# ANALECTA

## ARCHAEOLOGICA RESSOVIENSIA

VOLUME 19 RZESZÓW 2024

ISSN 2084-4409 | DOI: 10.15584/anarres

ANALECTA

ARCHAEOLOGICA RESSOVIENSIA

# ANALECTA

## ARCHAEOLOGICA RESSOVIENSIA

VOLUME 19 RZESZÓW 2024

FUNDACJA RZESZOWSKIEGO OŚRODKA ARCHEOLOGICZNEGO

Uniwersytet Rzeszowski
Kolegium Nauk Humanistycznych
Instytut Archeologii

WYDAWNICTWO UNIWERSYTETU RZESZOWSKIEGO

Abstracts of articles from Analecta Archaeologica Ressoviensia are published
in the Central European Journal of Social Sciences and Humanities
Analecta Archaeologica Ressoviensia is regularly listed in ERIH PLUS, CEJSH and ICI

Graphic design, typesetting
DOROTA KOCZĄB

Technical editor
EWA KUC

Cover design
JULIA SOŃSKA-LAMPART



**ISSN 2084-4409 DOI:10.15584/anarres**

2150

Editor's Address

INSTITUTE OF ARCHAEOLOGY
RZESZÓW UNIVERSITY
ul. Moniuszki 10, 35-015 Rzeszów, Poland
e-mail: iarch@univ.rzeszow.pl
Home page: www.archeologia.rzeszow.pl

THE UNIVERSITY OF RZESZÓW
PUBLISHING HOUSE
ul. prof. S. Pigonia 6, 35-959 Rzeszów, Poland
tel. 17 872 13 69, tel./fax 17 872 14 26
Home page: https://wydawnictwo.ur.edu.pl

RZESZÓW ARCHEOLOGICAL
CENTRE FUND
ul. Moniuszki 10, 35-015 Rzeszów, Poland
email: froa@froa.pl
Home page: www.froa.pl/

First edition, A4 format, 19 publishing sheets, 21,5 printing sheets, order no. 104/2024
Printed and binded: The University of Rzeszów Printing House

ANALECTA
ARCHAEOLOGICA RESSOVIENSIA
Volume 19 / Rzeszów 2024
ISSN 2084-4409
DOI: 10.15584/anarres

# Contents

## ARTICLES

**Katarzyna Tatoń**
Voiced or Silent? The Sound of the Sistrum in Ancient Egypt ..... 7

**Seweryn Rzepecki, Lucyna Domańska**
On the Edge. Relics of LBK Settlement at the Site of Kruszyn 3, Commune Włocławek (Household A) ..... 21

**Sławomir Kadrow, Anna Zakościelna**
The Socio-Cultural Background of the Genesis of the Lublin-Volhynia Culture ..... 41

**Wojciech Pasterkiewicz**
"A House for the Dead" or a Cremation Pyre? The Interpretation of Grave No. 10 Discovered in the Globular Amphora Culture Cemetery in Sadowie in the Sandomierz Upland ..... 57

**Magdalena Przymorska-Sztuczka**
Hook Pins in the Grave Inventories of the Wielbark Culture. A Case Study Based on the Finds from Cemeteries in Czarnówko, Lubowidz and Wilkowo Nowowiejskie, Lębork District (PL) ..... 93

**Andrzej Kokowski**
Jet Beads from Grave 436 from Masłomęcz. A Further Contribution to the Study of Contacts between the Gothic Population of the Masłomęcz Group and the Sarmatians ..... 105

**Halina Dobrzańska**
The Environmental Context of the Early-Slavic Culture Settlement at Zofipole, Site 1, Kraków District ..... 117

**Marek Florek**
Military Accessories from the "Tursko Castle" Near Połaniec, Świętokrzyskie Voivodeship. A Contribution to Research on Mongolian and Mongolian-Ruthenian Raids on the Sandomierz Lands in the 13th Century ..... 131

**Anna B. Kowalska**
Problems of the Continuation of Medieval Manufacturing Traditions in Modern Shoemaking Based on Archaeological Finds in Szczecin ..... 143

**Małgorzata Grupa, Piotr Pawlak, Waldemar Dryjański, Dawid Grupa, Tomasz Kozłowski, Wiesław Nowosad**
Preliminary Conclusions Following Archaeological-Anthropological Studies in the Crypts of the Church of Saint John the Baptist and the Five Martyred Brothers in Kazimierz Biskupi, Kazimierz Biskupi Commune, Konin County, Greater Poland Province (2022 Season) ..... 157

## REVIEW

**Marek Kamień**
(review) Elżbieta Kowalczyk-Heyman. *Średniowieczne rękojeści antropomorficzne (próba klasyfikacji i interpretacji)* [*Medieval anthropomorphic handles (an attempt at classification and interpretation)*]. Warszawa 2021: Instytut Historii im. Tadeusza Manteuffla Polskiej Akademii Nauk, Wydział Archeologii Uniwersytetu Warszawskiego, 229 pages, 73 figures, 12 maps, 10 tables. ..... 171

ANALECTA
ARCHAEOLOGICA RESSOVIENSIA
Volume 19 / Rzeszów 2024
ISSN 2084-4409
DOI: 10.15584/anarres

ARTICLES

Katarzyna Tatoń

DOI: 10.15584/anarres.2024.19.1

Doctoral School, University of Rzeszów, Rejtana 16c, 35-959 Rzeszów, Poland;
e-mail: katarzynata@dokt.ur.edu.pl; ORCID: 0000-0003-0491-0362

# Voiced or Silent? The Sound of the Sistrum in Ancient Egypt

## Abstract

Tatoń K. 2024. Voiced or Silent? The Sound of the Sistrum in Ancient Egypt. *Analecta Archaeologica Ressoviensia* 19, 7–19

The sistrum was one of the most popular idiophones of Antiquity and, of all the musical instruments, it was most closely associated with the culture of Ancient Egypt, being present there for most of the time of this civilization's existence. To this day, numerous examples in a diversity of shapes have remained and their representations also appear on the walls of temples and tombs. They also can be found in statuary sculptures as well as small plastic art. The sound of sistrum was an important element of the cult of varies deities, but primarily that of Hathor. The symbolic function was so strong that the instrument itself became a votive object. Some researchers believe that only the arched sistrum performed a sound purpose, while the faience naos-sistrum supposedly lacked this function. To obtain a more comprehensive picture of the sounds produced by the sistrum, and to evaluate the acoustic capabilities of the naos-sistrum, the experimental approach was employed.

**Keywords:** Ancient Egyptian rattles, archaeological rattles, music in Ancient Egypt, Ancient Egyptian instruments, archaeoacoustics, archaeomusicology

**Received:** 31.07.2024; **Revised:** 21.08.2024; **Accepted:** 01.10.2024

## Introduction

Rattles are one of the simplest and oldest musical instruments, with artists from almost all the entire ancient world having created various forms of rattles, adapted to the function they performed. The sistrum is not the only rattle found in Ancient Egypt (Tatoń and Czajka 2021, 8) but no other Egyptian rattle had such a characteristic form or fulfilled such an important function. Certainly, no other rattle made a similar sound. The sistrum's sound and, more broadly, its acoustic properties based on spectral analysis is the author's primary focus in this study.

