Ancient and Modern Bone Artefacts from America to Russia
Cultural, technological and functional signature

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Archaeological Evidence of Pre-Industrial Worked Bone Activity in 18th Century Seville, Spain

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Abstract

A rich bone debris assemblage derived from the manufacture of objects from this raw material was recovered from a blind drain in C/ San Luis (Plaza de El Pumarejo), Seville, Spain. The archaeological sequence of the site, represented in multiple structures, spreads from the 2nd century AD up until the present, with a hiatus between the 6th and 9th centuries. The worked bone waste, dated to the 18th century, attests to the occurrence of pre-industrial craft activity on the site. The morphological analysis of the discarded bone material indicates a high degree of standardisation - multi-faceted cylindrical pieces were hand-carved from cattle metapodials that had previously been split in fine strips. The tiny perforation right in the centre that some of them have suggests the use of a lathe to produce the final objects – bone beads for rosaries. In spite of the volume of bone debris very few finished items were recovered.

Introduction

With the development of urban archaeology, bone remains associated with crafts have become more frequent (MacGregor 1985; 1989; Serjeantson and Waldron 1989). Multiple finds are described in the literature (Choyke and Bartosiewicz 2001; Luik et al. 2005) but there are still geographical areas, like the Iberian Peninsula, or chronological periods, such as the Modern Age, for which archaeological data are very scarce. Thus, the material studied here aims to go some way to filling that gap.

Bone processing activities on a site can be identified not only by the recovery of objects such as combs, handles, pins, buttons, and so on (MacGregor 1989) but also by the occurrence of raw material to be worked, blanks and rough-outs, unfinished objects and/or faulty items that were discarded during different working phases. These remains can indicate where the town’s workshops were located, although it is not uncommon to find many of them in secondary deposits like fills and dumps, mixed with food refuse. More interesting than that is the fact that close examination of such bone debris enables us to: a) reconstruct the production techniques used in the manufacture of the final objects; b) identify the species and skeletal elements from which they were fashioned and c) assess how different manufacturing techniques evolved as the range of tools diversified. In sum, this kind of material, that at first sight appears rubbish, proves to be more informative than the finished products to understand the development of bone crafting over time. Finally, from medieval times onwards documentary evidence provides a corpus of data that should not be ignored.

Written records from artisans’ guilds, archives, illustrations shown in historical works and occasionally detailed descriptions of particular craft activities are sources that offer an opportunity to visualize not only the social and economic circumstances in which different trades developed but also the various stages of the working process and even the tools used.

The archaeological context

Archaeological excavations were conducted by one of us (P.L.A.) in C/ San Luis nº 93, next to Plaza de El Pumarejo, Seville (Spain) between April and July 2004 (López Aldana 2007). The site is located 100m away from the city wall in an area known as the Historical Centre of Seville (Figure 1). These quarters were a marginal living area until the construction of the wall in the 12th century AD, under the rule of the Almoravid and Almohad peoples. After the Christian conquest in the 13th century the urban perimeter of the city was not altered. Buildings and structures were re-used and re-occupied without major modifications until the 15th century. By the 18th century Seville was in an advanced state of decadency worsened by the earthquake of Lisbon (1755) that caused the destruction of many buildings. As a result, important urban transformations took place at that time. The northern area of the city, although located within the city walls, was far away from the political and financial centre. The results from archaeological work done around Plaza de El Pumarejo over the last decade show that since the late medieval period this neighbourhood was dedicated to artisanal or pre-industrial activities, such as silk processing, glass making and so on (Mejías García 2000; Bernad Gómez 2001).
The excavations at C/ San Luis nº 93 revealed a complex of regular, shaped pits of different sizes (between 60cm and 120cm deep), wells and blind drains (Figure 2) filled sometimes with abundant faunal remains (currently under study by A.P.P.) and fragments of storage, cooking and tableware pottery vessels dated to different chronological periods from the 2nd century AD onwards.

From one of the blind drains (E.U. 28; Figure 2) came a rich animal bone assemblage derived from manufacture in this raw material. Hence, bone crafting would be another trade practised in these quarters. The pottery remains present in that context date the bone debris to modern historical times, from the end of the 17th century to the beginning of the 18th century.

