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The Oxus Auloi: Research Background, Organological Introduction and Catalogue

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Abstract

Although the aulos was one of the most important musical instruments of the ancient Graeco-Roman world and has a rich history of research, certain significant archaeological finds have only recently become the subject of extensive music-archaeological study. This article, together with Gunvor Lindström's and Stefan Hagel's contributions in this volume, present the results of the latest research carried out on an exceptional set of Hellenistic wind instrument fragments from the Oxus temple in Takht-i Sangin, Tajikistan. This contribution gives a summary of the previous and current research on the Oxus find, as well as an introduction to constructional aspects, including a classification of the preserved instrumental sections. It also provides a complete catalogue of all individual Oxus fragments with photographic documentation, detailed measurements, and a brief description.

Keywords

Aulos – Organology – Musical technology – Bactria – Hellenism

1 Research History and Background

1.1 Study of the originals

My personal journey with the Oxus auloi started in 2010 in Mannheim, Germany,[1] where eight fragments were displayed in the temporary exhibition *Alexander the Great and the Opening of the World* at the Reiss-Engelhorn-Museen.[2] Thanks to the director of the National Museum of Antiquities of Ta-

[1] For the research background before that time, see G. Lindström's contribution to this volume.

[2] The exhibition *Alexander der Große und die Öffnung der Welt: Asiens Kulturen im Wandel*, curated by Nicola Crüsemann and Gunvor Lindström, was running at the Reiss-Engelhorn-Museen Mannheim, Germany from October 2009 to February 2010, before moving to Leoben, Austria (from March to November 2010), and Madrid (from December 2010 to Mai 2011).

jikistan, Saidmurod Bobomulloev, and support of the staff of the Reiss-Engelhorn-Museen, I was allowed to study those fragments without the need for lengthy travel to Tajikistan. During this study, Mr. Bobomulloev informed me about the existence of many other fragments which had also been retrieved from the Oxus temple. However, I was unaware of the work which had been done already in 2004 by archaeologist Gunvor Lindström (German Archaeological Institute, Berlin).[3] Only several years later, in 2018, we came into contact, and Gunvor Lindström generously shared her entire unpublished documentation of all 43 Oxus bone pipe fragments (technical drawings and photographic documentation). In the same year, a detailed study of the Oxus auloi had been envisaged as one of the core parts of Stefan Hagel's research project "Ancient Music Beyond Hellenisation", funded by an ERC Advanced Grant and conducted at the Austrian Archaeological Institute of the Austrian Academy of Sciences in Vienna.[4] In the course of this project, we reviewed the existing research on the fragments and carried out a comprehensive music-archaeological study of all the original objects, now stored in two different museums in Dushanbe, Tajikistan.[5] However, this undertaking had to overcome a few obstacles.

At first, the organisation of the study itself was a challenge, as it required institutional involvement on the level of foreign affairs. It was possible to arrange this only thanks to the experience of Gunvor Lindström, who has been carrying out professional archaeological research on the Oxus temple for more than two decades. Originally, a research trip for a team, composed of Stefan Hagel, Moisés Hernandez Cordero, Gunvor Lindström and myself, was planned for March/April 2020, but the journey had to be cancelled due to the outbreak of Covid-19. In that situation, the team was forced to continue the study without accesses to the original items, basically using the available data collected previously by Lindström and myself, in addition to the previously published works.[6]

The next opportunity to carry out the study on the originals occurred only two years later, in 2022. Unfortunately, another obstacle arose due to international events. Shortly before the planned field trip to Dushanbe, the Russian invasion of Ukraine took place. As a consequence, completing the research on the originals of the Oxus auloi had to be carried out by a reduced research team, composed of Gunvor Lindström and Stefan Hagel.

1.2 Timeline

1983–1984	Discovery of the Oxus auloi by Igor Pichikyan as part of the Southern Tajik Archaeological Expedition led by Boris Litvinsky.
1999	1st publication by B. Litvinsky: *Greek flutes (auloi) in Central Asia* in: Acta Iranica 34, 517–543 (Litvinsky 1999: text in Russian with an English summary), with drawings on pp.521–8.

[3] See G. Linström's contribution in this volume.
[4] ERC-ADG Nr. 787522 – AMBH, https://cordis.europa.eu/project/id/787522.
[5] National Museum of Antiquities of Tajikistan and National Museum of Tajikistan.
[6] For a report of that event and the following steps within the project during the pandemic, see a brief report posted on a blog of the Eurasian Department of the German Archaeological Institute (Hagel et al. 2021).

2001 Some of the fragments, now cleaned and treated, are on display at the National Museum of Antiquities of Tajikistan in Dushanbe.

2004 G. Lindström studies the pieces, producing measurements, technical drawings and photographic documentation of 43 fragments (001–043).

2006 2nd publication by B. Litvinsky: *Hellenic melodies on the banks of the Oxus – Greek flutes (auloi) in Central Asia*, in: Memoirs of the Oriental Department of the Russian Archaeological Society. New Series. Volume 2 (27) – Saint Petersburg: «Petersburg Oriental Studies», 444–495 (Litvinsky 2006: text in Russian).

2010 3rd publication by B. Litvinsky: *The temple of Oxus in Bactria (Southern Tajikistan). 3: Art, fine art, musical instruments*, Moscow, 424–441, plates 86–96 (Litvinsky 2010: text in Russian).

February 23: O. Sutkowska studies and measures eight fragments (004, 009, 019, 024, 026, 033, 038, 039) displayed at the exhibition *Alexander der Große und die Öffnung der Welt* in Reiß-Engelhorn-Museen Mannheim.

Five of the fragments are transferred from the National Museum of Antiquities of Tajikistan to the National Museum of Tajikistan, both in Dushanbe (009, 012, 019, 040, 041).

2021 March 17: Online lecture: *The Oxus Auloi and their Relation to Greek Music* held by S. Hagel, G. Lindström and O. Sutkowska within the lecture series of the *Hellenistic Central Asia Research Network* (HCARN).

Hagel, Lindström, and Sutkowska: *Virtuelle Musikarchäologie trotz Reisebeschränkung*, on the blog "Archaeology in Eurasia", 21st of June (Hagel et al. 2021).

2022 March 31 – April 10: Examination and documentation, including photogrammetry, of all pieces, conducted by S. Hagel and G. Lindström.

2023 Hagel, Lindström, and Sutkowska: *Griechische Musikinstrumente (auloí) aus dem Oxos-Tempel in Takht-i Sangin. Die Arbeiten des Jahres 2022*. In: e-Forschungsberichte vom Deutschen Archäologischen Institut, Faszikel 1 (Hagel et al. 2023).

Lindström, Hagel, and Sutkowska: *Греческие музыкальные инструменты (авлосы) из храма Окса на городище Тахти Сангин*, in: Historian, Bd. 1 (33) (Lindström et al. 2023: Russian translation by Marina Hilliger of the 2nd AMBH-contribution above).

October 4: S. Hagel adds 3D-printed reconstructions of the five pieces that had been transferred to the National Museum of Tajikistan to the display in the National Museum of Antiquities, Dushanbe.

October 5: Presentation by G. Lindström and S. Hagel: *Greek Musical Instruments from the Temple of the Oxus at the Site of Takht-i Sangin*, at the Takht-i Sangin Conference in Dushanbe.

October 6: A first working model of an instrument reconstructed from the fragments, printed in 3D, was played by S. Hagel at the site of the Oxus Temple.

2024 Chrēstos Terzēs completes a playable reconstruction of an instrument in artificial ivory and copper alloy.

1.3 Publications before 2020

The Oxus auloi had been already published by Boris Litvinsky, the excavator of the instruments.[7] There are several variants of Litvinsky's publications and in order to avoid errors and confusion they require separate attention. For a long time, the English summary of Litvinsky's first publication from 1999 was the only widely accessible source of knowledge on the Oxus auloi. The publications from 2006 and 2010 were published in Russia and written in Russian, and before meeting Gunvor Lindström we were not even aware that they existed. These two articles are almost identical, with only a few subtle differences, such as slight terminological changes or, in the 2010 version, some corrections and two additional photographs of selected fragments.[8] Both publications contain a catalogue of the fragments with descriptions and basic measurements. In Litvinsky's catalogues from 2006 and 2010, six unlocatable items are listed in addition to the 43 bone fragments that can currently be located. Four of them have received separate entries in the catalogue in Chapter 3 below (044–047), while the remaining two, which Litvinsky appends to his list under the captions "unnumbered 1" and "unnumbered 2", are almost certainly duplicate entries of items 005 and 009+043, respectively.

Apart from Litvinsky's publications, there is an unpublished German translation of still another slightly different version, at least regarding the numbering of the illustrations. The translation was made by Anjelina Drujinina, having been commissioned by renowned music-archaeologist and former director of the Orient Department of the German Archaeological Institute, Ricardo Eichmann, who intended to publish the Oxus fragments in German and thus give them more visibility in music-archaeological circles. While this publication never came to fruition, we are immensely grateful to Ricardo Eichmann for sharing the manuscript, which proved extremely useful for our research, since neither Stefan Hagel nor myself is acquainted with the Russian language.

As previously mentioned, the Project *Ancient Music Beyond Hellenisation* at the Austrian Academy of Sciences in Vienna has established an opportunity for a thorough music-archaeological study on the Oxus fragments. Some preliminary results of this research have already been published.[9] The present contributions by Gunvor Lindström, Stefan Hagel, and myself now constitute an inclusive publication of our results, giving this incredibly important Hellenistic find the prominence it deserves in ancient doublepipe studies.

[7] Litvinsky 1999; Litvinsky 2006; Litvinsky 2010.

[8] Litvinsky 2010: Рис. 92.

[9] Hagel et al. 2021; Hagel et al. 2023; Lindström et al. 2023 – which basically forms the Russian translation of the original German text published online as part of the reports of the German Archaeological Institute (Hagel et al. 2023).

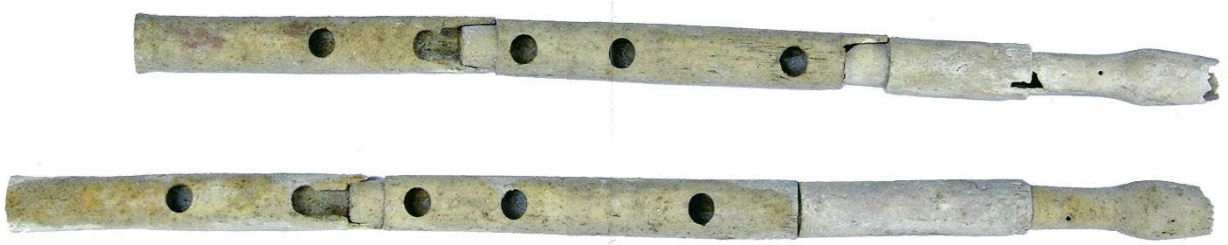


Figure 1: Paestum/Poseidonia auloi, 5th century BCE: an almost entirely preserved auloi. Each pipe consists of four individual sections connected by a spigot and socket: broken parts reveal internal joints. Photo: Paul J. & Barbara Reichlin-Moser (Reichlin-Moser and Reichlin-Moser 2011: 12–13).

2 Organological Introduction

2.1 Classification of the Oxus fragments of wind instruments: section types

Most of the fragments of wind instruments found in the Oxus temple in Tacht-i Sangin belong to auloi-like instruments – the ancient Greek doublepipes with double reeds. Nevertheless, there are a few pieces which most probably belonged to an ancient wind instrument of a different type, presumably a straight trumpet (*sálpinx*: 004, 011, 016, 027?).[10] All of the Oxus fragments are made of bone and only a few are additionally equipped with some metal elements of different shapes and functions. Those are either parts of a mechanism for closing and opening of the bass toneholes (033, 034, 051) or reinforcements of the connection between two individual instrument sections (005, 006, 016, 030, 032).

The Oxus auloi are preserved only in fragments, but fortunately there are other archaeological auloi finds excavated as entire pipes, so that we do have well-founded evidence for the construction of a complete instrument and its basic features. In the archaeological record, there are a few auloi made of bone which are preserved as (almost) entire instruments. The most contemporary and the ones comparable in terms of construction to the Oxus find are the two Hellenistic Megara auloi from the first quarter of the third century BCE.[11] But also the earlier complete auloi finds made of bone, such as those excavated at Paestum/Poseidonia (Figure 1) and Pydna from the fifth and fourth centuries BCE, are a valuable source of knowledge on the construction features of bone auloi.[12]

As the length of the available bones for auloi production is naturally limited – generally, the instruments were made out of the metatarsals of animals such as deer, sheep or donkeys – the auloi pipe had to inevitably comprise several sections connected by a so-called spigot-socket-joint (Figure 1). This type of connection between the individual sections of a wind instrument is also very common in modern times.