## Sistrum – an overview of the rattle

The term "sistrum" is derived from Greek and has been commonly adopted to describe a kind of rattle. It is one of the most popular idiophones of Antiquity, occurring, among others, in Ethiopia, Mesopotamia, Crete, Palestine, Greece, and Rome as well as on the islands of Melanesia and in North and South America (Pawlicki 1974, 11). Although there are places where the sistrum has been used up until modern times, we associate it primarily with the culture of Ancient Egypt. It has long aroused the curiosity of researchers and much has been written about the sistrum. However, among the numerous analyzes so far, none have been devoted to the acoustic characteristics of these objects.

In general, it is said that sistrum is a rattle consisting of a U-form frame to which metal rods and small discs (sounding plates) are loosely attached so that they jingle when the rattle is shaken (Sachs 1940, 70). According to the Hornbostel-Sachs Classification of Musical Instruments, the sistrum is an indirectly struck idiophone, a stick rattle, where the player himself does not go through the movement of strik-

ing; percussion results indirectly through some other movement by the player. The intention of the instrument is to yield clusters of sounds or noises, and not to allow individual strokes to be perceived. Rattling objects are strung on a bar (*MIMO Consortium*, 5).

The sistrum was present in Ancient Egyptian culture for most of its existence. The art of the land of the pharaohs is recognizable at first glance and may seem uniform, but it changed markedly with the development of the Kingdom. Of course, every musical instrument or sounding tool is not an independent phenomenon and its evolution is related to the evolution of the entire culture. As a result, the sistrum underwent changes over time, taking on various forms. Perhaps this is why the first classification of sistra discovered in Egypt, made by F. Petrie, consisted of as many as five types: with the face of Hathor and large, protruding ears; with a depiction of a lotus instead of Hathor's face; with a lotus flower and Hathor's head above it; with the representation of Hathor's head in the middle part of the instrument and with rods formed in the shape of snakes. Scholars have agreed that this division has many inaccuracies regarding the construction of the instrument itself, the function performed by the instrument, and the material from which it was made (Pawlicki 1974, 7).

Nowadays, two basic types of Egyptian sistrum are distinguished. The first is the arched sistrum, sometimes also termed the loop one (Suddreth 2019). It consists of a loop that is pierced by horizontal metal rods and sometimes the rods can be additionally equipped with plates to enhance the sound. An arched sistrum is usually made of metal but can be made of various materials from wood to faience. The rods and plates were generally metal, although other views can also be found in the literature. As A. Tsakalidou states: *The disks inside the sistrum could be made of various materials, such as ceramics or metal* (Tsakalidou 2021, 28).

The second type is the so-called naos-sistrum, made mostly from glazed faience (Reynders 1998, 1013). It derives its name from the element above the handle, taking its inspiration from the shape of a temple portal (Manniche 2010, 13). The representations of the arched sistrum may be shown as white or yellow, suggesting silver and gold, while the naos-sistrum is depicted in yellow – gold (Manniche 2010, 13–14).

All of the preserved examples of both types differ in appearance. Some of them are very simple in decoration, but the others have ornamentation in various forms. The centerpiece of most of surviving sistra both types is a head of Hathor, the handle often takes the form of a papyrus stem. From the Late Period sistra appear with new elements such as cats and kittens, figures of Bes and uraeus serpents (Manniche 1991, 63). There are many complete examples or their fragments in museums. However, there are equally, if not more numerous, iconographic representations of sistrum. We can find them on the walls of tombs, temples and buildings. They are depicted on stelae, statues, figurines and small works of art as well as on ostraca and papyri.

The first representations of the naos-sistrum come from as early as Old Kingdom – the 4th dynasty, to which the relief from the tomb of Nunetjer in Giza is dated (Köpp-Junk 2020, 16). The oldest preserved instrument of this type also comes from the same period. It is an unusual sistrum made of travertine or Egyptian alabaster, inscribed with the names of King Teti, dating ca. 2323–2291 BC, the 6th dynasty (Pawlicki 1974, 11). The arched form is slightly younger, appearing in the Middle Kingdom, but its depictions are known mostly from the New Kingdom onward (Manniche 1991, 63). They are mentioned earlier in inscriptions, however, the problem here is a bit more complicated.

Generally Ancient Egyptians used two terms for sistrum: *sḫm* and *sššt*. In the older literature we can find a simple designation for both terms. The authors used *sššt* to denote naos-sistrum, while *sḫm* referred only to arched sistrum (Fig. 1; Sachs 1940, 89; Hickmann 1962, 46–51; Pawlicki 1974, 8–9; Manniche 1991, 62–63 and others). This simple interpretation of the reading of both types of sistrum is followed by most older authors. However, over time some of them point out a confusion in the assignment of these terms to a specific type and which term is used to which sistrum in which period of Ancient Egyptian history: e.g. on the scene from Medinet Habu there is a depiction where the term *sššt* appears next to the arched sistrum (Fig. 1). Also, both terms are found for each type in Ptolemaic texts (Reynders 1998, 1014). Furthermore, it was noted that the term *sḫm* does not necessarily refer to a musical instrument and should not always be interpreted as such. As the embodiment of the goddess Bat (Fig. 2; Baines and Málek 1995, 163), the sistrum was the symbol of the 7th nome of Upper Egypt (Fischer 1962, 7). As H. Fischer notes: *By the New Kingdom Bat was completely eclipsed by her powerful neighbor, and Hathor ruled in her place as mistress of Hu, or IJw.t-sḫm 'Mansion of the Sistrum' capital of the 7th nome was then called* (Fischer 1962, 7). This is how M. Reynders explains the matter: *the two words known for Egyptian sistrum have to be interpreted with distinct*

**Fig. 1.** From left: Naos-sistrum and the term *sššt*, Temple of Seti I in Abydos; arched sistrum and the term *sḫm*, Temple of Hathor in Dendera; arched sistrum and the term *sššt*, Temple of Ramesses III in Medinet Habu (photo and elaboration by the author).

*levels of meaning. Sššt is always used for the sistrum when the actual function of the instrument is meant, that is, to make noise. It is not the name of any particular type. Sḫm, however, refers to the symbolic representations of the sistrum as 'a' sekhem of Hathor, and not to the sistrum as a musical instrument. A relief on the southern outer wall of the temple of Opet at Karnak shows a procession of Egyptians provinces: the 7th nome of Upper-Egypt, the nome of the goddess Bat, is depicted as an arched sistrum on a standard. The name hw.y sḫm designating this nome, is however, not to be read as 'The Mansion of the Sistrum', but as 'The Mansion of the sekhem'. The sekhem that is meant here is, of course, the goddess Bat, whose features appear from the Middle Kingdom onward on various Hathoric emblems such as the sistrum* (Reynders 1998, 1023–1024). A similar phenomenon occurred in the names of kings. The phonetically read hieroglyph representing the sistrum, Gardiner's symbol "Y8" (Allen 2001, 447), was part of royal names, e.g. Sekhemkhet, a king of the 3rd Dynasty, Sekhemrekhuitaui, aking of the 13th Dynasty (Schneider 2006, 286–288), Neferhotep I Khasekhemra (Fig. 3; Baines and Málek 1995, 37). The names of the latter can be translated: Neferhotep – the perfect one is satisfied, Khasekhemra – the power of Ra appears (Schneider 2006, 194).

