groups across the spectrum, including very high registers and ultrasounds.

In order to find the reason for the similarity of the sound spectra of rattles with completely different external shapes, a zoomorphic rattle from the Brzezie site, dated to the 5th period of the Bronze Age, and a pear-shaped rattle from the same site, but dated to the Hallstatt period, were subjected to computer X-ray tomographic examination. The results were surprising (Figure 4). The tomogram illustrates how the inside form of the zoomorphic rattle's body differs from the outward

[23] Tatoń 2021: 90, Fig. 23.

form, which is figurative. The chamber has a slightly conical, geometric shape. Likewise, the pyriform rattle tomogram reveals that one of the clay balls inside has been lodged in the neck. It does not contribute to sound production, but rather modifies the chamber's shape in such a way that it resembles the inside of a zoomorphic rattle.

At the current stage of research, we can say that the phenomenon of a type of sound may be closely related to the internal shape of the rattle chamber, which is not always in keeping with its external form. The sound itself is, of course, the product of many morphological factors, but the internal shape of the belly-corpus seems to be of decisive importance. It should be emphasized that the above conclusions are preliminary and require confirmation in the course of further research.

Figure 5: The rattle from Szadek, grave 32, cat. no. 3597 (District Museum of the Kalisz Land in Kalisz). Photo by K. Tatoń.

3 Acoustic analysis of the rattle from Szadek

3.1 Szadek

The site in Szadek, Kalisz District, is a Lusatian cemetery located in South Wielkopolska Lowland upon the middle and lower Prosna River, ranking among the most remarkable Hallstatt burial sites in Wielkopolska. Based on the results of excavations and information about accidental discoveries, the area of the site has been tentatively estimated to be roughly 1.9 ha in extent. The investigations estimate that 750 graves could have been deposited in the destroyed area of the site, while an unexcavated part of the cemetery may potentially still hide nearly 2800 burials. So far only one rattle was discovered in the cemetery (Figure 5), in grave No. 32, which is the rather well-equipped burial site of a child – *infans II*. Apart from the rattle, the following items were found: a cremation urn, a pot covered by a plate, two cups inserted one in the other, a vase, a miniature vase, a mug, an iron ring, and a fragment of a bronze coil.[24]

[24] Szczurek and Pudełko 2015: 12–113.

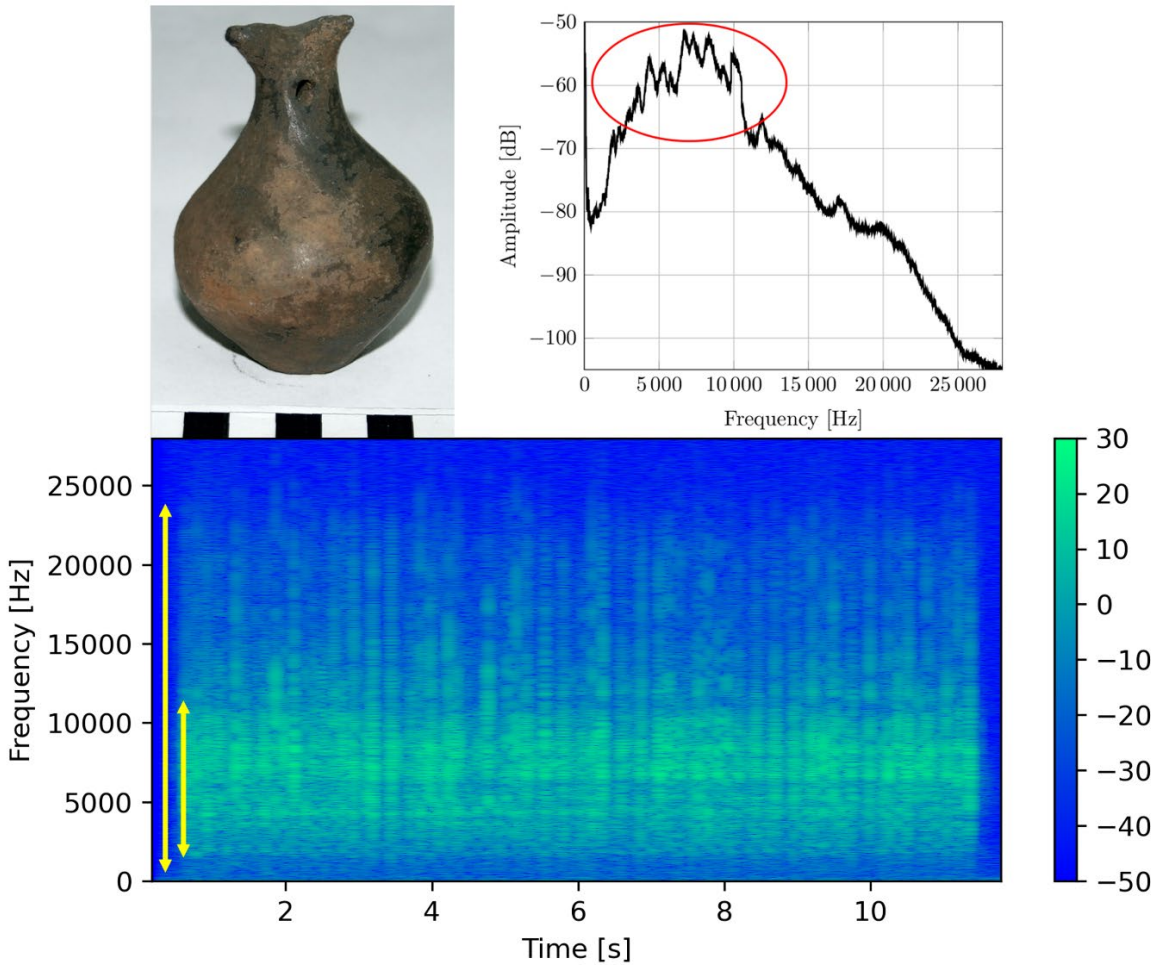

Figure 6: The rattle from Szadek. Top: sound spectrum; bottom: sonogram with marked two, differently amplified areas of noise, without distinct bands of amplified frequencies. Recording, photo, graphic and elaboration by K. Tatoń.

According to archaeological typology, the rattle from Szadek represents geometrized type – it is biconical, with a rounded body, a horn-shaped handle, and pierced with a hole.[25] The rattle's outer surface is smooth, fired a dark brown-black. The clay body was tempered with fine-grained crushed rock.[26] It seemed to be quite well preserved, but the sound spectrogram shows the opposite (Figure 6).

The rattle sound was recorded in non-laboratory conditions at the District Museum of the Kalisz Land. The recording was made with a sampling rate of 96 kHz and 32-bit float. The spectrogram shows an almost balanced spectrum, which is atypical for ceramic rattles. There are no clearly visible narrow enhanced bands, only one wide range, up to 10 kHz. The formant area is almost invisible (approx. 8 kHz). The remaining excited frequencies are noise. This type of

[25] Tatoń 2021: 73–4.
[26] Szczurek and Pudełko 2015: 44.

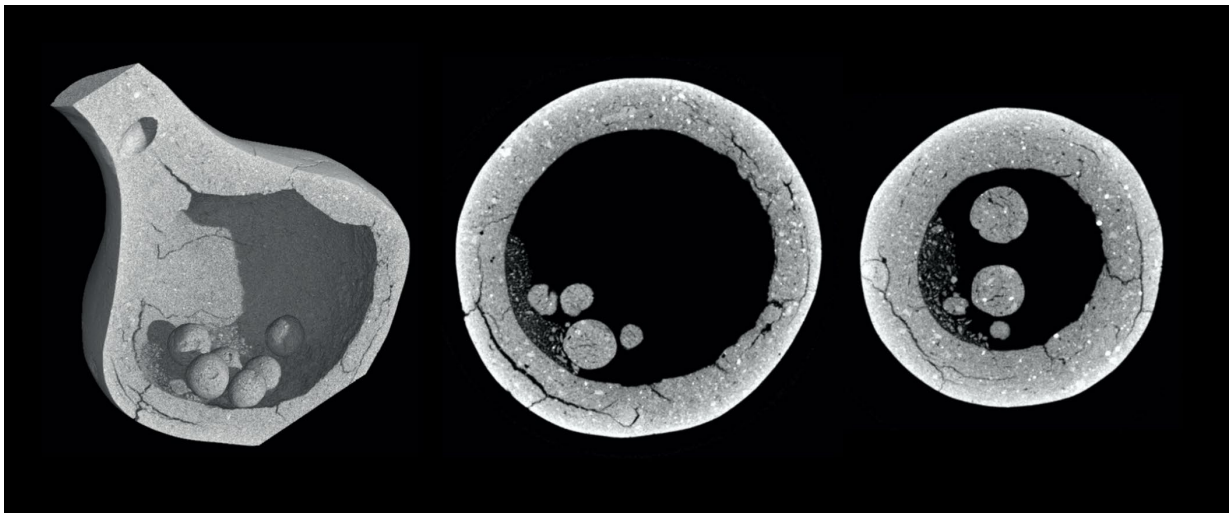

Figure 7: Rattle from Szadek. Tomographic imaging by NANOTOM S device by the AGH Laboratory of Micro and Nano Tomography in Kraków.

spectrum is characteristic for damaged rattles. The X-ray tomographic test[27] revealed features not visible at first glance. The condition of the rattle is not as good as its outer surface looks (Figure 7). There are numerous cracks in its walls. Also inside, apart from the ceramic balls, there is a lot of small debris. These damages significantly affect the acoustic properties of the rattle.

3.2 Analogies

Since it is known that the Szadek rattle's present sound is not its original, it is worth taking a closer look at objects of this type from nearby Lusatian sites. Rattles of a similar shape, biconical with a horn-shaped upper part, were abundant at the cemeteries of the Górnośląsko-Małopolska group of Lusatian culture.

The spectrogram of the rattle from Kępno (Figure 8) shows the spectrum typical for such idiophones, characteristic of multifarious sounds. Against the background of the wide noise band up to 24 kHz range, narrower enhanced areas (7–17 kHz) are clearly visible. The highest amplitude is achieved by the amplified components of about 8 kHz (H8–C9 sound) and it is the decisive spectral component with regard to tuning: the formant area. The other significant components are distributed closely in several groups across the spectrum. All the lines in the spectrum create a certain order: bundles of several amplified bands distributed quite densely throughout all the spectrum.

Another object, analogous to Szadek, is the biconical rattle from Nadziejewo (Figure 9). The main formant area can be seen in the range of 9–11 kHz with a maximum amplification of 10.5 kHz (E9 sound). In addition, there are other well-marked important components, grouped into several bands, distributed over the entire spectrum: 6–7 kHz, 14–15 kHz and 17.5–19 kHz.

A comparison of the spectra of the rattles from Kępno and Nadziejewo shows many similarities in shaping the sound (Figure 10). They not only look alike but also, when set in motion, they produce a congruent sound. In the lower frequency range, up to approx. 6 kHz, while the spectrum

[27] Tomographic imaging: NANOTOM S device at the AGH Laboratory of Micro and Nano Tomography in Kraków.

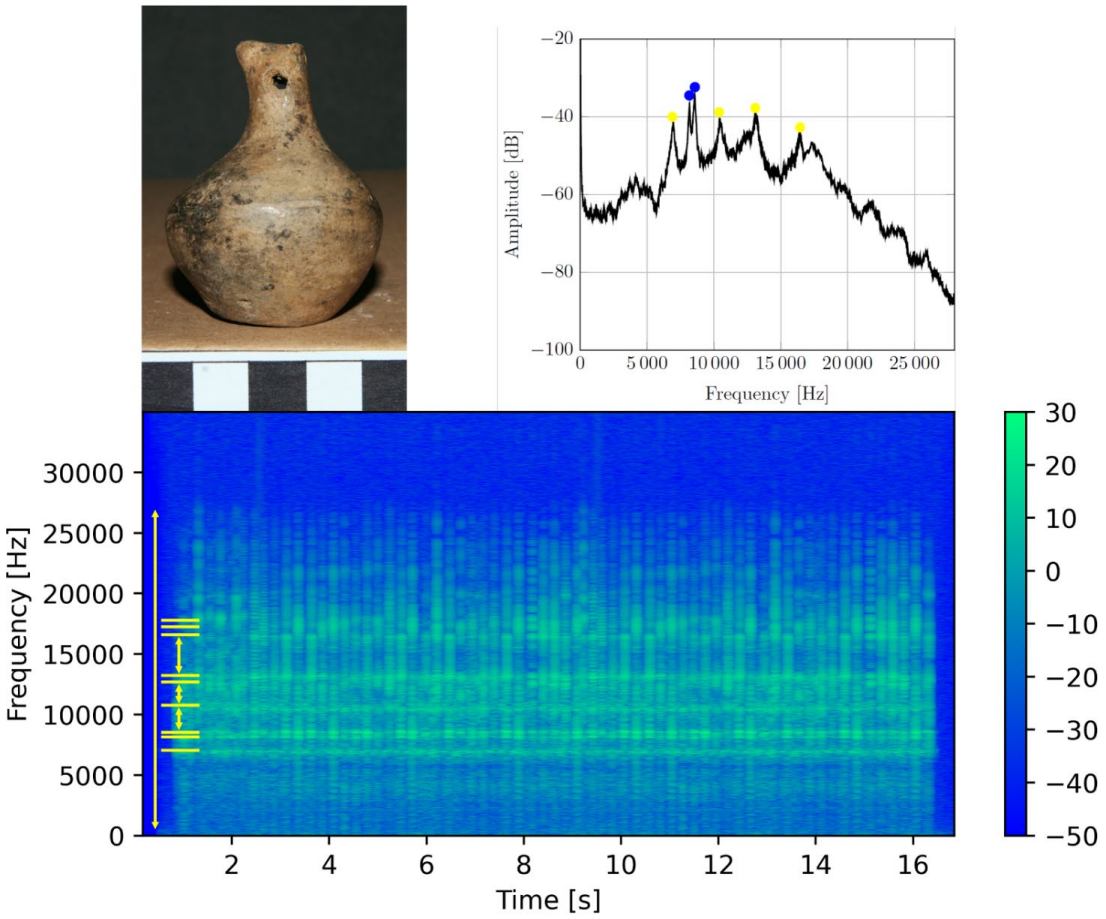

Figure 8: Kępno cat. no. 1942:1731 (Archaeological Museum in Poznań). Top: sound spectrum. Peaks of amplified components are marked with yellow dots, formant with blue ones; bottom: sonogram with marked distinct, amplified components. Recording, photo, graphic and elaboration by K. Tatoń.

basically flattens, the noise remains slightly elevated. The spectrum also consists of a large number of band groups distributed over a wide range of 7–20 kHz. In the case of the rattle from Szadek, the sound spectrum is characterized only by a broad band of high-intensity noise. It is not easy to identify the peaks with the greatest amplitude. In addition, the noise range of the rattle from Szadek is limited to about 10 kHz, while in the spectra of the rattles from Kępno and Nadziejewo, the main formant area is located between 8 and 11 kHz, and the densely spaced remaining components are located up to the limit of audibility.

3.3 Ceramic models

In the absence of any current comparison material from Poland, studies on ceramic rattle copies – models made specifically for this use – provide fruitful conclusions. These kinds of experiments have already been conducted and have yielded satisfactory results. The models were manually constructed, so their compatibility with the originals is subject to considerable error. The first difficulty concerned the manual repetition of the form, the second one concerned the lack of knowledge about the rattling elements placed inside the rattles, and the next one resulted from

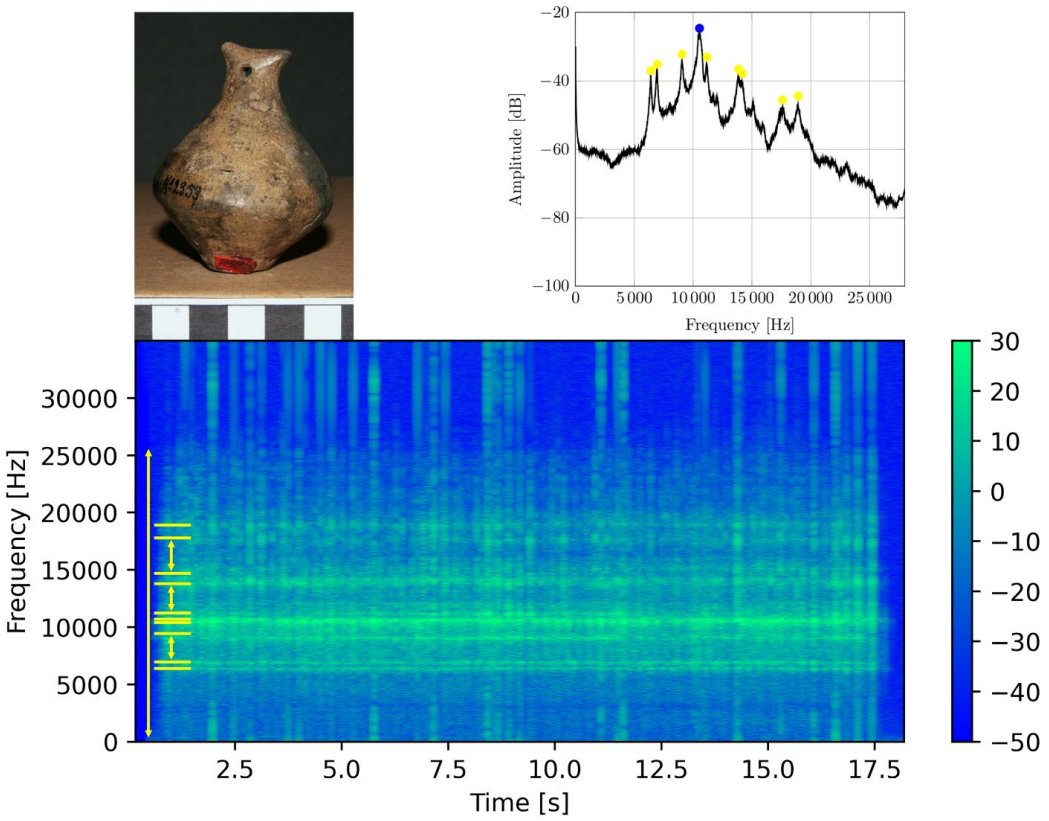

Figure 9: Nadziejewo cat. no. TPN 2353 (Archaeological Museum in Poznań). Top: sound spectrum. Peaks of amplified components are marked with yellow dots, formant with a blue one; bottom: sonogram with marked distinct, amplified components. Recording, photo, graphic and elaboration by K. Tatoń.

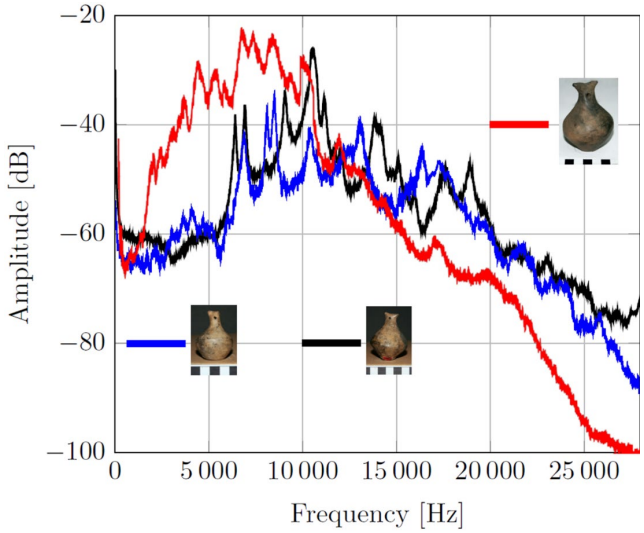

Figure 10: Comparison of the sound spectra of rattles from Szadek (District Museum of the Kalisz Land in Kalisz) – red line, Kępno cat. no. 1942:1731 – blue line, and Nadziejewo cat. no. TPN 2353 – black line (Archaeological Museum in Poznań). Elaboration by K. Tatoń.

the use of modern ceramic mass intended for firing in an electric kiln. Despite this, the sound spectra obtained by setting the models in motion are very similar to the sound spectra of their prototypes (Figure 11 and Figure 12).

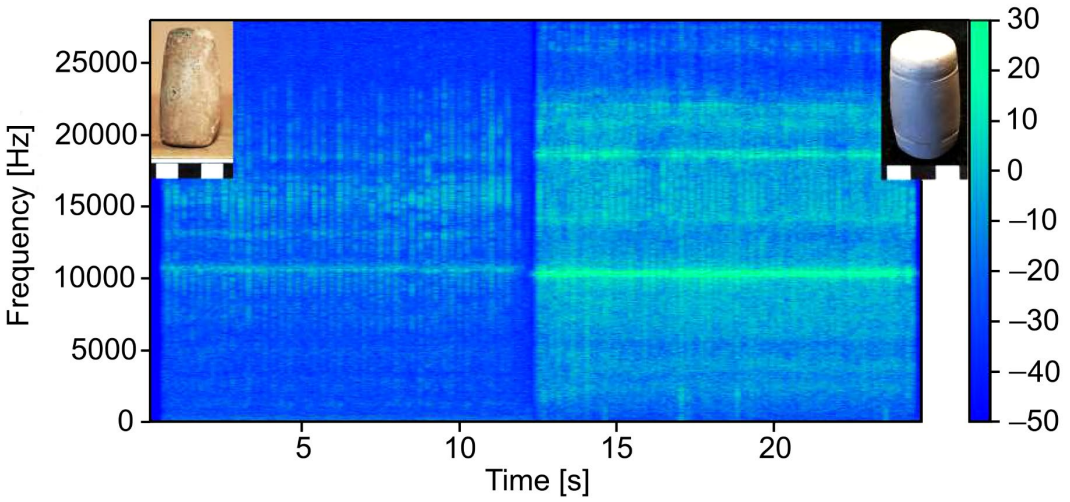

Figure 11: On the left: spectrogram of a rattle from Kowalewko, cat. no. 1991:30, Archaeological Museum in Poznań; on the right: spectrogram of a ceramic model of the rattle. Model, recording, photo and elaboration by K. Tatoń.[28]

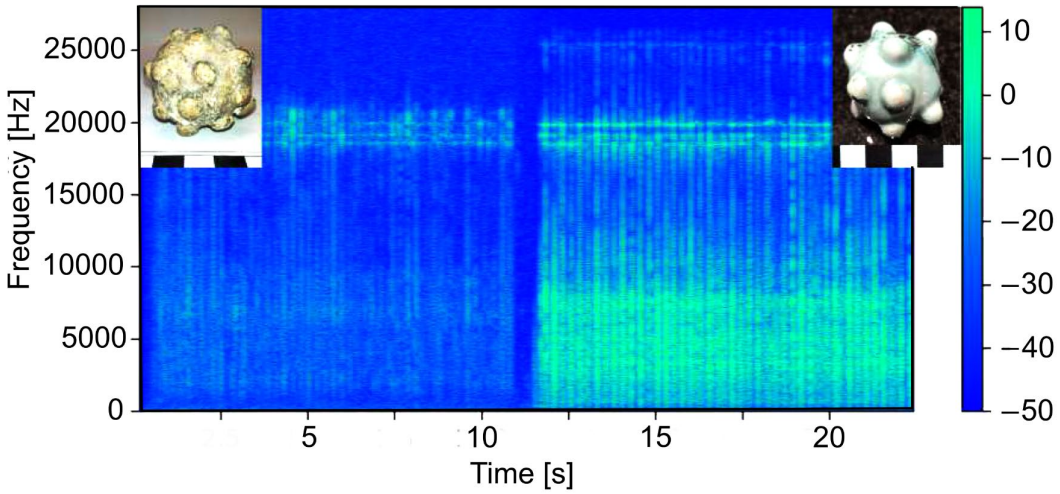

Figure 12: On the left: spectrogram of a knobby rattle from Krakow, cat. no. 47/9, Archaeological Museum in Krakow; on the right: spectrogram of a ceramic model of the rattle. Model, recording, photo and elaboration by K. Tatoń.[29]

Also, the character of the sound of the rattle from Szadek is confirmed with the use of the modern ceramic model (Figure 13). The sound spectrum of the model is similar to the spectra of rattles from Kępno and Nadziejewo. Of course, they are all differently tuned, but their spectra have many common features, including a large number of important components and their specific distribution across the entire spectrum.

It can be assumed that the original sound of the rattle from Szadek represented all the features of the sounds of analogous objects from Kępno and Nadziejewo, as well as the ceramic model. Therefore, its spectrum can be classified as typical for the group of biconical rattles (Figure 14). Due to a large number of high-frequency components, it probably had a bright, maybe even metallic, timbre.

[28] Tatoń 2023: 199, Fig. 6.
[29] Tatoń 2023: 200, Fig. 7.

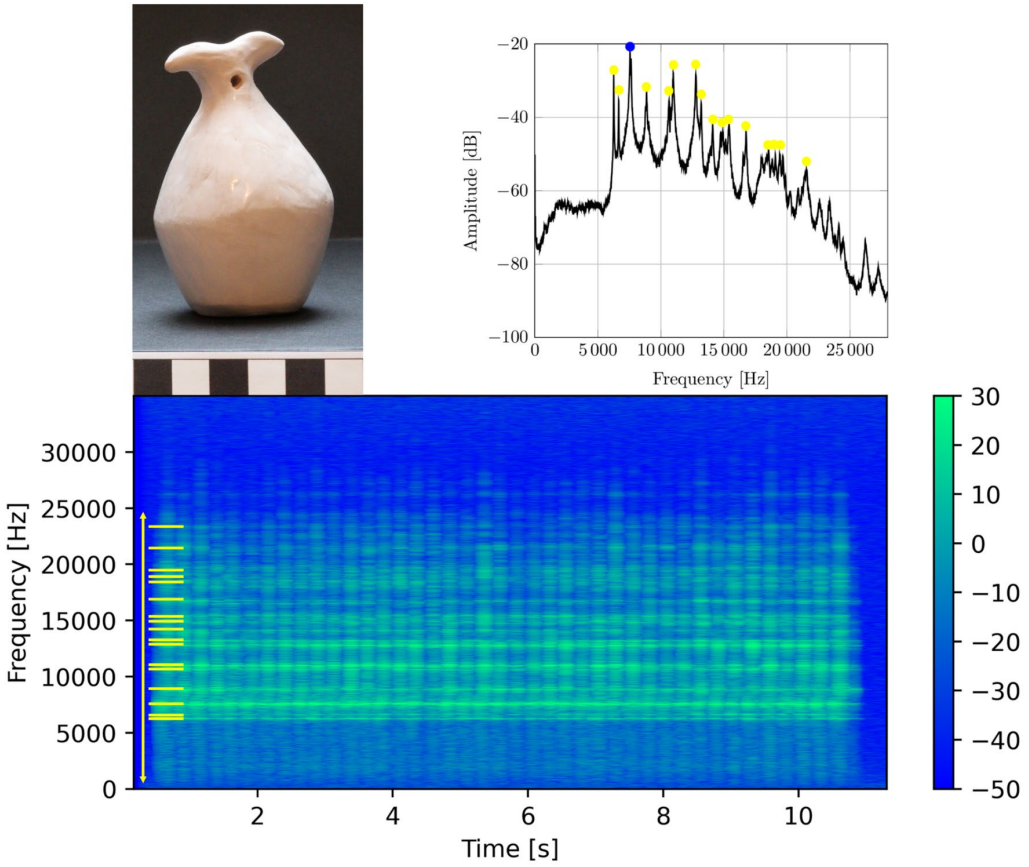

Figure 13: Ceramic model of the rattle from Szadek. Top: sound spectrum with peaks of amplified components marked with yellow dots, formant marked with blue one; bottom: sonogram with marked distinct, amplified components. Model, recording, photo and elaboration by K. Tatoń.

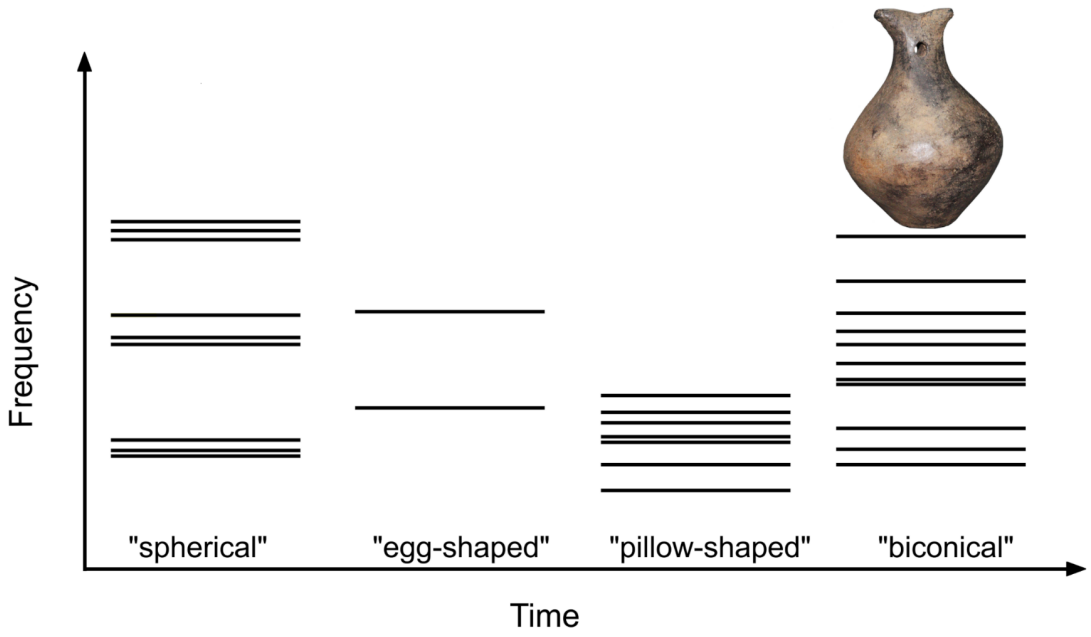

Figure 14: Four groups-types of sound and a “biconical” character of the rattle from Szadek. Elaboration by K. Tatoń.

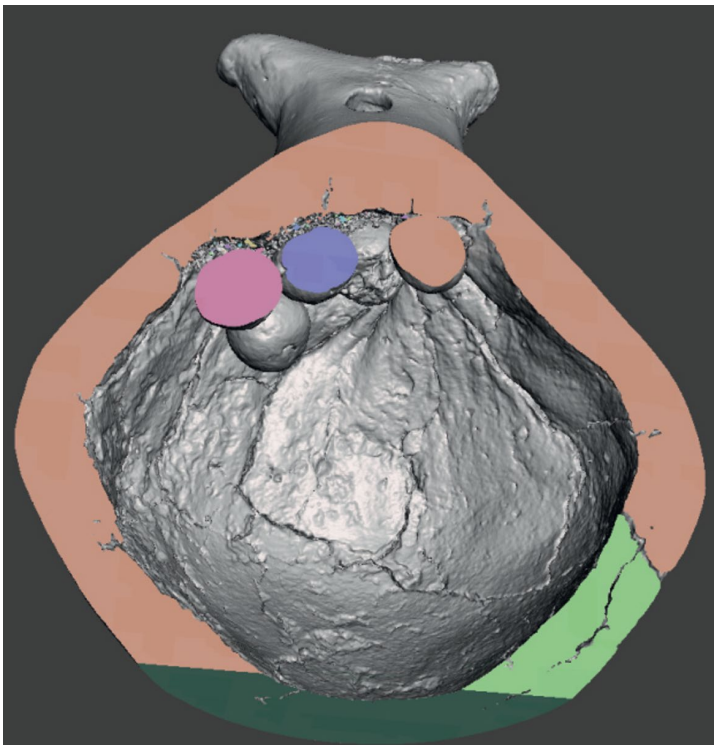

Figure 15: Rattle from Szadek. 3D tomographic imaging by NANOTOM S device at the AGH Laboratory of Micro and Nano Tomography in Kraków.

4 Numerical sound reconstruction

As has been shown earlier, the state of preservation of these artefacts is often unsatisfactory, and thus the original behavior of the discovered objects has been lost. One of the commonly practised methods is making a replica. In order for such a replica to fulfill its function, its creator must have very high manual qualifications. Moreover, such a copy requires recreating not only the shape but also the material and the technological process itself. Those factors are of equal importance because of the influence of technological processes on material parameters such as Young's modulus and density. Those parameters determine the value of sound speed in material (in this case ceramics) which determines values of *eigenfrequencies* (natural frequencies).[30]

The analyzed ceramic rattle from Szadek seemed undamaged, but after careful examination of the side surface, it turned out that it was cracked. A more detailed analysis showed that the crack was large enough to disqualify the acquired sound recordings. There was a need to describe the geometrical shape of the rattle with the real values of wall thicknesses, so X-ray tomography was performed to determine these values, as well as the state of preservation of this artefact (Figure 15).

[30] Each physical object is vibrating with a set of natural vibration shapes called also 'eigenmodes' or 'modes'. Those shapes are determined by object shape and dimensions (i.e. spring sinusoidal shapes with zero displacement at mounting points). Natural vibrations' shapes can be interpreted as standing waves, so the value of sound speed determines frequencies for each natural mode of vibrations (called 'eigenfrequencies') and therefore determines peaks of the sound spectrum of such objects.

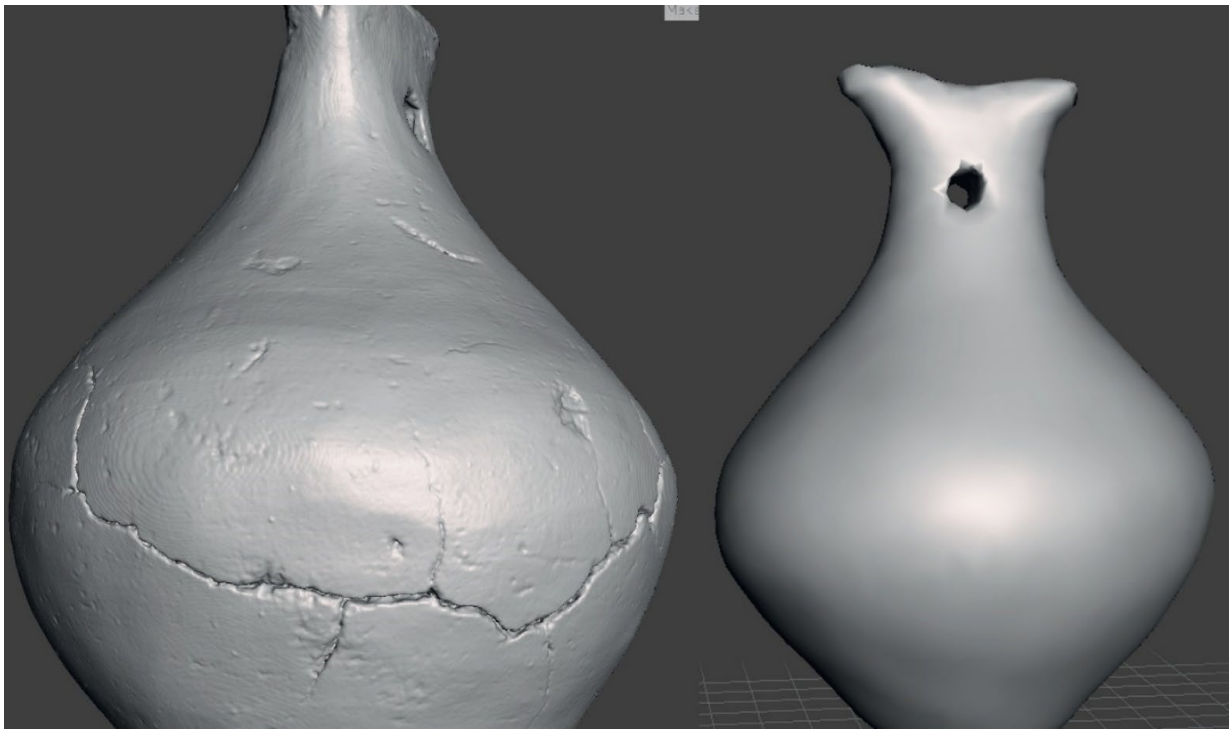

Figure 16: Scanned clay rattle surface before (with cracks) and after necessary corrections. Elaboration by I. Czajka.

The tomography was performed at the Laboratory of Micro and Nano Tomography of AGH University of Kraków. As a result of the tomography, 7,833,768,572 cubic cells with a size of 60 µm were obtained. Each of the cells contained information about the relative density of the material, which describes its ability to absorb X-rays. The obtained relative density values were in the range of 0 to 1. Based on the density value, it was possible to determine the boundaries of the body of the rattle. In this way, the initial grid describing the surface of the rattle with triangles was obtained. The average size of the triangle was about 0.1 mm, therefore this grid was very accurate, but consisted of more than 6.5 million faces and 3.3 million vertices. Since the material of the rattle is full of discontinuities (cracks), which were probably caused by post-deposit processes, it was necessary to make some adjustments. After these adjustments were introduced, the size of the mesh had 3571 vertices and 7138 triangular faces. Both the initial and corrected mesh can be compared visually in Figure 16.

After correcting the mesh, it was necessary to build a solid model, on which a computational mesh, mostly consisting of tetrahedral elements, was superimposed. After the meshing process, it was necessary to adopt coefficients describing the mechanical properties of the ceramic material of the rattle.

The values obtained from the analysis of the rattle from Zbrojewsko from the grave No. 1248 were adopted: Young's modulus 10.128 GPa, Poisson's ratio 0.25, density 1810.9 kg/m^3.[31] The numerical analysis consisted of solving the eigenproblem, called the modal analysis, which allows us to determine the set of natural frequencies and the shapes of natural vibrations corresponding to

[31] Czajka 2021; Vojtko et al. 2011.

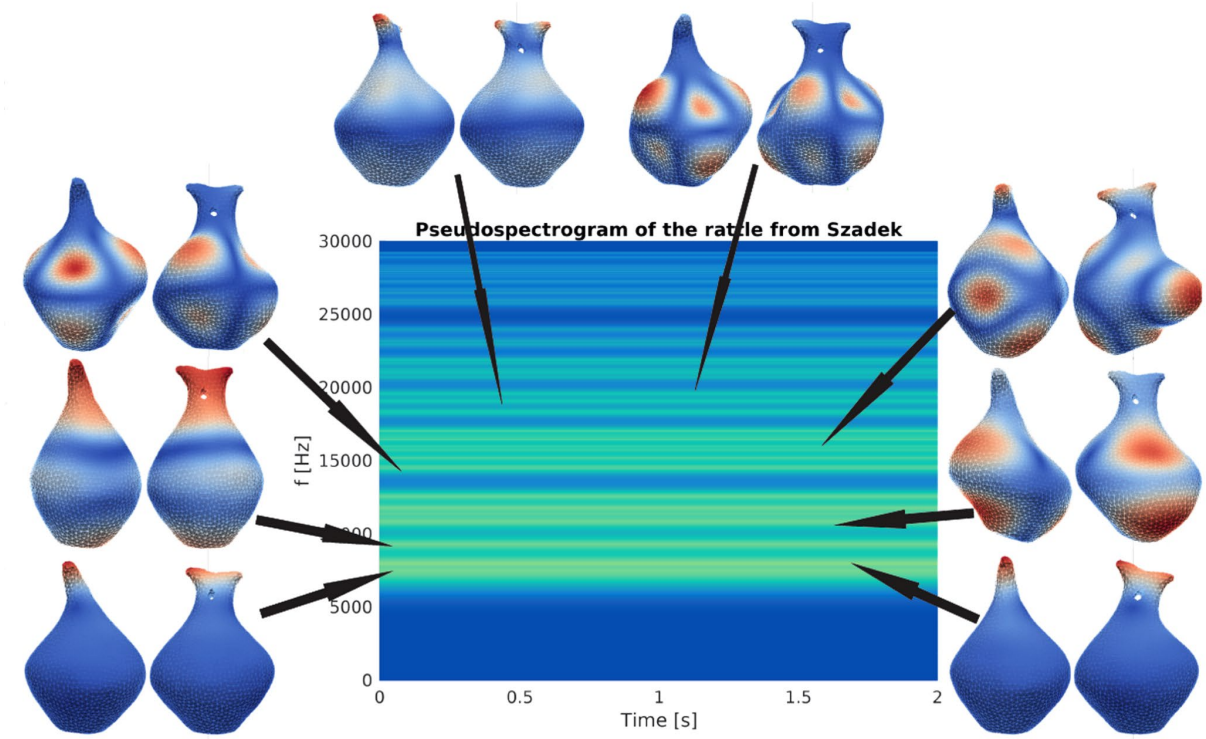

Figure 17: Sound pseudospectrogram of the rattle from Szadek. Elaboration by I. Czajka.

each of these frequencies.[32] Based on the determined frequencies of natural vibrations, the spectrum shown in Figure 17 was constructed, which allowed for the reconstruction of the rattle sound.[33]

The sound produced by the object comes from the vibrations of its surface, which compress air near the object's surface. *Eigenfrequencies* (natural frequencies) are related to the natural forms (shapes) of vibrations of an object (e.g. rattle). We can think of natural forms of vibrations as certain patterns of fundamental vibrations, and any movement of the surface of an object can be understood as an infinite sum of those fundamental vibrations with some amplitudes. Because each mechanical system can be thought of as a low-pass filter, we are able to sum up a finite amount of natural forms of vibrations to obtain any kind of vibrations. In reality, we can consider any vibration system to be a superposition of those natural forms of vibrations. As stated earlier the vibrations' shapes depend on the shape of the rattle. Therefore, we can consider the form of a set of natural vibrations to be a consequence of the internal void shape and wall thickness, or external shape and wall thickness, but we will be able to describe it in more detail after further investigation. Figure 17 shows eigenmodes for frequencies: 7,500 Hz, 8,010 Hz, 9,326 Hz, 10,871 Hz, 14,501 Hz, 15,997 Hz, 19,112 Hz, 19,655 Hz.

[32] Pluta 2019.
[33] Czyżewski 2001.

We achieved a very good qualitative agreement with the recorded spectrum. The numerical reconstruction of the sound confirmed the 'biconical' character of the rattle sound from Szadek. It can therefore be used to effectively reconstruct the sounds of defragmented artefacts. The main difficulty in carrying out such a reconstruction is the need to know the values of the parameters describing the mechanical properties of the material of the artefact, because these parameters, such as Young modulus, density and damping, depend not only on the chemical composition of the material, but also on admixtures, manufacturing technology, and process parameters. Straw or fibers, for example, can be used as admixtures. Process parameters are, for example, firing temperature, oxidising or reducing atmosphere, re-firing, and so on.

The second important piece of information researchers must have is the shape and dimensions of a rattle. The more precise the shape, the better the results that can be obtained. But, as we can see in Figure 17, the wavelength of the standing waves for each mode depends on the frequency. Higher frequencies have eigenmodes with shorter waves. And the wavelength determines the size of the shape imperfections, which affects modes. In other words, the natural shape of vibrations remains the same as long as the rattle shape modification is much smaller than wavelength. This feature allows for rattle model simplifications while still obtaining results with quite good agreement with the measurements.

5 Conclusion

The interdisciplinary study of ceramic rattles, exemplified by the rattle from Szadek, highlights the complex interplay between archaeology, acoustics, and material science in reconstructing the auditory characteristics of ancient artifacts. Despite the challenges posed by poor preservation, modern techniques such as reverse engineering and numerical sound reconstruction have proven invaluable in uncovering the acoustic properties of these artifacts. The diverse sound spectra of rattles, influenced by their internal structure rather than external morphology, underscore the importance of comprehensive acoustic analysis.

Our research has revealed that the rattle from Szadek, although visually well-preserved, exhibits significant internal damage that affects its sound production. This finding emphasizes the necessity of thorough non-invasive examinations, such as X-ray tomography, to accurately assess the condition and acoustic potential of archaeological finds. The reconstruction of the sound spectrum of the rattle was achieved through comparison with other similar objects and a hand-crafted reproduction imitating its original, undamaged shape.

The variability in the sound spectra of Lusatian rattles, from distinct amplified components to predominantly noise spectra, suggests a rich diversity in their use and cultural significance. The identification of sound types and their correlation with internal structures, rather than external forms, opens new avenues for understanding the functional and symbolic roles of these instruments in ancient societies.

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Musical and Dance Motifs on Roman Engraved Gems of the Augustan Era

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Abstract

This paper presents a selection of Roman engraved gems (cameos and intaglios) which are decorated with musical and dance motifs, focusing primarily on artifacts dated to the Augustan era. The iconography of gems from this era varies, including figures that hold or play a musical instrument or dance, or sometimes only a musical instrument that covers the surface. The musicians and dancers are usually figures derived from Greek mythology and religion. This paper has three aims: first, to classify the motifs according to the mythical figures or musical instruments that they represent. Second, to present/describe their iconography, and third, to interpret, how these objects were used by Roman rulers. I divided the gems examined into four categories: a) objects related to Apollo's iconography; b) Dionysian themes; c) musical motifs with tritons; and d) single musical instruments.

Keywords

Augustus – Gems – Gem engravers – Musical iconography – Glyptic – Greek mythology – Religion

1 A short introduction

The Roman emperors and elite adapted the ancient Greek custom of using engraved luxury gems as jewellery (usually ring-seals, earrings, necklaces, and pendants), amulets, or gifts (private or diplomatic). They assembled interesting collections and owned *dactyliothecae* (ring cabinets), as Hellenistic rulers also did.[1] These small engraved gemstones have the form either of *gemma excisa*/cameo (i.e., the design of the relief carvings projects out of the background) or of *gemma incisa*/intaglio (i.e., the design is cut into the flat background of the stone). Both types could be

[1] According to Pliny (*HN* 37.5) M. Aemilius Scaurus, Sullas' son-in-law, was the first person we know to have built up such a *dactyliotheca*; for a long time this was the only one in Rome. The following *dactytliothecae* seem to be spoils of war (e.g., by Pompeius from Mithridates VI from Pontus, in 61 BCE, others by Julius Caesar and Marcellus). Finally the Roman elite started collecting: cf. Vollenweider 1966: 18; Zwierlein-Diehl 2007: 108–9; cf. 264–304; Micheli 2016: 73–113. On Roman seal-boxes, see Platz-Horster 2011: 224–5.

either private objects used for various purposes, or a powerful and fascinating medium that was used for transmitting ideas, which promoted political, cultural or religious ideals, or for self-representation as in the case of portraits.[2] Some of these artefacts were created by famous Greek gem engravers, who earlier had worked in Hellenistic court-workshops, and then later in Roman Republican and Imperial ones.[3] Sometimes they signed their works, as did for instance Skylax, Solon, Sostratos, Dioskourides and his sons (Eutyches, Hyllos and Hyrophilos). The Greek gem engravers subsequently taught Roman artists. The gem cutters included musical themes from Greek mythology and religion in their iconographical repertoire; such as Apollo, Hermes, the Muses, Eros, heroes as musicians (Heracles, Achilles), centaurs, tritons, satyrs, and maenads. They were influenced by Late Classical or Hellenistic glyptic original works, various monumental artworks in sculpture or painting, coins, and medals. The Roman gems' iconography combines various elements into new symbolisms, useful for private and political goals.[4]

This paper presents a selection of engraved gemstones (cameos and intaglios) with musical representations.[5] Due to the enormous quantity of objects, I divided them into four categories according to their motifs and iconography, their style, and their meaning and symbolism: namely, a) objects related to Apollo's iconography; b) Dionysian themes; c) musical motifs with tritons; and d) single musical instruments.

The examples were selected according to the importance of the mythical figures to music, as well as their meaning for Roman rulers and society (Apollonian–Dionysian). The motifs representing tritons are associated with the god Neptune, who offered his protection and support during naval battles, and also with Venus Pelagia/Marina; the fourth group is comprised of representations of contemporary musical instruments. The motifs will be classified according to the mythical figure or the musical motif that they illustrate, their iconography will be presented and their meaning in the Roman period interpreted, with a specific focus on the Augustan era, and, finally, it will be shown how these amazing and luxurious objects were used by Roman rulers, elites and ordinary people.

[2] About the use of images for political purposes by Roman emperors, see Zanker 1987: 79–100; 245–63; and passim; Roccos 1989: 587, ns. 76–7; Wolters 1999; Zwierlein-Diehl 2007: 126–32; cf. Gołyźniak 2020. For Augustus and the bankers, see D'Hautcourt 1997: 800–10 (references for propaganda in nos 1–2).

[3] About Greek gem cutters in Rome, see Vollenweider 1966; Zwierlein-Diehl 2007: 109–46.

[4] See e.g. Gołyźniak 2020; regarding the visual language and employment of archaic and classic elements in Roman art, see Zanker 1987; Zanker 1988; Zanker 2010; Hölscher 1987; Hölscher 2006; Hölscher 2018.

[5] I selected representative examples, often made by famous gem engravers, who sometimes signed their creations. The examples were selected according to the importance of the mythical figures to the music and their meaning for Roman rulers and society. For their authenticity, i.e. their construction in Antiquity, I relied upon the literature, as well as on personal observation/research and discussion with experts; especially at an international conference on gems, where I presented a paper. No one has expressed the opinion that these examples are modern imitations/replicas: Liveri 2021: 69–70.

2 Apollo's images on gems

Among the musician deities who were venerated by Romans, Apollo, the Greek god of music, light, prophecy, etc., is the dominant figure. Apollo's cult was promoted by Roman rulers (both during the Republican and Imperial periods) and especially by Sulla, Caesar, Octavian/Augustus and Nero; each of these individuals used different symbolism for Apollo and supported the cult with varying intensity. The dictator Sulla worshipped Apollo as symbol of *libertas* and promoted his cult, especially among his soldiers.[6] Caesar expressed his support for Apollo's worship by organizing in his honor the *ludi Apollinares* in 45 BCE, celebrating this festival during his birth month Quintilis, which he renamed to Julius (6–13 July).[7] He financed these games and began the construction of a large theater for the scenic performances. It was completed by Augustus, who dedicated it posthumously to his nephew Marcellus.[8]

The culmination of Apollo's cult occurred under Octavian/Augustus. Apollo was among the most popular gods of his reign. He became his patron god, because Octavian believed that the god secured his victory against Cleopatra and Marc Antony in the naval battle of Actium (2 September 31 BCE).[9] The victorious Octavian, after he became emperor and obtained the title Augustus, dedicated the temple of Apollo Palatinus on the Palatine Hill in Rome to Apollo on 9 October 28 BCE, which was directly connected to his *domus*/'palace' via frescoed halls and corridors.[10] It was reinstituted during the *ludi saeculares* in 17 BCE, which included sacrifices, hymns, theatrical performances, chariot races, and other events, associated with the feasts for the beginning of the *aetas aurea/saeculum aureum* (Suet., *Claud.* 21).[11] This temple was the earliest in a long series of impressive

[6] Plut., *Sull.* 29.6: λέγεται δὲ ἔχων τι χρυσοῦν Ἀπόλλωνος ἀγαλμάτιον ἐκ Δελφῶν ἀεὶ μὲν αὐτὸ κατὰ τὰς μάχας περιφέρειν ἐν τῷ κόλπῳ, ἀλλὰ καὶ τότε τοῦτο καταφιλεῖν οὕτω δὴ λέγων: ὦ Πύθιε Ἄπολλον, τὸν εὐτυχῆ Σύλλαν Κορνήλιον ἐν τοσούτοις ἀγῶσιν ἄρας λαμπρὸν καὶ μέγαν ἐνταῦθα ῥίψεις ἐπὶ θύραις τῆς πατρίδος ἀγαγών, αἴσχιστα τοῖς ἑαυτοῦ συναπολούμενον πολίταις; "There is also a story that Sulla had a little golden image of Apollo from Delphi which he always carried in his bosom when he was in battle, but that on this occasion he took it out and kissed it affectionately, saying: O Pythian Apollo, now that thou hast in so many struggles raised the fortunate Cornelius Sulla to glory and greatness, can it be that thou hast brought him to the gates of his native city only to cast him down there, to perish most shamefully with his fellow-countrymen?" (transl. B. Perrin); cf. Gołyźniak 2020: 75–6.

[7] Julius Caesar renamed the month Quintilis in his reform of the Roman calendar and the institution of a new one (Julian Calendar): Scullard 1981: 158; Caesar was born on the 13th of the month Quintilis; regarding the Julian Calendar reform and the *ludi Apollinares*, see Weinstock 1971: 13; 156–7; and passim; cf. Bernstein 1998: 171–86, esp. 183–86; cf. 335–48; Meyboom 2005: 235, n. 51.

[8] Meyboom 2005: 235.

[9] For Actium, see Gurbal 1995; Sheppard 2009.

[10] See, for instance, Zanker 1983: 21–40, figs 1–2; Zanker 1987: 73–5, figs 51–2; 54a; 72; and passim for its decoration; cf. 279–81, fig. 222 (wall paintings from Augustus house); Kellum 1985: 169–76; Kellum 1993: 75–84; Simon 1986: 19–25 (buildings on the Palatine Hill); 182; 184–94, pls 28–9; 34, figs 240–45; 247–48; Lefèvre 1989; Hekster and Rich 2006: 149–68; for Apollo Palatinus or Apollo Actius on coins, see Jucker 1982: 82–100, figs 1–6; Zanker 1987: 90–91; 227–8, figs 68 (denar of C. Antistius Vetus, Rome, 16 BCE, Apollo Actius on a podium, decorated with *rostra* motifs), 179c (coin from Lugdunum/Lyon 15 BCE, Apollo Actius); Restani et al. 2010: 166, fig. 3; for Augustus' house, cf. n. 45 below.

[11] Zanker 1983: 24–36; Zanker 1987: 74; cf. 171–77; Zanker 2010: 88; Gołyźniak 2020: 226–7; on *ludi Apollinares*, cf. Bernstein 1998: 171–86, esp. 183–6 for *ludi scaenici*.

monuments. The cult statue represented Apollo Citharoedus. It was Greek original marble work of the fourth century BCE, made by Scopas for the Apollo sanctuary at Rhamnus in Attica, that transported to Rome in 28 BCE and installed in the temple of Apollo on the Palatine Hill.[12] A copy of this statue is the 'Apollo Barberini' marble statue in Munich from Tusculum (first – second century CE).[13] The musician god holds his cithara with his left hand and with his right perhaps a cup (the right arm is missing). It is worth mentioning that "Apollo also symbolized the new era and he was responsible for the world order like Octavian/Augustus, who after the Battle of Actium changed the rhetoric of his propaganda putting emphasis on his capabilities to rule the Roman Empire".[14]

The image of Apollo was engraved on various glyptic artefacts (e.g. coins, medallions, plaques and jewellery in gold and silver), including gemstones (cameos, intaglios) or less valuable materials (glass paste) for ordinary people and mass production.[15] The most renowned artists were already employed by the leading politicians and the Roman elite in Republican times, and after Augustus they were also employed at the imperial workshops. We can distinguish the following Apollo types on gems: a) Apollo's heads or busts; b) Apollo standing alone as musician holding or playing his cithara or lyre; c) Apollo standing or in other positions in various compositions with other figures; and d) Apollo punishing the satyr Marsyas after their musical contest, where the god was the winner.

Numerous gems produced in the first century BCE represent Apollo's bust or head in variations, usually diademed or laureate, i.e., with a diadem or a laurel wreath around his head, to the left or to the right with an object beside or behind him: such as a bow, a bow and a quiver, a musical instrument (usually a cithara or lyre) or a laurel branch.[16] Such motifs were extraordinarily popular beginning in the time of Sulla. The trend continued during Caesar's dominance and became enormous during Octavian/Augustus, being associated with his cultural, religious and political reforms.

One of the perhaps best illustrations of a glyptic Apollo bust in profile, without a musical instrument, is a carnelian intaglio (2.0 × 1.4 cm) in St. Petersburg (Figure 1), signed by the son of Dioskourides Hyllos (ΥΛΛΟΥ, last third of the first century BCE), that depicts a diademed bust of Apollo looking to the left[17] (the later inscription "LAVR MED" indicating it belonged to the

[12] See some fragments of the Apollo Palatinus statue in Jucker 1982: 95–6, figs 14–15; cf. Roccos 1989: 571–88, figs 8–9; cf. figs 3–7 (various statues' versions of Apollo Palatinus); on Scopas: Stewart 1977; contributions in Katsonopoulou, Stewart 2013.

[13] Munich, Glyptothek, inv. 211: Lambrinudakis et al.1984: 204–5, no.146, pl. 196 (O. Palagia); Fuchs 1992: 203–11, no. 30, figs 201–6; Flashar 1992: 200–217, figs passim and 184–5.

[14] Gołyźniak 2020: 183–4; for Roman emperor cult, see the contributions in Cancik and Hitzl 2003; esp. for Augustus' and Apollo's cult, Edelmann 2003: 196–98; Castaldo 2018: 96–114; for the age of Augustus, see Eck 2007.

[15] Cf. Apollo's image on various other artefacts, as e.g. on sculptures, reliefs, paintings, etc.: see e.g. Zanker 1987; Zanker 1988; Simon 1986.

[16] Cf. corresponding representations on coins: e.g. in Böhm 1997.

[17] St. Petersburg, State Hermitage Museum, inv. Ж 1229 (after Neverov); ГР-21426 (after the Museum's website): https://www.hermitagemuseum.org/wps/portal/hermitage/digitalcollection/18.+carved+stones/1068920 [accesed: 16 November 2021]. The setting is a later work; this gem belonged to the Collection of Lorenzo il

Figure 1: Apollo's bust without musical instrument, after Apollo Palatinus. Carnelian intaglio/gem, signed by Hyllos (last third of the first cent. BCE). St. Petersburg, State Hermitage Museum, inv. ГР-21426. Courtesy of the State Hermitage Museum. © The State Hermitage Museum, photo by Svetlana Suetova.

collection of Lorenzo Medici is also visible). According to Richter (1971: 151, no. 708) this Apollo type imitates an original of the fifth century BCE.

His hairstyle is elaborate, with his curly long hair tied back by a ribbon. Parts of his *himation/or* citharode's robe are visible, fastened on the left shoulder by a buckle. It is comparable to the hairstyle of Apollo Citharoedus bust on a carnelian gem (1.43 × 1.17 × 0.13 cm) in Berlin (last third of the first century BCE, Figure 2).[18] However, small differences are visible regarding Apollo's hairstyle (in Berlin: a long strand of temple hair is tucked into the hair band above the ear), facial features (in Berlin: eyes, large nose, half open lips) and a citharode's robe. In my opinion, in the example in St. Petersburg they are represented or engraved more expressively and harmoniously

Magnifico: Vollenweider 1966: 71–2, 119, pl. 81.1 and 3 (on Hyllos, pp. 69–73); Richter 1971: 151, no. 708, fig. 708; Neverov 1976: 73–4, no. 113; Zwierlein-Diehl 2007: 416, fig. 474 (Abguß/casting); Gołyźniak 2020: 183; 216; 227; 412, no. 10.8, fig. 779.

[18] Berlin, Antikensammlung, Dressel collection, inv. 32.237, 431: Weiss 2007: 145, no. 77, pl. 13 (last third of the first century BCE).

Figure 2: Bust of Apollo Citharoedus. Carnelian gem (last third of the first cent. BCE). Berlin, Antikensammlung, inv. 32.237, 431. Courtesy of the Antikensammlung. © Antikensammlung, Staatliche Museen zu Berlin – Preussischer Kulturbesitz. Photo by Bernhard Platz, CC BY-SA 4.0.

than those in Berlin, showing the creator's skills; in the Berlin gem parts of the stringed musical instrument (cithara) have also been added. This Apollo type is called 'Palatine'/'Palatinus', perhaps after the Apollo Citharoedus/Palatinus statue in the temple of Apollo Palatinus or Apollo Actius on the Palatine Hill in Rome, although its head is not preserved; perhaps it is a reference to the ideal musician god, as is also mentioned by L.J. Roccos.[19] Dioskourides (active 65–30 BCE) succeeded Solon as the official gem engraver of Augustus, leading the imperial workshops in Rome and working with his skillful sons (Herophilos, Eutyches and Hyllos), "created a sort of dynasty of gem engravers delivering top quality works of glyptic art to the imperial court" (see also below).[20]

The diademed or laureate bust or head of Apollo Citharoedus was very popular in Augustan Age glyptics. This type was cut by famous artists or copied by ordinary ones, as examples e.g. in Perugia, in Berlin, in Lisbon and elsewhere show.[21]

Another idealized Apollo Citharoedus bust decorates an orange carnelian stone (21 × 19.5 mm) in Naples (Figure 3), from the Augustan and Julio-Claudian period (27 BCE–68 CE).[22] The artist's name is unknown. The bust of Apollo is turned in profile to the left. Only parts of his garments are visible: the god is wearing a *chiton* with long sleeves, and over that the long citharode's robe, fastened to the left shoulder by a buckle, as in the previous example. He has a different, more elaborate hairstyle than in the example in St. Petersburg. His long curly hair is gathered back. A part of his cithara, carved in very low relief, is visible on the background in front of him.[23] This engraved gem reached a high level of aesthetic quality, showing harmonious, expressive features in the style of Hellenistic originals.

Diademed or laureate busts of Augustus or of young princes who were members of his family, and identified with Apollo, were also included in the engraved gems iconography.[24] This shows that Augustus also used the glyptic art to promote his successors and to build a respectable position for

[19] "With the Palatine Apollo the reference is to the ideal musician god and specifically to the Athenian cult statue of Apollo Patroos": Roccos 1989: 583; cf. n. 77.

[20] For Dioskourides and his sons, see Pliny, *HN* 37.8; Suet., *Aug*. 50.1; Vollenweider 1966; Gołyźniak 2020: 215–16 with references.

[21] E.g. the above mentioned carnelian in Berlin (n. 18); for other examples, see Gołyźniak 2020: 183; 227; 389, nos 803–6, fig. 596.

[22] National Archaeological Museum of Naples, inv. 26145/307 bis: De Caro 1994: 284; Pannuti 1994: 165–6, no. 131. He argues that perhaps the gem was found in the house of Menander in Pompeii.

[23] Cf. a carnelian with a bust of Apollo Citharoedus in Museum Grassi für Angewandte Kunst in Leipzig, inv. 505 (end of the first century BCE – beginning of the first century CE): Cain and Lang 2015: 23; 56–7, figs 8–9, I 8 (J. Lang).

[24] See e.g. examples in Simon 1986: 155, fig. 205; Gołyźniak 2018: 68–71, nos 6–7, figs 6–7.

the Julio-Claudian dynasty.[25] Octavian/Augustus' head is depicted on the obverse of aurei and silver denarii after the Actium battle, while on the reverse a standing Apollo Actius as lyre player or Citharoedus is visible.[26] Sometimes, he stands on a podium decorated with *rostra* motifs. He offers a libation on an altar, holding his instrument with his left hand and a *phiale* with his right.

Figure 3: Bust of Apollo Citharoedus. Orange carnelian stone (first cent. BCE – first cent. CE/68-69). National Archaeological Museum of Naples, inv. 26145. Photo after De Caro 1984: 284. © National Archaeological Museum of Naples. Courtesy of the Ministero della Cultura – Museo Archeologico Nazionale di Napoli.

Variations of the single standing Apollo Citharoedus type, or Apollo as lyre player based on Hellenistic originals, are also used by gems engraved in the Roman period.[27] The god is represented holding either his cithara or lyre in his hand (as in Boston, Naples and St. Petersburg) or with it laying on the ground (as in Boston and Vienna), or on a base, a pillar or a column (as in Berlin and Rome). In the Naples example, on an intaglio in plasma, in a dark seaweed green color, Apollo stands in three-quarter posture in the middle of the composition with his head in profile.[28] He is turned to the left, holding with his right hand a lyre or a cradle cithara, while touching its strings with his left. His hair is combed into a bun/chignon (*krōbýlos*), with his head crowned by a diadem or laurel. He is naked, but he has a cloak (*khlamýs*) over his shoulders, which falls back to his calves. The god is flanked by an idyllic landscape: to the right is a small cliff (or a heap of stones), on which a raven in profile to the left has been placed. On the left, a rocky hillock is visible (perhaps a representation of the omphalos?[29]), on which or behind it there is an *aedicula* with a standing figurine inside. Behind this construction a small tree, perhaps a laurel, completes the scene. To the variations belongs a lyre-playing Apollo standing to the right on a *nicolo* blue on dark intaglio in Boston (first century CE)[30] and on a sardonyx ring stone in St. Petersburg (first century BCE).[31] In

[25] Gołyźniak 2018: 69; cf. Gołyźniak 2020: 241–9; cf. 389, nos 803–6.

[26] Jucker 1982: 84–91, figs 1–6 (Apollo Actius); for coinage/Münzprägung before and after Actium, see Simon 1993: 172–81; p. 91 (no. 52: Rome, denar, 16 BCE, = obv. Augustus' head and rv. Apollo Citharoedus); p. 92 (nos 54–6, Lugdunun, aurei and denari, 15 and 10 BCE: obv. Augustus' head and rv. Apollo Citharoedus), pp. 99–101; cf. n.10 above.

[27] See Simon and Bauchhens 1984: 396–402, nos 172–261, pls 311–16 (passim on gems and coins).

[28] National Archaeological Museum of Naples, inv. 26050/212: Pannuti II 1994: 164–5, no. 130; Platz-Horster 2010: 183, n. 15; on the term prase/plasma, 180–81.

[29] Cf. a standing Apollo Citharoedos in front of an *omphalos* on a coin from Megara (209–212 CE): Lambrinudakis et al. 1984: 200, no. 93, pl. 191 (O. Palagia).

[30] Boston, Museum of Fine Arts, inv. 01.7579: https://collections.mfa.org/objects/180366/oval-gem-with-standing-apollo?ctx=610296ee-8c98-4bd5-a07d-ca037ff15eb1&idx=27 [Accessed: 16 November 2021].

[31] St. Petersburg, State Hermitage Museum, inv. 1220 after Neverov, ГР-21426 after the Museum's website: Neverov 1976: 100, no. 88; Lambrinudakis et al. 1984: 240, no. 442, pl. 218 (O. Palagia); cf. a similar carnelian ring stone in the same Museum with the same inv. no. in Simon and Bauchhens 1984: 396, no. 175, pl. 311.

the latter, the god walks holding a *phiale* with his right hand and a lyre or a cithara with his left, (as on the aforementioned coins). In other examples, Apollo Citharoedus stands in front of a tree (perhaps a laurel, his sacred tree) and a tripod on a round pedestal, as in a carnelian intaglio in Leipzig (end of the first century BCE – beginning of the first century CE);[32] the god stands on his left leg, while the right is on the podium. The tree and the tripod suggest that the scene took place in Delphi.

Apollo walks while playing his lyre on a green glass gem with white-blue-white stripes on the example in Hanover (second – third quarter of the first century BCE).[33] The god is nude; his mantle falls back forming a background. He holds his lyre vertically on his body. On another glass gem in the same museum (third quarter of the first century BCE), a nude Apollo stands frontally in 'counterpoise' posture, holding his lyre with his right hand and a plectrum with the left.[34] On a rock crystal intaglio in Leipzig (first – second century CE) the god seems to be playing his cithara.[35]

On a dark violet amethyst in Vienna (last third of the first century BCE) Apollo is leaning on a column with a bow and arrow, while his lyre is on the ground at his feet.[36] This example shares some similarities with a Hellenistic garnet intaglio in Boston (second century BCE).[37] In the latter example, the statue-like god stands frontally, being seminude, leaning with his left elbow on a short column, on which stands a tripod, with his large lyre placed on the ground. A bird sits on one of the instrument's bars. The god raises his right hand and looks down to the left.