[10] Fragments 004, 011, 016 especially stand out with their significantly larger external and internal diameters. Whereas most of the auloi parts have an external diameter of about 18 mm, that of those fragments ranges between 22 and 23 mm. On the salpinx, see West 1992: 118–21 and Holmes 2024.

[11] Terzēs and Hagel 2022.

[12] Psaroudakēs 2008; Psaroudakēs 2020a.

In fact, almost all of the Oxus aulos parts constitute individual pipe sections terminating in a socket on one side and a spigot on the other. When interpreting those on the basis of the archaeological evidence of entirely preserved instruments produced from bone, we can expect the following construction parts of an aulos pipe, which is made up of several bone sections, starting from the top:

- a reed cone and following bulb with its characteristic curved shape of the external surface (while maintaining a cylindrical bore);[13]
- an extension – a part of the pipe without fingerholes;
- a central part of the pipe with fingerholes – the row of five fingerholes is split between two (Paestum/Poseidonia, Megara, Oxus) or three (Oxus) individual sections;
- another extension below the row of fingerholes (Megara, possibly Oxus);
- a lower part of the pipe with bass toneholes, possibly equipped with mechanisms (Megara, Oxus);
- a bell – a slightly flared end part of the pipe.

Table 1 shows all of the Oxus fragments classified according to their section types. The table is organized in a way that it reflects the construction of the pipe from the top to the bottom. Nevertheless, this rule does not apply to the extensions, as this section type could be located in different parts of the pipe – both above and/or below the row of the fingerholes. An important indicator for interpreting the direction of individual sections are spigots and sockets. As a general rule, the spigots are expected to be located towards the bottom of the pipe with the sockets towards its top. Table 1 also reflects our interpretation of the toneholes as fingerholes or openings for the bass notes located on the lower region of the pipe, at least some of which must have been operated by a mechanism.

Four of the fragments belong to two section categories: 003, 008, 013, 034. Fragment 013 could be either an extension or a section with one fingerhole for the little finger. The fingerhole itself is not preserved, but large broken parts on the top of the fragment leave enough space for a possible fingerhole. Fragments 003, 008 and 034 are the sections with the bottommost bass tonehole in the pipe which are located at its end part terminating with a slight widening. Out of this set, fragment 034 shows an unusual feature, which is the presence of two sockets in one aulos section. Typically, as mentioned before, there is a socket on the top of the fragment and a spigot on its bottom. As there is a socket on both sides of the fragment 034, there must have been originally another piece attached. Nevertheless, this fragment falls into the end sections category, as its clearly conical shape suggests that it must have been located at the end of the pipe, even if not at the very end.

Other somewhat problematic fragments in the end sections category are the items 004 and 027. Whereas the clearly flared shape of fragment 004 or the thickening of the bottom edge of piece 027 would imply that they belong to the exit parts of the pipe, the presence of the spigot on the other end of those fragments would be an indicator of their contrary direction. Thus, it is possible

[13] Originally made of one piece, bulb and cone later became separate parts, particularly in the Roman-Imperial period; see e.g. Pompeii Auloi/Tibiae (Hagel 2012).

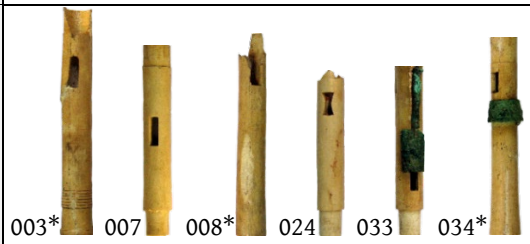
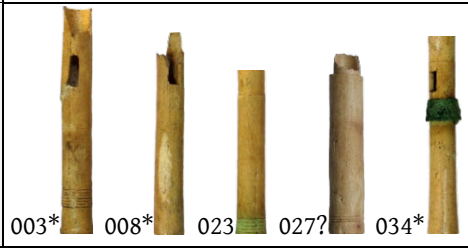
Section Type		Aulos	Salpinx (?)
Reed cones & bulbs (in a single section): 4 or 5		 010 014 017 039 046?	
Extensions (sections without toneholes): 10 aulos, 2 salpinx?		 005 013* 015 018 021 028 029 030 040a 041	 011 016
Sections with toneholes (24/25–25/26)	Probable uppermost fingerhole, for index finger: 7	 002 006 020 032 037 038 040b	
	Sections with a thumbhole and further fingerholes: 7/8	 001 009+043 012 019 026 036 042	
	Probable bottommost fingerhole, for the little finger: 4–5	 013?* 022 025 031 035	
	Bass toneholes: 6	 003* 007 008* 024 033 034*	
End sections: 5 aulos bells, 2 salpinx mouthpieces?		 003* 008* 023 027? 034*	 004 027

Table 1: Section types of the Oxus fragments. Sections marked with a star belong to two categories; "L" and "R" in thumbhole-sections are for the left- and right-hand pipes respectively.

that fragments 004 and 027 might have belonged to another wind instrument genre – presumably, a salpinx.

2.2 Toneholes versus fingerholes

2.2.1 Shapes and function

The toneholes are certainly one of the most important constructional features of a wind instrument. Their number and shape as well as their position on a pipe determine its tonal range. The archaeological finds of wind instruments with the toneholes are crucial, especially when trying to reconstruct the ancient musical system in terms of utilised scales, the archaeological finds of wind instruments with the toneholes are crucial. Although a musician could influence the generated tones by his/her embouchure and blowing pressure, the placement of the toneholes on a pipe reflects the desired scale and its pitch level that an instrument maker of the past wanted to achieve.[14]

Among the Oxus fragments there are several different kinds of toneholes. Some of them were operated by the fingers and thus are called fingerholes. The others, which according to our interpretation were located out of the fingered range on the lower part of the instrument and operated by the mechanisms. It appears that the shape of a tonehole reflects its function.

The Oxus aulos fragments display altogether six different shapes of toneholes, which can be classified in three categories:

1) circular (fingerholes)
2) elongated (fingerholes; see Figure 7 in Hagel's contribution in this volume):
   a) a 'double' fingerhole: two fingerholes in one long opening with a clear round shape on both the upper and lower ends (001)
   b) an enlarged fingerhole in which the lower part preserves its typical circular shape, whereas the upper part elongates towards the top of the pipe in a triangular shape with a smooth and round apex (002), recalling the shape of a pear
   c) a long but narrow fingerhole (009+043)
3) angular (bass toneholes operated by the mechanisms):
   a) rectangular (003, 007, 008, 033, 034)[15]
   b) 'hide-shaped', i.e. narrowing at the centre (024)[16]

Sections 001 as well as 009+043 – two bone cylinders forming a kind of mechanism to be discussed below – are rare examples of parts with two different shapes of toneholes on one fragment. Also, as will be argued in Hagel's contribution in this volume, the toneholes on this fragment are the only ones which are operated both by fingers and a mechanism of internally rotating bones.

[14] For an analysis of the possible tonalities on the Oxus auloi, see S. Hagel's contribution in this volume.
[15] Cf. Psaroudakēs 2012: 550–51, where other aulos fragments with rectangular toneholes are juxtaposed.
[16] Similarly shaped toneholes are preserved in an aulos fragment from Jerusalem (see Psaroudakēs 2012: 550 fig. 35; originally described in Braun 2002: 223, 224 fig. V.20) and in the Hellenistic side-blown flute from Koilē (Athens); here the 'hide' shape includes a rectangular 'tail' on one side (Psaroudakēs 2012: 549 fig. 32).

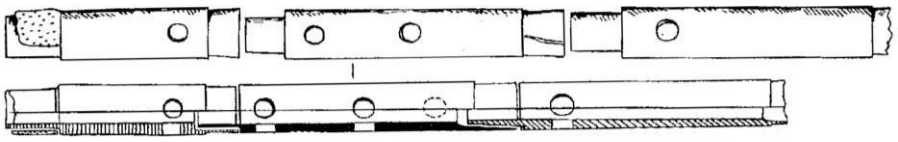


Figure 2: Fragments 035+036+037 (from the left) in Litvinsky's publications (1999: 521; 2006: 463 Рис. 10; 2010: Рис. 93).

Another aspect worth mentioning is the smooth shape of the edges observed on some fingerholes. They are curved in such a way that the fingers can rest on them comfortably (especially the thumbholes in 001, 002, and 026, but also a hole for the index finger in 020). This feature can be taken as an indicator that the Oxus aulos fragments were once part of extensively-played actual musical instruments.

2.2.2 Distribution on individual sections

A brief look at the section types of the Oxus auloi juxtaposed in Table 1 is enough to see that there is a certain pattern in the distribution of the fingerholes and bass toneholes on individual sections. With only one exception (026), the row of five fingerholes is split between three separate sections. This interpretation of the fingerholes' position on a pipe is based mostly on two indicators. First, as previously mentioned, the spigots and the sockets are an almost certain hint for the fragments' direction. Second, based on our knowledge of the fully preserved auloi from about the same period, the presence of a thumbhole, which is the only fingerhole located on the opposite side of the pipe, always takes the second position in the fingerholes' set.

We can differentiate between the three kinds of sections across which the entire set of fingerholes is distributed based on the number of fingerholes in one section, and on the fact that the spigots are generally located towards the bottom of a pipe. The sections can be divided as follows:

1. a section with one fingerhole for the index finger (which is the topmost fingerhole): the fingerhole is located next to the spigot at the distal end of the section.
2. a 'central' section with three fingerholes for the thumb, middle and ring fingers – respectively the second, third and fourth fingerhole from the top; fragment 026, which is equipped with a thumbhole and three further fingerholes, constitutes an exception.
3. a section with one fingerhole for the little finger, which is the fifth fingerhole from the top: the fingerhole is located next to the socket part at the top end of the section.

The central fingerhole sections, which are equipped with a thumbhole and, in most of the cases, two further fingerholes, are often carriers of important information, namely a slight displacement of the thumbhole towards the right or the left side, from the players perspective, indicates whether the pipes were designed for the right or the left hand.[17] Our interpretation of those sections as parts of a right- or left-hand pipe is given in Table 1.

The distribution of the entire row of fingerholes among three individual sections is also preserved in one of the few original joints between fragments, as documented in Litvinsky's publications: fragments 035+036+037 (Figure 2). The distribution of the set of five fingerholes between the

[17] Cf. the "Law of the 5 Ls" proposed by Steliōs Psaroudakēs (Psaroudakēs 2020b: 20 n. 27).

three individual sections in the Oxus auloi occurs as a new constructional pattern (see also the reconstructions of instruments 001, 009, 012, 019, and 036 in Hagel's interpretation in this volume). On the Megara auloi, as well as on the earlier bone auloi such as Paestum/Poseidonia or Pydna, the set of fingerholes was distributed across only two individual sections.

2.3 Mechanisms: previously known and newly revealed

From an organological point of view the most interesting feature of the Oxus aulos fragments may be the presence of the mechanisms for operating toneholes and fingerholes. Before the start of our project, on the sole basis of Litvinsky's publications, Lindström's documentation and the present author's study of eight fragments, only item 033 was undoubtedly identified as carrying a slider mechanism of a type that was already well known. While preparing for our planned visit to Dushanbe, Stefan Hagel and I together discovered the original connection of fragments 009 and 043, revealing another kind of mechanism, of a previously unknown construction. The examination of the pieces in 2022, finally, revealed yet again another novel type of mechanism on fragment 034. Altogether, the Oxus aulos fragments exhibit three different kinds of mechanisms for closing and opening toneholes and fingerholes:

1. sliders: fragments 033 & 051.
2. bone tubes rotating within each other: fragments 009+043 (Figure 3).
3. a sliding metal ring: fragment 034.