Of course, there is a connection between the word *sḫm* and the sistrum, but there are quite a few examples where the word *sḫm* is written with determinative of the sistrum or *sekhem*-sceptre but the word itself does not mean sistrum (Reynders 1998, 1020). Whereas *sššt* refers to the noise made by this instrument, and that because of this *sšš.t* can be used to designate the sistrum itself, whatever the type. *Sššt* mostly appears in the fixed construction *ir(.t) sššt* "doing the

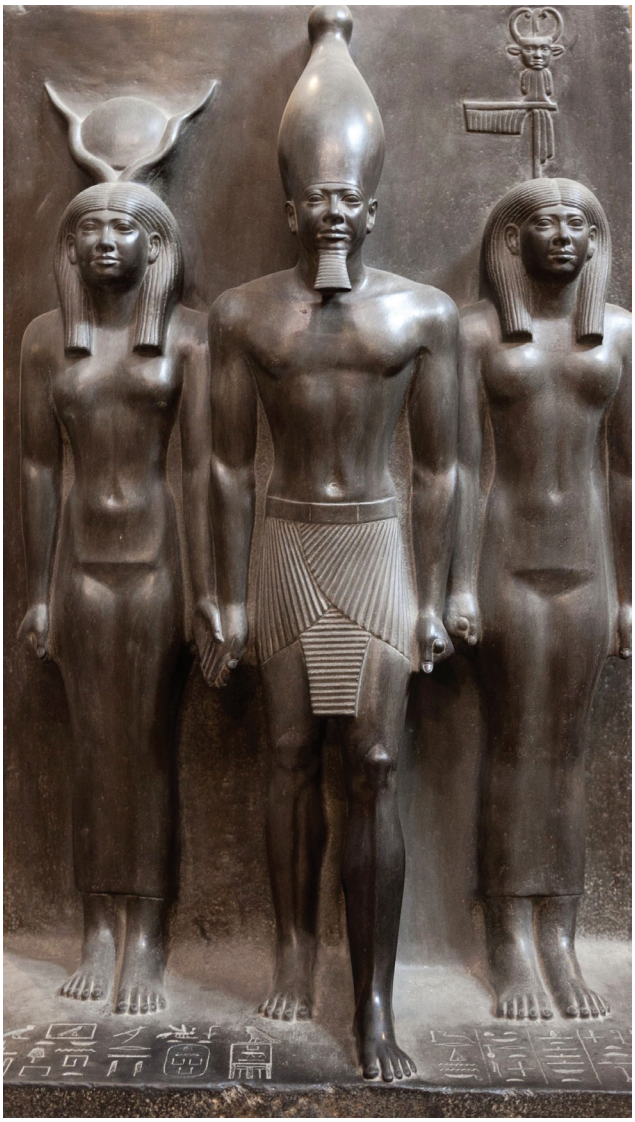

**Fig. 2.** Triad: King Menkaure positioned between two goddesses; to his right is the goddess Hathor, and to his left is the personification of the seventh nome of Upper Egypt, the goddess Bat, with the sistrum emblem (after: Baines and Málek 1995, 163).

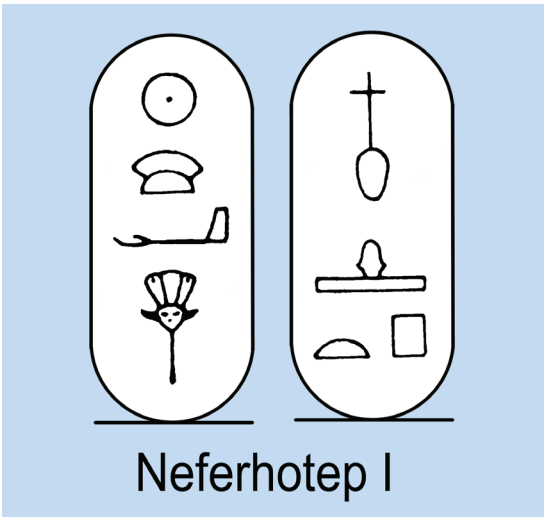


**Fig. 3.** Cartouches with the names of Neferhotep I Khasekhemra, containing Gardiner's symbol "Y8", the phonetically read hieroglyph representing sistrum (after: Baines and Málek 1995, 37).

shaking". The word *sššt* can be regarded as a participle form "that which is shaken", thus "the sistrum" (Reynders 1998, 1020).

The Ancient Egyptians sometimes used the term *iba* interchangeably for the arched sistrum. Evidence of this can be found in a fragment of text placed in the temple of Hathor in Dendera. The scene shows Hathor holding the naos-sistrum in her right hand and the arched sistrum in her left. Below the image there is an inscription: "*sššt* is in my right hand, *iba* is in my left hand" (Sachs 1921, 31). Scenes where the arched and naos-sistrum are in the hands of one person can also be found in other temples, e.g. in Edfu, at Philae or Luxor. They suggest of using both types at the same time.

## Sistrum as a rhythm maker

Sistra were commonly depicted in a few ways: in identical pairs – either the arched or naos-type (Ziegler 1984, 960) in pairs of a naos- and an arched sistrum, or an arched sistrum accompanied by a *menat*. The latter was very popular: the temple songstresses would often perform in groups of three or more, singing a hymn in praise of the god; they probably shook the sistra to divide the phrases of recitation. The sistrum's sound might be enhanced by the *menat*'s rattling, which the women carried in their hands rather than wearing (Manniche 1991, 63). These scenes were quite common during the New Kingdom and onward, with the rhythmic nature of the performance vividly conveyed here. One of such scenes was depicted on the wall of Hatshepsut's sanctuary in the temple of Amun at Karnak (Fig. 4), similar in Theban Tomb no. 82 of Amenemhat (Manniche 1991, 63), and another in the temple of Horus in Edfu (Fig. 4). Lise Manniche points out Apuleius' description of such procession in honour of Isis, where the carrying a sistrum shook it three times in succession. The authoress transcribed this into the rhythm (Fig. 5; Manniche 1991, 65).

