Tools Made of Hard Material of Animal Origin from Shahr-i Sokhta: Preliminary Analysis

Alberto Cosimo Potenza
Università del Salento, Dipartimento di Beni Culturali

1. Introduction

This paper sets out the preliminary results of the study of some of the tools made of hard material of animal origin from two buildings (*Building 1* and *Building 26*) and the areas outside them in the Bronze Age settlement of Shahr-i Sokhta. The tools were discovered during excavations conducted from 1997 onwards by the Iranian Archaeological Mission.

The tools analysed are from trenches excavated both inside the buildings and in the areas outside them, and can be dated to Shahr-i Sokhta Periods II and III (2800-2200 BC), considered to be proto-urban and proto-state phases (Biscione *et al*. 1977: 84).

Building 1 (Fig. 1) is of large dimensions and is located in the residential area of Shahr-i Sokhta, where the excavations began in 1999. Occupying an area of about 1600 m^2, it is situated in the north-east corner of Square O, which measures 250x250 m. Six levels of occupation were identified in *Building 1* (levels A-F): the first five are attributable to Periods II and III of the site (2800-2400 BC), while level F can be chronologically assigned to Phases 2 and 3 of Period III (2600-

Fig. 1: Shahr-i Sokhta, general view of *Building 1* (in Moradi 2015: 36 Fig. 1в).

Fig. 2: Shahr-i Sokhta, general view of *Building 26* (da http://shahresokhteh.com/Explain/8/Area_No_26).

2400 BC). Levels D and E contain the most important architectural structures (Moradi 2015: 36).

Building 26 is found in the northern part of the residential quarter (Fig. 2). The excavations have unearthed a series of parallel rooms stretching towards the east and a long corridor.

The building is datable to the final phases of occupation in this area, what has been labelled Period IV (2200-1800 BC) (Salvatori - Tosi 2005: 290).

2. Methods

The methods adopted are based on a detailed analysis of each tool, taking account of the stratigraphy of the finds and their position within the buildings. The study had the following aims:

- Determination of the tool;
- Determination of the species, part of the anatomy and age of the animal from which the tool was obtained;
- Description of the tool's characteristics;
- Assessment of the tool's state of conservation;
- Analysis by microscope of the traces of processing and/or wear;
- Measurement of the dimensions of the tool.

The tools were first sorted on the basis of their typological characteristics, (Camps Fabrer 1979; Camps Fabrer *et al*. 1990a; 1990b) subdividing them into the functional categories of awls, points, handles, plaquettes, necklace beads, pouring sticks and generically "worked bones".[1]

The next step was to identify the part of the bone used to make the tool and the species of origin. These determinations were made with recourse to the relevant reference manuals (Pales - Lambert 1971; Schmid 1972; Barone 1974; Bokony - Bartosiewicz 2000). The genera *Ovis* and *Capra* were distinguished where possible on the basis of the observations made by Boessneck, Müller and Teichert

1. The phrase "worked bones" refers to all those tools that show traces of processing and/or retouching but cannot be included in any specific category.

(Boessneck *et al.*, 1964; Boessneck 1969: 331-358), combined with the studies of Prummel - Frisch (1986: 567-577) and the more recent work by Zeder - Lapham (2010: 2887-2905).

The animals were divided into adults and sub-adults on the basis of the fusion of the articular epiphyses, with reference to the studies by Silver (1969: 283-302; De Grossi Mazzorin 2008) and Wilson, Grigson and Payne (1982).

The description of the tools involved a detailed analysis of each individual morphological characteristic. The distinctive features of each object were described analytically, focusing on the processing techniques and the state of conservation.

The next step was the identification of traces that could indicate the specific techniques used to make the tool and its function. These traces were photographed with a digital *RoHS* microscope with an optimal resolution of 640x480 pixels and a maximum magnification of 500X. The traces identified were determined and classified in terms of the type of contact on the bone, i.e. production; abrasion; use; gnawing (De Grossi Mazzorin 2008).

The last operation in this phase of study was the measurement of each tool in terms of maximum length, width and thickness. For the awls it should be pointed out that when the epiphysis that the tool was made from is conserved, the width and thickness were measured at the point of maximum expansion of the diaphysis: this is because the epiphysis is not the functional part of the tool and its measurement would considerably distort the dimensional characteristics of the object.

3. Bone industry

A total of 112 tools obtained from hard animal material were analysed. Of these, 56 are not from specific buildings, 44 are from *Building 1* and 12 are from *Building 26* (Fig. 3).