Whereas sliders were already known from other aulos finds dating to the Hellenistic period,[18] the other two types of mechanism are so far unique to the Oxus find; they are discussed in detail in Hagel's contribution below, including a remote parallel from Taranto in Italy. Rotary sections of tubing for closing and opening toneholes appear regularly in later finds from the Roman Imperial period, for instance in Pompeii or London; however, these are invariably made of metal.[19]

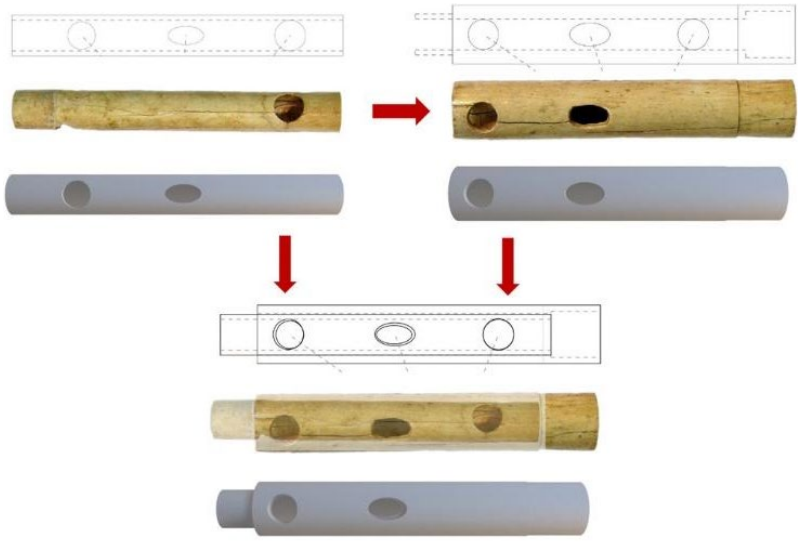


Figure 3: Mechanism of rotary bone tube: fragments 009+043. Photo: O. Sutkowska on the basis of technical drawings and 3D models made by Stefan Hagel and pictures taken by Gunvor Lindström.

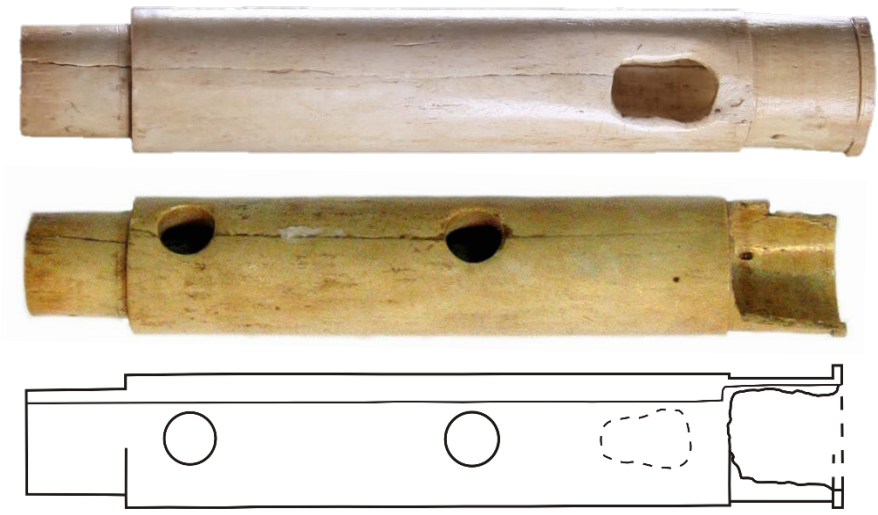
[18] On the mechanisms of the auloi/tibiae, see the short introduction and list of the preserved archaeological finds in Sutkowska 2015.

[19] Lawson and Wardle 1998; Sutkowska 2012; Wysłucha and Hagel 2025.

3 Catalogue

The following catalogue of the extant fragments is based on a database which was developed within our project at the Austrian Academy of Sciences.[20] It describes the entries in tabular form, which is explained in Appendices 1 and 2. The 51 consecutive numbers also reflect the progress of our work. The entries from 001 to 043 form the main set of verified bone fragments. The entries 044 to 047 refer to items which are known from Litvinsky's publications only, and it remains uncertain whether they ever existed or if some or all of Litvinsky's entries were duplicates of others. Fragment 048, in contrast, does not appear in Litvinsky's publications, but was found by Gunvor Lindström in the museum storage together with the aulos pieces. Nevertheless, it is unclear whether it formed part of an aulos. Entries 049 to 051 were added only after the visit to Dushanbe in 2022. They include small parts of broken bone sockets (049–050) and another slider which had been exhibited in the museum as a spoon, but was identified by Gunvor Lindström as part of an aulos during that visit (051). We are planning to publish more extensive data online.

001	NMA	Exc.: 4171	Rest.: 25	Inv.: M7172

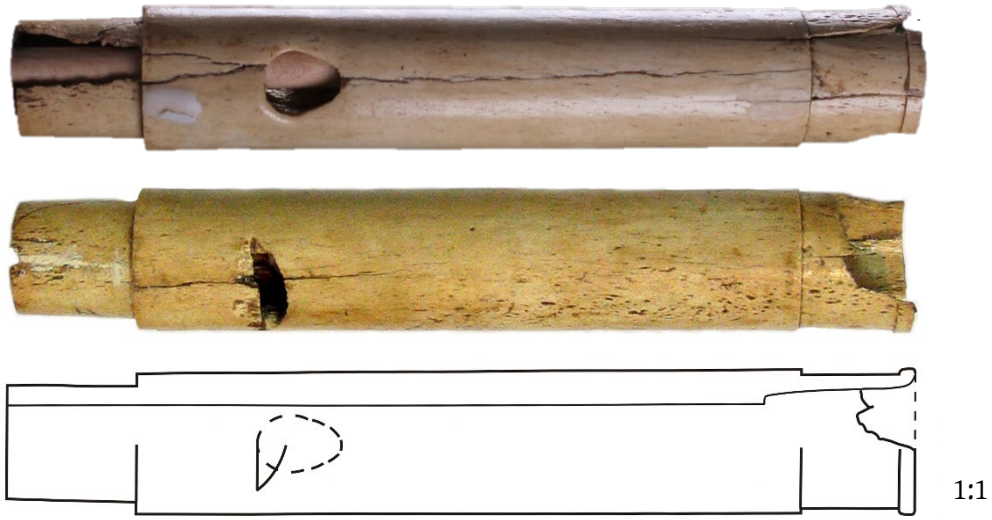


Central section with three fingerholes: T, M, R. Part of a left-hand pipe. The thumbhole shape is unusual and belongs to the 'elongated' category. Its smoothed edges support handling. The socket is half-broken, so that its interior with the step for a spigot is clearly visible. The socket area is slightly recessed, leaving space for a reinforcement between the sections, probably in the form of a winding of thread.

Lng=94.4
Di=11.0
Do=18
Sp1L=13.5
Sp1D=14.3
So2L=17
So2D=13.75
H1Pos=7.5
H1Dl=7.4
H1Dt=7.7
H1Az=-9
H2Pos=45.5
H2Dl=7.4
H2Dt=7.8
H2Az=0
H3Pos=67.5
H3Dl=13.5
H3Dt≈7.6
H3Az=169
Sct1=82.2
Sct2=93.5
M=23.3

[20] For a screenshot of this database and a short description, see Hagel 2021: 409.

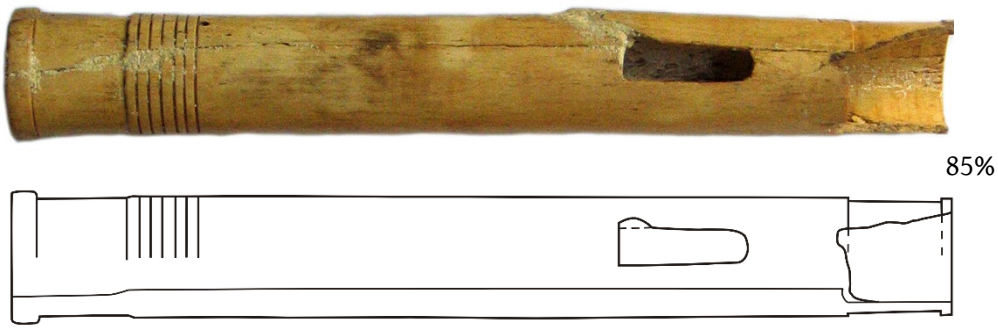
002	NMA	Exc.: 4172	Rest.: 16	Inv.: M7183



Section with one fingerhole of unusual shape, presumably for the index finger: elongation towards the top of the pipe in triangular form with very smooth edges, or a pear. Crescent opening on back side directly opposite the fingerhole: round edge rough, straight edge smoother but splintered: probably damage, not part of the design. The socket area is slightly recessed, leaving space for a reinforcement between the sections, probably in the form of a winding of thread. The upstream socket is deeper than the external recession above it.

Lng=104.1
Di=11.0–11.6
Do=18.75
Sp1L=16.8
Sp1D=15.5
So2L≈20.5
So2D=14.0–14.5
H1Pos=20.5
H1Dl=10.1
H1Dt=8.4
Sct1=88.5
Sct2=101.5
M=24.2

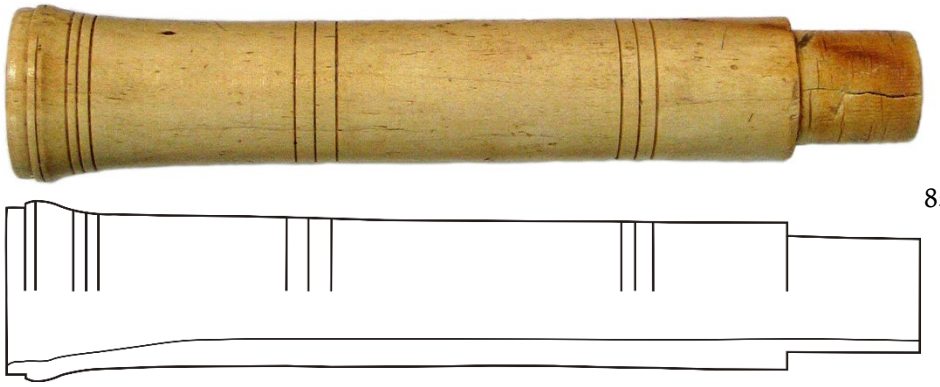
003	NMA	Exc.: 4173	Rest.: 3	Inv.: –



End section with one rectangular bass tonehole (B). Its upper edge is slightly rounded. On the opposite side of the fragment significant parts of the bone are broken off. The bottom end of the fragment shows slight widening in the form of a small bell. The socket area is of slightly smaller external diameter than the rest of the fragment, leaving space for reinforcement between the sections, probably in the form of a winding of thread. The same applies to the end of the fragment where an apparent recession for a reinforcement is preceded by six decorative incised lines.

Lng=145.7
Di=10–9.5
Do=20.5–18.2
So2L=19.8
So2D=13.5–14.2
H1Pos=104.1
H1Dl=19.4
H1Dt=5.9–5.4
H1S=R
Sct1=4.1
Sct2=18.3
Sct3=129.4
Sct4=143.5
E1T=B
M=35.1

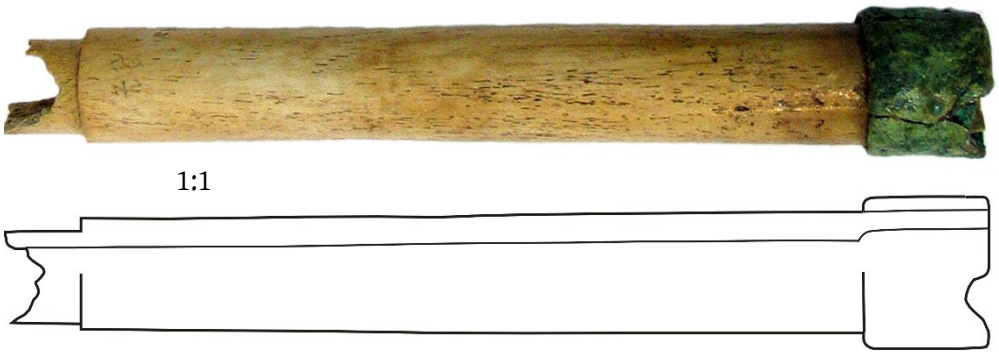
004	NMA	Exc.: 4183	Rest.: 29	Inv.: M7189



End section without toneholes. Bottom in form of a small bell, but the widening is only at the very end; the spigot on top with dark discolouration. The external surface: there are three sets of three incised decorative lines around the tube; at the bottom of the fragment there is an outer step which might once have received a narrow decorative metal ring, though no traces have been identified. The large internal and external diameter of this fragment suggests its interpretation as a possible part of a salpinx (a mouthpiece?).

