First identification of bone whistle-use in Dynastic Egypt

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Abstract

Despite over 200 years of intensive academic interest in Pharaonic Egypt, little focus has been given to understanding the production, use, and diversity of the osseous material culture created by this enigmatic culture. Here the authors present the identification of a bone whistle recovered from the Eighteenth Dynasty (late 14th century BC) city of Akhetaten (modern Amarna), Middle Egypt. Found at the Stone Village, a peripheral workers' settlement, this object fits with ideas that this community was heavily policed because of their proximity to the royal cemetery and likely connection to work on the royal tombs. Significantly, this object is the first of its kind identified in a Dynastic context and demonstrates the potential insights that wait to be gained from intensive examination of Egypt's osseous technologies.

Keywords: Osseous technology; Pharaonic Egypt; Instruments; Policing; Phalangeal whistle; Amarna.

Introduction

The city of Akhetaten (modern Amarna) was established by Pharaoh Akhenaten in c.1347 BC and flourished for only a single generation before being largely abandoned shortly after his death in c. 1332 BC. The site provides unique insight into pharaonic Egypt. Not only are the ruins of monumental architecture left behind, but also the houses and workshops of the wealthy through to the dependent (Kemp 2012). Amarna is one of the most extensively excavated pharaonic settlements, in part through the work of the Amarna Project since the 1970s, which has prioritized investigations of urban life through the integrated study of artefactual and environmental remains alongside textual, artistic and architectural evidence.

In the desert plains east of the city centre are two small isolated settlements, the Workmen's Village and Stone Village (Figure 1). Their locations, and parallels with the famous tomb workers' community at Deir el-Medina (at modern Luxor), suggest these settlements housed workers involved in creating rock-cut tombs, especially in the royal cemetery situated in a wadi (dried water course) in the eastern cliffs. The Stone Village lies in a bay on the edge of a low plateau on the desert plain (Figure 2). Survey and excavation here from 2005–2009 identified a central occupation area of c. 55 x 65–85 m (the Main Site), and a diverse and broadly residential artefact assemblage (Stevens 2012a, b). Unlike the well-organised ground plan of the Workmen's Village (Kemp 1987, 2012: 191–93), which is an excellent example of a state-built labourers' settlement, the Stone Village was constructed in a more organic fashion and seems to have been a step further removed from the institutional support provided to the Workmen's Village (Stevens 2012a). The Workmen's Village may have housed skilled stone-cutters, and the Stone Village a secondary labour force or personnel tasked with bringing supplies to tomb workers (Kemp 1987, 2012: 190–96; Stevens 2012a).

Both settlements, and the eastern boundary of the city generally, seem to have been closely monitored by security forces. Evidence for this includes the presence of a complex network of roadways around the desert plain and adjacent cliffs, formed of linear tracts from which loose stones have been cleared and piled along the edges. Some roadways lead out to tombs and were probably chariot routes, but others cross steep ground that would have been impractical for chariots, or for transporting supplies on foot or by pack animals. In part, the road network seems intended for foot patrols by security personnel stationed at intervals and responsible for discrete sections of road (Petrie 1894: 4–5; Timme 1917: 16, 24–27; Fenwick 2004: 883–84; Kemp 2012: 158–61; Stevens 2012a: 77–80, 414–15). This interpretation is reinforced by the presence of three closed roadway circuits around the Workmen's Village, Stone Village, and the royal cemetery itself (Harrell 2018; Figure 1). These seem to mark boundaries around these sites, suggesting that particular attention was paid to movement in and out of these areas.

On the outskirts of the Stone Village there are two simple stone structures (Structures 1 and 2) built into the road circuit that are thought to have been connected with the supply and monitoring of this site (Stevens 2012a: 89–93, 312–60). Excavation within Structure I in 2008 recovered a single artefact (object 39482) — a perforated cow phalanx with no other signs of working. Recent examination of this object identified it as a probable phalangeal whistle, based on comparison to previously reported bone whistles, experimental results, and traceological analysis. This identification is outlined below, and the find is placed within its archaeological and cultural context to consider the possibility it was used by security forces as they monitored Amarna's desert outskirts. This non-descript piece also establishes a new class of object for Dynastic Egypt, that of phalangeal whistles.