Pointed tools are predominant (Fig. 4): the sample analysed is composed of 67 awls (60% of the tools), 13 points (12%), 7 handles (6%), 9 pouring sticks

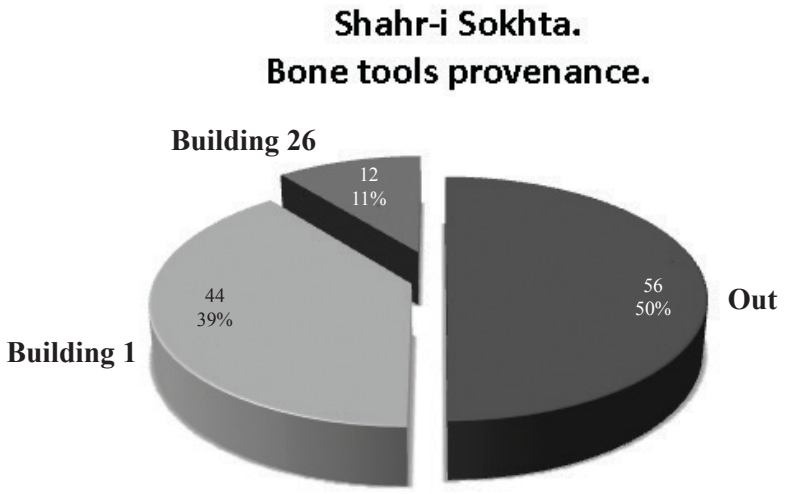

Fig. 3: Shahr-i Sokhta, provenance of bone tools.

(8%), 6 plaquettes (5%), 2 necklace beads (2%) and 8 worked bones of uncertain functional attribution (7%).

Subdividing the sample by provenance (Fig. 5), awls are the most representative objects made of hard material in all contexts.

4. Awls (67)

A total of 67 awls (Camps Fabrer *et al.* 1990a) were analysed, 29 of which were from trenches outside the buildings, 32 from *Building 1* (Periods II and III) and 6 from *Building 26* (Period IV). They were all made from long bones and they exhibit no typological differentiation with respect to the different periods. In those cases where it was possible to determine the species of the animal of origin, only caprines were recognised, distributed as follows: for the external trenches, 17 cases out of 29 (58.6 %); for *Building 1*, 26 cases out of 32 (81.2 %); for *Building 26*, 4 cases out of 6 (66.6 %). It was also possible in some cases to distinguish between sheep (*Ovis aries*) and goat (*Capra hircus*), with a general predominance of the former (Tab. 1).

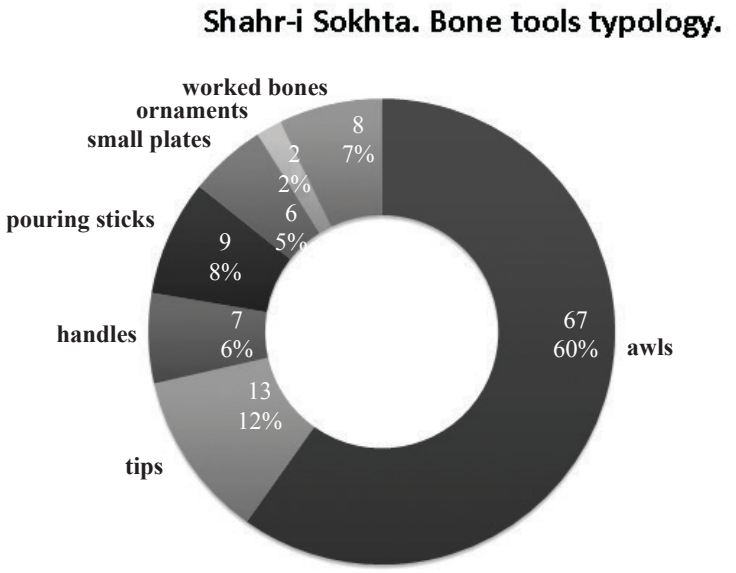

Fig. 4: Shahr-i Sokhta, type of bone tools.