As said above, the sistrum was a significant element of the Bat and Hathor cult. But its role did not end here, it was also related to the cult of other deities. The name of Hathor's son – Ihy was interpreted, among others, as a sistrum-player and also *who personified the jubilation associated with the use of the sacred instrument* (Wilkinson 2005, 132). Bastet, as a lioness goddess, since the Middle Kingdom was depicted as a cat or a woman with the head of a cat, often with a sistrum in her hand. The connection between the goddess and the sistrum was so strong that the instrument itself was often decorated with the image of a cat (Wilkinson 2005, 178). The cult of Bes had an equally strong sistrum association – the representation of the god was often placed on the handle of the instrument, e.g. richly decorated arched sistrum from the Roman Period, with the handle formed by a figure of the god Bes, who stands on an elaborate pedestal and whose headdress makes a sort of capital beneath the Hathor head (British Museum, EA6365). The sistrum was also an important element of the rituals of Isis and in the course of the spread of Isis worship in the late period, it reached Greece and Rome (Tsakalidou 2021, 28). It can generally be said that rhythm was essential to religious rituals and the sound of sistrum could calm the gods and increase their willingness to protect and help mankind (Teeter 2009, 25).

Music also appears to be accompanying everyday activities, giving rhythm to people's work, granting the requisite merriness to festivities or ensuring an appropriate tone at funerals or weddings. The iconography of the sistrum in tombs or temples shows it in the hands of not only the priestesses but also people of high status, including kings and queens who are seen playing the ritual sistrum in various religious contexts, regardless of whether it is arched or naos-shaped. Both men and women were performers and musicians, but their roles seemed to be distinct. The women would shake the symbols of Hathor, the beaded *menat* necklaces and the sistra while the men most likely sang and clapped the rhythm with them (Tsakalidou 2021, 36). On the wall of a Middle Kingdom tomb in Kom el-Hisn, the owner – Khesuwer is depicted giving girls lessons in playing the sistrum and hand clapping (Manniche 1991, 123; Yehia and Abdelhakim 2021,

**Fig. 4.** The arched sistrum accompanied by meant; above: the "red chapel" placed in the sanctuary of the Amun-Ra temple in Karnak, below: Horus temple in Edfu (photo and elaboration by the author).

**Fig. 5.** The rhythm of the sistrum transcribed by Lise Manniche (after: Manniche 1991, 65).

43). Unfortunately, the scenes depicted by painters or sculptors do not reflect any articulation details of the use of the sistrum, they do not allow us to fully reconstruct the gesture of shaking the instrument (Saura-Ziegelmeyer 2015, 224). According to some researchers, it is possible that the most skilled performers were able to achieve various tones through different articulation (Quiñoes de Leon 2015–2016, 202). Regardless of articulation, the scene depicting a lesson in playing the sistrum proves that singing accompanied by a sistrum was specialized knowledge in ritual music.

## Symbolism of the sistrum in Ancient Egypt

Musical instruments in Ancient Egypt can be found in contexts of a secular or religious nature. Among them, the sistrum has the biggest, specific sacred associations (Manniche 1991, 62). The main sacred sistrum connection, of course, was with Hathor. This association was so large that, as M. Reynders notes: *she was believed to be actually immanent in them so that those who touched or handled them would*

*be in direct contact with the deity itself* (Reynders 1998, 1020). This means that not only the sound of the sistrum had religious significance, but also the object itself. In fact, since the times of the Old Kingdom it was both an instrument and a votive object (Suddreth 2019, 8). Its symbolism may concern many aspects, starting with the name itself. Papyrus stems were traditionally hauled up and shaken in front of Hathor as part of a ritual. *Sššt*, the Egyptian word for sistrum, was the onomatopoeic term for the sound of a bundle of papyrus being shaken (Manniche 1991, 63).

Undoubtedly, the shape of the rattle and its decoration also had a votive significance. In most cases it was depiction of Hathor and other deities. Yet another symbolic feature may also have been the color of the instrument. Preserved examples of naos-sistrum are most often made of faience covered with blue or green glaze, which is reminiscent of turquoise, a material associated with Hathor (Manniche 2010, 13). It could be said that the sistra were manifestations of Hathor. In the Amarna period, it was used to establish the role of Nefertiti in the universe of Akhenaten as the unbroken fundamental concept of the origin of the world (Manniche 2010, 13).

Since it gained importance as a votive object, we can observe naos-sistrum occurring in various sizes, suggesting a non-musical use. Nehi, the viceroy of Kush during Thutmose III's reign, as depicted in a statue in the Nubian Museum in Aswan (Fig. 6: 1), is seen kneeling and holding a large naos-sistrum before him. The sistrum is definitely too big to be a real musical instrument. A similar depiction, identified as Kaemwaset Kneeling with an Emblem of Hathor, also dating to the New Kingdom, is in the Brooklyn Museum (Fig. 6: 2). A representation of the sistrum as a purely symbolic object can be also found in the mortuary temple of Ramesses III in Medinet Habu. In a procession of priests carrying various symbols, one priest holds a large naos-sistrum. Again – its size makes it too large to be a real rattle (Fig. 6: 3). The symbolic importance of these sistra is emphasized by the fact that they are shown without the bars or plates that acoustically make them musical instruments. All the more so because both are unusually large and the representation of holes or bars would not pose any technical difficulty. At the same time, representations of the arched sistrum have rods and often plates, even in the case of representations of relatively small size. In turn, two holes are located in the side walls of naos-sistrum tiny dimensions (Fig. 6: 4), made of grey-green, shiny faience, dated to the Late Period, currently in the collection of the National Museum in Krakow. The object is so small that it would be difficult to fit rods into its holes. It certainly couldn't have performed a sound function but is rather identified as an amulet figurine. The goddess Hathor was distinctly represented by the sistrum and this influenced the temple builders of the 18th dynasty. The columns of Hathor's temple at Dendera have the shape of the sistrum (Fig. 6: 5; Baines and Málek 1995, 113). Temples of other deities also used Hathoric column capitals, which seem to provide sound for the goddess in the afterlife.

The question remains unexplained: when the sistrum had a sound function, when it was only a votive object, and when it fulfilled both functions. Scientists differ in their opinions. A. Saura-Ziegelmeyer believes that it does not seem that the person holding the sistrum was a musician in the eyes of the Ancients (Saura-Ziegelmeyer 2015, 229). Some authors consider only the naos-sistrum to not have been a musical instrument. M. Reynders points out that although the lack of metal rods in the preserved specimens of naos-sistrum and their representations does not determine the purely symbolic function of these objects, but it may testify to it (Reynders 1998, 1013). R. Suddreth explains that the earliest sistra, which were the naos type, were exclusively votive and symbolic in nature, whereas arched sistra were meant almost exclusively as musical instruments. The author explains the reason for this division by the fact that metal is less fragile and more acoustically pleasing than the faience (Suddreth 2019, 9–10). L. Manniche likewise represents a similar viewpoint: acoustically the sistrum, especially when made of faience, would have been less impressive than other musical instruments (Manniche 1991, 63), as she notes: neither on the Karnak blocks, nor in the two representations in the ka-room of Amenophis III in Luxor Temple, nor in the contemporary tomb of Kheruef do we see metal rods and disks which would produce the tinkling sound. This encouraged her to advance some further conclusions, namely that *the symbolic significance of the objects surpasses its musical properties* (Manniche 2010, 19).