Lng=123
Di=14–11
Do=26.5–22.5
Sp2L=20.3
Sp2D=18.3–18
E1T=B
M=61.0

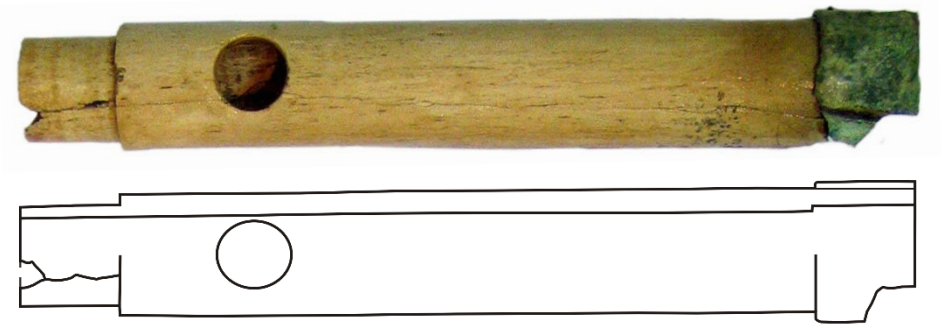
005	NMA	Exc.: 4222	Rest.: 27	Inv.: M7187



An extension with metal reinforcement over the socket. The external diameter of this metal ring is larger than the bone part of the fragment, at first place due to the lack of a recession in the bone under the ring, and additionally because of corrosion. The external diameter of the bone is slightly smaller than in most other fragments; only 042 is similar in this regard. The spigot is partially broken. Most probably this fragment is described twice by Litvinsky: description and measurements of his “unnumbered 1”, listed penultimate in his catalogue, corresponds with our item 005.

Lng=119
Di=9.5–10.1
Do=15.5
Sp1L≈11.3
Sp1D=12.5
So2L=13.4
So2D=12.1–12.6
Sct1=102.5
E1P=0
M=24.3

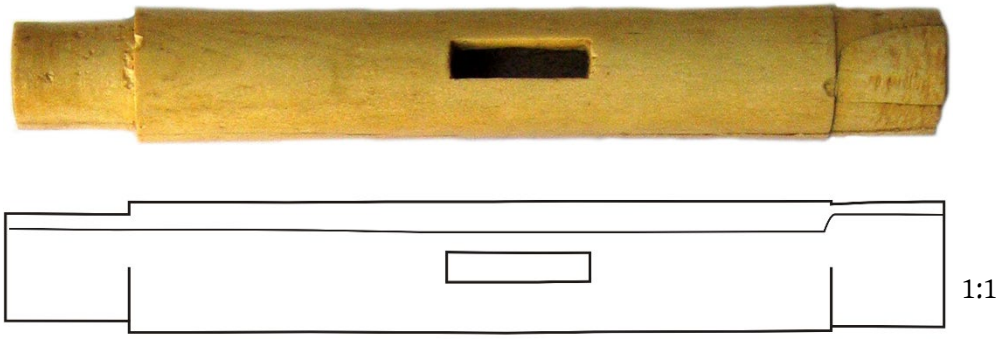
006	NMA	Exc.: 4244	Rest.: 23	Inv.: M7191



Lng=105
Di=9.9–10.1
Do=16.4–16.7
Sp1L=13
Sp1D=13.6
So2L=14.3
So2D≈13.5
H1Pos=18
H1Dl=9.4
H1Dt=9.5
Sct1=92.3
M=22.6

Section with one circular fingerhole, probably for the index finger, and metal reinforcement over the socket, which is half broken.

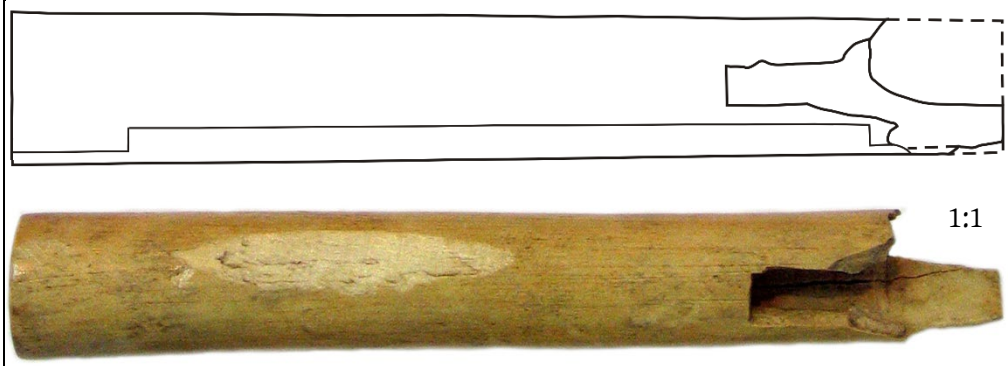
007	NMA	Exc.: 4281/2 (Lit.: 4245)	Rest.: 37	Inv.: –



Lng=107.6
Di=9.8–10.1
Do=18.1
Sp1L=16
Sp1D=14.5–15
So2L=15.3
So2D=13.5–13.6
H1Pos=50.7
H1Dl=17.5
H1Dt=4.3
H1S=R
Sct1=93
M=31.7

Section with one rectangular bass tonehole (B). Recession of the external bone surface on the socket area for strengthening the joint section, which was most probably done by a winding of thread.

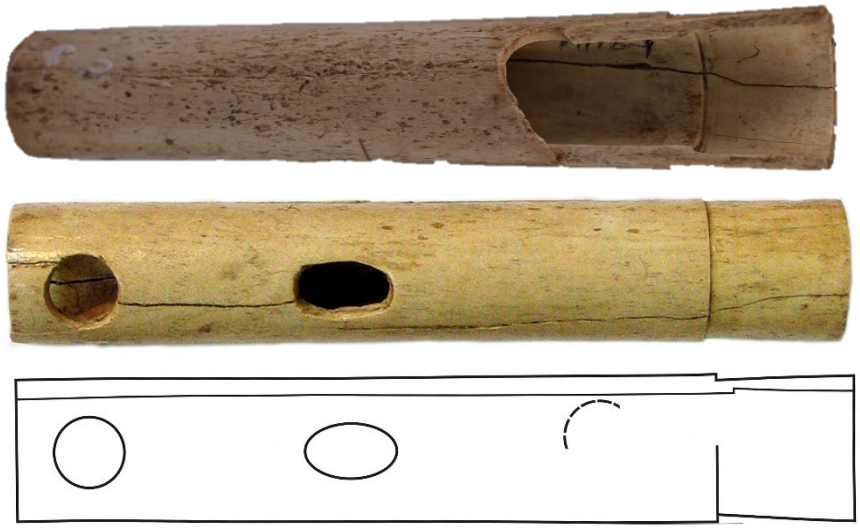
008	NMA	Exc.: 4251	Rest.: 4	Inv.: M7180



Lng=130.2
Di=10.5
Do=18
So1L=15.5
So1D=13.5–12.6
So2L=17.2
So2D=13.8
H1Pos=101.75
H1Dl≈13.5
H1Dt=6.3
H1S=R
E1T=B
M=36.5

End section with one rectangular bass tonehole (B). Its upper edge is broken off, as it is the greater part of the upper socket. Parts of the socket were previously attached to 035 due to a false restoration attempt. The original placement of those socket remnants on 008 has been restored during the examination in 2022. The fragment widens slightly towards the bottom. Unusually, it also features another socket in the lower end, suggesting another terminal section which has not survived.

009	NMT	Exc.: 4260	Rest.:	Inv.: 14116/1 (NMA: M7173)

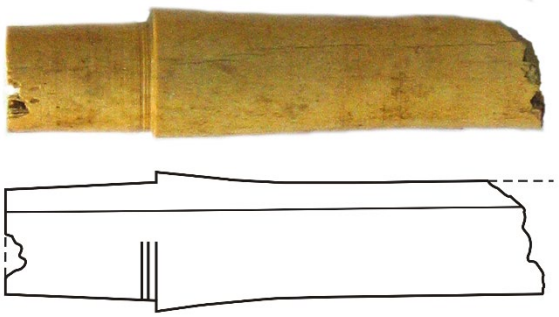


1:1

Central section with three fingerholes: T, M, R. Part of a left-hand pipe. The thumbhole is broken off, but it must have been of a circular shape, likewise the ring-finger hole; the middle-finger hole is elongated and of slightly narrower transversal diameter. The left end has completely flat edges and neither a spigot nor a socket, thus nothing indicates a connection to another fragment. This is due to the fact that this fragment forms an outer tube for 043. The socket area shows a recession of the external bone surface forming a step for a supportive binding. The socket is slightly conical. There are cracks along the whole fragment on the front and on the back sides. Most probably this fragment is described twice by Litvinsky: his "unnumbered 2", which is listed last in the catalogue, corresponds with our items 009+043 combined, although the drawing reference leads to fragment 005. Nevertheless, since there are a few mistakes in Litvinsky's articles in terms of illustration references, a similar mistake could have occurred as well, especially considering that 005, also listed twice as "unnumbered 1", is only one position above.

Lng=111.2
Di=12.9
Do=19–19.4
So2L=15.8
So2D=14.7–15.2
H1Pos=10
H1Dl=9
H1Dt=9
H1Az=0
H2Pos=44
H2Dl=12.1
H2Dt=7
H2Az=0
H3Pos=77.25
H3Dl=9.5
H3Dt=9.5
H3Az=147
Sct1=92.3
M=21.2

010	NMA	Exc.: 4261/1	Rest.: 18	Inv.: –

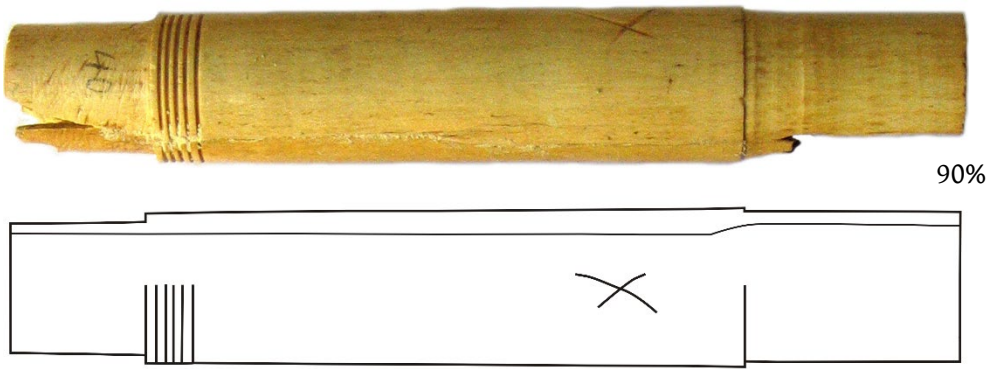


1:1

Lower part of bulb section. The grooves on the spigot are visible, especially close to the main body of the piece.

Lng=53
Di=9.5–9.6
Do=18
Sp1L=19.5
Sp1D=14.2–15.1
E2P=0
E2T=R
M=11.5

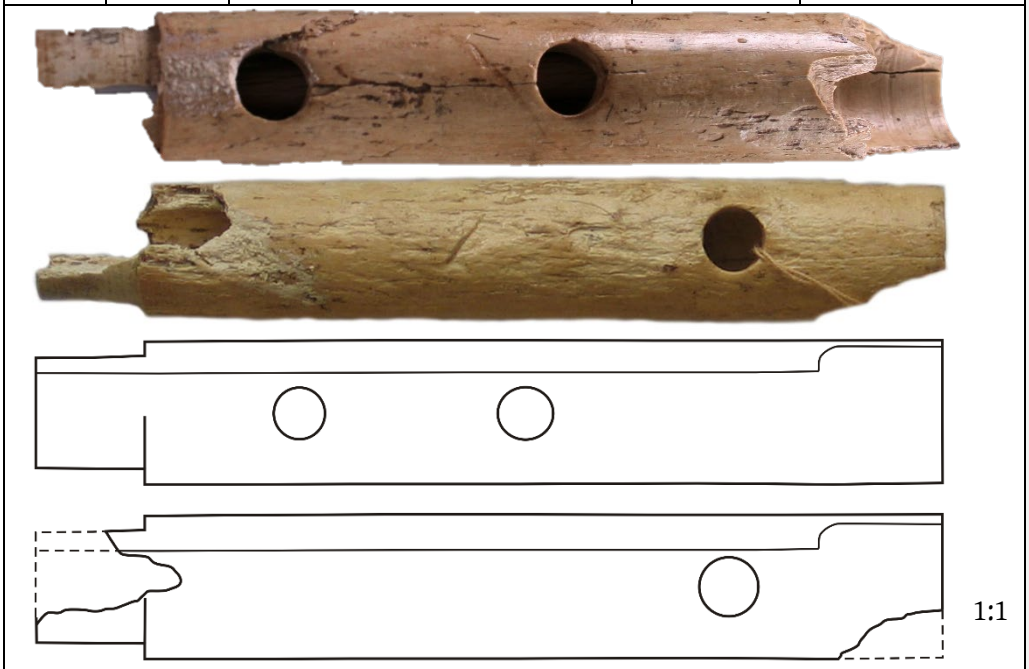
011	NMA	Exc.: 4327/1 (Lit.: 4261/2) (label: 4327)	Rest.: 40	Inv.: –



Lng=119.5
Di=16
Do=22.1–23.1
Sp1L=21
Sp1D=19.5–19.8
So2L≈27
So2D=16–17
Sct1=87.7
M=54.4

Section without toneholes. Five decorative incised lines at the end of the fragment. The socket has no step. The socket area shows a recession of the external bone surface forming a step for a supportive binding. An exceptionally big external and internal diameter indicates that the fragment is most probably not part of an aulos, but instead presumably of a salpinx. On the external surface below the socket area is an incised X of unknown meaning; the incision is mentioned in Litvinsky's description.