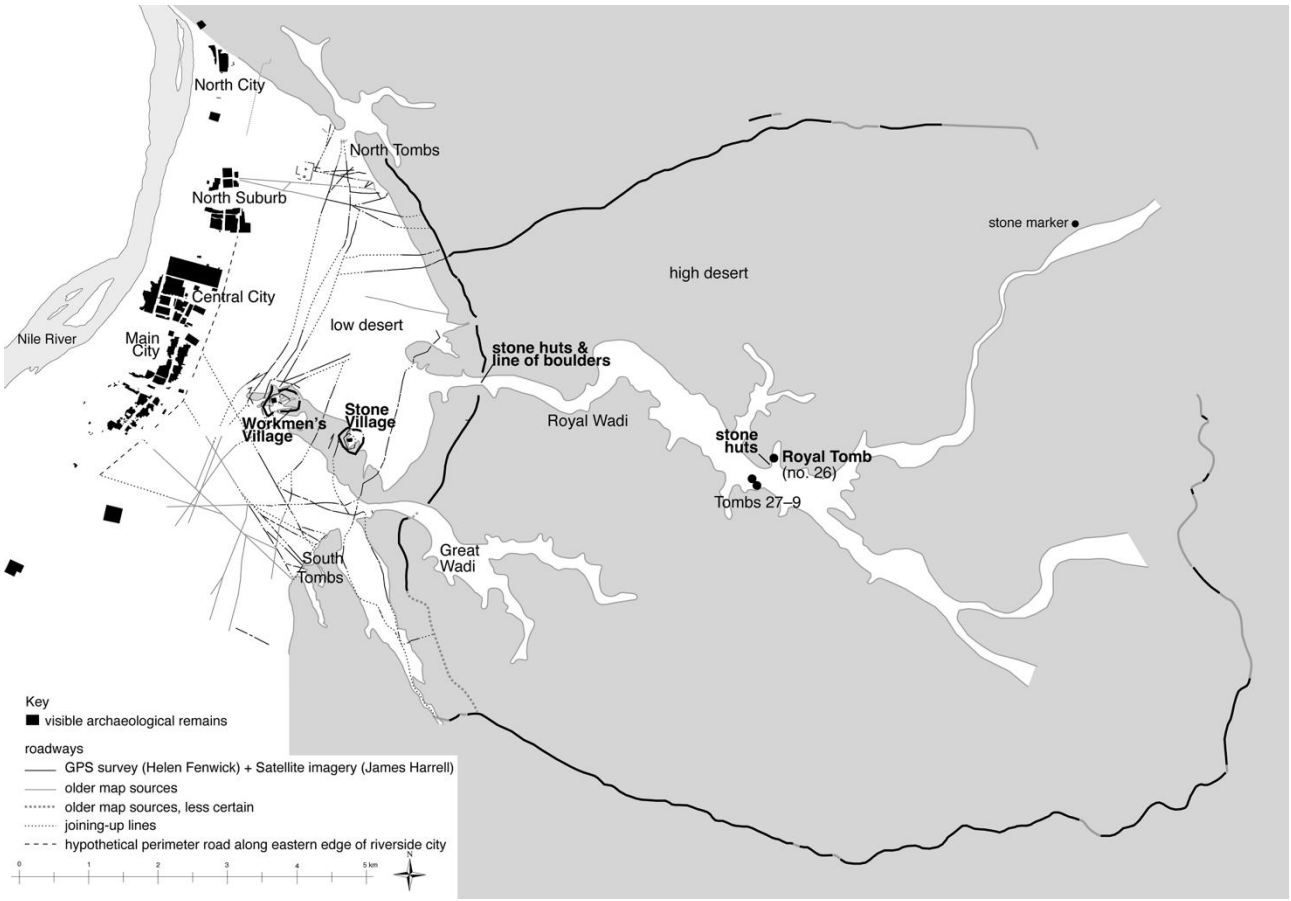

Figure 1: Map of Amarna showing the Stone Village and network of desert roadways. In bold are the road circuits around the Stone Village, Workmen's Village, and Royal Cemetery. Map of the main bay by Barry Kemp and Helen Fenwick (Amarna Project); circuit around the Royal Cemetery redrawn from Harrell (2018: fig. 1).

Context

Structure I is built into the road circuit south of the Main Site (Figures 2–4). Structure II, 30 m to the west, connects with this same roadway (Figures 2 and 4). Both sit on top of the low plateau overlooking the Main Site and are positioned in gullies that provide convenient access points to the Main Site (although it is not yet clear where the entrance/s to the latter were located). Structure I is rectangular, measuring c. 12 x 7 m, and built of local limestone boulders and clay mortar (Figure 3). The floor was of smooth clay, possibly the natural bed of the gully. Through most of their surviving height of c. 45 cm, the walls were terraced into the gully. This may be close to their original height, as there was relatively little stone collapse within the structure, although flood waters had disrupted the construction and potentially washed-out some building collapse. There were no obvious doorways, which supports the idea that the walls were not full-height. The lack of roofing plaster in the fill could suggest that Structure I had an ephemeral cover, made from textiles, matting or similar.

Figure 2. Plan of the Stone Village. Image courtesy of the Amarna Project.

Figure 3. Structure I after excavation, facing north-east. Image courtesy of the Amarna Project.

Figure 4. Structures II (foreground) and I after excavation, facing north-east. Note the roadway joining the structures. Image courtesy of the Amarna Project.

Structure I was filled with windblown sand (Unit 12330), and some stone wall collapse (Unit 12332). While Structure II and the Main Site showed evidence of looting (e.g., pits, modern debris), there were few signs of disturbance at Structure I. Very little material culture was encountered within or immediately surrounding the construction, suggesting that it was clean at the time of abandonment, or that items were washed outside by flooding. This lack of material culture contrasts with Structure II where items such as potsherds, bone and metal fragments were noticeable in deposits and trampled into floors. The bone object was, in fact, the only artefact found within Structure I (in Unit 12330). It is unlikely that artefacts were washed *into* the structure, as it is located on high ground with little material culture visible in its vicinity. Although the windblown sand of Unit 12330 is not an original or sealed deposit, it is reasonable to propose that the bone object was present here at the time the settlement was abandoned and was not washed in or (re)deposited during later looting.

Methods

The bone artefact was examined at the Amarna dig house using a portable MS3 digital microscope, with macrophotography conducted using a Canon EOS 400D digital SLR camera. Technological description follows standards set out in previous analyses of osseous material culture (e.g., Buc & Lopont 2007; Choyke 2005; Choyke & Bartosiewicz 2001; Langley 2023; LeMoine 1994). Mitutoyo digital calipers, the jaws covered in a layer of plastic coating to prevent damage to the object, were used to collect metric data. Identification of taphonomic alterations, manufacturing marks, and use traces were based on comparison to published works (e.g., Fernandez-Jalvo and Andrews 2016; Harrison 1978; LeMoine 1994; Fisher 1995; d'Errico & Villa 1997; Buc & Loponte 2007; Christidou 2008; Backwell *et al*. 2012; Bradfield 2015). Identification of the bone element was provided by A. Legge cited in Stevens (2012b: 375).