On the other hand, from the Old Kingdom onward, the sistrum is known from the depictions where sistrum players along with dancers and singers are shown performing during funeral processions at the entrance to the tomb. Such a well-preserved scene decorates Niunetjer's tomb at Giza (Spencer 2003, 115). The figures carrying the sistra are moving and shaking them, but the representations of the instruments are again devoid of metal rods. Whereas the traces of verdigris indicating the presence of rods, are found on the holes in the


**Fig. 6.** 1 – Nehi, the viceroy of Kush during Thutmose III's reign, kneeling and holding the large naos-sistrum before him, the Nubian Museum in Aswan (photo by the author); 2 – Kaemwaset Kneeling with an Emblem of Hathor, dating to the New Kingdom, the Brooklyn Museum (after: https://www.brooklynmuseum.org/opencollection/objects/100541, access: 29.07.2024); 3 – Procession of priests carrying various symbols, including a large naos-sistrum, mortuary temple of Ramesses III in Medinet Habu (photo by the author); 4 – Amulet naos-sistrum, made of grey-green, shiny faience, dated to the Late Period, currently in the collection of the National Museum in Krakow (MNK XI-A-370, after: Tatoń 2013, fot. 27); 5 – Hathoric column capitals, Hathor temple at Dendera (photo by the author).

walls of the alabaster sistrum described above, with the Names of King Teti. This rattle may actually have been used for sound purposes (https://www.metmuseum.org/art/collection/search/543897).

The most questionable is the sound function of the naos-sistrum. Researchers most often point to the low acoustic attractiveness of instruments made of fired clay. Is this really the case? Could a faience rattle make a sound comparable to that of its metal counterpart? The answer lies in an in-depth acoustic analysis.

## The acoustic characteristic of the sistrum

The sound of a sistrum is not completely unknown to us since we can hear it thanks to modern instruments as well as replicas – today's researchers often turn to experimental methods. Building replicas and recreating the sound of the Egyptian instruments from the Roman period such as sistra was implemented, e.g. by the research project: The European Music Archaeology Project (Both 2019, 428). Increasingly,

scientists are also paying attention to acoustic properties, e.g. Heidi Köpp-Junk examined the acoustic conditions at various music venues. During the research she took acoustic measurements of the replicas of Egyptian instruments and modern equivalents, including the sistrum (Köpp-Junk 2020, 23).

Generally, idiophones, such as sistrum, are featured by an impulsive character of excitation. When shaken, the frame itself, the rods, and the sounding plates vibrate. The nature of the sound we hear when shaking an instrument depends on its material coefficients, such as density, elasticity and damping (Czajka 2021, 129). The impacts of moving elements – rods against frame walls as well as plates against rods or frame walls, and each other, are stochastic in nature. Two similarly performed shakes of the rattle can produce different sounds (Gruszczyńska-Ziółkowska and Tatoń 2021, 104). The amplitude-frequency spectrum of an impulse is very wide, and the shorter the duration of such an impulse, the wider it is. Thanks to this, objects stimulated by impulses can vibrate at very high frequencies (Czajka 2021, 135).

The spectral analysis of the sounds of small idiophones, carried out so far, has shown the individual character of the sound of each object. Their spectra most often have features typical of multifarious sound: the narrower enhanced areas, like lines or bundles, are clearly visible against the background of the wide noise (Drobner 1973, 54). They differ in the range of excited frequencies, formant areas, number of important components – partials, and their distribution in the spectrum. Of course, some of these differences can be explained by the different conditions for sound recording. Therefore, when examining different rattles, it is important to use the same devices – recorder and microphones, organize similar recording conditions, and use exactly the same articulation when producing sound (Tatoń 2021, 73–74). During this research, the sound was recorded using a set consisting of the sensitive, broadband microphone Peluso CEMC-6, and a Zoom H4N pro recorder. The recordings were made at a sampling frequency of 96 kHz, each sample saved as a binary number with a length of 24 bits. The recorded signals were edited using the Audacity audio editor. Two sistra were constructed for the acoustic tests: a brass arched sistrum with a hollow handle and a naos-sistrum made of fired clay, covered with glaze. Their sound was recorded in several stages:

– frames without transverse rods,
– sistra with brass rods in place,
– sistra with brass rods and stainless steel tambourine sounding plates,
– sistra with brass rods and brass tambourine sounding plates.

The brass sistrum frame, without metal rods (Fig. 7), produces the not-very-loud sound when struck with the brass bar. Its timbre can be described as bright, bland, and tinkling. The range of excited frequencies covers the wide band from 100 to 25,000 Hz. The partials at 1300, 2500, 3900, 5000, 5800, 8200, and 9200 Hz are clearly distinguished from the background noise. Additionally, the enhanced area is demonstrated in the zone of higher frequencies, close to the limit of human hearing, at the level of 17,600 and 18,400 Hz. The amplified bands are characterized by the significantly longer decay phase than the noise. The average duration of the noise of a single shake is 0.3 s, the decay of partials is 0.5 s. The lowest amplified band, 1300 Hz, has the longest decay time, approx. 3 s. It determines the pitch of the sound we can hear – E6.

Observation of commonly used idiophones shows that not only metal has the parameters that enable it to produce what we could call a "metallic" sound. Other materials, sometimes not very obvious, have similar properties, e.g. stone, wood or ceramics. This is proven by idiophones with a specific pitch, which are made of them. Lithophones are known, among others, in the form of xylophone bars, but not only. Their sonority is as good as others. Xylophone, marimba bars and other percussion sticks or acoustic boxes are made of appropriate types of wood. Fired clay can be used as a material for constructing, e.g. bells. All of them are characterized by a clear sound and although their spectra do not have a steady phase of the sound, the phases of build-up and decay are easy to spot. The frame of the naos-sistrum constructed for present tests was made of chamotte clay, subjected to the so-called biscuit firing at the temperature of 800 degrees Celsius. Then the frame was glazed and fired again at a temperature of 1,200 degrees Celsius. The sound spectrum of the frame made in this way is quite similar to the sound spectrum of the brass frame (Fig. 7) but the sound seems less resonant. Bands of amplified unharmonic components stand out in a wide noise background: 1400, 2800, 3800, 5600, 6850, 7400, 11850 Hz. The overall range of excited frequencies is slightly narrower, limited to 25,000 Hz. Unlike the sound of a brass frame, in the sound spectrum of a ceramic frame, no significant component is distinguished by its decay length. All of them take about 0.5 s, while the decay time of the noise is 0.3 s. The lowest partial gives the impression of the F6 sound. So, we can say that the ceramic frame is tuned half a tone higher than the brass frame. However, the human ear cannot distin-