The material

The total worked bone waste assemblage is constituted by 1050 pieces (Figure 3) and five partially finished objects - three beads and maybe two pinheads (Figure 4). In order to understand how that debris was produced and what the final product(s) was/were the material was grouped according to morphological characteristics as follows:

**Group 1**

This group comprises two chopped off distal ends of cattle metapodials and twenty-six additional shaft fragments that could also be identified as metapodial fragments (Figure 5). These meatless bones were traditionally favoured as raw material to be worked in a diversity of objects (i.e., skates (Küchelmann and Zidarov 2005), combs (Vretemark 1997), beads (Spitzers 1997), bone anvils (Moreno-García et al. 2006), and so on) probably due to the fact that they are robust and they present thick walls. Also, they were easily available as whole bones since they were generally separated at the first butchery stage in the slaughterhouse (Serjeantson 1989).

**Group 2**

Group 2 includes the un-worked ends of 135 rods (Figure 6) fashioned from the shaft of a long bone. The artisan held the rod by the un-worked end that usually corresponds to the spongy bone closed to the epiphyses. The remaining part was prepared by creating several straight, smooth facets. The resulting worked strip was then sawed transversally as evident by the flat surface on the opposite side. Obviously, the most appropriate part of the metapodials to be used was the thick, straight portion of the diaphysis.
Group 3

This group includes two complete bone strips (Figure 7) of 11.8cm and 14.7cm length each. They have a faceted surface and roughly worked ends.

Group 4

Nearly 80% of the assemblage is classified in this group. It consists of 837 ends of bone faceted strips (Figure 7) that present one pointed edge and another transversally flat cut. Their length and width range from 7.2cm to 1cm and 1.6cm to 0.4cm, respectively.

Group 5

An additional 17 ends of bone faceted strips were considered as a separate group because they display one or two parallel, fine incision lines around their perimeter, a few millimetres away from the point where the strip was detached. Their mean length is 3.5cm.
Figure 7: Bone debris included in Groups 3 and 4. Two complete multifaceted bone strips to the left and several ends of others that present one transversally cut edge and another pointed.

Group 6

Group 6 comprises 10 cylinders with a diameter and height of approximately 1cm. They were sawn across the top and the bottom and present multifaceted sides (Figure 8).

Group 7

Group 7 includes two cylinders of equal characteristics to those recorded in Group 6; the only difference is that they were pierced on one of the flat edges right in the centre (Figure 8). The size of the perforation in both cases is 1.5mm. The spongy bone tissue that is visible on the top and the bottom surfaces suggests that they came from the ends of bone strips. They were probably discarded because of this circumstance, as only the solid part of the strip was suitable for further work.

Group 8

This group consists of 19 more cylinders similar to those described in the previous groups but that were pierced through. They present a double central perforation on both flat edges. Measurements of their diameter reveal that they are of conical shape. This fact is clearly visible in one of the four pieces that are broken in half (Figure 8).

The manufacturing process

Observation of the morphology of the waste products and the traces they display (often visible to the naked eye) allows us to recognize that the bone debris collected was produced at different working phases during the manufacturing process of a bone object fashioned repeatedly and in large quantities. Cattle metapodials appear to have been the favoured raw material chosen to be worked, or at least these are the only skeletal elements that could be identified in the whole assemblage.

Probably the first step, before the manufacturing process began, was to clean the bones by removing skin, tendons and fat. This operation was done either leaving the metapodials exposed to the elements to dry out for a period of time or by cooking them in water for few hours. Experiments show that the latter methodology is preferred since bones do not crack much (MacGregor 1985). After this treatment, the distal ends of the bones were transversally chopped off with a heavy chopper or axe at the level of the foramen, as suggested by the deep, crude cut marks on the fragments included in Group 1 (cf. Figure 5). Although there is no evidence that the same action occurred with the proximal ends, it seems the aim was to work the diaphysis, eliminating the spongy parts of the articulations. The shaft of the bone was then longitudinally split into rods with the aid of an adze or a knife. The marks of successive blows are clearly visible in the fragments included in Group 2 (cf. Figure 6). In
turn, these rods were fashioned into multifaceted strips (Group 3 in Figure 7) using a metal tool, as their rough surface evidences. The next step was to discard the unshaped ends of the faceted strips. These are the fragments found in Group 4 - small pieces of bone with one unfinished end and another smooth flat surface (cf. Figure 7). The regular and parallel striations displayed on that side suggest the extremities of the strips were sawn transversally.

Measurements taken from the refuse fragments in Groups 2, 3 and 4 show that the mean diameter of the useful part of the strips was 8mm. Therefore, the finished object could not be larger than that.