012	NMT	Exc.: 4281/1	Rest.: 8	Inv.: 14116/6



Lng=105.9
Di=10.0–11.5
Do=18.75–19
Sp1L=14
Sp1D=13.4
So2L=16.7
So2D≈13.7
H1Pos=12.5
H1Dl=8.3
H1Dt=8.3
H2Pos=48.5
H2Dl=8.2
H2Dt=8.2
H3Pos=77.7
H3Dl=8
H3Dt=8
H3Az=-171
M=24.6

Central section with three fingerholes: T, M, R. Part of a right-hand pipe. The fragment is in a very bad condition with heavy breaks on both ends. Only a small part of a spigot survived, nevertheless its original length is preserved. The grooves are visible on the spigot and socket surface.

013	NMA	Exc.: 4245 (Lit.: 4281/2)	Rest.: 6	Inv.: –

An extension or a fragment with one fingerhole for the little finger. Both ends, spigot and socket, are heavily broken, nevertheless their original length is preserved. Big parts of the fragments are also broken off, so that a presence of a tonehole cannot be excluded. There are several grooves visible at the upper end of the spigot.

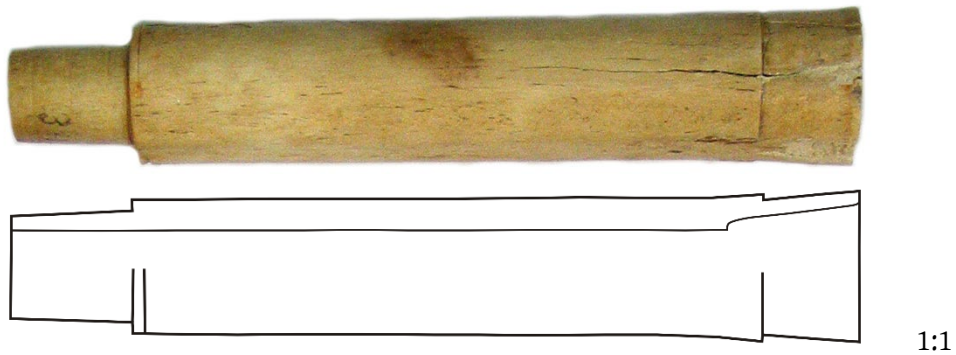
Lng=83.7
Di=10–9.5
Do=18.2
Sp1L=19.4
Sp1D=14.3
So2L=14.8
So2D≈13.1
H1Pos=60.2
H1Dl≈8.25
H1Dt≈8.25
M=18.8

014	NMA	Exc.: 4316	Rest.: 13	Inv.: M7174

A bulb. The reed socket almost entirely broken off. The internal step of the socket is marked externally by a narrow bulge around the tube, which probably bounds the area where the socket was reinforced by a winding of thread. The spigot is slightly conical.

Lng=109.5
Di=9.2
Do=18
Sp1L=16.8
Sp1D=14.3–15
So2L=3.75
So2D=14
Sct1=105.75
E2P=0
E2T=R
M=31.1

015	NMA	Exc.: 4317/2 (label: 4317)	Rest.: 34	Inv.: M7186



An extension. Spigot partially broken. Grooves on its surface visible. Spigot and socket slightly conical. Recession of the external surface on the socket area for reinforcement between the sections probably in form of a winding of thread. The upstream socket is deeper than the external recession above it. One incised line next to the lower end of the section.

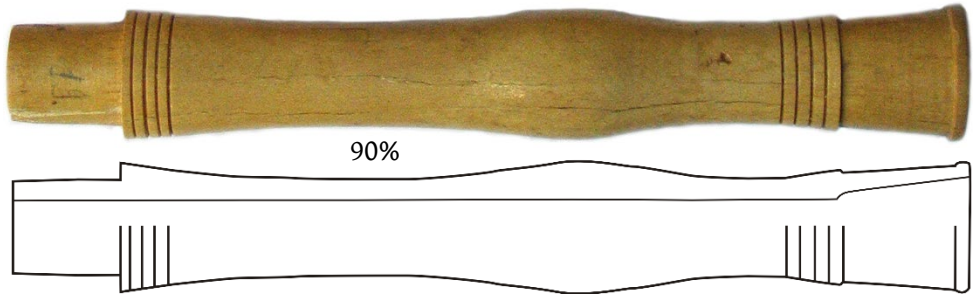
Lng=95.8
Di=9.5–10.5
Do=18.6–19
Sp1L=16.2
Sp1D=12–13
So2L=17.6
So2D=14–14.5
Sct1=82.5
Sct2=94.5
M=29.1

016	NMA	Exc.: 4318	Rest.: 1	Inv.: M7188

An extension or, judging from the large diameter, rather part of a salpinx. The tube shows a narrow bulge at its lower end and a significant recession on the upper end over which a metal ring was fitted, which is now removed from its original position by 6mm. There are several grooves on the upper half of the spigot, probably for an adhesive.

Lng=121
Di=12.5
Do=23
Sp1L=24.9
Sp1D=20
So2L=27.5
So2D=16.4
Sct1=86.5
M=72.8

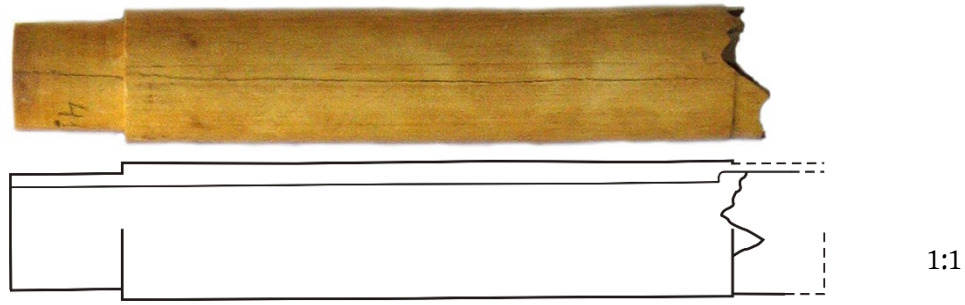
017	NMA	Exc.: 4319	Rest.: 19	Inv.: –



A bulb. Entirely preserved, forming one of the best-preserved fragments overall. The tail and bulbous section feature four incised decorative lines on either end. There is a recession in the external surface on the reed-socket area for a reinforcement, probably in the form of a winding of thread, similarly to the Louvre aulos. The reed-socket does not terminate in a clear step. This bulb is very similar to one found at Taranto (National Archaeological Museum of Taranto, inv. 12528–7; see S. Hagel's contribution in this volume, Figure 1).

Lng=124.4
Di=9.8–9.4
Do=18.8
Sp1L=16.7
Sp1D=14.1
So2L≈17.7
So2D=~12.5–13.7
Sct1=105.6
Sct2=121.5
E2T=R
H1Pos=91.5
H1Dl=0.9
H1Dt=0.9
M=31.3

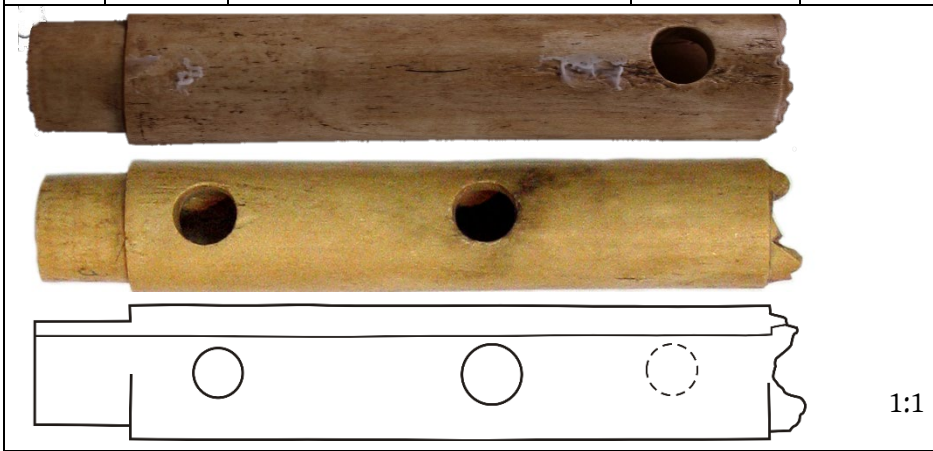
018	NMA	Exc.: 4320	Rest.: 11	Inv.: –



An extension. The upper end of the spigot is slightly thicker. The upstream socket is slightly deeper than the external recession above it. The fragment is broken at the beginning of the socket, parts of which are stuck on 025.

Lng=98.2
Di=9.6
Do=17.5–17.8
Sp1L=14.9
Sp1D=14.2–15
So2L=19.75
So2D=14–14.5
Sct1=80.9
M=25.8

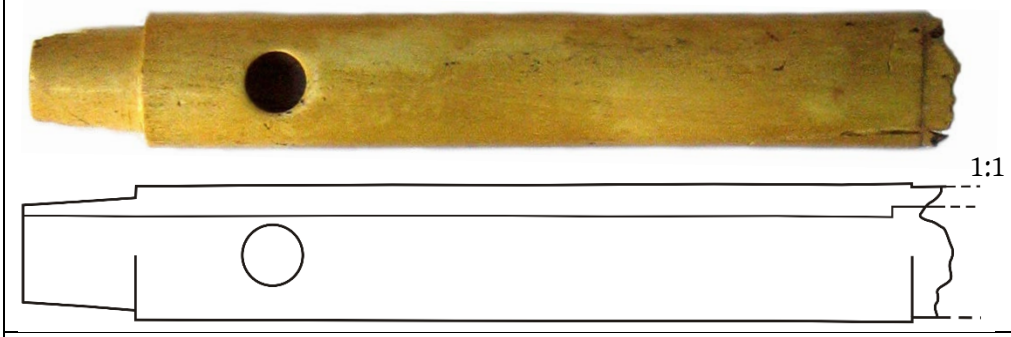
019	NMT	Exc.: 4321	Rest.: 35	Inv.: M7179



Central section with three fingerholes: T, M, R. Part of a right-hand pipe. The socket is almost entirely lost; nevertheless, a recession in the external surface for the reinforcement between the sections is noticeable. The lower end shows a significantly smaller internal diameter, as if the lower part was not worked through.

Lng=89
Di=8.2–10
Do=17.6–18
Sp1L=11.6
Sp1D=14.6–14.8
So2L=4.1
So2D=13
H1Pos=10.8
H1Dl=7.8
H1Dt=7.6
H2Pos=47.2
H2Dl=7.8
H2Dt=7.6
H3Pos=72
H3Dl=7.8
H3Dt=7.6
H3Az=-167
Sct1=84.5
E2P=0
M=27.8

020	NMA	Exc.: 4322	Rest.: 5	Inv.: –



Section with one circular fingerhole, probably for the index finger. The edge of the fingerhole is smoothed on the upper part for a better seat for the finger. The socket is almost entirely broken; nevertheless, a recession in the external surface for reinforcement between the sections is clearly visible. The upstream socket is deeper than the external recession above it. The spigot is slightly conical.