A very interesting scene (Figure 4) decorates an oval carnelian intaglio (2.27 × 1.78 × 0.46 cm, including frame and loop) in Berlin (end of the first century BCE/beginning of the first century CE).[38] It represents the controversy between Apollo and Amor based on Ovid's description regarding "Daphne and Phoebus".[39] Apollo, holding his bow with his left hand and resting on his lyre with the right, follows a small Amor who holds his two arrows with the left hand, while raising the other. The god is naked; his mantle falls only on and behind his shoulders. The figure of Apollo reveals reflections of an original Greek statue (perhaps of Lycean Apollo?).[40] This hypothesis is based on the fact that the god leans with his right hand on his instrument that stands as a support on a garland-adorned base. However, the typical gesture of the Apollo Lycean type, i.e., resting his other

[32] Leipzig, Grassi Museum für Angewandte Kunst, inv. 330: Cain and Lang 2015: 56; 59, fig. I 9 (J. Lang); cf. another green agate intaglio in the same collection in Leipzig with Apollo seated on an altar in front of a tripod and a tree (first–second century CE), p. 59, fig. I 10.

[33] Hanover, August Kestner Museum, inv. K 87a: Schlüter et al. 1975: 68, no. 245, pl. 39.

[34] Hanover, August Kestner Museum, inv. K 1641: Schlüter et al. 1975: 68, no. 246, pl. 39; Simon and Bauchhens 1984: 396, no. 172, pl. 311.

[35] Leipzig, Museum Grassi für Angewandte Kunst, inv. 97: Cain and Lang 2015: 59, fig. I 11 (J. Lang).

[36] Vienna, Kunsthistorisches Museum, inv. IX B 1275: Simon and Bauchhens 1984: 396, no. 171c; Zwierlein-Diehl 1973: 135, no. 411, 69 (she mentions cithara, but it is a lyra); Gołyźniak 2020: 389, no. 809.

[37] Boston, Museum of Fine Arts, inv. 99.362: https://collections.mfa.org/objects/187226/oval-gem-with-apollo?ctx=b766f4b4–4056-4851-99bf-5240519775f1&idx=239 [Accessed: 6 November 2021].

[38] Berlin, Antikensammlung, inv. Misc. II863, 46: Zwierlein-Diehl 1969: 165, no. 439, pl. 77; Lambrinudakis et al. 1984: 284, no. 816, pl. 255 (G. Kokkorou-Alewras).

[39] Ovid, *Met.* 1.452–6, esp. 463–73.

[40] About Apollo Lykeios, see Simon and Bauchhens 1984: 448–50, nos 509–31; Nagele 1984: 77–105; Schröder 1986: 167–84.

hand on his head, is missing. Nevertheless, some examples show Apollo standing and supporting himself with one hand on his lyre, which is placed on a base (column, pillar, pedestal, etc.).[41] On another glass gem in Rome Apollo (or Augustus as Apollo) is standing *en face* between a tripod on an altar and his cithara on a column.[42]

Therefore, Apollo Citharoedus was a very popular iconographical motif, used in a variety of artworks: either in Greek originals, transported from Greece or in their copies: as e.g., a) the cult statue in the temple of Apollo Palatinus in Rome, which I have already mentioned; b) the bronze statue of Apollo Citharoedus from the House of the Cithara Player in Pompeii (middle of the first century CE), a copy of a Greek original of the middle of the fifth century BCE, attributed by some scholars to Phidias' teacher Hegias; [43] c) numerous other statues and reliefs; and d) on wall paintings in Rome (Palace of Augustus on the Palatine Hill),[44] and in the Vesuvian area in Campania (Pompeii, Moregine and Herculaneum).[45]

Figure 4: The controversy between Apollo and Amor. Carnelian intaglio (late first cent. BCE/early first cent. CE). Berlin, Antikensammlung, inv. Misc. II863. Courtesy of the Antikensammlung. © Antikensammlung, Staatliche Museen zu Berlin – Preussischer Kulturbesitz. Photo by Johannes Laurentius, CC BY-SA 4.0.

Another motif involving Apollo is the punishment of Marsyas. This event took place at Mount Tmolus in Phrygia, after the musical contest between them, (*aulós*/*tibiae* for Marsyas and cithara for Apollo).[46] According to the Muses' judgment the god won, and Marsyas was hanged from a tree and flayed alive. The Phrygian satyr Marsyas invented the aulos or, according to another legend, he found it after Athena, the divine aulos inventor, threw it away.[47] Olympus and

41 Simon and Bauchhens 1984: 448–50, nos 511–12; 516–19; 530–31, pls 344–6.
42 Gołyźniak 2020: 389, no. 811.
43 National Archaeological Museum of Naples, inv. 5630: De Caro 1994: 209.
44 Carettoni 1983; Tomei 1998; Tomei 2004; Iacopi 2008.
45 Simon and Bauchhens 1984: 403–6, nos 271–82, pls 317–18 (standing); nos 286–300, pls 319–20 (leaning or seated); Melini 2008: 31–2.
46 Weis 1992: 366–76, esp. for the contest 370–73; Restani 1995; Zschätzsch 2002: 146–56 (agon Apollo–Marsyas); cf. Van Keer 2004: 20–37.
47 For the contest between Athena and Marsyas, see Zschätzsch 2002: 3; for Athena and aulos, 1–14, pl. 1a–b; Liveri 2018: 39, n. 1.

Hyagnis were also mentioned as the inventors of the aulos and were famous musicians in ancient Greece.[48] A peaceful scene before the contest was included in Polygnotus *Nekya*/Underworld (460–450 BCE), which decorated the Cnidian Lesche in Delphi (Paus., 10.30.9). It depicted Marsyas sitting on a rock teaching Olympus, a beautiful boy, to play the pipes. This painting was lost, but has been reconstructed according to Pausanias' description (10.25.1–31).[49]

Marsyas' punishment by Apollo was a very popular subject in glyptic art from the early first century BCE onwards. It was also used as an allegorical glyptic motif for political purposes; first by Sulla to illustrate his victories over barbarian tribes (Cimbri and Teutones) and in the East (First Mithridatic War), then by his opponents in order to mock him, and later by Octavian for his victory over Marc Antony and Cleopatra at Actium (see below).

The subject appears in some variations on Roman gems relating to iconography and style. Nevertheless, various scenes depicting Marsyas, Apollo, and Olympus show common features on Roman imperial gems of the first and second centuries.[50] Usually, the artists engraved the moment just after the Muses declared Apollo the winner of the musical competition and just before Apollo flayed Marsyas alive as punishment, pinning his skin to a pine tree. Two main versions of the scene regarding Marsyas can be distinguished: a) Marsyas is depicted sitting on a rock bound, awaiting his punishment; and b) he is shown hanging bound to a tree trunk. The type of Marsyas *religatus* is surrounded by other figures associated with the myth (Apollo, Olympus, one or two satyrs, Victory). Regarding the musical instruments, we observe that Apollo, usually holding his cithara or lyre, stands on the right or left. However, the aulos, Marsyas' musical instrument for the contest, is not always depicted in punishment scenes.

Some selected gem examples bearing this motif will be presented: the first one is a glass gem in London, associated with Sulla.[51] Marsyas in the middle of the scene hangs bound on a tree, flanked on the one side by Apollo and Olympus, and on the other side by a standing Victory. The god holds his lyre or cithara, whereas Olympus, a pupil of Marsyas and later also famous aulos player, is placed in front of him. S. Toso argues that intaglios decorated with this motif are associated with Sulla's political aims, based on a statuary group composition of this myth during his time in Rome, which was a copy of an original Hellenistic work, created in Pergamon in the second half of the third century BCE.[52]

Another version was created later, under Augustus, by the famous engraver Dioskourides, decorating an orange-brown carnelian intaglio (40.2 × 34 mm) in Naples (Figure 5).[53] This object, the

[48] Olympus was also a legendary founder of ancient Greek music: Weis 1994: 38–45; Van Keer 2008: 23–79.

[49] For a reconstruction of Nekyia, see Stansbury-O'Donnell 1990: 213–35, figs 1–5; cf. Kebric 1983; Manoledakis 2003: 62–77; Van Keer 2008: 33–5, fig. 13; Roscino 2010: 38–66; on Polygnotus, see also Matheson 1995.

[50] Cf. also a white and milky chalcedony intaglio in Oporto/Portugal (second century CE) bearing a bearded Marsyas: Cravinho 2018: 150–51, no. 6 with examples.

[51] Toso 2007: 222–3; Gołyźniak 2020: 76; 343, no. 7.13–14, fig. 112.

[52] Toso 2007: 222; cf. Gołyźniak, as in previous note.

[53] National Archaeological Museum of Naples, inv. 26051/213: Vollenweider 1966: 61–2; 114, pls 63.2; 64; Richter 1971: 58, no. 251, fig. 727a; cf. 156, no. 727; Dacos et al. 1973: 55–7, no. 25, figs 18; 61; De Caro 1994: 344; Pannuti

Figure 5: The Punishment of Marsyas by Apollo or 'Seal of Nero'. Orange-brown carnelian intaglio, decorated by Dioskourides (c. 30 BCE–20 CE). National Archaeological Museum of Naples, inv. 26051. Courtesy of the Ministero della Cultura – Museo Archeologico Nazionale di Napoli. Photo by Giorgio Albano.

so-called seal of Nero, was probably created in the imperial workshop in the Augustan period. Its history is colorful, from its creation to its inclusion to the collection of Lorenzo de' Medici in Florence and finally to its transport in Naples (the abbreviated inscription "LAV.R. MED." is visible in front of Marsyas head). Three figures (Apollo, Marsyas and Olympus) are represented on this gem. On the right stands a half-nude Apollo holding his large cithara with his left hand and the plectrum with the right. His torso is turned to the right, his head to the left, where Marsyas sits nude on a lion skin laid on a rock with his hands bound behind his back; perhaps they are tied to the tree, from which hangs the *sybḗnē*, the case for his pipes, which are visible to the right. He is turning hopefully to his kneeling pupil Olympus, his mourner at the contest, who pleads with Apollo to spare Marsyas' life.[54]

1994: 161–2, no. 127; Melini 2008: 31; Restani et al. 2010: 168, fig. 5; Rambach 2011: 131–47, fig. 1; Lapatin 2015: 137; 247, pl. 95. He dates it to 30 BCE; Gołyźniak 2020: 173, no. 9.615, fig. 519.

[54] Van Keer 2008: 23–6; for Olympus, cf. n.48 above.

It is possible that the engraver Dioskourides was influenced by a fourth-century BCE wall painting by Zeuxis depicting Marsyas bound, which decorated the temple of Concord in the Roman Forum.[55] Versions of the subject appear also on wall paintings in Pompeii (e.g., in the House of M. Epidius Rufus, IX.1.20, where the Muses listen to the competition between Apollo and Marsyas).[56] The figures of Apollo and Marsyas are influenced by plastic works (statues[57] and reliefs[58]) as well.

A great variety of interpretations and symbolisms were attributed to the musical competition between Apollo and Marsyas, which ended with the god's victory on this intaglio: some scholars interpret it as a political allegory related to the battle of Actium in 31 BCE. Apollo was identified as Octavian/Augustus, who was the victor against Marc Antony and Cleopatra, themselves identified with the barbarian Marsyas and Dionysiac elements. He also was characterized as 'New Dionysus' (see below). Additionally, the cithara, a symbol for harmony and culture, ideals which Octavian/Augustus sought to represent,[59] was the winner against the aulos, an orgiastic symbol, which provoked passions and symbolized the Barbarian Orient, which Marc Antony was said to have favored. Apollo would, therefore, represent a successful and cultivated agonist, enjoying his victory over his defeated competitor. Therefore, additionally, this agon has a variety of symbolisms: ugliness versus beauty; presumption (*hybris*) versus punishment (*nemesis*); chaos versus order; passion versus reason; barbarian versus Greek; East versus West; nature versus culture; life versus death; mortals versus gods; Dionysian versus Apollonian; wind versus stringed instrument.

An ancient imitation/reproduction/replica gem related to the previous example of Dioskourides is a fragmentary amethyst intaglio in Lyon (dated in the third quarter of the third century BCE).[60] Numerous artworks are decorated with this motif. Different composition of the scene, i.e. a different placement of the figures, and a different style appear on a carnelian gem (18.1 × 13.1 × 2.6 mm) in Malibu (first century CE).[61] Here Marsyas is hanging from a tree, while two satyrs

[55] Pliny the Elder mentions Zeuxis' painting (Pliny, *HN* 35.36): *zeuxidis manu romae helena est in philippi porticibus, et in concordiae delubro marsyas religatus.* "There is at Rome a Helena by Zeuxis, in the Porticos of Philippus, and a Marsyas bound, in the Temple of Concord there."; cf. Rambach 2011: 132; Ovid states also the myth of Marsyas (Ov., *Met.* 6.382; Ov., *Fast.* 6.695–710).

[56] This house part is dedicated to Diadumeni (g), triclinium (s): Schefold 1962: 135; 177; figs 173.3–4 (Apollo plays his cithara and Marsyas his aulos); Rawson 1987: 32–3; 197–8, no. A29, fig. 15; Weis 1992: 371, no. I 26 with fig.; Pompei 1998: 916–55, esp. 944–53 with figs (p. 953, no. 71: Marsyas playing his aulos and Olympus); cf. Melini 2008: 30–31. For more examples of representations of this competition on Pompeii's wall paintings, see Rawson 1987; also, *Pitture e Mosaici:* e.g. Pompei 1996: 7–8, figs 63–4 (Marsyas holding his *tibiae*: House of the Golden Bracelet, VI.17.42, triclinium 19).

[57] Cf. copies from Greek bronze original works: a) the statue of Marsyas from the Marsyas Group by Myron (450–440 BCE) in Vatican, Musei Vaticani, inv. 9974: Fuchs 1983: 349–51, fig. 388; Jalouris 1994–1995: 117; 244, no. 88, fig. 88; b) the statue of the hung Marsyas from the Marsyas group with Scythian in Paris, Louvre, inv. MA 542: Jalouris 1994–1995: 198; 272, no. 212, fig. 212.

[58] Cf. Greek original works, e.g. the relief base from Mantineia, a work of Praxiteles (330–320 BCE), Athens, National Archaeological Museum, inv. 215: Fuchs 1983: 455, fig. 530; Jalouris 1994–1995: 190–91; 268–9, no. 197, fig. 197.

[59] E.g. according to his narration in Res Gestae Divi Augusti: Sheid 2007; Cooley 2009; cf. Eck 2007.

[60] Lyon, Médaillier du Musée des Beaux-Arts: Rambach 2011: 133–4, figs 4–5.

[61] Malibu, Getty Villa Museum, inv. 85. AN.370.48: Spier 1992: 113, no. 288 with some examples; he, following Henig (1978: 35), uses the shape form A4 for this gem (see fig. 5). Similarly for the Maenad in Malibu (see

Figure 6: Plectrum of plasma/chromian chalcedony (first cent. CE). Berlin, Antikensammlung, inv. FG 11371. a: Exterior surface; b: Interior surface: Apollo and Marsyas after the musical contest. Courtesy of the Antikensammlung. © Antikensammlung, Staatliche Museen zu Berlin – Preussischer Kulturbesitz. Photos by Johannes Laurentius, CC BY-SA 4.0.

prepare to flay him. Apollo stands holding a lyre behind the tree and in front of a column. Olympus is omitted.

Two objects in Berlin bear particular representations: a unique supposed plectrum (Figure 6) of plasma, (3.57 × 3.69 cm) in a vivid green color, in the form of an *akanthos* chalice (first century CE);[62] and an oval red-yellow jasper (first century CE, Figure 7).[63] In the first example Apollo stands on

below).

62 Berlin, Antikensammlung, inv. FG 11371: Zwierlein-Diehl 1969: 174, no. 468; Zwierlein-Diehl 2007: 427, pl. 119, fig. 566; Platz-Horster 2010: 189, pl. VIII, 2–3; Platz-Horster 2012: 100, no. 103, pl. 23; Schwarzmaier and Zimmermann-Elseify 2021: 29–30. This object has been identified as a plectrum: the musician would have held it by the swinging leaves and could use the rounded end to pluck the strings of a kithara or lyre. I would like to thank Stefan Hagel for discussing the function of this item; however, he does not agree with its identification as a plectrum because he finds the three prongs at the bottom of it impractical.

63 Berlin, Antikensammlung, inv. FG 8393: Zwierlein-Diehl 1969: 173–4, no. 466, pl. 83; cf. a dark orange carnelian gem in the Dressel collection in the Antikensammlung in Berlin with similar motif: Weiss 2007: 128, no. 26, pl. 6.

the right, holding with the right hand the plectrum of his lyre and resting with the left on his lyre, which is placed on a base. Marsyas is kneeling on the left and begs him to spare his life. His pipes are behind the tree. In the second example Apollo is seated on the rock on the right side, holding his lyre with his right hand, while he supports himself with his left. Before him Marsyas and his pipes are hanging from the tree and Olympus kneels before him, wearing his Scythian garments. Perhaps this scene's iconography is influenced by a plastic group from the middle of the third century BCE in Pergamon.[64] Nevertheless, the Marsyas' instrument is not always depicted; sometimes it is placed in front or between the crossed legs of the seated Marsyas.[65]

Figure 7: The punishment of Marsyas by Apollo and kneeling Olympus. Oval red-yellow jasper (first cent. CE). Berlin, Antikensammlung, inv. FG 8393. Courtesy of the Antikensammlung. © Antikensammlung, Staatliche Museen zu Berlin – Preussischer Kulturbesitz. Photo: Archiv.

3 Dionysian musical and dancing themes

Dionysus was also venerated in Rome either by adaption of Greek beliefs and cult practices or under a Latin name (Liber) and an adjusted interpretation and perception of his worship.[66] This is confirmed by the use of numerous Dionysian themes which decorate various artworks, including musical or dancing motifs, and also by the success of Dionysian scenes in Augustan 'sacral-idyllic' landscapes.

Dionysian musical or dancing subjects depicted on Roman engraved gems represent either a single member of a *thiasos* (satyr, silenus, maenad) or a Bacchic group (two or more figures performing a variety of dances or other musical activities): e.g., they dance ecstatically, sometimes also singing, holding a wine cup or a *thyrsos* or both, or they move while holding or playing a musical instrument (aulos, cithara, cymbals, lyra, syrinx, tympanum). Centaur musicians associated with Dionysus and Ariadne are also included in this group, usually drawing the divine chariot separately or together. Numerous examples are preserved with such Dionysian motifs on Roman cameos and intaglios of precious stones or glass, based on Greek Classical and Hellenistic originals.[67]

Variations of dancing satyrs and maenads were very popular. For instance, dancing satyrs in a great variety of dance movements are engraved in glyptic works from the first century BCE – first

[64] Zwierlein-Diehl 1969: 174; cf. n.55 above.
[65] See examples in Cravinho 2018: 150–51; cf. also the preceding.
[66] Gasparri 1986: 540–66; cf. Gasparri and Veneri 1986: 414–514; Wyler 2020.
[67] On centaurs as musicians, see Rodríguez López, Romero Mayorga 2018: 26–50.

century CE in Berlin[68], Boston[69], Hanover[70], St. Petersburg[71], London[72], Naples[73] and elsewhere[74]. The dancers are represented as statue-like, nude or seminude, holding usually a *kantharos* and/or a *thyrsos* while dancing. A very elaborate design appears on a purple glass gem in Boston. The satyr moves to the left. His head is thrown back sharply, in a manner that over-extends the neck and thrusts the chin upwards. His right leg is bent back and very shallowly carved. He holds a staff (*thyrsos*) in his extended left arm; and a panther pelt is draped over his right arm.

Figure 8: Dancing satyr. Oval convex carnelian intaglio, attributed to Sostratos' workshop (first cent. BCE). St. Petersburg, State Hermitage Museum, inv. ГР 21518. Courtesy of the State Hermitage Museum. © The State Hermitage Museum; photo by Evgenia Tkachuk.

This motif is common with small variations on numerous gems; for instance, on a carnelian gem in the Hermitage (2.0 × 1.6 cm, first century BCE, Figure 8), attributed to the Sostratos' workshop, the satyr has similar stance as his counterpart in Boston. Additionally, on the ground, between his legs, an inverted vase with a plant is visible. In Berlin, on a different gem, an oval plasma, bright green, translucent with small brown spots (3.81 × 2.30 × 0.72 cm, first quarter of the first century BCE) the satyr moves to the right (Figure 9):[75] his body is represented as very muscular and not as harmoniously proportioned as the one in the Hermitage; the panther pelt is also engraved differently. Perhaps the increase in Dionysian themes is associated with Mark Antony's entry into Ephesus in early 41 BCE, where he was

[68] Berlin, Antikensammlung, inv. 32.237; 259, carnelian dark orange (third quarter of the first century BCE): Weiss 2007: 155–6, no. 112, pl. 18; cf. no. 113, pl. 18 and other examples in Richter 1971: 45; 143, nos 177–80; 693 with corresponding figs.

[69] Boston, Museum of Fine Arts, inv. 98.745: https://collections.mfa.org/objects/186321/rectangular-gem-with-dancing-satyr?ctx=184aa1fa-050d-4a00-a7b5-19f73a6ffd2b&idx=222 [Accessed: 16 November 2021].

[70] Hanover, August Kestner Museum, inv. K 298 (jasper, red-brown): Schlüter et al. 1975: 174, no. 861, pl. 112 (first half of the first century CE).

[71] St. Petersburg, State Hermitage Museum, inv. Ж 13221: Neverov 1976: 67; 99, no. 80.

[72] London, British Museum: Vollenweider 1966: 19 (n. 20); 94, pl. 9/3–4.

[73] National Archaeological Museum of Naples, inv. 25873/41 (cameo fragment of a white onyx on light brown agate), from Lorenzo de' Medici collection: Vollenweider 1966: 19 (n. 20); 94, pl. 9.1; Pannuti II 1994: 129–30, no. 97.

[74] See examples in Vollenweider 1966: 18–22; 94, n. 20–32, pl. 9/1–5; Joys 2002: 120–21; Overbeck and Overbeck 2005; cf. a similar motif (dancing satyr) in Zwierlein-Diehl 2007: 426, pl. 117, fig. 556 (carnelian, third quarter of the first century BCE, in Xanten, Dom St. Victor); see also some examples (carnelian, banded agate, jasper and chromian chalzedony) in Grassi Museum für Angewandte Kunst in Leipzig, nos132; 99; 109): Cain and Lang 2015: 59, figs I 40–42 (C. Götz).

[75] Berlin, Antikensammlung, inv. FG 2300: Vollenweider 1966: 19 (n. 20); 94, pl. 9.5 (casting); Zwierlein-Diehl 1969: 147, no. 375, pl. 67.

Figure 9: Dancing satyr. Oval plasma, bright green, translucent with small brown spots (first cent. BCE – first cent. CE). Berlin, Antikensammlung, inv. FG 2300. Courtesy of the Antikensammlung. © Antikensammlung, Staatliche Museen zu Berlin – Preussischer Kulturbesitz. Photo: Archiv.

worshiped as Dionysus the Giver of Joy and the Beneficent (χαριδότην καὶ μειλίχιον).[76] In other depictions dancing satyrs also play a musical instrument: for example a cithara, as in Tarragona, attributed to Skylax (mid-first century BCE?).[77]

The female counterparts of the satyrs, the maenads, were similarly popular. Numerous variations of single ecstatic dancing maenads, based on Late Classical and Hellenistic prototypes,[78] were preserved in Roman times. The motif of a dancing maenad with swirling drapery was very popular on rings in 300 BCE. It was also used in other media (e.g. paintings, reliefs, statues and statuettes), and may reflect the influence of a well-known statue of a dancing maenad by the famous sculptor Scopas.[79] Two groups of examples are more prominent: maenads dancing while holding either a *kantharos* or a *thyrsos* or their shawls, and maenads dancing while playing a musical instrument.

To the first category belong gems in Malibu, Naples, New York and Berlin.

A classicizing carnelian stone, but only slightly convex (14.2 × 10.3 × 2.7 mm) in Malibu (Figure 10), created by an unknown cutter (first century BCE) depicts a maenad in profile dancing to the left holding

[76] Plut., *Ant*. 24.1–3; see esp. 24.3: "At any rate, when Antony made his entry into Ephesus, women arrayed like Bacchanals, and men and boys like satyrs and Pans, led the way before him, and the city was full of ivy and thyrsus wands and harps and pipes and flutes, the people hailing him as Dionysus Giver of Joy and Beneficent. For he was such, undoubtedly, to some; but to the greater part he was Dionysus Carnivorous and Savage"; on Antonius as Neos Dionysos: Plut., *Ant.* 60.3; Cass. Dio, *HR* 48.39.2; cf. Fear 2020: 96, n. 18; Vollenweider 1966: 19–20.

[77] Tarragona, National Archaeological Museum of Tarragona, inv. 7543: Németh and Canós-Villena 2002: 157–64, fig. 1.

[78] E.g. on Greek gold and silver rings of the fourth century BCE, as for instance in the examples of Malibu (400–350 BCE): Malibu, Getty Villa Museum, inv. 85. AM.279; 81. AN.76.154: Spier 1992: 34; 36, nos 52; 57; Joys 2002: 123; Gerring 2000: 180, no. Vr. 10 (gold ring).

[79] Some scholars recognize the statuette of a dancing Maenad in Dresden as a copy of the Scopas' original: Dresden, Staatliche Kunstsammlungen und Albertinum, inv. Hm 133 (mid. fourth century BCE): Barr-Sharrar 2013: 321–37, figs 1–6; 10–22; 28 with references; cf. the contributions of Wolf, Petropoulos, and Geominy in Katsonopoulou and Stewart 2013; "Alternatively Wilfred Geominy in his paper entitled *Looking for a new Skopaic Maenad* proposes the so-called Berlin Dancer, a figure he considers as corresponding well with the style of a fourth century sculpture, as actually representing this masterpiece of Scopas instead of the Dresden Maenad."; Childs 2018: 133–4, fig. 190.

a *kantharos* in her right and a *thyrsos* in her left hand.[80] Her hairstyle is unusually wild and stands upright. Her garment consists of a fine long and sleeveless *chiton*, whose folds follow her movement, and of a shawl (*himation*) over her arms. The style instead reveals some archaism and seems to be local. Perhaps it comes from Asia Minor.

Figure 10: Dancing maenad. Carnelian intaglio (first cent. BCE). Malibu, Getty Villa Museum, inv. 85.AN.370.67. Digital image courtesy of the Getty's Open Content Program.

Two chalcedony agate cameos from the Pietro Barbos gem collection in Naples (Figure 11 and Figure 13), are attributed to the famous gem carver Sostratos (Late Hellenistic, last quarter of the first century BCE).[81] He was a very skillful Greek artisan, active at the court of Cleopatra and Marc Antony in Alexandria of Egypt, who were known to stage Dionysian performances, both in public and at court.[82] Later, he moved to Rome to work for Roman rulers (e.g., Augustus). Sostratos and his workshop preferred Dionysian scenes and represented figures in complex poses.[83] In contrast, our next examples, a brown fragmentary glass gem (mid. first century BCE)[84] and an oval amethyst (2.85 × 2.21 × 0.68 cm, last third of first century BCE, Figure 12)[85], both in Berlin, and a glass cameo (3.5 × 2.7 × 0.6 cm, first century CE, in New York, Figure 14)[86] are unsigned.

Figure 11: Dancing maenad. Chalcedony agate cameo, attributed to Sostratos (last quarter of first century BCE). National Archaeological Museum of Naples, inv. 25914/81. Courtesy of the Ministero della Cultura – Museo Archeologico Nazionale di Napoli. Photo by Giorgio Albano.

All maenads are represented in white low relief performing different steps and holding their mantles or waving shawls behind

[80] Malibu, Getty Villa Museum, inv. 85. AN.370.67: Spier 1992: 93, no. 219; (he includes this gem in the form A4; for this form, see n. 61 above); Joys 2002: 121.

[81] National Archaeological Museum of Naples: a) inv. 25914/81: Pannuti II 1994: 133–4, no. 101; https://artsandculture.google.com/exhibit/the-gem-collection-of-the-mann-national-archaeological-museum-of-naples/pgJi8kv2qQrBLw [Accessed: 16 November 2021]; b) inv. 25934/101: Pannuti II 1994: 134–5, no. 102; https://artsandculture.google.com/exhibit/the-gem-collection-of-the-mann-national-archaeological-museum-of-naples/pgJi8kv2qQrBLw?hl=en [Accessed: 16 November 2021]; Vollenweider 1966: 19–20; 101, pl. 26.4–7.

[82] Vollenweider 1966: 19–20; cf. Gradel and Gennaioli 2020: 182; Gołyźniak 2020: 204.

[83] For Sostratos and related works, see Vollenweider 1966: 32–3; Vollenweider 1972: 181; Spier 1992: 154; Zwierlein-Diehl 2007: 112–13; 409–10; Prioux 2015: 58–65; Gradel and Gennaioli 2020: 181–7; Gołyźniak 2020: 193–4.

[84] Berlin, Antikensammlung, inv. FG 6242: Zwierlein-Diehl 1969: 148–9, no. 381, pl. 68.

[85] Berlin, Antikensammlung, inv. FG 2301: Zwierlein-Diehl 1969: 167, no. 446, pl. 78.

[86] New York, The Metropolitan Museum of Art, inv. 17.194.10: https://www.metmuseum.org/art/collection/search/249255 [Accessed: 16 November 2021]; Gazda 2000: 223–4, no. 91; Draper 2008: 15, fig. 23.

them. The first maenad in Naples (23.9 × 20 mm, Figure 11) is engraved in three quarter view, bent or moving to the left. Her long fine dress follows the movement of her body. Her right leg is bent forward and her left leg outstretched back. The right edge of her shawl is wrapped around her right hand, and she holds with her right hand an inverted *thyrsos* and with her left the other side of her shawl, almost diagonally behind her. Thus, she performs an ecstatic dance. The second maenad in Naples (26.2 × 19 mm, Figure 13) is depicted almost in profile to left (head and under body), whereas her upper body is cut in a three quarter posture/view. She dances on her toes moving her left leg elegantly forward and her right leg to the back. At the same time, she holds her mantle or waving shawl with both hands behind her, forming an impressive background. The second maenad in Naples, the first in Berlin and this one in New York (Figure 14) each throw back one of their hands during their ecstatic dance, a motion common in numerous examples, influenced also by Greek Late Classical works (e.g. Mänadenkrater in Berlin, Derveni crater in Thessaloniki).[87]

Figure 12: Dancing maenad. Oval amethyst intaglio (last third of first cent. BCE). Berlin, Antikensammlung, inv. FG 2301. Courtesy of the Antikensammlung. © Antikensammlung, Staatliche Museen zu Berlin – Preussischer Kulturbesitz. Photo by Johannes Laurentius, CC BY-SA 4.0.

Figure 13: Dancing maenad. Chalcedony agate cameo, attributed to Sostratos (c. 25–1 BCE). National Archaeological Museum of Naples, inv. 25934/101. Courtesy of the Ministero della Cultura – Museo Archeologico Nazionale di Napoli. Photo Archivio MANN.

The first Berlin maenad dances holding her shawl below forming a bow. The second Berlin maenad (Figure 12) dances on her tiptoes to the right, whereas her upper body and head turn back. Her body is in three quarter view, her head in profile. She wears a sleeveless transparent chiton that leaves a breast free. She has a transparent veil around her head and upper body. However, one observes iconographical differences between the maenads mentioned above; e.g. regarding the folded garments and the movements. Therefore, the Naples gems are of higher quality regarding iconography and style, showing a more elaborate figure treatment than that on the glass gem in New York. Different styles and movements are shown by the Berlin dancers as well.

In other depictions on gems, the maenad dances while playing a musical instrument, usually a tympanum (frame

[87] Derveni crater: Thessaloniki, Archaeological Museum, inv. B1: cf. Vocotopoulou 1997: 265–6, nos 169–75, pls 170; 172; Tsigarida and Ignatiadou 2000: 75–82, figs 78–80; 82; 84; cf. Barr-Sharrar 2013: 321–2, fig. 7 (Mänadenkrater); 324–5, figs 8–9 (Derveni crater).

Figure 14: Dancing maenad. Cameo glass medallion (first cent. CE). New York, The Metropolitan Museum of Art, inv. 17.194.10. Photo: The Metropolitan Museum of Art, OA/public domain.

Figure 15: Maenad dancing and playing a tympanum (frame drum). Oval orange carnelian intaglio (early first cent. BCE). Berlin, Antikensammlung, inv. FG 6833. Courtesy of the Antikensammlung. © Antikensammlung, Staatliche Museen zu Berlin – Preussischer Kulturbesitz. Photo by Johannes Laurentius, CC BY-SA 4.0.

drum: for instance in Berlin, Figure 15,[88] in Nijmegen and in Munich[89]), but also auloi (in Naples[90]). The Berlin example (2.68 × 1.89 × 0.58 cm), an oval orange carnelian intaglio (beginning of the first century BCE), represents a maenad moving to the left while holding a large tympanum and a ribbon with both hands. She wears a transparent *chiton*, which follows her movements. Maenads dancing and playing a tympanum or cymbals decorate reliefs and wall paintings, e.g. in Pompeii.[91]

The maenad on the glass ring stone in Nijmegen is carved in a different expressive pose (first century BCE).[92] She is represented from behind in three-quarter view dancing to the right on her tiptoes, throwing her head back and holding a large tympanum with her left hand while striking it with the right. A snake, also a Dionysian attribute, is wrapped around her arm. She is nude, whereas her fine folded dress seems to be in front of her, like a large shell in the background. Remains of her *nebrís* are also preserved. Such single exotic dancers or abbreviated dancing and musical scenes

88 Berlin, Antikensammlung, inv. FG 6472: Zwierlein-Diehl 1969: 148, no. 380, pl. 68.

89 Joys 2002: 123–4, figs 4 (Nijmegen), 5 (Boston) with examples. However, the amethyst glass in Boston is modern (18th–19th century) according to the Museum's website.

90 National Archaeological Museum of Naples, inv. 2586/35 (cameo in *nicolo*): Pannuti II 1994: 139–40, no. 106.

91 Schefold 1962: 106, pls 62 (from the House of the Vettier); 70 (from the House of the Dioskouri, both Maenads with tympanum); Aoyagi and Pappalardo 2006; 60 (cymbals); Melini 2008: figs on pp. 67; 76; 86 (conch, cymbals and tympanum); cf. Liveri 2021: 77–82 (percussion music used by Dionysos' worshippers).

92 Nijmegen, Museum Kam: Joys 2002: 123; 125, n. 38 with references.

Figure 16: A Bacchic group. Sardonyx cameo (first cent. BCE – first cent. CE). New York, The Metropolitan Museum of Art, inv. 25.78.96. Fletcher Fund, 1925. Photo: The Metropolitan Museum of Art, OA/public domain.

were, due to their ecstatic and erotic wild dancing, suitable for decorating jewellery that was worn by symposiasts or other luxury objects (e.g. glass cups in cameo technique).[93]

'Sacral- or sacro-idyllic' scenes[94] are perhaps represented on the next examples, which show the calm behavior of bacchantes in an idyllic ambient. Sometimes a satyr is shown amusing the infant Dionysus. Such a scene is carved on an onyx-sardonyx cameo in the Farnese Collection in Naples (30–20 BCE).[95] A naked satyr is seated on a rock to the left carrying the infant Dionysus on his shoulders while joking with him, whereas his staff and his *syrinx* are on the rock. The bucolic scene is carved very carefully in high relief with details.

[93] Harden 1988, nos 31–2; Restani et al. 2010: 167–8, figs 4a–b.

[94] On 'sacral- or sacro-idyllic' landscapes, see Simon 1986: 182–210; Zanker 1987: 284–90, figs 224c–227; Silberberg 1989; Silberberg-Pierce 1980: 241–251; Kotsidu 1998: 91–105; Croisille 2010; Hinterhöller-Klein 2015.

[95] National Archaeological Museum of Naples, inv. 25880/48: Dacos et al. 1973: 54, no. 23, fig. 17; De Caro 1994: 345; Pannuti II 1994: 117–18, no. 86; Melini 2008: 64; Gasparri 1986: 553, no. 160, pl. 443.

On a Hellenistic or early imperial sardonyx cameo in New York (3.3 × 3.6 cm, Figure 16, first century BCE – first century CE) a Bacchic group consisting of a satyr, two maenads, and a small panther is illustrated.[96] It seems that they are resting after their dance with tympana and cymbals. In the center is a half-inclined maenad with her bare back facing the viewer. She leans her head on her hands looking at the satyr in front of her who holds the panther's tail, while the animal is breastfed by the maenad. Her position is erotic. She has left her cymbals and drum on the ground, flanking a crater lying on its side a vase associated with Dionysus and wine.

Figure 17: Seated silenus holding an aulos pipe in each hand. Carnelian intaglio (mid. first cent. BCE). Berlin, Antikensammlung, inv. FG 6833. Courtesy of the Antikensammlung. © Antikensammlung, Staatliche Museen zu Berlin – Preussischer Kulturbesitz. Photo: Archiv.

To the right another half nude maenad is seated, resting her drum on her left thigh, while her right hand tries to hold her fluttering mantle over her head. This Bacchic scene reminds us of resting maenads with or without their tympanum found on reliefs and wall paintings in Pompeian houses.[97] However, they are depicted in a different style and with different iconography.

Variations have also been found; e.g. on two onyx cameos from the first century CE: on the first example, Dionysus and Ariadne are seated seminude on layered rocks.[98] The god holds a *kantharos* with his left hand; behind it is a disc, perhaps a tympanum. On the right a hermaic stele in the form of a small draped standing silenus is visible. The second cameo bears a maenad on the left reclining in the sanctuary of Dionysus.[99] She is seminude and raises her hand to take a tympanum that is hanging from a bare tree. A *syrinx* hangs from a branch over the goat's head on the right. A clothed statue of Bacchus, a goat, and a seated youth are included in the scene.

[96] New York, The Metropolitan Museum of Art, inv. 25.78.96: https://www.metmuseum.org/art/collection/search/251876 [Accessed: 16 November 2021]; Gazda 2000: 223, no. 90; Boardman 2009: 218–19, no. 481.

[97] Jashemski 1993: 348–56, figs 406–7; 412 (painted pinakes in: no. 60. VI. Insula occid. 42, House of the Wedding of Alexander); Simon 1986: 195–6, fig. 254; wall paintings in room 32 of the House of the Golden Bracelet in Pompeii: Pompei 1996: 117–22, figs 151; 153; 155, no. 153; Coarelli 2002: figs on pp. 210–11; Aoyagi and Pappalardo 2006: 187, figs 10 and on the pages 189–95; 209–10; 221 (from Oecus 32); cf. a sleeping Maenad in: Pompei 1990: 146–8, nos 51–2 (House of the Cithara Player, I.4.5 and 25, in triclinium 19). On the gardens of Pompeii, see also Jashemski 1979.

[98] Boardman and Wagner 2018: 222, no. 207.

[99] Boardman and Wagner 2018: 224, no. 209.

Satyrs or sileni are also depicted dancing, holding, or playing a musical instrument, such as a seated pot-bellied old silenus on a carnelian intaglio in Berlin (mid first century BCE), who holds one aulos pipe in each hand, while his aulos case (*sybḗnē*) is visible on the ground (Figure 17).[100]

Another satyr/silenus who is also seated plays a lyre on a dark green plasma in Vienna (first century CE)[101] and on a black glass gem in Lisbon (second half of the first century BCE)[102]. Among the interesting pieces of the Lisbon collection are: a pale-green chrysoprase (first century BCE – first century CE),[103] where a young satyr seats on the floor holding a *syrinx* in his raised hand, and a pale-orange carnelian (first – second century CE)[104] with a bearded satyr/silenus who walks to the right while playing a pipe held in his raised hand and holding another pipe in his left.

Centaur musicians are depicted on gems either singly or pulling the chariot (*biga*) of Dionysus and/or Ariadne in triumphal processions.[105] A young centaur decorates two orange carnelian intaglios in Vienna (first century BCE). The first one moves to the left while playing a lyre.[106] The second centaur places his lyre at the top of a column.[107] Single centaurs play auloi on sardonyx cameos in Naples[108] and in Alnwick Castle (first century BCE – first century CE?)[109].

Usually, two centaurs (a male-female pair) are the deities' charioteers. Representations in various versions are preserved. Sometimes, one or both of them hold or play a musical instrument. For instance, on the sardonyx-agate cameos in Paris and Florence one centaur holds or plays a lyre;[110] while on the Paris cameo that illustrates the Triumph of Dionysus and Ariadne, the female centaur companion beats cymbals. In both examples the divine pair of Dionysus and Ariadne sit embracing on the chariot, surrounded by cupids; in the Paris example, marine or earthly deities/figures are placed on the ground below.

On the sardonyx-agate cameo (4.2 × 2.7 cm) from Alexandria in St. Petersburg, attributed to the workshop of Sostratos of the first century BCE, both centaurs play music (Figure 18):[111] On the

[100] Berlin, Antikensammlung, inv. FG 6833: Zwierlein-Diehl 1969: 147–8, no. 377, pl. 68; Zwierlein-Diehl 2007: 426, pl. 117, fig. 558.

[101] Vienna, Kunsthistorisches Museum, inv. IX B 1287: Zwierlein-Diehl 1973: 148, no. 469, pl. 77; cf. similar motifs on two gems in Boardman and Wagner 2018: 184–5, nos 170–71 (in the first one additionally a *syrinx* hangs on a tree).

[102] Lisbon, National Archaeological Museum, inv. Au 639: Cravinho 2017: 187–8, no. 16, pl. 2, with many examples or parallels.

[103] Lisbon, National Archaeological Museum, inv. Au 669: Cravinho 2017: 188, no. 17, pl. 2.

[104] Lisbon, National Archaeological Museum, inv. Au 1206: Cravinho 2017: 190, no. 20, pl. 2.

[105] On Dionysiac processions in the art, see Boardman 2014: esp. 22–6 on cameos; cf. passim for various artefacts and periods of the Antiquity.

[106] Vienna, Kunsthistorisches Museum, inv. IX B497: Zwierlein-Diehl 1973: 99, no. 260, pl. 45.

[107] Vienna, Kunsthistorisches Museum, inv. IX B720: Zwierlein-Diehl 1973: 99–100, no. 261, pl. 45.

[108] National Archaeological Museum of Naples, inv. 25921/88 (perhaps from the Medici collection): Pannuti 1994: 199–201, nos 167–8.

[109] Alnwick Castle, Beverly Collection, inv. (10591) K 53: Scarisbrick et al. 2017: 38, no. 31.

[110] a) Paris, Bibliothèque Nationale de France (*Cabinet* des *médailles)*, inv. Chab. 61: Gradel and Gennaioli 2020: 184; 186, fig. 8; Boardman 2014: 25–6, fig. 13; b) National Archaeological Museum of Florence, inv. 14457: Giuliano and Micheli 1989: 177, no. 60; Gradel and Gennaioli 2020: 184; 186, fig. 11.

[111] St. Petersburg, State Hermitage Museum, inv. ГР-12696: Gradel and Gennaioli 2020: 183; 186, fig. 9.

Figure 18: Two centaurs pull the chariot of Dionysus (or Ariadne?), both playing music (conch and cymbals). Egypt, Alexandria, sardonyx cameo (first cent. BCE). St. Petersburg, State Hermitage Museum, inv. ГР-12696. Courtery of the State Hermitage Museum. © The State Hermitage Museum. Photo by Svetlana Suetova.

right, the female, with a human upper body that faces to the front, beats cymbals, [112] while her male companion blows a conch. His head and lower body are represented in profile, and his upper body is in three quarter view. In this interesting scene in white low relief, Dionysus (or Ariadne?) is half naked while holding a *thyrsos,* reclining alone on a chariot drawn by the centaur pair, who are moving in profile to the right.[113] The representation of Bacchic pairs could have another symbolic meaning that is also comparable to contemporary leading political pairs;[114] the Dionysus-Ariadne pair may especially be identified with Antony and Cleopatra VII and their 'sacred marriage', moving in a triumphal procession and accompanied by loud music.[115] As mentioned above, these Dionysian *thiasos* motifs are associated with the triumphal processions of Marc Antony in Ephesus in 42 BCE and in Alexandria in 34 BCE after his Armenian military campaign.[116]

In another version of the subject in St. Petersburg (Figure 19), on a sardonyx-agate cameo (3.1 × 2.3 cm) attributed also to the Sostratos' workshop, the centaur pair pulls Dionysus' (or Ariadne's) chariot to the right. Here the female counterpart/companion seems to play a large tympanum while looking to the left.[117] However, the movement has been rendered clumsily, and unsuccessfully. The left arm of the male centaur is also omitted. Centaur musicians are also depicted on sarcophagi and on wall paintings, e.g. in Campania, in the Vesuvian area (Pompeii etc.).[118]

4 Triton musicians

The next examples were inspired by nautical themes. Poseidon/Neptune and his followers (the tritons and nereids) were also a very popular motif for gem engravers. Poseidon, as god of water

[112] On cymbals in the cult of Dionysus, see Liveri 2013: 1104–5.
[113] Whether the figure is male or female cannot be determined. It seems effeminate with breasts. We observe the same in the next example from St. Petersburg.
[114] Plantzos 1999: 86–7; Gołyźniak 2020: 193–4.
[115] Ibidem, 204.
[116] Plut., *Ant.* 50; Cass. Dio 49.40.3; Tondriau 1946: 160–67; Vollenweider 1966: 19–20, pl. 23.1.
[117] St. Petersburg, State Hermitage Museum, inv. ГР-12669; Vollenweider 1966: 35; 100, pl. 23.5 and 7; Boardman 2014: 25; Gradel and Gennaioli 2020: 183; cf. 183, fig. 10.
[118] See examples and references in Pannuti 1994: 198–201.

Figure 19: Two centaurs pull the chariot of Dionysus (or Ariadne?); one of them playing the tympanum. Egypt, Alexandria, sardonyx-agate-onyx cameo (first cent. BCE). St. Petersburg, State Hermitage Museum, inv. ГР-12669. Courtesy of the State Hermitage Museum. © The State Hermitage Museum; photo by Konstantin Sinyavky and Svetlana Suetova.

and the sea and a protector in naval battles, and Venus Marina were included in the Roman iconographical repertoire, especially after Actium.[119] The mythical sea creatures, the nereids and tritons, are depicted in very pleasant and playful scenes, either singly or in groups in various compositions.

Tritons are usually portrayed blowing into a conch shell, as on a chalcedony intaglio in Vienna (first quarter of the first century BCE) which is decorated with a triton in the sea, in profile to the right.[120] He blows into a conch shell holding it with both hands. A variation appears on the carnelian intaglio of Geneva, signed by Hyllos (first century CE).[121] Here a triton with crustaceous claws for legs carries a trident while blowing a conch shell.

Rarely do tritons play other musical instruments, e.g. an aulos, as on a carnelian intaglio (1.00 × 1.46 × 0.26 cm) from the first century CE in Hanover (Figure 20).[122] It represents another naked and bearded male triton to the right, holding two pipes with his left hand crosswise, while he raises his right. He faces to the front, his upper body being seen in three-quarter view. On another carnelian intaglio in Vienna a triton is depicted as a lyre player (first century BCE).[123] He moves in

[119] Venus also protected Augustus as Venus Genetrix of the Julian house. For Venus Pelagia and a triton on a gem (early first century CE), see Gołyźniak 2020: no. 232, fig. 877; cf. depictions of Aphrodite/Venus *Velificans* on two gems: a) riding a sea dragon; and b) riding a sea horse accompanied by a dolphin and two Erotes; also on the reliefs of the Ara Pacis Augustae in Rome: Galinsky 1969: 211–12, figs 151–2.

[120] Vienna, Kunsthistorisches Museum, inv. IX B 1304: Zwierlein-Diehl 1973: 150, no. 481, pl. 79; Icard-Gianolio 1997: 76, no. 36a, pl. 51.

[121] Geneva, Musée d'Art et d' Histoire; Vollenweider 1966: 71; 118, pl. 77. 7; Icard-Gianolio 1997: 76, no. 36b.

[122] Hanover, August Kestner Museum, inv. K 500: Schlüter et al. 1975: 191, no. 950, pl. 125 with examples; Icard-Gianolio 1997: 76, no. 37, pl. 51.

[123] Vienna, Kunsthistorisches Museum, inv. IXB 1471: Zwierlein-Diehl 1973: 98, no. 254, pl. 44; Icard-Gianolio 1997: 81, no. 100, pl. 58.

profile to the left, while a wingless Eros rides on his back playing an aulos. Similar entertaining and playful motifs of a triton, usually holding or blowing a shorter or longer conch shell, also adorned various Roman artworks, such as mosaics, wall paintings, reliefs and other artefacts.[124]

Figure 20: A triton holding an aulos. Carnelian cameo (first cent. CE). Hanover, August Kestner Museum, inv. K 500. Courtesy of the Museum. © Landeshauptstadt Hannover, Museum August Kestner. Photo by Christian Rose.

However, the most interesting and important glyptic work bearing tritons is the famous sardonyx cameo in Vienna (after 27 BCE), the so-called 'Actium cameo' (Figure 21), showing four tritons drawing Augustus' chariot/quadriga.[125]

The scene's composition is impressive, including various motifs and symbols. The relief carvings are very elaborate. It should be mentioned that all the heads were replaced in the second half of the sixteenth century. The triumphant sea victor Augustus-Neptune (or Genius Augustus?), wearing the toga, stands on the chariot while holding a branch in his right hand and a scepter in his left. Only the second triton from the left holds a conch shell in his right hand while raising the other; his counterpart on the right holds a dolphin. The two outer tritons hold other objects: with their raised hand a globus on which are placed other symbols of imperial power: on the left the *clipeus virtutis*, i.e. a gold shield surrounded by an oak wreath and carried by capricorns; on the right Victory/Victoriola with an oak wreath (*corona civica*). The outer tritons hold with their downward left hands a sword in its sheath (the sword hilt is missing) and a rudder. Therefore, according to the scene's iconography, music also plays a role in this triumphal naval procession, as represented by the triton musician with a conch shell. This cameo is a masterpiece of glyptic art, commemorating Augustus' victory and power. It is a representative work, used for his political aims, after his victory at Actium.[126] The creator of this piece was a genius, combining all the symbols of the new era in a composition that demonstrates the new ideology of the emperor.[127] Thus, the *princeps* Augustus is glorified after his victory in the naval battle in Actium as the guarantor of peace and prosperity for the Roman people.

[124] Melini 2008: figs in p. 67 (conch); Icard-Gianolio 1997: 75–7; 79–82, nos 28; 30a–b; 31; 32a; 33; 36b; 40–41; 43b; 44–5; 50; 69; 77a–b; 78; 82; 95; 97; 107; 108; 122 pls 49–59 (conch); no. 74 (*syrinx*). Compare an unusual representation of a triton with lobster/crayfish lower body to the right blowing a long conch on a fresco at Portici in Herculaneum: Fröhner 1878: 24–5; https://jenikirbyhistory.getarchive.net/media/froener-notice-sculpture-p025-b20559 [Accessed: 13 January 2024].

[125] Vienna, Kunsthistorisches Museum, inv. IXa 56: www.khm.at/de/object/3499ff579a/; https://www.khm.at/objektdb/detail/59148/ [Accessed: 16 November 2021]; Zanker 1987: 102, fig. 81; Zwierlein-Diehl 2008: 92–7, no. 5, figs 28–31; 36–7; Gołyźniak 2020: 221; 415, no. 10.92, fig. 812.

[126] About Actium, see references in n. 9 above; additionally, Davis 1999: 63; cf. Eck 2007.

[127] See references in note 125.

Figure 21: 'Actium Cameo'. The victorious Augustus on a chariot drawn by four tritons (after 27 BCE). Sardonyx and enamelled gold cameo. Vienna, Kunsthistorisches Museum, inv. IXa 56. © Kunsthistorisches Museum Vienna.

5 Musical instruments

Individual musical instruments (usually the string instruments lyre and cithara) also decorate gems either as single motif or in combination with other motifs, e.g. a *khélys* (χέλυς) lyre flanked at the top by two birds, shown on a glass gem in London (last third of the first century BCE).[128]

Variations of stylized lyres with two to nine strings appear in various collections: such as for example in Lisbon (three strings, black and pale-blue nicolo fragmentary intaglio, late second – third century CE, or third century CE),[129] in Berlin (four strings, sardonyx, beginning of the first century CE),[130] in St. Petersburg (five strings, a shard-agate onyx cameo, 1.2 cm, first century BCE,

[128] It is re-set in a third-century CE bronze ring: Gołyźniak 2020: 236; 432, no. 10.533, fig. 929.

[129] Lisbon, National Archaeological Museum, inv. 1194: Cravinho 2017: 222, no 66 with parallels.

[130] Berlin, Antikensammlung, inv. 1816: Platz-Horster 2012: 84, no. 60, pl. 13 with parallels; cf. an orange carnelian and a brown-red garnet gem (both dated to the third quarter of the first century BCE) in the Heinrich Dressel collection der Antikensammlung in Berlin: Weiss 2007: 304–5, nos 611–12, pl. 80.

Figure 22: Lyre with five strings. Sard-agate onyx cameo. St. Petersburg, State Hermitage Museum, inv. ГР-12595. Courtesy of the State Hermitage Museum. © The State Hermitage Museum; photo by Evgenia Tkachuk.

Figure 23: Lyre with five strings. High oval nicolo (first cent. CE). Hanover, August Kestner Museum, inv. K 1215. Courtesy of the Museum. © Landeshauptstadt Hannover, Museum August Kestner. Photo by Christian Rose.

Figure 24: *Khélys* lyre with four strings. Light brown glass cameo with casting overhang (second half first cent. BCE – beginning first cent. CE). Hanover, August Kestner Museum, inv. K 1414. Courtesy of the Museum. © Landeshauptstadt Hannover, Museum August Kestner. Photo by Christian Rose.

Figure 25: *Khélys* lyre with seven strings. Light brown glass cameo with casting overhang (second half first cent. BCE – beginning first cent. CE). Hanover, August Kestner Museum, inv. K 1415. Courtesy of the Museum. © Landeshauptstadt Hannover, Museum August Kestner. Photo by Christian Rose.

Figure 22),[131] in Hanover (five, a high oval nicolo, 0.94 × 0.71 × 0.25 cm, first century CE, Figure 23, and six strings),[132] and in Naples (nine strings, cameo in agate-sardonyx).[133]

Two *khélys* lyres, with four and seven strings respectively, are found on light brown glass cameos that are included in the collection of Hanover; both are upright oval with casting overhang, dated to the second half of the first century BCE to the beginning of the first century CE: the first one (Figure 24, 1.31 × 1.04 × 0.26 cm) is decorated with bands below and on the field above, flanked by a plectrum.[134] From each horn of the second *khélys* lyre (Figure 25, 1.25 × 1.04 × 0.28 cm), hangs

131 St. Petersburg, State Hermitage Museum, inv. ГР-12595: https://www.hermitagemuseum.org/wps/portal/hermitage/digital-collection/18.+carved+stones/1002446 [Accessed: 16 November 2021].

132 Hanover, August Kestner Museum, inv. K 1215 (five), K 1213 (six): Schlüter et al. 1975: 253, no. 1344, pl. 185 (five); Platz-Horster 2012: 84 (six).

133 National Archaeological Museum of Naples, inv. 25922/89 (from Medici collection): Pannuti 1994: 296–7, no. 264.

134 Hanover, August Kestner Museum, inv. K 1414: Schlüter et al. 1975: 153, no. 745, pl. 96.

Figure 26: Seven-stringed lyre, syrinx and two inclined auloi. Orange carnelian gem (first cent. CE). Hanover, August Kestner Museum, inv. K 1217. Courtesy of the Museum. © Landeshauptstadt Hannover, Museum August Kestner. Photo by Christian Rose.

a dolphin-shaped band/ribbon.[135] Single musical instruments also decorate wall paintings in Pompeii.[136]

A unique representation of a new musical instrument, the hydraulis (water organ), which had been invented by Ctesibius in Alexandria about the middle of the third century BCE, is engraved on a sardonyx gem from Italy in London (first century BCE).[137] The performer, standing perhaps on a podium, as is best known from terracotta models, is visible up to the chest behind the row of pipes. At each side of the instrument, we find figures working the pistons. The abbreviated inscription "AMVV", meaning 'VIVAM', i.e. "Success to myself", would apply to the owner of the gem.

A *syrinx* surrounded by other objects (a grape, a fruit or tympanum on a branch or pedum?) decorates a black glass gem with white horizontal stripes in Hanover (second half of the first century BCE).[138] A grasshopper sits in profile on the *syrinx*. Gems with a *syrinx* motif are also visible in Berlin and Munich.[139] A plectrum and a scabellum flank a lightning motif on a white glass gem in Berlin (third quarter first century BCE).[140]

Depictions of a group of different instruments are unusual, e.g. on an orange carnelian, in Hanover (transverse oval, 0.79 × 0.89 × 0.18 cm; first century CE) include a seven stringed lyre, a *syrinx* and two inclined aulos pipes beneath it (Figure 26).[141]

Engraved gems decorated with musical instruments, either singly or in combination with other fertility symbols (fruits, grasshopper), belong to the symbolic gems, associated with Augustus' political, cultural and religious reforms, to promote the ideas of peace (*pax*) and prosperity (*prosperitas*) during his Golden Age (*aurea aetas*).[142] They must have had a similar significance under his successors.

135 Hanover, August Kestner Museum, inv. K 1415: Ibidem: 153, no. 746, pl. 96.
136 Aoyagi and Pappalardo 2006: figs on pp. 236–7; 241 (cithara on a tripod); Melini 2008: figs on pp. 75–9 (tympana, panpipes, cymbals, lyres, citharas).
137 London, British Museum: Perrot 1971: 84, fig. 2; Markovits 2003: 38–40, pl. 1 with references; about the mechanism of the hydraulis, see also Hagel 2023.
138 Hanover, August Kestner Museum, inv. K 1704: Schlüter et al. 1975: 147, no. 704, pl. 91.
139 Ibidem, 147 (Berlin); Brandt and Schmidt 1970: 227, no. 2140, pl. 185 (Munich).
140 Weiss 2007: 305, no. 613, pl. 80.
141 Hanover, August Kestner Museum, inv. K 1217: Schlüter et al. 1975: 253, no. 1346, pl. 185.
142 Gołyźniak 2020: 234–8, esp. 235; cf. 'sacral- or sacro-idyllic' scenes above.

6 Conclusions

We have seen a variety of musical themes on Roman engraved gems. Some of these small portable objects are masterpieces, characterized by high artistic quality, elaborated treatment of motifs and deep symbolism or great significance. Their iconography is usually influenced by Classical Greek or Hellenistic original artworks in sculpture, paintings, gems, etc. However, the glyptic iconography is also enriched by adapting to the trends of the time in which it was created, i.e., following contemporary political and religious ideas that served political purposes. The musical theme (musicians, dancers, or single musical instruments) was either the main decoration's motif that covered the small space available on the gem, or a secondary accompanying subject. Apollonian themes dominate, following the political, cultural, and religious ideas of Octavian/Augustus, and associated with the promotion of the peace, wealth, and prosperity in the 'New Golden Age' of the Empire. Nevertheless, Dionysian subjects (satyrs, maenads, centaurs pulling the chariot of Dionysus and Ariadne) are also very popular, showing an opposing world, identified with Marc Antony, Octavian's rival, and associated with religious mysteries, symposia, etc. The maritime subjects represented by the triton musicians, and associated with Neptune and Venus Pelagia/Marina, show the significance of the sea in Roman life. Calm and peaceful Bacchic or musical scenes, triton musicians, single or multiple musical instruments combined with other symbols (e.g. fruits, grasshopper) can be included in the 'sacral-idyllic' scenes which represent the changing iconography and significance of the motifs, according to the new ideology and mentality of Golden Age society.[143] Various musical instruments (e.g. the lyre, cithara, aulos, cymbals, tympanum, panpipes, shell conch) are depicted. The aforementioned engraved gems include official ones, commemorating the victories of Octavian/Augustus, especially in Actium, such as the intaglio with the punishment of Marsyas in Naples and the state cameo in Vienna.

Their creators were mainly famous and skilful Greek engravers, who were active initially in the court workshops of Hellenistic rulers and then in Roman ones; sometimes they signed their works. They used a variety of materials, including precious or semi-precious stones, such as amethyst, chalcedony agate, carnelian, sardonyx and glass. The latter material was also used by numerous workshops for mass reproductions, because it was cheap and widespread. The Greek cutters followed Classical or Hellenistic models, but also adopted new forms according to contemporary trends in symbolism, aesthetics and fashion.[144]

The musical motifs commissioned by the Roman emperors were used not only for personal reasons (adornment, amulets), but also served their political, cultural and religious aims, transmitting powerful messages and specific ideas. Therefore, the meaning of some motifs could be interpreted according to a new symbolism, representative of the new Golden Age of Augustus, which was dominated by the ideas of peace, old Republican virtues (e.g. *pietas* and *virtus*), wealth, and prosperity in the Roman Empire, under a glorious, divine leader. Similar motifs were used for the

[143] For Aurea Aetas, see Zanker 1987: 171–96.

[144] About Greek styles and Art in Augustan Rome, see Hölscher as n.4 above.

decoration of all artworks (architecture, paintings, sculpture, etc.), in coinage, and in private and official life. They also appear in contemporary Roman literature (as mentioned in Vergil and Horace, but also in Ovid and Propertius, albeit only critically) and in other areas of life.

Finally, these amazing objects of minor art, often valuable and of extraordinary workmanship, and appreciated for their beauty and rarity, confirmed both the skills of their engravers and the wealth and power of their owners. Their popularity and adoption not only among the aristocrats and the elite, but also by the lower classes (both followers and others) confirms the success of Augustus' methods, which used the power of the images in order to consolidate his reforms (political, religious and cultural) and to give rise to a new ideology (including perhaps a new cultural identity) which combined and transformed various elements of past political, religious, and social life).

Abbreviations

AGDS: Antike Gemmen in deutschen Sammlungen
LIMC: Lexikon Iconographicum Mythologiae Classicae

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How do we perceive the sounds of both original and replica archaeological metal sound objects? An interdisciplinary study of systematic musicology, music psychology, and music archaeology

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Abstract

The history of metal idiophones dates back as far as metalworking itself. These sound objects served various purposes, such as attracting attention, displaying social status, and practical use in signalling. While once integral to everyday life, these sound objects are now rarely seen outside of museums or medieval markets. In the project "Metallic Idiophones from 800 BC – 800 CE", original and replicated metal idiophones from Central Europe were examined for their acoustic properties. Within the group of examined objects, variations in construction, shape, and alloys based on era and region can be seen. In this study, a selection of 21 original and replicated idiophones that cover most of the variations are examined for the subjective perception of their sounds. Participants in the online listening experiment (n=102, mean age = 35.6) rated sounds on pleasantness, brightness, sharpness, complexity, activation, and valence. Personality traits, musicality, preferences for sound jewellery, and beliefs in object properties were also assessed. While 75% showed low preference for sound jewellery, some associated it with high social status or metaphysical abilities. Belief in these abilities correlated with openness and preference. No age or gender effects were observed in sound ratings. Overall, sound level negatively correlated with pleasantness and positively with sharpness, activation, and valence. Sounds with higher tone-noise-ratio were perceived

as brighter and sharper. Bell sounds were rated brighter, sharper, and higher in valence/activation than chimes, but lower in pleasantness. Though not directly applicable to the past, the study revealed effects related to human hearing rather than socio-cultural significance. Loud, bright, and sharp sounds were rated unpleasant, suggesting a shift from jewellery to signalling use.

Keywords

Music Archaeology – Psychoacoustics – Psychology of Music – Metallic Idiophones – Originals - Replicas

1 Introduction

The research project "Metallic Idiophones between 800 BCE and 800 CE in Central Europe" (FWF, Hertha Firnberg Programme, project number T 1136-G) examines archaeological contexts and the acoustic effects of metallic idiophones such as bells, pellet bells and sounding jewellery over a time span of 1600 years, including the Early Iron Age/Hallstatt culture, the Roman Period, and the Early Middle Ages/Avar period. The project aims to gather new information on the function, the social impact, and influence of metallic idiophones on the life of past societies, and on their acoustic, psychoacoustic, and psychological effects. In an interdisciplinary approach, research methods from archaeology, metallurgy, ethnomusicology, acoustics, psychoacoustics, and psychology are used, supported by experimental archaeology as well as studies of written (for the Roman period and the Early Middle Ages) and pictorial sources (Pomberger et al. 2021b; Pomberger and Mühlhans 2022; Pomberger et al. 2022b; Pomberger et al. 2020; Pomberger et al. 2021a, Pomberger et al. 2021c; Mühlhans et al. 2022; Pomberger et al. 2023b). To gain information about possible connections between (psycho-)acoustic parameters and subjective ratings from listeners, an online study by using the platform SoSciSurvey (Leiner 2023) was carried out. In this article we present the results of our online study on the originals and replicas of archaeological metal sound objects.

2 Research question

It is assumed that jewellery idiophones were historically used as status symbols, signalling devices, and ritual objects, among other purposes. The sound perception of these objects therefore plays a key role in their possible function. While the perceptions of the culture at the time of their original use can no longer be reconstructed, we may nevertheless consider how these sound objects are perceived today:

1. Are there differences in the perception between original objects and exact replicas?
2. Are there differences between the different types of idiophones (bells, pellet bells, sounding jewellery)?
3. Are there differences between materials in multiple replicas of the exact same type?

To answer these questions we chose two methods, one being the objective (psycho-)acoustical measurement of the recordings of these idiophones, and the other being an online experiment evaluating subjective perceptions of the sounds. Those two methods belong to the standard repertoire of systematic musicology, which represents the empirical branch of the research field that seeks to find evidence for causal explanations of, for instance, sound perception and cognition (Schneider 2018: 9).

3 Historical background of the idiophones

The recorded idiophones can be classified into idiophones worn on the body and those that predominantly hung on buildings, vehicles, and plants, as well as on animals.

The sound objects we used for the listening study originate from burials of the Hallstatt culture (Early Iron Age), the Avar period (Early Middle Ages) and from settlements of the Roman period. They were clothing accessories like fibulae, which functioned to keep garments together, ring pendants, which signalled a special status within a society, and pellet bells, which served as apotropaic amulets (Pomberger forthcoming).

Fibulae were used to close and fasten garments according to the principle of the safety pin. A needle pierces two pieces of fabric and holds them together – usually in the shoulder area. The bail of the needle, needle head, and needle holder provide space for artistic decoration. Fibulae thus also functioned as jewellery, status symbols, and objects of representation (Heynowski 2019: 33). They could also be bearers of symbols. Ring pendants are combinations of larger and smaller rings suspended one inside the other. In the case of ring pendants with shafts, a larger ring or a wheel-shaped ring sits at the lower end of a bar. Rattling rings and chains with jingling plates complete the ensemble. Ring pendants can be fitted with an eyelet and animal protomes, but some objects lack both. Ring pendants were used as pectorals and were evidently only worn by women. They appear in Upper Austria, Salzburg, southern Bavaria, the Upper Palatinate and very rarely in Lower Austria (Pomberger 2016: 258, 261; Glunz-Hüsken 2017: 237). Pellet bells and bobbles, which are only found in women's graves in the Hallstatt culture, symbolise fruits such as poppy capsules – opium poppies have been known in Europe since the Neolithic (Salavert 2011) – pomegranates and rose hips. Due to their large number of seeds, these fruits symbolise fertility, prosperity and eternal life (Pomberger forthcoming).

3.1 Hallstatt culture objects

The prehistoric collection of the Natural History Museum of Vienna houses a great number of objects excavated in the famous necropolis of Hallstatt Hochtal, Upper Austria, dating from 800 – ca. 400 BCE (Grömer and Kern 2017: 183). One of them, a moon shaped fibula (NHM inv. 25255, see Figure 1a) with 19 chains and 18 pairs of flat-domed cymbals attached to the chains, was found in grave 505 of Hallstatt-Hochtal (Kromer 1959: 117, plate 96/5).