Results

The object is an intact first phalanx of a juvenile *Bos* featuring a single perforation through its 6.3 cm length (Figure 5). No other signs of working were observed. While present in two pieces today, the element being unfused, it would have been connected by cartilage and a single piece when in use. The piece is slightly weathered, presenting a chalky appearance to the surface and some termite damage, limited to a star-shaped pit on the proximal end of the ventral surface, and clusters of shallow, sub-parallel striations to both the ventral and dorsal surfaces (Figure 5). This damage is superficial and does not impact either perforation rim.

Excavations at the Stone Village produced a relatively small assemblage of faunal remains. In part, this probably reflects the excavation strategy, which focused on residential and working spaces that were kept largely clear of organic refuse; it is unlikely to be due to dogs or other mammals having digested substantial portions of the sample (Legge 2012: 10). It could also indicate a limited meat supply at the site, although more work is needed. Almost certainly, most of the meat was sent into the settlement from the riverside city and not farmed on site. Of the fauna present, 40.4% was made up of caprine bone and another 36.8% of cattle, including a small number of bones from feet, which could be a typical joint rationed out to lower socio-economic communities (Legge 2012: 10). As such, the raw material selected for use would have likely been relatively easily available.

The perforation, being over 6 cm long, is too long and straight to have been incidentally produced by a carnivore (e.g., dog, hyena, fox). Additionally, trampling can be ruled out as while experiments

undertaken by Harrison (1978: 10-14) found that holes could be produced in the proximal end of the posterior surface of similarly-shaped elements (and indeed, where most Palaeolithic examples are pierced) when trampled in gravel, the perforation on the Amarna example is through the thickest section, the condyles. Further, shallow sub-parallel oblique striations running around the circular perforation lip at either extremity along with a slight deviation in the axis of the perforation for the last 1 cm section, indicate drilling from both ends. The maximum perforation diameter is 6.02 mm at the proximal extremity and is slightly smaller at the distal end (5.03 mm) reflecting that drilling advanced slightly more from the proximal end. Both rims are regular and smooth, indicating that the perforation was made into fresh bone.

In terms of the perforating tool, a metal (copper, bronze) awl or small chisel would be adequate. Little is currently known about the specific methods and techniques used to craft osseous materials in the Pharaonic context, though Krzyszkowska & Morkot (2000: 328-329) state that, “many of the tools — saws, chisels, knives, points and drills — employed in ivory-working were those used in woodworking…and the craft may have been utilizing by the same workers”. The use of bronze-edges to shape bone has been observed on other bone material culture recovered from Amarna (MCL pers. obs.), and while lithic edges were also in use, it would have had to be a very narrow (c. 5 mm) blade to accomplish the resulting perforation.