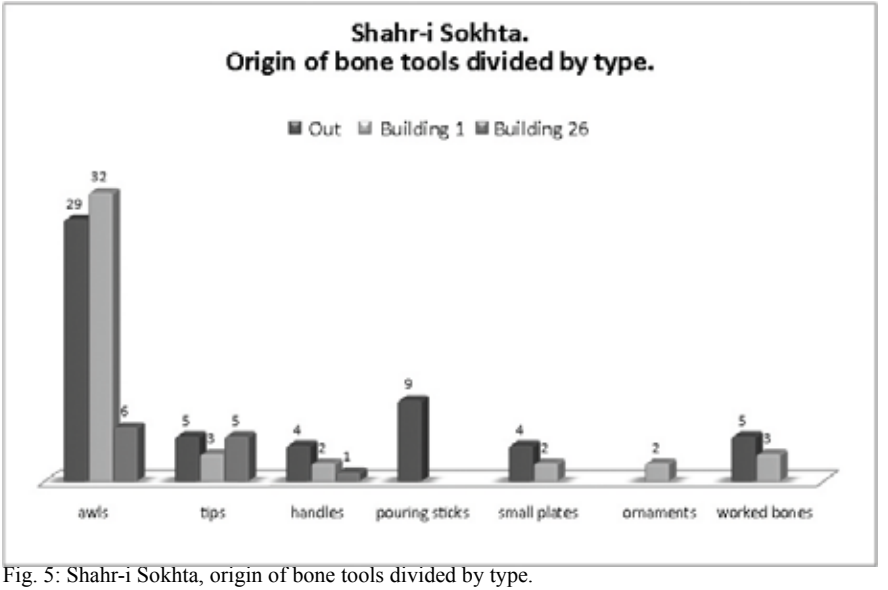

Fig. 5: Shahr-i Sokhta, origin of bone tools divided by type.

Punteruoli (67)						
				Ovis aries	Capra hiurcus	Ovis vel. Capra
		Out		3	2	12
Su ossa determinabili	47	Edificio 1		15	2	9
		Edificio 26		2	1	1
		Out	12			
Su ossa indeterminabili	20	Edificio 1	6			
		Edificio 26	2			

Tab. 1: identification of the species from which the awls were obtained.

5. Points (13)

The points differ from the awls in terms of morphological characteristics, post-depositional fractures, state of conservation and dimensions. In this study it was decided to separate them from the awls because, as they are almost all fragmentary, they might be the extremities of composite tools with handles.

Of the 13 points analysed, 5 are from the trenches outside the buildings, 3 are from *Building 1* and 5 are from *Building 26* (Fig. 9).

They are all obtained from diaphyses of indeterminate mammal bones, and they measure from 20 to 60 mm. In 7 cases the extremity is flattened, sharpened and roughly triangular, in one case elongated cone-shaped and 5 cases sharpened.

6. Handles (7)

This category includes bones that have been carved into a cylindrical shape, polished on both edges, inside which a bone or stone point was inserted. They are considered handles because in some cases, sharpened pieces of bone have been found inside them, having possibly been held in place by pieces of wood (Bulgarelli 1977: 272).

They are all obtained from the long-bone diaphyses of caprines, generally tibiae. Four were discovered in the external trenches, 2 inside *Building 1* and one in *Building 26* (Fig. 10). There is no typological differentiation in terms of the various periods of occupation of Shahr-i Sokhta.

Fig. 6: Shahr-i Sokhta, awls. 1: awl on distal part of O/C metapodial; 2: awl on distal part of *Ovis aries* metacarpal; 3: awl on distal part of *Ovis aries* metatarsal; 4: awl on distal part of O/C tibia; 5: awl on distal part of *Capra hircus* tibia; 6, 7: awls on proximal parts of O/C ulna; 8: awl on undefined long bone diaphysise; 9: awl on proximal part of *Ovis aries* radius; 10: awl on distal part of *Capra hircus* radius.

Fig. 7: burning awls.

Fig. 8: awls with abrasion marks.

Fig. 9: Shahr-i Sokhta, tips.

7. Pouring sticks (9)

The term pourer (Bulgarelli 1977: 272) refers to elongated objects with a semicircular cross-section obtained from the diaphysis of the humerus of a large bird, which was probably used for mixing liquids.

Pourers have been discovered in Shahr-i Sokhta in both urban contexts inside the necropolis as part of the grave goods of burials dated to Periods II and III (Piperno - Salvatori 2007). Studies performed on the bones of large migratory birds (Cassoli 1977: 173-182; Gala - Tagliacozzo 2014: 327-329) including the humeri of greylag goose (*Anser anser*), bar-headed goose (*Anser indicus*), cinereous vulture (*Aegypius monachus*), Siberian crane (*Grus leucogeranus*), steppe eagle (*Aquila nipalensis*), eastern imperial eagle (*Aquila heliaca*) and Dalmatian pelican (*Pelecanus crispus*) confirm the presence of traces of butchering. Regarding the pourers, although the part of the diaphysis used to make the tool and the processing of the bone make it impossible to determine the species of origin, they were probably made from the humeri of the above-mentioned species.

All the pourers analysed in this study are from the excavation of the trenches outside the buildings of Shahr-i Sokhta and are highly fragmentary given their

Fig. 10: Shahr-i Sokhta, handles.

delicate nature. In those cases in which they were retrieved intact or it was possible to reconstruct them, they are rounded at both ends and polished all over. In only one case, the proximal extremity is pointed (while the distal extremity is broken). The edges are carefully polished (Fig. 11).

In only one case, the dorsal face of the tool has nine small circular decorative notches along the longitudinal axis.