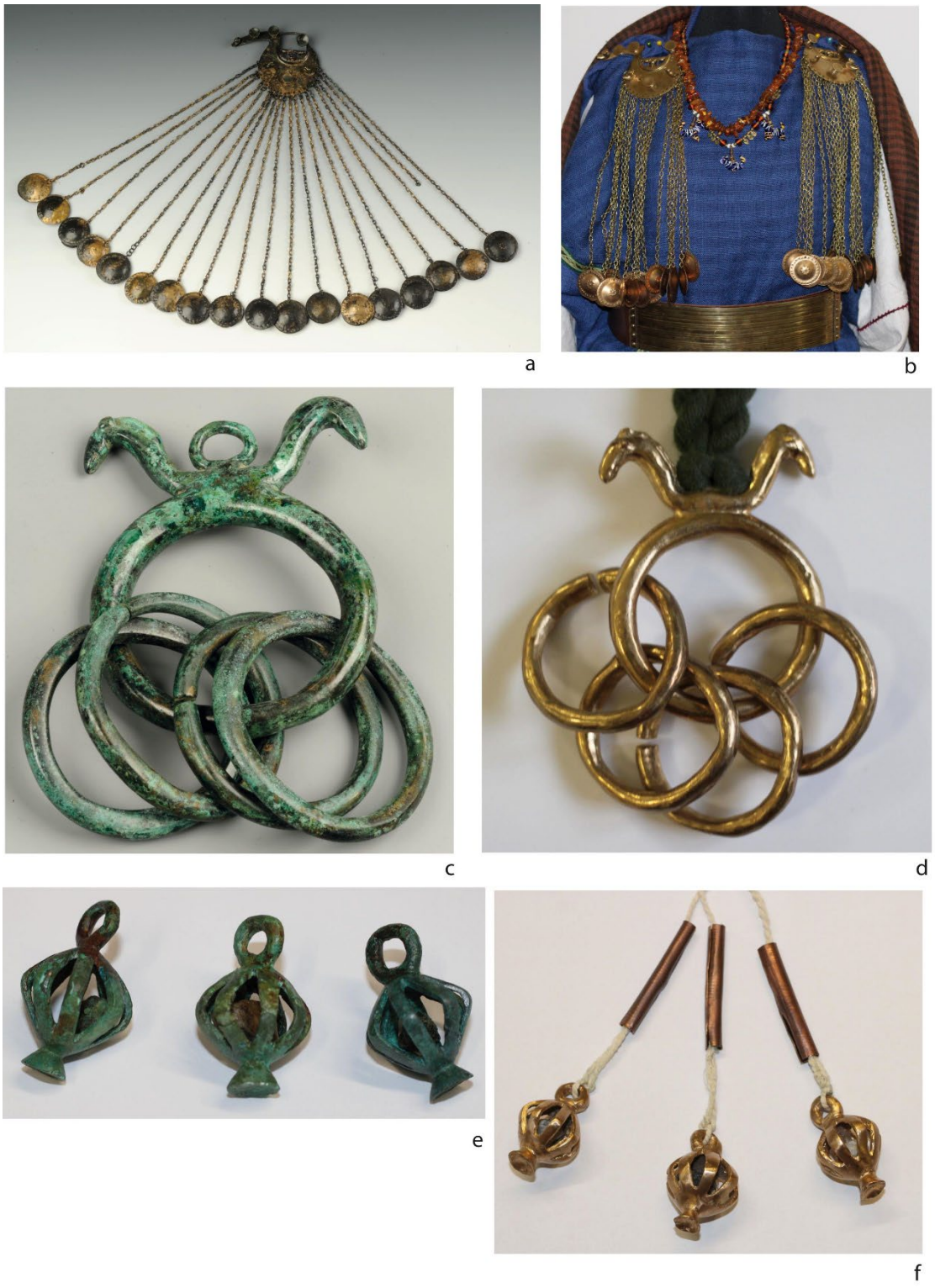


Figure 1: Idiophones/jewellery from Hallstatt culture. a: original fibula, burial 505, Hallstatt; b: fibula replica; c: original ring pendant, burial 890, Hallstatt; d: ring pendant replica; e: pellet bells, burial 4, Kernenried/Oberholz; f: replicas of pellet bells. Photos: a and c: A. Schumacher; b, d and f: B.M. Pomberger, © Natural History Museum Vienna; e: B.M. Pomberger, © Archaeological Service Kanton Bern.

This grave is the cremation burial of a woman, dating to Hallstatt D1, around 600 BCE (Hodson 1990: 49, 55, 67). The fibula is cast in a copper alloy, presumably bronze. The cymbals are hammered

from softer bronze sheets. The whole composition has an astonishing length of 34 cm and a weight of 234 g. The cymbals' diameter is 3.2 cm. Their frequencies range from 0.8 kHz up to 20 kHz. Fibulae work like fixing pins. They fix, for example, a peplos – a tubular garment worn by women – fastened together on the shoulders. According to their artistic design, they indicated, among other things, the social status of the wearer. Considered idiophones, they can be classified as pendulum rattles (112.121 in Hornbostel and Sachs 1914/MIMO 2011).

Another recorded object is a ring pendant (NHM inv. 26359, see Figure 1c) from burial 890, dating to the phase Hallstatt C1, around 800 – 725 BC (Kromer 1959: 171, plate 176/15). The ring pendant was found on the chest of a deceased woman. It is a combination of a larger ring crowned with an animal protome, and four smaller rings hooked in. The object is cast in copper alloy and weighs 211.14 g. Ring pendants were worn as pectorals by only a few women and are only known from Southern Bavaria, Salzburg, Upper- and Lower Austria (Glunz-Hüsken 2017: 237; Pomberger 2016: 258–61). They probably functioned as symbols for special power, infinity, and the cycle of life (Pomberger forthcoming). The ring pendant's frequencies range between 2.8 kHz and 19 kHz. Ring pendants are classified in the same group as stick rattles and frame rattles (112.112 and 112.12 in Hornbostel and Sachs 1914/MIMO 2011; see Pomberger 2016: 259).

3.2 Pellet bells

Pellet bells are rather rare finds in Hallstatt culture and have their origins in Northern Iran (Castelluccia and Dan 2014; Contenau and Ghirshman 1935). Their walls are openwork and they remind of cages. Three pellet bells belonging to belt hangings are kept in the archaeological collection of the Archaeological Service of the Kanton Bern in Switzerland (find number 57295 for all, see Figure 1e). They were found in a woman's burial (no. 4) in Kernenried-Oberholz. The skeleton of the woman was decomposed, but the pellet bells lay near the right pair of arm rings and thus clearly hang from a belt or ribbon. The burial dates to the second half of the 8th century BCE (Ramstein and Cueni 2012). XRF analyses showed that the pellet bells were cast in bronze (Stapfer forthcoming). Their sizes vary between 3.8 and 3.9 cm and their weights between 11.72 g and 13.22 g. Pellet bells 2 and 4 are filled with pebbles, whereas pellet bell 3 contains a piece of cinder (Pomberger and Mühlhans forthcoming). Pellet bells are classified as metal vessel rattles (112.13 in Hornbostel and Sachs 1914/MIMO 2011).

3.3 The original Roman bells

Bells played an important role in everyday life during the Roman period and were used in both the profane and religious spheres (Pomberger et al. 2022a). The Roman town *Colonia Claudia Savaria* (ancient Szombathely, Hungary), located near the Amber road, was the centre of the imperial cult

Figure 2: Roman bells. a: bell R. 54.380.6; b: bell R. 54.380.1, both from Savaria (photo: B. Santá, © Savaria Museum Szombathely); c: bell MV 9.950/4, Vindobona (photo: B.M. Pomberger, © Wien Museum); d: bell AMC 13414. Photo: B.M. Pomberger, © Archäologisches Museum Carnuntinum.

bell	site	size	weight	material	frequency range
R. 54.380.1	Savaria/Szombathely	47 mm	46 g	leaded bronze	2.3 – 9.8 kHz
R. 54.380.6	Savaria/Szombathely	44 mm	38 g	bronze	3.3 kHz – 18 kHz
MV 9.950/4	Vindobona/Vienna	65 mm	78.13 g	red brass	1.5 kHz – 20.7 kHz
AMC 13914	Carnuntum/Petronell Carnuntum-Bad Deutsch-Altenburg	48 mm	50.02 g	copper alloy	2 kHz – 20.8 kHz

Table 1: Roman bells, their materials, measures and frequency ranges.

of the Roman province Pannonia Superior and was famous for its cult districts. 37 Roman bells are known so far from Savaria. The sounds of two bells, dating to the 2nd – 4th century CE, are parts of our online-study. The bells' find contexts are unknown. While bell R. 54.380.1 is cast in leaded bronze, bell R. 54.380.6 consists of nearly pure bronze. The analyses were carried out by using the XRF-method. Both have rectangle bases and their iron clappers are not conserved. Their sizes are

Figure 3: Avar pellet bells. a: burial 86, Komárno IX (Lodenica), SK; b: burial 92, Holiare, SK; c: burial 1689, Zamárdi-Rétiföldek, HU; d: burial 104, Gyenesdiás, HU; e: replicas of a pellet bell from burial 110, Komárno IX (Lodenica) in different sheet metals, from left to right: copper – bronze – iron. Photos: B.M. Pomberger, a: © Podunajské Múzeum v Komárne; b: © Institute of Archaeology, Slovak Academy of Sciences Nitra; c: © Rippl-Rónai Múzeum Kaposvár; d: © Balaton Múzeum Keszthely; e: © L. Kerbler.

less than 50 mm and the frequencies range between 2.3 kHz – 18 kHz. The bells are kept in the Savaria Museum in Szombathely, Hungary (Pomberger et al. 2021c). One bell, cast in red brass, is housed in the Wien Museum in Vienna (MV 9.950/4). It was found on the ancient trail from the military camp *Vindobona* (Vienna) via Inzersdorf – now part of the 23rd district of Vienna, Austria – to *Aquae* (Baden, Austria) and *Scarbantia* (Sopron, Hungary). The bell with a rectangle base probably belonged to a draft or pack animal and is dated between the 1st and 5th century CE (Pomberger et al. 2022d). The last bell we used for our research work originates from Carnuntum's Roman military camp (Figure 2; Table 1).

3.4 Avar period

Pellet bells were not very common in the Avar Khanate. They appeared during the middle of the 7th century and mostly were found in children's burials, in some women's and a few men's graves (Pomberger and Stadler 2018). Pellet bells probably served as amulets. They were fastened on belts and perhaps also on sleeves, and were worn on bracelets and necklaces. In the author's opinion, pellet bells imitate vascular shaped fruits and thus are symbols for fertility, abundance, and eternal life, and as a result protect against evil forces (Grömer and Pomberger 2024; Pomberger forthcoming).

They are cast in different copper alloys or forged from metal sheets. Our chemical analyses of original sound objects were carried out by using scanning electron microscopy and XRF-analyses

replicas	material	weight	frequency range
pellet bell burial 110, Komárno IX	bronze	18.45 g	1.6 kHz – 20 kHz
pellet bell burial 110, Komárno IX	copper	14.27 g	1.2 kHz – 20 kHz
pellet bell burial 110, Komárno IX	iron	15.13 g	2.0 kHz – 20 kHz
ring pendant burial 890, Hallstatt-Hochtal	bronze	357.1 g	0.6 kHz – 20 kHz
fibula with cymbals, burial 505, Hallstatt-Hochtal	tombac	444.5 g	0.68 kHz – 20 kHz
pellet bell 2, burial 4, Kernenried/Oberholz	bronze	23.3 g	7.3 kHz – 20 kHz
pellet bell 3, burial 4, Kernenried/Oberholz	bronze	24.1 g	7.7 kHz – 20 kHz
pellet bell 4, burial 4, Kernenried/Oberholz	bronze	26.4 g	6.8 kHz – 20 kHz

Table 2: Replicas, their material, weight and frequency-ranges.

(Pomberger et al. 2021a; Pomberger et al. 2021c; Pomberger et al. 2022a; Pomberger et al. 2022b; Pomberger et al. 2022c; Pomberger et al. 2022d; Pomberger et al. 2023).

Their sound slots have simple or cruciform shapes and some even are without sound-slots. The number of sound holes varies between none and four. The pellet bells' surfaces are smooth or decorated with grooves and some show face-like features with eyes. Small pebbles, bronze balls, or cinders serve as pellets. The sounds of four original pellet bells cast in copper alloy and three replicas in three different sheet metals – replicas of one original metal sheet pellet bell – are parts of the online-study (see Figure 3). The originals originate from the cemeteries of Komárno IX (Lodenica) and Holiare, Slovakia, and from the Hungarian sites Zamárdi-Rétiföldek and Gyenesdiás. The pellet bell from burial 86, Komárno IX (Lodenica), a child's grave, was found between the pelvis and the right arm. It is cast in bronze,[1] is 28 mm high and weighs 18 g. Its frequency spectrum ranges from 2 kHz up to 20 kHz with peaks at 4.5 kHz (Pomberger et al. 2021a). A child's corroded pellet bell was found in grave 110, lying near the right leg (Trugly 1993: 198; Pomberger et al. 2021a). Another bronze pellet bell originates from an adult/senile woman's burial, grave 92, in the Slavic-Avar cemetery of Holiare in Slovakia (Točík 1968: 25). It has a height of 3.6 cm and is decorated with vertical grooves. Frequencies range from 1.7 kHz up to 21 kHz. In the grave of a juvenile individual in the cemetery in Zamárdi-Rétiföldek, burial 1689, a completely conserved pellet bell cast in bronze with zigzag lines on its surface was detected (Bárdos and Garam 2014: 40). Its height is 3.9 cm. A small bronze ball serves as a pellet. The pellet bell shows frequencies between 0.9 kHz and 22 kHz. The last original pellet bell to be mentioned was found in an infant's burial (grave 104), in the cemetery of Gyenesdiás, Hungary showing a height of 3.45 cm and a weight of 22.24 g. Its frequency range is from 2.1 kHz up to 16.5 kHz (Pomberger et al. 2023a; cf. Figure 3a – d).

3.5 The replicas

We are aware that the original metal objects no longer have the same sounds as they had when they were made and used. When the objects are buried in the ground for centuries and are exposed

[1] See Pomberger et al. 2021a.

to air and moisture, the metals oxidize and the material properties change greatly, which also affects the sound properties. The amount of metal in the object decreases dramatically, while the amount of metal salts increases greatly. The objects thus lose density, while at the same time the wall thickness increases. This leads to damping, so that the porous originals hardly sound at all. This has a major impact on the partial tones, their prominence and also the overall loudness or sound pressure level. Metallurgical examination can provide good information about the alloy that was used. Using this knowledge to produce replicas, the original sound can be reconstructed within a relatively small margin of variation, which is what makes it possible to evaluate the original sounds today.

Replicas were made of the fibula from burial 505 and the ring pendant from burial 890, both Hallstatt-Hochtal, the three pellet bells from burial 4, Kernenried/Oberholz and the pellet bell from burial 110, Komárno IX. A copper alloy (bronze) consisting of 90 % Cu and 10 % Sn was used for the ring pendant and the three pellet bells from Kernenried/Oberholz.[2] The fibula was produced from tombac, which is a kind of brass with more than 70 % Cu.[3] The Avar period pellet bell – the original is forged from iron sheet – from burial 110, Komárno IX Lodenice, served as a model for three replicas in different sheet metals, which were forged in copper, bronze and iron sheet. Each is filled with a small pebble (Figure 3e; cf. Mühlhans et al. 2022). Non-astonishingly, they show different weights (Table 2). Bells were replicated, but since the bells had many casting defects (Mühlhans and Pomberger 2023), we decided not to use their recordings.

4 Methods

4.1 Method 1: (Psycho-)acoustic measurements

The sound recording forms the basis of the objective analysis. Any given sound has temporal features, such as the excitations per time period or the decay time of a sound, and also spectral features, such as the frequency range, amplitudes of partial frequencies, the spectral peak frequency and many more. These acoustic parameters can be extracted using audio analysis software, and represent the sound on what is called a "low level" in acoustics, meaning that each single parameter only gives very limited information about the sound itself, but a number of parameters can be combined to represent sound on a higher level.

Sounds of the original objects were recorded on-site at museums and archaeological collections using a portable recording chamber (Pomberger and Mühlhans 2022). The setup consisted of a Laptop with Adobe Audition (Adobe Inc. 2023) and a PreSonus audioBox iOne interface with the PRM 1 measurement microphone. The replicas were recorded in studio of the MediaLab, Faculty

[2] Replicas cast by Michael Konrad, Schrattental, Austria.

[3] Replica made by Stefan Jaroschinski, Frankenberg, Germany. The precise composition of the alloy is the artisan's secret.

of Philological and Cultural Studies of the University of Vienna, also using Adobe Audition, a Presonu Studio 24c interface and the Earthworks M30 measurement microphone.[4]

4.1.1 Acoustic parameters

The sound of an idiophone is emitted by the entire object oscillating after excitation, which is caused by the physical impact of an external or internal object or part of the instrument itself. The partial oscillations inside of the object are called 'modes' and they create the partial frequencies that form the sound. Sound is created either by simply shaking the objects, which causes a small encapsulated pellet to hit the inner walls of the object, and single parts like rings and plates to hit against each other, or by hitting the object with a separate clapper, as was the case for many bells.

Basically, the sound of constant excitation of an idiophone is not one single sound, like the sustained note played on a flute, but a quite dense 'cluster' of single impulsive sounds (Benade 1976: 10) that occur roughly 5–10 times per second for external excitation with a clapper, and up to 20–30 times per second for the internal excitation with a small stone or lump of metal inside of a pellet bell. The single hits can be identified from either the waveform (Figure 4a) or the spectrogram (Figure 4b – c) of the sound. In the figures, stimulus 14 was used as a typical example for an original Roman bell and stimulus 20 for an original Avar pellet bell. Visualisations of other stimuli in the same category are rather similar.

Another acoustic property common to all idiophones is the non-harmonic structure of the partials. Unlike aerophones and chordophones, this type of instrument does not have a fundamental frequency whose integer multiples make up the harmonics, but rather several partial 'modes' of oscillation, which produce a series of non-harmonic partial frequencies (or simply 'partials'). For this reason, the perception of pitch is weaker in idiophones than in the other two types. As a result of their shape and mode of excitation, bells create more pronounced partials, and thus clearer pitch perception, than pellet bells (Figure 4), because they oscillate more freely with less dampening. Narrow high peaks in the spectrum indicate clear partials (tonal components), broader flat peaks indicate a higher proportion of noise. This property also affects subjective perception of some psychoacoustic parameters, like tonality, harmonicity, brightness and some more.

4.1.2 Psychoacoustic parameters

Psychoacoustics is a sub-field of psychophysics that seeks to understand the relation between physical parameters and human perception of sound (Roederer 1973: 6–10). Human perception cannot be calculated directly, because it varies between subjects, but can be estimated using algorithms designed with the findings from listening experiments. The human perception of sound, sound quality, and timbre is highly dependent on acoustic parameters, but is still subjective to a

[4] The choice of software and interface has no impact on the recordings. While there may be slight differences between microphones, measurement microphones are designed to have nearly identical frequency responses. In fact, the microphones used in this research were tested against one another, revealing only minimal variations in measurement parameters – well beyond the threshold of human auditory perception.

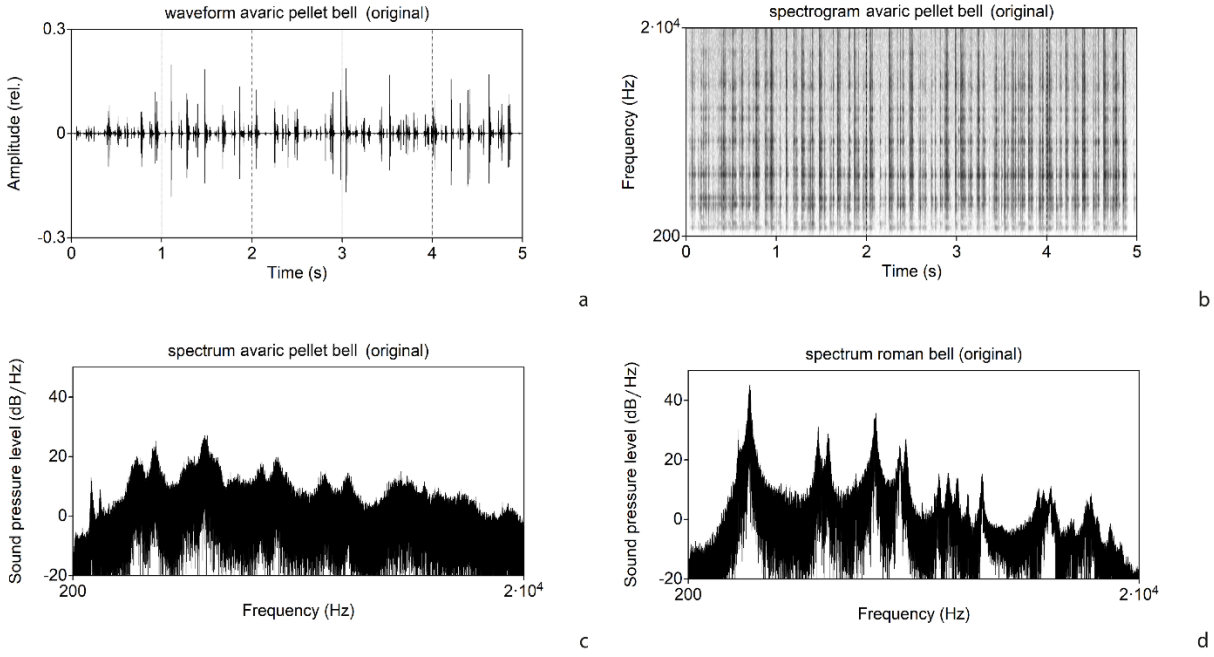


Figure 4: Side-by-side comparison of the acoustic parameters of stimulus 20 (left side, original Avar pellet bell) and stimulus 14 (right side, original Roman bell) in the waveform (a), spectrogram (b) and the spectrum (c–d). Graphic and ©: J. Mühlhans.

certain extent. Among those are the perception of qualities like the loudness, brightness, or sharpness of a sound. Some can be predicted directly from one single acoustic parameter, others are constructed from a variety of so-called 'audio features' with different weighting and highly complicated algorithms of computation. Below are the objectified psychoacoustic parameters:

Loudness is the subjective perception of the intensity of sound. The objective parameter that can be measured is the sound pressure level. They are correlated but do not match exactly, because the ear is rather insensitive to very low and very high frequencies but quite sensitive to the frequency range around 2–5 kHz. Human perception of loudness is estimated using "phon" or "sone", which scale differently but are basically just different methods of calculating. At 1 kHz a sound pressure level of 40 dB equals 40 phon or 1 sone (Fastl and Zwicker 2007: 203). In the phon scale, 10 phon more represent a sound twice as loud to the human ear, in the sone scale it simply represents a doubling of the value. 40 phon and 1 sone is the same loudness level, a sound twice as loud would be described as 50 phon or 2 sone (and so on).

Sharpness is an addition to the sensation of unpleasantness of a sound and depends on the spectral shape, density, and especially the tonal content of a sound in the frequency range where the ear is particularly sensitive. The unit for that parameter is 'acum', which scales the same way that sone does (Fastl and Zwicker 2007: 239).

Roughness is produced by the fluctuation in amplitude and also adds to the sensation of unpleasantness of sounds. It is calculated in 'asper' as a value between 0 and 1, with 1 being the highest possible roughness sensation, as experiments showed (Fastl and Zwicker 2007: 257).

Brightness of sounds is basically what is being expressed in verbal descriptions like "bright", "high", "brilliant" and their counterparts "dark", "low" and "dim". However, there is a physical measurement that is correlated to that sensation, namely the spectral centroid (SC) or spectral centre of gravity. It is a simple measure that divides the spectrum (or rather the spectral energy) in two equal halves and gives the dividing frequency in Hz. The higher the SC, the higher, brighter or more brilliant a sound is perceived (Marozeau and Cheveigné 2007: 383).

Tonality, also known as tone-noise-ratio (TNR), is a measure that separates the tonal component (partial frequencies) from the noise part of a sound and gives a value in decibels. Negative values indicate more noise than tonal components, positive values indicate more tonal components than noise (Becker et al. 2019: 5820).

Impulsiveness of sound is determined by high energy that is usually caused by an impact – as is mostly the case in idiophones (Blommer et al. 1995: 2302).

4.2 Method 2: Empirical online survey with an audio experiment

Despite the fact that the psychology of music has been a completely independent scientific discipline since the mid-20th century, it is also an important part of systematic musicology because of its empirical methods (Thaut 2009: 552). While music psychology is primarily concerned with researching the perception and cognition of entire pieces of music, psychoacoustics is more concerned with the same questions about individual sounds and noises. However, both disciplines count listening tests and associated questionnaires on the subjective perception of the stimuli presented as their most important tools.

The perception and evaluation of music highly depends on the cultural background of the listener (Becker 2001: 136). The perception of sound and noise in the psychoacoustic understanding is on the other hand closely related to the physical properties of the sound itself and the nonlinear behaviour of the human ear (Fastl and Zwicker 2007: 11). We are fully aware that subjective ratings of sound perception from today's audience cannot be directly transferred to an audience in the timespan between 800 BCE and 800 CE. However, since the evolution of the human (like any mammalian) hearing is a very slow process, and studies have shown that land mammals have quite common frequency responses (Kanders et al. 2017), it can be assumed, that the properties of the human ear have not changed significantly over probably even millions of years. Perceptions that highly depend on the behaviour of the human hearing thus might not have changed much over the decades. Using psychophysics, in this case psychoacoustics, as a method to find correlations between a physical stimulus and psychological response is most likely the best approach to the questions at hand.

An audio experiment requires two essential things, one being well prepared and controlled audio stimuli, and the other being carefully selected 'items' for a questionnaire.

name	object	type	category	period
stimulus01	ring pendant 26359, Hallstatt burial 890	ring pendant	original	Hallstatt Culture/Early Iron Age
stimulus02	replica of stimulus01	ring pendant	replica	Hallstatt Culture/Early Iron Age
stimulus03	fibula, Hallstatt burial 505	fibula	original	Hallstatt Culture/Early Iron Age
stimulus04	replica of stimulus03	fibula	replica	Hallstatt Culture/Early Iron Age
stimulus05	Kernenried pellet bell 2	pellet bell	original	Hallstatt Culture/Early Iron Age
stimulus06	replica of stimulus05	pellet bell	replica	Hallstatt Culture/Early Iron Age
stimulus07	Kernenried pellet bell 3	pellet bell	original	Hallstatt Culture/Early Iron Age
stimulus08	replica of stimulus07	pellet bell	replica	Hallstatt Culture/Early Iron Age
stimulus09	Kernenried pellet bell 4	pellet bell	original	Hallstatt Culture/Early Iron Age
stimulus10	replica of stimulus09	pellet bell	replica	Hallstatt Culture/Early Iron Age
stimulus11	replica pellet bell, Komárno IX/burial 110: copper	pellet bell	replica	Avar/Early Middle Age
stimulus12	replica pellet bell, Komárno IX/burial 110: bronze	pellet bell	replica	Avar/Early Middle Age
stimulus13	replica pellet bell, Komárno IX/burial 110: iron	pellet bell	replica	Avar/Early Middle Age
stimulus14	bell Savaria 54.380.1	bell	original	Roman Period
stimulus15	bell Savaria 54.380.6	bell	original	Roman Period
stimulus16	bell Vindobona MV9.950–4	bell	original	Roman Period
stimulus17	bell Carnuntum 13914	bell	original	Roman Period
stimulus18	pellet bell, Komárno IX/burial 86 (A_5683)	pellet bell	original	Avar/Early Middle Age
stimulus19	pellet bell, Gyenesdiás/burial 104, FNR_104–1	pellet bell	original	Avar/Early Middle Age
stimulus20	pellet bell, Zamárdi-Rétiföldek/burial 1689, inv. 247.1.1689.1	pellet bell	original	Avar/Early Middle Age
stimulus21	pellet bell, Holiare/burial 92, inv. 92 2760	pellet bell	original	Avar/Early Middle Age

Table 3: Table of stimuli and periods.

4.2.1 Stimuli for the experiment

A set of 21 stimuli, covering a range of various objects from different eras, and both original and replicated sounds, has been selected for the experiment (see Table 3). To avoid the effects of stimulus duration, every sound has been limited to 5 seconds of constant excitation with a 100 ms fade in/out in the beginning and end of the stimulus. Amplitudes were maintained to keep the original loudness of the items, since this parameter influences others, like pleasantness, sharpness, or valence, as well as arousal ratings. Low frequency ambient noise was quite low in the recording itself,

but was still removed using a 500 Hz high pass filter. A separate test sound was created that included multiple sounds similar to, but not exactly matching the stimuli, for the participants to set up the volume on their speakers or headphones. This sound was not evaluated nor analysed.

4.2.2 Sample

In this exploratory within-subjects study design, an ad hoc sample of 102 participants was recruited for an online study using the platform SoSciSurvey (Leiner 2023). The age of the sample varied between 18 and 65 years (age_{mean}=37; SD=13.78) and consisted of 66 female (age_{mean}=35.61; SD=13.27) and 36 male (age_{mean}=39.56; SD=13.96) participants. In this sample 73.53% of participants reported an academic degree, 24.51% a high school diploma, 0.98% compulsory education and 0.98% a master craftsman as highest education.

Before the actual listening trial, participants were asked to self-assess the Big Five personality traits with the German version of the BFI-10 (Rammstedt and John 2007) on a five-point Likert-scale. The Big Five personality traits are a set of five broad dimensions of personality that are used to describe human personality. The five traits are neuroticism, extraversion, openness, conscientiousness, and agreeableness. To assess musical preferences participants were asked to complete six items from the German revised Music Preference Questionnaire (MPQ-R; see Nater et al. 2005) which is a self-assessment on how much music and which music genres participants listen to, as well as in which situations they listen to music. A transcript of the questionnaire (original language German) can be found in the appendix. The list of the raw data is available on the repository of the Natural History Museum (Foramitti 2024).

In order to further investigate the metaphysical and apotropaic beliefs in metallic idiophones (Pomberger forthcoming), another eight items were used to determine the extent to which participants consider bells to be toys, status symbols, or even utilitarian objects. Three of these were specifically aimed at evaluating beliefs in supernatural abilities, such as driving away evil spirits or bringing good luck. Also, participants were asked for their preference for sounding jewellery.

In the main part of the experiment, the 21 stimuli were presented in a random sequence to avoid effects of order. Along with each stimulus, participants were asked to rate the sound using a slider on a bipolar scale for six parameters: pleasantness (unpleasant/pleasant), brightness (dark/bright), sharpness (dull/sharp), complexity (simple/complex), arousal (calming/activating) and valence (sad/happy). Participants could listen to the stimuli as often as preferred during ratings.

Valence (negative/positive or sad/happy) and arousal (low/high or calming/exciting) especially are items often used in studies to evaluate emotional perception of music or sounds using the circumplex model of affect (Russell 1980).

For the statistical comparisons with the subjective ratings, acoustic and psychoacoustic parameters were measured using ArtemiSuite (HEAD 2023) and Praat (Boersma and Weenink 2023). Statistical calculations were done using JASP (JASP Team 2023).

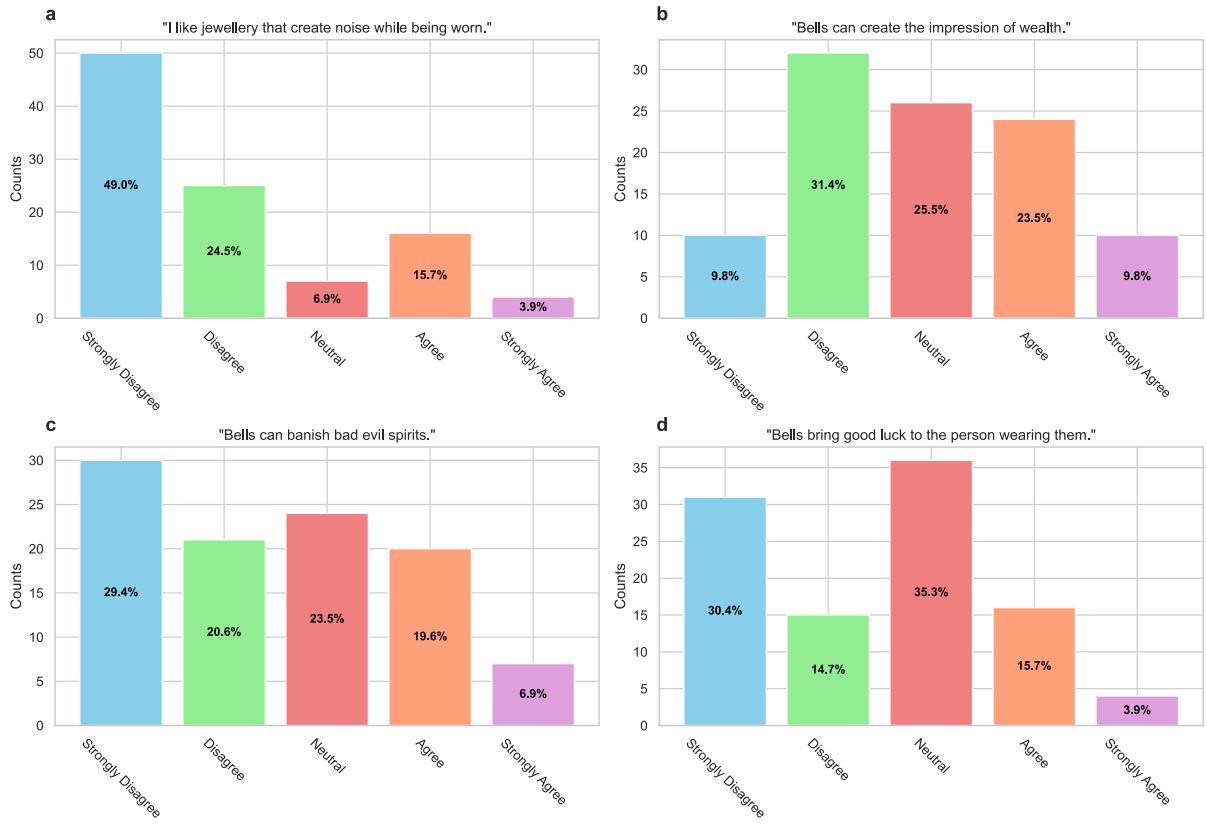


Figure 5: a, b: distribution plot for preference and status symbol; c, d: distribution plots in belief 'metaphysical powers' banish spirits concerning (pellet) bells. Graphic and ©: M. Foramitti.

5 Results

5.1 General findings

Even though the sample scores relatively high in the personality trait 'openness', preference for the objects is rather low, only about 20% of the participants stated they like or very much like ringing jewellery (Figure 5a). Still, about 33% agree or strongly agree that (pellet) bells can create the impression of wealth (Figure 5b).

20–25% agreement with the supposed metaphysical abilities of bells (Figure 5c – d) seems a lot, as it is generally assumed that such a belief decreases with the level of education. However, studies show that this is not the case (Lindeman and Aarnio 2007). This finding is relevant when it comes to assessing the development of belief in metaphysical properties in the population, especially those in the supposed apotropaic effect of such decorative idiophones (Pomberger and Stadler 2018b; Pomberger et al. 2021b). Although such findings are not simply transferable to historical societies, they can at least help to provide some evidence for very relevant questions, such as the possible use or application of such objects in earlier eras.

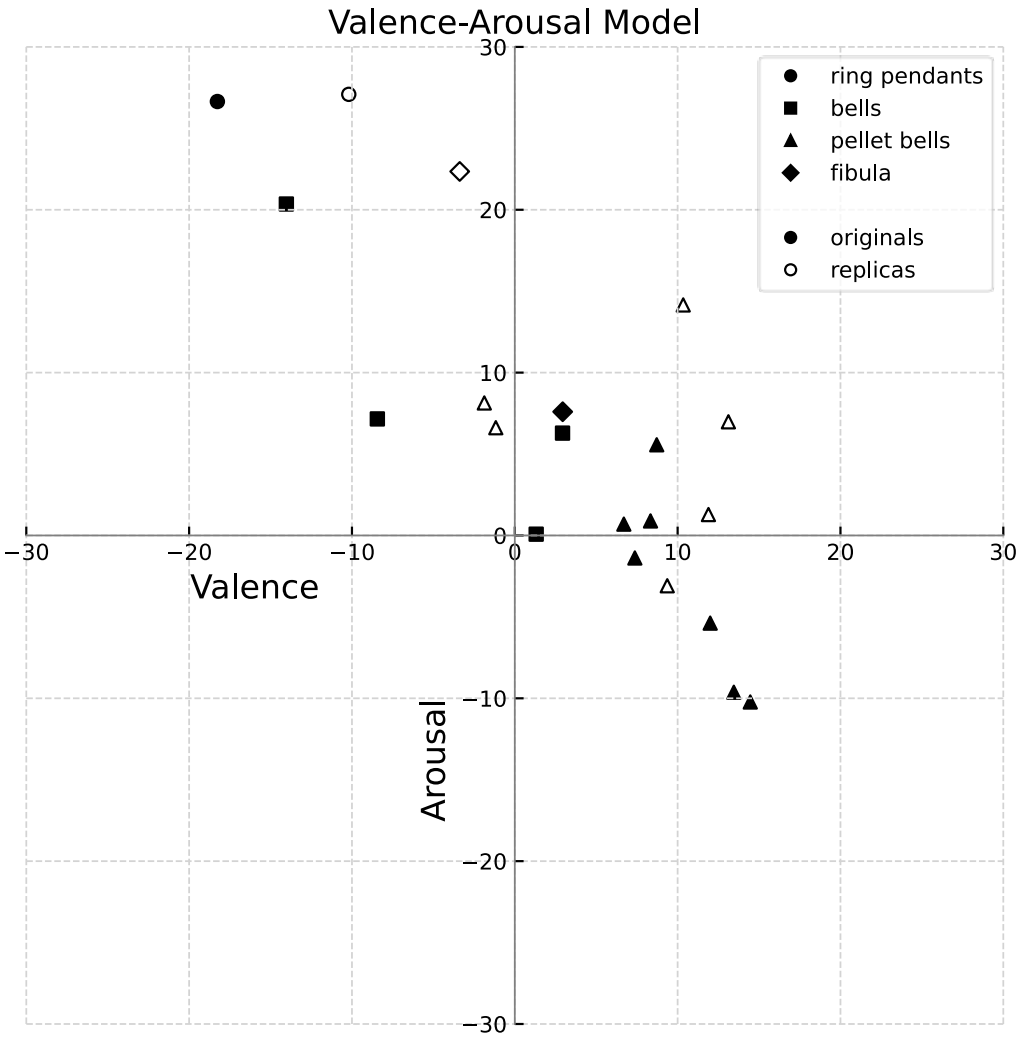


Figure 6: Valence-Arousal-Graph for all 21 stimuli, coded by type and originals/replicas. © J. Mühlhans/M. Foramitti.

On average, the six subjective ratings of the sounds were rather neutral, with only brightness ratings being higher in most cases, because the frequency range is high compared to most other known music instruments or sound objects. No correlation between personality traits and any of the ratings could be found. The combined valence-arousal-graph (Figure 6) shows that pellet bells score higher in valence than bells, and other types of objects score higher in arousal (most likely because they are much louder).

Many correlations could be found both within (psycho-)acoustic parameters and subjective rating as well as between them. Most notably, loudness or level-related parameters and sharpness are highly correlated to most ratings (see Figure 7).

Loud and sharp sounds are considered less pleasant, but higher in arousal and in valence. Interestingly, among the two parameters that were measured (psychoacoustic model) and rated, only sharpness is correlated, while brightness is not. For further investigation, stimuli have been divided into groups by their category or type.

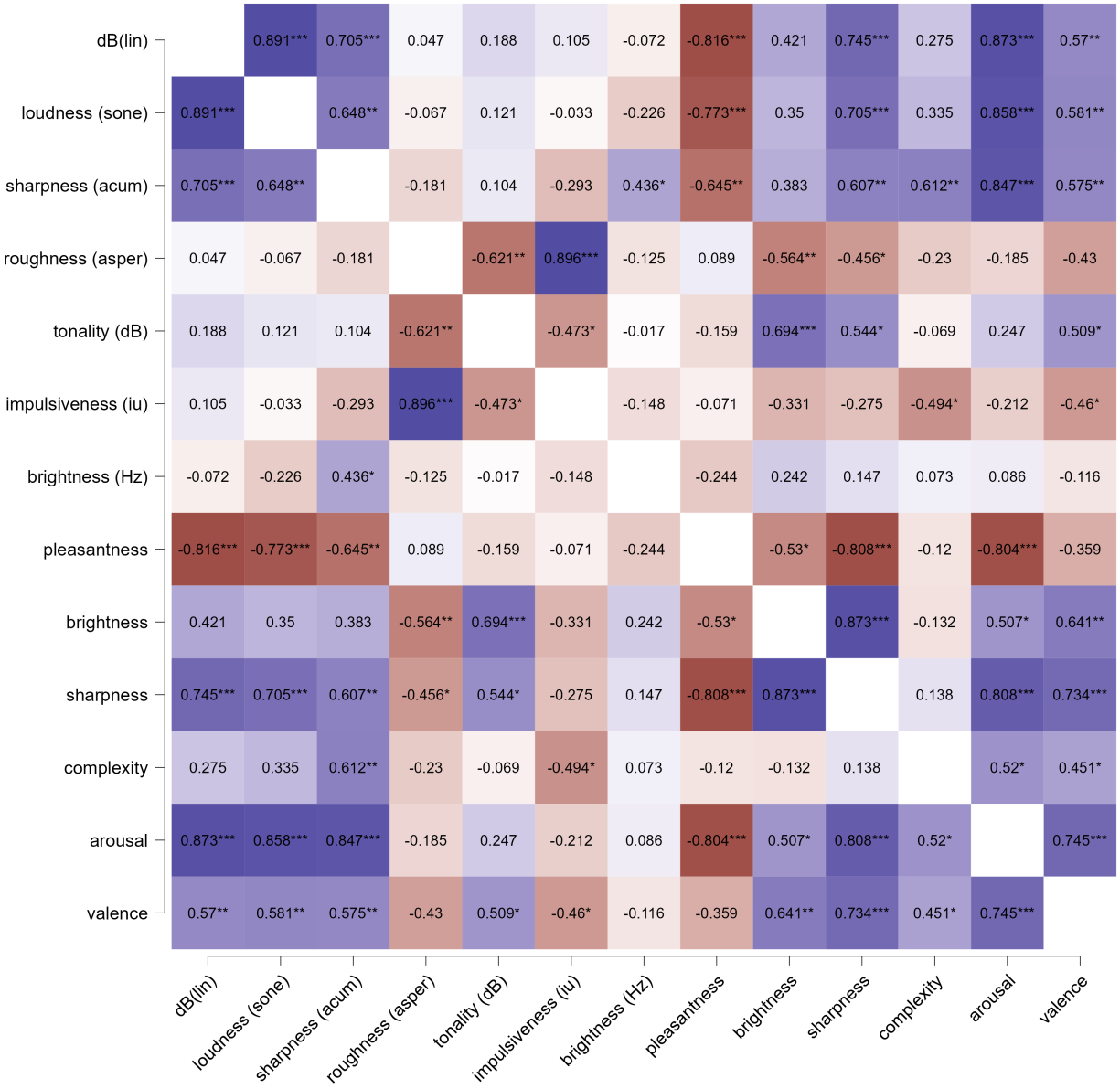


Figure 7: Pearson's Heatmap of correlations between all acoustic parameters and subjective ratings for all stimuli. Parameters with units in brackets are objective measures, parameters without units are ratings from participants. R-values in the fields indicate the correlation coefficient (blue equals positive correlations, brown indicates negative ones), stars the level of significance (*p<.05, **p<.01, ***p<.001). Graphic and ©: J. Mühlhans.

5.2 Original vs. replicated objects

Firstly, original idiophones (n=5) were compared to their replicated counterparts' (n=5) subjective ratings. Since the Shapiro-Wilk test of normality indicates a deviation from normal distribution in the data, this comparison was conducted with the non-parametric Mann-Whitney-U test. It showed that subjects evaluated the stimuli of the originals as being significantly more pleasant (p<.001, r=.307) and significantly darker (p<.001, r=.554) than their replicated counterparts. The

replicates have been rated significantly higher in sharpness (p<.001, r=.539), arousal (p<.001, r=.531) and valence (p<.001, r=.374) than the originals.

This might be explained by the higher average sound pressure level of the replicas (81.3 dB) in comparison to the originals (69.9 dB). Measured sharpness is indeed higher in replicas on average as well (6.7 acum) than in originals (4.8 acum). The brightness ratings also reflect the measured brightness values of the items (11.7 kHz vs. 8.4 kHz; see Figure 8a).

5.3 Bells vs pellet bells

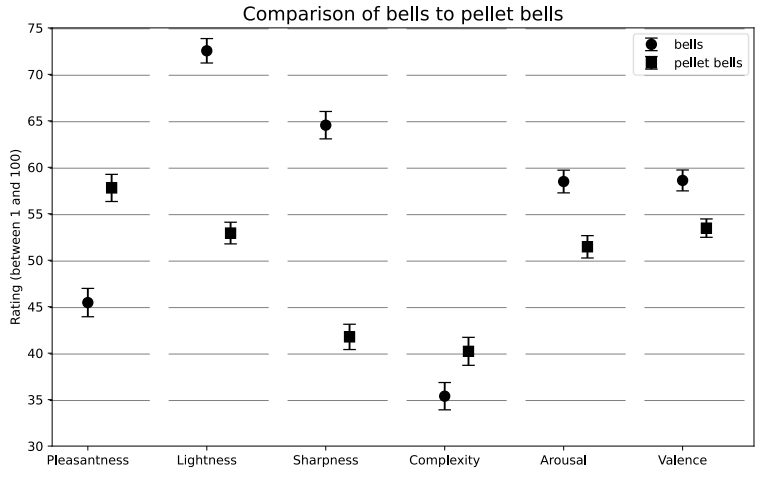
Secondly, original bells (n=4) were compared to original pellet bells (n=4) in their ratings, using the Mann-Whitney-U test. The sounds of the bells were rated as being significantly brighter (*p*<.001, *r*=.738), sharper (*p*<.001, *r*=.738), more arousing (*p*<.001, *r*=.321) and higher in valence (*p*=.001, *r*=.307) than the pellet bells. Yet, the sounds of the bells were rated as being significantly less pleasant (*p*<.001, *r*=-.501) as well as less complex (*p*=.01, *r*=-.209) than the pellet bells.

Bells are louder (43.8 sone) than pellet bells (27.0 sone), but almost equal in sharpness (4.3 and 4.6 acum). Bells are also more tonal (20.4 dB TNR) than pellet bells (11.8 dB) but not as bright in terms of spectral centroid (4.6 kHz vs. 5.6 kHz), with brightness ratings reflected by the acoustic data (Figure 8b).

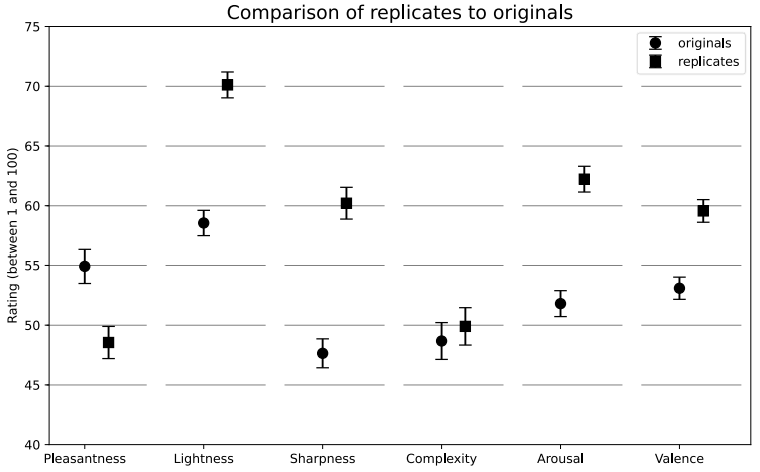
5.4 Identical replicas with different materials

The three replicas of pellet bell 110, Komárno IX Lodenice in different materials (bronze, copper, iron) were also compared separately (n=3), to see whether the large differences in acoustic parameters are also reflected in subjective ratings. This was done using preliminary Kruskal-Wallis tests, followed by post-hoc Dunn's tests with a sequential Bonferroni-Holm correction, to reduce the likelihood of false positives. The comparison shows significant differences between the objects in the rating of darkness (p<.001, η^2=.087), sharpness (p<.001, η^2=.062) and arousal (p<.001, η^2=.059). The post-hoc tests show that the copper pellet bell has been rated as significantly darker than the bronze pellet bell (p<.001, d=.36) and the iron pellet bell (p<.001, d=.75). The copper pellet bell has also been rated as being significantly less sharp than the iron pellet bell (p<.001, d=.626). Finally, the iron pellet bell has been rated as being significantly more arousing than the copper pellet bell (p<.001, d=.609) and the bronze pellet bell (p=.03, d=.339). There are no significant differences between the pellet bells of different materials in their ratings of pleasantness, complexity and valence.

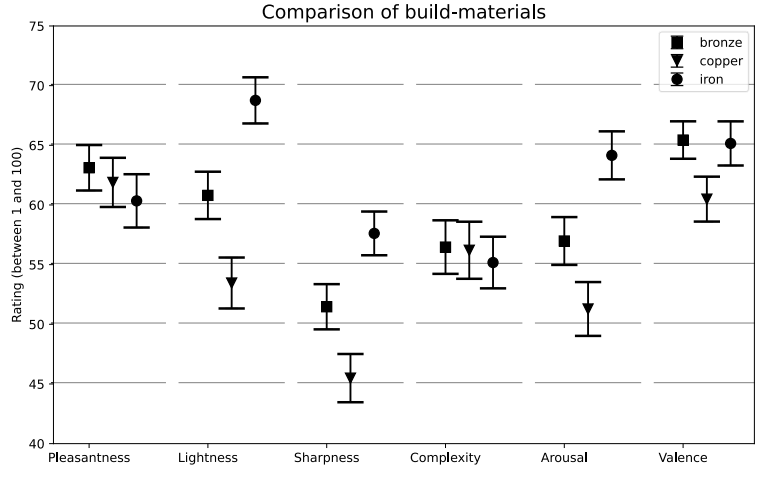
With n=3 objects, correlations between averages of ratings and measured parameters hardly reach a satisfying significance level, however, there are several very high correlation coefficients (r>.95). Loudness, sharpness, and tonality, showing the most results, are positively correlated with perceived brightness, sharpness, and arousal, and a tendency to correlate with valence, but not at all with pleasantness and complexity, however, exactly those two parameters are correlated with impulsiveness (Figure 8c. p-values for the higher r-values range between .006 and .1).



a



b



c

Figure 8: Graphic of Results. a: comparison of the originals and replicates according to their assessment in pleasantness, brightness, sharpness, complexity, arousal, and valence (whiskers represent the standard error); b: comparison of bells and pellet bells replicas according to their assessment in pleasantness, brightness, sharpness, complexity, arousal, and valence (whiskers represent the standard error); c: comparison of build-materials according to their assessment in pleasantness, brightness, sharpness, complexity, arousal, and valence (whiskers represent the standard error). Graphic and ©: M. Foramitti.

No gender effects[5] could be found in the ratings of sounds nor in preference for sounding jewellery or the belief in what might be called 'spiritual power' thereof. The only significant finding being male participants were more likely to consider (pellet) bells to be decorative objects rather than jewellery (p=.018, F=5.8).

6 Conclusion/Discussion

The aim of this study was to find out more about the actual subjective perception of sounding jewellery from a contemporary perspective, in order to come closer to an assessment of its possible uses in the age of its creation. In particular, we also wanted to know how the different types of sound jewellery differ in terms of perception beyond the measurement data, how originals and replicated objects are perceived differently, and what influence the material has on the sound and its perception. Through the acoustic measurements, we were able to isolate some parameters that are strongly related to the different perceptions.

In general, we were able to show that loud (dB SPL, sone), bright, and sharp objects of all categories have an activating effect but are also perceived as unpleasant. This can be explained by the fact that they contain a relatively large amount of sound energy in a range to which the human ear is very sensitive. This supports both the hypothesis that the objects could have been worn to attract attention in the social environment and to send out signals in general.

The belief in metaphysical properties (driving away ghosts, bringing good luck) is present in about 20–25% of the test subjects today, while at the same time the preference for sounding jewellery is rather low. However, over 30% of the test subjects ascribe status to these objects. This naturally raises the question of what this distribution might have looked like in society in different eras and regions.

We would like to point out once again that we are well aware that such results cannot be directly transferred to the perception of a population living at the time from the Hallstatt period to the Avar period. Nevertheless, we believe that this method is useful for estimating the possible perception of sound features, especially those that depend more on the physical characteristics of the ear than on cultural socialisation.

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[5] "No gender effects" is the standard phrase to indicate that there have been no differences between the sexes/gender affiliations.

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Appendix: Transcript of the questionnaire

The questionnaire started with an explanation about the experiment and some basic instructions about handling the rating scales. Participants were asked to take their time and do the experiment in a quiet surrounding, if possible with headphones or a loudspeaker system (no laptop speakers). A test-sound was presented for the participants to adjust the volume of their system to a clear and loud but not unpleasant volume.

Stimulus ratings

Items and rating scales were the same for every single stimulus during the experiment, they were presented randomized to avoid effects of order. For every sound, six bi-polar scales with descriptions at the extremes were used. Participants rated every item using a slider:

Q: Please use the slider to evaluate how you would describe the sound with the given adjectives. Please answer intuitively.

A1: Unpleasant – Pleasant

A2: Dark – Bright

A3: Dull – Sharp

A4: Simple – Complex

A5: Calming – Activating

A6: Sad – Happy

Sociodemographic data

Q: What gender do you identify with?

A: Male, Female, Divers, No Answer

Q: How old are you?

A: I am [ ] years old.

Q: What is your highest education?

A: Elementary School, Compulsory School, High School, Collage, University, Craftsmanship Apprentice, Craftsmanship Master

Musicality

For the evaluation of musicality, the MPQ-R-6 (Nater et al., 2005) was used with 4 selected items.

Personality traits ("Big Five")

For the evaluation of personality traits, the German version of the BFI-10 (Rammsted and John, 2010) was used with all ten items.

Other single item questions:

Q: To what extent do you agree with the following statement?
S1: I like jewellery (necklaces, bracelets...) that create noise while being worn.
S2: (Pellet) Bells can create the impression of wealth.
S3: (Pellet) Bells can banish bad evil spirits.
S4: (Pellet) Bells are jewellery.
S5: (Pellet) Bells can chase away wild animals.
S6: (Pellet) Bells are rather children's toys.
S7: (Pellet) Bells are rather decorative objects.
S8: (Pellet) Bells bring good luck to the person wearing them.
S9: (Pellet) Bells can reduce stress.
A(all): Not at all – Fully agree (5 point scale)

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Mapping Roman Sounds: A Methodological Approach to Reconstructing Roman Soundscapes

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Abstract

The great relevance of music and sounds in antiquity is contrasted by the fact that sounds have faded away and cannot be reproduced; only the echoes in archaeological, iconographic and literary sources have been preserved. The sources on ancient music are thus the result of a remarkable medial transformation process from sound to images and texts. This medial transformation has to be revealed through a critical examination of contexts and genres to open up new perspectives on the meaning of sounds in Roman antiquity. Through our concept of "Klang-Raum" (Soundspace), the corresponding analysis of the sources enables the reconstruction of manifold urban soundspaces. Taking the funeral procession, the *pompa funebris*, as an example, we demonstrate how the synopsis of different source genres reveals a complex picture of the significance of sound and music in the Roman funerary ritual.

Keywords

Soundscapes – Pompa funebris – Funeral procession – Nenia

> "Beshrew me if I think anything more requisite than silence for a man who secludes himself in order to study! Imagine what a variety of noises reverberates about my ears! I have lodgings right over a bathing establishment. So picture to yourself the assortment of sounds, which are strong enough to make me hate my very powers of hearing! When your strenuous gentleman, for example, is exercising himself by flourishing leaden weights; when he is working hard, or else pretends to be working hard, I can hear him grunt; and whenever he releases his imprisoned breath, I can hear him panting in wheezy and high-pitched tones. Or perhaps I notice some lazy fellow, content with a cheap rub-down, and hear the crack of the pummeling hand on his shoulder, varying in sound according as the hand is laid on flat or hollow. Then, perhaps, a professional comes along, shouting out the score; that is the finishing touch. Add to this the arresting of an occasional roysterer or pickpocket, the racket of the man who always likes to hear his own voice in the bathroom, or the enthusiast who plunges into the swimming-tank with unconscionable noise and splashing. Besides all those whose voices, if nothing else, are good, imagine the hair-plucker with his penetrating, shrill voice,—for purposes of advertisement,—continually giving it vent and never holding his tongue except when he is plucking the armpits and making his victim yell instead. Then the cake-seller with his varied cries, the sausageman, the confectioner, and all the vendors of food hawking their wares, each with his own distinctive intonation."[1]

In this passage from a letter to his friend Lucilius, the Stoic philosopher Lucius Annaeus Seneca (4 BCE–65 CE) complains about the variety of sounds and noises in Baiae, the famous recreational spot for wealthy Romans in the Gulf of Naples.[2] He describes a typical bathing situation comparable to a modern outdoor pool or beach in the summer holidays: exercising, panting men, massage slaps, the splashing sounds of pool fun, the seller of food and entertainment on the beach. This variety of sounds, noises, and music creates the impressive and unique soundscape of the bath. These sounds give us a vivid impression of a day out at a Roman recreational hotspot.[3] This passage presents a specific reception and judgment of these sounds, referring to Seneca as a noble man who – necessarily – strongly dislikes to be disturbed during his study time, his *otium*. To a Roman man of his noble status, the sounds of daily life at the summer spot seem to be inappropriate, even trivial. By underlining the importance of a search for *otium* as the appropriate reason for his summer stay, the social distinction between the noble and the simple-minded is clearly intentionally expressed within the description of the soundscape, comparable to the frivolity of modern popular summer vacation locations.

[1] Seneca, *Epist.* 56.1–2 (trans. R. M. Gummere, Loeb Classical Library 75).

[2] The collection of the *Epistulae morales* contains 124 letters in 20 books, all written in the years 62–64 CE.

[3] On the interpretation of this specific soundscape in Seneca see Bouton-Touboulic 2021 (esp. 86–90), Vincent 2016; Hartnett 2016: 159–62; Vincent 2015b.

This rich description brings up the question of what kinds of sounds were present in ancient daily life and how they were perceived. In another passage in the letter, Seneca introduces the sounds and noises of the city of Rome by stressing the different reception of noises and words:

> "Words seem to distract me more than noises; for words demand attention, but noises merely fill the ears and beat upon them. Among the sounds that din round me without distracting, I include passing carriages, a machinist in the same block, a saw-sharpener nearby, or some fellow who is demonstrating with little pipes and flutes at the Trickling Fountain (*ad Metam Sudantem tubulas experitur et tibias*), shouting than singing."[4]

In addition to the recreational soundscape, Seneca refers to carriages, workers, and handymen as well as to a musician, adding to the acoustic atmosphere of the city. Even though there are countless sounds and noises in a city, there are places or events that had a specific soundscape to the ancient listener.[5] But how is it possible to get a clearer impression of music and sound in such a specific soundscape? As the concept of "soundscape" is controversial in historical disciplines,[6] we will present a new methodological approach to the iconographic and textual sources, aiming to understand, define, and reconstruct Roman soundscapes. After a theoretical explanation of our method, we will apply it to the case study of the *pompa funebris*.

1 Mapping Roman Sounds – A Methodological Approach to the Reconstruction of Roman Soundscapes

Sound is – as an acoustic phenomenon – physically described as the propagation of acoustic waves through a medium like air, therefore it is coupled with the criteria of time and space. Any sound is produced at a certain moment in time to be received by a listener. Thus, the act of the production of sound might happen intentionally or unintentionally, whereas the reception can take place actively or passively. This also refers to noises which often are, unlike the produced, intended signals, unintentionally in nature or elsewhere, for example the wind moving the leaves, rushing cars on the streets, doors slamming, and so on. With the differentiation of the intention of the listener or producer, we can classify sound as *played* music or *unintentional* noise.[7] Beside that identification there is also the criteria of defined space for the acoustic propagation and the producer or listener of the sound. This environment creates a specific soundscape that is strongly connected with the recipient's expectations. Imagine, for example, a European train station when a train arrives at a platform: in our subconscious inner ear, we might be hearing the train arriving with a whoosh, the

[4] Seneca, *Epist.* 56.4–5. (Transl. R. M. Gummere. Loeb Classical Library 75). The term *tubulus* might also be understood as a little (water) pipe. Obviously, Seneca plays with the double meaning of the word *tubulus*. For the meaning of that passage in the context of the Meta Sudans, see Leitmeir (forthcoming).

[5] Cf. recent research of the multisensory approach of ancient cities, especially the aural sense: Betts 2011; Hartnett 2011; Quatember 2016; Hartnett 2016; Laurence 2017.

[6] For a recent discussion of the term and the historical soundscape, see Vincent 2015b; Vendries 2015.

[7] For the definition of sound, cf. Altenmüller 2018: 83–103; Morat and Ziemer 2018: VII-IX (with further literature).

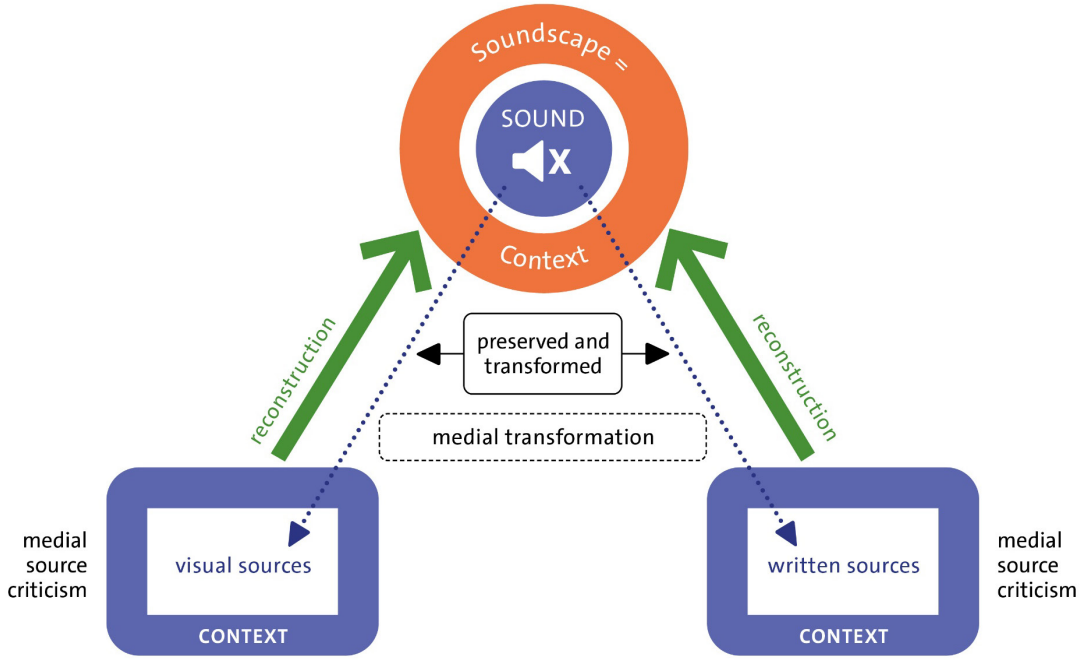

Figure 1: Methodological scheme of the reconstruction of the soundscape (Authors; design: C. Kiefer).

brakes of the train squeaking intensely, the doors opening with a high signalling sound, people rushing on the pavement to get to the doors, the noise of the luggage being drawn on the pavement together with footsteps, children crying or shouting in excitement, information being conveyed over speakers with a signalling melody, people descending and boarding the train, scenes of hello and goodbye. At the same time, we might imagine the hustle and bustle of the train station as part of the general soundscape that plays into our expectations of this specific situation, whereas our auditive imagination changes if the same situation is pictured in another country. If, in the course of our imagination, we add other sounds not specific to our expectation of this soundscape, such as wolves howling, an opera singer rehearsing at the platform, a bomb crashing down, honking of cars and so on, we might be able to integrate these sounds and noises into the soundscape, but they do not enhance our immersion into the imagined soundscape; to the contrary, they counteract the soundscape in a distorted way.

This modern impression of different categories of sounds that we are confronted with is obviously not easily transferred to historical periods, since our knowledge of how sounds were perceived is restricted to a few selected sources. In contrast, the importance of sound in the Roman Period is prominent in texts, images, and archaeological relics of sound tools, even if the real and original sound has vanished. By evaluating the sources under the lens of the critical-historical analysis of the preserved genera and the situational setting, we can identify and reconstruct specific soundscapes in the Roman Period as shown in Figure 1.

In order to evaluate our sources, we can understand them as communication media, and therefore categories like producer (artist/author) and receiver (viewer/reader) are useful. When interpreting the sources as relics of sound we have to be aware of the medial transformation of sound into other media and the specific context of this media. For example, the images of musi-

cians in the amphitheatre at gladiatorial combats generally come from villas (mosaic) or graves (reliefs).[8] The same applies to poetic texts, using the full score of musical metaphors and *topoi* from a wide range of literary settings and traditions. This critical view on the sonic sources allows us a perspective through a single lens of the material or text from antiquity, preserved at a moment in time, created and/or judged by the ancient author. The detailed critical consideration of the sources needs to be at the base of our soundscape analysis: we must deconstruct the medial transformation in order to then reconstruct a specific soundscape. To return to the modern example of the train station soundscape, for a distant future music archaeologist who neglected to properly value medial transformation, an opera singer could become a central aspect of the soundscape.

In this way, "soundscape" could be understood rather as a performative setting than a specific place. Thus, our aim of reconstructing the specific soundscape lies in representing the impressions and expectations of the ancient listener in contrast to reconstructing a specific ancient sound or music.[9] In the following section, we choose the *pompa funebris* as an example of a specific soundscape in Roman times.

2 The *pompa funebris* as a soundscape

The *pompa funebris*, the funeral procession from the house of the deceased to the cemetery, is one of the central rituals in Roman culture, starting in the early Republican period, and even finds its way into the Christian culture in Late Antiquity. It was an important medium of public communication and commemoration within the social structure of the city.[10]

Despite its importance, the sources for the ritual are very scarce. The main written references are the histories of the Greek historian Polybios (*Histories* 6.53f). According to him, the *pompa* itself took place in the inner urban space of Rome, passing along a defined sacred route consisting of places of great importance for the *res publica* and the family of the deceased. Its route expressed the family's achievements, as manifested in donated buildings and other places of importance for the noble family. The idea of the perpetuation of the deceased through the representation and remembrance of his great deeds publicly stands out in Polybius' description. Lined up at the front of the procession are the ancestors, embodied by actors, wearing wax masks of the ancestors' faces. These are the impressive men of the family who gained importance because of their great achievements. The observer does not see all the family's history, but only those persons who were successful and therefore worth remembering. Following the long line of ancestors, the dead body is carried

[8] E.g. Mosaic: Zliten, Villa Bar duc Amméra, Tripolis Mus. Aurigemma 1960: Taf. 137.143. Relief: tomb of C. Lucius Storax, Chieti, Museo Archeologico Nazionale, inv. 4421 a–c; Flecker 2015: 205–9 A27.

[9] For the importance of the listener, cf. Breitsameter 2018: 94.

[10] We are well informed about the three main types of processions: the *pompa triumphalis*, the *pompa circensis*, and the *pompa funebris*. Significant research on the three types of *pompae* has been carried out over the years. A good overview with further literature is provided by Boschung 2015: 15–166. On the *pompa triumphalis*, see Brilliant 1999. On the *pompa circensis*, see Latham 2016: 67–101. On the *pompa funebris*, see Bodel 1999: 259–81 and Toynbee 1982: 46–8. On the *pompa funebris* in Late Antiquity, see Günther 2019: 93–7. On the specific use of music in the procession, see Vincent 2016: 199–205.