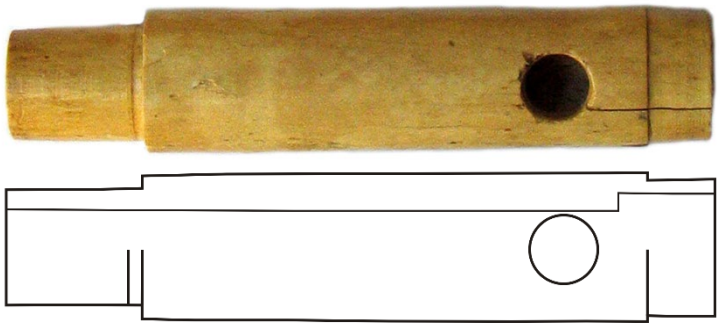
Lng=107
Di=10.1–10.5
Do=18.1
Sp1L=15
Sp1D=~13–14.2
So2L≈8
So2D=13.5
H1Pos=17.5
H1Dl=8
H1Dt=8
Sct1=102.4
E2P=0
M=27.0

021	NMA	Exc.: 4323	Rest.: 9	Inv.: –

An extension. An external recession over the socket is clearly visible. The upstream socket is deeper than the recession above it.

Lng=95.6
Di=10
Do=18
Sp1L=15.5
Sp1D=14–14.5
So2L=19.8
So2D=14–14.6
Sct1=81.3
M=25.5

022	NMA	Exc.: 4324	Rest.: 12	Inv.: –

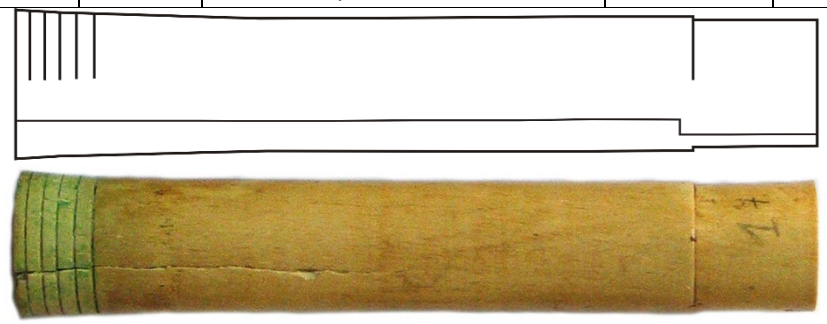


1:1

Lng=75.7
Di=9.5
Do=18.8–18.9
Sp1L=18.3
Sp1D=15.1–15.9
So2L=12.9
So2D=12.6–12.9
H1Pos=54.7
H1Dl=8.6
H1Dt=8.6
Sct1=67.2
M=27.3

Section with one circular fingerhole, presumably for the little finger. The spigot has a little groove at its beginning where it meets the main tube. The socket is comparatively short, although fully preserved. Over it there is a relatively narrow external recession for a reinforcement between the sections. The upstream socket is deeper than the external recession above it. According to Litvinsky, there was originally a short, broken tube inserted into the socket.

023	NMA	Exc.: 4325/1	Rest.: 17	Inv.: –



1:1

Lng=105.7
Di=9.95
Do=17.5
So2L=18.8
So2D=13.5–14
Sct1=10.2
Sct2=89.3
E1T=B
M=26.9

An end section without toneholes – a bell. The socket has an external recession for a reinforcement of the joint; it is slightly deeper than the recession above it. The lower end widens slightly, forming a bell which was once covered by a ring of copper alloy; parts of it are still shown in Litvinsky's drawings (Litvinsky 2006: 463 Pl. 10–2, 464 Pl. 11–7). Five incised lines in bone ensured a better grip of the metal ring, which has left behind a greenish discolouration on the bone.

Connections: 024 to the right (seamless fit; excavated together; Litvinsky's joint).

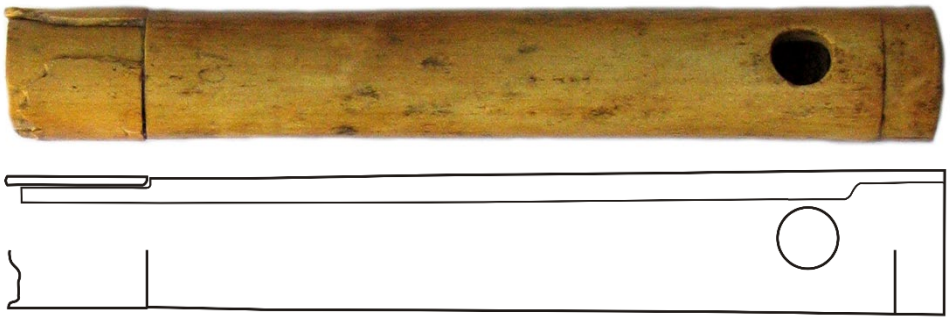
024	NMA	Exc.: 4325/2	Rest.: 2	Inv.: M7181

Section with one tone hole in form of a hide, for a bass note. The socket is almost entirely broken, but the recession for its reinforcement is clearly visible.

Connections: 023 to the left (seamless fit; excavated together; Litvinsky's joint); 035 to the right (perfect match between the broken sockets).

Lng=91.3
Di=9.65–9.9
Do=17.5–17.8
Sp1L=17.6
Sp1D=14–14.5
So2L≈7.3
So2D=13.5
H1Pos=68.75
H1S=H
H1Dl=14.5
H1Dt≈5.625
Sct1=85.6
E2P=0
M=27.9

025	NMA	Exc.: 4326	Rest.: 10	Inv.: –

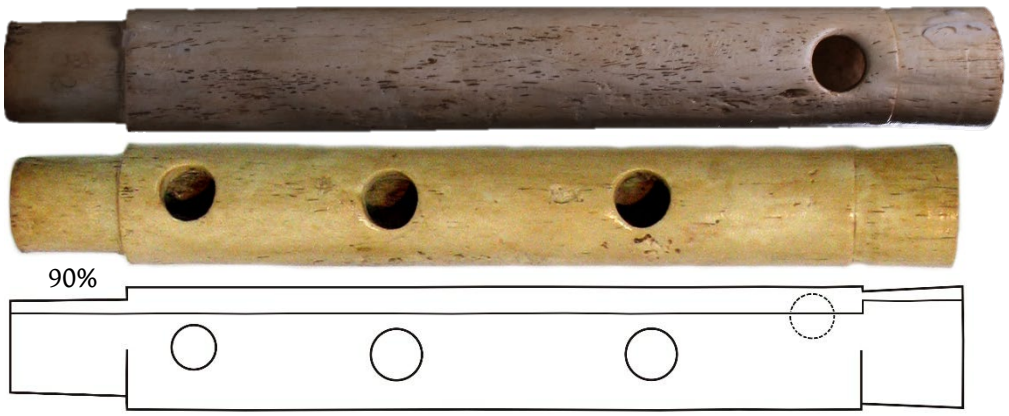


Section with one fingerhole, presumably for the little finger. Narrow recession over the socket for its reinforcement. The upstream socket is deeper than the external recession above it. There are rests of a socket of 018 stuck over the downstream spigot. The external surface is slightly conical.

Connections: 018 to the left.

Lng=105
Di=9.6
Do=17.3–18
Sp1L=18
Sp1D=14.5
So2L=12.8
So2D=13.5–14.6
H1Pos=86.8
H1Dl=8.0
H1Dt=7.8
Sct1=97.9
M=32.6

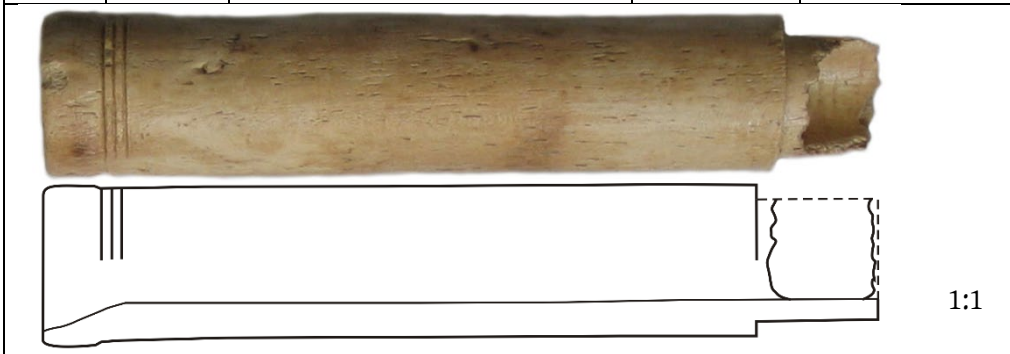
026	NMA	Exc.: 4327/1	Rest.: 32	Inv.: M7185



Central section with a thumbhole and three fingerholes: T, M, R, S. The only such section with four fingerholes. All of them are circular. The edge of the thumbhole is especially smoothed for a better seat of the thumb. Part of a right-hand pipe: not only the thumbhole, but also the small-finger hole are shifted to the right. Over the entire socket there is a recession for its reinforcement – this part is slightly conical, widening towards the top of the fragment.

Lng=123.3
Di=10.1
Do=18
Sp1L=17
Sp1D=14.6–14.7
So2L=15
So2D=13–14
H1Pos=10
H1Dl=8
H1Dt=8
H1Az=-9
H2Pos=40
H2Dl=8
H2Dt=8.2
H2Az=0
H3Pos=77
H3Dl=8
H3Dt=8
H3Az=0
H4Pos=100
H4Dl=8
H4Dt=8
H4Az=-159
Sct1=108.25
M=33.8

027	NMA	Exc.: 4327/2	Rest.: 33	Inv.: –



An end section: a bell, or not part of an aulos (perhaps the mouthpiece of a salpinx?). If it was an aulos, the position of the spigot on the top part would be unusual. Three incised lines close to the slightly wider left edge of the fragment. Left end widening to Di=15.5.

Lng=94.4
Di=11.8–11.5
Do=20–21.5
Sp2L=14.3
Sp2D=16.3
E2P=0
E1T=B
M≈33.8

028	NMA	Exc.: 4327/3	Rest.: 38	Inv.: –

Extension with an exceptionally long and slightly conical spigot. Socket broken, but its entire length is preserved; over it, a recession for its reinforcement.

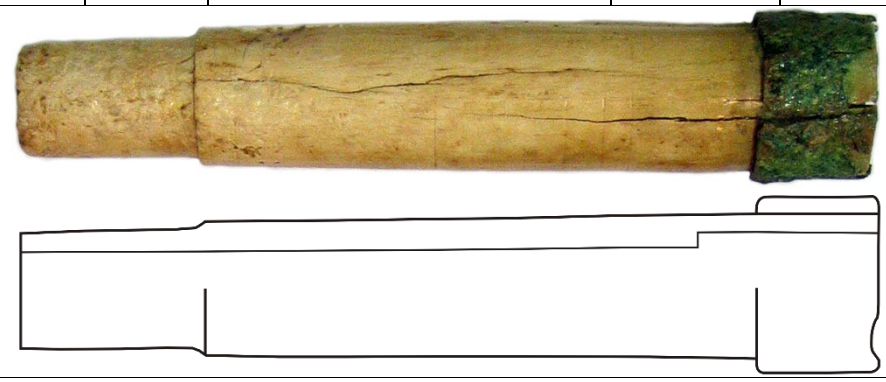
Lng=89.4
Di=9.5–10
Do=18.2–18.6
Sp1L=23
Sp1D=14.0–14.7
So2L=16.6
So2D=13.5–14.7
Sct1=72.9
M=28.0

029	NMA	Exc.: 4327/4	Rest.: 30	Inv.: –

Extension. Broken on the socket part – length of the section not entirely preserved. The socket terminates in a double step. The spigot becomes wider next to the main body.

Lng≈64.1
Di=9.1–8.2
Do=16–16.5
Sp1L=12.6
Sp1D=13
So2L≈11
So2D≈12.5
E2P=0
M=14.2

030	NMA	Exc.: 4327/5	Rest.: 26	Inv.: M7190



Extension with an exceptionally long and slightly conical spigot. The socket is also of exceptional length. A copper-alloy ring on the socket is partly preserved; it is not set inside a bone recession, but extends above the bone both originally and additionally due to corrosion.