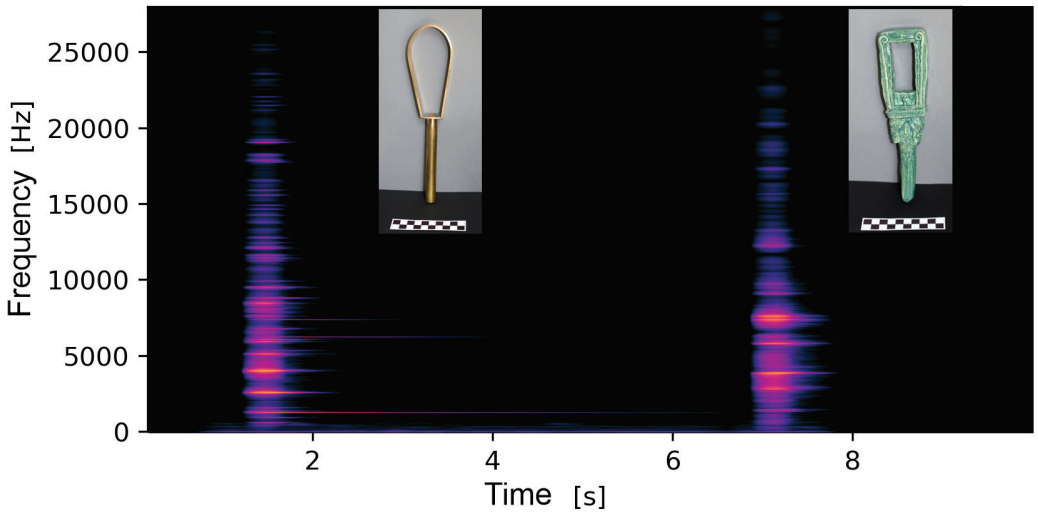


**Fig. 7.** Comparison of the spectrograms of the sounds of sistrum frames excited by a brass rod; left: brass frame, right: ceramic frame (recording, photo and elaboration by the author).

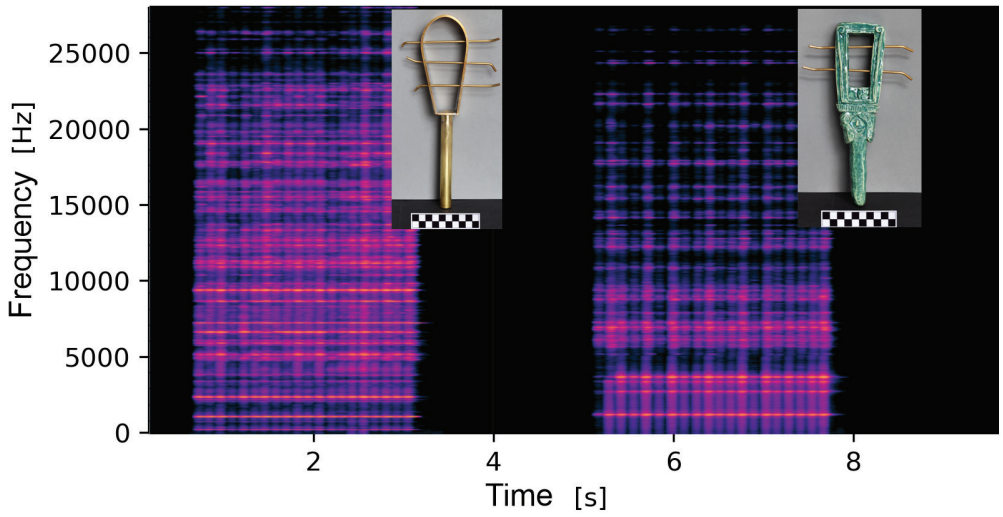


**Fig. 8.** Comparison of the spectrograms of sounds of sistra equipped with brass rods; left: brass sistrum, right: ceramic sistrum (recording, photo and elaboration by the author).

guish such differences precisely in the idiophone with a range of such high frequencies.

The differences between the sounds of analysed instruments deepened in the audible assessment when they were equipped with brass rods. Both spectra were highly noisy (Fig. 8). Again, the range of frequencies excited is wider in the case of the brass sistrum, but the difference includes ultrasonic frequencies that are actually beyond the limit of human hearing. Both spectrograms show an increased number of partials. The sound spectrum of metal sistrum has many more, densely distributed, narrow, amplified frequency bands. Its sound became clearly lower than the sound of the ceramic instrument – the partial at the level of 500 Hz appeared (note B4). The sound spectrum of the ceramic sistrum is poorer. Regardless of the pitch and number of frequency bands amplified, both rattles produced a pretty loud, bright, metallic sound.

Placing stainless steel sounding plates on the rods caused radical changes in the sound spectra of both sistra (Fig. 9). While the sound of the frames equipped with rods can rather be called noise, the presence of plates causes the appearance of the few very clearly cut-off partials. In the case of the metal sistrum sound spectrum, three significant component areas can generally be distinguished: 4000–9700, 10900–12600 and 16500–19200 Hz. In addition, the partials with the greatest amplitude value, creating the formant: 6500 and 9200 Hz, and the bands at 1200, 2500 Hz, respon-

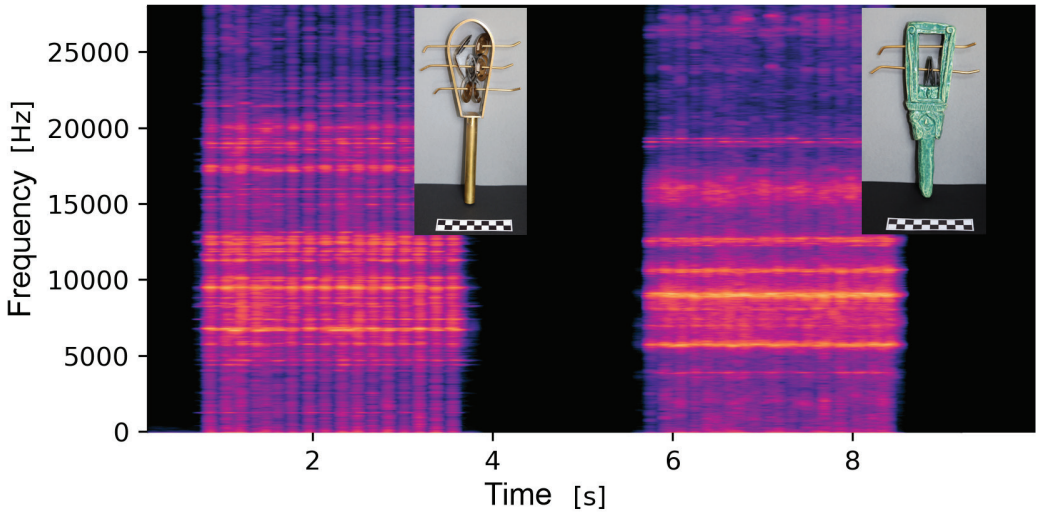


**Fig. 9.** Comparison of sound spectrograms of sistra equipped with brass rods and stainless steel sounding plates; left: brass sistrum, right: ceramic sistrum (recording, photo and elaboration by the author).