Figure 2: Amiternum, relief with a *pompa funebris* (https://arachne.dainst.org/entity/6577581, photo: B. Malter).

along, probably by the undertaker's slaves. On site are all the other noble families, who watch the procession, as well as the plebs of Rome. To this end, Polybius underlined the importance of the ancestors' parade as a moral exemplum for the noble youth. In sum, the *pompa funebris* demonstrated the wealth and power of the family and its status within the society.[11] Were Polybios our only source for the ritual of the *pompa funebris*, the music and sounds specific to the occasion would have been lost, since he only names the funeral speech and does not explicitly refer to the impact of sounds of the procession on the observers or participants. Other sources, however, allow us to gain at least some impression of the different sounds (vocal mourning[12], musical instruments) produced during the *pompa funebris*. According to the medial qualities of the sources, we will first take a look at the visual evidence and thereafter at the written sources.

2.1 The visual evidence

Whenever the Roman *pompa funebris* is discussed, a relief from Amiternum of the late Republican period must be examined as the main, and possibly only, surviving visual evidence for the organisation of a *pompa funebris* (Figure 2).[13] Nevertheless, what the relief shows is a procession led by a group of musicians: a *lituus*-player[14], two *cornicines* and four *tibicen*, divided into two registers. Behind the *cornicen* stand two women facing the person on the *lectus*. They can be identified as

[11] Cf. Flaig 2015: 108–13.

[12] Cf. Hope 2019.

[13] L'Aquila, Mus. Nazionale d'Abruzzo, height: 65 cm, width: 164 cm, depth: 40 cm. Franchi 1966; Bodel 1999; Schrumpf 2006: 35–59, 256–81; Vincent 2016: 200–9; Coarelli 2013. The dating of the relief is still in discussion. The first half of 1st century BCE is generally accepted, although cf. Hughes 2005 and Flecker 2015: 109, where 100 BCE is proposed. – It should be stressed here that we must be aware that this singularity complicates the general reconstruction of a *pompa funebris* since we cannot decide how realistic or stylised the depiction is.

[14] Franchi 1966: 24–6; with discussion of earlier research, which also saw it as a *tuba*. Cf. Vincent 2016: 209; Castaldo 2019: 71f.; Alexandrescu 2008; Alexandrescu 2010. Despite these efforts, however, the attribution remains unclear; Franchi (1966: 25) spoke of a "'longa tuba' in forma dei lituus", Alexandrescu (2010: 34) also equates the Etruscan *lituus* with the Tyrrhenian *tuba*. In this context, the Italic-Etruscan influence on an instrument used on a Late Republican–Early Augustan monument needs to be examined.

praeficae, or lamenting women. They are followed by the *dissignator*, the responsible person for the organisation of the funeral, and eight men carrying a *ferculum* with the *lectus funebris*, a kind of couch, for the deceased person. Upon the *lectus* is the recumbent figure of the person. Whether this is the corpse itself, or a puppet, or an actor is disputed vividly in research; if the latter, the corpse would then be in the box under the *lectus*.[15] Behind the figure of the person is stretched a cloth with stars and a crescent moon. Following the men carrying the *lectus* are the *familia*: a lamenting woman, possibly the mother of the dead, supported by two female servants, three lamenting women and two further persons, one of them holding a fan. At the tail of the procession walks a young servant.[16] As nearly one third (9 of 28) of the members of the *pompa funebris* are actively producing sound, the musical iconography of the relief is striking.

In the following, we will attempt to define the visual sound space of the *pompa funebris* by approaching the meaning of the sounds on the relief in different ways. Regarding the formal composition of the relief, we can draw a formal dividing line between the left and right groups of persons, whereby the instrumentalists are clearly separated. In the case of the left group, the turning of both sides towards the *lectus funebris* is noteworthy, because the sound is directed towards the deceased and hence supports the visual spotlight. This visual and sonic reading of the image is seen also on the right side: if we follow here the direction of the sound, a 'sound cloud' of the brass is created. The sound of the *tibiae* mixes with that of the first *tibia*. It is also worth noting that both musicians on the right are shown frontally. This underlines their importance from a contentual standpoint, but the frontal depiction may also be understood in purely formal terms in that the two delimit the scene to the right and thus the group of instrumentalists. As regards the sound producing characters, it is remarkable that they are all represented in action. They play their instruments with cheeks inflated or articulate their voices with open mouths. Further differentiation of the sounds created during the procession is possible through the analysis of the different sound tools depicted, which can be divided into brass and woodwind instruments, as well as the human voice.

The *tibia*, consisting of two tubes and played with a double reed, has a sonorous and penetrating sound, amplified due to the number depicted in the procession. The elongated brass instrument with its curved and wider bell should depict a *lituus*. As for the perceived tone of this instrument, however, we should be careful. Although the shrill sound of the *lituus* is mentioned in Ennius, the longer *lituus* on the Amiternum relief could have had a deeper tone.[17] The tonal spectrum of the curved *cornu* was perceived as rough.[18] In addition to these instrumental sounds, the human

[15] Cf. Schrumpf 2006: 51–6.

[16] Franchi (1966: 26) thought of the depiction of the *pollictor*, the slave who washes and rubs the corpse with ointment. He seems to be carrying a *situla*, so we should identify him better as one of the slaves or servants of the *libitinarius.*

[17] Ennius, *Ann.* 530 (cf. Wille 1967: 83). Schrumpf (2006: 40, fn. 100) discussed the *Klangfarbe* of the *tuba* and *lituus*, coming to the conclusion that: "...doch auch wenn es sich um einen *lituus* handelte, änderte dies an der Grundaussage nichts – mit seinen wenigen, aber dafür schrillen Tönen war er lediglich das helle Gegenstück zur tiefen *tuba*, erfüllte also denselben Zweck."

[18] Verg. *Aen.* 8.1f.; Coripp. *Ioh.* 5.32; Lucan. 1.236–8. Cf. Wille 1967: 84.

voice is present in the lamentations of the *praeficae* and the woeful cries of the relatives. It remains unclear if the *praeficae* responded somehow to the intonation of the instrumentalists, however, and composition of the relief does not imply this. The group is formally separated from the instrumentalists, and the gestures of the right *praefica* and the female relative (raised right arm, head) are quite similar. Because of this visual similarity, it is safer to assume that the lamentation of the *praeficae* differed only slightly from the spontaneous sounds of the relatives.

Although it is certainly not clear from the relief which sounds or even melodies were produced, we can possibly make some statements about the qualities of the sounds based on the social status of the procession members. In the same way that the professional lamentations of the *praeficae* can be contrasted with the spontaneous calls of the female relatives of the deceased, the playing on the *tibia* generally implies more intensive musical training than that required for the signalling brass instruments. Schrumpf (2006: 278–81) points out that the latter could be simple employees or slaves (*operae*) of the undertaker, whereas the *praeficae* and *tibicien* are to be regarded as hired freelancers who were engaged to supplement and enhance the procession.[19]

The archaeological context of the relief belonged to a sepulchral area. Together with another relief, it once adorned a burial structure that, based on the inscriptions found, was associated with the *gens Pedaucaea* and the *gens Aspisia*.[20] The presumed placement of the relief on the outer façade of the burial structure granted it a higher visibility and underlined its representative character.[21] Taking this into consideration, it can be surmised that the message of the relief was to praise not only the overwhelming and sonorous atmosphere of the spectacle, but also its high costs. A similar function can be found in funeral inscriptions where the sum paid for the funeral is mentioned (cf. Campbell 2021: 152–55).[22]

To define the function of the sounds, we can categorise a triad of signalling (brass), ritual lamenting (*tibicines* and *praeficae*), and spontaneous lamenting (relatives) functions. The "acoustic maximum" (Wille 1967: 71) achieved by the relief thus represents not just a sonic mishmash, but a multi-layered and balanced visual composition of the sound space of a *pompa funebris.* It remains unclear if the number of musicians depicted unveils a correlation to the volume. Besides the emotional lamentations and the calls to attention of the signalling instruments, this sound space thus also included the ritual-lamentive sounds of the *praeficae* and *tibicines*. Since mourning women

[19] For hiring musicians, cf. Vincent 2016: 247–55.

[20] Nothing of the tomb itself has survived, but another relief with similar dimensions and stylistic similarities, showing a gladiatorial fight, probably also belonged to it. Cf. Flecker 2015: 189–90, A 5. However, Hughes (2005: 79) proposes to recognize Publius Aspisius as the deceased person in the relief.

[21] On the so-called *arte plebeia*, cf. Hölscher 2012. In terms of research history, this question is relevant in view of the classification of 'Italic' pictorial elements, e.g., the *lituus*.

[22] One could also imagine that the relief adorned the tomb of a *libitinarius* representing his services by depicting the acoustic maximum for the *pompa funebris*. For similar representations on the tomb of another professional, cf. Zimmer 1982. Although this interpretation cannot be discussed here in detail, it must be stressed that it is not contradicted by the possible connection of the relief of the *pompa funebris* with the gladiatorial relief from the same tomb. The foundation of a *munus* could also be used for the burial since a *libitinarius* could either act as a sponsor organization of a *munus* himself, or could also organise a gladiatorial fight within the framework of the burials.

more often only appear on sarcophagi bearing scenes of the death of Meleagros,[23] the combination of *tibia* with *praeficae* is very rare, and is only observed elsewhere in the *collocatio* (lying-in-state of the corpse) scene from the tomb of the Haterii at the Via Appia (early 2nd century CE).[24]

2.2 The written sources

In contrast to the lack of sound in Polybios, other authors of earlier and later imperial times are more forthcoming in providing information on music in the processional context. For example, Suetonius (late 1st century CE), one of our main historical sources for the early imperial era, wrote about the discussion in the Senate on how to deal with the first emperor's death and memorial. As part of this, he also referred to musical elements of the ritual:

> "In their desire to give him a splendid funeral and honor his memory the senators so vied with one another that among many other suggestions some proposed that his cortege pass through the triumphal gate, preceded by the statue of Victory which stands in the House, while a dirge (*nenia*) was sung by children of both sexes belonging to the leading families."[25]

Those so-called *neniae* were poetic compositions to be sung before or after the *laudatio funebris*, the funeral speech, as we learn from Horace (65–8 BCE) in three short passages of his *Carmina*, as well as from the later author Festus (2nd century CE) in a short notice.[26] In contrast to Horace and Festus, the singing of the dirge by both boys and girls of the leading families of Rome, as well as the suggestion to take the route of a *pompa triumphalis* instead, demonstrates the general uncertainty as for how to deal with the first emperor's death. Obviously, in contrast to the ritual in republican times, the senators were searching for a more splendid version to honour the first emperor, and this social difference was to be emphasized through music as well. The *laudatio funebris* which was delivered by an important male member of the family, often successor or son, also plays into the soundscape of the *pompa funebris*, since it is delivered in the forum where the processional train stopped for giving praise to the deceased.[27] The speech, or the speeches, depending on the family and importance of the deceased, was commonly performed following specific poetical meters of praise and grief, and thus evoked a certain atmosphere and aural setting.[28]

Next to the vocal character of sound in the singing of the dirge and the performed speeches on the forum, other written sources report on instrumental music during the procession. Suetonius again refers in a passage of *The Deified Julius*, the first book of his biographies of the emperors,

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[23] Koch 1975: 38–47.

[24] https://arachne.dainst.org/entity/1081228 [Accessed 4 December 2024].

[25] Suet. *Aug.* 100.2 (trans. J.C. Rolfe, Loeb Classical Library 31).

[26] On the *nenia* as funeral songs see Horace, *Carmina* 2.1.37, 2.20.21 and 3.28.16, and Festus 155. Cf. Wille 1967: 65–9; Günther 2022: 161–3. In contrast to the *neniae*, the professional lamenting women (*praeficae*) are rarely mentioned in the written sources referring to funeral processions. Cf. TLL s.v. *praefica.*

[27] On the acoustics of the *laudatio funebris* on the Forum Romanum, see the inspiring article by Favro and Johanson 2010.

[28] Kierdorf (1980) collects many funeral speeches from republican to late ancient times and gives a profound overview of the structure, meter, and circumstances of these speeches.

how *tibia*-players together with actors ripped and burned their clothes to honour Caesar after his *pompa funebris*.[29] Indeed, the *tibia*, the double-reed instrument commonly consisting of two pipes and nowadays often mistaken as a flute, is at the heart of every religious cult in Roman times and therefore to be expected in the setting of the *pompa funebris* as well. In the oldest inscription on legal affairs, the so-called *Law of the Twelve Tables*, table ten informs us about the number of *tibicines* allowed in a funeral procession, as Cicero (106–43 BCE) testifies in *De legibus* 2.23.59.[30] Ovid (43 BCE–17 CE) also refers to this law when he points out in his *Fasti* 6.13.663–666[31] that these laws had been given in early times, after Greek freedom was curtailed by the ascendancy of the Romans, in order to stop the tradition of the funerary becoming more and more luxurious.

Pliny the Elder (died 79 CE) and Ovid both report on the meaning of the instrumental music in the context of funeral scenes of birds. Whereas Pliny describes in book ten of his great *Natural History* a *tibicen* at the funeral of a raven,[32] Ovid, in a wonderful love poem dedicated to a dead parrot (*psittacus*), underlines the use of trumpet players instead of *tibicenes* to accompany the bird's funeral procession.[33] In the transformation of the ritual to the animal world it becomes clear just how central the playing of the wind instruments *tibiae* and *tubae* was for Roman funeral rites.

In his satirical work *Pumpkinification*, Seneca provides information on the burial of the emperor Claudius (41–54 CE). Since Seneca had been exiled by Claudius in the years 41–49 CE, he deals with the emperor's death, apotheosis, and his attempt to enter heaven in a deeply satirical manner. In this short passage, he describes Claudius' funeral:

> "While they were going down by way of the Via Sacra, Mercury inquired about the meaning of the great crowd: was it Claudius' funeral? And it was the most gorgeous spectacle, with no expense spared, so that you clearly knew that a god was being buried. There was such a mob of trumpet players (*tubicinum*) and horn players (*cornicinum*) and every kind of brass instrumentalist (*omnis generis aeneatorum*) that even Claudius could hear (*audire*) it. Everyone was happy and full of joy. The people of Rome were walking around as if they were free men. Agatho and a few advocates were weeping (*plorabant*), but clearly with sincerity. Legal authorities were emerging from the shadows, pale, thin, and barely breathing, as if men just at the point of coming back to life. One of these, when he had seen the advocates putting their heads together and crying over their bad luck, went up and said: 'I kept telling you that Carnival Time would not last forever.' When Claudius saw his own funeral, he realized that he was dead. For with a great song and dance (*μεγάλωι χορικῶι*) a dirge was being sung (*nenia … anapaestis cantabatur*)."[34]

[29] Cf. Suet. *Iul.* 84.4.

[30] Cf. Cic. *Leg.* 2.23.59.

[31] Cf. Ov. *Fast.* 6.13.663–66. On the passage and the *tibicenes* in the *Law of the Twelve Tables* in Ovid and Cicero, see Vincent 2016: 199–210.

[32] Cf. Plin. *Nat.* 10.40.122.

[33] Cf. Ov. *Am.* 2.6.

[34] Sen. *Apocol.* 12.1.3 (trans. G. Schmeling, Loeb Classical Library 15). Instead of 'chorus', Schmeling translates 'dance', referring to the ideal of χορός, a dance performed by a chorus from early Greek times.

In this passage, especially the brass instruments play a significant role in the described soundscape. Seneca names trumpets (*tubae*), horns (*cornua*) and then to distort the funeral setting satirically states that there are so many playing so loudly that Claudius, already watching from above, was able to hear these sounds. The combination of instruments and their sounds are obviously portrayed as suitable to the funeral context – indeed, appropriate to burial of a god – even though the volume is satirically emphasized.[35] Furthermore, this passage combines the instrumental soundscape with the vocal one, since the dirge, sung in *anapaest*, was included in the funeral setting, obviously helping to evince a certain aural atmosphere for his readers appropriate to that of a funeral. He of course distorts the setting in a cynical way, so typical for his style, by using a bilingual tautology of a massive choir (μεγάλωι χορικῶι). In contrast to this satirical description of Seneca, Suetonius states of Claudius' burial only that he received a burial befitting the role of an emperor.[36]

Another passage revealing the character of the funeral procession soundscape comes from Petronius (died 66 CE). His *Satyricon liber* is a novel based on the main character Encolpius' brilliant report of his travels in Southern Italy with the wealthy freedman Trimalchio. The satirical nature of the text is demonstrated very well in the following passage, which revolves on the excessive volume of a horn player:

> "The whole thing was absolutely sickening, when Trimalchio, now deep in repulsive drunkenness, ordered fresh entertainment, horn players (*cornicines*), to be brought into the dining room. And propping himself up on a heap of pillows, he stretched out along the edge of the couch and said: 'Imagine I'm dead. Play something pretty.' The horn players all together blasted out a funeral march (*funebri*). One of the horn players, a slave of the undertaker, who was the most respectable man among them, blew his horn so loudly that he roused the whole neighborhood. So the night sentinels who were patrolling the area round about, thinking that the house of Trimalchio was on fire, suddenly broke down the door, and with water and axes began to create a disturbance to the full extent of their rights."[37]

In this passage, Petronius reports about a banquet hosted by Trimalchio, a former slave who became a rich *homo novus*. To entertain his guests, Trimalchio pretends to be dead and asks the musicians, a group of horn players, to play at his funeral. He himself lies down in the specific pose typical for a funeral procession (stretched out on cushions) and the horn players play funeral music (*funebri*). Petronius states satirically that the undertaker was the most respectable of the guests,

[35] This aspect is misinterpreted in Schrumpf 2006: 39–40, who takes loudness and noise as the typical soundscape for funeral processions.

[36] Cf. Suet. *Claud.* 45: "He was buried with regal pomp and enrolled among the gods" (trans. J.C. Rolfe, Loeb Classical Library 31).

[37] Petron. 78.6 (trans. G. Schmeling, Loeb Classical Library 15). Very commonly, Schmeling mistranslates the instrument here: instead of a horn he names a trumpet since the signalling function of the trumpet obviously came to his mind rather than the horn. The same applies to the "funeral march": this demonstrates excellently the concept of an imagined soundscape from nowadays, like the one we introduced in the picture of the European train station, inadvertently superimposed on ancient sources.

yet his slave is the one of the musicians overdoing his job. Usually the undertaker (*libitinarius*) has musical slaves to be rented for the funerals.[38] In the passage shown, the duality of sound reception for the sound "horn" becomes clear: the instrument's sound might be appropriate to the context of funeral, but it can also be a sound of signal. Obviously to underline the comic element of the passage, the musician overdoes his efforts so much that the fire brigade could misinterpret the immoderate blows of his horn as a signal of danger.[39] If we "clean" this description from the humoresque element, it becomes clear that the funeral music was to be played in a rather serious, decorous manner.

A final sonic element present at Roman funerals comes from the *Lex Libitinae* from Puteoli which dates to Augustan time. It refers to a ritual needed to be performed to dispel the negative influence of pollution (*miasma*), which went so strongly together with death and burial in Roman ideas, from around the corpse. The ritual refers to the *tintinnabula*, little bells, that were to be played constantly when the corpse is laid out to keep evil spirits away.[40]

To summarize the information on music and sounds presented in miscellany of texts dated to the early imperial period, which extended from historiography to satirical novels to inscriptions, the *pompa funebris* was accompanied by funeral music played on wind instruments such as *tibiae*, *tubae* and *cornua*. *Tintinnabula* escorted the body musically to the forum in order to dispel the death-pollution. Before or after the *laudatio funebris*, the *neniae* are sung by a variety of voices, depending on the setting and the social status of the deceased person. Although we have a distinction between the moving portions, which were accompanied by instruments, and the stationary portions, defined by vocal performances, of the procession, it must be imagined that both musical parts defined the soundscape for the ancient listener. Since the texts do not always highlight both, often only one part – the funeral music or the dirge – still the aural imagination of single musical elements defines the soundscape *pompa funebris*.

3 Conclusion

In the foregoing investigation of the soundscape of the *pompa funebris*, the literary and iconographical sources of the late republican/early imperial period contributed different but complementary results for this particular context of sound. Information from three main categories were recovered: First, the sound categories of the procession, second, the sonority of the sounds at the procession, and third, the function of the sounds within the specific genre and funerary soundscape.

In terms of sound categories, the source materials differentiate between a mixture of voices and brass/wind instruments. The relief of Amiternum clearly depicts female mourners, whereas these do not play a central role in the literary texts describing the procession. Conversely, the sing-

[38] Wickert 1926: 114 (*libitinarii*). On musicians-for-hire and contract musicians, see Vincent 2016: 247–54.

[39] Cf. Schrumpf (2006: 40) interprets this passage towards the differences in musical quality within the musical slaves.

[40] *Lex Libitiniae Puteolana* col. II, 14: *cadavera erunt cum tintinnabulo extrahere debebit* (Hinard and Dumont 2003: 122). Cf. Bodel 2000: 146–7 (on the corpse-dragger's bell and the apotropaic function of bells).

ers of the *neniae* only appear in the texts, and here only in reference to the burials of noble Romans and the emperors. Interestingly, the *neniae* can be sung by both boys and girls, depending on the family status as well as the social status of the deceased. Both text and image portray brass instruments, such as trumpets and horn, as part of the procession. These obviously played a central role in defining the soundscape of the *pompa funebris*. The *tibiae* were well-known instruments at the *pompa funebris*, most notably when their number is restricted to ten per funeral in the *Law of the Twelve Tables*. For the sonority of the soundscape of the *pompa funebris*, this is reflected in the number of players depicted and the testimonies of volume. The Amiternum relief shows numerous *tibicines* in contrast to the horn players and trumpeters. Interestingly, the *lituus*, a specific local instrument of Central Italy and mainly Etruria, is depicted. Within the literary texts, volume can become a factor for transformative, even satirical, misunderstanding: If the horn players play too loud, the funerary soundscape can be distorted to another one, and the horn-playing assumes the function 'signal' instead of 'funeral music'. Finally, the function of the sounds of the *pompa funebris* is also reflected in both the iconographical and the literary tradition. The expression of dirge is central not only to the female mourners and female professional lamenters, but also in the singing of the *neniae*. Furthermore, the expression of honour for the deceased and his family is a central function. It is reflected in the solemnity and reverence that was expected of funerary music. Another central function of the sound must be seen in contrast to the audience: by taking a central route through urban Rome, the procession creates publicity which is mainly sustained through music. The music functions as an announcement, a signal of the arriving procession, and represents thus an act of communication central to the ritual. Especially the *neniae*, being sung at a certain stop at the forum, create a soundscape specific to the occasion. Here, we can detect a mixture of brass instruments, playing solemnly while marching, and the voices of the choir of children or adults who sing the composed *neniae* as hymns of the deeds of the deceased person to frame and support the laudation speech. Through the public remembrance of the family's achievements, a deep dismay is evoked in the audience in order to provoke collective lament. To sum up, male and female voices – the former only singing sweetly, the latter both singing sweetly and also lamenting – complemented by trumpeters and horn players playing solemnly, defined the soundscape of the Roman funeral procession. Thus, the *pompa funebris* was defined by musical instruments and human voices, and was clearly audible for the ancient listener as a central ritual in Rome and further Roman cities.

The methods proposed in this article, especially the medial transformation within the preserved genera, open up a broader perspective on the soundscape preserved in the texts and the relief itself. By combining a detailed analysis of the presented sources, we could demonstrate how the complementary evidence from the visual as well as in the literary sources combine to form a picture of the *pompa funebris* as it was expected by the ancient listener of late republican and early imperial times. By bringing together the variety of music, noises, and sounds that clearly defined the *pompa funebris* for the ancient ear, we were able to unmute this specific musical ritual just a little bit more for our modern ears.

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Teotihuacan Whistling Vessels

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Abstract

This paper presents the study of a sample of pre-Columbian whistling vessels from Teotihuacan, Mexico, in terms of their organology (morphology, construction and functionality), sonority, iconology and sound symbolism, contributing to the interpretation of their possible uses and cultural contexts during the Classic period of Mesoamerica in a time range of 100–650 CE. In addition, the instruments are compared with possible predecessors, contemporary variants, and adaptations from Oaxaca and the Maya area, revealing interrelations with other cultures. Apart from a thorough examination of the accessible sound artefacts, and the comparison with published specimens, the construction and subsequent test of a series of experimental reproductions are also taken into account.

Keywords

Ancient music – Classic period Mesoamerica – Teotihuacan – Whistling vessels – Pre-Columbian organology – Sonority – Music iconography – Musical knowledge – Cross-cultural exchange

1 Introduction

The present study forms part of a research project on the sonic environment of Teotihuacan, a UNESCO World Heritage site situated in the Central Mexican Highlands at an altitude of 2280 masl and representing one of the most powerful cultures in Mesoamerica during the Late Preclassic and the Classic periods between 150 BCE and 650/700 CE.[1] One part of the project consists in the archaeological and organological documentation of the many sound artefacts excavated at the site, currently stored in several museums and research laboratories worldwide. Another part of the project consists of the experimental reproduction of these instruments and sound tools in the form of replicas (exact copies), reconstructions (exact copies of fragmented finds with reconstructed parts, if possible produced within the size ranges of comparable finds documented for the project), and

[1] TVSM (Teotihuacan Virtual Sound Map), H2020-MSCA Individual Fellowship, University of Huddersfield, United Kingdom (2019–2022). For more information, consult https://cordis.europa.eu/project/id/846012 [accessed December 21, 2023] and the website of the project, www.teosoundmap.com [accessed December 21, 2023].

experimental models (versions of the acoustically relevant organological parts designed for functional tests). In the manufacture of a series of specimens per instrument type, carried out by the author and the instrument maker Osvaldo Padrón Pérez with original material and only a few tools (which, in the case of ceramic objects included low fire clays, water, wooden sticks of different shape, and a blade, burning in the campfire and larger objects in a brick stove), we aimed to understand the organology involved in the construction of each instrument, particularly in relation to the way sound is generated and which particular sonic characteristics are produced. Analysis of the Teotihuacan whistling vessels, within this experimental process, produced a large amount of specific data with regard to the use and function of these enigmatic sound devices.[2]

Whistling vessels are instruments exclusively developed and employed in the pre-Columbian Americas by the cultures of Mesoamerica, Central America and the Andean region. The aerophones, which are in organological terms indirect-blown flutes, consist of manifold variations on two basic forms: one composed of a single chambered vessel (a form documented in Mesoamerica only for the Middle and Late Preclassic periods in a time range of 1400/1200–700/500 BCE), the other composed of a double vessel with two interconnected chambers, usually by means of a tubular conduit (documented in Mesoamerica from 750–400 BCE onwards). The double-chambered instruments always present one chamber open and the other chamber closed, with the latter being equipped with the whistle. The vessels of South America frequently present a spout that allows for blowing them with the mouth, with or without the use of a liquid.[3] The instruments are therefore either air-driven or liquid/air-driven. In contrast, the double-chambered instruments of Mesoamerica always show a cup-shaped open chamber whose large rim diameter usually does not allow for making an airtight seal with the mouth. Therefore, it can be suggested that most of the vessels documented in Mesoamerica were exclusively operated by means of the flow of a liquid poured into the container. The instruments are therefore liquid/air-driven, and constructed in a way that, when the vessel is tilted in forward motion, the rising level of the liquid flowing into the closed chamber pushes air through the airduct of the whistle, thus activating its sonic function (Figure 1).

Because of the absence of chemical analysis, the components of the employed liquids have not been verified. It has been commonly suggested that the instruments were operated with water, but the use of other liquids such as beverages produced from agave (*aguamiel*, *pulque*), corn (*atole*) or cacao beans, for Mesoamerica, or corn mixed with other substances (*chicha*), for South America, could not be excluded. Obviously, employment of different liquids has implications on the cultural contexts, especially when used as a component of ritual or ceremonial activity, but variability of the particular flow velocities also has an impact on the sonority of the vessels, as discussed further below.

[2] Regarding the experimental models of the whistling vessels included in this study, it was hoped to exactly reproduce the organological features and size of the whistles and, in copying the internal morphology of the chambers, the number of milliliters of the operational liquid, but not always the exact outer form, in particular that of the figurative elements.

[3] For cross-cultural comparison, and particular discussion of the organology and acoustics of the instruments, see Crespo Toral 1966; Pérez de Arce 2006; Schmidt 2006, especially for the South American particularities.

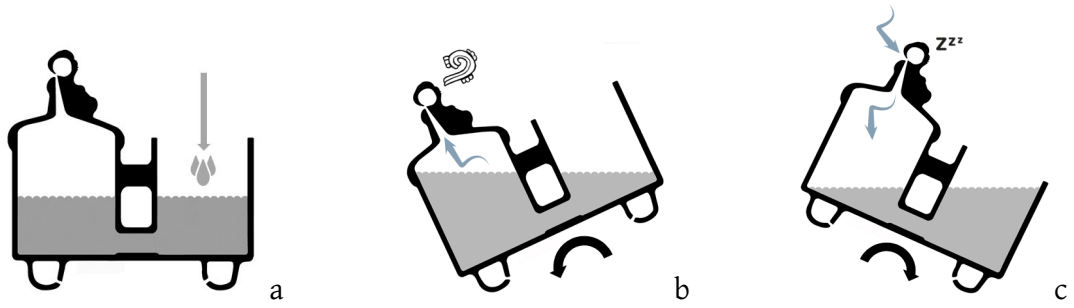

Figure 1: Cross-section of a Teotihuacan whistling vessel showing the principle hydraulic/eolic and sonic function of the instrument; a) liquid is poured into the vessel; b) infilling movement: the liquid flows into the closed chamber and air is pushed through the duct of the whistle, activating it; c) refilling movement: the liquid flows back into the open chamber and air is sucked into the closed chamber, producing respiratory sounds. Drawings made by the author.

Depending on the size and the morphology of the chambers, as well as the playing technique employed, liquid/air-driven whistling vessels generate a spectrum of very particular sounds. The activation of the instruments by tilting it forward and downward, which results in the flow of liquid towards the closed chamber (Figure 1b), generates a range of whistle tones of particularly high frequencies, varying between short strokes with triller effects and long and fragile tones, which fade out. Within the tonal range of the whistle, the sounds present microtonal variations, accompanied by the diverse noises produced by the flowing liquid. In addition, the instruments emit respiratory sounds, generated by the whistle when the vessel inhales air in the tilted retrograde motion, corresponding to the moment when the liquid flows back into the open chamber, thus creating a vacuum sucking air back into the closed chamber (Figure 1c). In general, the sound level of the instruments is low, having certain implications for the performance contexts.

As there is a constant succession and interaction of different sounds during the operation of the vessels, each instrument generates a sonic cycle with particular rhythmic accents, circumscribed by the particular flow of the liquid, which in turn is circumscribed by its consistency and amount, the form of the containers and the way they are interconnected. The moments of maximal (or minimal) quantity of liquid deposited in one of the chambers during the inflowing and reflowing motions create a sort of natural pulse. Depending on the morphological composition of the instruments and the consistency of the employed liquid, the individual cycles may be quite long, with pulses lasting between one or two seconds per motion. Also, the player can modify the pulse with the application of different movements. With stronger actuations it is possible to produce faster motions and shorter tones, with softer actuations slower motions and longer tones.

The technological level of design, construction, operation, and sonority of the whistling vessels shows that in the pre-Columbian world profound knowledge with regard to the function of aerophones was achieved, taking into account hydraulic effects in combination with the eolic effects of compression. Without doubt, these instruments represent some of the most complex products of pre-Columbian pottery design, reflecting the highest craftsmanship in the instrumental ceramic art.

Class	Subcategory	Size (length)
small	minor	< 12.5 cm
	major	12.5–15.0 cm
medium	minor	15.0–17.5 cm
	major	17.5–20.0 cm
large	minor	20.0–22.5 cm
	major	22.5–25.0 cm
	superior	> 25.0 cm

Table 1: Categorization of the whistling vessels according to size, taking the length as the reference point.

1.1 Measures applied for categorization and comparison

Whistling vessels are most comprehensively characterized and distinguished by a series of features, such as their provenance and chronological dating, ceramic type, form (including the organology of the whistle), size, weight, and iconology (figurative elements, relief and other forms of decoration). Taking into consideration these traits as a whole, it is possible to amplify and deepen the existing knowledge on the temporality, regionality, and cultural affiliation of the instruments, and the relation that they have among each other. Thus, find groups sharing certain elements, which are distinctive in comparison to other groups, can be established, and the diverse interrelations and developments can be better understood.

Earlier studies dedicated to whistling vessels had not taken into consideration the particular size of the finds. However, we observed that size appears to be an important factor not only with respect to the operation of the instruments, but as a general measure of comparison. We established three principal size classes for the whistling vessels by taking the length as reference point: *small* (vessels of a length of less than 15.0 cm), *medium* (vessels of a length within 15.0–20.0 cm), and *large* (vessels of a length greater than 20.0 cm). To create an even more precise categorization, we utilized two, and in one case three, further subcategories per class (Table 1).

Apart from the above-mentioned traits, we also took into account the quantity of the liquid in milliliters, required for the operation of the instruments. This particular measure appears to be more important than the total volumetric capacity of the chambers, as the latter does not bear any informative value for the operational function of the vessels. Effectively, for comparative means the quantity of the liquid would be as indicative as the size of the vessels. However, we decided to take the length as principal measure, as this data is by far more frequently published and also more easily obtained. Regarding the Teotihuacan specimens, only by making a series of reproductions could the range of milliliters be obtained. In order to establish the individual range per vessel, the lowest quantity of operational liquid corresponds to the amount required to fully fill the conduit (below this amount, air would escape the conduit and no compression would be generated). The maximum quantity of operational liquid corresponds to the amount of liquid making the whistle sound without entering its airduct.

Other factors contributing to the establishment of find groups is the organological and acoustical information of the whistles. For this categorization, the size of the resonator, the range of the generated frequencies, and especially the airduct-windway assemblage are to be taken into account. With regard to these features, particular organological traditions, aesthetics and musical knowledge indicative for a given culture become apparent. For example, certain frequency ranges indicative for the whistling vessels of different cultures can be established. For the Teotihuacan vessels, the resonators are very small and therefore the obtained frequencies are very high (approximately 2390–4370 Hz, equivalent to the tonal range between D_7+30 and $C\sharp_8$–26). In contrast, instruments with resonators considerably larger producing lower frequencies are reported for Mesoamerica for the Central Mexican Highlands during the Preclassic period,[4] one vessel from Oaxaca,[5] and the Epiclassic/Early Postclassic instruments from Xochicalco, Morelos.[6] In South America, lower-pitched whistling vessels with larger resonators are documented for the Peruvian cultures Vicús, Moche and Chimú, and the Ecuatorian Jamacoaque culture,[7] while the majority of other cultures in South America produced high-pitched instruments.[8]

1.2 The sample set of Teotihuacan whistling vessels

For the present study, twelve well preserved whistling vessels of Teotihuacan are documented in total. Two basic models have been concurrently employed: Teotihuacan-A (four finds: vessels no. 1–4, see Table 2) and Teotihuacan-B, the latter presenting two variants, B/Small (two finds) and B/Large (six finds: no. 7–12). Only four vessels have well documented archaeological contexts (Culpulalpan, Tlaxcala: no. 2; Teotihuacan, Zacuala Patios, 2:N2W2: no. 5; Teotihuacan, La Ventilla A, 5:S1W2: no. 7; Tecamachalco, Puebla: no. 8). Apart from the above mentioned finds from the actual states of Tlaxcala and Puebla, four further vessels are from sites of the Central Mexican Highlands, located within the domain of Teotihuacan (Huejotzingo, Puebla: no. 1; San Juan del Río, Querétaro: no. 3; San Martín Texmelucan, Puebla: no. 10; Tepeaca, Puebla: no. 11). Two further finds are without information of provenance (Reiss-Engelhorn-Museen, Mannheim: no. 4; Museo Nacional de Antropología, Mexico City, both possibly from Teotihuacan: no. 6). Finally, two exported Teotihuacan whistling vessels are from Oaxaca (Field Museum of Natural History, Chicago, possibly from Mitla: no. 9; Museo Frisell de Arte Zapoteca, Mitla, without information of provenance, possibly Valley of Oaxaca: no. 12).

Apart from these twelve sound artefacts, at Teotihuacan and other Classic period sites of the Central Mexican Highlands no finds identified as fragments of whistling vessels are reported. In addition, no depictions of whistling vessels in Teotihuacan mural or figurative art are documented, a condition of non-representation, which the site has in common with virtually all other cultures

[4] Martí 1970: 38–9, fig. 19.
[5] Sánchez Santiago 2020: 11, tab. 1.
[6] Both 2014: 62–4.
[7] I express my gratitude for this information to one of my reviewers.
[8] Garret and Stat 1977; Both 2011.

in which whistling vessels were produced. As the finds are dated to different phases of the Classic period, roughly from 100/150–650 CE, and also come from different sites situated in the Central Mexican Highlands and Oaxaca, their standardized form and homogeneous size points to a strong stylistic continuity and a blooming music tradition that Teotihuacan shared with a number of related sites during a period of various centuries.

Of the Teotihuacan whistling vessels in our sample, nine are manufactured from Thin Orange ceramics employed for a variety of luxury objects, whose trade was controlled by Teotihuacan and whose geological source has been located in the south of the modern state of Puebla (Rattray 1990). Two whistling vessels of our sample were made from a bluff sort of the Thin Orange ware, called *Anaranjado Burdo*, a ceramic type with a reddish color and more granular texture (Teotihuacan-A specimens from Culpulalpan, Tlaxcala: no. 2; San Juan del Río, Querétaro: no. 3). One vessel of the sample is made from a ceramic type called *Café fino* (Teotihuacan-B/Small specimen from Zacuala Patios: no. 5). The latter vessels are likely to be of indigenous Teotihuacan production, while the Thin-Orange-ware instruments may have been produced in southern Puebla for particularly Teotihuacan-related trade or exchange.

2 Whistling vessels of the model Teotihuacan-A

The first group, Teotihuacan-A, consists of a sample of four small whistling vessels, which hardly differ in terms of general measurements. The most variable elements of the vessels within this group are the ceramic types (Thin Orange and Anaranjado burdo wares, two finds each), different forms of decoration, and figurative details such as the seated position of the effigy situated on top of the closed chamber, simulating a monkey. The general measures of the vessels are in the range of 13.5–16.5 cm in length, 7.0–8.0 cm in width, and 12.5–15.0 cm in height. Taking into consideration the above-established sizes categories, the vessels can be grouped in the classes small major (three specimens: no. 1–3) and medium minor (one specimen: no. 4). The weight of the finds varies between 350 and 450 g and the operational quantity of the liquid, corresponding to the size of the vessels, between 50 and 125 (small major specimens) and 75 to 325 ml (medium minor specimen). According to the presence of the Thin Orange ware in Teotihuacan, the vessels date from approximately 100/150–650 CE, with greater frequency in the Xolalpan and Metepec phases between 350 and 600 CE.[9] The latter dates also correspond to the most abundant presence of the Teotihuacan tripod vessels, which may possibly have served as a model.[10] The instruments produced from Anaranjado burdo only correspond to a later phase. According to Rattray, this ware was most common during the Metepec phase, between 550 and 650 CE.[11]

[9] Rattray 1979: 57.
[10] Kidder et al. 1946: 192.
[11] Rattray 1979: 58.

no	Find context	Current storage	Ceramic ware	Dating (CE)	Type	Size class	Size (cm) L x W x H	Range (ml)	Frequency range (Hz)	Direct obser-vation	Experi-mental model
1	Huejotzingo, Puebla	Museo Nacional de Antropología, Mexico City	Thin Orange	350–600	A	small major	14.08 × 7.6 × 12.3	50–125	whistle damaged	yes	yes
2	Culpulalpan, Tlaxcala (Burial 1)	Etnografiska museet, Stockholm	Anaranjado Burdo	550–650	A	small major	14.7 × 7.0 × 12.0	50–125	whistle damaged	yes	yes
3	San Juan del Río, Querétaro	Francisco Cabrera collection (currently untraceable)	Anaranjado Burdo	550–650	A	small major	13.5 × 8.0 × ? (>15.0)	c. 50–125	unknown	no	no
4	Unknown (possibly Teotihuacan)	Reiss-Engelhorn-Museen, Mannheim	Thin Orange, stuccoed	440–700	A	medium minor	17.0 × 8.5 × 15.5	75–325	3080–3360	yes	yes
5	Teotihuacan, Zacuala Patios (2:N2W2), Burial 11	Ceramotéca, ZMAT, San Martín Teotihuacán	*Café fino*	350–650	B/Small	small minor	11.2 × 7.8 × 8.8	25–75	4000–4370	yes	yes
6	Unknown (possibly Teotihuacan)	Museo Nacional de Antropología, Mexico City	Thin Orange	100/150–650	B/Small	small minor	11.0 × 8.0 × 7.2	25–100	3750–4330	yes	yes
7	Teotihuacan, La Ventilla A (5:S1W2), Structure 1, Patio 2	Museo Nacional de Antropología, Mexico City	Thin Orange	300–550	B/Large	medium major	18.0 × 11.8 × 14.2	75–325	2390–2740	yes	yes
8	Tecamachalco, Lomas de Santa Cruz, Puebla	Unknown (possibly Tecamachalco)	Thin Orange	c. 300–550	B/Large	medium minor	16.5 × 10.0 × 14.5	c. 75–300	unknown	no	no
9	Unknown (possibly Mitla, Oaxaca)	Field Museum of Natural History, Chicago	Thin Orange	350–550	B/Large	medium minor	16.0 × 12.0 × 15.0	c. 75–300	c. 3750–4370	no	no
10	San Martín Texmelucan, Puebla	Musée du quai Branly, Paris	Thin Orange	c. 300–550	B/Large	large minor	20.8 × 13.8 × 16.0	100–550	unknown	no	yes
11	Tepeaca, Puebla	Museo Regional de Puebla	Thin Orange, stuccoed	c. 300–550	B/Large (?)	unknown	unknown	unknown	unknown	no	no
12	Unknown (possibly Valley of Oaxaca)	Museo Frisell de Arte Zapoteca, Mitla (currently untraceable)	Thin Orange (?)	c. 350–550	B/Large (?)	unknown	unknown	unknown	unknown	no	no

Table 2: The sample set of Teotihuacan whistling vessels.

The Teotihuacan-A whistling vessels consist of a double vessel with two cylindrical chambers. The chambers are of the same size and volume, and connected by a conduit at the bottom and a small handle located above. One of the chambers is open, while the other one is closed by means of an element simulating a conical lid with a vertical rim, called a 'false lid', as the element is firmly attached and cannot be removed. The form of the closed chamber is a clear reference to the Teotihuacan tripod vases with lid. In place of the handle of the lid of the tripod vases, the false lid supports the small effigy of a seated monkey. On the basis of its characteristic crest, the animal can be identified as the Central American spider monkey (*Ateles geoffroyi*). The visual orientation of the monkey is always towards the open chamber. The vessels have three supports, which are similar to the hemispherical or conical supports frequently employed for tripod vases. Notably, the double-chambered vessels of this group still represent tripod vases, as one of the chambers (in general the closed one) has two supports while the other chamber has one. The supports are hollow with a small perforation on the side, made for the escape of air during the process of firing, but unlike the tripod vase forms with rattle supports, these supports never contain a ceramic pebble to make a rattling sound.[12]

Despite their size, the spider monkey figures attached to the false lid are represented in great detail. In contrast to the pregnant female monkey figures shown in the Teotihuacan-B vessels (see below), the monkeys shown in the Teotihuacan-A specimens are not shown with a curved belly and thus could be identified as representing males. The small whistle is placed in the head of the monkey, with the windway situated in its occiput. The whistle is connected to the interior of the closed chamber by means of a conical or tubular airduct, of which only the small circular or slightly oval exit hole is visible. Only one specimen of the sample (Reiss-Engelhorn-Museen, Mannheim: no. 4) has the windway intact, which in this case is circular in shape.

Vessel no. 1

As mentioned above, three Teotihuacan-A whistling vessels are grouped according to their size in the 'small major' class. One of these instruments was reported to be from Huejotzingo, Puebla (Figure 2; Table 2, no. 1). It was mentioned for the first time by Noguera without providing details about the find context.[13] At present, the vessel is preserved in the Museo Nacional de Antropología, Mexico City. It is made from Thin Orange ware and measures 14.8 cm in length, 7.6 cm in width, and 12.3 cm in height. The closed chamber is ornamented with, as part of the decoration of the false lid, five incised undulating lines, and around the vertical rim, six circular applications with a horizontal incision in the form of coffee bean type eyes. The monkey is shown with its arms resting on its knees, while the legs are bent and the feet placed together. The tiny exit hole of the airduct has a diameter of only 0.15 cm. The head of the monkey with the incorporated whistle has been

[12] Both 2021b.
[13] Noguera 1937: fig. 23.

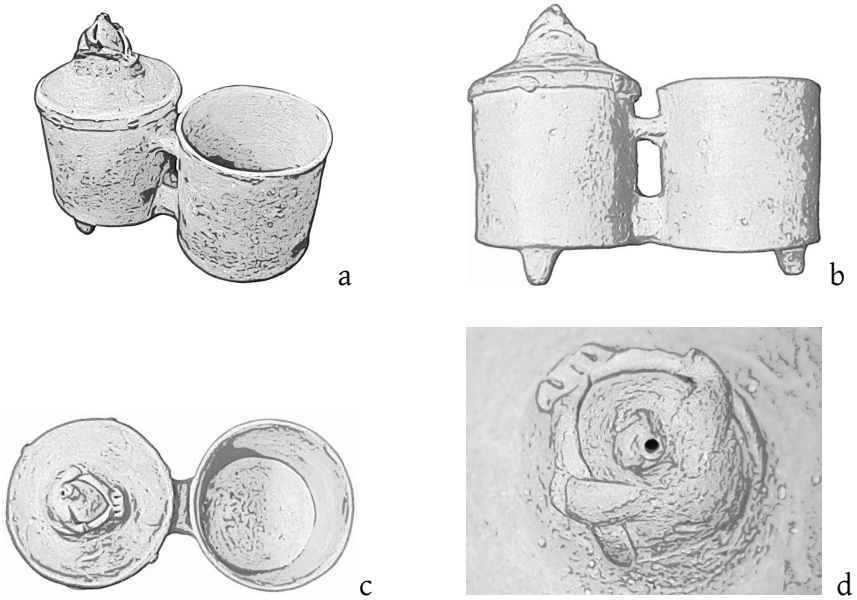

Figure 2: Teotihuacan-A whistling vessel from Huejotzingo, Puebla (L 14.8 cm, W 7.6 cm, H 12.3 cm; 350–650 CE); Museo Nacional de Antropología, Mexico City (Inv. 10–336582): a) three-quarter view; b) profile view; c) top view; d) detail of the monkey effigy showing the exit hole of the airduct. These and all following image-filtered whistling vessel drawings in this article are made by the author.

Figure 3: Reproduction of the Teotihuacan-A whistling vessel from Huejotzingo, Puebla, made by Osvaldo Padrón Pérez (2021), low fire clay. This and all following photos of whistling vessel reproductions in this article are made by the author.

knocked off. Possibly, this form of symbolic decapitation or ritual death of the vessel was related to the annulment of its sonorous function, indicating that the vessel originally formed part of a mortuary offering. For a reproduction of the find with replicated and reconstructed parts (Figure 3), the measurements of the preserved whistle of the Teotihuacan-A specimen from the Reiss-Engelhorn-Museen, Mannheim (see below, no. 4) have been applied.

Vessel no. 2

The second whistling vessel of the group is from Culpulalpan, Tlaxcala (Figure 4; Table 2, no. 2). The find measures 14.7 cm in length, 7.0 cm in width, and 12.0 cm in height and is currently stored in the magazine of the Etnografiska museet, Stockholm. It was excavated in 1935 by the Swedish

Figure 4: Teotihuacan-A whistling vessel from Culpulalpan, Tlaxcala, Burial 1 (L 14.7 cm, W 7.0 cm, H 12.0 cm; 550–650 CE); Etnografiska museet, Stockholm (Inv. 1935.09.0200): a) three-quarter view; b) profile view; c) top view.

archaeologist Sigvald Linné in one of the *teteles* or mounds of the site, and formed part of the mortuary offerings of Burial 1, which was associated with the topmost platform and temple structures of the building and therefore belonged to its last period of construction.[14] The vessel was located close to the back of the head of the deceased, who was buried in an extended position with the skull cap oriented towards the north and the sight towards the west (Figure 5). At approximately 150 cm in height, the buried person belonged to an adult age group, and the position of the burial indicates high status. Unfortunately, the condition of the osteological remains did not allow for sex determination. Further mortuary offerings consisted of a bowl decorated with *chalchihuites* (incised lines in the form of discs referring to something precious), a vessel without decoration, and a bead made from greenstone. All vessels were deposited in an inverted position towards the head of the deceased, possibly reflecting the thought that their physical and/or sonic contents were meant as a gift to the dead and an accompaniment of his travel into the underworld. The whistling vessel is made from *Anaranjado burdo* ware. As previously mentioned, this ware of Teotihuacan production was most common during the Metepec phase (550–650 CE), a time range which might well correspond to the latest construction stage of the excavated mound. Stylistically, the vessel could also be dated to an earlier phase, as suggested by Kidder et al.[15]

The decoration of this vessel presents engraved lines forming three flowers with five petals each, applied around each of the chambers. Notably, the flowers represent a variant of the Teotihuacan flower-symbol with four petals, supposedly related to the offering of sound or music and, according to a suggestion proposed by Manzanilla, representing the place glyph of Teotihuacan.[16] Additionally, the vessel shows a succession of *chalchihuites* engraved around the border of the false lid, and another incised line on its top side close to the vertical rim. The chambers also have a horizontally engraved line at the height of the conduit, possibly indicating the minimal quantity of liquid required for operation. Additionally, the vessel shows all over the surface, including the

[14] Linné 1942: 65–7, figs 115–17.

[15] Kidder et al. 1946: 192.

[16] Manzanilla 2009: 28, fig. 2.6a. A connection of the Teotihuacan flower-symbol with the notion of sound or music is made clear, among others, by the facade decoration of the Temple of the Plumed Conches (Both 2010: 186, fig. 8) and murals showing priests with stick-rattles from the Great Compound (Cabrera 1995: 19–20, fig. 2.1).

interior side of the open chamber, black spots of a so-far unidentified substance.[17] The monkey effigy has its arms resting on its knees, and legs crossed in the style of a lord. Its head is knocked off, a situation also observed in the vessel of Huejotzingo, Puebla (vessel no. 1), and possibly related to the ritual killing of the instrument as part of the funeral ceremony.

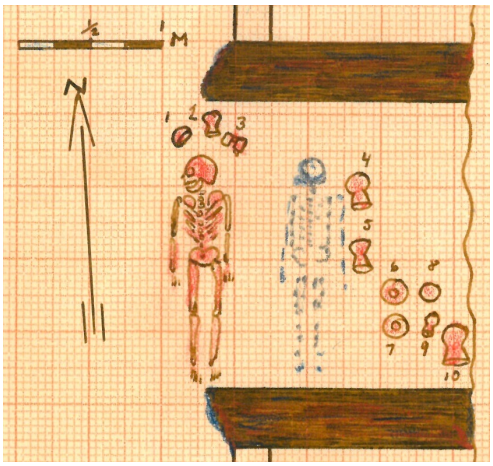

Figure 5: Sketch by Sigvald Linné showing the distribution of the osseous remains and mortuary offerings of Burial 1, Culpulalpan, Tlaxcala. The whistling vessel discussed is object number 3. Taken from the field notes of Sigvald Linné, Etnografiska museet, Stockholm.

Notably, the exit hole of the airduct of the vessel from Culpulalpan has exactly the same form and diameter as the find from Huejotzingo, which points to the close relation between these two instruments, despite their divergent decoration, differing type of ceramics and suggested place of manufacture (Teotihuacan for the vessel from Culpulalpan and southern Puebla for the vessel from Huejotzingo). As for the vessel of Huejotzingo, Puebla, the measurements of the preserved whistle of the Teotihuacan-A specimen from the Reiss-Engelhorn-Museen, Mannheim (see below, vessel no. 4), have been applied to create a reproduction of the find consisting of replicated and reconstructed parts (Figure 6).

Figure 6: Reproduction of the Teotihuacan-A whistling vessel from Huejotzingo, Puebla, made by Osvaldo Padrón Pérez (2021), low fire clay.

A unique feature among whistling vessels is the inclusion of three pebbles of porous volcanic stone (*tezontle*) in the closed chamber, deposited there before closing it with the false lid during the production of the instrument (Figure 7). In earlier publications these elements, which could be detected with a telescope camera, were never mentioned, although the pebbles clearly produce a sound when hitting against each other and the interior of the closed chamber, if the vessel is moved. In playing the above-mentioned reproduction with water it could be observed that the pebbles still produce sounds, although in this case the sound is perceived as less obvious.[18] Apart from the sound effects produced by the movement of the pebbles no effect on the flow velocity of the liquid or the acoustics of the whistle have been observed. It can be supposed that the inclusions were not deposited due to their sonorous effect but for another, rather symbolic motive. Possibly, they are related to

[17] Possibly, the spots represent drops of heated gum, which might indicate some ritual activity eventually carried out during the funeral, although it could not be excluded that the spots correspond to the remains of the operational liquid used for sounding the vessel.

[18] Therefore, the find could also be classified as a ceramic rattle, in organological terms, or even better as a whistling vessel-rattle, e.g. a hybrid aerophone-idiophone instrument, of which a number of conventional whistle-rattles are known at Teotihuacan as well.

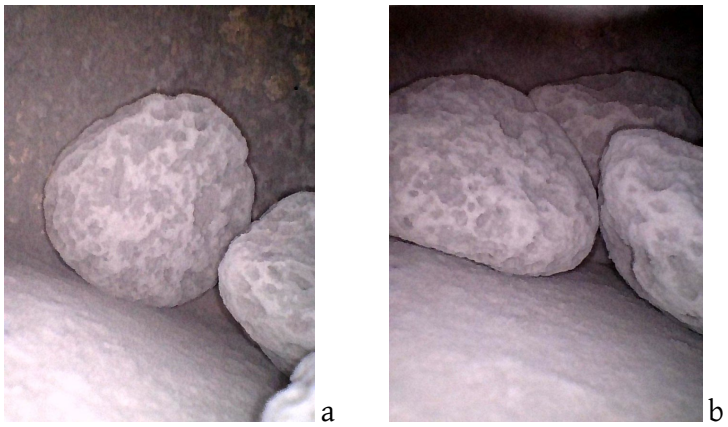

Figure 7: Photos taken by the author with a telescope camera, showing the stone pebbles deposited in the closed chamber of the whistling vessel from Culpulalpan, Tlaxcala.

the meaning of the Teotihuacan triple clusters consisting of three repeated elements reflected in multiple ways, such as in the architecture, the design of utilitarian objects, or the iconography.[19]

Vessel no. 3

Figure 8: Teotihuacan-A whistling vessel from San Juan del Río, Querétaro (L 13.5 cm, W 8.0 cm, H c. 15.0 cm; 550–650 CE); collection Francisco Cabrera, unknown repository: three-quarter view.

The third whistling vessel of the group is reported from San Juan del Río, Querétaro, and originally belonged to the collection of Francisco (José?) Cabrera (Figure 8; Table 2, no. 3). Its actual place of preservation is unfortunately unknown. The only existing and therefore quite valuable testimonials are a photo and the general measurements published by Martí.[20] According to the photo, the vessel is likely to be made of a granular ceramic, most possibly *Anaranjado burdo* like the aforementioned vessel from Culpulalpan, Tlaxcala (no. 2). The instrument measures 13.5 cm in length and 8.0 cm in width (Martí did not report its height, but roughly calculated it should not be greater than 15.0 cm). Each of the chambers has on the exterior wall a horizontal engraved line close to the bottom and a second line approximately located at the highest level of liquid for operating the instrument, framing engravings in the form of vertical or inclined bands composed of three semicircles each. These iconographic elements refer to clouds, sometimes applied in Thin Orange vessels and also found in the mural art. The monkey effigy seems to hold its hands in front of the mouth, as if it would whistle.

[19] Triple clusters are present, for example, in the array of three temples around a patio or in the erection of the three principal pyramids of the site (Pyramid of the Moon, Pyramid of the Sun, Temple of the Feathered Serpent), the number of supports of the tripod vessels, or the signs of three hills, three obsidian blades and three semicircles symbolizing clouds. It is also found in the form of three circles appearing in tassel headdresses, in the year sign, and in the sign of the marine shell/shell horn.

[20] Martí 1968: 117.

Figure 9: Teotihuacan-A whistling vessel, unknown provenance, possibly Teotihuacan (L 17.0 cm, W 8.5 cm, H 15.5 cm; 440–700 CE); Reiss-Engelhorn-Museen, Mannheim, collection Dieter and Evamaria Freudenberg (Inv. V Am 7231): a) profile view; b–c) details of the monkey effigy showing the circular exit hole of the airduct (b) and the circular windway (c) at the rear part of the figure.

Vessel no. 4

The only Teotihuacan-A whistling vessel belonging to the *medium minor* class is from the collection of Dieter and Evamaria Freudenberg currently preserved in the Reiss-Engelhorn-Museen, Mannheim (Figure 9; Table 2, no. 4). It is made from Thin Orange ware and measures 17.0 cm in length, 8.5 cm in width, and 15.5 cm in height. According to thermoluminescence dating, its period of production ranges between 440 and 700 CE, roughly during the phases of Late Xolalpan and Metepec.[21] The archaeological context of the find is unknown.

In contrast to the other whistling vessels of the Teotihuacan-A model, the instrument from the Freudenberg collection shows remains of a fine stucco layer covering the exterior surface, including the interior side of the open chamber. As in the instrument from San Juan del Río, Querétaro (vessel no. 3), the chambers have two horizontal engravings, one located at the bottom, the other one approximately at the highest level of liquid for operating the instrument. The three supports of the vessel present two falciform incisions each. The monkey attached to the false lid has its legs flexed, but not crossed. Unfortunately, the find was obtained in fragmented condition and restored in a way that prevents the whistle from sounding. It has an airduct with an oval exit hole of a diameter between 0.1 and 0.2 cm and a circular windway of a diameter of 0.2 cm. With an exterior diameter of 1.8 cm and a diameter of the resonator of approximately 1.4 cm, the whistle would sound

Figure 10: Reproduction of the Teotihuacan-A whistling vessel preserved in the Reiss-Engelhorn-Museen, Mannheim, made by Osvaldo Padrón Pérez (2020), whitish low fire clay.

[21] Freudenberg n.d. (unpublished catalogue of the collection). With the date of approximately 700 CE, Hickmann (2008: 176) only gave the latest date of the analyzed sample, information, which has been adapted subsequently, by that time unfortunately without knowledge of the Freudenberg catalogue (Both 2011: 74).

in a range of frequencies between 3080 to 3360 Hz, equivalent to a tonal range between G_7 (-31 cents) and $G\sharp_7$ (+19 cents), as tested on hand of a reproduction of the find with a functional whistle in the exact size of the original (Figure 10). The frequencies are higher than registered for the Teotihuacan-B/Large specimens and lower than registered for the Teotihuacan-B/Small ones.

3 Whistling vessels of the model Teotihuacan-B

The second group of Teotihuacan whistling vessels, identified as Teotihuacan-B, consists of a sample of eight specimens in total. The instruments of this group are composed of a double vessel whose chambers differ in terms of their form, size, and volume. The open chamber always presents the shape of a cup with slightly protruding walls. The closed chamber is always molded in the form of a female spider monkey effigy in seated position with the drawn-up legs only indicated. The monkey is shown to be in a more or less advanced stage of pregnancy, frequently in the position of caressing its belly. In contrast to the Teotihuacan-A model, the visual orientation of the effigy is in the opposite direction to the open chamber. As in the Teotihuacan-A vessels, the windway of the whistle is always situated at the occiput of the animal and at a higher position than the rim of the open vessel. Except for one specimen (Zacuala Patios: no. 5), the Teotihuacan-B instruments are all made from Thin Orange ware. As for the Teotihuacan-A models, the finds date approximately between 150/200 and 650 CE. In terms of size, two variants can be distinguished, denominated Teotihuacan-B/Small (two specimens: no. 5–6) and Teotihuacan-B/Large (six specimens, of which two are of unknown dimensions, but tentatively grouped here: no. 7–12). The B/Small vessels correspond to the *small minor* class (length less than 12.5 cm), and the B/Large vessels to the classes *medium minor* (15.0–17.5 cm in length, two specimens: no. 8–9), *medium major* (17.5–20.0 cm in length, one specimen: no. 7), and *large minor* (20.0–22.5 cm in length, one specimen: no. 10). Despite the homogeneous form of the vessels, apart from the divergent sizes some instruments differ in terms of figurative details of the monkey effigy and in the way the chambers are connected. A greater variability is also found in the organological composition of the whistles, especially in terms of the airduct-windway assemblages.

3.1 The whistling vessels of the variant Teotihuacan-B/Small

The instruments of this group correspond to the smallest whistling vessels documented for Mesoamerica. The measurements of the two documented finds are nearly identical, varying between 11.0 and 11.2 cm in length, 7.8–8.0 cm in width, and 7.2–8.8 cm in height. Due to their small size and the fine wall thickness the specimens are very light, ranging between 100 and 125 g. Compared to the greater volume of the open chamber, the closed chamber is always much smaller, which considerably reduces the maximum quantity of liquid that the vessel could contain for its operation. According to the experimental models, the quantity of operational liquid ranges between 25 and 75 ml (Zacuala Patios: no. 5) and 25 and 100 ml (MNA: no. 6), approximately.

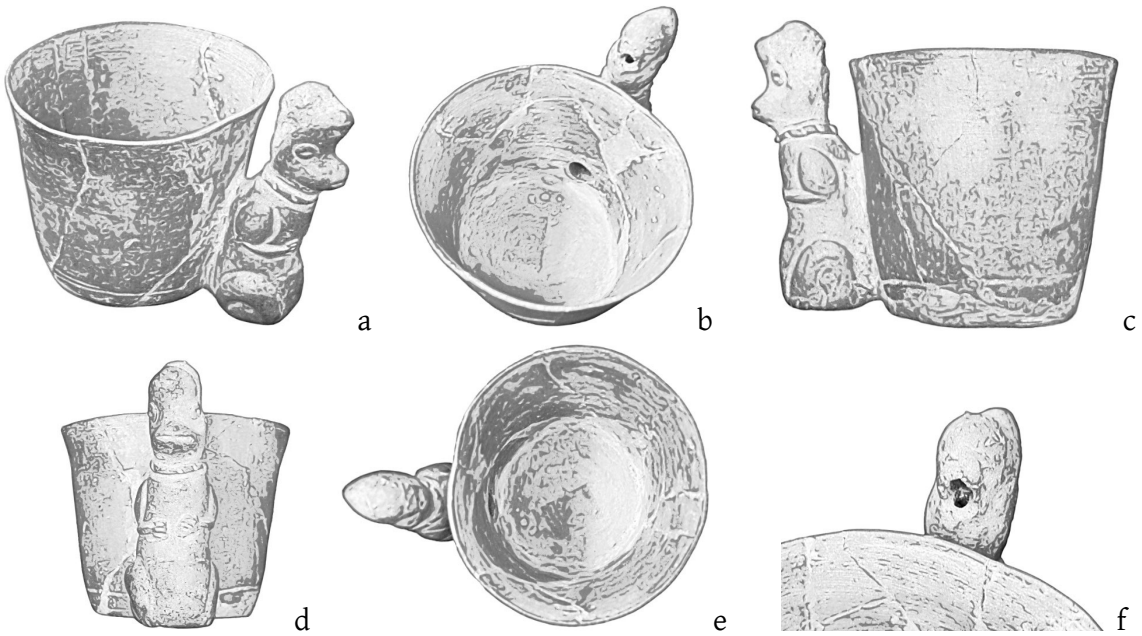

Figure 11: Teotihuacan-B/Small whistling vessel from Zacuala Patios (2: N2W2), Burial 11 (H 11.2 cm, W 7.8 cm, H 8.8 cm; 350–650 CE); Ceramotéca, ZMAT, San Martín Teotihuacán (Inv. 10–336626): a–b) three-quarter views; c) profile view; d) front view; e) top view; f) detail showing the airduct-aperture assemblage.

Vessel no. 5

One of the documented whistling vessels of this variant is currently preserved in the Ceramotéca, ZMAT, San Martín Teotihuacán (Figure 11; Table 2, no. 5). It formed part of the mortuary offerings of Burial 11 of Zacuala Patios (2: N2W2), excavated by Séjourné between 1955 and 1958.[22] The instrument measures 11.2 cm in length, 7.8 cm in width, and 8.8 cm in height, and its weight without liquid is 120 g. The ceramic style was earlier identified with Thin Orange ware, but according to our current analysis it is related to a ceramic type denominated by *Café fina*, particularly as its color does not have any orange or reddish components. According to Rattray, this ware represents a small group of special objects made from a local clay without the addition of any degrease, usually employed for the production of small cylindrical vases and cups of fine quality, especially during the phases of Late Xolalpan and Metepec, approximately dating from 500–650 CE.[23]

Burial 11 of Zacuala Patios belonged to an adult woman and was located below the wall of one of the rooms. In terms of its date, it was possibly related to the time of the construction of the compound during the Early Xolalpan phase, approximately between 350 and 500 CE, although the possibility that the burial dates to a later phase cannot be excluded.[24] The date is supported by the above-mentioned occurrence of the *Café fina* ware at Teotihuacan. According to the quantity and the type of the mortuary offerings, as categorized by Sempowski and Spence,[25] the woman

[22] Séjourné 1959: 57–8, lám. 31–2, fig. 38a; Séjourné 1966: fig. 153; Arndt 2015: 97–8, 102, fig. 2.37.
[23] Rattray 1979: 56.
[24] Sempowski and Spence 1994: 62.
[25] Sempowski and Spence 1994: 62.

belonged to a social group of high status. Apart from the whistling vessel, the burial contained a vessel with supports, 16 miniature vessels, an articulated figurine with movable arms and legs, osteological remains of a bird and a dog, a shell pendant (probably forming part of a row-rattle composed of shell tinkles before being offered), an obsidian blade, and the decayed remains of textile, a corncob and gourd (the latter probably forming part of one or two gourd rattles).[26]

The monkey effigy of the vessel shows the animal holding both hands over its chest. The belly is presented as slightly curved. In addition, the monkey wears an element in form of a cord around its neck, possibly showing a sling, although it could also simulate a necklace (see the whistling vessel from Tecamachalco, further below). In both cases the element indicates that a captured and domesticated animal is shown. With a diameter of 0.4 cm, the circular exit of the airduct is larger than the one of the whistling vessels belonging to the Teotihuacan-A model. In comparison, at 0.7 cm in width by 0.5 cm in length the oval windway is also quite large. On the other hand, the whistle itself is very small and therefore the generated frequency extremely high. The resonator presents an outer diameter of 1.4 cm and an inner diameter of approximately 1.0 cm. In operating an experimental model with accurate measurements of the whistle, frequencies from 4000 to 4370 Hz were produced, equivalent to the tonal range between B_7 (+21 cents) and $C\sharp_8$ (-26 cents).