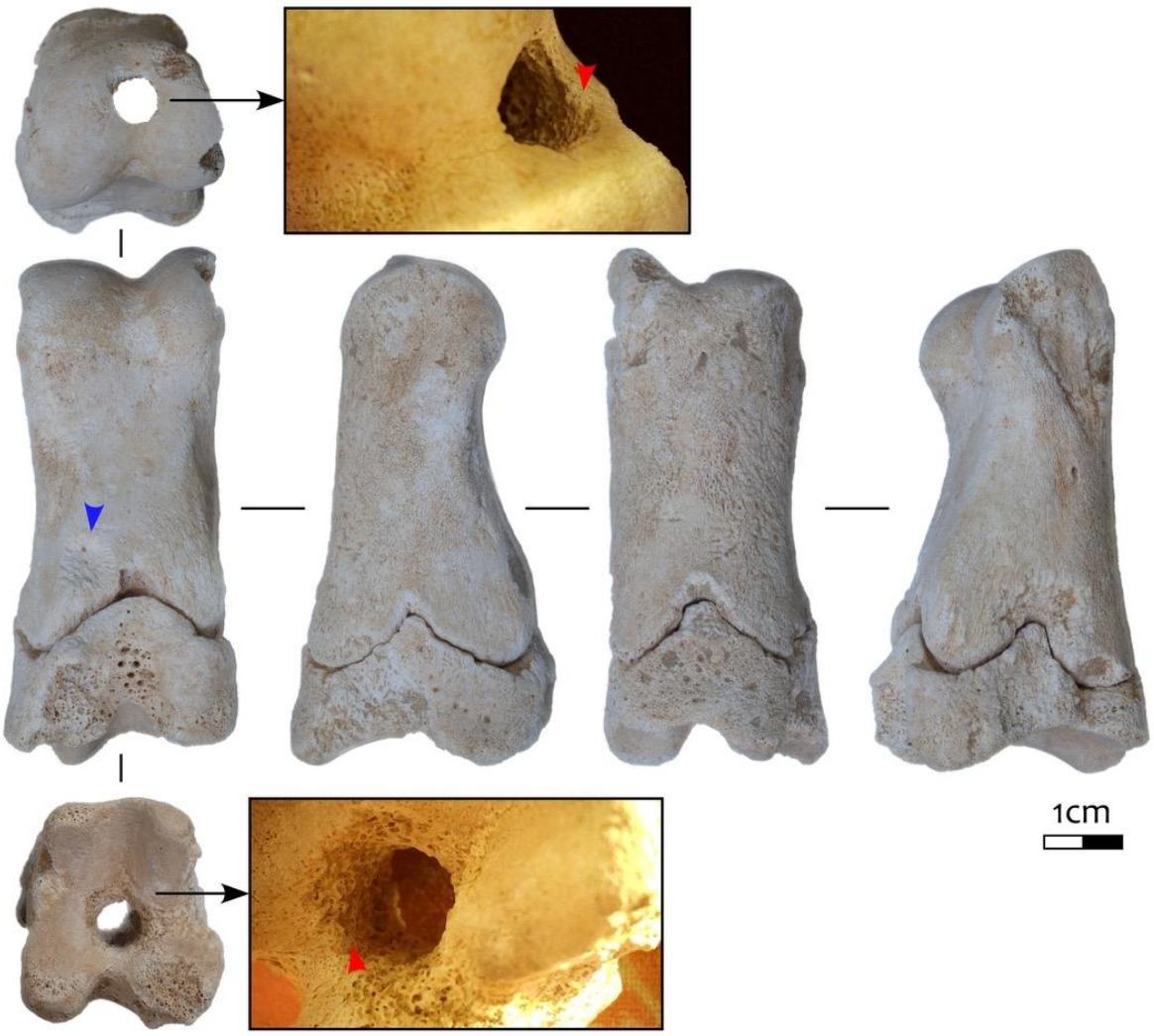

Figure 5: Phalanx of a juvenile *Bos* with a single perforation through its length. Red arrows indicate striations from drilling. Blue arrow indicates area of termite damage.

The identification of this object as a likely whistle is based on comparison to phalangeal artefacts reported globally. While ungulate feet and leg bones are reported in both ethnographic and archaeological contexts as having been used to make figurines or dolls (Siret 1908; Caldwell 2009; Christidou *et al*. 2009; Pawłowska & Barański 2020; Yeomans *et al*. 2021), as components in creating the 'hole-and-pin' game (Guilday 1963; Morse 1963; Jolly 1979; Crowe 2001: 33), and to make beads (Torres *et al*. 2020), none of these options fit the Amarna artefact as will be unpacked below.

The Amarna artefact does not exhibit any signs of stringing wear (rounding or notching of the perforation rim) and as such, a pendant or other suspended form of artefact can be ruled out. In terms of being a game component, there are two ethnographically and archaeologically recorded possibilities which utilise ungulate phalanx bones (or similarly-shaped skeletal elements). The first is the hole-and-pin (also known as the 'ring-and-pin' or 'cup-and-pin') game. This game entails a series of perforated phalangeal bones which are strung together. The player softly tosses the series of bones into the air and attempts to 'catch' them on the end of a long unipoint attached to the end of the string (Jolly 1979: 56). Deer phalangeal bones are the elements of choice for creating this game which saw widespread popularity across Indigenous North America into recent times (Culin 1907: 527–62). The Amarna perforated bone, while the same element (if from a different ungulate species), is not consistent with this interpretation, however. These game pieces feature a large opening at one end, the entire base of the bone being cut open to create a cavity for the pin to catch, and a smaller hole at the opposing end through which the string passes. The perforation on the Amarna piece is practically the same width throughout and much too small for 'catching' on a pin-head. Furthermore, the game pieces would accrue a distinctive series of use-related wear: stringing wear around the rim of the smaller perforation, rounding on the top section from nesting into the bone piece above (several bone 'cups' are strung together in series), rounding of the bottom edge from nesting with the piece below; and short, shallow, and randomly orientated striations on the interior and exterior surfaces from the pin tip scratching against the piece as it tries to catch it. While it is conceivable that some of this wear may have been removed from the Amarna piece owing to the slight weathering of its surfaces, others (rounding of the edges, stringing wear) should remain evident. None of these characteristics, however, were observed.

The other type of game which utilises ungulate phalanges is reported for northern Europe, and specifically across Finland, the Åland Islands, Sweden, Estonia, Lithuania, Russia, Denmark, Germany, the Netherlands, the British Isles, and Iceland. Here, cattle phalanges have been widely reported from Iron Age through to 17th century contexts and often exhibit a range of modifications, including perforations, smoothing, cut marks, incised decorations, and the addition of metal pieces (Bläuer et al. 2019; Blaževičius 2008; Lawrence 2005; Luik 2016; Luik et al. 2015; MacGregor 1974a; Traill 1890). Closer to Egypt, a similar sounding game is also recorded for ethno-historic Syria (Gilmour 1997; Schaeffer 1962, 103–105). Most typically, these finds feature a hole in one end or side which doesn't pass through the bone completely, and into which metal was stuffed (nails, scrap metal, liquid metal being poured into the bone cavity) to increase the weight of the piece. These bones often also display a cut extremity (most commonly the posterior side) to create one surface which is flatter or smoother than the naturally shaped surfaces. Some examples feature incised decoration, and a good number have been observed to feature well-developed patina from extensive handling (Bläuer et al. 2019). Such bones are interpreted as components in a skittles type of game, in which those pieces with incised motifs were targets to be hit, while those without were the items

thrown at the target. In another game, bones with one side flattened were part of a game where they were thrown and how they landed was read (Bläuer et al. 2019; Helanko 1975; Lawrence 2005; Luik 2016; MacGregor 1974b; Roes 1963). Bläuer et al. (2019) suggest that first phalanges of cattle are said to be popular for use as gaming pieces as they are easy to obtain, small, and can naturally stand upright.

While it is possible that the Amarna item could constitute a gaming piece, if this was the case it doesn't appear to have been used in the manner recorded for northern Europe as not only was it found in isolation to other similar pieces (or anything else), no evidence of battering, extremity or side flattening, or marking are evident. Furthermore, careful observation of the interior of the perforation found no discolouration nor remnants of metals which have been found in phalanges used as gaming pieces elsewhere.