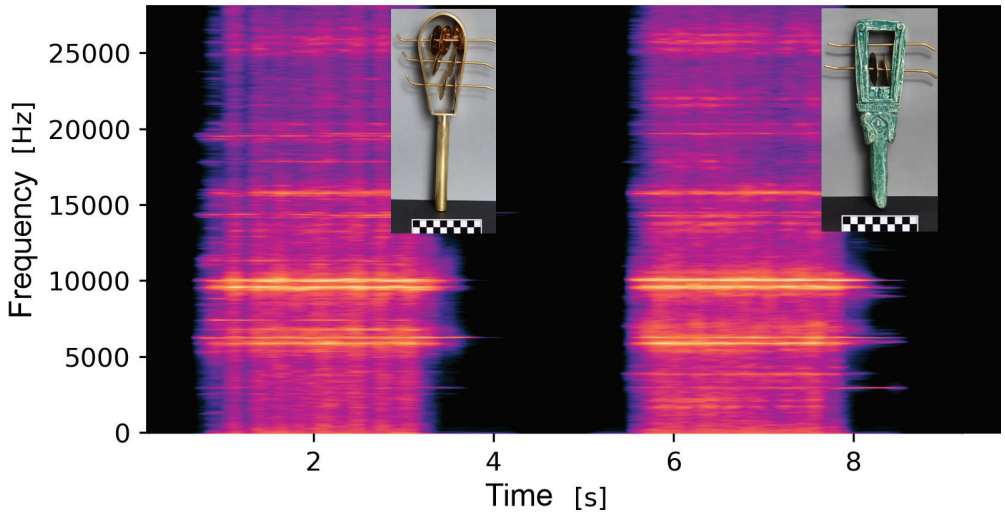


**Fig. 10.** Comparison of sound spectrograms of sistra equipped with brass rods and brass sounding plates; left: brass sistrum, right: ceramic sistrum (recording, photo and elaboration by the author).

sible for low tuning can be seen. The sound spectrum of the ceramic sistrum contains three distinct bands of frequencies at 5500, 8700 and 10300 Hz, with the middle one having the highest amplitude and constituting the formant. In addition, the spectrum contains two similar bundles of partials in the areas of 11900–12400 and 18000–18500 Hz, and the wide band of amplified noise in the range of 14000–16000 Hz. The band at 3700 Hz is probably responsible for the impression of pitch. Generally, both spectra became very similar, and the sound of both instruments became loud, expressive tinkling, and sharp. Although the ceramic sistrum again seems to be tuned higher, their sound is very similar in perception.

Even more amazing results were obtained by swapping out the stainless steel sounding plates for brass ones, which have better acoustic characteristics (Fig. 10). Now both sistra produced a very loud, bright, and sharp sound, with a very sonorous timbre. Despite the difference in the number of sounding plates – it was only possible to hang two in the ceramic sistrum – no noticeable discrepancies are found in the auditive evaluation. Their spectrograms also look almost identical. Narrow bands with the greatest amplification are initially apparent. In both spectrograms there are two areas with two bands, including formant: 5700 + 6050 Hz and 9200 + 9700 Hz. Background noise is more amplified than previously. The partials' decay time is

also significantly longer than before, up to 3 s. This type of construction gives both brass and ceramic sistrum a very resonant sound that is likely to be discernible even at long distances.

In order to measure the objective loudness, the sounds of both instruments were recorded in a small anechoic chamber at the Department of Mechanics and Vibroacoustics of the AGH University of Kraków. The chamber is a cube with the outer edge of 10 m, which gives the internal volume of about 1000 m3. The temperature was 26 degrees Celsius. During the recordings, measurements were also taken using a sound level meter. The amplitude spectrum shows the intensity of individual partials, not the entire signal. It is not possible to draw conclusions on the loudness of the sound tool on this basis. Without calibration of the measurement path, it is impossible to determine the relationship between the unit of the signal value and the sound pressure, but only to determine the share of individual frequencies amplified in a given signal. Therefore, the sound pressure level was measured by a Svantek Svan 948 device. Instruments were measured at a distance of 1 m. As a result, the volume of the metal sistrum was achieved at a level of 96–99 dB and that of the ceramic sistrum at a level of 92–96 dB, using different methods of excitation of the instruments. This result is higher than that obtained by H. Köpp-Junk in her research (Köpp-Junk 2020, 23), but the conditions of measurements were different and the results are difficult to compare. However, the aim of this study was to assess the acoustic parameters of a fired clay sistrum. Therefore, the sound of the instrument with a ceramic frame was compared to its metal frame counterpart. The recording was based on tests conducted under exactly the same conditions – force and manner of shaking, distance from the microphone, etc.

## Conclusions

The sistrum is an instrument from the percussion family, a type of tinkle. It is an object with a wide range of possible uses. Its simple construction means that the sound could be produced by anyone just by shaking it, with no special training required. Perhaps for this reason, the sistrum enjoyed tremendous popularity in Ancient Egypt. The metal form of the rattle, also known from other areas, was adopted here with great success. However, a form not known elsewhere was developed in Egypt – the faience naos-sistrum, characteristic of Egyptian art. There is evidence of the use of the sistrum there at least since the Old Kingdom. It was most often used in cult rites associated with deities, mainly Hathor, and Isis in the late period. The popularity of the rattle moved along with the cult of the latter to the world of ancient Greece and Rome.

As can be seen from superficial observations, the sistrum may produce both a bland, dull sound, which is in fact a kind of noise or a clear and deep timbre similar to the sound of a bell, with a multitone spectrum, extended decay phase, and a small share of noise. Depending on social demand, the tool could be constructed so that its sound had the desired voice. As preliminary research has shown, the frame of an instrument and its handle, including a material from which they are made, significantly affect its acoustic properties but they are not decisive. It seems that the character of the sound of the sistrum depends directly on its movable elements – rods and sounding plates and their acoustic features. Transverse bars and sounding plates determine the sonority of the entire instrument. This hypothesis was only constructed on the basis of initial research, and of course, requires confirmation in the course of in-depth, more detailed analyses. Many of the questions remain unanswered, and others are only beginning to surface. The first concerns the proportion of the acoustic features of all structural elements in the sound spectrum. What effect does the material used have on the spectrum, and what effect does the shape of individual parts of the instrument have? Further research should be extended to include the construction of faithful replicas of specific instruments. Another direction of research should be the numerical reconstruction of both individual examples of the sistrum and its sound, which has proven fruitful in the case of research on other small idiophones of Antiquity.

Undoubtedly, due to its simple construction and considerable acoustic potential, the sistrum could perform a multitude of functions, being well suited for both musical and non-musical purposes. Even its musical use could vary, since the sistrum could serve as a rhythmic accompaniment for dancing or marching or as a means of attracting the attention of the goddess and the procession participants. Depending on the movable elements used, it could produce a quieter or more resonant sound. It was suitable for use both indoors and during outdoor ceremonies. It could be shaken by non-musicians, and at the same time, professional rhythmic effects could be obtained with its use. It is worth mentioning that only advanced player could achieve a very sophisticated and spectacular sound. In addition to their inherent acoustic characteristics, materials could also be thought of as parts

and symbols of functional and votive roles. Certainly, the function of the sistrum in Ancient Egypt was variable, and not only over time.