Vessel no. 6

The second whistling vessel of the variant B/Small is currently exhibited in the Museo Nacional de Antropología, Mexico City (Figure 12; Table 2, no. 6). The instrument measures 11.0 cm in length, 8.0 cm in width, and 7.2 cm in height, and it weighs only 100 g. It is of Thin Orange ware, with a slightly reddish toned color, and the only decoration is an engraved line applied around the open chamber, more or less located at the maximum height of the liquid required for operating the vessel. The monkey effigy holds one of its hands over its belly and the other one above, slightly below the chest. The oval form of the exit hole of the aeroduct is identical to the form documented for the vessels' whistle from Zacuala Patios (no. 5). It measures 0.2 by 0.35 cm and is thus somewhat smaller. However, the windway is rectangular, presenting 0.5 in width by 0.3 cm in length, and thus differs considerably from the find from Zacuala Patios. Despite the difference, the measurements of the resonator of the whistle in terms of external and internal diameters are virtually identical to those of the vessel from Zacuala Patios, resulting in the production of comparable acoustical parameters. By blowing into a flexible tube inserted airtight into the entrance of the conduit, we managed to activate the whistle of the original find. It produces frequencies from 3750 to 4330 Hz, equivalent to the tonal range between $A\sharp_7$ (+10 cents) and $C\sharp_8$ (-41 cents). A reproduction was made with special emphasis on the correct measurements of the whistle, producing a comparable range in terms of the frequencies generated (Figure 13).

[26] A photo published by Séjourné (1959: 57, lám. 31) shows part of the mortuary offering.

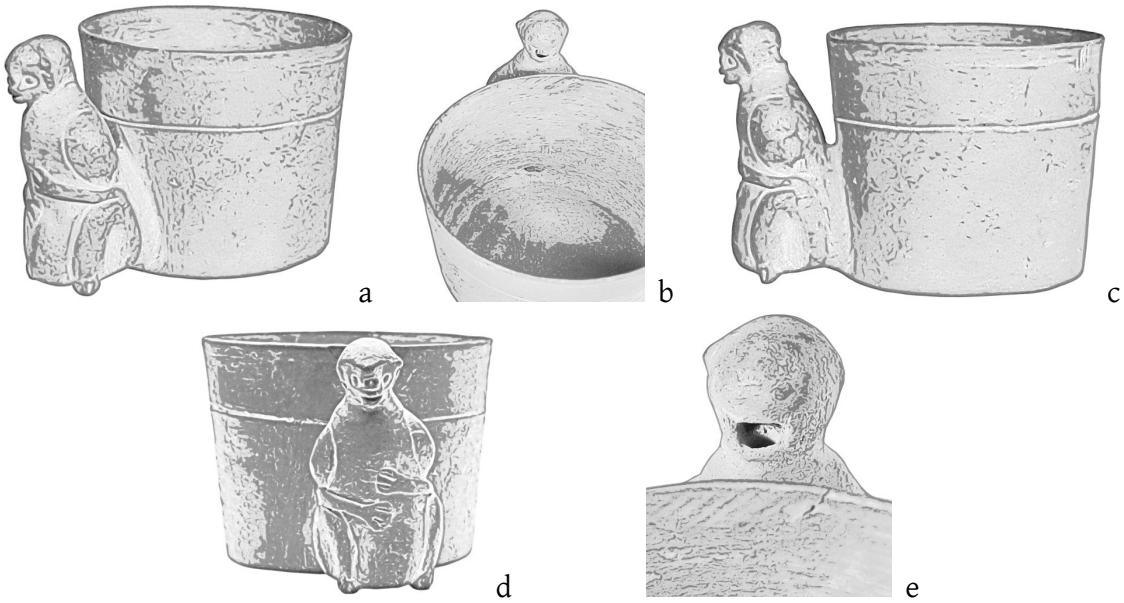

Figure 12: Teotihuacan-B/Small whistling vessel from Teotihuacan (L 11.0 cm, W 8.0 cm, H 7.2 cm; 350–650 CE); Museo Nacional de Antropología, Mexico City (Inv. 10–223557): a–b) three-quarter views; c) profile view; d) front view; e) detail showing the airduct-aperture assemblage.

Figure 13: Reproduction of the Teotihuacan-B/Small whistling vessel preserved in the MNA, Mexico City, made by Osvaldo Padrón Pérez (2021), low fire clay.

3.2 The whistling vessels of the variant Teotihuacan-B/Large

The instruments of this variant show a greater variability than the models previously described in terms of size and morphological details. Their size varies from 16.0 to 20.8 cm in length, 10.0 to 13.8 in width, and 14.2 to 16.0 cm in height. According to length, the majority belong to the classes medium minor and major (size range between 15.0 and 20.0 cm). Only one vessel of the sample (San Martín Texmelucan: no. 10) is a little bit larger, corresponding to the large minor class. The latter instrument also differs in terms of some construction elements. The weight of the instruments

ranges between 490 and 790 g. Compared to the volume of the open chambers, the closed chambers are still smaller, but much larger than in the Teotihuacan-B/Small variant. As a result, the vessels may contain a higher quantity of liquid, ranging between 75 and 325 ml (medium class specimens: no. 7–9) and 100 and 550 ml (large minor specimen: no. 10). The monkey effigies of the Teotihuacan-B/Large instruments show a belly by far more curved than in the Teotihuacan-B/Small models, indicating more strongly that these vessels show female monkeys in the state of pregnancy.

Vessel no. 7

One of the specimens of the variant Teotihuacan-B is currently exhibited in the Museo Nacional de Antropología, Mexico City (Figure 14; Table 2, no. 7). The instrument was made from Thin Orange ceramics. It measures 18.0 cm in length, 11.8 cm in width, and 14.2 cm in height, corresponding to the *medium major* class, and its weight is 490 g. It was excavated in 1963 by Piña Chan and Gonzales in Patio 2 of Structure 1, La Ventilla A (5: S1W2).[27] The burial has been dated to the phases Late Tlamimilolpa, 300–350 CE,[28] or Xolalpan, 350–550 CE.[29] Because of the poor osteological conditions, neither the sex nor the age of the deceased could be defined. Among the mortuary offerings were, apart from the whistling vessel, four bowls, a plate, a miniature florero, and the lid of a miniature vessel. On the surface of the instrument, including the interior of the open chamber, black spots are observed similar to those of the Teotihuacan-A specimen from Culpulalpan, Tlaxcala (no. 2). This possibly reflects a comparable funerary practice with an identical substance being offered, or identical remains of the operational liquid (see footnote 17). The whistle of this instrument has the exit hole of the airduct in the form of a slit (0.78 by 0.05 cm) and, such as in one of the Teotihuacan-B/Small vessels, a rectangular windway (0.65 cm in width by 0.3 cm in length). The resonator of the whistle has an exterior diameter of 1.8 cm and an interior diameter of 1.4 cm, approximately. The whistle is still intact, although a small perforation located in the wall of the whistle must be covered in order to measure its frequency range (as in the B/Small vessel described above, by blowing into a flexible tube inserted airtight into the conduit). According to our results, the whistle produces a frequency between 2390 and 2740 Hz, located in the tonal range between D_7 (+30 cents) and F_7 (-34 cents). Thus, the instrument sounds considerably lower than all other Teotihuacan specimens documented so far. Correspondingly, no other Teotihuacan whistling vessel documented presents a larger-sized resonator. Within the reproduction process a series of experimental test models from the find has been produced with the aim of better understanding the function of different organological parameters according to the whistling vessels' morphology, size and sound production (Figure 15).

[27] Martí 1970: 108–9, fig. 192; Arndt 2015: 98–9; 104, fig. 2.39.
[28] Sempowski and Spence 1994: 79.
[29] Teotihuacan 2009: 348.

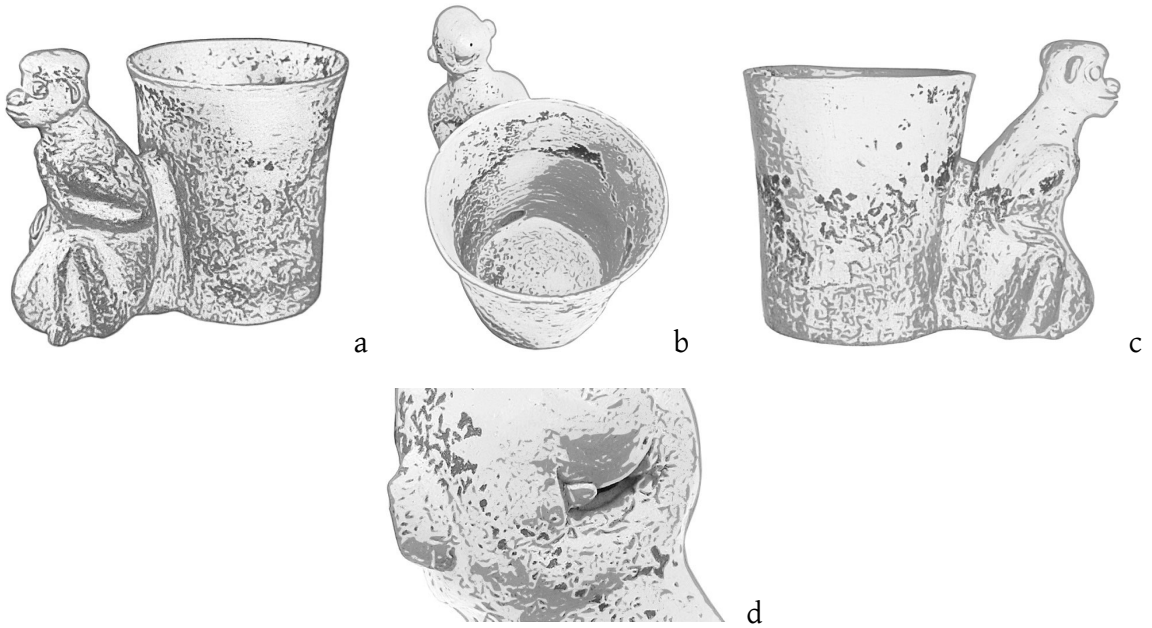

Figure 14: Teotihuacan-B/Large whistling vessel from La Ventilla A (5: S1W2), burial of Structure 1, Patio 2 (L 18 cm; W 11.8 cm, H 14.2 cm; 300–550 CE); Museo Nacional de Antropología, Mexico City (Inv. 10–0080673): a–b) three-quarter views; c) profile view; d) detail showing the airduct-aperture assemblage.

Figure 15: Reproductions of the Teotihuacan-B/Large whistling vessel from La Ventilla A: a) a production step of the experimental model without detailed figurative finishing made by Osvaldo Padrón Pérez (2020), low fire clay, sun-dried condition before burning (the whistle in front is a copy of the instrument built into the head of the monkey figure); b) version with accurately-sized containers made for experiments with different liquids made by Osvaldo Padrón Pérez (2021), low fire clay.

Vessel no. 8

Another instrument of the group was discovered accidentally in 1972 by the farmer Francisco Marin in the locality of Lomas de Santa Cruz of Tecamachalco, Puebla (Figure 16; Table 2, no. 8). The vessel is made from Thin Orange ware and measures 16.5 cm in length, 10.0 cm in width, and 14.5 cm in height, corresponding to the *medium minor* class. According to Hernández Reyes and Velázquez Cano,[30] who managed to review the find, the vessel might still be preserved under

[30] Hernández Reyes and Velázquez Cano 2017.

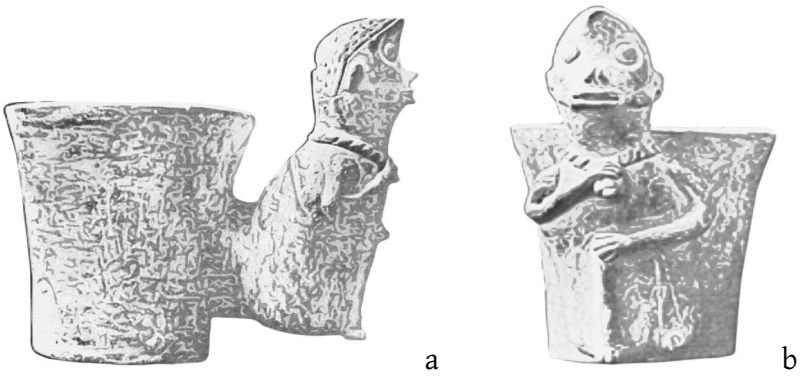

Figure 16: Teotihuacan-B/Large whistling vessel from Tecamachalco, locality Lomas de Santa Cruz, Puebla (L 16.5 cm, W 10.0 cm, H 14.5 cm); unknown repository: a) profile view; b) front view.

custody of the local authorities of the municipality of Tecamachalco. It formed part of a particularly rich burial, consisting of a cylindrical pit of 1.30 m in depth and a diameter of 0.9 m, excavated in the limestone bedrock. The pit was provided with a circular annex and covered by means of partially worked stones. The burial contained the osteological remains of three deceased people, one deposited in the annex and the other two in the pit, the latter in a seated position. Among the objects of the mortuary offering were, apart from the whistling vessel, 11 ceramic vessels of Thin Orange ware, such as a tripod vase with lid and a zoomorphic vessel in the form of a dog or coyote, 27 vessels of a ceramic type identified as *Café claro*, and 30 vessels of a type identified as *Café oscuro pulido*. Among other objects were two fragments of worked shell (possibly previously forming part of a shell rattle), four prismatic obsidian blades, three necklace beads, and a needle made from greenstone. Furthermore, the burial contained three superimposed sections of volcanic stone presenting remains of stucco, having the total height of 0.62 m (a cylindrical part, a conical part with steps, and a ball-shaped part decorated with four-petaled flowers in relief). Apparently, these sections formed part of a stela comparable to the ballgame marker discovered at La Ventilla, although the disk-shaped top section was missing from the mortuary offerings of the burial and the stela appears to be of smaller size and less ornate in terms of its relief decoration. Notably, the burial of Tecamachalco shows other relations with findings from La Ventilla. For example, burial pits excavated in the bedrock comparable in terms of their particular form and the seated position of their occupants were located by Vidarte in La Ventilla B (especially the Burials 3, 4, 10 and 16).[31] With respect to the offered objects, the zoomorphic vessel of a dog or coyote is similar to a vessel unearthed in Burial 86 of La Ventilla B,[32] while the whistling vessel is comparable to the previously described instrument from La Ventilla A (no. 7). The finds suggest close relations between the inhabitants of La Ventilla and the site of Tecamachalco, Puebla.

According to the available evidence, the open chamber does not present any decoration. Its form and the way it is attached to the open chamber show particularities not present in other vessels of the Teotihuacan-B model. Notably, the animal hardly shows a curved belly. Around its

[31] Vidarte de Linares 1964.
[32] Rattray 1997: 149.

neck it wears an element similar to the vessel from Zacuala Patios (no. 5), in this case undoubtedly simulating a necklace with a pendant composed of three sections, possibly to be identified with the Teotihuacan sign of the heart. In the context of the vessel, the pendant might be taken as a sign for any offering related to the context of the instrument as a sound-producing container for a sacred liquid. Particularly unusual is the way the chambers are attached. The base of the closed chamber is much higher than the base of the open chamber, making the latter the only proper stand of the instrument. The unique composition of the vessel also has an effect on the playing possibilities and its sonority, as the entrance of the conduit in the open chamber is placed much higher than usual. In operating an experimental model, we observed that the configuration does not allow for the full amount of liquid to flow into the closed chamber in a forward-tilting motion, with the result that some liquid always remains in the open chamber. Unfortunately, no information about the organological configuration of the whistle is present, apart from assuming its usual position at the occiput of the monkey. So far, no reproduction of the find has been made.

Vessel no. 9

The third whistling vessel of the group is currently preserved in the Field Museum of Natural History, Chicago (Figure 17; Table 2, no. 9). The instrument was first mentioned by Kidder and colleagues.[33] It is made from Thin Orange ware and measures 16.0 cm in length, 12.0 cm in width, and 15.0 cm in height, corresponding to the *medium minor* class. Probably, the find is from Mitla, Valley of Oaxaca, but there were always doubts about the exact provenance, except that it is likely to be from Oaxaca. If this is the case, it represents an object designed for long-distance export and interchange, which Teotihuacan maintained with several sites in the Valley of Oaxaca and beyond, from approximately 350 CE onwards for at least two centuries.[34] The design of the open chamber of the vessel is composed of engraved horizontal double lines, framing a band of undulating double lines with another undulating line of dot perforations in between, placed in the upper section of the outer wall. In the context of the whistling vessel, the iconography might refer to the operational liquid employed for the activities in which the instrument played a role. According to Rattray,[35] designs composed of these elements are characteristic to Thin Orange ceramics especially produced for export. The effigy of the closed chamber shows the crest of the spider monkey in a larger and therefore more emphasized form than in the previously described vessels. The face of the animal is slightly elevated and the mouth open, clearly showing it in a posture of vocal articulation. Below the eyes the effigy presents engravings simulating tears. This element could indicate that the vessel formed part of a funerary offering, such as the whistling vessels with archaeological

[33] Kidder et al. 1946: 192, fig. 197d-e.

[34] In terms of the interchange of musical knowledge the finds of Teotihuacan quadruple flute mouthpieces from Monte Albán are comparable testimonies (Winter et al. 2002: 631–2, fig. 3; Arndt 2014: 86–90, fig. 11; Sánchez Santiago 2016: 170, fig. 5.60).

[35] Rattray 1990: 188, fig. 6.

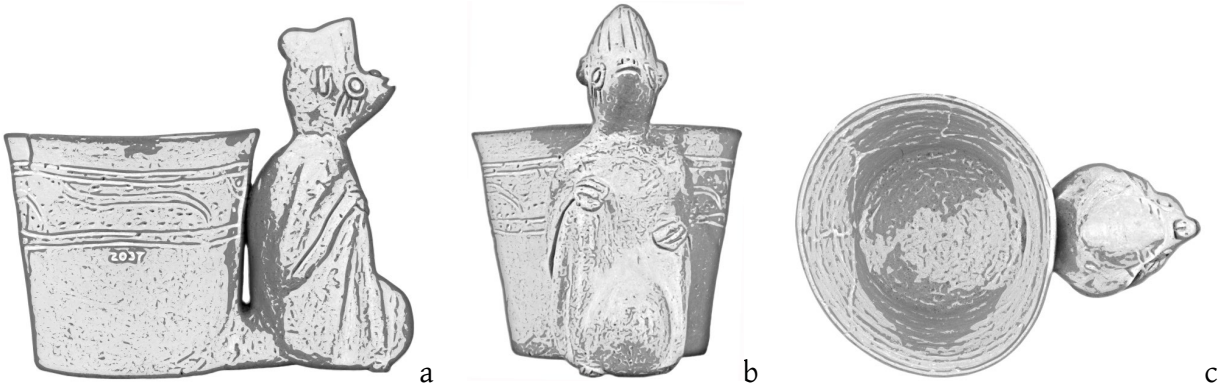

Figure 17: Teotihuacan-B/Large whistling vessel, possibly from Mitla, Oaxaca (L 16.0 cm, W 12.0, H 15.0 cm; 350–550 CE); Field Museum of Natural History, Chicago, collection W.H. Rice (Inv. 2037): a) profile view; b) front view; c) top view.

context previously described. According to the photos of the find published in the online catalogue of the museum,[36] the whistle presents a rectangular or trapezoidal windway, measuring approximately 0.45 cm in width by 0.25 cm in length. Neither the form nor the dimension of the exit hole of the airduct can be discerned. The outer diameter of the whistle measures approximately 1.5 cm and thus might produce a very high frequency located in the range of the B/Small whistling vessels mentioned above. So far, no reproduction has been made from this find.

Vessel no. 10

The largest whistling vessel of the sample is currently preserved in the Musée du quai Branly, Paris (Figure 18; Table 2, no. 10). The find is said to be from San Martín Texmelucan, Puebla.[37] It is produced from Thin Orange ware, and measures 20.8 cm in length, 13.8 cm in width, and 16.0 cm in height, corresponding to the class of *large minor* vessels. The size and form of the containers allow for a higher amount of operational liquid than in the previously described instruments. The instrument differs from the other vessels of the Teotihuacan-B model not only for the volume of the containers, but also in terms of a small handle placed between the open and the closed chamber, a constructive detail referring to the Teotihuacan-A model. Such as in the whistling vessels from La Ventilla A (no. 7) and Tecamachalco, Puebla (no. 8), the instrument does not bear any decoration in the form of engraved lines. The female monkey is shown in advanced pregnancy, holding its left hand over its belly. In the photos published in the online catalogue of the museum[38] the organological details of the whistle cannot be detected. Using a reproduction of the find (Figure 19) we observed that with the maximum amount of water the noises of the moving liquid and the respiratory sounds become very prominent.

[36] Consult the anthropological collections of the Field Museum online https://collections-anthropology.fieldmuseum.org/catalogue/1108518 [accessed December 21, 2023].

[37] Teotihuacan 2009: 348, Cat. 167b.

[38] A photographic documentation of different views of the find is published in the online collections of the museum http://collections.quaibranly.fr/ [accessed December 21, 2023]: search for "71.1878.1.1033".

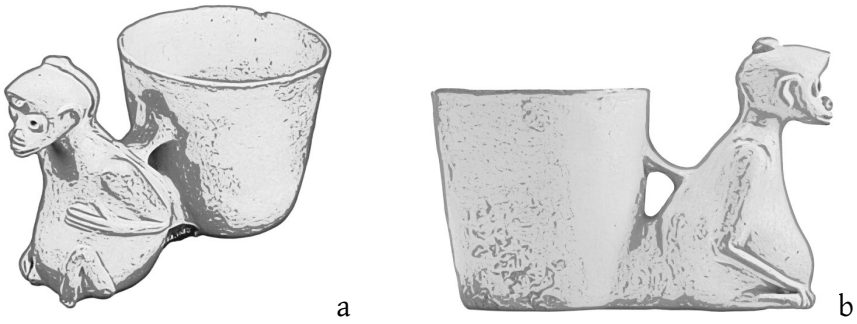

Figure 18: Teotihuacan-B/Large whistling vessel from San Martín Texmelucan, Puebla (L 20.8 cm, W 13.8 cm, H 16.0 cm; 350–650 CE); Musée du quai Branly, Paris, collection Eugène Boban (Inv. 71.1878.1.1033): a) three-quarter views; b) profile view.

Figure 19: Reproduction of the Teotihuacan-B/Large whistling vessel from San Martín Texmelucan, Puebla, made by Osvaldo Padrón Pérez (2021), low fire clay.

Vessel no. 11

Two further finds of the Teotihuacan-B model are documented but the only extant information available are photos and we cannot be sure if they form part of the B/Small or the B/Large variants, as the measurements are not given. Tentatively, we grouped these instruments here. One of the vessels is from Tepeaca, Puebla (Figure 20; Table 2, no. 11), and was first mentioned by Noguera.[39] Currently, the find is exhibited in the Museo Regional de Puebla. It is made from Thin Orange ware and in terms of its general form and design it is very similar to the specimen from La Ventilla A (no. 7). Apparently, it differs only in two details, the figurative simulation of the ears in form of a sound scroll, referring to the sonorous function of the vessel, and the application of a fine layer of stucco, whose remains are still visible on the photos published by Noguera. As previously described, stuccoed whistling vessels are also documented for Teotihuacan-A models (specimen from the Reiss-Engelhorn-Museen, Mannheim: no. 9). According to a more recent photo published in the Mediateca of the INAH, the remains of stucco are absent.[40] Notably, the instrument presents intentional damage in the exterior wall of the whistle placed at the monkey's forehead, similar to

[39] Noguera 1937: figs 21–2.

[40] https://www.mediateca.inah.gob.mx/islandora_74/islandora/object/objetoprehispanico%3A24887 [accessed December 21, 2023]. It might be that the stucco pulverized and flaked off, or that the remains were removed due to an inappropriate handling of the find. A comparable loss of stucco was documented for a whistling vessel from Oaxaca (Sánchez Santiago 2020: 6).

Figure 20: Teotihuacan-B whistling vessel from Tepeaca, Puebla (undocumented measurements; 350–550 CE); Museo Regional de Puebla (Inv. 10-203342): a) three-quarter view; b) profile view; c) front view.

the perforations observed in the whistling vessel from La Ventilla A and the further below described Maya instrument from Teotihuacan.

Vessel no. 12

For the last whistling vessel of the sample, only a photo in black and white is known (Figure 21; Table 2, no. 12). The find is currently preserved in the Museo Frisell de Arte Zapoteca, Mitla.[41] However, during a recent inventory, the object could not be located.[42] It can be assumed that the vessel is from a Teotihuacan-related site in the Valley of Oaxaca and represents an imported object, such as the previously described vessel preserved in the Field Museum of Natural History, Chicago (no. 9).[43] The instrument presents some elements similar to the described specimens, namely the ears in form of sound scrolls, comparable to the vessel from Tepeaca, Puebla (no. 11), and the element in form of a sling or a necklace without pendant, comparable to the vessels from Zacuala Patios and Tecamachalco, Puebla (no. 5 and 8, respectively).

Figure 21: Teotihuacan-B whistling vessel, unknown provenance, possibly from the Valley of Oaxaca (undocumented measurements; 350–550 CE); Museo Frisell de Arte Zapoteca, Mitla, collections of Robert Frisell and Howard Leigh: three-quarter view.

4 Cross-cultural comparisons

4.1 *Preclassic period whistling vessels*

The whistling vessels from Teotihuacan represent autochthonal forms, having little in common with the Preclassic instruments known from the Central Mexican Highlands, which are character-

[41] Boos 1966: fig. 453.

[42] Sánchez Santiago, personal communication, 2021.

[43] For the photo a rare perspective and probably also an inappropriate objective lens has been chosen, which appears to show the monkey effigy of the closed chamber as rather large in comparison to the open chamber, and the closed chamber by far slimmer than proposed.

ized by a single chamber, or the Preclassic double chambered vessels from Oaxaca, Chiapas, and Guatemala.[44] A trait the Teotihuacan instruments do share with some Preclassic specimens documented for the Mixteca Alta and the Valley of Oaxaca is their small size in terms of two important measures, namely the length, as the principle measure taking as reference point for comparison (see above), and the operational quantity of the liquid in ml. Effectively, these instruments and the Classic period Teotihuacan-B/Small specimens belong to the smallest whistling vessels documented in the Americas.

Another common trait is the presence of the closed chamber in the form of the monkey, a feature already observed in some Preclassic period whistling vessels of Oaxaca, the Highlands of Chiapas, and the Guatemalan Highlands. In one particular find excavated in Chiapa de Corzo, Chiapas, the effigy can already be identified as a spider monkey. The vessel from Chiapa de Corzo dates to the Middle Preclassic period, 750–400 BCE,[45] and thus represents the earliest double-chambered whistling vessel documented for Mesoamerica so far. As with the Teotihuacan whistling vessels, in this specimen the whistle is incorporated into the head of the animal, here in the place of the typical crest of the spider monkey and not in the back of the head, such as in the Teotihuacan specimens.[46] Engravings below the eyes of the monkey effigy simulate tears.

A roughly contemporary Preclassic period vessel from Oaxaca currently preserved in the Museo Nacional de Antropología, Mexico City, also has a closed chamber in the form of the spider monkey.[47] Undulating incised lines below the eyes of the animal symbolize tears. Its crest is shown in an overemphasized manner, such as in the Teotihuacan-B vessel said to be from Mitla (Field Museum of Natural History, Chicago: no. 9), the latter also presenting engraved lines representing tears, indicating that these monkeys are portrayed in the state of crying.[48] Across the chest, the vessel presents further engravings, probably referring to the operational liquid, while outlines of a penis between the legs clearly identify a male monkey, referring to fertility such as the female monkey effigies in the state of pregnancy of the Teotihuacan-B specimens.

Another instrument also dating from the Preclassic period, possibly originating from Kaminaljuyu, Guatemala, and of 24 cm in length, shows the closed chamber in the form of the face of a monkey, with two whistles incorporated in such a way that the windways are located in place of the eyes.[49] This feature results in the effect that, by using a sufficient quantity of liquid, the instrument may truly 'cry', and in this very moment would triller and eventually lose its sonorous

[44] Martí 1970: 38–9, fig. 19; Sánchez Santiago 2020; Bachand 2013: 41–2, fig. 15; Rodens et al. 2013.
[45] Bachand 2013: 41.
[46] In consequence, the crest presents an elongated and round form, possibly contributing to the interpretation of the effigy as a dwarf with a type of cap (Bachand 2013: 41).
[47] Caso et al. 1967: 164; 168, fig. 120; Sánchez Santiago 2020: 7–8, fig. 12.
[48] Paradoxically, only human beings shed tears of emotion, indicating that the monkeys are either humanized or that humans transformed into monkeys are shown. In both cases mythological thought might be inherent.
[49] Rodens et al. 2013; Matthias Stöckli, personal communication 2021.

function.[50] The repeating aspects related to the notion of grief and fertility documented for some of the Preclassic whistling vessels are certainly related to the possible uses and functions of these instruments.

4.2 *Classic period whistling vessels*

A series of Classic period whistling vessels, in particular from Oaxaca and the Maya area, show Teotihuacan influence and thus could be labeled as foreign variants representing adapted forms. So far, five vessels from Oaxaca related to the Teotihuacan-A model are known. Two of these instruments are currently preserved in the Museo Nacional de Antropología, Mexico City, and have a documented archaeological context. The better-known specimen has been excavated as part of a funerary offering in Tomb 109 of Monte Albán;[51] the other, unpublished and partially fragmented one is from Ejutla.[52] The other three, partially fragmented vessels belong to the Frisell Collection without archaeological context information.[53] All these instruments are larger in size than the Teotihuacan-A specimens. The vessels also differ in the absence of the three supports and the border of the false lid, the application of relief designs in the form of cartouches, and figurative details of the monkey effigy situated on top of the closed chamber. Some of the instruments show a higher form of the cylindrical chambers and thus could represent morphological bridges to contemporary Maya whistling vessels (Metropolitan Museum of Art, New York, see below) and the Epiclassic/Early Postclassic whistling vessels from Xochicalco, Morelos.[54] The acoustics of the whistle of one of the vessels from the Frisell Collection (Inv. 2964) was recently documented.[55] With frequencies between 2088 and 2222 Hz, corresponding to the tonal range between C_7–4 and $C\sharp_7$+4, the instrument sounds over a full tone lower than the Teotihuacan models.

Four Classic period Maya whistling vessels could be classified as adaptations representing a mixture of the Teotihuacan models with new elements. Three of the instruments are without documented archaeological contexts. One of these instruments, currently preserved in the collections of the Library of Congress, Washington (Inv. KISLAK PC 0128), refers to the Teotihuacan-B model, with the exception that the open chamber shows two supports and the pregnant monkey effigy has more strongly emphasized legs, which are a third support.[56] The find is possibly from the lowlands of Guatemala and presents a length of 24.0 cm, corresponding to the *large major* class of whistling vessels. Therefore, it is much larger than the Teotihuacan instruments. Teotihuacan iconography is copied by engraved lines representing ascending scrolls on the closed chamber and

[50] In operating the original instrument with water, it could not be sounded at all, likely due to either invisible damage of the airduct-windway assemblages or bits of earth blocking the airducts.
[51] Caso et al. 1967: 300, fig. 256b; Sánchez Santiago 2020: 9–10, fig. 15.
[52] A photographic entry of the latter find is to be found in the Archivo Fotográfico 'Manuel Toussaint', Instituto de Investigaciones Estéticas, UNAM, Mexico City (Sánchez Santiago, personal communication 2021).
[53] Caso et al. 1967: 164, 169, fig. 122; Boos 1966: fig. 45; Sánchez Santiago 2020: 10, figs 16–17.
[54] Both and Giles 2017: 62–4, fig. 16a–c.
[55] Sánchez Santiago 2020: 10–11; 13; tab. 1, figs 18 and 22.
[56] Dunkelman and Ehrenberg 2007: 26, Cat. 73.

especially by a border of scrolls in the form of waves below the rim of the open chamber. In the context of the vessel, these can be taken as a reference to the operational liquid of the instrument and its sound. Two cartouches engraved on the wall of the open chamber show snakes in profile view.

The second instrument is currently preserved in the Metropolitan Museum of Art, New York (Inv. 1978.412.90a,b), and shows similarities to the Teotihuacan-A model, with the exception that the vessel presents four supports instead of three and that both chambers are equipped with lids, a false one for the closed chamber and a real one for the open chamber.[57] The false lid shows, in place of the monkey effigy, a figure representing the Principal Bird Deity, whereas the removable lid presents a male human figure wearing a headdress and assuming position of praying or offering.[58] A third figure identified as a jaguar is attached at the intersection of the chambers at the height of the conduit. In comparison with the Teotihuacan-A vessels, the instrument is larger (18.7 cm in length), placing it in the *medium major* class. As the height of the chambers is roughly two times greater than in the Teotihuacan-A vessels, a far greater amount of operational liquid could have been used.

The third Maya instrument has been documented without reference to the actual storage in the Precolumbian Portfolio published online by Justin Kerr (K4009).[59] The vessel differs in terms of the closed chamber, shown not in the form of a monkey, but of a person represented in the seated position of a lord, with his mouth open as if talking or singing. The visual direction of the effigy towards the side of the vessel is particularly unique. The open chamber resembles the cylindrical form of the Teotihuacan-A model and even shows a miniature form of the characteristic support.[60]

Most interestingly, the fourth Maya find, which has not been published so far, has been excavated in Teotihuacan (Figure 22). Currently, it is preserved in the Museo Nacional de Antropología, Mexico City. Unfortunately, information on its find history is lacking in the museum records. The vessel is made from orange-reddish ceramics with black spots, strongly resembling the Usulután ware of the Maya area, dated to the Late Preclassic period dating from 400 BCE–250 CE.[61] Notably, a Maya whistling vessel from San José Escuintla, Guatemala, is also made from Usulután ware,[62] and as the Escuintla region maintained close contacts with Teotihuacan, it is likely that the vessel originates from there. For its presence in Teotihuacan, it could be dated roughly 200–250 CE or to the beginning of the Early Classic period from 100–250 CE. The instrument measures 17.8 cm in length,

[57] Newton 1978: 189. Photographic views of the find are published in the online collections of the MET https://www.metmuseum.org/art/collection/search/310542 [accessed December 21, 2023].

[58] For an interpretation of the scene, see Taube 1987.

[59] Consult http://research.mayavase.com/kerrportfolio.html [accessed December 21, 2023]: search for "4009".

[60] Vessels with anthropomorphic effigies combined with open chambers in cylindrical form are also documented for Postclassic finds from the modern states of Puebla and Michoacan (Noguera 1937: 16, figs 15–16; 20; Kidder et al. 1946: 191–2, fig. 78f), representing legacies of the Classic period Teotihuacan-A and related Maya vessels.

[61] Demarest and Sharer 1982.

[62] Kidder et al. 1946: 191, fig. 78c.

Figure 22: Maya whistling vessel from Teotihuacan (L 17.8 cm, W 10.7 cm, H 16.3 cm; 200–300 CE); Museo Nacional de Antropología, Mexico City (Inv. 10-223556): a) profile view; b) front view; c–d) details of the effigy showing the exit hole of the airduct and the windway.

10.7 cm in width, and 16.3 cm in height, corresponding to the *medium major* class, and it has a weight of 630 g.

The find shares a series of elements with the vessel documented by Kerr mentioned above (K4009). In the form of the closed chamber, it presents another version of the male person shown in the seated position of a lord, with the difference that the visual direction is in the opposite direction to the open chamber, like in the Teotihuacan-B vessels. His face presents very similar traits, especially in terms of the form of the eyes and the open mouth. The figure stands out for its hairstyle, having very long hair bound together with a knot at the back of the head. Furthermore, the person wears large earspools and a necklace of massive beads, both elements simulating greenstone jewelry. The position of the hands is unknown, as they are knocked off, possibly as a result of intentional damage. The wall of the open chamber is slightly protruding and thus is similar to the form of the open chambers of the Teotihuacan-B vessels, while the conduit at the bottom and the handle above resembles constructive details of Teotihuacan-A specimens.

As in the Teotihuacan-B instruments, the windway of the whistle is situated at the occiput of the effigy. However, differences in terms of its organological configuration can be observed. The exit of the airduct is falciform (shape of a slightly curved slit) and the windway is circular, a combination not observed in the Teotihuacan whistling vessels and also not in other wind instruments from the site. Notably, the wall of the resonator presents a small circular perforation, which is nearly identical to the damage documented in the vessels from La Ventilla A and Tepeaca, Puebla (no. 7 and 11, respectively). According to our interpretation, these damages, such as the knocked-

off effigy heads documented for the Teotihuacan-A vessels, reflect forms of intentional destruction or ritual killing of the instruments, related with the annulment of their sonorous function.[63] The resonator has an outer diameter of 2.0 cm, and an inner diameter of approximately 1.5 cm, and is thus slightly greater than the largest one documented for the Teotihuacan whistling vessels (La Ventilla A: no. 7). Maybe because of its damaged part, but more likely because of invisible damage or insufficient cleaning of the airduct, the whistle does not sound. In playing a replica of the whistle (the whistling vessel has not been reproduced so far), frequencies between 2390 and 2580 Hz were obtained, corresponding to the tonal range between D_7 (+30 cents) and E_7 (-38 cents).

In summary, the contemporary instruments from Oaxaca and the Maya discussed represent variations or adaptations of Teotihuacan forms. They generally consist of larger vessels, which might contain a higher amount of operational liquid, and their whistles are characterized by larger resonators, resulting in somewhat lower frequencies. In the organological configuration of the whistles, different combinations of the airduct-windway assemblage can be observed. In the Teotihuacan-A and B/Small vessels consistent combinations are present (airduct with circular exit – circular windway in Teotihuacan-A, airduct with circular or oval exit – rectangular or trapezoidal windway in Teotihuacan-B/Small), while the combinations of the B/Large instruments and their respective sizes present a greater variability. The foreign instruments show comparable configurations, but also combinations not documented for the Teotihuacan models. An example is the above-described Maya vessel found in Teotihuacan, which has an airduct with slit-shaped/falciform exit and a circular windway. This unique configuration clearly demonstrates that the instrument is an imported object. It can be supposed that the different configurations reflect different musical traditions developed within the cultures and in constant interaction with others.

5 Considerations regarding the construction and functionality of the Teotihuacan whistling vessels

For the instruments of both Teotihuacan models, especially those grouped into the *small* class of whistling vessels (most of the Teotihuacan-A and the B/Small specimens), we observed the highest craftsmanship in the design of the instruments, achieving a precise equilibrium of the morphological composition and its related hydraulic/eolic and organological/sonic functions. Among the principal elements are the general form of the chambers (defining the volume of the liquid required for the compression of the air and the acoustical function), the length and the diameter of the conduit (defining the flow velocity of the liquid and therefore also related to the generated air pressure), and the position of the whistle and its organological configuration (defining its acoustics). Through the production and operation of the replicas and experimental models we managed to analyze the effects of the different forms and sizes of these elements, a process which must have also occurred during the development of these instruments in pre-Columbian times. This approach

[63] In the case of the small circular perforations, it is possible that they were made by means of a precise blow with an obsidian arrowhead.

revealed the technological and organological knowledge inherent in the Teotihuacan whistling vessels.

One result of the experiments is that the conduit is the crucial hydraulic device for the operation of the instruments. In terms of its size, the difference between a functional and a nonfunctional instrument lies within the range of millimeters. If the length of the conduit is too short and the diameter too small, the flow velocity of the liquid is reduced, resulting in the effect that the hydraulic movement does not generate sufficient air compression for activating the whistle. In general, by means of the experiments it could be verified that the conduits require a diameter of at least 0.7 cm in the B/Small vessels, 1.0 cm in the Teotihuacan-A vessels and 1.4 cm in the B/Large vessels. The gradual augmentation of the diameters is clearly related to the respective size of the instruments. For all the models, the length of the conduits could not be shorter than approximately 2.5 cm.

Another crucial element for the functionality of the whistling vessels is the quantity of the liquid required for acoustic operation. In addition to the size of the conduit, the volumetric capacity has an effect on the flow velocity of the liquid and the air compression generated by the hydraulic movement within the containers. Because of its reduced weight, a smaller volume of liquid results in a lower amount of pressure. In handling the experimental models, we observed that instruments with volumes of operational liquid lower than for the model Teotihuacan-B/Small do not operate well, as not enough air pressure is generated. These instruments are among the smallest whistling vessels so far documented for the Americas. They hold only 25–100 ml of liquid, while the largest whistling vessels known may hold ten times that amount, up to one liter or even more.[64] Based on these observations it is clear that it was much more difficult to produce a functional whistling vessel of smaller size than a larger one. In the larger specimens, the required air compression depends less on the morphology of the constructive elements, as the higher pressure generated by the liquid always guarantees that the whistle sounds.

The placement of the whistle in a higher position than the height of the open chamber is related to the functionality of the instruments, as the probability that liquid enters the airduct, escapes, and finally blocks the windway is reduced. Moreover, the functionality is related to the construction of the whistle, produced so precisely (in terms of avoiding clay residues that might make the inner walls of the airduct and the windway uneven) that the instrument may sound with even the gentlest breeze, corresponding to the lowest pressure generated by the moving liquid.

By operating replicas and experimental models we could document that the length of the airduct has no great effect on the operation of the whistle, especially if its exit is small, as in the vessels of the Teotihuacan-A model (in which the exit of the airduct was the size of a needle point). In addition, we observed that by means of shorter airducts the probability that liquid enters the duct and stops the function of the whistle is reduced. This could represent one of the possible reasons for the implementation of short tubular or conical airducts with circular exit holes in place

[64] Both 2011.

of longer airducts with slit-shaped exit holes, especially for the Teotihuacan-A specimens. It should be mentioned that because of the absence of radiographies or computed tomographies of the Teotihuacan whistling vessels we could not verify the shape of the entrance of the airducts in the closed chambers. In the experimentations carried out with the Teotihuacan-A experimental models it was observed that it is possible to reduce the size and the form of the airduct to a constricted passage with a very small diameter and a length of not more than five millimeters, corresponding to the wall thickness of the false lid. The effect of such a configuration is that, even with the greatest inclination of the closed chamber in forward motion, virtually no liquid could enter the airduct. Such construction effectively means that the whistle cannot be prevented from sounding.

By contrast, in the tests carried out with the Teotihuacan-B reproductions mentioned above, we observed that it is virtually unavoidable that liquid escapes through the airduct and blocks the windway, especially when using the maximum amount of operational liquid. Usually, the sonorous function is stopped in such cases, as the airstream is interrupted. However, the liquid frequently does not fully block the windway, resulting in the effect that the remaining drops around the exit hole of the airduct and the windway produce trill effects. A possible organological support for this is the fact that the exit holes of the airduct and the windways are considerably larger than those of the Teotihuacan-A model. However, the continuous production of trill effects as part of the sonic cycle of these instruments is difficult to control in continuous playing, as the whistle will eventually be blocked. Operating the models with edible oil, we observed that with more viscous liquids than water the probability that the liquid will enter the airduct, escape, and block the windway is reduced. This could indicate the possible employment of a substance other than water for the Teotihuacan-B models, and in smaller amounts.

As previously mentioned, the earliest cultures in Mesoamerica in which double-chambered whistling vessels corresponding to the *small minor/major* class were produced, were situated in the Preclassic period regions of the Valley of Oaxaca and the Mixteca Alta. During the Classic period *small* class whistling vessels were exclusively produced in Teotihuacan. The reason for the production of such small instruments is a question still unanswered. The construction of these acoustic devices required the highest technological and artistic perfection. It certainly reflects an impressive level of knowledge or, in other words, is a sign of an elaborate culture. But there could also be other reasons, possibly related to the use of these instruments and their cultural context. Apparently, the vessels are associated with the employment (and possibly the consumption) of very small quantities of liquid.

The resulting sounds produced by different whistling vessel sizes and corresponding quantities of liquid is that larger instruments produce diverse noises of the moving liquid, while smaller quantities of operational liquid do not produce such sound effects. An interesting observation is that some of the largest whistling vessels documented in the Americas, having a length of 32.5 cm or more and thus corresponding to the *large superior* class, were employed contemporaneously to Teotihuacan in a region of contact, the Maya area (one of the largest known finds is from Tomb A-I, Kaminaljuyu; even larger specimens are known from the Bahía and Jamacoaque cultures,

Ecuador).[65] In other words, two Classic period cultures related to each other through a network of contacts employed whistling vessels of diametrically different sizes, one of the smallest ones and one of the largest ones documented for all pre-Columbian societies so far. Important in this context is the existence of foreign variants and adaptations of the Teotihuacan models produced in the Maya area on one side, and the Maya whistling vessel from Teotihuacan on the other side. This demonstrates the mutual knowledge of different-sized whistling vessels from the other cultures. Apparently, certain instrumental contexts required different sonorous aesthetics, with the sounds generated by the moving liquid preferred among the Maya, while these sounds were reduced in the smaller vessels documented for Teotihuacan.

Among the possible operational liquids already mentioned are water, or a series of beverages produced from agave, corn, or cacao, some of which contain alcohol and could have been enriched with extracts from psychotropic plants. Some of these liquids, especially the above-mentioned beverages, are thicker or more viscous than water and therefore flow in a slower motion. This condition also has an impact on the handling and the sound characteristics of the instruments. By means of playing the experimental models with olive oil (instead of using one of the above-mentioned beverages, which were not available), we tested different operational and acoustical effects compared to playing the instruments with water. The reduced velocity of the liquid in this experiment resulted in considerably longer sonic cycles and a longer duration of the tones generated by the whistle. Furthermore, virtually no noise was generated by the moving liquid.

Another factor related to the handling of the instruments is the additional weight added by the employment of different liquids. When operating the B/Small models with water, the liquid does not add more than 25–100 g to the weight of the vessel, while in the largest known instruments the quantity of water would add one kilogram or more. Thicker liquids would add even more weight. Certainly, the question of the type of operational liquid is related to the use of the instruments, their meaning, and cultural contexts, especially if the substance was considered sacred and therefore exclusively reserved for ritual or ceremonial activities. And the type of liquid may also have been dependent on whether the use of the liquid was restricted to certain groups of the society, and/or if handling the vessels included its consumption, during or after playing.

6 Meaning and cultural context of Teotihuacan whistling vessels

The existence of different models and variants of whistling vessels employed in Teotihuacan and other contemporaneous sites of the Central Mexican Highlands, evidence for exported Teotihuacan instruments in Oaxaca, and foreign variants and adaptations produced in Oaxaca and the Maya area, are indicators of a flourishing and charismatic music culture. Common elements related to the specific meanings and the cultural contexts of the instruments can be found between the different societies. However, it cannot be taken for granted that instruments virtually identical in

[65] Kidder et al. 1946: 190–91, fig. 77; 179h; 179i.

terms of their form were necessarily employed in identical contexts. Depending on the cultural developments and interactions across time, it can be assumed that a kaleidoscope of different associations and uses is present, of which only portions can be deciphered at present. Because of the absence of a greater sample, especially in terms of more finds with better documented archaeological contexts, the meanings and cultural contexts of the instruments are difficult to interpret. Also, it is still difficult to deduce information on the playing postures and movements, whether the instruments were employed in solo performances or in groups, if playing was a ritual activity only carried out by religious specialists and/or a courtly activity reserved to the chiefs and clan leaders, if the use of the instruments was gender specific, if the employed liquids were the subject of shared consumption, or other factors already discussed, such as the nature of the operational liquid.

6.1 Archaeological contexts

An important factor for understanding the meanings and cultural contexts is the archaeological find situation of the instruments. According to the available data, the vessels represent a very special and, compared to other mortuary offerings, rare group of burial objects. For the Thin Orange, *Anaranjado burdo* and *Café fino* wares, the amount and type of the other mortuary offerings deposited in the burial (especially rich the finds from Zacuala Patios and Tecamachalco, Puebla), and the position of the burials (especially the find from Culpulalpan, Puebla), indicate that the instruments were elite utensils related to persons who occupied higher ranks within the society. The position these persons occupied might never be known, but as the finds are quite rare in comparison to other, more conventional grave goods, it could be that the vessels were the personal objects of the buried persons. Apparently, the instruments were of such importance that they were offered in order to accompany the deceased to the world of the dead. The possibility that the instruments were specifically produced for the mortuary offering and that the occupants of the burials in fact never listened to their sound cannot be excluded, however. In this context it can be assumed that the instruments were sounded exclusively in the funerary rite and that the sounds of the vessel and the employed liquids were offered during the funeral.

6.2 Iconology

Certain aspects of the iconography of Teotihuacan whistling vessels might also be related to their possible function as objects forming part of the funerary rite. The effigies of pregnant monkeys especially in the Teotihuacan-B specimens could be related to the imaginations of the world of the dead, although ostensibly representing signs of life. We know that in the pre-Columbian thought the idea of a subaquatic underworld full of life existed, also believed to be the place of life-giving forces for the terrestrial realm.[66] In consequence, the pregnant monkeys could be understood as representatives of a new life generated in the world of the dead. However, this is only one of several

[66] For the Teotihuacan-specific concept, the Tepantitla mural with the flower-world realm in the lower portion can be taken as a reference.

possibilities, as the vessels could also stand as signs for terrestrial prosperity and fertility, and may not have been specifically produced to form part of a mortuary offering. As mentioned above, the Teotihuacan-A models are most probably provided with male monkeys and therefore might have been used in different contexts. Unfortunately, currently no sufficient information on the gender of the deceased is present. In only one of the three documented burials could the gender of the deceased be determined, and in this case the deceased was found to be a woman, accompanied by a Teotihuacan-B/Small vessel showing a pregnant monkey (Zacuala Patios). Because of this reason we still cannot deduce whether the gender of the monkey on the instrument was correlated with the gender of the possible owners/players.

Between the vessels with female monkeys (Teotihuacan-B/Small and B/Large) and those with male monkeys (Teotihuacan-A) a certain duality becomes apparent, also related to the different forms of the containers and the visual directions of the effigy. Another duality can be observed between the variants B/Small and B/Large. As indicated earlier, it can be supposed that these characteristics reflect different meanings and contexts of employment. A comparable duality between instruments produced according to the same form but in clearly different sizes is also observed in the case of the Teotihuacan quadruple flutes, with larger and smaller versions.[67] In the pre-Columbian world, such organological diversification rarely existed.[68] Certainly, the employment of different-sized instruments of the same model is the sign of an elaborate culture with a somewhat stratified musical system, in which a distinguishable set of tonal ranges played a role (comparable to the current employment of alto and soprano instruments).

According to the set of iconographical data, the symbolism of the Teotihuacan whistling vessels is generally related to concepts of life, and possibly intoxication (spider monkey, flower-sign), sacred sound and offering (scroll-sign, flower-sign, heart-sign), fertility, and water or other liquids (scroll-sign, cloud-sign, undulated engravings and dotted lines). Some of these elements, such as the five-petaled flower-sign and the cloud-sign in the Teotihuacan-A vessels made from *Anaranjado burdo* ceramics could equally represent toponyms and/or emblems of political entities. If the four-petaled flower-sign is understood as an emblem for Teotihuacan (see above), the five-petaled flower-sign could be related to the site and political dominion of Culpulalpan, Tlaxcala (no. 2), and the cloud-sign of the whistling vessel from San Juan del Río, Querétaro (no. 3), related to the latter site. If this is the case, these particular finds could represent signs standing for the relation between the sites, for example as official gifts interchanged between the elite groups. Iconographic elements showing possible toponyms or emblems of political entities are also documented for some of the foreign variants and adaptions from Oaxaca and the Maya area.

[67] Both 2021a: 524–32.

[68] Examples are the conical flutes of Xochicalco, Morelos (Both and Giles 2017: 52–5, figs 2–5), or the Nasca panpipes from Peru.

6.3 Sonority and sound symbolism

Among the factors that aid in interpretation of cultural settings for the use of these instruments is the low sound level of the vessels and their fragile tone quality, with delicate whistle tones in the infilling motion and barely perceptible breath sounds in the refilling motion, accompanied by the subtle noises generated by the flowing liquid. These particular sonics indicate a probably exclusive use among smaller groups in interior and ajar spaces within the urban environment, such as in the rooms, temple shrines, and smaller patios of the apartment compounds and other ceremonial structures, which were designated for gatherings, performances, and ritual activities. Outside these environments, such as in the larger open courtyards in front of the principal pyramids of the site or along the great processional pathway, the whistling vessels could not have been heard over large distances, especially not if large groups of people were present. Outside atmospheric conditions such as wind or humidity would also reduce the sonic perception of the instruments significantly.

Interpretation of the possible sound symbolism of the whistling vessels, including the possible psychoacoustical effects, supports reconstructing their meanings and cultural contexts. According to our observations, the sound symbolism is in line with some of the above-mentioned aspects. It might be related to life and fertility, on one hand, and the notion of grief, on the other hand.

At first, some sounds emitted by the vessels are strongly reminiscent of birdsong, which at first sight might represent a paradox, since in the case of the Teotihuacan whistling vessels the animal shown is not a bird. This condition is also frequently observed in other whistling vessels of the Americas (and in many other instruments worldwide), whose sounds are rarely related with those emitted by the beings shown in the decoration or figurative form of the instruments.[69] Among the vocalizations of the spider monkey is a sort of neighing for distance communication and a sort of barking when frightened and nervous, but these sounds have nothing in common with those generated by the instruments. However, spider monkeys also whistle and produce trills.[70] The latter vocalizations present comparable sonorous characteristics with the Teotihuacan whistling vessels. In consequence, it can be suggested that in the particular case of the instruments discussed here a sonic association with the effigy indeed might be present.

If the monkey, especially the female monkey in state of pregnancy, can be seen as a sign of prosperous life and fertility, according to Mesoamerican thought, the noises generated by the operational liquid are clearly related to this aspect. This might be especially the case if water was employed, but other liquids might stand for comparable notions, especially the alcoholic or psychotropic beverages that might have been employed for ritual activities and ceremonial gatherings. Water sounds, however, would be most predominant, as water creates greater turbulence due

[69] Pérez de Arce 2006: 167. At least for Mesoamerica, however, many wind instruments are reported, which do reproduce the sounds of the animal represented (for example, a large amount of vessel flutes representing owls, eagles, and other birds, or double whistles representing frogs).

[70] To obtain an idea on the diversity of the vocalizations of the spider monkey, the online database of the Macaulay Library may be consulted, https://search.macaulaylibrary.org/catalog?searchField=animals [accessed December 21, 2023]: search for "Central American spider monkey".

to its higher flow velocity. In continuously operating the larger Teotihuacan instruments (B/Large models) with water, sounds are generated reminiscent of a streamlet.

Other sounds generated by the whistling vessels, especially the fragile whistle tones produced in forward motion with a gradually lowering frequency and sound level towards the end of the sonic cycle, which finally exhale and die, do not present any similarity with the vocalizations produced by an animal or a noise present in the natural environment. This particular acoustic emanation of the instruments fortifies the subjective notion of grief, which is particularly interesting as all instruments with documented find contexts were deposited in burials. Remarkable in this context is that the vessels produce respiratory sounds in the reflowing motion. These effects are more predominant in the larger vessels (Teotihuacan-B/Large), for the augmented vacuum generated by the higher quantity of liquid flowing back into the open chamber. For the size of the smaller vessels (Teotihuacan-A and B/Small), the respiratory sounds are softer, reminiscent of the sounds made by a person sleeping in peace.

During our experiments we observed that during operation of the vessels the impression might occur that the instruments become almost animated. The sensation is tactile, due to the moving liquid inside the chambers, and visual, as the represented monkeys seem to whistle properly. Also, the fragile tones and the respiratory sounds strongly fortify the impression. Furthermore, it has been observed that the acoustic emissions could stimulate the brain in such a way that altered states of consciousness could be generated (for example, time perception could be altered, or olfactory and visionary sensations generated).[71] Contributing factors are the repetitive physical and acoustical movements, the slow pulse of the sonic cycles, and especially the generation of high-frequency tones located in a highly sensitive human hearing range.

7 Conclusions

It has been demonstrated that the Teotihuacan whistling vessels are extraordinary sonic devices in many ways. As tested on a series of replicas and experimental models, their morphology, construction, and functionality required a high level of technological and organological/musical knowledge. The principal parameters are comprehensively understood and a range of particular playing techniques, including the possible use of different liquids, and a range of different acoustic effects, were documented. According to the finds from various sites of the Central Mexican Highlands and Oaxaca, the production of foreign variants and adaptions in Oaxaca and the Maya area, and the presence of a Maya adaption in Teotihuacan, it can be shown that in terms of the employed sound artefacts a mutual interaction between Teotihuacan and related sites existed, in which Teotihuacan apparently played a dominant role. The find contexts of the vessels and the ceramic types indicate use by members of the elite. In taking all available data into consideration, including the

[71] Garret and Stat 1977; Wright 1992.

archaeological, iconographical, and acoustic information, the complex meanings and diverse cultural contexts of the discussed instruments can at least partly be deciphered.

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The Image and Connotation of Small Sculptures on Bronze Drums in Southern China

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Abstract

Lengshuichong type (冷水冲型), Lingshan type (灵山型) and Beiliu type (北流型) bronze drums are collectively known as 'Large Bronze Drums'. They were popular in Guangxi and Guangdong from the Han to Tang Dynasty (202 BCE – 907 CE), and were characterized by their large shape and numerous small sculptures located on the drum face or foot. In addition to the main frog motifs, there are also depictions of horses, cattle, birds, tigers, aquatic animals, and scenes of human-animal interactions such as riding, plowing with oxen, children playing with turtles and watching frogs fight, etc. The position of the sculptures reflects the playing method of each type of bronze drum: drums with sculptures on the face are generally played while placed flat on the ground, whereas drums with sculptures on the body are typically played while suspended. The sculptures on the bronze drums integrate elements of Lingnan culture, Central Plains Han culture, and Dian culture, reflecting the caster's contemplation of the universe, nature, and their relationship with humanity.

Keywords

Bronze drums – Multifarious sculptures – Totemism

Bronze drums are percussion instruments popular in southern China and Southeast Asia. They first appeared during the Warring States period (c. 453–221 BCE) and are still in use today. The drums are large, with a solemn and mysterious appearance, and are often used in folk ritual activities, representing family beliefs, wealth, and authority.

In China, bronze drums are generally classified into eight types. Their shapes and styles are compared in Figure 1 (arranged from left to right in chronological order, from earliest to latest). As can be seen, the bronze drums in the middle of the Figure 1 – the Lengshuichong type, Beiliu

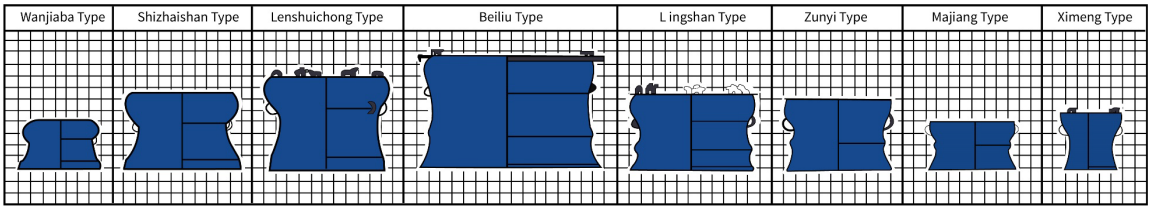

Figure 1: Shape comparison of bronze drums[2]

type, and Lingshan type – are the largest. These drums were prevalent in Guangxi and Guangdong from the Han to Tang dynasties, and are collectively known as 'Large Bronze Drums'. Diverse sculptures are mainly found on large bronze drums.[1]

These sculptures are also made of bronze, and are typically arranged in a counterclockwise direction around the edge of the drum face or beneath the handles on the drum body. Besides the main frog motifs, there are also depictions of horses, cattle, birds, tigers, aquatic creatures, and plants, as well as scenes of human-animal interactions, such as riding, plowing with oxen, maidservants feeding horses, as well as children playing with turtles, watching frogs fight, and striking bronze drums, etc. In contrast to the intricate rings and mysterious sun motifs engraved on the drum face, these sculptures appear simple and realistic. This design approach ensures that the overall decoration of the bronze drum does not become overly monotonous or complex, thereby achieving a visual balance.

1 The Shape and Small Sculptures of Large Bronze Drums

As mentioned earlier, the three types of large bronze drums are similar in their massive size and their sculptures. However, there are also some differences between them.

1.1 Lengshuichong Type Bronze Drums

The drums excavated from Lengshuichong in Tengxian County, Guangxi Province (广西藤县冷水冲, Figure 2), set the standard for Lengshuichong type bronze drums. The area in which they have been unearthed is concentrated in central and southern Guangxi and northern Vietnam, dating from the Eastern Han to Tang Dynasty. They can be divided into three periods. The decoration of Lengshuichong type bronze drums in the late stage is more complicated than that of the early and middle stages, and a fixed paradigm for this type has been established: the face diameter is equal to or slightly larger than the chest diameter, while the waist diameter is significantly reduced. There are often a pair of handles on the drum body in addition to two pairs of braided flat handles. The drum face is adorned with a twelve-ray solar motif at the center, with solid double-feather eye pendant patterns between the rays. Four large, robust frogs draped with rope patterns are arranged counterclockwise around the edge of the drum face, often with other small sculptures between them. The drum face and body are covered with halos and repeating patterns. The main

[1] Any bronze drums mentioned in this article without a specified province were excavated in Guangxi.
[2] Figures 1 and 5–17 are from Wu et. al. 2018.

Figure 2: Parts of a bronze drum. Image: Anthropology Museum of Guangxi, modified by the author.

halo on the drum face features abstract feathered men and flying herons, and the edge of the face often features eye patterns. The drum chest is decorated with abstract boat motifs, the upper part of the drum waist features feathered human figures, and the drum foot is decorated with drop-leaf patterns. The shape and decorations of the Lengshuichong bronze drum are the most consistent among the three types of large bronze drums.

Approximately 182 Lengshuichong type bronze drums have been found so far, most of which feature frog sculptures. Of these, 79 drums, or about 40% of the total, have additional sculptures on the drum face.[3] Notably, the sculptures on Lengshuichong drums are mainly located between the frog figures on the drum face, and are not seen on other parts, a feature that distinguishes them from the other two types.

1.2 Lingshan Type Bronze Drums

The Lingshan type bronze drums, named after the exemplars unearthed in Lingshan County, Guangxi Province (广西灵山县), are commonly found in the regions at the boundary between Guangxi and Guangdong, including Ling Shan, Pu Bei, and Heng Zhou Counties, and also date from the Eastern Han to Tang Dynasty. They are larger than the Lengshuichong type but smaller than the Beiliu type, with a drum face that is larger than the body (Figure 3). The drum handles are flat, featuring leaf-vein patterns. The sun rays in the center of the face are slender and their number varies. The edge of the face typically has patterns of six three-legged frogs arranged counterclockwise, or three single frogs alternating with three stacked frogs, the backs of which feature circular whorl patterns or incised lines. The main halo on the drum face features animal forms, patterns of people riding beasts, or flying herons, while other halos are filled with clouds and thunder patterns, four-petal flowers, Si Chu coins, and cicadas, which are generally used as edge patterns.

More than 70 Lingshan type bronze drums have been discovered to date.[4] The Lingshan type drums with small sculptures on the drum body account for about one-third of the total number,

[3] Luo 2000: 16.
[4] Yao et al. 1990: 931.

featuring only frogs on the drum face. Other figures, such as animals being ridden, birds, tigers, sheep, cattle, monsters, etc., are located at the foot under the handle on one side, as well as some on the inner wall of the drum cavity.

Figure 3: Lingshan type bronze drum.[5]

1.3 Beiliu Type Bronze Drums

The Beiliu type bronze drums, named after the bronze drums unearthed in Beiliu, Guangxi Province (广西北流县), are mainly found in the regions at the boundary between Guangxi and Guangdong, but also slightly further north, and date from approximately the Western Han to Tang Dynasty. Beiliu type drums are known for their large size, with a drum face that is wider than the body and a rim that extends beyond the body (Figure 4). Most of the sun patterns on the drum face have eight rays, and their shape is similar to those on the Lingshan type. The number of frogs ranges from four to six. Unlike the large, plump frogs on the other two types, most frogs on the Beiliu drums are simple, thin, and appear stiff. Initially, the patterns consisted mainly of clouds and thunder, but over time, motifs of coins, water waves, birds, feathered men, and four-petal flowers were gradually added.

Figure 4: Beiliu type bronze drum.

Beiliu type bronze drums typically feature frog sculptures, but there are three examples with additional sculptures: one features birds standing among the frogs on the drum face, and the other two have tigers standing on the drum foot.

The three types of large bronze drums all have large bodies: the face diameter of Beiliu type drums is generally 70–80 cm, while many Lingshan and Beiliu type drums exceed 100 cm. The Shuitong'an Bronze Drum, dates to approximately the Eastern Han period (25–220 CE) and has a face diameter of 165 cm, making it the largest bronze drum in the world. This remarkable size reflects the advanced bronze industry of their creators. Additionally, they all feature frogs on the drum face, indicating a common totemic worship. These similarities are due to the geographical proximity and shared cultural sphere of bronze drums, facilitating mutual influence.

However, their differences are also pronounced. Lengshuichong drums have a slightly elongated and slender body, with a rim that is sometimes extended on the drum face and a proportionally larger waist; in contrast, both Lingshan type and Beiliu type drums feature extended rims and

[5] Figure 3 and 4 are from Anthropology Museum of Guangxi. https://www.amgx.org/.

have a more evenly proportioned drum chest, waist, and foot. On the Lengshuichong type drums, there are often patterns of flying herons, feathered men, and boats, while the other two types lack these patterns and instead feature motifs of coins, clouds, and thunder not found on Lengshuichong drums. Moreover, on Lengshuichong drums, various small sculptures decorate the face, whereas the other two types feature only frogs on the face, with the other sculptures found on the lower sides of the handles or on the inner walls of the drum cavity.

Overall, Lingshan and Beiliu type bronze drums are generally similar to each other, whereas Lengshuichong drums differ somewhat from both. This variation can be attributed to the geographical distance between the user groups. Lengshuichong drums were cast by the Luoyue people (骆越人) and their descendants, the Lingnan Liao people (岭南 '僚人'), and were popular in central and southern Guangxi and northern Vietnam, covering a wider area and often considered a hybrid of Yunnan style and Lingnan style bronze drums.[6] The Lingshan and Beiliu types are thought to have been cast by the Li people (俚人), to whom belonged two of the most influential families from the Southern Dynasties period to the Tang Dynasty period (420–907 CE): namely the Ning and Feng families. The Lingshan type drums are associated with the Ning family,[7] while the Beiliu type drums are linked to the Feng family.[8] They were mainly popular along the border between Guangdong and Guangxi, and are often referred to collectively as Cantonese type drums, Hegel type II drums, and so on.

The Luoyue, Li, and Liao peoples mentioned above are the ancestors of the modern Zhuang. The Zhuang people are a significant ethnic group in Guangxi, and their cosmology appears to have played a notable role in shaping the overall design of the bronze drums. They believed that the universe is a cylindrical structure, divided from top to bottom into three parts: the sky, the earth, and the ocean, with the heavenly realm ruling over the other two. Correspondingly, on the bronze drum, the body is divided into three sections: the drum chest, the drum waist, and the drum foot. The chest is slightly wider than the lower two sections, symbolizing the ruling position of the heavenly realm.[9] The center of the drum face features a large sun motif, surrounded by multiple halos formed by cloud and thunder patterns, as well as heron patterns, seemingly evoking the imagery of a celestial realm. Frog sculptures, located at the edge of the 'heaven', symbolize the messengers connecting heaven with the human world.[10]

6 Qiu 1997: 39.

7 Zheng 2002: 183.

8 Yao et al. 1990: 934.

9 The Zhuang ethnic myth *Buluotuo* 布洛陀 tells the story of the world's division into three realms at the dawn of the universe. These realms are the sky, the earth, and the ocean. The upper realm is governed by the Thunder God, the middle realm by Buluotuo, and the lower realm by the Dragon King (Nong 2007: 47). Although the myth is not directly attested before the Ming dynasty, its origins are often dated much earlier: cf. e.g. Qin N.C. 2003, Mou 2005, Qin L.D. 2011.

10 The Zhuang folk tale *Casting the Bronze Drum* 铸铜鼓 mentioned that the frog is the son of the Thunder King and is responsible for conveying his commands to the human world (Nong 2007: 371).