In terms of being a figurine or doll, this interpretation is inconsistent with its cultural context. Human figurines for this period are not uncommon and are primarily made from fired or unfired clay, though examples made in faience, stone, ivory, and wood are also known (Waraksa 2008). These figurines tend to average about 15 cm in height and usually depict nude females, either standing, holding a child, or lying on a bed, sometimes with a child next to them. Many are painted and some dating from the Middle through the New Kingdom periods were decorated with faience, metal, or shell jewellery or created to appear as wearing tattoos or jewellery (Pinch 1993: 198–234; Waraksa 2008: 2). While anthropoid figures were also made from ivory in the New Kingdom, these are rare and carefully carved and polished (e.g., Hill 1992; Winlock 1922: 171).

Elsewhere, phalangeal anthropomorphic figurines — some drilled and some undrilled — have been observed being used as birthing amulets and dolls by recent circumpolar peoples (Jelínek 1979; Gorbatcheva *et al*. 2008), and as ritual items in southern Senegal (Baldé cited in Caldwell 2009). Archaeologically, incised ungulate phalangeal figurines have been found in Iberian Chalcolithic sites (Siret 1908), Neolithic Türkiye (Pawłowska & Barański 2020), Neolithic Levant (Christidou *et al*. 2009), and in the form of mammoth metacarpals or metatarsals in Upper Palaeolithic central Europe (Jelínek 1979). These specific bones are selected as they naturally provide an anthropomorphic appearance with the bone's proximal end appearing as a pelvis while the narrower distal end resembles shoulders with breasts (Caldwell 2009: 68). In ancient Egypt and neighbouring Nubia, distinctly shaped pebbles were sometimes used as human effigies, occasionally decorated with paint or carving (e.g., Pinch 1993: 209–20; Francigny & De Voogt 2014), and it is possible that bones were used similarly. The Amarna piece would attest to this practice more convincingly, however, if it were from the kind of ritual context in which these pebbles sometimes occur (e.g., votive deposits), or featured decoration (paint, carving, slip) or traces of attachments. Given that human figurines in Egyptian contexts have been discovered in a range of mediums and forms, none of which utilise phalangeal bones, or bone at all, the odds are slim that the Amarna artefact is a figurine.

Finally, there have been suggestions that perforated phalangeal bones could constitute containers or handles for points (Caldwell 2009: 68; Stevens 2012b: 375). Neither idea works well in this case as, in terms of being a container, two plugs would be required to close the perforation, the quantity of material able to be held would be exceptionally small, and residues or discolouration around the perforation rims and interior is not present. In terms of being a handle, only one end is typically perforated to haft the point (otherwise the hafted tool would not be fixed), and while it could be argued that the metal (or other material) point could have broken through the bone wall in use, both

perforations have been executed from the exterior surface towards the interior of the bone to entertain this possibility.

Lastly, a sound-making device – the 'buzz bone' – usually made on pig metapodials (for medieval European contexts) or cattle phalanges (for ethnographic North American contexts) should be considered. Like the Amarna artefact, these items are unmodified apart from a single perforation, except that the perforation on buzz bones is located through the centre of the shaft rather through the length of the bone. A long cord was passed through the perforation, allowing the bone to be spun swiftly on its axis creating a humming noise (Culin 1907, 751–7; Gál 2020). Apart from the location (and axis) of the perforation being in the wrong place for this interpretation, this noise-maker requires the attachment and agitation of cords or threads which would result in stringing wear around the perforation edges. These differences again rule out this interpretation.

Thus, we are left with only one viable option — as a whistle. Phalangeal whistles have been identified and discussed for Palaeolithic European contexts for decades (e.g., Lartet & Christy 1875: 22, 48, 172; Harrison 1978; Morley 2013: 37–38, 100–105). Such bone whistles have also been used in modern times, for example, by Native American peoples (Sollas 1924: 529, fig. 298i). In both of these contexts, the whistles are made on the first phalanx of reindeer (*Rangifer tarandus*) and feature a single perforation to the proximal end of the posterior surface. Experiments with recreating reindeer phalangeal whistles found that when the perforations are too small the whistle could only produce soft sounds. Larger perforations are required if loud sounds are sought. Whistles with larger holes can produce tones between 2,700 Hz and 4,000 Hz and be clearly audible up to 1.25 km away (Dauvois 1989: 5-7; Harrison's 1978: 15).

One of the key differences between the Palaeolithic examples and the Amarna artefact is the latter features a single, long perforation, creating a tube through the phalanx. To determine if the Amarna item could produce a tone and how it functioned, two fresh cattle phalanx were purchased at the local El-Hagg Qandil butcher. These bones were cleaned (flesh scraped off with metal knives and the bone washed in fresh water) and then a 5 mm hole drilled through their centre using a modern metal drill bit. As the aim was to test whether a tone could be produced, using technologies consistent with those used during the Amarna period was not necessary. In testing, it was found that the dorsal face of the proximal condyle provides the perfect natural surface for resting the lower lip at the correct angle for blowing air across the perforation rim. A high-pitch tone was produced, and with practice, this tone could achieve significant volume (see Supplementary Information for tone produced). The Amarna whistle acts more like bird bone whistles which have been recovered from contexts dating back to the terminal Pleistocene than the Palaeolithic form of phalangeal whistle (e.g., Conard *et al*. 2009; Davin *et al*. 2023) — but instead of utilising the natural tubular form of bird bone, an artificial tube has been created by drilling through the length of the bone. Like the reindeer phalangeal whistles, however, you can also achieve a 'trill-like' note if you cover and uncover the lower hole rapidly with a finger whilst continuously blowing across the hole (Harrison 1978: 17). As such, the Amarna object, with its perpendicular perforation, could produce both a solid and waving tone as needed.