Finally, perhaps we still do not know whether the naos-sistrum was voiced or silent. However, we can say with certainty that, in terms of its acoustic possibilities, the faience sistrum was no less attractive than its metal counterparts. If the naos-sistrum was used for non-musical purposes, it was due to factors other than the sound properties of the fired clay.

## References


Allen J. P. 2001. *Middle Egyptian. An Introduction to the Language and Culture of Hieroglyphs*. Cambridge: Cambridge University Press.

Baines J. and Málek J. 1995. *Egipt* (= *Wielkie Kultury Świata*), trans. T. Derda. Warszawa: Wydawnictwo Penta.

Both A. A. 2019. Archaeomusica – making the past audible. *The Museum Journal* 62(3), 425–437.

Czajka I. 2021. Odzyskać zamilkłe brzmienia: o numerycznej syntezie dźwięku grzechotek ceramicznych. In A. Gruszczyńska-Ziółkowska (ed.), *Wydobyte z ciszy*. Warszawa: Instytut Muzykologii Uniwersytetu Warszawskiego, Muzeum Uniwersytetu Warszawskiego, Fundacja Varia, 129–144.

Drobner M. 1973. *Akustyka muzyczna*. Kraków: Polskie Wydawnictwo Muzyczne.

Fischer H. G. 1962. The Cult and Nome of the Goddess Bat. *Journal of the American Research Center in Egypt* 1, 7–18.

Gruszczyńska-Ziółkowska A. and Tatoń K. 2021. Tajemnice dźwięku „pisanki". In A. Gruszczyńska-Ziółkowska (ed.), *Wydobyte z ciszy*. Warszawa: Instytut Muzykologii Uniwersytetu Warszawskiego, Muzeum Uniwersytetu Warszawskiego, Fundacja Varia, 95–128.

Hickmann H. 1962. *Musikgeschichte in Bildern*, 2: *Musik des Altertums*, 1: *Aegypten*. Leipzig: VEB Deutscher Verlag für Musik.

Köpp-Junk H. 2020. The Sound of Ancient Egypt – Acoustics and Volume Measurements. *ARS INTER CULTURAS* 9, 13–33. DOI: 10.34858/AIC.9.2020.327

Manniche L. 1991. *Music and Musicians in Ancient Egypt*. London: British Museum Press.

Manniche L. 2010. The cultic significance of the sistrum in the Amarna period. In A. Woods, A. McFarlane and S. Binder (eds.), *The Egyptian Culture and Society. Studies in honour of Naguib Kanawati*, 2. Le Caire: Publications du Conseil Suprême des Antiquités de l Égypte, 13–26.

*MIMO Consortium* = Revision of the Hornbostel-Sachs Classification of Musical Instruments by the MIMO Consortium, 08.07.2011 (http://www.mimo-international.com/documents/hornbostel%20sachs.pdf, access: 10.07.2023).

Pawlicki F. 1974. Egipskie sistra. *Rocznik Muzeum Narodowego w Warszawie* 18, 7–21.

Quiñoes de Leon M. S. M. 2015–2016. El Sistro: el sonido de Egypto en Creta. *ISIMU* 18–19: *De Egipto y otras tierras lejanas. Covadonga Sevilla Cueva in memoriam*, 201–216. DOI: 10.15366/isimu2015-2016.18-19

Reynders M. 1998. Sšš.t and shm: Names and Types of the Egyptian Sistrum. In W. Clarysse, A. Schoors and H. Willems (eds.), *Egyptian religion. The last thousand years. Studies dedicated to the memory of Jan Quaegebeur*, 2 (= *Orientalia Lovaniensia Analecta* 85). Leuven: Peeters Publishers, 1013–1026.

Sachs C. 1921. *Die Musikinstrumente des Alten Agyptens*. Berlin: K. Curtius.

Sachs C. 1940. *The History of Musical Instruments*. New York: W.W. Norton & Company Inc.

Saura-Ziegelmeyer A. 2015. Agiter le sistre pour la déesse: reconstituer la production sonore d'un idiophone. *Sons et audition dans l'Antiquité* 98/2015, 215–235. DOI: 10.4000/pallas.2753

Schneider T. 2006. *Leksykon Faraonów*, trans. R. Darda. Warszawa: Wydawnictwo Naukowe PWN.

Spencer B. 2003. Dance in the Ancient Egypt. *Near Eastern Archaeology* 66(3), 111–121.

Suddreth R. J. 2019. A Study of the Loop Sistrum (Accession Number: 1994.4.26) at the University of Memphis, manuscript of the thesis in the archive of the University of Memphis, Electronic Theses and Dissertations. 1977 (https://digitalcommons.memphis.edu/etd/1977, access: 10.07.2024).

Tatoń K. 2013. *Archeologia Muzyki. Starożytny Egipt*. Bielsko-Biała: Antenor.

Tatoń K. 2021. Grzechotki archeologiczne porządkowane dźwiękiem. In A. Gruszczyńska-Ziółkowska (ed.), *Wydobyte z ciszy*. Warszawa: Instytut Muzykologii Uniwersytetu Warszawskiego, Muzeum Uniwersytetu Warszawskiego, Fundacja Varia, 61–94.

Tatoń K. and Czajka I. 2021. The Rattles from Tell El-Farcha. Acoustic Research with the Use of Numerical Sound Reconstruction. *Studies In Ancient Art And Civilization* 25, 7–30.

Teeter E. 2009. Inside the Temple. The Role and Function of Temple Singers. In E. Teeter and J. H. Johnson (eds.), *The Life of Meresamun. A Temple Singer in Ancient Egypt*. Chicago: The Oriental Institute of the University of Chicago, 25–29.

Tsakalidou A. 2021. Music and Egyptian cult: another aspect to communicate with the gods, manuscript of the postgraduate thesis in the archive of the University of the Aegean, Department of Mediterranean Studies, Rhodes (https://hellanicus.lib.aegean.gr/handle/11610/22726, access: 29.07.2024).

Wilkinson R. H. 2005. *The Complete Gods and Goddesses of Ancient Egypt*. Cairo: The American University in Cairo Press.

Yehia E. F. and Abdelhakim W. M. 2021. Solo Singing Etiquette for Women in Ancient and Modern Egypt. *Athens Journal of History* 7, 41–70.

Ziegler C. 1984. Sistrum. In W. Helck and E. Otto (eds.), *Lexikon der Ägyptologie*, 5: *Pyramidenbau–Steingefässe*. Wiesbaden: Harrassowitz Verlag, 959–963.

www.metmuseum.org, access: 29.07.2024

www.britishmuseum.org, access: 29.07.2024

FUNDACJA
RZESZOWSKIEGO OŚRODKA
ARCHEOLOGICZNEGO

Uniwersytet Rzeszowski
Kolegium Nauk Humanistycznych
Instytut Archeologii

Wydawnictwo Uniwersytetu Rzeszowskiego