2 Frog Motifs and Their Connotations

Frog motifs are a standard feature of large bronze drums (with only a few exceptions), and are often positioned around the edge of the drum face. These are totemistic sculptures created by the Li and Liao people living in the Lingnan area. Although frogs are present on all three types of large bronze drums, different cultural connotations have led to distinct morphological characteristics.

Figure 5: Frog sculpture on Lengshuichong type bronze drum.

The frog sculptures on Lengshuichong drums are notably uniform in both number and form. Four frogs are evenly spaced around the edge of the drum face in a counterclockwise direction. They are robust, with hollow, flattened bellies, round eyes, and pointed snouts, and are adorned with rope-patterned bands (Figure 5). Unlike the other two types, these frogs do not exhibit stacked configurations. However, there are instances where frogs carry other animals on their backs, such as the drum excavated from Fenglin Village, Luobo Town, Wuming District, which features frogs with two small birds on their backs.

Lingshan type drums typically feature six frogs, arranged either as six single frogs or as a pattern of three single frogs alternating with three stacked frogs, often in a counterclockwise direction, though clockwise arrangements are also found. These frogs are also large and robust but shorter than those on the Lengshuichong type. They have round eyes and a pointed snouts, and their bodies are covered with patterns such as grain motifs, concentric circles, and spirals, which are more elaborate than those on the other two types. Frogs on the Lingshan drums often carry additional creatures on their backs, such as other frogs, snails, or birds. The most distinctive feature of these frogs is that their two hind legs merge into one, giving the frog a three-legged stance, commonly referred to as the 'three-legged toad' image (Figure 6).

Compared to the previous two types of bronze drums, the frog sculptures on Beiliu type drums do not follow a fixed pattern. The number of frogs varies, with four being the most common, followed by six, and occasionally up to eight; They are mostly arranged in a counterclockwise direction, although clockwise and paired arrangements are also significant. These frogs have a rather rigid and abstract appearance. Relative to the large drum body, the frogs appear small and inconspicuous, with thin bodies, and front and rear legs composed of four rectangular columns. The tops of the two rear legs are connected to form a square-shaped rump. They have round eyes and pointed snouts, and their bodies are usually plain (Figure 7), although occasionally a frog may carry another frog on its back.

Figure 6: Frog sculpture on Lingshan type bronze drum.

Figure 7: Frog sculpture on Beiliu type bronze drum.

There are several reasons why frogs were considered the most important totem by the ancestors of the Lingnan people, one of which relates to nature worship. For ancient people who relied on a natural economy, rain was a crucial factor for farmland productivity. Frogs often emerge during the damp rainy season, leading people to associate them with rain and view them as messengers of the rain deity, believed to convey news of rain.[11] Lingnan people considered the sound of bronze drums to be powerful and resonant, capable of reaching great distances, similar to the croaking of frogs, which was thought to have the ability to communicate with the gods.[12] Secondly, frog worship is related to the worship of the creation deities. It is believed that the character for frog had the same pronunciation as "Wa" in "Nvwa" in Chinese, with frogs thus equated to Nvwa, the goddess who created humanity in Chinese mythology, endowing frogs with sacred significance.[13] Thirdly, frog worship is related to fertility worship. In ancient societies with limited productivity, human labor was crucial for economic and social development. Frogs can lay thousands of eggs at once, symbolizing fertility and the hope for many offspring. To this day, some Zhuang villages still observe the tradition of the 'Frog Festival'. On the first day of the lunar New Year, villagers perform rituals to worship frogs, praying for disaster prevention and a bountiful harvest.[14]

Although all three types of bronze drums feature frog sculptures, the designs vary slightly, each carrying different symbolic meanings. For instance, the unique three-legged frog on the Lingshan type drums imitate the legendary 'three-legged toad', a mythical object believed to bring wealth. The stacked frogs symbolize fertility worship, reflecting various cultural significances.

3 Diversified sculptures and their connotations

Other thematic sculptures are generally smaller than the frog motifs and lack the intricate patterns seen on the frogs. They are more realistic, focusing on depicting genuine life scenes. This does not imply that they were created casually; ancient bronze resources were highly valuable, and all

11 The Zhuang folk tale *The Frog and the People* 青蛙与人 mentioned that the frog can foresee impending rain and informs humans about it (Nong 2007: 468).

12 The earliest records regarding the relationships between thunder, drums, and frogs can be traced back to the Tang Dynasty. For instance, in Feng Zhi's *Yunxian Zaji*, it is noted that 雷曰天鼓, 雷神曰雷公 "thunder is called the heavenly drum, and the thunder god is referred to as Lord Thunder". Additionally, the Tang poet Zhang Xiaobiao mentions in his poem *Autumn Night in Chang'an*: 田家无五行, 水旱卜蛙声 "In the fields, there are no five elements; the sounds of frogs predict drought and flood."

13 Yu 1991: 122.

14 The earliest written record of the Frog Festival can be found in the *Hechi County Annals*, compiled by Huang Zuyu and Li Dexuan in 1919.

sculptures required careful design and carving. These decorations are likely to reflect the ancestors' beliefs and their aspirations for a better life.

Figure 8: Horses sculpture on Lengshuichong type bronze drum.

3.1 Horse Motifs

Horse motifs are predominantly found between the frogs on the drum faces of the Lengshuichong type drums or on the drum body near the handles of the Lingshan type drums (the reasons for this placement will be discussed later). The horses are depicted in a fairly uniform manner, typically with a large head, short legs, and a long, drooping tail. The mane is neatly trimmed, the tail is tied, and some horses are equipped with saddles. These representations are inspired by locally bred miniature horses.[15]

Lengshuichong type drums feature a variety of horse sculpture combinations on their faces, with riding scenes being the most common, such as pairs of riders, single riders with foals (Figure 8), and riders carrying or embracing children. On the drums unearthed in Luohan Village, Zhongping Town, Xiangzhou County, there are two groups of single riders, one group of three riders, and a herd of cattle arranged with two at the front and one at the back. On the Guiping No. 13 bronze drum, which was unearthed in Dongtun, Xishan Town, Guiping City, the scene depicts a standing miniature horse with a girl, wearing her hair in double buns, standing beside it. She is shown stroking the horse's back with one hand and offering food with the other (Figure 9). Additionally, on Zugu No. 117, there is a 'mother and foal' sculpture, with a standing mare, which may have originally had a rider, now missing. Beside the mare is a foal that appears to be nuzzling the mare's belly, possibly seeking milk. These depictions illustrate that horses were not only valuable tools for travel and warfare but also integral to daily life.

Figure 9: 'Girl Feeding Horse' sculpture.

As previously mentioned, the horse motifs of Lingshan type drums are located under the handles of the drum body. A bronze drum unearthed at Ganglu Village, Wuwei Town, Yongning District, features a mounted figure on the drum's waist. This horse has a large head, short legs, and a long drooping tail, closely resembling the horse motifs on Lengshuichong type drums. The horse's back is fitted with a saddle, and a rider atop it is pulling back on the reins. The horse's head faces the bottom of the drum. When the drum is laid flat on the ground with the drum face up, the horse's head points downward, which does not convey its full significance. However, when the drum is hung by a rope through the handle, the drum face is oriented sideways (as shown in Figure 10), with the horse's head facing backward, towards the direction of the drum's sound. When the

[15] Wu et al. 2018: 260.

drum is struck, the sound emanates from the opening at the bottom. The horse's head, aligned with the drum's sound direction, harmonizes with the booming drumbeats, reflecting a spirit of vitality and determination.

Figure 10: The state of the drum when it is suspended.

The widespread appearance of horse motifs on bronze drums reflects the flourishing horse industry during the Han Dynasty. Since that time, horses became integral to the daily lives of the people in Lingnan, serving as vital assets for transportation and warfare.[16] However, not everyone could afford horses; only wealthy families had the means to own them. Thus, affluent families commissioned depictions of horseback riding on drums, both to flaunt their wealth and to express their aspirations for a prosperous life. Moreover, the veneration of General Ma Yuan and the admiration for martial valor also significantly contributed to the prevalence of horse motifs on these drums. Emperor Guangwu (5 BCE–57 CE) of the Han Dynasty appointed Ma Yuan (14 BCE–49 CE) as General Fubo tasking him with pacifying 'the Zheng Sisters' Uprising' (in present-day Vietnam, which was once part of the Eastern Han territory). After arriving in Lingnan, Ma Yuan undertook many initiatives that benefited the local people, such as improving transportation, constructing irrigation systems, and enhancing productivity, earning him the support and affection of the populace. In his honor, many temples were built, and several places were named after him. Since the Song Dynasty (960–1279 CE), there has been a historical precedent for referring to these large bronze drums as 'Fubo Drums'. The inclusion of horses on these valuable bronze drums symbolizes the people's remembrance of General Ma Yuan, their admiration for martial prowess, and their pursuit of victory through horsemanship in warfare.

3.2 Bird Motifs

Bird motifs also appear on the face of Lengshuichong drums and under the handle of Lingshan drums, with one instance found on the face of a Beiliu drum.

The bird sculptures on the Lengshuichong drums often depicted singly or in pairs, with a maximum of five birds in a group. These birds are typically represented as upright waterfowl, smaller than the frogs, with slightly elongated necks and heads that droop downward. Some feature engravings of feather patterns and rice ears on their backs, presenting a relatively realistic appearance. On a drum unearthed from Fenglin Village, Luobo Town, Wuming District, two small birds rest on the back of a frog, significantly smaller than the frog itself, which clearly does not reflect reality but instead indicates the differing symbolic sculptures of the two totems in the minds of

[16] Chen 1997: 76.

Figure 11: Bird sculpture on a Lingshan drum foot.

the creators. A bronze drum discovered from Baifenping in Tonghe Town, Pingnan County, showcases a lively scene with a sculpture group of three oxen – two walking side by side in the front and one behind, with a rider on the back of the latter, suggesting a scene of returning from grazing. Opposite the oxen sculpture is a set of birds, with five birds arranged in a 'two-one-two' formation facing the same direction. These decorations differ from the more mysterious motifs, presenting an everyday scene. Another unique bird motif can be found on a drum from Xinyan Village, Jintian Town, Guiping City, which features a large bird and a child holding a small bird. The large bird is as tall as the child, which is obviously not realistic. Some interpret this as a playful depiction of a 'child playing with geese', while others view it as a form of totem worship, reflecting a reverence for birds.

More than 70 Lingshan drums have been discovered, of which over 25 feature bird sculptures, accounting for about one-third of the total. This highlights the unique significance of birds to this ethnic group. The bird sculptures on Lingshan drums are more varied than those on the Lengshuichong drums, which display a more fixed form. They are typically located under the handles, with either one bird or two side by side. These birds are also waterfowl, some standing upright while others are reclining, and they are relatively small, exhibiting a realistic representation (Figure 11).

Bird motifs, like frogs, are often regarded as symbols of totem worship. The Zhuang people believe that birds possess the ability to communicate with celestial beings, leading to numerous myths surrounding bird totem worship. Stories of human-bird unions, such as *The Hundred Birds Garment*,[17] have long been popular in areas inhabited by the Zhuang and have evolved into various versions over time, remaining enduringly relevant. There is also the legend of *Cuckoo*,[18] in which people believe that birds can bring abundance to the land. The feathered men and flying heron patterns on bronze drums encircle the sun, symbolizing the people's imagination of the heavenly realm and are a direct reflection of bird totem worship. As the representation of birds transitioned from engravings to sculptures on the bronze drums, the images became more realistic, depicting common water birds from daily life. This shift diminished their sacredness, introducing a more relatable charm.

3.3 Cattle Motifs

The cattle motifs on large bronze drums are typically represented as sturdy water buffaloes with prominently curved horns, though some depict the peaked bull with bulging shoulders. These motifs can appear alone or in combination with farming tools, riders, fences, and granaries, illustrat-

[17] Collection of Chinese Folktales: Guangxi Volume: 468.
[18] Collection of Chinese Folktales: Guangxi Volume: 306.

ing scenes of labor and herding. They share similar themes with the riding sculptures, being less totemic but reflecting a broader vision of a prosperous and fulfilling life.

Figure 12: 'Ox Pulling a Plough' sculpture.

The cattle motifs on the faces of Lengshuichong drums depict scenes of plowing and harvesting. For instance, the drum excavated from Babao Village in Guancheng Town, Pingnan County, features a sculpture of an ox alongside a granary, which is built in the stilt style typical of regions with abundant rainfall. On the face of Zugu No. 103, there are two groups of opposing oxen pulling a plow (Figure 12). Each ox has a batten on each side of their shoulders, dragging a large plow behind them; one has two small birds perched on its back, possibly pecking at lice, reflecting a scene from field life. There is also a depiction of grazing; for example, a drum unearthed from Luohan Village, Zhongping Town, Xiangzhou, features a trio of oxen, the first two of which have entered a square fence, with the third closely following – apparently returning home after grazing (Figure 13). Most herds consist of three oxen, symbolizing abundance. In ancient China, the number three was commonly used to signify a multitude. For example, the pre-Qin classic *Guo Yu* states, "Three animals form a group, and three people form a multitude" (兽三为群, 人三为众).[19] Moreover, the drum from Mawang Village, Dapo Town, Cangwu County, is particularly notable, with four packed bulls taking the place of frogs. The bulls stand upright at the most important position of the drum face, suggesting that in the mind of the foundry, bulls and frogs hold equal importance, and that these bulls differ from the standard typical cattle images, embodying a unique and mysterious form. The bull statues on this drum likely serve as a totemic symbol.

Figure 13: 'Oxen Returning to the Fence' sculpture.

The cattle sculptures on Lingshan drums are all located on the inner wall of the drum cavity, with their shapes resembling those on Lengshuichong drums. Most represent sturdy working oxen with curved horns, representing the most common water buffalo in southern regions during that period. Drums featuring cattle sculptures on the inner wall often display bird sculptures on the exterior, highlighting the connection between cattle and birds in the local populace's perception.

Cattle are indispensable tools and companions in people's lives. Since prehistoric times, they have played a crucial role in human existence, becoming increasingly important as economies developed. Cattle motifs are frequently found on shell containers (containers used by the ancient people of Yunnan for storing currency) and Shizhaishan type bronze drums in Yunnan. There are two main types of cattle image on these shell containers: one depicts herding oxen used in farming, and the other represents the 'sacred bulls' coexisting with creatures like tigers and birds. The sa-

[19] Chen 1998: 60.

Figure 14: Cattle image on Shizhaishan type drum.

cred bulls have long, curved horns, large ears, and a robust physique, exuding a sense of spirituality. These two different types of sculptures indicate the equally important role of cattle in both daily life and belief systems. Additionally, many images of cattle are carved onto the bodies of Shizhaishan type bronze drums (c. 453 BCE–25 CE), distinguishing between males and females. Some bulls are depicted with prominent reproductive organs, reflecting fertility worship concepts. Some scholars suggest that the transition of cattle motifs from flat engravings on the waist of Shizhaishan drums to three-dimensional representations on large bronze drums indicates a heightened significance of the cattle totem.[20] However, the cattle designs on the Shizhaishan drums already held substantial importance; for instance, the Hezhou Longzhong drum features ten large square sections, each adorned with a standing bull, while the Longlin Bianya drum consists of six sections, each also decorated with a cattle motif. Numerous similar examples illustrate the vital significance of cattle motifs to the Shizhaishan drums and their associated communities (Figure 14). After the Han dynasty, the Shizhaishan drums, which originated in Yunnan, gradually declined, while the eastern 'frog drum' emerged as the dominant style. The Li people of Lingnan created dense halos using abstract motifs, such as feathered men and soaring herons, combined with layered geometric patterns, transforming concrete and poetic images into small sculptures. In contrast to the cattle images on the Shizhaishan drums, the cattle depicted on the larger bronze drums are vibrant and imbued with a sense of daily life, generally appearing smaller than the frog motifs. Rather than indicating an elevation in the status of the cattle totem, this transition from engravings to three-dimensional forms may suggest a decline in the sacredness of cattle since the emergence of frog motifs, or it may reflect the idea that, in the eyes of the Li people, cattle do not possess the same totemic significance as frogs.

3.4 Tiger and Goat Motifs

Tiger sculptures are primarily found on Lingshan and Beiliu drums, with approximately five known examples. Most are adorned with Si Chu coins pattern, a typical characteristic of these two types of bronze drums. The placement of tiger motifs on the drums is identical to that of horse motifs; both are located beneath one of the handles, with the tiger's head oriented downward. When the drum is hung, the tiger's head aligns with the sound direction, creating the illusion that the drum's sound is akin to the roar of a tiger. The most lifelike example is the tiger sculpture on a drum in Liantangping, Yulin City, where the tiger stands erect at the drum's base with a large head, round eyes, and a long, upright tail, appearing to roar forward (Figure 15). And the most unique example is found on the drum from Guibi Village in Hengzhou City, which features a flying tiger figure with a human passenger. This figure resembles a robust quadruped with a large head, round eyes, and

[20] Chen 1998: 62.

upright ears, flanked by wide wings. One of the wings supports two seated people, positioned with their hands clasped and legs crossed. Scholars generally regard this creature as a 'flying tiger',[21] and despite some distortion in its form, it retains a recognizable resemblance. The figure with tiger wings and hands clasped together may have been specifically designed by the caster to express its divine nature.

Figure 15: Tiger sculpture on a drum foot.

Tiger motifs have long symbolized authority in bronze vessel decorations. During the Shang and Zhou dynasties (c. 1600–256 BCE), tiger sculptures were frequently adorned with bells, such as the two 'four-tiger' bells housed in the Palace Museum in Beijing and the Shanghai Museum. Each of these bells features two standing tigers with long, curled tails positioned at the edges, appearing to roar downward. Ancient Dian people (the ethnic groups that inhabited the Yunnan region in ancient times) also commonly used three-dimensional or engraved tiger motifs to decorate shell containers, with the tiger's image closely resembling that found on the bronze drums – both depict a standing figure with a robust build and an upright tail. The *Geography* section of the *Sui Shu* (隋书) states: "Those who possess [bronze] drums are called *Du Lao*, which commanded great respect within the community."[22] The Lingshan and Beiliu bronze drums are large and required substantial human and financial resources to produce in ancient societies, where bronze was a valuable commodity and productivity was low. The combination of these drums with roaring tiger motifs serves as a symbol of authority and wealth. Like the dragon and taotie (饕餮, a ferocious and gluttonous beast from ancient Chinese mythology) motifs of the Central Plains, tiger decorations are considered celestial symbols and powerful tools for warding off evil.[23]

There is currently only one example of sheep sculptures decorating a bronze drum, located on a Lingshan style drum unearthed in Baimu Village, Sanhai Township, Lingshan County. This features a pair of sheep standing side by side, each with small curved horns and rounded bodies. One sheep gazes straight ahead while the other turns its head back, creating a lively and interesting image. Sheep are one of the totems created by the Yue people (a term referring to the ancient coastal inhabitants of southern China) and are often seen as symbols of good fortune. The rarity of sheep motifs on drums likely due to the personal preference of the casters.

3.5 Aquatic Animal Motifs

Aquatic creatures are also a theme in the sculptures of bronze drums, featuring representations of snails, fish, turtles, and crabs. Most of these motifs are found on the faces of Lengshuichong drums, while the frogs on Lingshan drums may occasionally carry snails on their backs.

21 Li et al. 1991: 65; Shen 1995: 15; Luo 1997: 81.
22 Sui Shu: 888.
23 Luo 1997: 84.

Figure 16: 'Fish on a Post' sculpture.

Snail sculptures are found both on the backs of frogs and independently on the drum faces. The Xiadong drum unearthed in Guiping City features four frogs, two of which have a snail on their back. The Lingshan drum from Yong'an Village in Bobai County showcases six frogs on its face, five of which each have one snail, while one frog carries two snails. Field snails are among the most common creatures found in rice paddies and along riverbanks, often collected by local people to create delicious dishes. The joy of eating snails is matched by the fun of gathering them. Those who grew up near rice fields often have fond childhood memories of collecting snails together by the river. The use of snails as intricate decorations on the bronze drum may therefore reflect the affection that people have for these creatures.

Fish motifs are primarily found on the Lengshuichong type drum face and come in two forms: one type clings to a frog's back, being only the size of a snail, while the other is larger and features in diverse arrangements, some paired with human figures, others connected, and some with their tails tied to a pillar. On a drum from Dapuhua Village, Zhongping Town, Xiangzhou County, there are two fish, each tied at the tail and secured to a wooden post (Figure 16). A bronze drum in the Rietberg Museum in Zurich features two large fish with their tails connected, behind which stand two figures – one facing the fish's tail, hands clasped at the chest as if pulling something, and the other holding an object in the right hand, seemingly casting it toward a cauldron-shape vessel behind.[24] Fish are often revered as totems by ethnic groups reliant on fishing for their livelihoods, symbolizing abundance and good fortune. Praying for fish or tying them to a wooden posts reflect a desire for a bountiful catch and the retention of auspiciousness.

Turtle motifs are found exclusively on the faces of Lengshuichong drums. They are slightly smaller than frog motifs, with their shells adorned in elaborate decorations like spiral and grain patterns. Some turtle sculptures stand alone on the drum face, while others are depicted crouching on the backs of frogs, and some are combined with human figures. On the drum from Xiyi Village, Daxin Township, Pingnan County, two turtles stand between the frogs on the drum face, while each of the four frogs carries a small turtle on its back. The No. 3 drum unearthed in Shuangluo Village, Sanli Town, features a scene of interaction between a turtle and a child: the turtle walks in front, with a child with double buns following, grasping the turtle's left hind leg with both hands, as if being dragged by or pushing the turtle (Figure 17). This set of statues is quite intriguing and showcases the interactions between humans and sacred beings. The turtle's larger body size compared to the child signifies a departure from reality, embodying artistic interpretation and mythical significance.

[24] According to Huang 1989, this bronze drum is of the Lengshuichong type and dates from the Eastern Han to the Northern Song period; however, it remains unknown how it came to be in Switzerland.

There is also a crab sculpture, located on a drum's face at Sun Yat-sen University, where a crab has replaced a frog in the fourth position. The crab, associated with the autumn harvest, subtly conveys a prayer for abundance.[25]

Figure 17: 'Child and Turtle' sculpture.

3.6 Other Types of Sculptures

There are also some sculptures with special meanings and unique aesthetic qualities from the foundry on certain Lengshuichong drums. On a bronze drum unearthed at Chedu Wharf in Wuxuan County, there are two groups of 'Frog Fighting Platform' sculptures, one of which is incomplete. The platform is square, supported by four columns, with a large frog in each corner facing each other in a stance poised for combat, while several onlookers are positioned nearby. Additionally, a drum housed in the Guangzhou Museum depicts a 'Drum Performance' scene, featuring a square platform between the frogs, on which four side-placed bronze drums are arranged, with one figure depicted as striking a drum. Furthermore, a plant sculpture is featured on a bronze drum unearthed in Hekou Village, Shizui Town, Guiping City. Three flower trees stand in a row, each with a thick trunk, and at the top, there appears to be a blooming flower.

4 Cultural Composition and Significance of Bronze Drum Sculpture

The three types of large bronze drums are distinct yet share commonalities. They all feature a similarly massive size, though with subtle differences in their details. Each type favors decorative figures, particularly frogs, as primary motifs, but they have unique concepts regarding other sculptures – such as the types of animals preferred, their forms (standing or lying down, solitary or in groups), and their placements (on the drum face or body) – reflecting the diverse aesthetics and thought processes of different ethnic groups.

The diverse imagery of the decorative elements on the bronze drum stems from the fusion of multiple regional cultures, while the interplay of realism and abstraction in these designs embodies the creators' reflections on the universe, nature, and their relationship with humanity, as well as their aspirations for life.

4.1 Integration of Diverse Cultures

The decorative figures on bronze drums reflect the cultural exchange and integration in the Lingnan region. While local culture played a decisive role in shaping these figures, the variety and imagery of the sculptures suggest the influence of other cultures as well.

[25] Wu et al. 2018: 279.

4.1.1 Lingnan Yue Cultural Factors

Frogs, turtles, snails and fish are common freshwater species in the Guangxi region. The use of frog figures, in particular, appearing on large bronze drums but being absent from other bronze artifacts, can be considered a unique feature rooted in the local culture of the Lingnan area.

4.1.2 Central Plains Han Cultural Factors

Since the Qin and Han dynasties, when centralized power was consolidated, the Lingnan region gradually came under the control of the Central Plains authorities and became increasingly influenced by Han culture. During the Han Dynasty, the use of oxen for riding and plowing became widespread in the Central Plains and was introduced to Guangxi, where it became an essential tool for agriculture. This influence is evident in the frequent depiction of cattle on bronze drum decorations, reflecting the impact of Han culture.

4.1.3 Dian (Yunnan) Cultural Factors

Lengshuichong type bronze drums are a hybrid of Yunnan and Guangxi styles, inherited some features of Dian style bronze drums (early types of bronze drums, such as the Wanjiaba type and the Shizhaishan type), and have influenced Lingshan and Beiliu type drums. For instance, the tiger motifs and the solitary bull statues bear a strong resemblance to the images on shell containers from Dian people, highlighting the connection between Lengshuichong and Yunnan style bronze drums.

4.2 Multiple Intrinsic Meanings of Sculptures

The sculptures on bronze drums carry rich meanings, some of which are totemic while others are more grounded in reality. In the early days of the bronze drum's emergence, due to low productivity, the production of a bronze drum was a laborious task, elevating its status to the highest level in people's minds. As a result, the decorative figures must have been imbued with a sense of sanctity. However, as productivity improved and bronze drums became more common, their mystique in people's minds gradually diminished, and the sculptures became increasingly realistic in nature.

4.2.1 Totem worship

Totem worship is a primary aspect of the cultural significance of bronze drums. Frogs, birds, turtles, tigers, and even some cattle figures might be considered elements of totem worship. Such potential totems are typically large in size and solitary on a drum, rarely depicted alongside humans or production tools, contributing to a serene sense of mystery. Frogs and turtles are often adorned with elaborate ribbons, circular swirls, wheat, and other decorations, elevating these standing figures to a sacred status beyond reality. Bird statues also bear patterns, but are more modest in comparison, reflecting more everyday, life-oriented scenes.

4.2.2 Hopes for Abundance and Prosperity

In an agricultural society, particularly in times of frequent warfare, a bountiful harvest and a sufficient supply of horses were crucial for a stable life. The Lingnan people cast oxen ploughing, herding, and horseback riding on bronze drums, symbolizing their deep hopes for a prosperous life. For the powerful clans who owned these drums, such imagery also served as a display of their wealth and status.

4.2.3 Reverence for a Martial Spirit

The minorities in remote regions have long been known for their warlike tendencies, with numerous historical accounts describing the Yue people as brave and fierce in battle, such as "the Yue people are inclined to attack each other" (粤人之俗, 好相攻击)[26] and "the southwest ethnic minorities have always been fierce" (夷獠劲悍, 历世不宾)[27]. They were innately resilient, a trait essential for their survival in challenging environments. The Li and Liao people of the Lingnan region were no exception. They adorned bronze drums with robust frog figures, equestrian figures, and frog fighting platforms, symbolizing their reverence for martial spirit. Furthermore, since Ma Yuan quashed a rebellion in Guangxi during the Han Dynasty, the admiration for Ma Yuan has fueled the popularity of his equestrian culture, further embedding warrior ethos in the hearts of the people.

4.2.4 Hopes for Offspring

As previously mentioned, in agrarian societies, the working population within families was essential for survival. Given the underdeveloped medical conditions in ancient times and the frequent occurrences of childhood mortality, the emphasis on producing offspring was of great significance to ancient peoples. Many early artworks depicted exposed breasts and male genitalia, expressing a cult of fertility and aspirations for reproduction, as seen in the bull engravings on the Shizhaishan bronze drums. By the medieval period (from the Han to Tang dynasties), such expressions diminished, giving way to more subtle animal imagery, such as frogs and snails, which symbolized fertility.

5 Conclusion

Small sculptures form a unique decorative feature of the Lingnan bronze drums, representing the distinctive style of Lingnan art. These ornaments embody both totemic and realistic elements, but overall, their style leans toward realism. This reflects the transformation of the bronze drum from a mysterious, heavy ritual instrument to a more everyday ethnic percussion instrument. Due to the remote terrain of ancient Lingnan and the lack of extensive written records compared to the Central Plains, our understanding of Lingnan culture relies largely on oral folklore, making it difficult to grasp its full picture. The bronze drum sculptures provide a channel for insight; their re-

[26] Han Shu: 17.
[27] Jin Shu: 377.

alism allows contemporary viewers to glimpse the lifestyles and beliefs of ancient Lingnan and, to some extent, corroborates folk tales. Although it is tempting and sometimes convincing to infer the thoughts and meanings behind the sculptures from such enduring legends, it must be acknowledged that such interpretations cannot be expected fully to replicate the true thoughts of the ancients. Therefore, much room remains for future exploration.

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The Sound of Thunder: A Turtle Shell Idiophone in Classic Maya Culture

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Abstract

The turtle shell idiophone is an instrument known from iconographical and archaeological sources from the Preclassic through the Classic Period of the Maya culture (250 BCE – 900 CE). It appears in historical scenes depicting ritual sacrifices, processions, and dancing, and is typically included in a percussion band along with gourd rattles and a tall, cylindrical drum. The mythological contexts of the turtle shell idiophone appearance provide more information on the possible symbolic significance of its sound. The author analyzes all known depictions of this idiophone and contextualizes them with archaeological findings, providing comprehensive information about the way this musical instrument looked and contexts of its use. Ultimately, the interpretation of the turtle shell's sound as symbolically connected to the sound of thunder is verified.

Keywords

Ancient Maya culture – Ancient Maya music – Ancient Maya iconography – Turtle shell idiophone

The Pre-Columbian Maya musical instrument made from a turtle shell is known primarily from iconographic sources showing individuals holding an oval object covered with a cross-hatched motif characteristic of representations of turtle carapaces.[1] These individuals are usually members of musical ensembles. The turtle shell is held under one arm, and sometimes the other hand, holding a deer antler, is visible. Therefore the viewer of such a scene can assume that the striking or scraping of the turtle shell (a hollow object) with a deer antler (a solid object) was the standard method of making the object sound. The iconographic sources suggest that the deer antler was most commonly used for striking the ventral part of the shell, known as the plastron, which is also

[1] The turtle shell consists of two components – the upper dorsal part is called a carapace, and the lower ventral one is called a plastron.

confirmed in the ethnohistorical sources (Civellero 2017). Since this instrument was recognized in iconography, some archaeological finds of turtle shells have been interpreted as idiophones.

According to the Hornbostel and Sachs classification system, the turtle shell is a directly struck, percussion vessel idiophone (Hornbostel and Sachs 1961: 111.24). Because scutes on the edges of the plastron have different thicknesses, it has the potential to generate two sounds of different pitch (Martí 1968: 35).

This kind of instrument is also known from ethnohistorical sources and modern observations of indigenous Maya music (Tozzer 1966; Vogt 1977). The turtle shell idiophone, called *ayotl* in Nahautl, was also used by the Aztecs. In iconographic sources it is also depicted as being struck with a deer antler. The figurines of musicians playing the turtle shell with a deer antler were found for other Precolumbian cultures, like Colima, Zapotec, and Gulf Coast cultures (Méndez Rojas and Pímentel Díaz 2010: 185). Turtle shell idiophones are used today by many indigenous groups of the Americas, with the shell being struck by a wooden club, claw, or deer antler (Civellero 2017), or used as a rattle (Gillreath-Brown and Peres 2017).

In the literature on Classic Period Maya religion and rituals, the sound of the instrument is said to symbolize the sound of thunder (Reents-Budet 1994; Quenon and Le Fort 1997; Zender 2006). In this text, I discuss detailed descriptions of the appearance and contexts of the use of the turtle shell idiophone in iconographic and archaeological sources, and I verify the existing interpretation of the symbolism of its sound, with the aim of revealing the complex nature of using the sounds of turtle shell idiophones and other musical instruments or objects in the Maya rituals. I will start with the emic introduction of the turtle and turtle shell based on the linguistic sources from the Classic Period.

1 Turtle shell idiophone in Maya epigraphy

The abovementioned cross-hatched pattern is a characteristic feature of a logogram representing the turtle shell with a phonetic value of AHK – meaning "turtle". Another sign related to the turtle is MAHK, which appears as the name of one of the Haab months (those of the solar year). Both signs represent the outline of the turtle shell, but in the case of MAHK, the carapace has a pattern of three or four black triangles (Zender 2006: 2). While AHK seems to be a pictographic sign, MAHK is translated as "shell". There are few inscriptions that are related to the use of the turtle shell as a musical instrument, although so far, we don't have evidence that the Pre-Columbian Maya used a separate word for naming this object as a musical instrument.

In Cahal Pech, Belize, an incised turtle shell was found in the elite Burial B1–2. The state of preservation was fragmentary; however, Awe and Zender read individual glyphs and arranged them into possible phrases:

(1) aku A.56J...	*Ahk Aj* ...	'turtle, he of ...'
(2) uju ...	*uju* ...	'his / her / its ju ...'

(3) K'AN-na- *HIX-...-wa	*K'an Hix ...w*	'Yellow / Tawny Jaguar ...'
(4) yu -...	*yu ...*	'his / her / its ...'

(Awe and Zender 2016: 158)

Even though only a small part of the inscription was preserved, it allowed the interpretation of a dedicatory formula: *ujuuch(il) akh aj* "it is the turtle shell of aj-" (ibid.). There are known instruments, for example, clay drums marked with similar formulas, in which the name of the item and the name of its owner appear (Ciura 2021). It is thus possible that it was a musical instrument, as the authors describing the artifact suggest, although its name, "turtle shell" is not directly connected to its sounding properties.

On the other hand, another, fully preserved, inscribed turtle shell bears the glyph naming this object as *yu-k'e-sa*, which may mean "weeper" (Houston and Tokovinine 2013). This "label" was apparently not designated for a specific instrument because the same word appears on a conch shell trumpet (Chrysler Museum of Art, #86.457). It may then be a reference to the sound of these instruments or the context of their use.

2 Depictions of the turtle shell idiophone

Depictions of the turtle shell idiophone appear on a wide array of visual media including vase paintings, murals, and figurines, with most of them dating to the Classic Period (250 BCE – 900 CE). The key to the presentation of the iconographic material is the context of the scene, I will start with the mythological scenes, and move to the historical ones.

The earliest known representation of this instrument is in a scene depicting a mythological narrative related to the Maize God, painted on the west wall of Structure Las Pinturas Sub-1 in San Bartolo, Guatemala (Figure 1). The mural is dated to the Preclassic Period, about 100 BCE (Chin-

Figure 1: Maize God (center) playing the turtle shell idiophone. San Bartolo, Structure Las Pinturas Sub-1. Drawing by the author after the reconstruction painting of Heather Hurst.

Figure 2: Mythological scene with the Maize God emerging from a cracked turtle shell also showing Chaak, and two Paddlers in canoes, vase K731. Photograph by Justin Kerr. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

chilla Mazariegos 2017: 156). The Maize God is depicted inside a turtle shell, represented in a quatrefoil manner, which was typical for representations of caves and portals. He is dancing while he beats a turtle carapace hanging on his neck with a deer antler or a bird claw (Saturno 2016: 139), and is flanked by two sitting characters: the rain god Chaak and another deity interpreted as an anthropomorphic version of the Waterlily Serpent (Chinchilla Mazariegos 2017: 222) or a god of freshwater (Saturno 2016: 139). The image of the turtle is part of a larger visual narrative. The scenes painted on both sides of the turtle may represent the Maize God's death in water and his rebirth (Chinchilla Mazariegos 2017: 221f.).[2] The music-making by the Maize God seems to be connected to his journey towards rebirth and the establishment of his relation with the pluvial deities.[3]

Another related mythological scene, though painted later, is depicted on vase K731[4] (Late Classic Period), showing four supernatural characters, three of which are standing in canoes while the

[2] In many iconic representations of the Maize God's resurrection (e.g. the Resurrection Plate, K4681, San Bartolo murals), a young man with an elongated skull emerges from a broken turtle shell. The turtle is interpreted as a symbol of the earth, the metaphor of the entire world, the so-called "cosmic turtle" (Looper 2009: 119). Zender (2006) came to a more precise conclusion, that the carapace symbolizes the dry, cracked earth, a layer that plants can break through with the flow of rain. This turtle-earth is connected to Old God, God N (e.g. God N is emerging from the turtle shell aperture), which signals the role of this supernatural entity in the resurrection. Additionally, the rear aperture of the turtle shell creates an occasion for the appearance of other beings, e.g., K'awiil – the god of lightning.

[3] Interestingly, the mural shows traces of breakage, possibly caused by someone hitting the painting with an axe, a gesture that symbolically helped to open the turtle shell, which was necessary for the Maize God's rebirth (Saturno 2016: 139).

[4] All K-Numbers in this article relate to Justin Kerr's Maya Vase Database: mayavase.com.

Maize God rises from a crack in a turtle shell (Figure 2). From the apertures in the shell, two old beings emerge. They bear features characteristic of God N, a deity related to the quadripartite structure of the world, who holds the earth and the sky.[5] Next to the Maize God, we can see a character with features of both Chaak, the rain god (with its characteristic head and death-eye collar), and K'awiil, the god related to lightning (sporting legs with a snake pattern), and holding a stone which can be interpreted as a device for creating lightning. The turtle shell instrument is held by a character standing in the canoe behind Chaak, who is identified as the Stingray Paddler by Marc Zender (2006: 8. See Figure 3a). We can see both parts of the shell – the carapace with a cross-hatched motif and the plastron marked with parallel, wavy lines. Additionally, a round element marked with the *k'an* cross[6] is added to one side of the shell. It may be a gourd serving as an additional resonance chamber. Another interpretation is that it is a gourd filled with corn, because the *k'an* cross can symbolize a yellow substance (Quenon and Le Fort 1997: 894). The musician is holding the instrument under his left arm; the shell itself is large, extending from the upper part of the chest and above his head. In his right hand, he holds a deer antler. The last person standing in the canoe is the Jaguar Paddler, who has jaguar spots on his face and is wearing jaguar pelt gloves. He is also holding a long object, which looks like a paddle, though with unusual features.[7] This mythological scene most likely reflects the moment of the Maize God's resurrection, complete with a thunderstorm, in conjunction with the presence of Chaak holding a stone associated with lightning. In these circumstances, the turtle shell instrument is interpreted as imitating and summoning the sound of thunder (Zender 2006: 10). The characters' placement in canoes, and the company of two supernatural Paddlers – who in other scenes are depicted as guiding the Maize God through

[5] God N is a supernatural entity as based on iconographic features initially recognized by Paul Schellhas (1904: 37–38) in his classification of Maya deities depicted in the Postclassic codices. The Classic Period version of God N was recognized as old, wrinkled, and bald, wearing simple clothing and a headwrap with a netted pattern. Often, he is depicted inside (or wearing) a turtle or mollusk shell marked with the '*k'an* cross', a quadrapartite sign, which is a logogran meaning "yellow, precious, ripe" (Stone and Zender 2011: 127; Martin 2015: 188). The variants of the Classic Period God N's name were transcribed as *Chan Itzam Tuun*, "Four Stone Itzam", and *Itzam K'an Akh*, "Itzam Yellow/Precious Turtle" (Martin 2015). Simon Martin (2015: 191) described God N as belonging to the Old Man complex, a group of beings sharing common traits in iconography and script. He sees God N as the quadrupled being, supporting the sky or even the whole world, related to four cardinal directions, associated with cosmic mountains and water.

[6] On the *k'an* cross, see n. 7. In one of the Maize God resurrection scenes, it is depicted in the turtle's carapace center in the crack from which the Maize God emerges. In this context, it is interpreted as denoting the importance of the hole from which the Maize God arises (Quenon and Le Fort 1997: 896). Another explanation is that it marks the 'center', the base of the axis mundi, the cosmic tree, which is maize (Martin 2015: 191). Looking at the visual form of the sign, *k'an* is a simple cosmogram, representing the four directions. As was summed up by the researchers analyzing the Early Formative Maya symbols: "This structure is associated with concepts of creation, cyclical completion, cardinal directions, lineages, gods, and colors. All of these concepts are embedded in the *k'an* cross – it is perhaps the most fundamental symbol of the Mesoamerican world and is found throughout Mesoamerica spatially and temporally" (Garber and Awe 2009: 157).

[7] The paddle blade is not rectangular but more wing-like with a pointed end, which led Taube (1985) to identify it as a digging stick – an agricultural tool. It may also be a conflation of a paddle and a digging stick, a tool used in swampy river areas (Quenon and Le Fort 1997: 893).

Figure 3: Left: one of the supernatural paddlers playing a turtle shell idiophone. Detail of the scene on vase K731. Drawing by the author after the photograph by Justin Kerr. Right: a supernatural being playing a turtle shell idiophone. Drawing by the author after the photograph published by Reents-Budet (1994: 207).

the watery Underworld – suggest the mixing of two episodes from the Maize God's mythological journey (Chinchilla Mazariegos 2017).

A very similar scene appears on the fragment of a ceramic vase published by Reents-Budet (1994: 207). Originally, at least three characters were depicted as standing on a watery band, their legs being still recognisable, but only one – a turtle shell player – is fully preserved (Figure 3b). The instrument is smaller than the one on vase K731; the carapace is depicted frontally, and again, there is a rounded shape attached to the bottom aperture of the turtle shell. The instrument is held under the left arm and hit with a deer antler. Another figure to the player's right is only partly preserved, but may be deduced from the presence of a paddle/digging stick and a jaguar foot. This is the same Jaguar Paddler as depicted on vase K731. On the left side, the legs of the unidentified character and the back of the big feathered headdress are visible.

There are more mythological scenes representing a turtle shell idiophone as part of a musical ensemble, usually comprised of percussion instruments. One of the typical forms of such an ensemble is a percussion trio in a standard sequential order of musicians, starting with a rattle-player, followed by a drummer, and ending with a percussionist playing the turtle shell. On vase K530, the action most likely takes place in a cave, a mountain interior, or the Underworld, which is indicated by a zoomorphic head of the Earth Monster that also serves as a throne occupied by the rain god Chaak (Figure 4). In front of the throne is an assembly of old men assisted by young women. Each of the old men has a name tag, including the ITZAM logogram, which clearly indicates that these characters belong to the Old Man/Old God complex (Boot 2017; Martin 2015). The fact that there

Figure 4: A typical percussion trio including a rattle player, a drummer, and a turtle shell player in a mythological scene taking place in the cave; vase K530. Photograph by Justin Kerr. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

are four of them may be associated with God N as the quadruple world bearer. They are involved in a ceremony, a ritual enema and feast performed to the accompaniment of music. The three musicians constituting the percussion trio look identical to Chaak, a fourth figure in this section of the scene, shown sitting on his throne. So in total, there are four Chaaks, four Itzams (old gods), and six women in the scene. The rattle player is depicted in the upper register, and the drummer and turtle shell player are shown sitting below. The turtle shell is oval, with its cross-hatched carapace clearly visible. The marginal scutes are painted blue, and the edge of the shell is wavy. The instrument is held under the musician's left arm and covers his entire chest. Above it, a fragment of white deer antler appears.

Relatedly, vase K3007 shows a mythological event in the 'heavenly' realm, as indicated by the sky band in the upper register of the scene. The musicians, depicted inside a structure marked with the *muyal*, "cloud" symbol, are older and dressed alike in rather simple clothing with ornaments in their ears. The turtle shell is held in front of the musician's chest, but the object used for striking it is not visible.

Vase K5506 is unfortunately only partially preserved, which makes its meaning difficult to understand (Figure 5). What can be discerned are three figures, two dancing while facing one another. They wear rich costumes marked with death symbols, such as bones and "death eyes". The third figure is probably the Maize God, or an impersonator of the same. One of the dancing characters is playing a rattle. Creating the duet, the figure in front seems to be holding a tiny turtle shell in one hand and a large, long bone in the other – which is a unique representation of this type of object used for hitting the shell.

One Codex-style scene from vase K1645 shows a turtle shell which is not played, and not even held by the musician (Figure 6). It is depicted lying on a bench, next to a small drum with a jaguar membrane, which helps indicate the identification of the shell as a musical instrument. The scene takes place in a supernatural palace and features two Bundle Gods and a child sacrifice placed on a plate, being burned or incensed (Steinbach 2015).

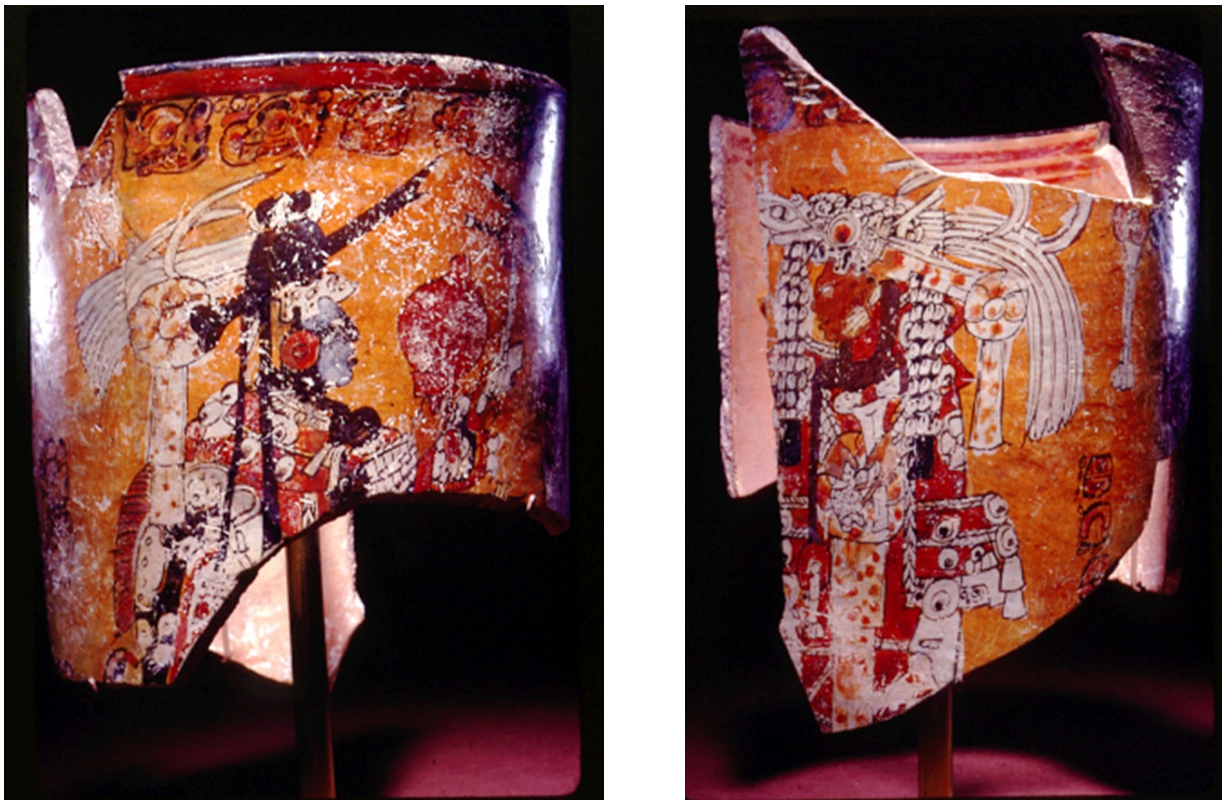

Figure 5: Scene representing two musicians playing a gourd rattle and a very small turtle shell idiophone; vase K5506. Photograph by Justin Kerr. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

A turtle shell is also depicted on supernatural-themed figurines from the Late Classic Period. Three represent a person with a duck-billed face – interpreted as a ritual clown (Taube and Taube 2009) or as a duck-billed wind god or masked impersonator[8] (Stone and Zender 2011: 175). Two of these figurines come from Jaina[9] and show a very small shell, which is proportionally the same size as a figure's hand (Figure 7). The third figurine without known provenance (Zalaquett Rock 2021: fig. 22) represents a duck-billed person holding a shell the size of his torso under his right arm and beating it with a deer antler.

A musician is represented on a figurine from Copan (Figure 8): it is a man with skin distortion in the area of the chin and cheeks, where round dimples appear, which may reflect the transformation into or spiritual coexistance with an animal.[10] He is holding a turtle shell under his

[8] The duck-billed character is said to be a form of the wind god, the one connected to Central Mexican traditions (Taube 2004; Katz 2018: 197). In other scenes, he is depicted dancing and singing (San Bartolo West Wall mural, Pinturas Sub-1A) or playing rattles (Stela 3, Seibal). Music and wind were related in Classic Maya culture, and it seems that music was considered an air-like substance (Taube 2004: 74).

[9] Figurine K3550 in Kerr's Precolumbian Portfolio and figurine from the collection of Museo Nacional de Antropología in Mexico published by Zalaquett Rock (2021: fig. 21).

[10] The faces with patches of unnatural, dimpled skin may be analogical to the logogram WAY, which is translated as "animal co-essence, animal spirit" and which represents the sign AJAW, "ruler" partly covered with jaguar skin. Such mixing of human and animal features may be a reference to the transformation or the double existence of a human and animal counterpart. Other examples of such a representation in the art are the drummer figurine K5785 and rattle-player depicted on the vase K1507.

Figure 6: Turtle shell not played, lying on a bench, vase K1645. Photograph by Justin Kerr. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

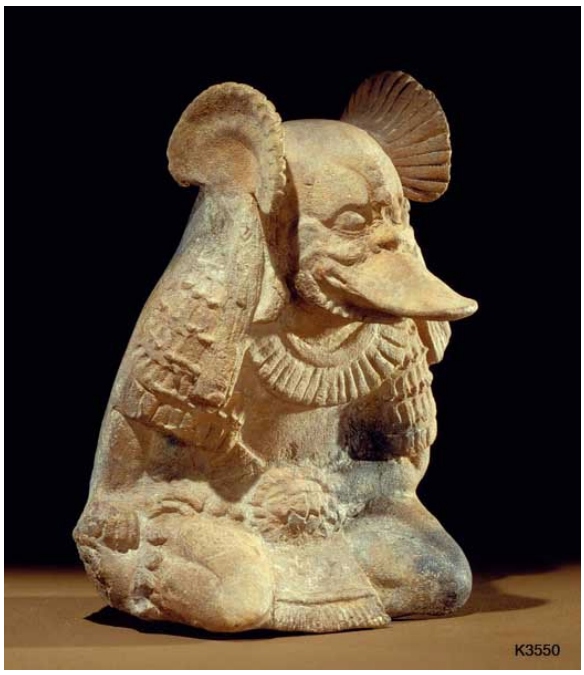

Figure 7: Figurine K3550 representing an anthropomorphic figure with a duck-billed face or mask holding a small turtle shell idiophone. Photograph from Justin Kerr's Portfolio. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

left arm; the shell is round and has a spherical attachment at the bottom, similar to the one represented on vase K731. The musician is hitting the shell with a stick with a rounded end. A cloth is wrapped around this attachment and the musician's neck and right shoulder, creating a carrier for the instrument (Zalaquett Rock 2021: 50).

Other scenes featuring the turtle shell as part of a percussion ensemble appear in contexts depicting human activities – palace events, rituals, wars, or processions. On vase K8947, the percussion trio stands at the entrance to a cave, symbolized as the zoomorphic Earth Monster (Figure 9). The depicted environment also features elements characteristic of a palace interior, such as walls and a throne; however, the throne is placed on the body of the Earth Monster, and the wall is

marked with the quatrefoil symbols of caves and the Underworld. Thus, it seems that we are looking at an event happening on the border between the human realm and the Otherworld. The inscriptions scattered throughout the scene were deciphered by Houston (2018: 65) as *5 Imix t'abayi ik'il ook*, "on the [day] 5 Imix, they rise up, the musical [windy] feet" or by Hoppan (2019) as *5 imix t'abaay ik' nal*, "on the 5 Imix, Ik' Nal ('the place of the primordial wind') is inaugurated". The musicians forming the percussion trio are dressed nearly identically, in richly embellished outfits including bracelets, anklets, beaded necklaces, and ear ornaments. Their instruments also have decorative features and are made of luxurious materials (a rattle with feathers, a drum with a jaguar skin membrane). In the scene, the turtle shell idiophone looks very natural; it is cream-colored (matching the two-tone color palette of the vase), and is oval with a smooth edge. The instrument is held diagonally under the right shoulder and is very large, covering the entire chest of the musician. The other hand, or object, with which the shell may have been hit, is not visible.

Figure 8: Figurine from Copan of a musician with skin distortion playing a turtle shell idiophone held in a cloth. Drawing by the author after a photograph published by Zalaquett Rock (2021: 51).

A percussion trio appears in a unique context in the scene of scaffold sacrifice, as shown on vase K2781 (Figure 10). To the viewer's left, there is a group of warriors with large headdresses and holding spears; while behind them, a percussion trio and three trumpeters flank the scaffold on its right. This particular combination of the percussion trio with two or three trumpets was apparently common in the arrangement of Classic Maya ensembles, although these two groups are usually visually separated (Stöckli 2011). All the musicians wear similar white loincloths with red patterns and fringes, but their headdresses differ. The turtle shell idiophone is held under the right arm of that musician; its central part is orange, and the sheath white, with a smooth edge, and a fragment of deer antler in white visible over the shell.

The next group of depictions shows dance and procession events. On vase K6294, six individuals are depicted in a row facing the same direction. This arrangement may imply a kind of forward, processional movement (Figure 11). One individual is depicted in a dancing pose, and two others are held up on the backs of other males, performing vivid gestures. The participant standing in the middle is holding an oblong object near his mouth, which may be a cigar or a trumpet. Judging from a trophy head attached to his hips, he is likely a warrior. The edge of the scene is marked with a vertical glyph band containing a Primary Standard Sequence[11], with a musical ensemble

[11] The 'Primary Standard Sequence' is the dedication formula usually painted under the vessel's rim. It contains basic information about the shape and purpose of the vessel, and occasionally also includes the name of the owner and/or the painter.

Figure 9: Percussion trio standing before the zoomorphic Earth Monster but also in the palace interior, accompanying a dancer performing before a throne; vase K8947. Photograph by Justin Kerr. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

Figure 10: Percussion trio and trumpeters performing for a human sacrifice; vase K2781. Photograph by Justin Kerr. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

leaning forward from behind it. The ensemble is comprised of three trumpets, a tall, cylindrical drum, and a turtle shell held in front of the musician's chest. The shell, showing the plastron side, is light green and has an unusual shape, with two longitudinal protrusions at the top, perhaps representing the aperture. The percussionist's left hand holds an antler that is also visible. The musicians have identical headdresses: a headband with a flower over their foreheads, which is also worn by the two figures carrying dancers on their backs. This suggests that they all belong to the same group of people preparing to assist in the ceremony.

A very characteristic type of depiction featuring the percussion trio is represented by the so called Chamá-style scenes showing processions in zoomorphic costumes.[12] Four such scenes include musicians (K3040, K3041, K3332, K5104), and three show the entire percussion trio (Figure 12). All the characters are depicted in a row with one leg extended, suggesting a processional movement. However, the presence of the immobile, tall *pax* drum in the row of participants either un-

[12] The Chamá style developed in the Chixoy River Valley, Alta Verapaz (part of the Maya Highlands), in the Late Classic Period. The motifs depicted on Chamá-style vases draw from the Lowland Maya culture and the style is characterized by a red, black, and orange color palette added to chevron motives around the rim and base of the vase.

Figure 11: Dancing procession accompanied by musicians; vase K6294. Photograph by Justin Kerr. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

dermines this interpretation or proves a conceptualized, unrealistic representation of the location of the drum in this event.[13] The turtle shell idiophone in all three cases is held under the left arm of the musician, and the carapace side is visible. On two vases (K5104 and K3041), the carapace is marked with a *k'an* cross, otherwise, the instrument displays features specific only to these three Chamá-style scenes. The shell is more angular with a rectangular aperture and its visible edge is straight and marked with semicircular lines, which doesn't look like a natural feature. It may be a result of the painting style or represent a modification of the instrument. The semicircular lines along the edge may represent grooves which would create an additional scraping sound if rubbed with deer antlers. That said, there is no archaeological or ethnographic evidence that would confirm a practice of shell modification.

The largest scene of a public ritual including a procession of musicians is the one represented in the Bonampak murals. The musical ensemble depicted in Structure 1, Room 1, comprises five rattle-players, one drummer playing a *pax* (skin drum), three turtle shell players, and additionally – separated from the percussion band – two trumpeters, and one additional rattle-player. This is the combination of instruments typical for a Classic Maya ensemble, although in Bonampak murals, the number of musicians is increased. Three turtle shell players are depicted on the right, holding deer antlers in their right hands and shells with plastrons facing the viewer held under

[13] Miller (1988) noticed, that the drummer playing the *pax* (the skin drum) represented on the mural in Room 1, Bonampak was standing while the rest of the musicians were following the procession (he is depicted frontally while others are depicted from the side) and proposed that the musicians were moving around the drummer. This may also be the case with other depictions of musical bands including this large standing drum.

Figure 12: (Top): procession of zoomorphic characters forming a percussion trio; Chamá-style vase, K3040. (Middle): procession of zoomorphic characters, including a percussion trio, Chamá-style vase K3041. The turtle shell has a *k'an* sign on it, although part of the sign is covered by the musician's arm. (Bottom): procession of zoomorphic characters, including a percussion trio, Chamá-style vase K5104. The turtle shell has a *k'an* sign on it, although part of the sign is covered by the musician's arm. Photographs by Justin Kerr. Justin Kerr Maya archive, Dumbarton Oaks, Trustees for Harvard University, Washington, DC.

their left arms (Figure 13). The shells are brown, oval-shaped, and large; the antlers are also brown and V-shaped. The percussion ensemble is visually unified by the uniform wearing of similar tall white headwraps. Another ensemble is depicted in Room 3, where musicians are squeezed in the upper register of the scene, next to dancers performing on stairs and wearing enormous headdresses. The rattle player is visible at the front of the group, and the drummer is carried on a litter. The other musicians are not clearly visible, but at least two are holding oval shapes under their left arms, possibly representations of turtle shells.

Another percussion band is depicted on a polychrome drum in the collection of the La Ruta Maya Foundation (Krempel and Paredes Maury 2017). In the lower register of the scene are seven

Figure 13: Musicians playing turtle shell idiophones, detail of the mural in Room 1, Bonampak. Yale University Art Gallery; gift of the Bonampak Documentation Project; illustrated by Heather Hurst, M.Phil 2006, Ph.D. 2009, and Leonard Ashby.

musicians, separated into two groups by a dedicatory text. A standing trio of rattle players is depicted on the left of the text. On the right, there is a percussion band led by a rattle player performing energetic movements that suggest dancing, while the drummer, turtle shell player, and a person who is clapping his hands are sitting with mouths open, perhaps singing (Figure 14). The large oval turtle shell is held under the left arm. The members of the percussion ensemble are dressed in similar turbans with dark dots.

Figure 14: A musician playing a turtle shell; a member of the percussion band depicted on the polychrome ceramic drum from La Ruta Maya Foundation, Guatemala, Cultural Property Registry no. 1.2.179.0155. Drawing by the author after a photograph published by Krempel and Paredes Maury (2017: fig. 2).

3 Turtle shell idiophones preserved in archaeological material

As an archaeologic relict, a natural object like a turtle shell is difficult to identify as musical instrument. For the Classic Maya, a turtle was the source of a variety of commodities, such as meat or material for ornaments, not to mention its symbolic meanings connected to water, earth, and the Maize God. Therefore, when its remains are found in archaeological contexts they could reveal many possible functions, some perhaps overlapping. It may also be problematic that turtle shell remains are described with varying degrees of accuracy in the archaeological literature. To wit, archaeologists do not always state which parts of the shell were preserved. One reason for these impre-

cise descriptions is the poor state of preservation typical of the material, a fact which absolves archaeologists of charges of imprecision, at least in this regard.

The first clue to the identification of a turtle shell idiophone is the *in-situ* finding of a whole shell or fragments of both the carapace and plastron without remains of a skull or limbs. This implies that the shell, and not the whole animal, was deposited. The second clue is the beater. The object paired with the instrument is most often a deer antler, shown in iconography as the prescribed object used to hit the surface of the plastron. This association occasionally appears in archaeological contexts. Other clues that favor identification as a musical instrument are traces of use, its presence in material assemblages of other ritual objects, and its presence with known musical instruments, such as drums or aerophones. Additionally, many turtle shells identified as possible instruments have small perforations, which could have been used for suspension. This means for holding the instrument have not been observed in iconography, but it is possible that some instruments were suspended, facilitating their mobility in performance. This said, when remains of a turtle shell contained features allowing for its interpretation as a musical instrument, and the species of the turtle was possible to identify, it turned out to be *Dermatemys mawii*, *Terrapene mexicana, Trachemys venusta, Rhinoclemmys areolata*, or a species of the Kinosternidae family. There are quite significant differences between the shells of different species, e.g. the shell of the *Dermatemys mawii* can measure up to 60 cm in length while the species from the Kinosternidae family measure between 12 and 17 cm (Lee 1996: 149–63). Such differences in size result in different acoustic properties, and such acoustic analyses and comparisons would be an interesting next step in archaeomusicological research of Maya culture.

Turtle shells identified as instruments were found in Classic Period residential contexts in Aguateca (Emery 2014), Caracol (Teeter 2001: 323), and Piedras Negras (Emery 2007: 63). However, by far the most common context of turtle shell finds is a burial one. A turtle shell was found among rich funerary gifts in Late Preclassic Burial E in Chan, Belize (Kosakowsky and Robin 2010: 48) and Early Classic Burial 8 in Mound 20, El Mirador, Guatemala – this specimen exhibits traces of red pigment and has suspension holes (Agrinier 1970: 30–31). Three large turtle shells were found in an Early Classic burial in Structure 7, Santa Rita Corozal, Belize (Zalaquett Rock 2021: 46). And finally, a unique deposit was found in Burial 10 in Structure 5D-34, Tikal, Guatemala, location of the resting place of an Early Classic ruler Yax Nuun Ayiin I (Coe 1990). It is a particularly interesting case because of the number and specific arrangement of turtle shells found there. Five turtle shells, arranged from the biggest to the smallest, were placed on a wooden frame, three large ones on the top of the frame, and two smaller ones probably at the bottom. It may have been used as the first Mesoamerican marimba-type instrument (Brill 2012) or gong rack.

Several burials from the Late Classic Period also contained turtle shells. A burial from Structure B118, Caracol, Belize, contained a shell with perforations (Teeter 2001: 128). Among the rich assemblage of Tomb 1, Copan, Honduras, were decorated vases, jade, shell and obsidian objects, two incised peccary skulls, a pottery whistle, a deer bone, and a turtle carapace (Longyear 1955: 140–41). Moreover, at Copan, Mound 36 – labeled by the excavators as a midden and burial struc-

ture – was a turtle shell placed with unworked deer antlers (*ibid*: 112). An almost whole turtle shell was found in Mayapan, Postclassic Burial 14, with holes in both parts of the shell drilled in the central axis, along with fragments of deer antlers (Hamblin 1980: 135; Pollock et al. 1962).

An exceptional context of a turtle shell finding is the Palace Reservoir in Cancuen – a water reservoir located near the royal palace of the site, that was used during the Late Classic Period (Thornton and Demarest 2019). Excavations revealed that the palace was the final resting place of at least 31 elite individuals of both sexes, most of whom showed evidence of trauma (*ibid*. 476). This mass grave is dated to around 800 CE, when the site went through a turbulent period leading to its eventual abandonment. The reservoir proved to be rich in artifacts connected with rituals of the Classic Maya elites, likely conducted prior to the final deposition of human remains. Among the artifacts and faunal remains were four turtle shells, two of them with abrasions in the center of the plastron. Additionally, deer antlers with polished tips were found in the same assemblage. The findings also included other musical instruments: a rasp made from a deer tibia, a shell trumpet, and figurine-whistles (Sears 2016; Thornton and Demarest 2019). Another watery deposit is known from Dzibilchaltun, where a turtle shell, was found in the *Xlacah* Cenote, and its entire shell was "covered with scratch marks" (Wyllys Andrews IV and Wyllys Andrews V 1980: 328).

4 Sound of thunder – interpretations and discussion

The interpretation that the sound of the turtle shell idiophone is connected to thunder was proposed by Seler (1990) and later developed in Taube's research of God N as a god related to turtles and thunder (Taube 1992: 99). The further implication was that it was used in rituals based on sympathetic magic as a mechanism for summoning rain through the replication of the sound of rain and storm (Reents-Budet 1994; Quenon and Le Fort 1997; Zender 2006). This kind of rain-summoning ritual is said to be represented on San Bartolo murals, depicting the Preclassic version of the Maize God resurrection, and on the Classic vase K731 (Zender 2006: 9). In the Preclassic scene, the Maize God, needing to escape the Underworld, plays the instrument to summon the rain. The surface of the Earth is represented by a turtle carapace, which resembles an enclosure of dry soil. The Maize God succeeds in his goal with the aid of Chaak. It is interesting how the two ideas may be connected – a turtle shell which in the resurrection context represents a "milpa after a period of prolonged, dry-season drought: a dried and hardened surface" (*ibid.*: 10) and the turtle shell idiophone, which helps to bring the rain ending the dry season. Taube (2009: 48) noted that "the natural act of lightning striking the earth is music-making on a cosmic scale, with thunder resounding from the carapace of the earth turtle". In this case, hitting the turtle shell idiophone would replicate hitting the earth by lightning. Below I discuss this interpretation.

Thunder as a meteorological event is one of the first signs of the rainy season in Maya Lowlands. It was described by Redfield and Villa Rojas during ethnographic research in the Maya village, Chan Kom, in north central part of Yucatan Peninsula:

> "The people scan the eastern sky, for there all the chaacs are gathered, ready to ride forth with the fructifying waters. At last, one day the clouds gather in the east, and the first low thunders of the season are heard. This is a welcome sound; now the rains will come within a very few days; when this first thunder rumbles, the men shout, He cutalo le yum chaacob! (Here come the lords chaac!). Soon the gathering clouds sweep westward, spreading across the heavens; the chaacs are riding the sky and the first rains fall."
>
> (Redfield and Villa Rojas 1962: 84)

Similarly, among Lacandon Maya, the god of thunder, called *Tanepekqu*, also announces the rain (Tozzer 1907: 98).

The notion of caves inhabited by otherwordly, usually dangerous beings connected with the watery, "meteorological" realm (including thunder, lightning, clouds, rain, and dangerous atmospheric phenomena) appears commonly in the ethnographic record (Vogt and Stuart 2005: 177; Ishihara 2007: 29). Researchers also noted contemporary Maya beliefs indicating clouds and rains as coming from caves by means of the wind. This may be based on observations of the phenomenon of clouds of mist rising from caves (Ishihara 2007; 2008; 2013). If these beliefs stretch back to the Classic Period, many of the artifacts found in caves could have been leftovers of rituals invoking rain, or been offerings to the gods of rain, lightning, and thunder. Based on the logic of sympathetic magic, smoke from copal incense was thus imitating clouds, and musical instruments were imitating the sound of the storms. Ishihara interprets ceramic drums found in Grieta Principal, Aguateca, Guatemala, as possibly used to symbolically replicate thunder (Ishihara 2007: 353). A similar interpretation is attributed to the ceramic drum from Actun Chanona, a cave in Belize (Peterson 2003: 31). There is also linguistic evidence for using drumming as an imitation of thunder sounds; the contemporary Yucatec word *pec* means both "drum" and "the noise of the thunder" (*ibid*.).