Discussion

Having narrowed down possible interpretations for the object to a phalangeal whistle, the question is for what purpose it might have been used. To start, the item is unlikely to have been a musical instrument. A range of wind instruments is attested for ancient Egypt, but these are generally multi-

holed and so capable of producing more complex sounds (Southgate 1890; Manniche 1991: 28, 61–62, 129). A musical role cannot be dismissed, but a connection with such actions as signaling, attracting, warning, etc, appears more likely.

Human-animal interaction is one potential use context. The use of whistles in communicating commands to dogs, for example, has a long history and is widespread in recent times (e.g., Dontsa 1999; McConnell & Baylis 1985). Dogs were popular pets in Egypt, also serving as working animals, including as hunting companions, and as watch and police dogs which assisted patrolling guards (Darnell & Manassa 2007: 80–81). There is no written or artistic evidence to connect whistles with dogs in ancient Egypt, but this must remain a possibility.

Recent finds from Israel show that simple bone aerophones may have been used to imitate the calls of birds of prey at least 12,000 years ago (Davin *et al*. 2023). Could the Amarna example have served a similar purpose? The ancient Egyptians were famously talented waterfowlers – in addition to the wider paraphernalia of throwing sticks, bows, nets, etc. artworks indicate that decoy birds such as herons (e.g., *Ardea cinerea*) and Egyptian geese (*Alopochen aegyptiaca*) were employed to draw birds to hunters (e.g., Houlihan 1986: 13-16, 62-65). To our knowledge, however, there is no such precedent in Egyptian art for whistles and it is unlikely that the Amarna object would have produced a note fit for the imitation of waterfowl which requires a lower tone rather than the high pitch produced by the experimental replica. Further, while the find location may simply reflect the point of manufacture, the Stone Village is some distance from the Nile banks where birding should take place. It is also worthy of note that the aerophones from Israel were manufactured from bird bones rather than those of mammals; from Green-winged Teal (*Anas crecca*) and Eurasian Coot (*Fulica atra*), both of which have also been recovered from Amarna (e.g., Luff 2007; Stimpson 2016).

Given the diameter of the hole of the Amarna object and higher pitched frequency range of the resultant whistle, if the purpose was to imitate birds, then the calls of birds of prey would have been more appropriate (cf. Davin *et al*. 2023). Birds of prey were sometimes mummified for ritual purposes in ancient Egypt, although there is little evidence for this from Amarna itself. Furthermore, in the bird bone assemblages for the site (e.g., Luff 2007; Stimpson 2016), birds of prey are not common and are represented in the main by a single species, the Egyptian vulture (*Neophron percnopterus*), with one reported incidence of Cinereous Vulture (*Aegypius monachus*) (Luff 2007; pers. obs). Rather than the products of dedicated hunts, however, it is more likely that these scavenging birds were attracted to the refuse of human activities, a behaviour commonly observed today. At present there is no evidence that birds of prey were deliberately hunted. In more recent contexts, the use of whistles instead tends to be associated with *trained* falcons and hawks and there is no unequivocal evidence for this practice in ancient Egypt.

A final possibility is that the whistle was used in the context of policing the occupants of the Stone Village; whistles are of course commonly used today in communicating information between people (e.g., Dontsa 1999; Meyer 2015). While there is no direct evidence for this, the find context of the piece and wider evidence for the policing of Amarna's borders do provide indirect support for this idea. Structure I, where the whistle was found, has been tentatively identified as a storage building, or even a sleeping place for security personnel, and Structure II as a check point/guard post (Stevens 2012a: 92, 438–41). Certainly, both are likely to be connected with the administration of the site, given their integration into the road circuit and its likely role in setting a boundary around the settlement. The road circuit at the Stone Village has a multi-part layout which both encircles the site

(although parts of it have been washed-out) and also runs to the top of spurs that overlook the Main Site, as though directing patrols to vantage points (Stevens 2012a: 69–80). A parallel to Structures I/II can be cited from the Workmen's Village, where a simple building (Site X1) close to the perimeter road on the approach to the settlement from the city has also been interpreted as a guard house or check point (Kemp 1984: 6–8, 1987: 23). The discovery of a small wooden military standard at the Workmen's Village provides further support for a security presence at this site (Kemp 1984: 3, 1987: 43–9). Elsewhere, the periphery of the Workmen's Village also contained chapels and animal pens but, importantly, these do not provide a close parallel to Structures I and II.

The reason why these settlements were policed is likely to do with their proximity to the royal cemetery and probable connection with work on the royal tombs. The entrance to the wadi containing this cemetery is clearly visible from the Stone Village. Access to this sacred location almost certainly required extra security precautions to ensure the inviolate condition of the royal tombs. The road circuits around the cemetery and the desert settlements probably maintained control of access to the former – and perhaps something of the sacred knowledge it represented – while also keeping check of the routines of workers and the equipment they used. Support for this can be found at the contemporaneous Theban royal cemetery (Luxor). Here, the tomb workers' settlement of Deir el-Medina has preserved a rich textual record that demonstrates how this community was considered part of the territory of the royal cemetery in the Valley of the Kings, and controlled accordingly. In addition to workers' attendance lists, the Theban infrastructure included a control point for supplies and personnel located on the boundary of the cemetery (possibly at Deir el-Medina itself) and a network of additional barriers or checkpoints around this landscape (Ventura 1986: 120–44; Frandsen 1989; Eyre 2009; Burkard 2013). Not one checkpoint has yet been identified archaeologically. Comparable systems must have been in place at Akhetaten and were likely represented in part by the roadways and structures associated with them (Kemp 2012: 158–61).