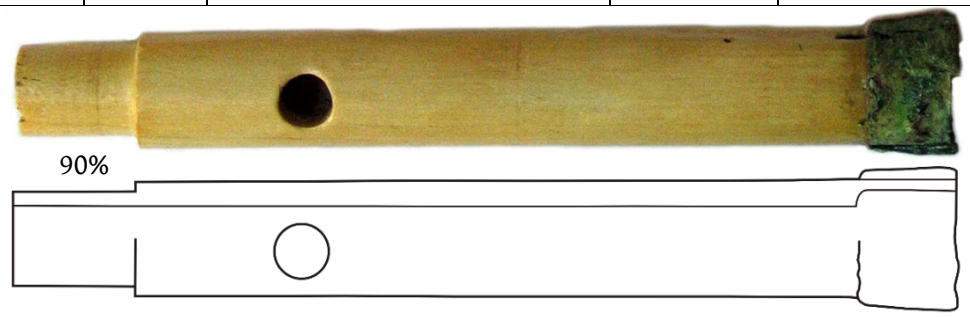
Lng=88
Di=11
Do=18
Sp1L=25
Sp1D=15
So2L=23
So2D=14.5
Sct1=73
M=36.1

031	NMA	Exc.: 4327/6	Rest.: 31	Inv.: –

Section with one circular fingerhole, presumably for the little finger, with smooth edge. The spigot is slightly conical, with incised lines throughout. Over the socket, there is a narrow recession for its reinforcement, terminated by a thin rim. The socket is deeper than the external recession above it.

Lng=102
Di=9.8
Do=18–17.8
Sp1L=15
Sp1D=14–14.4
So2L=14.25
So2D=13.4
H1Pos=79.5
H1Dl=7.6
H1Dt=7.6
Sct1=91.5
Sct2=100.1
M=27.1

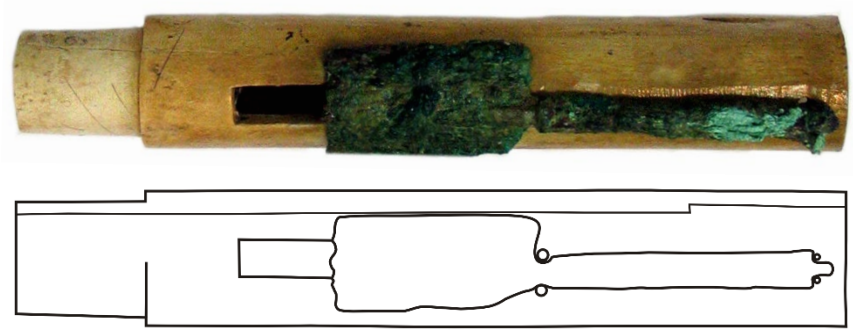
032	NMA	Exc.: 4414	Rest.: 20	Inv.: –



Section with one circular fingerhole, presumably for the index finger, and a copper-alloy ring reinforcing the socket. This ring is not set inside a bone recession.

Lng=121
Di=9
Do=17
Sp1L=18
Sp1D=14
So2L=17.5
So2D=12.5
H1Pos=25.5
H1Dl=8
H1Dt=8
Sct1=104
M=39.3

033	NMA	Exc.: 4418/1	Rest.: 26	Inv.: M7178



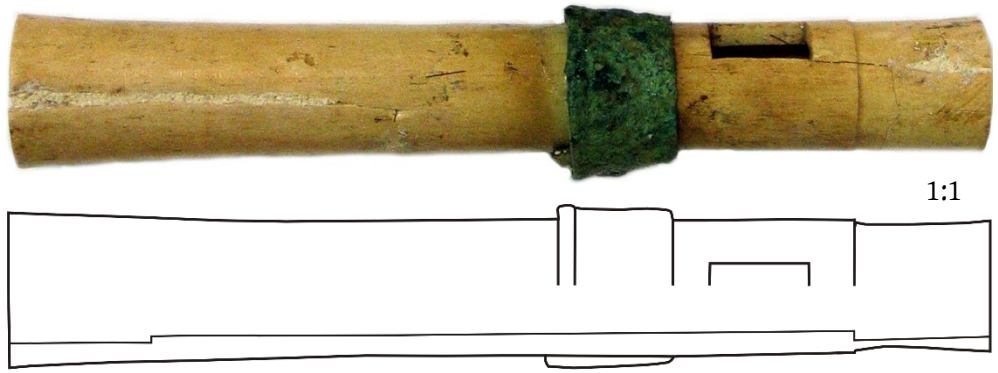
Lng=93.5
Di=10.2–10.5
Do=18
Sp1L=17
Sp1D=14.4–14.8
So2L=20.7–21
So2D=14
H1Pos=19.4
H1Dl=14
H1Dt=4.7
H1S=R
M≈30.9

Section with one rectangular tonehole for a bass note, furnished with a slider mechanism. Slider plate currently covers c. 2mm of the tonehole. The slider rod is broken at the end of the fragment. The spigot is slightly conical. There are significant differences in bone colour: the spigot is brighter than the rest of the fragment, apparently due to the fact that 033 and 034 were still joined when excavated.

The slider plate measures 27×15mm, the extant slider measures 37.4mm and is 4mm thick. Together, plate and extant slider measure 67 mm. The slider runs through a guide, which starts about 2mm above the plate.

Connections: 034 on the left side (excavated together; Litvinsky's joint).

034	NMA	Exc.: 4418/2	Rest.: 31	Inv.: M7184



Lng=129.9
Di=10.25–10.7
Do=18–20.5
So1L=18.85
So1D=12.15
So2L=17
So2D=13.8–14.7
H1Pos=99.5
H1Dl=13.3
H1Dt=6.4
H1S=R
Sct1=73
Sct2=88
Sct3=112.5
M=34.0

An end section with one rectangular tonehole for a bass note, with a sliding ring – so far the only known evidence of such a mechanism. The presence of two sockets in the same section is also unusual. The socket at the lower end might suggest that another piece was attached, such as a horn, as associated with the so-called *élymos* or 'Phrygian aulos'. On the other hand, the socket appears too narrow for a bone or horn spigot; perhaps the counterbore was only drilled for better intonation?

Connections: 033 on the right side (excavated together; Litvinsky's joint).

035	NMA	Exc.: 4424/1+2	Rest.: 7	Inv.: –

1:1

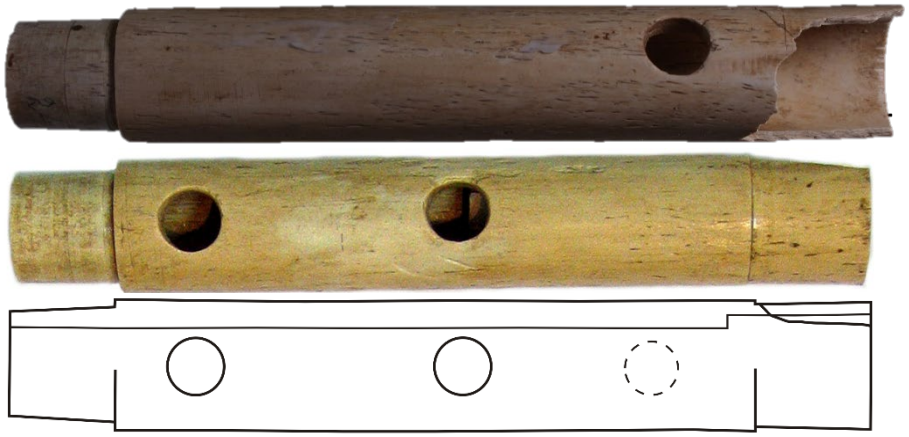
Litvinsky 2006: 463 Pl. 10/3

Section with one circular fingerhole, presumably for the little finger. In 2022, a substantial part of the spigot was covered by remnants of a socket, which, as closer inspection revealed, had been wrongly glued there and in fact belonged on 008. The pieces were reattached accordingly. Litvinsky's drawing appears to indicate the remains of a metal reinforcement over the downstream spigot area. A narrow recession over the socket for its reinforcement is present, although partially broken. The upstream socket is deeper than the external recession above it.

Connections: 024 to the left (perfect match between the broken sockets); 036 to the right (Litvinsky's joint).

Lng=63.3
Di=10.2–10
Do=18
Sp1L=18.4
Sp1D=14.5
So2L=15
So2D=13.7–14.6
H1Pos=41.2
H1Dl=7.9
H1Dt=8
Sct1=52.8
M=16.7

036	NMA	Exc.: 4424/3	Rest.: 24	Inv.: M7176



1:1

Central section with a thumbhole and two further fingerholes: T, M, R. All fingerholes are near-circular. Part of a right-hand pipe. The socket is half broken and there is a recession for a reinforcement over most of it. The spigot tapers down slightly and carries traces of lathe-turning throughout.

Connections: 035 on the right and 037 on the left side (Litvinsky's joint).

Lng=99.7
Di=10
Do=18.25–17.7
Sp1L=14
Sp1D=14.25–14.75
So2L=19
So2D=14
H1Pos=10
H1Dl=8
H1Dt=8
H1Az=9
H2Pos=45.5
H2Dl=8
H2Dt=8
H2Az=0
H3Pos=71
H3Dl=7.8
H3Dt=7.8
H3Az-164
Sct1=84.7
M=22.8

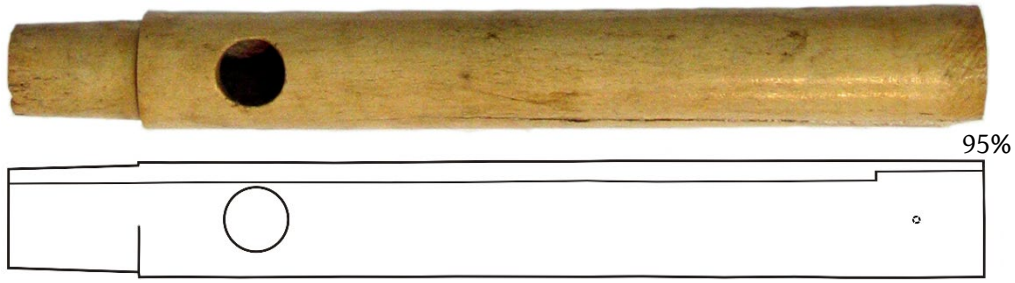
037	NMA	Exc.: 4424/4	Rest.: 15	Inv.: –

Section with one circular fingerhole, presumably for the index finger. The socket is almost entirely broken, nevertheless a recession for its reinforcement is clearly visible.

Connections: 036 on the right (Litvinsky's joint).

Lng=97
Di=9.4–10
Do=17.6–18.3
Sp1L=18.4
Sp1D=14.6–15
So2L≈6.4
So2D≈14.4
H1Pos=15.5
H1Dl=7.9
H1Dt=7.8
Sct1=91.7
E2P=0
M=29.3

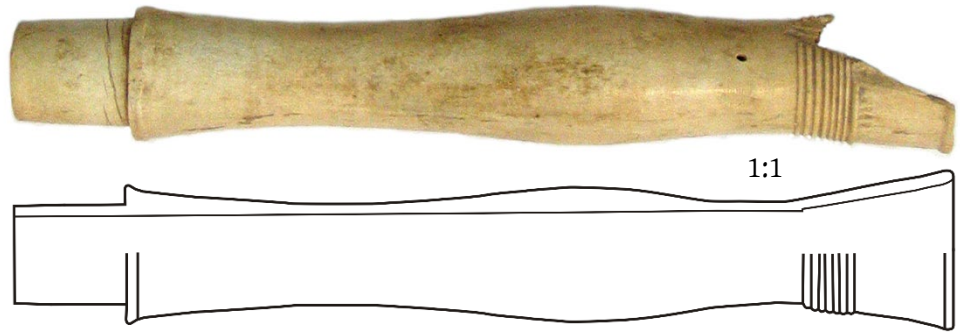
038	NMA	Exc.: 4451	Rest.: 41	Inv.: M7177



Section with one circular fingerhole, for the index finger, and a *sŷrinx* hole (to facilitate overblowing). The external surface at the upper end shows certain unusual features – perhaps a slight taper and diagonal marks. The spigot is clearly conical.

Lng=118.3
Di=9.6–10.5
Do=17.6–17
Sp1L=18.3
Sp1D=13.2–14.2
So2L=15
So2D=13–13.5
H1Pos=15.9
H1Dl=9.4
H1Dt=9.3
H2Pos=93
H2Dl=1.7
H2Dt=1.2
H2Az=177
M=24.6

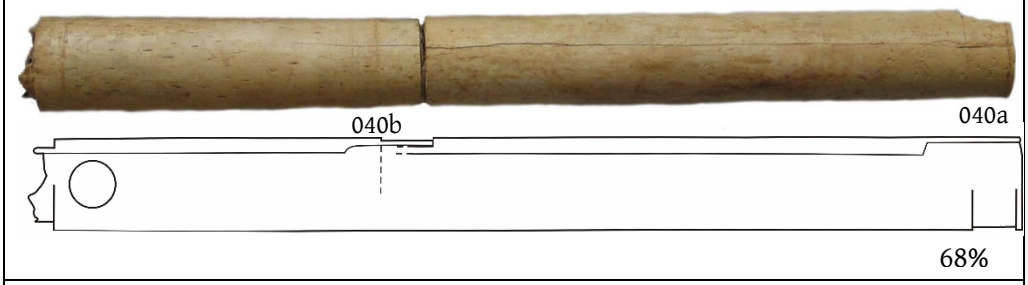
039	NMA	Exc.: 5006	Rest.: –	Inv.: –



Bulb and reed-socket section with a *sŷrinx*-hole located directly under the reed-socket. Additionally, there are seven ridges on the external bone surface, starting at the end of the reed-socket. The remaining part of it, between two rims, is suitable for a reinforcement in the form of a winding of thread.