8. Bone plaquettes (6)

Some fragments of small bone plaquettes, incised and decorated, were discovered inside the settlement of Shahr-i Sokhta. These small plaquettes can be interpreted as decorative elements, stamps or small gaming counters. Plaquettes made of stone, wood, ivory and bone associated with board games are very common in Iranic cultures (Jarrige *et al.* 2011: 24-25). Such objects are often associated with burials in Shahr-i Sokhta (Piperno - Salvatori 2007).

The objects analysed and attributed to this category are highly fragmentary and poorly conserved. Four are from the external trenches and two are from levels

corresponding to Periods II and III of *Building 1* (Fig. 12). They have geometric decorations with zigzags and concentric circles.

9. Necklace beads (2)

Two small cylindrical objects were interpreted as necklace beads (Camps Fabrer *et al.* 1990b), obtained from the diaphysis of a long bone of a small indeterminate mammal. Found in *Building 1*, they are both intact and polished all over. Tapering along the edges, they have a hole through them and were probably used as ornaments (Fig. 12).

10. Worked bones (8)

This generic term refers to all those bone fragments that have traces of processing but cannot be attributed to a specific type of tool, either due to their fragmentary nature or because they are unfinished.

This category includes 8 items, 5 of which are from the trenches outside the buildings and 3 from *Building 1*. No object of this type was discovered in *Building 26*.

Among the worked bones from outside the buildings, we find:

− a fragment of indeterminate bone with a rounded polished edge, on which small abrasion marks due to processing can be seen;

− a fragment of indeterminate long-bone diaphysis, polished all over, which forms a hollow cylinder polished at one end and broken at the other (possibly a fragmentary handle);

− a fragment of indeterminate bone with a rounded polished edge, on which small abrasion marks due to processing can be seen;

− a fragment of indeterminate long-bone diaphysis, polished all over, cylindrical in shape but tapering slightly towards the proximal extremity;

− a fragment of a bone object, probably circular in shape, polished on both edges and decorated on the dorsal face, with two grooves incised on each side running parallel to the edges.

Fig. 11: Shahr-i Sokhta, pouring sticks.

Fig. 12: Shahr-i Sokhta, small plates (1-6) and ornaments (7-8).

From *Building 1* we have:

– a fragment of sheep or goat horn, polished on one end, flattened and roughly rectangular. It has four holes;

– an object obtained from a fragment of indeterminate long-bone diaphysis, with the back part missing, polished all over and carved to form what was probably a cylindrical ornament. At about a quarter of the way along its length it has a deep polished groove that divides the object into two distinct parts;

– a fragment of indeterminate worked bone with a rounded polished edge and a hook on the rear face. Along the ventral face there are three large almond-shaped notches in an irregular pattern. The distal portion is broken off, making it impossible to determine the object's function.

11. Conclusions

This paper presents a preliminary analysis of a number of tools obtained from hard animal material from Shahr-i Sokhta. The sample analysed comes from two

buildings (*Building 1* and *Building 26*) datable to two different but consecutive phases of occupation (Moradi 2015: 36), while a third group of objects comes from trenches excavated outside these buildings.

In the sample analysed, the processing of the hard animal material appears unsophisticated, aimed at producing a small number of classes of tool, consisting mostly of pointed objects used for perforating or incising fabrics, ceramics and various utensils. Indeed, awls and points predominate in all phases of occupation and every environment analysed. In quantitative terms, these objects are followed by bone handles (also linked to tools for incising or perforating), derived mainly from long bones of caprines, in particular metapodials, tibiae, radii and ulnae.

No technological differences in the creation of pointed objects are observed, attesting to a morphological and typological continuity in production.

A special class of bone tools is that of the pourers, elongated in shape and semicircular in cross-section obtained from diaphyses of humeri of large birds, discovered in both urban contexts (such as the 9 specimens considered in this preliminary analysis) and inside the necropolis (Piperno - Salvatori 2007). Their actual use remains uncertain and is the object of study.

Extremely rare in contrast are ornamental objects. Some bone plaquettes have decorative motifs similar to stone stamp seals discovered in Shahr-i Sokhta and throughout the Middle East from the Mediterranean to the Indus (Tusa 1977: 257).

Another interesting issue is the quantity of objects discovered in the different buildings: while *Building 1* (dated to Periods II-III of the site) (Biscione *et al*. 1977: 84) yielded 44 tools, in *Building 26* (dated to the settlement's final phases of occupation, i.e. Period IV) (Salvatori - Tosi 2005: 290) just 12 objects were discovered. This quantitative difference might be related to a progressive decline in population and a crisis of urban civilisation seen across eastern Persia at that time (Biscione 2008).

However, in order to clarify their use and the degree of specialisation of production, a full analysis of all the bone tools discovered in the new excavations at Shahr-i Sokhta is necessary.

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