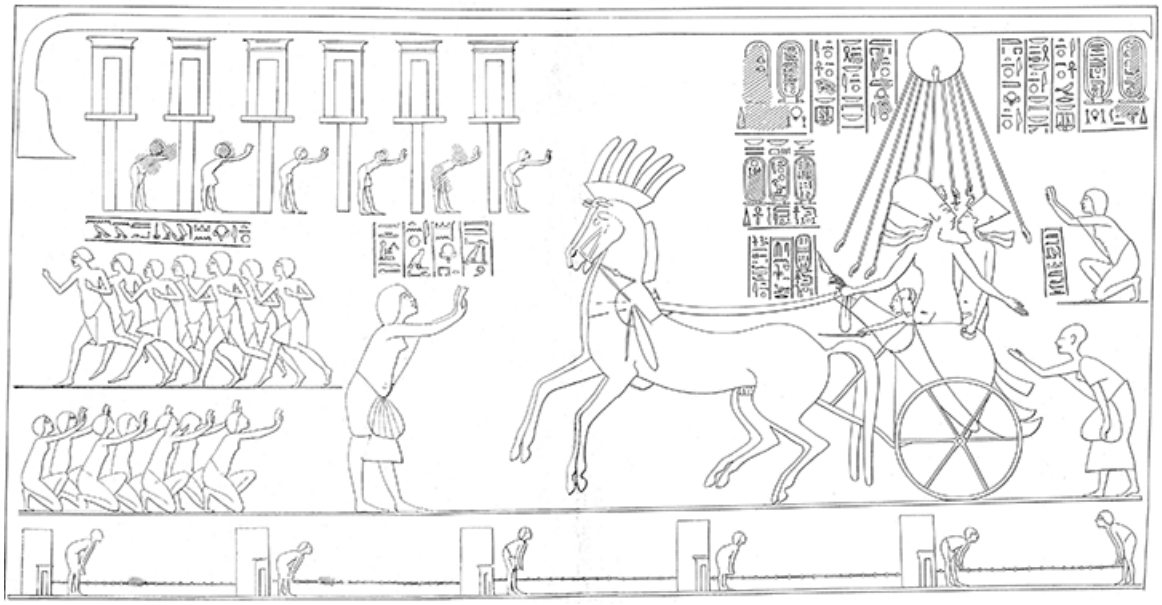

Figure 6. A scene from the Amarna tomb of the Chief of Police, Mahu, showing a series of possible watch-posts guarded by sentries (Davies 1906: Pl. XXII).

Additional support for the policing of the outskirts of Akhetaten is found in the tomb of its Chief of Police, Mahu. One scene shows police holding men in custody, seemingly having been caught trespassing on the city's perimeter (Davies 1906: 17, Pl. XXVI). Other scenes depict sentries in

connection with linear features with rounded protrusions that might represent the desert roadways (although see Monnier 2014). In one case, sentries stand outside small structures, some apparently raised and others connected by bumpy lines (Figure 6). These scenes and their setting have been much discussed. Some scholars situate them in the northern part of the city, and others the broader desert landscape, including the environs of the Workmen's and Stone Villages. The small structures have been interpreted as abbreviated buildings in the city (Kemp 1976: 97), Boundary Stelae (O'Connor 1987/8), or rock-cut tombs (Stevens 2012a: 419–20), although others see them as small military posts and signalling platforms (possibly within the city: Davies 1906: 16–17; Darnell & Manassa 2007: 194). Darnell and Manassa (2007: 194), noting that very little is known about pharaonic signalling techniques, suggest they represent communication outposts for receiving verbal and visual signals.

To date, little trace of raised or periodically spaced-out structures resembling those in the tomb scenes has been found in the city's urban areas or on its desert fringes. There are, however, occasional simple stone structures in the desert that seem reasonably interpreted as guard posts. There are examples around the Workmen's Village, near the non-elite cemeteries (Stevens *et al*. 2023: 99), and one on the low plateau north of the Main Site at the Stone Village (Structure III: Stevens 2012a: 81–5; Figures 2 and 7). Yet to be fully studied and published, many seem to be positioned in areas of high visibility. The example at the Stone Village provides an excellent view of the desert between the Main Site and the mouth of the royal wadi, where there is a cluster of stone huts that probably in part housed further guards. This is the most likely route taken by the occupants of the Stone Village if they travelled to the royal cemetery (Stevens forthcoming).

Finally, ancient Egyptian textual accounts provide clear evidence of the patrolling of borders in general (e.g., Darnell & Haddad 2003), usually by the police unit known in the New Kingdom as the *medjay* (Liska 2012). Whistles are not among the accoutrements of the armed forces known from depictions, texts, and tomb assemblages (Darnell & Manassa 2007: 70–85). They might not, however, have been a standard or prominent piece of equipment, or one that had enough prestige to be represented in formal art, particularly if as simple as the Amarna whistle. The lack of archaeological parallels to the bone whistle in general is not surprising. Much of the material culture that has come to be seen as representative of ancient Egypt originated from elite tombs, whereas the settlements and modest graves that are more likely to yield a simpler object of this kind remain under-studied and under-published.

In sum, there is evidence that the city perimeter was policed to control who was entering Akhetaten, and to keep track of resources, workers, and restricted knowledge between the city and royal tombs. While the acts of watching, enclosing, and directing movement seem to have been important components of controlling activity, the use of whistles at these peripheral locations would also make sense in that they would allow for easy alerting of neighbouring guards, other officials , or perhaps even guard dogs, when needing to draw attention to a particular space. This desert setting, distant from the built-up riverside city, would also seem to offer the perfect natural environment for aural signalling. Soundscapes, and sensory archaeology more broadly, are only beginning to be explored for ancient Egypt, with the former being considered largely within temple and ritual settings to date (e.g., Manassa 2011; Elwart & Emerit 2019; Von Lieven 2019). This small artefact, when contextualised against the archaeology and landscape of Amarna's eastern border, is a reminder of the potential sensorial and psychological aspects of social control in an everyday setting, where physically unimposing roadways may have represented powerful boundaries within a culture that

practiced corporal punishment, particularly for transgression onto sacred space (Lorton 1977; Willems 1990; Dabbs & Zabecki 2015).