Lng=108
Di=9.3–9.5
Do=18
Sp1L=15.7
Sp1D=14.0–14.3
So2L=20
So2D=12.2–13.5
H1Pos=79.8
H1Dl=1.5
H1Dt=1
E2T=R
M=21.2

040	NMT	Exc.: 5030	Rest.: –	Inv.: –



Two sections joined in their original position: an extension (040a) and a section with one circular fingerhole, apparently for the index finger (040b). The extension is extraordinarily long. Over both sockets, we find narrow recessions, terminating in rims, for a reinforcement of the joints, presumably in the form of windings of thread. The spigot of 040b is almost entirely broken.

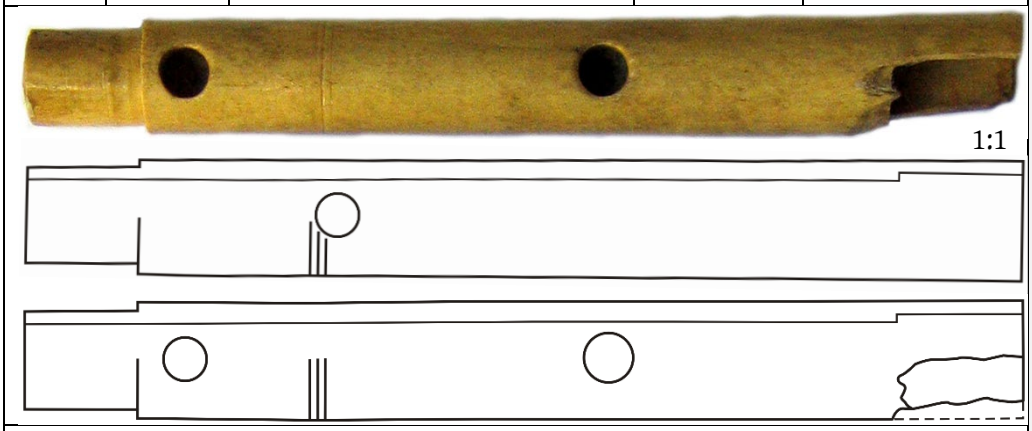
Lng=188.4
Di=11.4
Do=18.5–17.5
Sp1L=3.5
Sp1D=13.5
So2L=18.8
So2D=13.2–13.5
H1Pos=7.9
H1Dl=9.5
H1Dt=9.5
Sct1=74
Sct2=179
Sct3=187.5
E1P=0
M=34.4

041	NMT	Exc.: 5067	Rest.: 28	Inv.: 14116/4

An extension. The socket is broken, but its original length is preserved. There are turning marks on the entire length of the section and on the spigot.

Lng=70.5
Di=8.1–8
Do=16–17
Sp1L=11.9
Sp1D=12.6–12.8
So2L=14.2
So2D=11.8
M=17.7

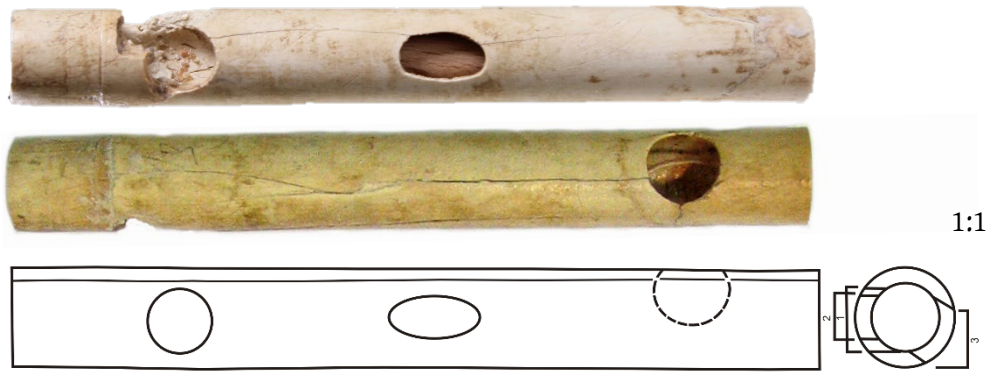
042	NMA	Exc.: 5068(a)	Rest.: 22	Inv.: –



Central section with three circular fingerholes: I, T, M. The fragment stands out for its slenderness; correspondingly, the fingerholes are also comparatively small. Three incised lines around the pipe mark the position of the thumbhole. Half of the socket is broken off.

Lng=116.8
Di=8.5–9.1
Do=15–15.5
Sp1L=15.3
Sp1D=12.75–12.9
So2L=17.5
So2D=12.2–13
H1Pos=5.3
H1Dl=6.5
H1Dt=6.5
H2Pos=34.6
H2Dl=6.5
H2Dt=6.5
H3Pos=60.7
H3Dl=6.8
H3Dt=6.8
M=23.0

043	NMA	Exc.: 4260 (Lit.: 4260b?)	Rest.: –	Inv.: –



1:1

Inner tube of the item 009, with three fingerholes of two different shapes: T and R are circular, M is elongated and narrow. When inserted into 009, its bottom part would extend beyond the latter, forming the spigot of the entire section 009+043; the boundary is clearly visible. Part of a left-hand pipe.

Lng=107.6
Di=9–10.2
Do=13.0–13.1
H1Pos=22.5
H1Dl=8.9
H1Dt=8.8
H2Pos=56.2
H2Dl=11.5
H2Dt=6.1
H2Az=-3
H3Pos=90
H3Dl=9.1
H3Dt=9
H3Az=151
M=10.3

044	NMA	Exc.: 4327/8	Rest.: –	Inv.: –

Drawing: Litvinsky 2006: 461, Pl. 7–7. 1:1

Fragment known only from Litvinsky's publications, but absent from the collections in Dushanbe. According to Litvinsky, it is slightly conical with spigots on both ends. However, the drawing appears rather to show a broken socket on the right side with the typical recession in the external surface, for a reinforcement of the joint. Several incised decorative lines next to spigot on the left side. It might be another part of a salpinx.

Lng≈100
Do≈22–26
Di≈16.5
Sp1L≈22
Sp1D≈18.5
Sct1=88

045	NMA	Exc.: 4327/7	Rest.: –	Inv.: –

Fragment known only from Litvinsky's publications, while not corresponding to any object in the collections in Dushanbe. Judging from Litvinsky's description and measurements, it appears to be identical with 044.

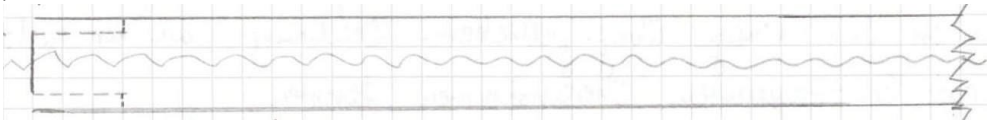
046	NMA	Exc.: 4317/1	Rest.: –	Inv.: –

Fragment known only from Litvinsky's publications, while not corresponding to any object in the collections in Dushanbe. According to Litvinsky's description, it is a bulb-plus-reed-socket section similar to 014. The entry may have been duplicated during Litvinsky's publication process, with two independent sets of measurements. Litvinsky provides no illustration, just a description.

Lng≈127
Do_{max}≈19
Do_{min}≈16
Sp1L≈18
Sp1D≈13

047	NMA	Exc.: 00754 (found in 1977)	Rest.: –	Inv.:	Lng≈155

preserved end *broken end*



Drawing by the author according to Litvinsky's description. 80%

Fragment known only from Litvinsky's publications, but absent from the collections in Dushanbe. According to G. Lindström, the fragment may either have been lost or wrongly classified as part of an aulos immediately after discovery, but reclassified after cleaning. The only fragment not retrieved from Corridor 6. According to Litvinsky's description, it was longitudinally split into two parts, like 048; however, it cannot be identical with 048, since the overall lengths differ significantly, and both ends of 048 are preserved. Litvinsky provides no illustration, just a description.

048	NMA	Exc.: –	Rest.: –	Inv.: –	Lng=115.7 Di=6.6 Do=18.5–16–19 Sp1L=11.1 Sp1D=11.5 So2L=15.8 So2D=10.7 M=15.6

1:1

A possible mouthpiece section with reed-socket. Nevertheless, the fragment is of extremely narrow internal diameter and perhaps not even part of an aulos. It has no context and is never mentioned by Litvinsky.

049	NMA	Exc.: –	Rest.: –	Inv.: –	Lng≈14

c. 1:1

Broken part of a socket, kept separately. The turning marks are clearly visible as well as a rim at the preserved edge, indicating the presence of a recession for the reinforcement of the socket.

050	NMA	Exc.: –	Rest.: –	Inv.: –	Lng≈13

c. 1:1

Broken part of a socket. A marking line for a recession of the external bone surface for a reinforcement between the sections clearly visible. It had wrongly been glued to item 035 and was removed from it in April 2022.

051	NMA	Exc.: –	Rest.: –	Inv.: M7004	Lng=278.5
 46%					
A slider which was identified as part of an aulos only during the research visit in 2022; accordingly, Litvinsky does not mention it in the context of the aulos finds. The slider plate measures 25.6×12.4mm, the rod is between 1.9–2.7mm thick.					

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Appendix 1: How to read the catalogue entries

000 --------- *Number in database*	NMA/T -------- *Current location*	Exc.: ---------- *Excavation number*	Rest.: ---------- *Restoration number*	Inv.: ---------- *Inventory number*	*Measurements taken on originals by S. Hagel in 2022* *(see Appendix 2 for the explanations of the abbreviations and comments)*
Photographs and drawings: for fragments with fingerholes on both sides of the pipe, two photographs are provided. *Authorship of photos and drawings: G. Lindström 2004 and S. Hagel 2022, edited by O. Sutkowska.* *Wherever space allows, items are depicted to scale. In other cases, the scale is indicated as a percentage.* *The downstream ends of the fragments (typically featuring a spigot or a 'bell') are generally shown pointing left.*					
Short description, starting with a classification section. For the toneholes, the following abbreviations are used: I – index-finger hole; T – thumbhole; M –middle-finger hole; R –ring-finger hole.					

Appendix 2: Abbreviations and comments to measurements

Museums: current locations of the Oxus fragments

NMA – National Museum of Antiquities of Tajikistan, Dushanbe
NMT – National Museum of Tajikistan, Dushanbe (009, 012, 019, 040, 041)

Measurements

Lng	overall length without spigot
Di	internal (bore) diameter
Do	external diameter
Sp1	spigot at the left end (typically the distal end)
Sp2	spigot at the right end (typically the proximal end)
Sp#L	spigot length
Sp#D	spigot external diameter
So1	socket at the left end (typically distal end)
So2	socket at the right end (typically the proximal end)
So#L	socket depth
So#D	socket internal diameter
H#	tonehole number #, counting from the left end
H#Pos	position of the centre of tonehole number #, measured from the left end, excluding spigot
H#Dl	longitudinal diameter of tonehole number #
H#Dt	transversal diameter of tonehole number #
H#Az	relative azimuth of tonehole, looking downstream, towards the bottom of the pipe (positive values indicate counterclockwise orientation)
H#S	specially-shaped tonehole number #:
	R rectangular
	H 'hide-shaped'
Sct#	boundary of 'section' number #, measured from the left end, excluding spigot; may be used for the start of slightly recessed areas, but also for incised lines etc.
E1	left end of fragment
E2	right end of fragment
E#P=0	end of fragment is not preserved
E1T=B	lower end of fragment is shaped as a bell
E2T=R	upper end of fragment forms a cone for inserting the reed mouthpiece
M	weight, in g

All measurements are given in mm, unless specified otherwise.
Approximate measurements are indicated by "≈" or "~".
Where ranges are indicated by hyphens, they typically apply from left to right, e.g. Do=18–17.

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