The sound of a drum as a means for conjuring a thunderstorm appears in modern Ch'orti myths as well. The maize myth hero *Kumix* finds out that his father was killed and his inheritance stolen – an inheritance comprised of objects, which, depending on the version of the narrative, include a whip, a drum, clothes (which were the clouds), or a machete, drum and a gourd. When *Kumix* recovers his father's belongings, he uses them to produce lightning, thunder, and rain (Chinchilla Mazariegos 2017: 187). Each object is thus used to imitate one natural phenomenon: the machete provides a visual symbol (sparkle-lightning), the whip provides a visual and auditory symbol (the crack of the whip and the cloud of misty vapor resembling the effects of lightning striking), the drum – an auditory symbol (drumming-thunder) – and the gourd can be filled with water and stand as a *pars pro toto* metaphor of rain (clothes-clouds also are used to make rain). This myth seems to be realized in the ritual invocation of rain performed at Chan Kom, in a ceremony which is presided over by the ritual specialist called *-h-men*, who selects an old man to impersonate *kunku-chaac* – the chief of the rain gods. He receives a gourd and a wooden machete – the attributes of a rain god. He uses his voice to imitate thunder, with the machete symbolizing lightning (Redfield

and Villa Rojas 1962: 142). Sosa's ethnographic research conducted in the Yalcoba town in Yucatan provided a similar example: "Then during some of the prayers, they would imitate thunder and rainfall by banging pieces of wood together and splashing water on the *ka'an ce'* and participants, and thus lent a dramatic air to the *hmeen's* performance" (Sosa 1985: 387).

The objects mentioned in myths and used in the rituals can be compared to the ones depicted on vase K731. There, Chaak, with a stone, may be producing lightning, and the turtle shell may be a symbol of thunder, while the Maize God is holding a gourd filled with water and maize seeds (Chinchilla Mazariegos 2017: 221).

Taube noticed also that a rattle staff – an idiophone with one or more resonating chambers filled with pellets – could have produced sounds symbolizing the sound of the thunder (Taube 1989). The rattle staff is topped with a serpent in some Postclassic depictions, and the serpent was the symbol of lightning.[14] In the Chan Kom village, where thunder and rain are believed to be connected with lords chaaks, there are different chaaks responsible for different aspects of a thunderstorm, among them *bohol-'caan-chaak,* which means "gourd rattle chaak", who produces much thunder and little rain (Redfield and Villa Rojas 1962: 115). Finally, the sound of a conch shell trumpet used in the *K'ichean'* serpent dance is another sound supposedly imitating thunder (Taube 1989).

Since contemporary Maya use a range of visual and auditory metaphors to reenact the mythological narrative and imitate nature in rituals, it is also possible that this was true of the Classic Period. I believe that the sound of the turtle shell idiophone could have symbolized the sound of thunder, especially in the Classic Period. However, ethnographic sources provide evidence that drums, rattles, the human voice, or conch shell trumpets could also have been used in the same manner. It seems that in the Maya culture(s), the formal specifics of the instrument were not the most important factor, but rather the context of the sound production and its relations to other metaphors used in the mythical narration or ritual influenced its symbolic values.

5 Other symbolical associations of the turtle shell idiophone

It is worth noting that, in mythological depictions, playing the turtle shell is connected with the moment before the Maize God's rebirth. This fits a rain-summoning interpretation, but also provides another, related understanding. On the San Bartolo mural, the Maize God plays the instrument while inside the turtle, yet the image is flanked by renditions of his death and birth. Thus, it may be that being inside the floating turtle is the moment in-between, a moment of journey and growth.[15] On vase K731 and the vase from Copan discussed previously the Paddler is found playing

[14] This type of idiophone is also called a "thunder-staff" by the contemporary Sierra Totonac (Taube 1989: 124).

[15] The motif of turtles bringing help, refuge and accompanying the moments of transition of the Maize Hero appears in modern myths and stories – Homshuk, hero of Popoluca, uses the turtle to go across the sea in search of his parents. When he reaches the land, he plays musical instruments like a drum, a turtle shell idiophone, and a flute (Chinchilla Mazariegos 2017: 188). In Q'eqchi' version of Hummingbird myth, the old deity related to the forest (called Earth Lord) has a daughter (identified with a moon), who is seduced by a

the instrument, and in the first image of this corpus, the Paddler is located in front of the resurrected Maize God. It does not automatically follow, however, that the Paddlers and the Maize God emerging from the turtle shell are engaged in the same episode of the story. Paddlers are usually depicted as beings who guide the Maize God through the watery Underworld, a metaphor for death. It was not uncommon in Maya art to employ narrative compression and combine elements from different stages of a story in one continuous scene. If this is true for vase K731, the music of the turtle shell would be connected with the death and journey of the Maize God. The instrument made of the aquatic animal was played during his passage through a watery Underworld in a canoe or inside the turtle. This observation seems significant in light of the findings of turtle shell idiophones in burials and watery deposits (Cancuen Palace Reservoir and Cenote Xlacah in Dzibilchaltun). Zalaquette (2021: 71) has already noticed, that the turtle shell found in burials may be a symbol of rebirth. These two contexts, archaeological and iconographic, are complementary in relating the turtle shell idiophone with the watery Underworld, the passage towards rebirth.

6 Conclusions

The majority of iconographic and archaeological sources confirm that the shell of a turtle was used as a resonating instrument by the Maya. There are three depictions of the turtle shell idiophone where it has an additional spherical bowl attached to the bottom, which could have been an additional resonator made of gourd or ceramic. However, such a modification has not been yet confirmed in the archaeological record. On two vases (K3041, K5104), the turtle shell is marked with a *k'an* cross, while on vase K731, this sign appears on the attached bowl. The use of this sign on a turtle shell idiophone may be a reference to the yellow color of the object, while on the other hand, it connects the instrument to other depictions of turtles in Maya art. The size of the turtle shell idiophone represented in Maya art is large, usually the same size as the torso of an adult male musician, suggesting the use of the *Dermatemys mawii* species, measuring up to 60 cm.

The visual sources clearly indicate that the turtle shell was held under the arm and beaten on the side of the plastron. There is not enough archaeological evidence of the use-wear marks on the plastron to assess which parts of the plastron were hit most often and if the Maya musicians benefited from the two-toned potential of the instrument. Deer antlers as solid objects used for beating the shell were commonly depicted, and there are also rare cases of antlers found alongside turtle shells in the same deposit. One depiction of a turtle shell being struck with a stick is represented in the figurine from Copan, while on vase K5506 a very small shell is struck with a long bone.

Supernatural musicians playing turtle shell idiophones are depicted in the context of the Maize God's journey through the watery Underworld and his resurrection. In such cases, the instrument was played solo by the Stringray Paddler (K731) or the Maize God himself (San Bartolo murals). Another supernatural character playing this idiophone is the duck-billed wind god or his

young hunter (identified with a sun). After he succeeded, the couple escaped in a turtle carapace, or on a crab or armadillo (Looper 2019: 78).

impersonator. On vase K530, the percussion trio made up of characters with Chaak's features accompanies an enema scene taking place in the Underworld. In the sky realm, a similar ensemble, this time comprised of old musicians is depicted on vase K3007. In both scenes, the band is located on the edge of the composition, and these ensembles are visually unified by their similar clothing.

The Chamá-vase scenes represent an ensemble of characters, who may be humans dressed in zoomorphic costumes, operating in the liminal space between the real and supernatural world. The figurine of a musician (Copan, after Zalaquette 2021: fig. 20) with distorted skin, highlighted by dimples around the chin and cheeks, is similar to representations of other individuals with deformations playing instruments (for example the drummer on figurine K5785 and rattle player on the vase K1507). Other musicians playing this instrument have human features; although none have name tags preserved (although it is possible that the musician depicted on the polychrome drum from La Ruta Foundation may have had a name tag that has since eroded: Krempel and Paredes Maury 2017).

Events where a turtle shell idiophone was employed took place in both interior private and exterior public spaces, though many scenes do not have clear markers of location. The activities performed with the accompaniment of a musical ensemble with turtle shells included dances, processions, and human sacrifice. Regarding the interpretations of the symbolic functions of the turtle shell idiophone, its sound could have been used as the sound of thunder in the imitative magical ritual of rain summoning. However, this imitative function was likely dictated by the mythological or ritual context of its use, and other sounds performed in such contexts could have had an analogous role. In Classic Period iconographic sources, the turtle shell idiophone is associated with the Maize God's journey from the watery Underworld, ending with his rebirth. This part of the mythological narration also neatly corresponds with the rain summoning, as the start of the rainy season brings the maize back to life. Taking into consideration that the turtle shell idiophone was placed in burials, it likely served as a sound object during the passage towards rebirth, mirroring its use by the Maize God. Therefore, the use of this musical instrument serves as an example of how the sphere of agricultural rituals and beliefs concerning the afterlife were interconnected in the Maya culture of the Classic Period.

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Sounds of a Grand Race: Conceptualizing Supernatural 'Vitra' Paths as Pre-Modern Sound-Musical-Spatial Infrastructure

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Abstract

This ethnomusicological, anthropological, and archaeomusicological study examines pre-modern conceptualizations of sound, 'music', and spatiality in northern Sweden before trains, electricity, gramophone, and radio arrived, through the lens of a specific body of material: mentions of sound and 'music' in recorded folklore accounts of the supernatural race known as the *vitra* and the 'supernatural' infrastructures known as *vitra paths.* The article introduces an extensive body of material – including both written records and sound recordings – from the northernmost landscapes of Sweden, especially Lappland, Västerbotten, and Ångermanland, with particular emphasis on Lycksele and Degerfors parishes. According to folklore, the vitra lived underground, in the woods, inside the mountains, and outside human culture. They were encountered along the paths they traveled through in the landscape, and especially in auditory and musical experiences. Vitra beliefs are documented in oral descriptions and in Sámi vuole, Swedish herding tunes, and other tunes attributed to vitra. Vitra 'music' has been described as strong, beautiful, chromatic, and dissonant, and could be vocal or instrumental. This study addresses the pre-modern reception of sound and 'music' through theories of hearing/listening, soundscapes, and acoustemology. It offers new perspectives on how people in the area studied have understood their sounding reality in relation to natural spaces, landscapes, and soundscapes. It presents an interpretation of the cultural meanings of vitra paths as an originally Sámi concept related to shamanism and *Saivo*, which mixed with Swedish and Finnish folk beliefs. The resulting *transculturation* was specific to the area and produced the acoustemological and *sound-musical-spatial infrastructure* concept of vitra paths, which have been perceived – along with vitra sounds – as spatial framings of vitra areas. The study ends with a discussion of pre-modern conceptualizations of sound and 'music' before the modern concept of *music* was established in northern Sweden (and all of Western culture) with the advent of modernity.

Keywords

Vitra – Vitra paths – Sound/'Music' – Saivo/Sájva – Sámi – Swedes – Finns – Sound-musical-spatial infrastructure

1 Introduction: Sounding traces of a 'Grand Race'

> "There was another race on Earth who lived happily alongside humans – but now they are no more."[1]
>
> "[they played] … such incomprehensible sounds …"[2]
>
> "Many have seen the 'vitra' and even more have heard them; in the forest villages, there are probably very few, even today, who do not claim the latter, or at least so it was in the past. And those who have are as certain in their belief in vitra as they are in their belief in their blessedness; so it has been with many old people whom I have come to know."[3]

The first two quotes above come from a Swedish study in religious history written in 1984 about northern Sweden and surviving beliefs in supernatural, folkloric beings called *vitra*: a foreign, intelligent 'race'. The third quote comes from an older study from 1926 about this folklore tradition by the distinguished scholar and priest Erik Modin (1862–1953).[4] Vitra beliefs were localized in the northern Swedish historical provinces of Norrbotten, Västerbotten, Lappland, Ångermanland, and Jämtland, concentrated especially in Ångermanland and the area that today is Västerbotten County ("län"), which includes southern Lappland.[5] The 1984 study showed that, interestingly enough, ideas about these nature beings – quite complex and multifaceted in their conception, and strongly connected to the old agrarian lifestyle – still survived in the modern, industrialized Swedish society of the late twentieth century. But rich material also exists from the times when vitra beliefs were a living tradition. Collected in archives, this material is nearly invisible in modern written history.

More important for this study, however, is the fact that these beliefs in the vitra 'race' included distinct conceptualizations of *sound* and *music*, including encounters with vitra who were playing music or dancing, and descriptions of melodies, instruments, harmonies, etc. In fact, sound and

1 The quotation is from an anonymous informant in Bjurholm, Ångermanland, cited in Hellsten 1984: 45. Translated by the present author from Swedish.

2 Cited in Hellsten 1984: 41. Translated by the present author from Swedish.

3 Cited in Modin 1926: 56–7. Translated by the present author from Swedish. "Många har sett vittrorna och ännu flera ha hört dem; i skogsbyarna är det väl än i dag högst få, som icke säga sig ha gjort det senare, åtminstone var det så förr i tiden. Och de, som gjort det, är lika vissa i sin tro på "vittra" som de äro i tron på sin salighet; så har varit förhållandet med många gamla, som jag lärt känna."

4 Berg (1985–1987).

5 In Swedish: *landskap* and *län*. *Landskap* (pl.) are historical provinces in the southern part of Sweden and on the Norrland coast with origins in pre-modern times. *Län* (pl.) are more recent administrative geographical divisions that date approximately from the seventeenth century. The two overlap, but only partly. Dalarna and Hälsingland are sometimes also mentioned as "vitra regions". They, too, lie partly north of the chalet border.

music components in descriptions of human encounters with vitra are extensive and various – and notably frequent. Vestiges of this folklore are preserved in documents but have not been systematically investigated, with a few exceptions in some fields of the humanities and then only in the Nordic languages.[6] It has been studied only partially and a very long time ago (50–100 years ago). Importantly, little if any[7] of this older research has investigated the auditory, musical, and spatial aspects of vitra beliefs: the connections between sound and landscape and the meaning of those connections. To the author's knowledge, this article will be the first study in English not only to critically synthesize the fundamental components of vitra beliefs, which will function as necessary context, but also to investigate beliefs in the vitra as *principal makers of sound and music* in a special kind of agrarian cultural border landscape where vitra were recognized along *vitra paths* (Swedish: *viterstigar*) or *vitra roads* (*vitervägar*).[8] Importantly, this subject has never been studied before from this perspective. This article fills a gap as a first attempt at and introduction to the subject for a modern, wider readership, framed using modern theories that address sound, music, and culture in the broadest sense.

According to archival recordings on 78 rpm records and tapes, as well as written records from the nineteenth and twentieth centuries, vitra lived underground and in the lakes, forests, and mountains of Norrland.[9] Sometimes humans were captured or invited into the world of the vitra, underground or in their mountain homes or other mysterious places. Humans and vitra could have various types of interactions – not infrequently, their encounters were friendly ones.[10] As the quotes above show, strong beliefs in the vitra, constituting a kind of folk religion, are well documented. Today they have been somewhat (although not completely) forgotten.[11]

Vitra is a plural word. The vitra were perceived as a people and were described as human-like, but more beautiful than humans – more seldom, as 'uglier'.[12] Vitra women, especially, are usually described as extraordinarily beautiful, with large, piercing blue eyes and beautiful hair. Folklore holds that they can be extremely tall (sometimes as tall as 4 meters, or over 13 feet) or very small. But often they resembled humans in size and height. Male and female vitra lived together in families and were born in the human manner. They lived, grew old, and died, and so they could vary in age and appearance. Vitra women are erotically attractive to humans, as are vitra men. Vitra and humans could have romantic encounters and engage in sexual intercourse. Sex could take place between vitra men and human women in the chalets (*fäbodar*, mountain cabins used during the summer when livestock were grazed on the upland pastures) or between vitra women and human men in the woods.[13] The vitra therefore seem to be physical beings to some degree – able

6 Hellsten 1984; Grundström 1959; Dahlstedt 1976; Johnson 1986.
7 With the exception of brief mentions in Dahlstedt 1976 and Johnson 1986.
8 Dahlstedt 1976; Kuusela 2021. Kuusela also uses a third term, "Vitterstråk", but the principle is the same.
9 Dahlstedt 1976; Westerström 1974a; Westerström 1974b.
10 Moman 1750: 22–3; Læstadius 1997.
11 Kuusela 2021.
12 Dahlstedt 1976; Lövgren 1961: 27–9.
13 Dahlstedt 1991.

to have sex – and yet also essentially different from humans: more invisible, spiritual, and eternal.[14] They had their own culture, working as underground farmers, shepherds, and reindeer herders, but sometimes they might be sighted above ground, mostly between spring and autumn.[15] According to the stories, they preferred to dress in strong colors. They wore red or green costumes with hoods, and they had special caps.[16] They could blend in with humans and sometimes lived (or live) among them. Vitra sounds and 'music' – which formed a point of contact with human culture – are different: vitra sing with overwhelming beauty, play instruments, and 'compose' songs that humans can hear and learn, if they are lucky. Some sources suggest that vitra 'music' had advanced harmonies with chromaticism and dissonance, in sharp contrast to the local folk music of both the Sámi and the Swedes. Of course, these songs are examples of 'supernatural music': an undercurrent in the history of human musical experiences.[17]

Vitra sounds and 'music' suggest an untold story about how music is perceived and conceptualized in the West. They are one example of *other* conceptualizations of what today is approximately defined as 'music' and 'sound' – that existed until recently in agrarian Europe. This conceptualization differs completely from both 'classical music' and 'folk music' – the modern, partly academic, partly commercially founded Western concepts developed in the nineteenth and twentieth centuries by an educated nobility, the *bourgeoisie*, critics, and philosophers – as well as from the twentieth-century concept of 'popular music', established in great part by the music industry. These concepts and genres are well defined and have been studied in musicology for a long time, but they have implicit limitations because of the defining discourses and power structures that formed them – even ethnomusicological perspectives have their limitations here. Further, the modern Western concept of 'music' was established outside of academia very late. It is a high art, academic concept that expanded with the development of modernity. Even if, in principle, its origins go back to antiquity, it had limited practical significance outside of the university (as a strictly theoretical discipline) for a long time. Cajsa S. Lund notes:

> "The word 'music' has not been found, either, in medieval texts written in any Old Norse language. There is no record of the word in Nordic linguistic usage before the 16th century. On the other hand, there are instances of words such as chant, sing, dance, play, etc."[18]

Timo Leisiö has argued convincingly that among farmers and Sámi people in Finland, the 'music' concept was established gradually as late as the 1920s, being unknown before that.[19] The reason is that the concept itself is quite abstract and general, requiring a highly developed written culture and musical professional specialists. Thus, it evolved over a very long period from the ancient Greek *mousiké* (which included what we call poetry and music) among philosophers and in the

14 The elves in J.R.R. Tolkien's *Lord of the Rings* represent, to some extent, a mythological parallel.
15 Modin 1926: 51.
16 Dahlstedt 1976: 20.
17 Compare Bebergal 2018.
18 Lund 2010.
19 Leisiö 1986: 186; Lund 2010a.

church.[20] I hypothesize here that the late establishment of a general music concept probably also applies to the farming population of northern Sweden (which was closely connected to the Sámi and the Finns). The critical perspectives of Lund, Leisiö, and others on pre-modern 'music' concepts have been transferred to archaeomusicology or music archaeology. Within the framework of an 'auditory or acoustic archaeology', they have advanced the critique that a homogenous (and in fact modern) music concept implicitly colonizes music history, writing backwards.[21] I want to contribute to developing this critical perspective.

The conceptualizations that will be presented here are quite difficult to grasp, understand, and categorize in relation to the abovementioned more established concepts, partly because they lack the kind of defining discourse that shaped, for example, the Romantic idea of folk music. They have more in common with the sonic worlds of indigenous peoples than with Western ones – a more ready subject for an anthropologist than a folk music scholar, maybe. For example, one striking and enigmatic concept – which has really never been investigated before now – is the *vitra paths*. These were perceived as real, physical paths or roads through the outdoor landscape, known to humans, where encounters with vitra could occur and vitra 'music' and noises could be heard. But what does this combined concept of nature, supernatural beings and their paths, and human experiences of sound mean culturally, psycho-acoustically, or musically? What needs does this concept fill? What does it explain; to what question is it the answer? And what were the characteristics of the environments and sonic worlds where humans believed in vitra and thought they could hear them? Are there any common characteristics of the sound and 'music' associated with vitra – or are there not? How did vitra sound and 'music' relate to the natural landscape and/or human culture? This article discusses these questions in depth. It proposes that the sound and 'music' experiences attributed to vitra paths were connected to humanly perceived spatiality in the natural landscape, and human infrastructures in or between cultivated lands, such as fields, meadows, and pastures, and the wilderness. The article also suggests that vitra paths can be understood as a pre-modern conceptualization of *sound*, *'music'*, *and spatiality*: perhaps as paths that go between or pass through cultivated agricultural lands and areas for farming, pastoralism, and nomadism. This conceptualization lost its currency with modernity and the disappearance of the old agrarian and herding culture. Probably, the vitra paths are also founded on a cultural and religious syncretism. They may represent traces of cultural abandoning or mixing: the pushing away of Sámi, for example, as well as the blending of different cultures, mythologies, and lifestyles.

The purpose of this article is to introduce and critically discuss parts of this rich, quite unknown folkloristic material and other relevant sources. It takes an *ethnomusicological, anthropological*, and *music* or *sound archaeological* (archaeomusicological) perspective: the latter in relation to its sister discipline of sound studies, with sound in its broadest sense as the primary area of interest.[22] With sound as the overall focus, I admit that I look at 'music' as a recent, historical construction,

20 Leisiö 1986: 186–91.
21 Leisiö 1986; Lund 2010; Kolltveit 2014: 80.
22 Till 2020; Lund 2008; Lund 2010b: 185–215.

fulfilled in modernity – and music history writing, as in musicology, as also constructed from this modern viewpoint, which I want to help deconstruct and rebuild. Therefore, when I talk about vitra 'music', I put 'music' in quotation marks, simply because it is anachronistic to use the term in this context. I look at vitra paths as more holistic sounding spaces and therefore see them as 'musical', as in the title for this article.

The broader aim is to contribute, within a defined cultural-historical context, to new perspectives on *pre-modern ideas and conceptualizations* of 'sound' and 'music' in relation to 'spatiality', using vitra paths as my example. I understand the studied culture in question as functionally pre-modern, even if it reaches well into the twentieth century. The specific research questions are:

1. What are the context for and the structure of the sounds and 'music' attributed to vitra?
2. What is the relation between spatiality/space and sound and 'music' on the vitra paths?
3. How can ideas held about vitra sound and 'music' and its spatial representations contribute to an understanding of pre-modern 'music and sound' conceptualizations?

2 Material, delimitations, theory, and methodology

A large part of the material for this article comes from the archives of Sweden's Institute for Language and Folklore (ISOF).[23] The material was provided in digitized form.[24] The material investigated consists of written and recorded interviews with both female and male informants in which *vitra* are specifically mentioned. Due to the extent of the overall material, only the provinces of Lappland, Västerbotten, and Ångermanland were considered. This geographical delineation is reasonable, as most earlier research points out this area as the epicenter of vitra traditions.[25] But I will also take into consideration some Sámi vuole traditions about vitra ("sájva") from Norrbotten County. And I will analyze material from Lycksele and Degerfors parishes in more detail, as this area is of special interest to me and I am particularly familiar with both its geography and its culture. For this particular study, only a subset of this material was selected, although much more has been taken into account.[26] Studies in ethnology, linguistics, and religious history are also used as sources and are presented below.[27] Methodologically, it is important to know that the folklore records investigated here have been shaped by historical circumstance. Many of the Swedish laws and institutions for handling archaeological and folkloristic remains were organized in the seventeenth and eighteenth centuries, when Sweden was a great power and needed a grand and long history, and they have remained in effect to the present.[28] A great deal of folkloristic material in-

23 ISOF is located in Uppsala, Sweden. *Dialect and People's Memories Archive*.
24 PDF and WAV files. In total, the material comprises 351 sounding memoranda: 111 from Västerbotten and 240 from Lappland. There are also 29 written memoranda from the selected provinces, many dating from the nineteenth century.
25 See Læstadius 1997; Westerström 1974; Dahlstedt 1976; Hellsten 1984.
26 The rest will, I hope, be analyzed in forthcoming studies.
27 For example, Modin 1926; Westerström 1974; Dahlstedt 1976.
28 Trigger 1993: 68–9.

cluding folk music was collected in the late nineteenth and early twentieth centuries, influenced by ethnography.[29] Sweden's Historic Environment Act (Kulturmiljölagen, SFS 1998:950) grants cultural history remains the same protections as graves, standing stones, and other more concrete remains. Chapter 2, Section 1, which is headed "Ancient Remains", states:

> "Natural formations associated with ancient practices, legends or noteworthy historical events and the remains of ancient popular cults are also ancient remains."[30]

In the case of vitra beliefs, however, the "remains of ancient popular cults" are relatively recent, nearly invisible, and mostly not marked out – with some notable exceptions to be presented later – as archaeological remains. It is difficult to find them without hearing someone talk about them, and there are hardly any vitra paths to be found in the landscape today even if the actual route of the path, whatever its origin in the landscape, was and sometimes still are well known among local inhabitants. Vitra lore is probably not alive in the memory of the younger generations, and is often misunderstood or forgotten in a Swedish folklore context.[31] From an archaeological perspective, there is certainly more to do in both localizing and investigating these paths.

My approach to the subject of the large-eyed 'race' of vitra and pre-modern conceptualizations of sound, music, and spatiality draws on several related disciplines, theories, and methods. My overall perspective is inspired by ethnomusicology, where the fundamental task is to study "the music expressions in cultures and cultural expressions in the music."[32] But my subject is not typical for ethnomusicological studies. Therefore, my theoretical perspectives are inspired by anthropology, sound studies, and music archaeology.[33] For pre-Christian Sámi religious history, a broad field of study exists as a reference.[34] The folklore documents, both written and recorded, are transcribed, analyzed, and understood within the framework of folklore studies as oral culture and narration.[35] Importantly, the languages of the folklore material are old Swedish and archaic dialects from Västerbotten, Lappland, and Ångermanland.[36] The related dialects from the communities of Vilhelmina and Vindeln in this area are the present author's mother tongues, which, together with being a cultural insider, gives me the competence to understand the meaning of these

29 Lundberg and Ternhag 2014: 11–15.

30 This law (revised in 1988) has regulated all handling of ancient monuments and archaeological remains in Sweden since the seventeenth century. https://www.riksdagen.se/sv/dokument-och-lagar/dokument/svensk-forfattningssamling/kulturmiljolag-1988950_sfs-1988-950/. English translation at https://www.raa.se/in-english/cultural-heritage/historic-environment-laws/historic-environment-act-1988950/. For a critical perspective on cultural heritage policy in Sweden, see: Gustafsson and Karlsson 2012. On how law and ethics affect professional archaeological practice, see: Soderland and Lilley 2015.

31 Compare Kuusela 2021.

32 Lundberg and Ternhag 2014: 9; Kjellström et al. 1988.

33 Feld 2015: 12–21; Grimshaw-Aagard 2019; Leisiö 1986; Lund 2010a; Lund 2019, cap. 1.2–3; Kolltveit 2014.

34 For example, Mebius 2003.

35 Arvidsson 1986; Arvidsson 1999: 73–82; 199–200.

36 Swedish in a general sense. The dialects in this part of Sweden were, at the end of the nineteenth century, quite archaic in their overall structure, showing similarities with old Norse and Icelandic. See, for example, Åström 1888.

documents. I have transcribed the folklore records in dialect – all quotes from recorded interviews – and translated them to standard Swedish before translating them to English.

The holistic perspective presented by Mark Grimshaw-Aagaard, which views sound as something both external (scientifically understood and described simplistically as 'sound waves') and more internal (psycho-acoustic, cultural etc.) was an important starting point.[37] I follow Tom Garner's and Mark Grimshaw-Aagard's argument that sound is not only acoustics – sound waves and rules for diffraction, absorption, reverberation, etc. – but neither, at the other extreme, should the focus be only on *discourses* about sound.[38] I embrace both. Sound is a complex phenomenon and hard to describe, and it cannot be simply reduced to component parts. But it is important to go behind both the acoustic aspects and the discourses – and here I understand folklore as discourses – especially when studying sound in the past. 'Sound as sound' presupposes and includes the laws of acoustics but also, importantly, cultural, psychological, and psycho-acoustical processes. There is always an aspect of subjectivity and imagination in how we as human beings perceive and interpret sound. In this text I will not refer much to acoustics explicitly, taking its laws as given. But it is important to see that in a pre-modern society, when the scientific principles of acoustics are unknown outside of a small group of specialists, listening – the imagining and experiences of sounds – could or can easily take the shape of a spiritual or supernatural event. This is probably important in understanding how vitra sounds and 'music' are described in the folklore sources in what is – from a modern Western perspective – sometimes a quite foreign and peculiar way.

An essential complement to this perspective on sound is Steven Feld's concept of 'acoustemology'. According to Feld, acoustemology is about "sound as a way of knowing". It looks at "what is knowable, and how it becomes known, through sounding and listening". "Audial history" can be used to understand the relation between humans and nature in its widest definition in a pre-modern society.[39] This concept is highly useful in the present context, because it was developed over a long period of time in an empirical setting when Feld was working as an anthropologist, evolving in direct response to his fieldwork on Papua New Guinea. It is thus grounded in how human perception of sound *can work* in real life, rather than being a fixed theory without this fundamental practical experience and understanding.[40] Feld's description of the "sociality of sound" could be used by analogy to understand the vitra concept in its pre-modern context:

> "To Bosavi ears and eyes, birds are not just 'birds' in the sense of totalized avian beings. They are *ane mama*, meaning 'gone reflections' or 'gone reverberations'. Birds are absences turned into presence, and a presence that always makes absence audible and visible. Birds are what humans become by achieving death."[41]

37 Grimshaw-Aagard 2019: 21: "[...] another definition of sound: sound is an emergent perception that arises primarily in the auditory cortex and that is formed through spatio-temporal processes in an embodied system."
38 Grimshaw and Garner 2015.
39 Feld 2015: 12.
40 Feld 2015: 15.
41 Feld 2015: 16.

Here we have a connection between birds – reflected "gone" sounds – and the world of the dead. These relations exist in my material, too: several stories describe how vitra answers to human calls resemble echoes and there is a connection with death. The early twentieth-century scholar Sigrid Drake, in her short synthesis of Karl Bernhard "K.B." Wiklund's ideas, mentions the Sámi's magic bird, the *keddner,* with its links to both the *kitnihah*, the 'underground' people, and echoes.[42] Maybe this connection says something about pre-modern concepts in general. Helping spirits in the shape of powerful birds are also crucial in Sámi shamanism.[43] We find an interesting analogous nature-bird-human relation in Västerbotten agrarian folklore in the myths around the Siberian jay, *Garrulus infaustus*, which is called *lavskrika* in Swedish, *röjvköksiken* in the local Västerbotten dialect (Degerforsmål), and *rökäringa* and *röfåla* in related dialects. And among the vuole (yoiks) left by Sámi Jonas Eriksson Steggo is one sung with his wife, Inga Steggo, to this particular bird.[44] It was believed that this jay, with its special cry, could hurt a hunter's luck. The name *röjvköksiken* probably means something like "the spy of the Lady of the Woods". The Lady (in Swedish named *skogsrået*; a kind of forest spirit sometimes confused with the vitra) was the undisputed queen protector of the woods and its inhabitants. She sent the *röjvköksiken* to warn animals of hunters. This reminds us of a pre-modern time and mentality with a highly animist view of nature and therefore great respect for it – far removed from today's perspective on nature, but with similarities to Feld's perspective.[45] In our post-modern day, we also find that the pre-modern idea of 'becoming-bird' is newly relevant in contemporary music composition, as shown by Elin Kanhov in her study *Encounters Between Music and Nature*.[46]

Feld also notes that acoustemology

> "favors inquiry that centralizes situated listening in engagements with place and space-time. Acoustemology prioritizes histories of listening and attunement through the relational practices of listening and sounding and their reflexive productions of feedback. Acoustemology, then, is grounded in the basic assumption that life is shared with others-in-relation, with numerous sources of action (*actant* in Bruno Latour's terminology; 2005) that are variously human, nonhuman, living, nonliving, organic, or technological. This relationality is both a routine condition of dwelling and one that produces consciousness of modes of acoustic attending, of ways of listening for and resounding to presence."[47]

The relationality perspective is highly applicable to vitra beliefs: especially the notion of "situated listening in engagements with place and space-time" and the idea "that life is shared with others-in-relation". This article uses "histories of listening" as its main methodology: the primary sources for ideas about vitra sound and 'music' are *stories*, in the form of folklore and music (written or

42 Drake 1918: 355.
43 Mebius 2003: 162–96.
44 Kjellström et al. 1988: 149.
45 Modin 1926: 11.
46 Kanhov 2023: 52–92.
47 Feld 2015: 15; Steven Feld citing Latour in Latour 2005.

recorded). Further, this material comes from a time and a pre-modern culture in which the farmers who believed in vitra lived very close to both domestic and wild animals and to the nomadic Sámi people.

Lastly, let us mention some important archaeomusicological perspectives on sound and environment in pre-modern times. One way to take a broader view of perceived sounds is to see them in relation to a 'soundscape'.[48] Soundscape theory, an extension of Murray Shafer's work, can be a point of departure for archaeomusicological classification.[49] Soundscape theory is the point of departure for Gjermund Kolltveit in his two texts *Classification of Sound, Sound Tools, and Soundscapes*[50] and *Animal Bells in Early Scandinavian Soundscapes.*[51] Kolltveit's arguments are of great interest here. He analyzes how cow and sheep bells worked in Viking soundscapes, a perspective that is productive for this study, because the bells of wandering animals make up a large part of the sounds perceived as belonging to vitra 'music' and soundscapes. Supposed similarities between the agrarian Viking society and the later, pre-modern agrarian Swedish culture before industrialization and urbanization also form a relevant, if not unproblematic, parallel.[52] Trains, electricity, telephones, and radio are crucial in shift of the latter (the pre-modern) culture to modernity – and along with the culture, its "keynote sound".[53] Soundscapes themselves can be *hi-fi* or *lo-fi.* In hi-fi soundscapes, characteristic of pre-industrial and non-urban societies, people can clearly hear all sounds, including direction and distance from the listener, without massive interference. Hypothetically, we can imagine the sound worlds of the older agrarian society in this way, with a high degree of auditory transparency: sounds of cow bells carrying over large distances, for example. In this landscape, it is not always obvious where sounds come from. For listeners inclined to such beliefs, they can easily be perceived as supernatural. By contrast, the listener in a lo-fi environment with a high noise level, such as a modern city, hears individual sounds much more poorly: the sound quality is systematically lower. The soundscapes in northern Sweden 100 years ago were mostly hi-fi, and the shift towards lo-fi with the introduction of industry, rail, and roads probably strongly affected the concept of vitra – and even more so the advent of electricity or the first radios or telephones, as suggested in some eyewitness descriptions. Drawing on the work of soundscape ecologist Bernie Krause, Gjermund Kolltveit mentions other important aspects of the soundscape: *geophony,* or the soundscape associated with the Earth, including sounds of wind, water, thunder, etc., and *biophony,* or the sounds of living organisms, both animals and plants. A subcategory of biophony is, of course,

48 The soundscape concept was first formulated by Murray R. Shafer (1994); the word is a portmanteau of "sound" and "landscape".

49 Kolltveit 2014; Schafer 1994. A *soundscape* is intended to contextualize the human sound environment in a given time and place. The soundscape is both a physical place and a way to experience that place sonically, and perhaps psycho-acoustically.

50 Kolltveit 2014.

51 Kolltveit 2008.

52 Compare Kolltveit 2008.

53 Schafer 1994. As part of his theory, Schafer formulated the concept of "keynote sound": a kind of fundamental tone in a soundscape. For coastal dwellers, it might be the roaring sea; for mountain dwellers, a whistling wind. This foundation is supplemented with sounds from both nature and human culture.

human sound: *anthrophony*. Certainly, the sounds of geophony and biophony all affect the human world.[54]

3 Vitra beliefs and folklore: General structure and earlier research

Following Tone Dahlstedt (1976), I spell vitra with just one "t" (as opposed to "vittra", the more common spelling in modern Swedish), as this spelling more closely corresponds to how the word is pronounced (with a long "i").[55] Vitra beliefs are deeply associated with the area north of the Limes Norrlandicus boundary, the so-called "chalet border". The line is both a cultural and climatic border, with Sweden's herding and chalet culture located on the north side. Historically, agriculture dominated south of the border, cattle raising north of it. The border also marks historical divides in material, food, and building cultures.[56] According to both literature and folklore documentation, a belief in the vitra 'race' was widespread north of the chalet border before the disappearance of the agrarian society and before the breakthrough of modern school education in the nineteenth century, followed by electricity and the spread of media such as the telephone, radio, and the gramophone in the twentieth century.

What, then, are vitra? Etymologically, the word has roots in the old Norse word *vættr* and is related to the Icelandic word *vättr*, meaning the people "underground".[57] It has sometimes been misinterpreted as having to do with the color white, but that is probably not correct. It is perhaps a bit old-fashioned, but not controversial, to connect vitra, as does folklorist Carl-Herman Tilllhagen, to the old Norse *svartalfer*, "black elves", who were believed to live underground, and – maybe even more so – to their counterpart in the skies, the *alfer* or *ljusalfer*, that is, "light elves". Both are mentioned in the *Eddas.*[58] As early as 1926, scholar Erik Modin argued that vitra were the direct mythological descendants of the light elves and their relatives, *älvor*, in southern Sweden and the *huldror* and *Huldrefolket* in Norway, as well as their Sámi counterpart, *ulta-folket*.[59] According to Tillhagen,[60] the common Norse cosmological heaven/earth pairing of *alfer/vättar* evolved over the centuries, in the area that would become Sweden, into the etymologically related underground races of *älvor* in the south and *vittror* (vitra) in the north. One difference between the two may be that vitra, as opposed to *älvor*, are more human- than demon-like (in some stories, vitra are distinctly angelic).

This connection is, of course, difficult to prove. Vitra beliefs might also have other cultural origins, and theoretically could be of much more recent date. As a concept, however, vitra beliefs show great similarities and parallels with beliefs in supranormal 'races' in other European coun-

54 Kolltveit 2014: 73–6.
55 Dahlstedt 1976: 8–9.
56 Larsson 2009: 20–21.
57 Dahlstedt 1976: 9.
58 The *Poetic Edda* and the *Prose Edda* (by Snorri Sturluson).
59 Modin 1926: 46.
60 Tillhagen 1996: 198–201.

tries,[61] even if they are probably not identical. Tillhagen points out many parallels with England's "fairies", "elves", and "elle-folk" and similar beings in Germany who are also said to love music and dance.[62] Other clear parallels in western Europe are Scotland's "Good People" (*Sleagh Maith*) and Ireland's "Gentry", as well as the Fair-folk (who like vitra, wear colorful caps), Sith, and other races on the British Isles and in France.[63] The "Good People" are notably also known for their "fairy tunes": melodies collected or memorized by human musicians, often close to mounds or earthworks or the sounds of water, and learned in secret or given to them as a gift by the fairies.[64] In eastern Europe, the Fenno-Ugric Samoyeds (today approximately the Nenets) believed in *Siirtje*, a happy, human-like underground race.[65] In the Nordic countries, related beliefs also exist in Finland, among Sámi, Finns, and Finnish Swedes alike.[66] In Norway, the folk tunes known as *huldreslåttar* are related to a quite similar folklore, and form their own genre within so-called hardingfele music (music played on the eight- or nine-stringed violin, the *hardingfela*, and connected to the water spirit known as the "Fossegrim"). Musicians play these tunes on retuned violins, often using peculiar violin tunings that are not used for other songs.[67]

Vitra were first written about as early as the eighteenth century in a dissertation by Jonas Moman at Uppsala University. In that thesis, entitled *De superstitionibus hodiernis* ("On contemporary superstitions"),[68] Moman states that "vetter" or "vittror" (he uses the Swedish words in his otherwise mostly Latin text) "are found at different places at night, it is said".[69] Moman distinguishes between vitra and other "intelligent" supernatural species such as "tomtegubbar" (pucks), "Necken" (nixies), "Strömkarlen" (a river spirit), "alver" (elves), and "gastar" (ghosts). He further says (and here I follow Stig Hellsten's[70] Swedish translation of Moman's Latin):

> "These goblins or vitra are said to appear to people in human shape – be it ever so tiny – and to take pleasure in consorting familiarly with them."[71]

It is not clear in which geographical area Moman finds these beliefs, but in the mid-eighteenth century, great areas of Lappland were not colonized by Swedes, so the "consorting familiarly" idea may have been collected in Ångermanland or Jämtland, for example. Just a few years later, Abra-

61 Probably also with similar beings in other parts of the globe, but that is not touched on here.

62 Tillhagen 1996: 200–201.

63 Vallée 1969: 15–93. In Brittany in France, "Korrigans". Cécile Bardoux-Lovén explains that "These trolls in Brittany (so-called Korrigans) are mainly associated with ring dances and with singing that they perform where they live (in nature, i.e. in the forest and in so-called 'lande', typically low vegetation along the Breton coast)". Cécile Bardoux-Lovén, (personal communication, e-mail from August 27, 2024).

64 Westwood 2009.

65 Bäckman 1975: 69–70.

66 Harjunen 2020.

67 Gunnar Ternhag, personal communication (e-mail) April 23, 2024.

68 Moman 1750.

69 Moman 1750: 22.

70 Hellsten 1984: 36.

71 Moman 1750: 22: "Dessa vätter eller vittor sägs uppenbara sig för människorna med mänsklig kropp, må vara mycket liten sådan, och finna glädje i att förtroligt umgås med dem." Compare with the Swedish translation in Modin 1926: 49, n.3. In Latin: "Vettæ s. Vittæ illæ humano corpore, licet minutissimo hominibus sese ostendere dicuntur, & eorum delectari familiaritate."

ham Hülphers set down a detailed vitra story in print in his *Samlingar til en beskrifning öfwer Norrland* (Collections for a description of Norrland, 1775). The story, dated April 12, 1671, is about a priest, Peter Rahm, in Ragunda, Jämtland, whose wife had given aid to a vitra woman in 1666, after being visited by a little grey-clothed man, a "Wettar", who asked her to help his own wife in childbirth. The main part of the story goes as follows:

> "After some consideration, the priest made a decision. He read prayers over his wife and blessed her and asked her to go with him [the vitra man] in the name of God. Taking with her some linen clothes, the priest's wife then went with the man. After traveling for a time through the air, as it seemed, she came into a cabin, and next to it was a dark chamber where the vitra man's wife lay in agony in a bed. She helped her as she birthed the child, and the vitra woman's labors were like those of any human woman. Afterwards the priest's wife was offered food, but she would not eat, knowing full well that to eat of the underground people's food is to be bound by them. But the man thanked her and followed her back to the summer pastures, and they journeyed back in the same way that she had come. Later that same day, as the priest's wife was rummaging through the summer pasture cabin, she found a pile of old silver spoons placed on a shelf in the cabin … she understood that they had been put there by the vitra man [*Wettret*]."[72]

Rahm himself attested to the truth of the event in a legal document, but it is also a classic mythological motif in many countries. Rahm is a historical person: he was executed in 1678 for treason.[73]

There is an obvious similarity between the vitra and the nearby *sájva* of the southern Sámi.[74] As several scholars have noted, the concentration of similar beliefs in southern Lappland and Västerbotten may suggest that the concept of vitra at least partly originated in the Sámi cultural area, stemming perhaps from pre-Christian religious beliefs in an underworld called Saivo, the kingdom of the dead, and its inhabitants, sájva.[75] No consensus exists, however, as to whether Saivo really was the realm of the dead or something else.[76] Yet the idea of Saivo was not homogenous or evenly distributed; rather, it seems to have been concentrated in the southern Lappland parishes of Särna,

72 Modin 1926: 59–60, n.1: "Efter något betänkande fattade kyrkoherden det rådet, att han läste över sin hustru några böner, välsignade henne och bad henne i Guds namn att följa honom. Medtagande några linnekläder, gick prästfrun nu med mannen, tycktes sig liksom föras i vädret en stund och kom så uti en stuga, varest bredvid var en mörk kammare, vari vitter-karlens hustru låg och våndades uti en säng. Hon hjälpte så henne, då hon födde barnet, och det var med lika åtbörder som andra människor plägar hava. Därpå bjuden mat, nekade likväl prästfrun intaga sådan, väl vetande, att om man förtär något hos de underjordiska, blir man bunden av dem. Men karlen tackade henne och följde henne tillbaka till fäbodarna, dit återfärden gick lika som bortfärden. Då prästfrun senare under dagen stökade i fäbodstugan, fann hon en hoper gamla silverskedar lagda på en hylla i stugan… kunnandes hon förstå, att de av Wettret voro ditlagda."

73 Hellsten 1984: 36. The story is retold in a similar form by, for example, Erik Modin (1926: 59–60, n.1) and Jacques Vallée 1969: 108–9, in his comparative essay on historical folklore and UFO folklore.

74 Sájva is also partly found in Northern Sámi territory.

75 Læstadius 1997; Wiklund 1916.

76 Mebius 2003: 81–8. There are many spellings of the word: Sáivo, Sajvo, Saiwo, Saivo. I use the last, following Bäckman 1975.

Vilhelmina, Lycksele and Åsele.[77] In 1926, Erik Modin presented an in-depth study of folk beliefs in Ångermanland including much information about vitra.[78] According to Modin, the nineteenth-century Lappland priest J.A. Nensén was the first to draw a connection between sájva and the vitra.[79] It has been suggested that the Sámi themselves saw a close relationship between one category of sájva and the Swedish vitra: *vittarah, vitarah, vijter, ulda, ullta* and *guffitarak*.[80]

In the nineteenth century, Lars Levi Læstadius, an educated priest who was himself of both Sámi and Swedish origin and was a contemporary of J.A. Nensén, critically analyzed vitra beliefs in the context of Sámi pre-Christian religion and mythology in a survey entitled *Fragmenter till Lappska Mythologien* (published in English translation as *Fragments of Lappish Mythology*).[81] Written in the 1840s, it was not published until much later.[82] Considering his strict Lutheranism, Læstadius' observations on northern folk beliefs are intellectually progressive, open-minded, and psychologically insightful.[83] He is an excellent source for vitra beliefs in the first half of the nineteenth century. Noting the great extent of the stories and testimonies about vitra that he has been told, he concludes that they originate in human primitive encounters with nature and darkness, and he suggests that anybody alone in nature might naturally tend to hear or see strange things. "In larger cities", he writes, "one has no time to listen to the fir ghosts and trolls. One is continually surrounded by people. If one hears strange sounds from an attic or wine cellar, the suspicion is immediately of thieves".[84] Interestingly, he writes that "in Westerbotten the underground people are called *Underboniga*[,] 'undergroundling[s]'". [85] He further states: "I heard innumerable stories about them in my childhood, about how people were taken into the mountain, etc".[86] Læstadius writes at length and with great familiarity about Saivo and its connections to shamanism, and he is also the first writer to point out the close relations between the otherwise distinct ethnic and linguistic cultural groups of the north – Swedes, Finns, and Sámi – as a common ground for vitra beliefs.[87] Læstadius gives a concrete description of Saivo as a hyperreal world for Sámi shamans. Every *noaidi* (Swedish: "nåjd", shaman) is in direct connection with related families in Saivo. Each family consists of four or five individuals. The noaidi travels via his drum's symbols: a bird, fish, and a reindeer. He drums, performs vuole, and travels with several magic birds to Saivo. Læstadius, citing Erich Johann Jessen, describes this relation (which somewhat resembles the fictional hyperreality of a modern computer game): when you were in Saivo, you could communicate and participate, buy and hold animals and magic tools, own them as your 'property', and live a kind of 'real' life

77 Bäckman 1975.
78 Modin 1926.
79 Modin 1926: 47, n.1; Forskningsarkivet.
80 Bäckman 1975: 73.
81 Læstadius was the founder of the religious movement known as Læstadianism.
82 Læstadius 1997.
83 Læstadius 1997: 53; 63; 127; 129; 132; 133.
84 Læstadius 1997: 63.
85 Læstadius 1997: 127.
86 Læstadius 1997: 127.
87 Læstadius 1997: 129.

there, which at the same time was fictional.[88] Læstadius also thinks it is a misinterpretation to think of Saivo as the realm of the dead; he says it is a world of living, half-spirit beings, which is close to the vitra concept.

Hans Mebius, in his analysis of pre-Christian Sámi religion, draws parallels between beliefs in Saivo and its Sámi counterpart, Jábbmeájmmo,[89] and both east-Asian shamanism and Tuonela, the underworld in Finnish mythology.[90] And K.B. Wiklund, the influential early twentieth century researcher, found that ideas about Saivo among the southern Sámi people in the Lappland area were still very much alive in the early twentieth century (he gives the inhabitants the same name as the land, Saivo):

> "These *Saivo,* men, women, and children, dwelt in certain mountains and in the land of the dead under the earth, where they led the same kind of life as the Sámi themselves, only in all respects in greater perfection, wealth, and happiness. They themselves had been Sámi during their lifetime; likewise, the Sámi wished to become *Saivo* after death. Even in life, the Sámi had many dealings with *Saivo,* visiting them, feasting with them and enjoying their help in every possible way."[91]

In the first half of the twentieth century the subject of vitra or sájva was commented on, but not very extensively. To my knowledge, the most important articles include one by K.B. Wiklund about Saivo in the Sámi religion[92] (see above) and others by Ella Ohlson[93] and Lennart Björkqvist[94] about various aspects of vitra beliefs. In 1959, Harald Grundström discussed the presence of a "vitra motif" ("vitermotivet") in Sámi yoiks (vuole).[95] The year before, he had published the major work *Lapska sånger: Texter och melodier från svenska Lappland* ('Lappish Songs: Lyrics and Melodies from Swedish Lapland'), with lyrics and notated transcriptions of phonograph recordings of Sámi vuole.[96] Based on this extensive documentation and transcription work, Grundström was able to identify a "vitra motif" in a number of vuole. This was not a musical motif *per se,* but a textual and thematic one. He pointed out that the underground peoples of Sámi beliefs – the *uldat,* the *hál`dit* (lady of the woods), the *gufit` tarat* (goblins), the *gadnihah* or *gidnihah* – were, in principle, synony-

88 Læstadius 1997: 108–11.

89 Læstadius 1997: 108–13. Spelled "Jabma-aimo", is the realm of the dead.

90 Mebius 2003: 87–8. Tuonela features, of course, in Jean Sibelius' composition *Tuonelas svan* ("Swan of Tuonela").

91 Wiklund 1916. Translated by the present author from early twentieth-century Swedish: "Dessa *Saivo,* män, kvinnor och barn, bodde i vissa berg och i de dödas land under jorden, där de förde samma slags lif som lapparna själfva, blott i alla avseenden i större fullkomlighet, rikedom och lycka. De hade själfva i lifstiden varit lappar, och lapparna åtrådde också att själfva en gång efter döden bli *Saivo.* Lapparna hade redan i detta lifvet mycken umgängelse med Saivo, besökte dem, voro på kalas hos dem och åtnjöto i allt möjligt deras hjälp" (cited after Dahlstedt 1976: 17). Modin 1926: 47. For information about K.B. Wiklund, see: Karlsson 2000.

92 Wiklund 1916.

93 Ohlson 1933.

94 Björkqvist 1943.

95 Grundström 1959.

96 Grundström 1958–1963.

mous with Swedish vitra. All were known for liking to sing and for singing "pleasantly".[97] The relationship between vitra and their Sámi counterparts sájva is largely implicit in Grundström's paper – he took it for granted – but he does mention several specific parallels, building on Læstadius' and Wiklund's approaches.[98] According to Grundström, in Västerbotten, from Sorsele and southwards, the Sámi name for underground vitra-like people is sájva – a terminology specific to the southern Sámi people.[99]

This problem was later discussed in depth by Louise Bäckman in her study *Sájva: Föreställningar om hjälp- och skyddsväsen i heliga fjäll bland samerna (*"Sájva: Beliefs about Help and Protection in Sacred Mountains among the Sámi").[100] Bäckman critically discusses the various sources for this religion, which was erased and to a great degree forgotten as the Protestant Church sought to Christianize the Sámi beginning in the sixteenth century. Bäckman concludes that the Sámi concept of holy ("passe", taboo[101]) lakes and mountains to a great degree corresponded to a realm of the dead, connected with different families or clans. Probably the concept was very old, with roots in old Norse culture and the practice of burying the dead in 'family piles'. Even if the concept of Saivo and sájva changed over time, however, it was a very important one for the powerful Sámi shamans. They used vuole and drums to contact ancestral spirits in the Saivo mountains – this shamanistic and to some degree 'musical' connection is worth noting.[102] At the same time, according to Bäckman, Sámi folklore about sájva "bears a striking resemblance to the vitra legends recorded among the Swedish population in the Sámi lands in question".[103]

Interestingly, the root of the word Saivo is probably not Sámi (a Fenno-Ugric language) but old Norse with an ancient, proto-Germanic pedigree. It may be related to Gothic *saiws*, meaning "sea" or "lake" and Swedish "sjö". Some have suggested that it also has other meanings, such as "soul", or, later, "holy": as in the holy lakes in the woods, *Saivo-jaure*,[104] and the holy mountains, Saivo, that were home to inhabitants called sájva.[105] Even in later recorded folklore, it is obvious that vitra, like sájva, are especially connected with lakes and mountains.[106] The overlapping nature of these beliefs finds further support in the Sámi concept of the *ulta* people in Norway and the Finnish *haltijat*, both of whom bear many similarities to both the sájva and the vitra. Both "ulta" and "haltijat" are etymologically the same word as the Norse, Swedish, and Norwegian *huldra,* which

97 Grundström 1959: 52; Bäckman 1975. The similarities between vitra and gadniha (spellings differ) are also discussed by author and artist Lars Pirak (1932–2008) in Sarstad 1982: 3.

98 Grundström 1959.

99 Grundström 1959: 52.

100 Bäckman 1975.

101 Bäckman 1975: 8; 18–22. "Passe" means taboo, holy.

102 Bäckman 1975: 8, 114–28; Mebius 2003: 81–8, 162–96.

103 Bäckman 1975: 9: "[...] har en påfallande likhet med de vittersägner som upptecknats bland den svenska befolkningen i ifrågavarande lappmarker."

104 Modin 1926: 48.

105 Wiklund 1916; Bäckman 1975: 13–17. Bäckman gives a detailed overview of the etymology. Spellings differ.

106 Recording: Daum_Bd_4346_m16, Örträsk, Skurträsk 1983, Harald Fors, Axel Gidlund, Olavi Korhonen. All Swedish translations and transcriptions from recordings and texts in this article are by the present author.

means "the hidden one".[107] Tentatively, it is fair to suppose that these ideas may have their origin in a syncretistic, multilingual, and multicultural area of northern Scandinavia: they may be of approximately Sámi, Norse, and Finnish origin. These three cultures (with subdivisions) lived side by side and blended with and influenced one another in intricate ways for hundreds of years before becoming integral parts of the Swedish and Danish-Norwegian states.[108] Citing Knut Bergsland, Louise Bäckman observes that all this points in one direction: "the Nordic peoples, the Sámi included, lived in a kind of 'symbiosis', rather than in different 'nations' each with its own 'independent' history".[109] The cultures and their respective musical traditions have historically differed radically, however. Yet as earlier scholars in the field have noted, there was also a good deal of cultural overlap: the different groups were always in contact. As early as 1926, Erik Modin presented the interesting idea that the vitra/sájva etc. might have an older, common Nordic origin.[110] These perspectives of a common origin appear valid but are certainly at odds with (for example) twenty-first-century nationalistic ideas about the Sámi's ethnic distinctness, separateness, and unicity as an indigenous people. To be sure, it is a historical fact that ethnicity and culture is not essential and unchanging, but rather is constructed, re-constructed, and modified over time.[111]

In southern Lappland, the area of Saivo beliefs, there is plentiful documentation of relatively recent vitra (or perhaps sájva) beliefs. There are clearly areas where records and reports of encounters with vitra are numerous. One such area is Vilhelmina in the Lappland part of Västerbotten County. In one interview conducted in Vilhelmina in 1991, an old man is asked whether vitra are real. He tells the interviewer, "Sure, I have met one of them, in the shape of a little girl", and describes in detail the encounter and the beauty of the girl, "who was terrible at running (fast)", until she vanished before his eyes. He says that "in the olden days, vitra were everywhere". There still seem to be frequent "encounters" with them, and several testimonies of vitra paths and vitra stones exist from Vilhelmina in modern times. A neighbor of the man just mentioned had the problem that vitra often used his snowmobile and moved it without permission.[112] Similar stories from a century ago are told of vitra who moved horses, cows, and reindeers. Clearly, in archaeological and anthropological terms, these fragments of beliefs from the last thirty years are a living cultural

107 Modin 1926: 49.

108 Including the part of Sweden that became the Russian Grand Duchy Finland in 1809 and later Norway in union with Sweden 1814–1905.

109 Bäckman 1975: 49 n.87.

110 Modin 1926: 49 n.2. Compare Drake 1918: 355.

111 Stoor 2007: 13–14; Barth 1969. On the one hand taking notice of the Swedish state's sometimes racist and overall colonialist oppression of the Sámi during the 20th century, and on the other hand the more modern perceptions of the Sámi as a much distinct group in the Nordic countries, the inhabitants in the north are often closely related. Many inhabitants in Norrbotten and Västerbotten counties are descended from several of these different ethnic groups, sometimes without knowing it. For example, I found out during my research that I am partly descended from Swedes from the coastland; westward-migrating Finns from Savolax and Tavastland, who founded the first agrarian colony in Örträsk in southern Lappland in around 1676; and southern Sámi from nearby Lycksele who became Christian citizens and for several generations were ringers ("klockare") in the Swedish church and state administration in Lappland in the seventeenth, eighteenth, and nineteenth centuries.

112 Recording: Daum_Ka_1510B_m16.

heritage, rooted in the landscape and in human, cultural collective memory: a deep belief grounded in firsthand experiences that you *do have* a concept for. It is an expression of traces of beliefs deeply rooted in a pre-modern, pre-industrial, pre-urban culture that to some extent still remain. It is the belief in a half-supernatural, half human-like race: "a reflection", in the words of one informant.[113]

It is clear that beliefs in both vitra and sájva – and huldrefolket, ulta, and haltijat – are almost completely non-Christian, pre-Christian, or 'pagan' in nature, even though tales do exist that explain the origins of the vitra and sájva within a Judeo-Christian context. According to these tales, vitra and sájva are the descendants of the hidden children of Adam and his first wife, Lucia or Lucidéa: "But with her he would not openly associate; therefore she and her offspring [i.e, vitra] grew shy and hid themselves from mankind",[114] and "some fell into lakes and some fell into mountains".[115] Some folklore records say that vitra themselves are either pagans or do not believe in God and have no religion.[116] It is also recorded that vitra and sájva are generally quite similar to humans in appearance, behavior, and living conditions, as one might expect of these supposed underground cousins. But they live in a parallel, partly invisible world: in the forests, under the earth, in the lakes and mountains. They are the equals of humans, and sometimes more advanced technologically. Those humans who see or hear vitra are "strong" individuals – psychologically stable, perhaps.[117] Vitra can cooperate in several ways, and they live in a dialectical interaction with human culture. This applies to all activities of daily life and subsistence, such as haymaking, milking, cattle herding, childbirth – when human and vitra women sometimes could help each other as in the example from 1666 above – housebuilding, and road construction, but also to cultural products as 'music' and other auditory phenomena.

Finally, some more important works should be mentioned here. Two studies by Tone Dahlstedt (*Tro och föreställningar kring vitra i övre Norrland*, 'Faith and beliefs about vitra in Upper Norrland', [118] and *Kvinnors möten med vittra: Närhet, ömhet, sexualitet*, 'Women's encounters with vitra: Proximity, tenderness, sexuality')[119] are the most comprehensive scholarly texts written about vitra to this day. The texts discuss all the important aspects of vitra, including their music in general and, notably, vitra paths in the natural landscape, as well as the occasional sexual encounters between vitra and humans, from a female perspective.[120] Dahlstedt draws on former research in the field, not least that of Læstadius and Grundström, whose theories she partly synthesizes.[121]

Another important overview, and one used here, is Alf Arvidsson's *Arbetslivets folktro: En sammanställning av traditionsmaterial från övre Norrland* ('Folk beliefs of working life. A compilation of

113 Recording: Daum_Bd_4044_m16, Sorsele 1982, Israel Jonsson, Olavi Korhonen.
114 Modin 1926: 48.
115 Recording: Daum_Bd_4346_m16, Örträsk, Skurträsk 1983, Harald Fors, Axel Gidlund, Olavi Korhonen.
116 Recording: Daum_Bd_4044_m16, Sorsele 1982, Israel Jonsson, Olavi Korhonen.
117 Recording: Daum_Bd_4349_m16, Örträsk, Långsele 1983, Harald Fors, Olavi Korhonen, Ingvar Königsson.
118 Dahlstedt 1976.
119 Tone Dahlstedt 1991.
120 Dahlstedt 1976: 46–8.
121 Mention should also be made here of Westerström's (1976) study on the history of names.

traditional material from Upper Norrland'), a compilation of traditional material partly about vitra.[122]

Stig Hellsten, already mentioned above, published a discussion in 1984 of testimony about vitra beliefs that he recorded with the help of priests in fifteen Ångermanland parishes in the autumn of 1933. Fifty years after the recordings were made, he returned to them, linking the old records to new reports from the parish priests to see if beliefs in vitra were still alive or had disappeared. Hellsten found that vitra beliefs were still very much alive and identified Bjurholm Parish as a last stronghold of vitra beliefs in the early 1980s.[123]

The subject of supernatural sounds in a Swedish context has been briefly discussed in one ethno-musicological study: Anna Johnson's wide-ranging dissertation *Sången i skogen: Studier kring den svenska fäbodmusiken* ('The song in the woods: Studies of Swedish chalet music'), about herding music. Johnson takes up with the subject of supernatural music in chalet culture in some detail, and, importantly, synthesizes some of the beliefs that existed about supernatural and vitra music: it is mainly vocal, peculiar, "stunningly beautiful", and richly ornamented with elements of halftone steps and different sounds. She also points out the richness of this material.[124]

An article by the present author has appeared in the "musicology of music/record production" research field, proposing an experimental approach to music research with vitra music as a case study.[125] Two recent works deal with sexuality and bodily movement in old and modern folklore: Catarina Harjunen's *Att dansa med de(t) skeva: Erotiska möten mellan människa och naturväsen i finlandssvenska folksägner* ('Dancing with the skewed: Erotic encounters between man and creatures of nature in Finnish-Swedish folk tales')[126] and Tommy Kuusela's "Swedish fairy belief: Traffic accidents, folklore, and the cold light of reason".[127] Kuusela's text, on modern vitra-related folklore, critically discusses modern beliefs in "fairies", among which he includes vitra. He also takes up the idea of humans crossing paths with vitra and accidents happening as a result. Importantly, he points up the biases in early twentieth century folklore collections, particularly the strongly nationalistic tendency to see Swedish folklore as stemming from old Norse mythology. While this is a *bias* we should remain aware of, I think it is hard to deny the principal correctness in the observations of the early folklorists of the obvious connections between this non-Christian folklore and older pre-Christian religious beliefs. Clearly, however, ideas always change over time.[128]

In addition, there are several other texts that describe vitra mythology and are used here as sources: *No finns vittra* ('Well, vitra exist'),[129] *Gamm-Strid och vittra* ('Old Strid and vitra'),[130] *Vittra vid*

122 Arvidsson 1986: 42.
123 Hellsten 1984.
124 Johnson 1986.
125 Burlin 2015.
126 Harjunen 2020.
127 Kuusela 2021.
128 Kuusela 2021: 260–61.
129 Westerström 1974: 1: 58–9.
130 Westerström 1974: 2: 118.

Manjaur ('Vitra at Manjaur'),[131] and an in-depth high school paper, *Vittra: Edgar Nilsson berättar om ett sällsamt naturväsen* ('Vitra: Edgar Nilsson tells about a strange creature of nature').[132] With that, most of the known and relevant titles have now been mentioned.

Vitra beliefs were alive for at least 400 years but are probably of much older origin – how old depends on your perspective. In this article, the beliefs, themselves, fascinating as they are, are not the fundamental focus but rather a point of departure. They provide the context for an investigation of the strong sonic element of vitra mythology, folklore, and beliefs and its relation to spatiality – the sonic landscape – that will here be sketched out.

4 Cases: Descriptions of encounters with sound and 'music'

From folklore records of the nineteenth and twentieth centuries, we know that vitra, at least at times, could be both seen and heard. They could even be noisy. Written records and sound recordings attest to two main types of auditory experiences related to vitra beliefs. What I will call Type A experiences involve hearing non-musical sounds made by vitra primarily as *social creatures*. The listener hears vitra speaking, shouting, and engaging in everyday social interactions – and even communicating vocally, but non-musically, with humans, such as through laughter. Type B experiences involve perceiving sounds made by vitra primarily as *musical creators and communicators*. In this case, the listener hears, for example, bells of different but unknown shapes, instruments, and vocal melodies or other musical sounds. Type B experiences seem also to occur even in non-musical contexts, when the listener is alone, in solitude, in moments of self-absorption, spontaneously, and without warning. Both types of experiences typically occur when the listener is out of doors: on a mountain, beside a lake, in the woods, or on a vitra path. Men, women, and children could all hear vitra, and the auditory experiences of sounds and melodies occurred in normally comfortable situations: typical settings include fishing, hunting, or being out in a pasture.

I will now outline how vitra auditory experiences are described in the sources, with reference to these two main categories. Leaving the general aspect of sound experiences aside – and here again, I take Grimshaw-Aagard's perspective on the subjective side of sound experiences as my point of departure – let us dive directly into the folklore records. The story below reproduces general mythological motifs, such as how to steal animals belonging to the vitra with pure steel, but importantly, it also includes distinctive descriptions of both vitra sounds and vitra 'music'. This particular story – remarkable for its concrete details – is about a human-vitra encounter that took place sometime in the nineteenth century. The story, from informant Alf Burström, was recorded on tape at Vindelns folkhögskola in 1935 and transcribed by Gunnel Westerström. It was passed down to Alf Burström from his father Elias Burström in Åbyn, Burträsk, Västerbotten. Elias Burström was born in the 1880s. The "Strid" of the story is Gamm-Strid ("Old Strid"), whom stories

131 Eklund 1984.
132 Nilsson 1979.

say was an "old soldier, knowledgeable in all uncleanness and sorcery, and a strong man of honor":[133]

> "As Strid approached the Kvarnbäcken [a brook], a vitra family came walking. Quick as lightning, Strid sought out his sharp file and hid in the moss. When the vitra family had waded across the brook with their seven children and nineteen red-spotted cows, the vitra man shouted: 'We rest here!' The children jumped into the brook and gamboled about on the swirling water and ate the white foam. The mother gathered leaves for their tea. The father sat on a clump of grass and sang the vitra song, which begins this way: 'We have a mind that makes the blood pulse / you can hear it beat when I say the Word'.
> This was Strid's moment. A grazing cow came closer and closer. Hardened though the warrior was by famine, hardship, and troubles, yet his hand trembled. And now the file was thrown across the cow from the left, and in that instant he became the owner of the cow. And now an infernal howl and noise arose. They all knew what they must do: gather the remaining cows and return the way they had come, back to Gobacktjärnberget [a mountain]. Strid found his file. For safety, he threw it a few times more across the cow from left to right. All the while the cries of the fleeing vitra family could be heard... Strid traveled many times up to Gobacktjärnberget. He finally found out that he had been wrong. The inhabitants of that mountain were trolls. They had a castle with ninety-nine windows but no door. The vitra lived some way off, in Trångmyrberget. One should not mix up vitra and trolls. The vitra are a grand race."[134]

Unlike trolls, who were perceived as more malevolent, vitra were indifferent to humans, or even kind to them. Sometimes trolls are confused with vitra and the story above leaves open the possibility of multiple interpretations. This story describes sounds of both Type A and Type B – the sounds of both the vitra and their music – even if it is hard to *hear* the tune in the story. The story has concrete ingredients that are visual, sounding, spatial, and interactive: the encounter in the midst of the natural landscape, the vitra singing, the noise, and the physical interaction between vitra and humans. It reveals an important, immanent spatial dimension: the meeting is in nature, with all its spaces, and the places where the vitra live are also mentioned. Similar points could be made about the stories below. They include entire scenes that are in their essence cinematographic: unreal, but with a special credibility. In a recording from 1971, informant Oskar Nord of Granö relates the following story told to him by his uncle:

> "My uncle told me about when he was a little boy and was the shepherd boy. He was sitting with cows in a field in the forest where it had burned a few years earlier. So there the cows had good grazing. He called it the hunter's grass, it went up next to the cows, they had such good pasture there. They got so quiet there. So he was sitting on a stump with the cows one day. Then all of a sudden he heard the rattling of bells, cowbells, and people shouted and

133 Westerström 1974: 118, translated from Swedish by the present author.
134 Westerström 1974: 118. "Grand" is a translation of the Swedish word "storvulen".