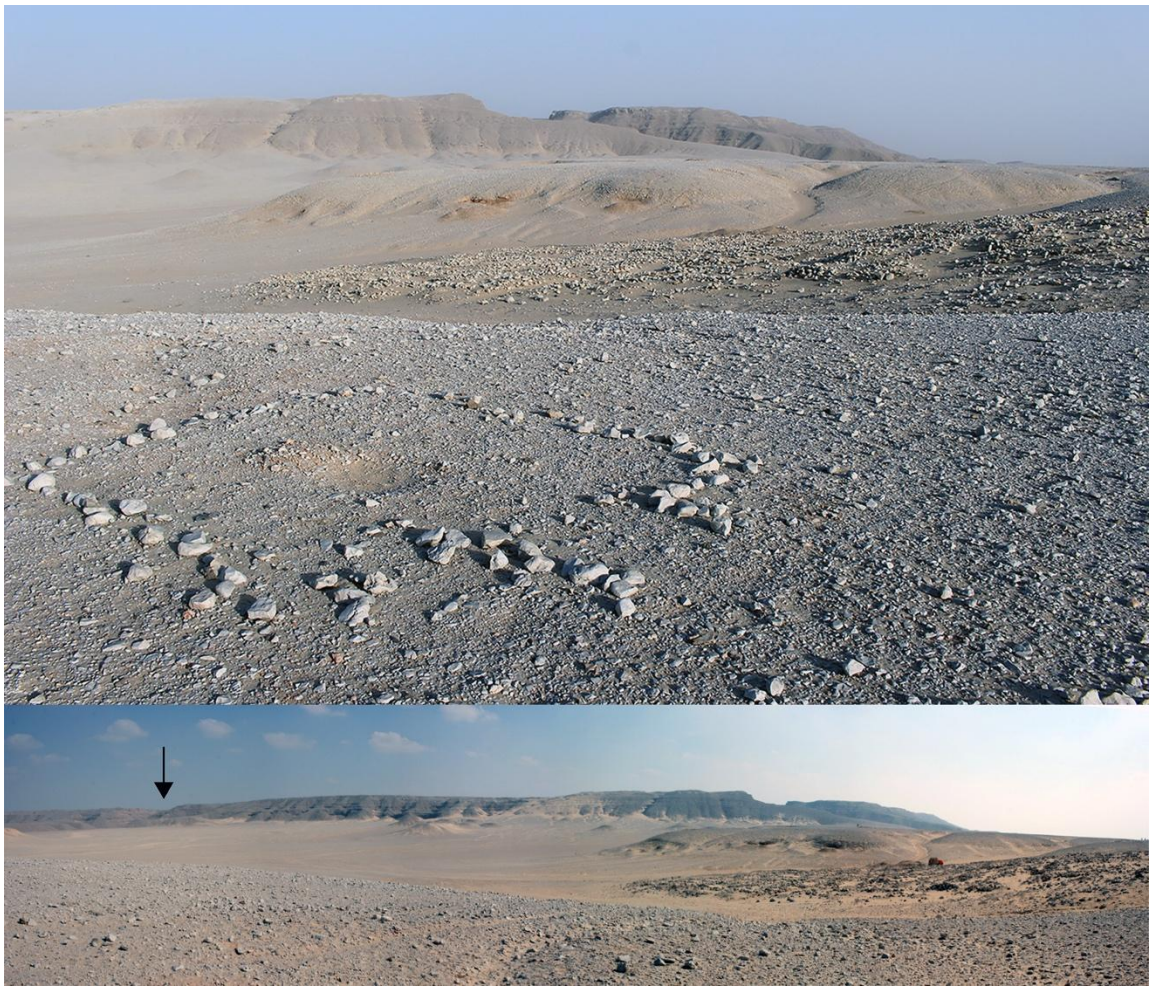

Figure 7 Top: A possible look-out point at the Stone Village (Structure III). Below: The view from Structure III, which encompasses the Main Site (right) across to the wadi containing the royal tombs (marked by the black arrow).

As whistles of any kind are yet to be firmly identified in a Pharaonic context, that this example is 'simple' in its design and made on readily available raw material does not detract from its importance in everyday use or place within the ancient Egyptian material culture repertoire. On this last note, while focused study of some Pharaonic bone technologies and their possible functions are beginning to emerge (see Kemp & Vogelsang-Eastwood 2001; Spinazzi-Lucchesi 2020, 2022a, b), much remains to be examined and understood. It is hoped that this study helps to spur similar work to be undertaken in the future.

Conclusion

The Stone Village, together with the Workmen's Village of Amarna, offers insights into life on the fringes of a major urban settlement during the New Kingdom. Representing a particular situation in which a working community moved between everyday life and the realm of the dead, careful recovery

and examination of all forms of material culture from such spaces can provide new details about how this — possibly tense — situation was policed and maintained. This research also highlights the value of considering what appear to be the most mundane of items amongst a wealth of bright and glittering material culture. Not all that was made and used by Dynastic Egyptians were made from heated, transformed, and moulded materials, and even the most basic, uncooked bone could represent a significant insight into the Egyptian past.

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Data Availability Statement
All data pertaining to this study is provided within the manuscript itself.

Conflict of Interest
The authors declare no conflict of interest.

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