> came out of the mountain, and it was high and steep there, stony, a man could not make his way down there, and there were cows coming down, there were many cows, and all the men were dressed in red, and the women were dressed in white. And so they passed right next to him on the way west."[135]

This story of hearing bells is a typical example of a combined Type A and Type B experience. Here, the informant reproduces another person's story of a vitra experience that was both auditory and visual. The sound environment is the one most typically described for vitra; the vitra also have their most typical appearance and behavior. They have colorful clothes, prosperous livestock; they make sounds, whisper, and talk, just like humans; the sound of bells is also heard. At the same time, the vitra show that they do not obey the laws of nature or living beings; that they do not belong to this world as we humans do. They can walk down a steep cliff with ease.

Some stories, by contrast, give the modern reader the impression that the vitra encounter might actually have been an encounter with an unknown human, secretly observed. One 81-year-old woman told the following story in 1926:

> "When I was 12 or 13 years old, I saw a vitra woman dancing on an early summer evening just after the sun went down. It was up on a stone hill in Svya [Sveden], north of the village of Strinne, that I saw it. Round, round she danced, while she sang an unusual song: it was only in one turn [beat]. The vitra woman was dressed in a blue skirt but wore no bodice, only her 'shirtsleeves'. I listened and watched for so long that I learned the song, which I can still sing today."[136]

This example is definitely a Type B experience: a visual experience of seeing the vitra woman dancing as well as singing. Unfortunately, there is no transcription of this song from approximately about 1850. A recorded lyric for another vitra song (without melody) is from 1860 and goes: "Kó, tjäva mó, kó, tjäva mó, langspenete gäta!"[137] Another herding girl in the early twentieth century heard vitra herding calls and said they were much more beautiful than those of humans: as "lovely to hear" as the bells of the vitra's cows.[138] Vitra are mentioned now and then as being good dancers. At the Adak mine in Västerbotten, which was opened in 1921, it was said that the Sámi had hidden silver treasure and asked the vitra to protect it. But vitra had been seen dancing at the treasure sites.[139]

In many accounts, the idea of vitra music appears indirectly, as when the accounts describe dancing. In the material I have investigated most closely, it is more common to find *descriptions* of

135 Recording: Daum Umeå 19710623, Oskar Nord, Granö, Degerfors, Västerbotten, Gunnel Westerström.

136 Modin 1926: 66: "Då jag var 12–13 år gammal, såg jag en vitterkvinna dansa en försommarkväll strax efter att solen gått ner. Det var uppe på en stenbacke i 'Svya' (Sveden), norr om Strinne-byn jag såg det. Runt, runt dansade hon, under det att hon sjöng en ovanlig låt: den var blott i en "vändning" (takt). Vittran var klädd i en blå kjol, men hade intet livstycke, utan var bara klädd i 'överdelsärma'. Jag hörde och såg på så länge, att jag lärde mig låten, som jag kan sjunga än idag."

137 Modin 1926: 66. In principle untranslatable to Swedish and English.

138 Modin 1926: 67.

139 Recording: Daum_Bd_4000_m16, Malå, 1982, Olavi Korhonen, Gustav Lundstedt, Joel Skoglund.

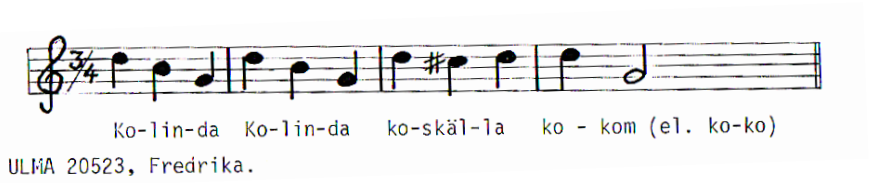

Figure 1: "Vitterkök" from Fredrika, Lappland. Cited after Tone Dahlstedt 1976.[142] Also mentioned in document 13444, Astrid Vange, 1939, Tärna, Kungl. Universitetets bibliotek Uppsala.

remembered songs or movements – as in the examples above – than saved melodies *per se*. A 50-year-old teacher in 1926 remembered an strange encounter she had when she was a student and out in the woods: "she heard a wonderfully beautiful herding call", answered it with her own call, but couldn't find the other singer, and answered several times with no reply, "whereafter she heard the same voice and the same trills, so tender and beautiful-sounding" beside her on the road, frightening her greatly until she reached more populated areas, upon which the voice disappeared.[140] Sometimes, however, real melodies were written down. Figure 1 shows the melody of a vitra herding call that was heard enough times to be remembered – a "Vitterkök", or shepherd calling tune, mentioned by Tone Dahlstedt.[141] Note the unusual halftone step from D to C sharp.

Some preserved Sámi vuole related to vitra are found in Harald Grundström's anthology *Lapska sånger* (*Lappische Lieder*, 1958–1963), which includes commented transcriptions of vuole recorded by several informants in Norrbotten county. Grundström himself identifies what he calls "the vitra motif" in Sámi vuole, and gives several examples of lyrics intimately associated with vitra and/or sájva, where the melodies are not known or are variable.[143] One of these informants was Jonas Eriksson Steggo, an exceptional "expressive specialist" who in February 1943 recorded about 83 vuole in some intense sessions in front of a microphone and electric engraving machine together with researchers from Landsmåls- och folkminnesarkivet (a predecessor to ISOF) in Uppsala.[144] Together, these vuole form a "united work of art" about Steggo's life, according to later research.[145] Musically, they exhibit a notable variation in tonality and rhythm. Some use only a couple of notes (a major second); others use the whole octave. Often the only intervals are fifths or thirds.[146] One of two vitra-related vuole transcribed in *Lapska sånger* is "Jordiskii vuolle" ("Vitrornas, de underjordiskas, vuolle") from volume 1, sung by Steggo.[147] The other is "Gidniha vuolle" ("En vitervuolle") from volume 2,[148] sung by Johan Persson Ragnefjäll, Radnejaur, Arjeplog. "Jordiskii vuolle" is rhythmically complex, transcribed in $^{15}/_{8}$, $^{9}/_{8}$, and $^{15}/_{8}$ time. The tonality is G major; the musical tension is principally developed in the rhythm. The vuolle seems to be at-

140 Modin 1926: 70–71.
141 Dahlstedt 1976: 46.
142 Dahlstedt 1976: 46.
143 Grundström 1959.
144 Grundström 1958: 57.
145 Ternhag 1990; Stoor 2007: 107–18.
146 Kjellström et al. 1988. For more on Jonas Eriksson Steggo, see pp. 131–50.
147 Grundström 1958: 57. The vitra vuolle is also mentioned as one rare example of a religious dimension in Steggo's vuole: Kjellström et al. 1988: 148.
148 Grundström 1963: 56–7.

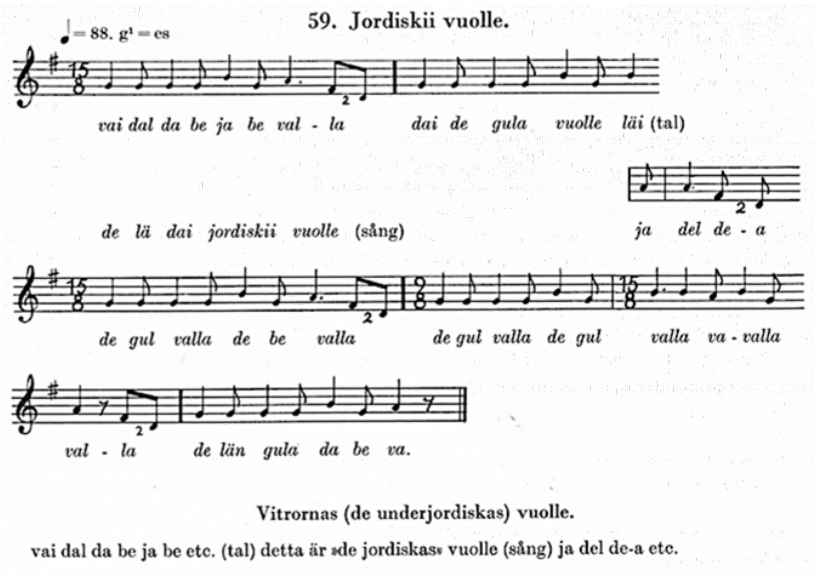

Figure 2: Transcriptions: "Jordiskii vuolle" performed by Jonas Eriksson Steggo. From *Lapska sånger* 1, 1958: 57.

tributed to the vitra: the lyrics say, "this is the vuolle of 'the earthly ones [i.e. the underground ones, or vitra] …". Meanwhile, "Gidniha vuolle", which is transcribed in a free rhythmic $^{3}/_{4}$ meter, has lyrics that seem to be a prompting from the vitra to the Sámi reindeer herders to wake up and capture the herd of reindeer that has been scattered in all directions: "Ah, chap, get up, get up! The calves have scattered here and there, here and there, about each other, yes, here and there åija våija. Get up, get up, the herd set off helter-skelter all vaija holla våla. Get up at once, the herd went on its way helter-skelter, helter-skelter".[149] According to Krister Stoor, who specifically mentions these two vuole about vitra (although from a performance perspective), in this vuolle it is the vitra man (or woman) who calls the reindeer herder "godfather", which implies some kind of alliance between them.[150]

More than twenty years before Grundström's recordings, the pioneer of recording Sámi vocal traditions, Karl Tirén, published his monumental work *Die Lappische Volksmusik* (1942). In a recent re-publication in Swedish (by Gunnar Ternhag in 2022), retitled in Swedish as *Den samiska folkmusiken,* two vuole are explicitly attributed to the *katnihah* creatures (singular "kani"), who are somewhat similar to vitra. The two vuole are No. 343, "Katnihavuolle", and No. 362, "Katnihavuolle", both recorded in 1912 in Lule Lappmark. Both are written in complex meters (6 + $^{7}/_{8}$ and $^{5}/_{4}$, respectively) and No. 343 has lyrics about two beautiful *katnihah* girls singing.[151]

Compared to the vitra-related songs of the Swedish-speaking populations, these vuole are different: musically, lyrically, and in the relationship between vitra and humans that they express. As 'music' or transcriptions themselves, they are principally Type B sounds – tunes 'from' vitra – but the stories connected with them have elements of Type A sounds, such as the sounds made by the vitra wake the herders up. The vuole seem to be both *by* vitra and *about* them and their relation to the reindeer herders; in a deep way, the songs connect humans and vitra. According to Grundström, the Sámi perceived vitra or sájva in part as the spirits of their forefathers; therefore,

149 In Swedish (from Sámi): "Ah, guffar, stig upp, stig upp! Kalvarna har skingrats hit och dit, hit och dit, om varandra, ja, hit och dit åija våija. Stig upp, stig upp, hjorden gav sig iväg huller om buller alla vaija håla våla. Stig upp med detsamma, hjorden for sin väg huller om buller, huller om buller."

150 Stoor 2007: 44–8.

151 Tirén 1942/2022: 232; 236; Ternhag 2018.

the vitra were always friendly and helpful, waking tired reindeer herders at critical moments, talking and singing to them. But there are also traditional tales about vitra who, instead of helping the Sámi, fooled, tricked, and imitated them in a not-so-kind way when they were collecting their reindeer.[152]

The tunes coming from vitra otherwise seem to have a special character of escape. They could also be threatened by the Christian faith (generally, baptism protects against vitra tricks, like prayers), as they belong to another world. The 'music' of vitra often corresponds to memories: lost or nearly lost. Erik Modin, in his book from 1926, records the following story of a forgotten vitra melody:

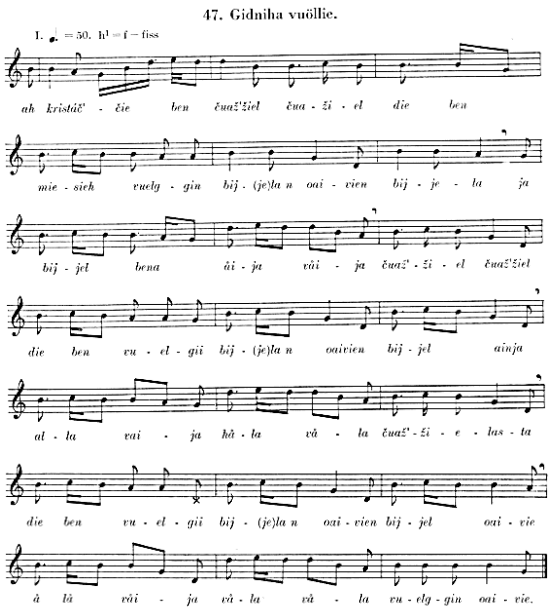

Figure 3: Transcription: "Gidniha vuolle". Performed by Johan Persson Ragnefjäll, Radnejaur, Arjeplog. From *Lapska sånger* 2, 1963: 56–7.

> "When the vitra women take the cattle up to the pasturelands, they sing and call to them with pleasant voices, and in several places it has been possible to record both the words and the melodies to these 'vitra songs' or 'vitra-kökar'. One such record is found in the aforementioned book *Gamla Tåsjö* from a village, Rotnäset, in the parish there. In Multrå about 10 years ago, an old woman named Brita died, who sang a 'vitterkök' for the present author that she had heard a vitra woman sing out there in the countryside in her youth, when she went herding. Since I myself was not in a position to record the melody that she sang, I sent to the woman's cabin a couple of young ladies who knew music, who would do me that service. They learned the song from the old lady with the intent of writing it down when they got home to the piano in the parsonage. But as they neared the parish church, all at once they completely forgot what they had learned and later they could not reproduce the melody. And shortly afterwards, the old lady died, taking her secret with her."[153]

152 Recording: Daum_Bd_5857_m16, Arvidsjaur, Stenbacken, Johan Lundström, Aldor Stenvall, Krister Stoor.

153 Modin 1926: 52–3. Translation from Swedish: "När vitterkvinnorna gå i vall med kräken, 'köka' de och locka på dem med behaglig röst, och man har på flera håll kunnat uppteckna både ord och melodi till sådana 'vitterlåtar' eller 'vitterkökar'. En sådan uppteckning finnes i den förut anförda boken 'Gamla Tåsjö' från en by, Rotnäset, där i socknen. I Multrå dog för ett 10-tal år sedan en gammal kvinna, Brita, som sjöng en 'vitterkök' för förf., som hon i sin ungdom hört en vitterkvinna sjunga bort i marken, då hon gick där och gätade. Enär jag själv ej var i stånd att uppteckna melodin efter hennes sång, sände jag till kvinnans stuga ett par musikkunniga fröknar, som skulle göra mig den tjänsten. De lärde sig låten av den gamla i akt och mening att sedan uppteckna den hemma vid pianot i prästgården. Men komna i närheten av sockenkyrkan, glömde de med ens alldeles bort vad de lärt och kunde sedan ej återge melodin. Gumman gick också kort därpå i graven med sin hemlighet."

In a recording made in Åmsele in Västerbotten in 1970, Edvard Karlsson tells the following story about an experience of his own:

> "It was [...] ... in Bjurträsket ... it was, we were there and were going to shoot, the grouse was playing [...] and so then in the morning, the sun had just come up, and we heard sounds starting to come from a boat, and we saw two [persons] start to row, now understand, each time they rowed it made such a loud sound ... it was so early, and as they rowed and rowed they began to play an accordion, and they played such beautiful things, my God [laughter], oh, then we heard them when they made land, sounds came from the two of them in the boat, then it got quiet, what was that then? Was it the vitra?"[154]

This story also includes sounds of both Type A and Type B. It is worth noting that the vitra seem to keep up with new music technology – here, the modern accordion, which they play nicely and to great effect. At the same time, the story reminds us that some lakes and ponds were ruled by vitra and, among the Sámi, by Saivo and sájva. Læstadius writes of fishing ponds about which the noise of fighting could be heard, and, in dreams, fighting between Sámi and sájva – the latter did not like to be disturbed.[155] In stories by another informant, Sigfrid Hellsten, the vitra also play the accordion, and the only sounds are of Type B:

> "I was there, at home, I think I was eleven years old when we went out from inside, me and Dad, and Dad said, did you hear that, he said, well, it was accordion music, the *best* accordion music we could ever hear, we heard it then, and then he says now, now we should bring in the hay, because later the weather will be bad, and so it happened, they [the vitra] had such [power] ..."[156]

Vitra are obviously predictors of bad weather, and they also seem to have the power to govern it. Hellsten next relates a story about how one of the vitra took the shape of a train, although there was no railway at his family home. While it is unusual for vitra to act like machines, it is in line with overall beliefs that vitra can take whatever form they want (even if that form most often is human-like):

154 Recording by Gunnel Westerström 1970–06–03: "He va just de där... i Bjurträsket... he var, vi va där och skul skjut, spelt tjäder och ve hå och så då på morgonen, sola hade just kömme opp å, då hört vi hur det börje på och rapple i ten båt, och se to börje de på å ro, förstå var gang de rodd dill dem hårt hur e låt, å se då å ja hade ja på var träsket låg då, det var så tidigt, å se då, bäst, bäst som dem rodd denna så börje dem spela dragspele å spela så harregud (skratt), fina saker, å då hort vi dom när dom tog land å, he ramle sammales i båten, sen blev det töst, å vad va he då? Var he vittra he?" (Transcription by Toivo Burlin. Recorded by Gunnel Westerström, 1970–06–03). Edvard Karlsson tells several stories about vitra in this recording, which he says happened to him, as well as those told to him by others. Even so, he expresses great skepticism about whether vitra really exist. He tends toward the belief that experiences of this kind are a "transmission" of sounds and pictures from another part of the country or the world, like television. Exactly how he thinks this happens is not clear, but he also claims to have heard vitra several times although he has never seen them. He also explicitly says that vitra have their paths along which they can be heard and seen.

155 Læstadius 1997: 287–8.

156 Recording: Daum_Bd_5680_m16, Malå 1981, Sigfrid Hellsten, Olavi Korhonen.

> "I only know one summer that we had [vitra], there was a bog below the house, the house just stood out on the hillside, and then a wet area went up from the new cultivation area up over the bog here, a big ditch, and there comes the train, we really *saw* it, how the train went along the edge of the bog going choo choo! And it made sounds and went down to the new cultivation area. Oh my God! said Father, what will it be? And it was true, the weather was so bad, yes, for several weeks, the weather was bad."[157]

In this story, vitra act even more modern, like a train. Yet they are still warning of bad weather ahead, both visually and auditorily. The sounds here are neither Type A nor Type B but something else: a sounding machine. In a number of accounts, vitra are more seen than heard, and when seen, they are definitely not so visually clear as in the "vitra train" example. To *see* vitra seems to be somewhat extraordinary. Not everyone has the spiritual strength to see them. Hearing them is also rare, but as we have seen, not perceived as unique.[158] Some vitra stories are about strange abductions and sounds. In one story, a 16-year-old herding boy is abducted by vitra. The boy mysteriously disappears. The cows came home without him – a bad sign. The people in the village look him for a long time, using the sounds of keys and horse bells as well as magic rituals such as crosses drawn on the ground to ward off vitra. When the church bells finally ring, they suddenly find him lying by a stone. Sick and confused, he says that a beautiful woman had come and taken his hand and led him into a bright room where the sun was shining. Then he became ill. This story is a good example of how bells in different shapes and sizes are seen as a fundamental weapon against vitra.[159]

To summarize, folklore records, both the examples above and others that I have not discussed in detail, often emphasize the exceptional musicality and power of the vitra, which has multiple aspects. Vitra tunes was generally perceived as powerful, beautiful, and advanced. Sometimes vitra are seen dancing – on occasion in groups, but the absence of "fairy ring" dancing is noticeable. Vitra seem sometimes to learn human waltzes, vuole, and herding calls, but the opposite – humans

157 Recording: Daum_Bd_5680_m16, Malå 1981, Sigfrid Hellsten, Olavi Korhonen. In Swedish dialect: "jag var ju ve om, hem, jag var fell, höll oppa va jag tror jag skulle va elva år då vi kom ut, inifra, jag och pappa och pappa sa, men har du hort, sa han, ja då var det dragspel, det *bäste* dragspelsmusik vi kunde få höör, hörde vi da, då säg en så här att, nö, nu jer vi ve om lada in hö, för då skull de bli daaligte veer, så det skedde, dem had såna der [...] Jag vet bara en sommar att vi had' ju, det var en my'yr nedanför kåken, kåken stod just ut bara på backubranten, å sen var det en flarkmyr opp från nyodlinga opp över myra hänna, stort e dik å der komme tåge, vi *saage* ju, hur tåget komme etter myrkanten, å tut tut tut tut! Å det de laate och for ner åt nyodlinga etter, men harre gud! sa pappa, men vi ska he va'al, å det stämde det blev så daalite väder, ja flere vecker, vart det dåligte väer." In standard Swedish: "jag var ju med om, hemma, jag tror jag skulle vara elva år då vi kom ut, inifrån, jag och pappa och pappa sa, men har du hört, sa han, ja då var det dragspel, det bästa dragspelsmusik vi kunde få höra, hörde vi då, då säger han så här att, nu, nu ska vi lägga in höet, för då skulle det bli dåligt väder, så det skedde, dem hade sådana där [...] Jag vet bara en sommar att vi hade ju, det var en myr nedanför huset, huset stod just ut bara på backen-branten, å sedan var det en myr upp från nyodlingen upp över myren här, ett stort dike å där kommer tåget, vi såg det ju, hur tåget kom efter myrkanten, å tutade, tut tut tut tut! Å det lät och for ner mot nyodlingen. Men herre Gud! sa pappa, men ska det bli? Och det stämde det blev så dåligt väder, ja i flera veckor blev det dåligt väder."

158 E.g., Recording: Daum_bd01498_m16_Degerfors_VB.

159 Holmberg 1999: 50–51.

learning vitra 'music' – is more frequently reported. Humans can hear, learn, and – if they have musical training – even write down vitra songs and melodies. Vitra melodies are perceived as special and seem to have a communicative, direct meaning. They are commonly described as particularly beautiful and different. Often mentioned are vitra cowbells, which are tuned in different pitches, can be heard from afar and make sounds of great beauty: "such incomprehensible sounds", as beautiful as the glossy, fat red vitra cows themselves.[160] And when vitra abducted humans, sounds could be used to force them to set their prisoners free. The vitra melodies themselves were usually forgotten, or not transmitted or recorded.[161] But there *are* herding calls, fiddler tunes, and vuole that supposedly come from the vitra and, when preserved, are recorded as having been "heard from" them. There are also many folklore records that testify to other auditory 'non-musical' phenomena, such as voices and sounds that could not be connected to humans and which therefore were associated with vitra. Vitra are often described as human-like sound creators, but they can also take other shapes, including the shape of a train – a sounding machine. The existence of these songs and records raises the overall question of what auditory experiences of the vitra meant for listeners. Based on both the written and oral sources, they seem to have made great and lifelong impressions: sometimes of beauty, sometimes of fear.

5 Vitra paths as supernatural infrastructure: Examples from Lappland, Ångermanland, and Västerbotten including Degerfors and Lycksele Parishes

To understand the spatial dimension of vitra sounds, we must examine the idea of vitra infrastructure in nature: namely, the idea of "vitra paths" (*viterstigar*) or "vitra roads" (*vitervägar*).[162] Vitra paths have been described by authors such as Erik Modin (1926), Tone Dahlstedt (1976), and Tommy Kuusela (2021),[163] but not really problematized. What are vitra paths? One short answer is that vitra paths are part of a magical geography associated with many rituals, including the protective use of steel and other metals as well as procedures for warding off vitra, for protecting the home, and for protecting animals against the vitra penchant for stealing or borrowing them. In folklore, vitra were mostly encountered from spring to autumn, when both humans and animals were out-of-doors. Vitra were, in principle, never to be found indoors, but could be found within the limits and borders of human culture. They might be under the barn, in remote meadows, in the woods, in streams, ponds and lakes, under or next to mountains. In a number of recorded accounts, their paths are linked to motifs of warnings, including warnings of incoming storms or of supernatural, sometimes utterly destructive phenomena such as *vitterhunden*, "black dogs". *Vitterhunden* were demon dogs with large, shining eyes that could be heard barking out in the woods, using only three barks, or "words", at a time: an ill omen, sometimes together with "a very peculiar melody in sev-

160 Cited in Hellsten 1984: 41.
161 Cited after Hellsten 1984: 41; Modin 1926: 50.
162 Both terms are used; here I have chosen "vitra paths", which seems a good description.
163 Modin 1926; Dahlstedt 1976; Kuusela 2021.

eral different parts".[164] Strange three-part sounds with simultaneous sightings of otherworldly black horses are also reported.[165] In principle, however, the view was that if people took due account of vitra needs, often in rituals, and vitra paths, they could also receive good help in return: for example, in the form of weather warnings, which seems to be a vitra specialty. These rituals also include, importantly, making offerings to the vitra. These might be of metal, or, as among the Finns in Tåsjö, Ångermanland, near-daily offerings of fresh milk (*vitterkoppen*).[166] Generally, the vitra paths were to be avoided – failure to do so could bring misfortune in the form of illness or accidents.[167] The paths were perceived as ancient and somewhat sacred (maybe "passe" in Sámi terminology) to the vitra, and their route was not negotiable.[168]

A natural explanation is that sometimes the vitra paths may have been about animal trails, paths created by the repeated movement of wild animals through an area. Vitra paths or roads seem to have been perceived as the spatial, linear framing for all kinds of human-vitra encounters, and especially the hearing of sounds (and music) attributed to vitra. When a human hears vitra sounds or music, she can be quite sure that she is on or close to a vitra path. One magical ritual involved binding the vitra to their paths (if these were known) with sacrificial stone mounds or swastikas of branches laid beside them.[169] In northern pre-modern agrarian culture, the swastika symbol was called the *vitterkors* ("vitra cross") or *torsmärke* ("Thor's mark") and could be painted as a magical protective symbol on everything related to the all-important livestock.[170] The implicit sun and time symbolism is present on several levels. Vitra supposedly mimicked activities humans performed clockwise (the Swedish word is *medsols*, "with the sun") but not counterclockwise (in Swedish *motsols* and in the archaic Degerfors dialect *anschsöns*, "against the sun") – maybe an example of pre-Christian religion leaving traces in vitra beliefs.[171] As some researchers have pointed out, there is indeed something very archaic about the vitra lifestyle, even compared to the standard agrarian culture. They are always shepherds who tend livestock; they own only cows and oxen, almost never have horses, and their paths are often for their animals.[172] On the subject of vitra paths, Tone Dahlstedt notes:

> "It was believed that vitra had their own roads where they traveled with their cattle. These roads were called vitra roads. 'When the vitra moved, they followed certain predetermined paths, the so-called vitra paths, but where these went the people did not know.' A path in the forest that stayed clear even if no one used it was thought to be a vitra path. The road from Vitterbäcken to Stångoberget in Lycksele Parish was one such road, kept open by vitra

164 Modin 1926: 67–8; Pettersson 1929/1962: 889.
165 Pettersson 1929/1962: 888–9.
166 Modin 1926: 54.
167 Recording: Daum_Bd01497, Edvard Karlsson, Gunnel Westerström.
168 Bäckman 1975: 8.
169 Modin 1926: 55. Modin mention one mound for vitra in Skedom, Multrå, Ångermanland.
170 Modin 1926: 53.
171 Modin 1926: 50.
172 Modin 1926: 51.

> cows. Reports from Bjurholm say that the vitra routes followed the lines of underground springs. If you set foot on the roads or obstructed progress along them in any way, you came into conflict with the vitra. A man in Dorris in Vilhelmina Parish tells the story of building a haystack in the middle of a vitra road. The result was that every time he put it up, it fell down. Vitra did not want to be hindered. An attempt has been made to map the vitra roads in Degerfors Parish. [...] The surveyor believes that there are three known vitra roads in the parish. He does not mention where he got the information from, however; but apparently it is a general belief in the area. Strange things have happened along these roads. What distinguishes the vitra roads is that they often run along watercourses or stretch between two lakes or ponds. 'Vitra roads often passed by ponds and streams, and therefore some ponds became notorious for being special vitra ponds, because of the events that occurred there.'"[173]

Those who chanced to build their house on a vitra path usually had to move or demolish the house. Therefore, and importantly, one had to consider vitra pathways *before* building:

> "Even when building cattle shed or stables, you had a lot to observe. In Norrland – especially in Ångermanland – it was considered necessary to offer compensation for the land of the undergroundlings, who otherwise did not leave the animals in peace. This was done by burying silver under the floor, in the threshold, or under one of the corners of the house. Furthermore, one had to make sure that the house was not built over an underground stream or spring, because then it became 'unknowable'. Also, one had to avoid building on a vitra path or over a vitra settlement."[174]

Alternatively, one could make offerings of metal objects – preferably silver – to the vitra as a kind of tribute, and even speak directly to them. In some reports of houses and buildings that happened to lie across vitra paths, regular negotiations between humans and vitra about who should move or stay were considered to have taken place.[175] The outcome was not always a given. One story describes fighting with vitra who live near or directly under the dwelling house. The informant

173 Dahlstedt 1976: 48. Translated from Swedish by the present author: "Man trodde att vitra hade sina egna vägar där hon drog fram med sin boskap. Dessa vägar kallades vitervägar. 'När vitra flyttade följde hon vissa bestämda vägar, de s.k. vittervägarna, men var dessa gingo visste icke människorna.' En stig i skogen som ej växte igen trots att ingen nyttjade stigen, trodde man var en sådan väg. Vägen från Vitterbcken till Stångoberget i Lycksele sn, var en sådan väg som var upptrampad av viterkor. Från Bjurholm meddelas att vitra hade sina färdvägar längs kallkällådrorna under jorden. Beträdde man dessa vägar eller hindrade framfarten på något sätt, kom man i konflikt med vitra. En man i Dorris, Vilhelmina sn, berättar hur han satte upp en höhässja mitt i en viterväg med påföljd att den föll ned för var gång han satte upp den. Vitra ville inte bli hindrad. Det har gjorts ett försök att kartlägga vitervägarna i Degerfors socken. [...] Kartläggaren menar att det finns tre kända vitervägar i socknen. Emellertid omtalar han inte varifrån han fått uppgiften, men tydligen är det en allmän föreställning i trakten. Underliga saker och ting har skett vid dessa vägar. Det som utmärker dessa vitervägar är att de ofta går längs vattendrag eller sträcker sig mellan två sjöar eller tjärnar. Då vitervägen ofta gick förbi vid tjärnar och vattendrag, kom därför en del tjärnar att bli beryktade som speciella vittertjärnar beroende på de händelser, som inträffat där."

174 Björkqvist 1943: 82.

175 Modin 1926: 50.

Figure 4: Map of the northernmost Swedish regions of Lappland, Norrbotten, and Västerbotten. (schoolmap by Haage 1954).

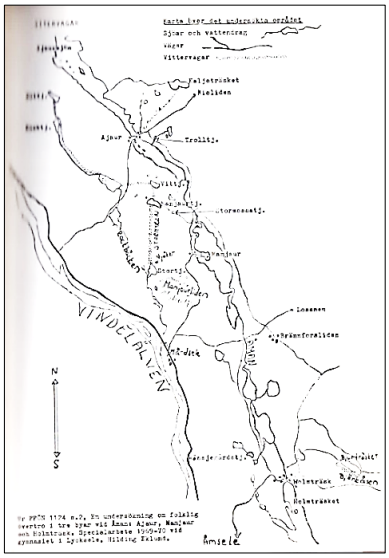

Figure 5: Map of vitra paths (*vitterstigar*) in Degerfors and Lycksele Parishes marked with dotted lines. Map reproduced from Dahlstedt 1976: 47 (Dahlstedt reproduced map by Eklund 1970).

recounts how his father-in-law, one morning after a period of many disturbances, sees a vitra woman sitting and combing her hair "in the gate" on the farm, where he shoots at her with a rifle. No corpse was found – fortunately – but the next day he heard:

> "[...] Then [vitra] moved away. They [humans] heard them do that. Then they [vitra] traveled with bells and cows and shouted and lived about, as when the Sámi drove their reindeer, and moved away in that direction, toward a little mountain creek there north, that they call the Skirkeberget, and there they moved and there they stayed."[176]

Tone Dahlstedt mentions that "Manjaurtjärn [a lake] is located by a vitra path, and here fishermen and others have often been told that they were inside the vitra area".[177] The abovementioned villages of Manjaur in Degerfors Parish and nearby Ajaur in Lycksele Parish were founded by mid-eighteenth century. It is worth noting that the area was relatively recently colonized, in about 1750–1790, by an agrarian Swedish-speaking population who competed with the Sámi in Sámi-dominated areas.[178] Before that, it was only visited by the Sámi (who continue to this day to bring their reindeer here every winter).[179] The place names are still Sámi; "jaur" means "lake" or "pond". It is probably not a coincidence that the idea of vitra paths is so conspicuous here. Perhaps the vitra paths in this area could tentatively be interpreted as memories of an old cultural border. The notion of invisible vitra paths that are only partly known seems to have been very strong in the folklore tradition in the area, as the maps above show.[180] While it remains speculation, it seems

176 Arvidsson 1986: 32.
177 Eklund 1984: 21. Translated from Swedish by the present author.
178 Göthe 1961: 41–53.
179 Bunte et al. 1982: 29–31.
180 Dahlstedt 1976: 47 cited after Eklund 1970/1984.

probable that the idea of local vitra paths is of Sámi origin and was retold to the farmers, maybe in order to protect "vitra area" ponds such as Jopptjärn – perhaps it is "passe", a *Saivo-jaure*.[181] The same is probably the case for the Manjaur and Ajaur ponds. All three pond names are obviously of Sámi origin, as are some names of lakes in the area.[182] Manjaur and Ajaur are located only about 45 kilometers north of the Jopptjärn pond.[183] Degerfors Parish still has its own mythical geography of vitra and other legends – some of Sámi origin – mirrored in its place names and folklore.[184] The oral folklore stories are connected to these ponds and lakes as well as places like Joppberget (a mountain) and Joppmyren (a bog), all known as the home of vitra and other supernatural events.[185] Located nearby is Getskalleberget ("goat head mountain"), ancient Sámi cemetery and the subject of several paranormal legends.[186] Another legendary mountain is Storskällberget ("great bell mountain"), which can be seen from far away and is known as *the* home of vitra, including associated histories of abductions of humans by vitra. These are only some examples of vitra-related local traditions involving vitra paths, mountains, and lakes from the Degerfors and Lycksele Parishes area. It is a rich area in that respect and what must be considered a cultural-historical borderland.

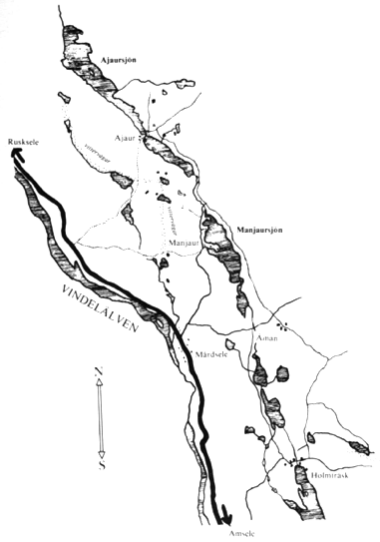

Figure 6: Detailed map of vitra paths around Ajaur and Manjaur. Reproduced from Eklund 1984: 6. Compare with Figure 5.

There are also known physical and archaeological remains attributed to vitra and vitra paths: for example, the vitra stairs in Granåsen, Dorotea, and the vitra stones in Vilhelmina and Umeå.[187] In the village of Granåsen, the very first settler, a Sámi, had to move his buildings because of prob-

181 One legend has it that the frozen Jopptjärn pond was a place the Sámi passed and the site of feasts many hundreds of years ago. The word "Jopp-", probably of Sámi origin, in folklore is said to mean "dance"; in the winter the frozen pond was a meeting place for Sámi who danced at the ice. Told to me by Ture Burlin (and maybe other relatives), who heard it from his friend, Sámi reindeer herder Per Skum.

182 Isof: https://www.isof.se/lar-dig-mer/kunskapsbanker/lar-dig-mer-om-ortnamn-i-sverige/ortnamn-pa-finska-meankieli-och-samiska/ortnamn-pa-samiska. Manjaurtjärn is also called Manjaurträsket on modern maps.

183 Eklund 1984, cited in Dahlstedt 1976.

184 Westerström 1976: 96–7.

185 Folklore includes stories about vitra and unknown flying objects.

186 Recording: Daum_Bd 848_m16 19660525, Albert Näslund, Emmy Näslund, Gunnel Sandström. There are several stories of mystical encounters at the road and the mountain. It is also said to be the location for a pre-Christian Sámi cemetery, where dead bodies were placed high in trees: folklore records that a Sámi ghost shaman, *nåjd* (noaidi) was observed lifting a goat's head towards the sky near the cemetery, and cars suddenly stopped working. In the 1930 s a priest is said to have been driving over the mountain when suddenly dead skulls started to jump on the bonnet, whereafter the car mysteriously "died", and the priest had to spend the night at the place.

187 "L1937: 4855 Ristning, medeltid/historisk tid". Riksantikvarieämbetet; "L1938: 7426 Naturföremål/-bildning med bruk, tradition eller namn". Riksantikvarieämbetet. https://www.raa.se/hitta-information/fornsok/; Sveriges Radio (2022). The potential connection to for example, Sámi circular stone offering sites is beyond the scope of this article. See Spangen 2016.

Figure 7: Lake Ajaursjön in summer 2024. Photograph by Toivo Burlin.

Figure 8: Jopptjärn pond in summer 2024. Photograph by Toivo Burlin.

lems with the vitra inhabitants, who had built stairs in the cliff and danced on it.[188] The previously mentioned Manjaur and Ajaur settlements – as nearby Holmträsk rich in vitra mythology – without doubt had Sámi inhabitants before the first Swedish settler colony in 1754.[189] These are only a few examples, but they suggest that the idea of vitra paths may sometimes have been transferred to Swedish and Finnish settlers by those who inhabited the area first, often the Sámi. This might be a strong indication that the vitra path concept is Sámi.

The notion of physical paths between ponds and lakes – and sometimes under buildings – suggests the importance of the landscape and spatiality in vitra beliefs and in vitra sounds and 'music'. In short, vitra paths were both *sonorous* and *spatially extended physical paths* in the landscape, and in that respect acted as 'windows' to changes in natural conditions, such as the weather.[190] The following story from 1935 about an encounter in 1905 is one example:

> "One evening about thirty years ago I saw vitra. At the time, I was in forestry work in Hälsingland. When I was walking home from work one evening, I heard something. It sounded like a rattle. Before I could think, a woman stood in front of me. She gave me a

188 Sveriges Radio (2022).

189 Granström: "Manjaurs historia; Eklund: "Vitterdansen i Holmträsk".

190 Recording: Daum_Bd_5680_m16, Malå 1981, Sigfrid Hellsten, Olavi Korhonen, Recording: Daum_Bd_6242_m16, 1994, Arvidsjaur Granberget, Agda Lundberg, Elsy Nyman, Ingegerd Westerlund, Recording: Daum_Bd_01487, Gunnel Westerström, Sofia Åström, Recording: Daum_Bd_01497 Edvard Karlsson, Gunnel Westerström.

> sharp glance but continued down the path. I was scared at first, but then I gathered my courage and went up to her. She raised her hand as if to signal that I should leave. However, I was not afraid, but I continued to walk beside her. She then took a stick, turned towards me, and raised the stick, as if she was going to hit me. I got scared and started reading the Lord's Prayer, which I had heard was good against such mischief. Before I could look back, she was gone. I only heard a jingling, as of bells, after her. A few steps later, it started to pour rain. I thought this was strange because the sky hadn't looked like rain. I think it was 'vitra' because, oh, it was 'vitra', I'm sure of it!"[191]

When various aspects of what is known about vitra paths are considered together, certain patterns emerge. In the regions of Lappland, Västerbotten, and Ångermanland, vitra beliefs emerge according to fairly coherent and similar patterns. All accounts suggest that these beliefs developed in a syncretistic cultural fusion of influences from ethnic Sámi and ethnic Swedes as well as ethnic Finns, who all inhabited and colonized the area. According to the sources, the Saivo belief, in itself syncretistic, was widespread in this particular area. Around Lycksele, for example, sacred ("passe") and supernatural Saivo lakes (*Saivo-jaure*) were particularly common, where special rules applied to activities such as fishing: mentioned ponds and lakes Jopptjärn, Ajaur and Manjaur are located here. The sájva ruled these lakes or ponds and could act protectively.[192] Alf Arvidsson mentions how fishers, for example, may be helped or robbed by the vitra and then hear their derisive laughter.[193] It is possible that when the Finnish and Swedish settlers arrived in these areas during the seventeenth and eighteenth centuries, the Sámi, who often competed with the colonizers for the same natural resources, conveyed ideas about this sacredness, "passe", including the sájva/vitra paths between lakes and ponds. These merged with the farming population's own magical beliefs from both eastern Finland (Savolax and Tavastland) and southern Sweden, which, from this perspective, gives northern Swedish folk beliefs their uniqueness in comparison to southern Swedish beliefs. In northern Swedish folklore, sounds and 'music' and supernatural vitra paths have a particularly prominent meaning and place.

191 Hjalmar Holmgren 1935. Isof 8575.pdf, recording of Karl Lundgren, 78 years old, former forest worker, born in Yttertavle, living in Innertavle, Umeå parish: "En afton för omkring trettio år sedan såg jag 'vittra'. Jag var den tiden i skogsarbete i Hälsingland. När jag en afton gick hem från arbetet, hörde jag någonting. Som en skallra lät det. Innan jag hann tänka stod en kvinna framför mej. Hon såg skarpt på mej, men fortsatte efter stigen. Jag blev först rädd, men så fick jag mod och gick fram till henne. Hon lyfte handen som till tecken att jag skulle avlägsna mig. Jag var dock ej rädd utan jag fortsatte att gå bredvid henne. Hon tog då en käpp, vände sig mot mig och höjde käppen, som om hon tänkte slå till mig. Jag blev rädd och började läsa bönen 'Fader vår' som jag hade hört vara bra mot sån't där otyg. Innan jag hann se mig om var hon försvunnen. Jag hörde bara ett pinglande, som av skällor, efter henne. Jag hann ej gå många steg förrän det började hällregna. Detta tyckte jag var konstigt, ty det hade ej sett regnigt ut på himmelen. Jag tror att det rådde 'vittra' för, å att det var 'vittra', de är jag säker på!"

192 Bäckman 1975: 13–17.

193 Arvidsson 1986: 42.

6 Memories of vitra's sounding paths: Past and present perspectives

The ideas of vitra paths as potential meeting points between humans and vitra continues to survive. Let me present a concrete example of the vitra path concept in modern folklore that I discovered myself, without previously knowing much about it. In the summer of 2010, I, the present author (A), had the following conversation with a visiting local resident (L.R.) in the kitchen of a summer house in village Blåliden, Västerbotten.[194] The local resident, born in 1948, was over for a short visit and suddenly said: [195]

L.R.: "Did you know that this house is built on a vitra path?"
A. [slightly surprised]: "You don't say?"
L.R.: "Yes, at least that's what I've heard."[196]

Let us pay attention to what L.R. seems to point out: that it is known that the house (built in 1939, close to the site of an older house from the nineteenth century) is built on a vitra path. L.R.'s remark could be understood as an explanation or warning, or just as an introduction to the deeper parts of the culture. The remark certainly shows that vitra beliefs still persist to some extent. Vitra paths were said to follow streams, lakes, and other lines in nature, and I knew, when I thought about it afterwards, that there were underground and aboveground streams and springs nearby.

A few years later, a pair of siblings, relatives of mine, told me that they themselves had *met* vitra along the vitra path, about one kilometer from the house mentioned, and on one occasion had heard sounds or noises (though not "music").[197] In about 1963, as a boy of 6, the younger sibling had met what he came to believe was a member of the vitra when he was walking by the nearby pond, Jopptjärn, with the family dog. As mentioned, Jopptjärn is known locally as a vitra area – several stories are told about it – but at the time, as a young boy, he was unaware of that. As he was walking, a very tall woman whom he did not recognize, wearing clothes in strong colors – a red costume with a blue pinafore and blue hood – suddenly appeared in the bog behind a brook fed by a spring. The boy thought it might be someone he knew from the nearby village. Wanting to be polite, he began to move towards her. Suddenly the dog, incredibly frightened, stopped and began to growl. Then the woman, with a wave of her hand and from distance of some meters away, stopped him and the dog from coming closer. The power that came from her nearly killed the dog, who fell down unconscious. The boy tried hard to wake the dog. It took a while. As this was happening, he also heard loud hissing sounds. When the boy stood up, the woman had disappeared completely. When the boy came home with the dog, his father saw that something was wrong with the dog and asked about it, but the boy did not tell him what had happened. According to this story, the being whom the boy perceived as a vitra woman acted as a strong elementary force with the

194 The family homestead, *Burlin's,* 150 years old, in the small village of Blåliden in Degerfors parish (Vindeln), Västerbotten.
195 One of the main inspirations for this study.
196 Transcribed and translated from the local dialect, Degerforsmål, by the author.
197 Older relatives of the author. Several other living persons have claimed to have heard "music" in the form of strange flute playing at the path.

power to hurt or kill the dog – but she spared the boy. [198] The other sibling in about 2017 recounted that as an older woman, she saw in a kind of dream a woman dressed in red walking "the vitra path" over the family building plot – the same area mentioned by L.R. The woman suddenly disappeared behind the barn, an area known to be a bit forbidden even today. In the dream the woman thought: "Now I must tell my family that I have seen vitra!"

What then happened to these beliefs in Lappland, Västerbotten and Ångermanland? Here are some accounts recorded by informants in the late 1970s and the early 1980s. The first informant comes from Sorsele:

> "Well, there are still vitra today, but they must have fled for civilization, where have they gone, do you think? I guess they haven't had time to investigate what vitra actually are, I think not... [they were] a spirit movement, which disappeared and appeared."[199]

An informant from Örträsk says:

> "Vitra, they were the spirits who were out in the fields, and who were seen by truthful people, and seen up until the forties [i.e., 1940s] here, a woman who lived up here on Vilan, a kilometer from the village, saw a whole entourage of vitra with cows and everything on the snow, who set off, so you don't know what to say about that... [...] Vitra were spirit beings, who lived on earth just like humans, they were not ominous... [they were] a natural thing, beings who lived here but were visible only sometimes."[200]

And one informant from Fredrika says:

> "I've never been afraid of vitra, they are a part of nature [...] Dad said that when they were small there were so many vitra that they actually lived together with vitra, every single day, they forged in the forge and they cut aspens and they talked loudly with the cows, in the village they never heard them come until they saw them. But they have disappeared with time, oh dad, he, yes, I think he missed that, they disappeared with the electricity and the radio, [the] new [things]."[201]

Finally, an informant from Skurträsk:

198 A natural explanation for the strange experience, suggested by Jon Johansson (personal communication, e-mail) of June 3, 2024, could be that the boy and the dog had encountered a thunderstorm and a lightning strike.

199 Recording: Daum_Bd_4044_m16, Sorsele 1982, Israel Jonsson, Olavi Korhonen: "Nä nog finns vitra än idag, men hon torde ha flytt för civilisationen, vars ha hon nästan farit? Dem har väl visst inte hunnit utreda vad vitra är för någonting egentligen, det tror jag int... en anderörelse, som försvann och visade sig..."

200 Recording: Daum_Bd_4329_m16, Örträsk 1983, Harald Fors, Greta Jonsson, Olavi Korhonen: "Vitra det var ju andeväsen som fanns ute i markerna, och som dom har sett, sanningsenliga människor och sett ända in på fyrtiotalet här, en kvinna som bodde här uppe på Vilan en kilometer från byn såg ett helt vitterfölje, med kor och allt på snön, som gav sig iväg, så det vet man inte vad man ska säg om... [...] Vitra var andeväsen som bodde på jorden likaväl som människorna, de var inget illavarslande. En natursak, väsen som levde här men var synliga bara ibland."

201 Recording: Daum_Bd_3148_m16, Fredrika, Dammet 1979, Thomas Andersson, Elsa Siljebo.

> "Science says that when you get too many buildings too close together, they disappear …"[202]

In his article about vitra beliefs, Stig Hellsten cites several informants who observe that vitra beliefs disappeared with the advent of schools, public education, and influences from the mass media. Hellsten writes:

> "A former church ringer in Vilhelmina says: 'When you have seen them yourself, you are sure they exist', but after telling stories about his own experiences he adds (1956), 'Now nobody sees anything.'"[203]

And as Hilding Eklund poetically writes in his book *Vittra vid Manjaur*, it is not hard to understand the reason why the vitra disappeared:

> "Vitra appear rarely or almost never in modern times. This is because vitra have left their old areas and paths. These have largely been destroyed by human excavation and clear-cutting and by buzzing high-voltage lines. Vitra have therefore retreated to other, more isolated forests to find pastures for themselves and their cows."[204]

Or in the words of folklorist Erik Modin, who as early as 1926 saw a world, almost a paradise, lost:

> "Humankind has made and is making itself more and more dominant over nature. But nature becomes more and more impoverished at the same time; it loses, as time goes on, its strange mystery, its horror, its allures, its richness – its poetry."[205]

The falling into oblivion of the vitra folklore and many of the melodies and paths attributed to vitra that are consistently described in the recorded sources points to something larger: a cultural oblivion in a time of crisis and change. To sum up, it is clear that the elements of vitra beliefs, and the idea of vitra paths, instead have lived on in modified form. Tommy Kuusela presents many recent examples of such beliefs, by now quite distorted, from the twenty-first century.[206] And as my own examples of my neighbor L.R. and others show, the older forms still live on too: in people's minds, and, perhaps, in conversations between them. This is true even though some people, under the influence of modernity and extended education, began to think about vitra beliefs in a more 'scientific' way, as in this condensed quote: "I guess they haven't had time to investigate what vitra actually are" but "science says that when you get too many buildings too close together, they disappear." Statements like these are probably another way of saying that the old beliefs were no longer sufficient, meaningful, or perceived as correct. But they were hard to abandon completely.

202 Recording: Daum_Bd_3392B_m16, Axel Gidlund, Tore Holmlund, Skurträsk 1979: "Vetenskapen säger att när det blir för tätt bebyggt då försvinner dem …".

203 Cited after Hellsten 1984: 50.

204 Eklund 1984: 57.

205 Modin 1926: 75: "Människan har gjort och gör sig allt mera ensamrådande i naturen. Men denna blir samtidigt mer och mer utarmad; den förlorar, vad det lider, för henne sin underliga hemlighetsfullhet, sin skräck, sina lockelser, sin rikedom – sin poesi."

206 Kuusela 2021.

7 Results and discussion

This article set out to answer the following questions:

1. What are the context for and the structure of the sounds and 'music' attributed to vitra?
2. What is the relation between spatiality/space and sound and 'music' on the vitra paths?
3. How can ideas about vitra sound and 'music' and its spatial representations contribute to an understanding of pre-modern 'music and sound' conceptualizations?

Briefly, the findings are, first, that the perceived context of all sounds attributed to vitra (and sájva) was the natural world – from a modern perspective, its *biophony* and *geophony* – outside of, but close to human culture (and its anthrophony). Regarding the structure of vitra 'music', some characteristics are frequently reported. These include (but are not limited to) 'incomprehensible' sounds, that is, sounds "not of this world"; a grand beauty; strong, overwhelmingly beautiful voices; strange, difficult, or chromatic intervals; a predominance of vocal tunes, "kulning" or "kókning", high-pitched herding calls or rhythmically complex vuole; and also, instrumental pieces. These instrumental pieces are described as widely varied in style and instrumentation, having been played on, for example, the Jew's harp, violin, flute(s) of different kinds, bells of different kinds, proportions and set-ups, and accordion. The strong connection to the herding and chalet culture, however, means that these tunes have clear features of chalet music, one of which is high-pitched singing by beautiful silvery voices and another of which is the sound of animal bells. The chalet culture, which existed outside cultivated lands, i.e., in woods, lakes, mountains, and marshes, is the primary *cultural* and *spatial* context of this supernatural music.[207] But the overall picture is that this is an adaptation of the Sámi concept of Saivo and the supposed paths used by its inhabitants, the sájva, for their reindeers between mountains and lakes – probably with shamanist dimensions – reconceptualized by Swedish- and Finnish-speaking settlers. It is the result of a cultural mix and meeting, a *transculturation*, specific to the area and its life circumstances.[208]

According to Grimshaw-Aagard and Garner, sound is more than acoustic events transmitted to our ears. Sound is also a subjective impression and experience.[209] The human brain plays a major role, not only as the interpreter of acoustic signals, but also to fill in what is missing, and even to 'compose'. In a society without the concepts of 'composing', 'improvising', or 'creating' music, it may be difficult to say "I made this melody" or "I heard this harmony in my head". Many of the described encounters with vitra, at least as they involve hearing sounds and melodies, must be understood as real human (psycho-)acoustic impressions of sounds of unknown origin – perhaps they were transmitted acoustically over a long distance and changed in the minds of the listeners. These impressions were interpreted in the light of a familiar concept, namely the concept of the vitra and vitra paths. In several recorded accounts, it is obvious that many of the experiences described can be explained as sounds probably created by other humans, animals, or nature itself –

207 Johnson 1986: 198–206. "Sången i skogen", her material is from Dalarna, Jämtland and Härjedalen.
208 Lundberg and Ternhag 2014: 130–32.
209 Grimshaw-Aagard 2019.

anthrophony and *biophony* – which, in the ears and brains of the human listeners, who might themselves have been very musical, became beautiful music, 'incomprehensible sounds', or melodies that they attributed to the vitra. Steven Feld's concept of *acoustemology*, where sound is a "way of knowing", suggests that the acoustemological environments of the northern Swedish agrarian and herding culture, within and abutting vast areas of natural wilderness, needed vitra and vitra paths as both friend and 'other' – something to interact with, connect to, and talk about. Like birds for the Bosavi people, the vitra can be understood in a mythical sense as human forefathers or distant cousins: as 'gone reverberations', absences, transformed into a concept of an audible and sometimes visible presence on vitra paths, preparing humans to always be observant and aware, teaching that nature can be an enemy as well as a friend. In this sense, vitra offered a kind of relational feedback to human existence in a dark and frightening natural world, and as distant relatives of humans, they used sound and music to communicate, saying: "We are almost like you. Share our melodies!"

Secondly, vitra sounds/soundscapes and 'music' are strongly associated with vitra paths. The *transculturation* mentioned above produced an acoustemological and a *sound-musical-spatial infrastructure* concept, vitra paths, that have been perceived – together with the perceived sounds – as spatial framings of vitra areas, of both nature and culture. These paths are also the ultimate borders of human culture. Nature is a medium for the sounds – a soundscape. As the concept of acoustemology suggests, engagements with place and space-time are highly important when sharing and listening to sounds.[210] It is also in "histories of listening",[211] i.e., in talking with one another about hearing experiences, that the engagement becomes real. Because both vitra sounds and vitra 'music' are always heard in natural settings, it is the spatiality of this *biophony* and *geophony*[212] that is their, so to speak, 'stage'. Many testimonies and histories attest that hearing the beautiful voices echoing between mountains, in valleys, and across lakes and ponds is a wonderful event, remembered for life. Spatiality and time (manifested in long reverbs and echoes) are an essential part of these sound and musical experiences in nature. There is an implied sounding spatiality in many of the stories told about vitra and sájva. It is probable that these outdoor sound experiences were shaped by the natural acoustics of woods, lakes, and mountains, and that stories about listening to sounds in this soundscape were an essential part of the conception of this 'other': vitra sounds and 'music'. The natural sounding landscape – the geophony – of the Lappland, Västerbotten, and Ångermanland areas is quite varied, with woodlands, mountains, and many lakes and ponds. It is often very well suited to long decays and imagination-provoking echoes. One example is the abovementioned Blåliden, where a vitra path has been pointed out: the local acoustics, if one shouts or sings loudly, are absolutely stunning, with a lot of long echoing and reverbs on the nearby ponds and mountains. Examples such as this are, if not conclusive, at least suggestive of a connection between the perceived spatial aspects of the geophony and soundscape and the perceived vitra

210 Feld 2015: 15.
211 Feld 2015: 17.
212 Kolltveit 2014: 73–6.

paths. As noted by Riita Rainio et. al. in their technologically advanced and careful archaeo-acoustical investigation of the Sámi acoustic spaces of canyon lakes Julma-Öllky and Rotkojärvi in northern Finland, there are clear indications of a general close relation between Sámi shamanism, certain sounding cliffs, mountains and lakes, and concepts of the Underworld.[213]

From the earliest known records of vitra beliefs to the extensive folklore documentation to recent popular culture,[214] vitra paths are also *physical remains* in the landscape – still awaiting archaeo(musico)logical investigation – that connect concepts of *nature,* such as sounds of animals, woods, lakes, and mountains, with communicative concepts of *culture,* such as 'music'. The infrastructure of vitra paths can therefore be understood as a highly important part of this nature-culture and spatiality-sound/'music' connection. I suggest that we should understand 'sounds', 'music', spatiality, and 'vitra paths' together as both *cultural concept* and *acoustemological environment*: the vitra paths create a bridge between past and present, real and unreal, nature and culture, sound/music, time and the spatial environment, the supernatural and the natural, bad and good weather, humans and 'the others'. The vitra paths can thus be said to metaphorically transcend past and present in a world turning from 'magical' to 'modern'. One might even speculate that the vitra paths are a cultural translation of the worldview of the Sámi shaman, noaidi, in which the drum and its symbols were a tool for traveling the road to Saivo, the home of the sájva/vitra. Even when the concept of both vitra and vitra paths dissolved under the influence of modernity, traces of the old beliefs lingered.

Thirdly, the concept of vitra paths, which are the sites of both physical and supernatural sounds, can be viewed as a point of entry into a more significant problem: what conceptualizations of both sound and what modernity calls 'music' existed in pre-modern agrarian society? How were these concepts understood? I will give a short answer first, and then offer some more detail. Among the majority of the population in the northern Swedish regions investigated here, it is likely that there was no concept of music as we know it *at all before approximately 1900.* It is important to understand that the impact of modern Western culture, including the concept of 'music', grew to influence generations of adults and children only gradually. As Timo Leisiö has pointed out, today's universal concept of music did not exist at all among Finnish and Sámi populations in Finland before the twentieth century.[215] Probably the same applies to similar nearby populations in Sweden. In fact, a modern concept of music was probably not completely established until much later, in the 1920s to 1930s, under the influence of modern media, especially radio.[216] Probably there was a concept of 'music' or several particular 'musical' concepts before then, which included sounds and melodies and notions of sonic or melodic beauty. But this older concept is hypothetical and has no name. Certainly many musical practices are known or can be surmised to have existed: for example, singing lullabies, vocalizing herding calls, playing instrumental dance pieces and dancing to

213 Rainio et al. 2017.
214 To be discussed in another study.
215 Leisiö 1986: 186.
216 Leisiö 1986: 186.

them, performing work songs, etc. There probably also was some basic understanding of harmony (and regular rhythmic patterns), at least among Swedish speaking farmers. A main avenue for this influence was hymn singing in the Swedish Protestant church, a powerful institution. In northern Sweden, however, farmers and reindeer herders had to travel long distances to reach the nearest church, meaning that contacts with the church, in practice, varied in degree. Later, from 1842 onwards, most resident children in Sweden received basic education in public elementary schools, but they usually attended school for only a few years, learning some writing, reading, math, and Christianity, among other things, before often going on to live their lives as farmers. 'Music', if ever used as a concept in church or in school, meant approximately 'songs' or 'singing'.[217]

Beginning in 1925, public service radio broadcasting set completely new standards for every Swedish citizen about almost everything. Both music and the Swedish language became standardized and mediatized. Music became an umbrella concept, eventually including all genres on top of the classical tradition (but somehow related to it).[218] With this development towards modernity, the strong notion of the musical and sonorous communication of the vitra, connected to paths and spaces outside houses and villages, changed. For a long time, scales that deviated from major-minor tonality as well as unusual sounds, could be conceptualized as something 'other': the sounds of forefathers or cousins, in an acoustemological pre-modern perspective. According to one informant, the first Finnish settlers to arrive in Örträsk in Lappland in the 1670s, met with vitra who already lived there.[219] The vitra seem to have remained: they were both seen and heard regularly in Örträsk until the 1930s or 1940s. But according to consistent testimony, they sadly left the area permanently when the human inhabitants installed electricity and radio.[220]

That sound and 'music' before modern technology and media could be conceptualized as 'supernatural' in this concrete way points to a fundamental change in human perception and conceptualization of the world. We can think of it as an extended, hard Enlightenment: trains, electricity, telegraphy, telephone, and radio completely changed people's life circumstances and eventually their concepts of what was 'real' and what was not. The mysterious, parallel, sounding world of the vitra paths were replaced by soundwaves in the ether and the realistic sounds of human voices and music from the radio in the living room. Indeed, within a short span of time, these modern technologies and media gave northern Sweden – and indeed all of Western culture – a fundamentally new concept of communication, of sound and music as 'things' electrically recorded, transmitted, mediated, and modern, creating a new kind of scientifically based transparency that effectively closed the perceptual and conceptual doors on even recent historical times.[221]

217 Florin 2010.
218 Löfgren 1990; Ehn et al. 1993; Björnberg 1998.
219 Recording: Daum_Bd_4973_m16, Lycksele Knaften, 1985.
220 Harald Fors 1986: 75.
221 Volgsten 2019.

8 Coda: The eternal bells

Finally, let us take the important sound tool of vitra lore, the bells, as an example of the sounds in pre-modern soundscapes that disappeared with modernity. I will turn the floor over to Ture Burlin,[222] a well-known member of the local community, a collector of bells, a local storyteller and 'memory expert', in Blåliden and Vindeln, Västerbotten. He lived most of his life in Blåliden and continued an agricultural lifestyle into the 1960s, never owning a tractor. He himself owned a few mountain cows ("fjällkor"), a north Swedish horse, a few pigs and goats, and a dog and a cat. He spoke the archaic dialect known as Degerforsmål (or "bondska").[223] Ture Burlin was probably the first person to mention "vitra" to the present author in the late 1970s. Indeed, he had several stories about vitra (among other things) that he told to adults that were not meant for children's ears. As far as I remember, he denied that vitra had any real existence. But one story that he did tell me in the 1980s involved an experience his father, Oskar Burlin (1885–1963), supposedly had at the mentioned Jopptjärn pond when he was a shepherd boy in the nineteenth century. By the pond one day, he saw another boy shepherding cows. He heard the sound of their bells, from a distance at first, and thought it was a boy from a neighboring village bringing his cows to the pond – until the boy passed very close by him without looking at all in his direction or answering when Oskar spoke to him. Instead, the boy led the cows straight down into the pond, walking out into the water. Slowly, both the boy and the cows walked farther and farther out until they finally disappeared completely – perhaps along with the sound of the bells – under the surface of the water. This story is reminiscent of several other recorded accounts with its emphasis on the sound of bells. It also emphasizes the supposed reality of both vitra and their home under both earth and water, in what was known to be their own pond.[224]

The animal bells with their 'incomprehensible sounds' did play a crucial role in the vitra stories. And as Gjermund Kolltveit has pointed out, bells were important sound tools in Nordic culture and its landscapes for long periods of time.[225] Cowbells and other bells, such as bells for horses – Kolltveit lists three types of pre-modern bells for animals – had a great deal of importance in agricultural soundscapes, especially those that existed as natural parts of the lives of farmers and shepherds. Probably the bell ("skälla" in Swedish)[226] was strongly connected with the farming societies that expanded and developed in Scandinavia, including the Funnel Beaker culture (ca. 4000 BCE), the Battle Axe culture (ca. 3000 BCE), and the agricultural communities of the Bronze Age (1700–550 BCE) and the Iron Age (550 BCE–750 CE), continuing in principle until the present day.[227] Animal bells on cows, sheep, goats, horses, and, among the Sámi, reindeers, have had several purposes.[228]

222 The author's grandfather.
223 Degerforsmålet. See Åström 1888.
224 This story is a piece of oral folklore that I heard from Ture Burlin at least once before I was 20 years old, and which has now been written down properly.
225 Kolltveit 2008: 148–9.
226 Kolltveit 2008: 148.
227 Kolltveit 2008: 148–53.
228 Kolltveit 2008: 148; Price 2015.

One was to allow shepherds or farmers to hear the animals and find them if they got lost; another was to let one or a few animals lead the herd, and with the sounds of the bells deter possibly dangerous predators and beings in the forests, including wild animals, as well as beings like the vitra. Along with a sound tool, like the bells, it is necessary to also consider the concept of the soundscape, as sketched out in several articles by Gjermund Kolltveit, Cajsa S. Lund and Rupert Till.[229] Of bells, Kolltveit writes:

> "[O]ne purpose of bells in human perception is that they are makers of time and space. Especially relevant for animal bells is that they form, define and shape space. [...] More specifically, we can imagine that bells were territorial markers, acting as symbolic borders around the area that people used and controlled."[230]

As territorial markers, bells also symbolically delimited the areas which were controlled by the vitra. Maybe it is because of their strong symbolic function as markers of space and borders, that bells – often with an 'otherworldly' sonic touch – are so often mentioned in the vitra stories and so much associated with the vitra paths. Ture Burlin described his own childhood experiences of hearing real bells in the woods in a recording made in the autumn of 1973.[231] As a child growing up at the beginning of the twentieth century, he, like other children, used to shepherd cattle in the forest, roaming freely there from morning to night. On the recording, he speaks about his memories of these wanderings. He describes how he used to climb up a mountain and listen with pleasure to the calls that he heard from all over the forest. He loved to stand there, listening to this landscape of the sounds of far-off animal bells in all directions. On the recording, he says it was "great to hear". [232] He complains that in 1973, this landscape of sounds has passed away and is no more. "Maybe you hear a logging truck and a chainsaw; that's what you hear", he says.[233] But the landscape – and the soundscape – had already started to change before Ture was born in 1909. Between 1883 and 1894, the Stambanan railway was built through Norrland, passing close to the area we have been talking about, so that in the early twentieth century, the sounds of trains became a new, natural, and very modern part of the soundscape.[234] Nonetheless, as a child, the young Ture still found himself in a mostly pre-modern soundscape. Agriculture and agrarian life were still much the same as they had been for millennia or at least for hundreds of years: self-sufficient, without tractors, cars, or any large machinery. It is possible to imagine that Ture Burlin's auditory experiences of this world, recalled by him so many years later, offer a clue to what many children and

229 Lund 2008; Lund 2018: 14; Kolltveit 2014; Till 2020.

230 Kolltveit 2008: 149–50.

231 Recording: "Samtal i köket Vindeln (mars 1973)". *Familjens klassiker Volym 2*. 2004. Recorded by Tommy Johansson. Produced by Toivo Burlin.

232 Ture Burlin loved bells of all kinds, especially cow and horse bells, and collected them. The author owns a large part of this collection today.

233 See n. 231.

234 https://sv.wikipedia.org/wiki/Stambanan_genom_övre_ Norrland and www.historiskt.nu (maps of the Swedish railway from 1880, 1894) [accessed 2024-09-24].

adults experienced in the Scandinavian forests for thousands of years. This *was* the vast landscape that once was big enough for both humans and vitra.

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