The tiny multifaceted cylinders with flat edges recorded in Groups 6, 7 and 8 suggest that the faceted strips were further transversally sawn into smaller pieces (cf. Figure 8). Finally, a longitudinal perforation was drilled right through their centre. What was the purpose of this perforation? Was it to allow mounting of these small bone objects on a lathe for final shaping? Was it because they were to be strung? Or are both these hypotheses right? The striations transversal to the longitudinal axis on three of the partially finished objects recovered among this waste assemblage indicate the outer faceted surface of the tiny cylinders was indeed smoothed down by turning them on a lathe (cf. Figure 4). Bone beads were the final product so the same perforation would be eventually used to pass a string through.

**Bead making techniques**

During the Late Middle Ages beads were mainly used in rosaries (prayer counting chains) or *paternosters* after the prayer for which they were mostly used (Picod 1999; Romero Mensaque 1998; Spitzers 1997, 158). Rosaries were in fashion among all social classes and beads were made of different materials, *i.e.*, wood, metals, precious stones, glass and bone.

Finds related to bone bead production are known from various medieval towns in the United Kingdom (MacGregor 1985), Hungary (Kovács 2005), Germany (Spitzers 1997) and France (Meyer 1979; Picod 1999) among others. They usually date from the 13th to 18th centuries. It is remarkable that with the exception of the French cases the refuse items recovered reflect different processing techniques from those described here. They namely consist of long bone strips or ringlets repeatedly perforated with holes. MacGregor (1985, 101) notes that “the profile of the holes shows that they were drilled first from one side of the bone and then the other (…) The implement used was evidently a centre-bit with a curving profile and with an extended central point which, when it had penetrated the bone from one side, allowed the drill to be aligned on the same spot from the other”. The same technique would have been used for making buttons, with the difference that the discs cut would have been both larger in diameter and thinner than those produced for beads.

Interestingly, Spitzer (1997) accounts for a change in bead-working technology in the German town of Constance, spanning the fourteenth century which conducted a more standardised process and larger scale production. In the 13th century the beads were cut, using a bow-lathe, as rings rather than spheres, and along with cattle metapodials other less suitable bones (*i.e.*, *ramus verticalis* of mandible) were also used. The process would be similar to that illustrated in the much-reproduced drawing of a German *Paternosterer* at work, from the Stadtbibliothek in Nürnberg, dated to 1425-1436 (Spitzers 1997, fig. 7). By the end of the 14th century, the whole practise became more efficient. Straight portions of the metapodials were used, and only spheres were drilled out of the strips of bone. Huge quantities of small beads, 4 - 5mm diameter, were produced, and a smaller number of larger beads with diameters of 6 to 12mm. At last, by the 16th century, the work was more systematized and probably split into standardized actions that were constantly repeated by the same person following regular patterns.

In France, two and a half centuries later, Diderot and d’Alembert’s Encyclopédie (1762-1772) volume 7, portrays such an organized professional bead manufacturing workshop (Figure 9). The “Patenôtier” plate shows five individuals, each one performing a particular operation but curiously, none of them is shown drilling bone strips. According to the legend, one splits the bone into rods with a chisel on a log. Those are passed to worker B who creates faceted strips with a big knife on a three-legged bench while worker C saws them transversally into small portions. The task of individual D, to the right of the plate, is to perforate those pieces in the centre, and finally worker E, to the left, works them on the lathe for shaping. The lower part of the plate depicts a series of figures that show the aspect of a metapodial and what seems to be a radius with an attached ulna as they go through those working phases. Finally, several sorts of beads are depicted. The variety of tools employed in the different operations and raw materials other than bone (*i.e.*, fruit seeds and coconut shells) used for bead manufacturing are also described.

In conclusion, we have here the same bead making technique that was practised in Seville (Spain) at the end of the 17th century. This was also the method followed by the bead-makers from Saint-Denis (Paris, France) as evidenced by the bone debris recovered from excavations in a rubbish pit dated to the late 15th or early 16th centuries (Meyer 1979), at present exhibited in the Art and History Museum of this locality. Does the archaeological evidence suggest that this particular technique was preferred by craftsmen from France and Spain? If so, why was that? Also, can we say it was a more efficient method, since the diaphysis of a long bone such a metapodial or a radius was cut in many thin strips? Does thorough utilization indicate lower availability of raw material (i.e., cattle long bones) in those countries compared to other European regions? To answer these
questions more bone debris assemblages of this kind are needed.

How many rosaries?

From the bone refuse recovered in Constance (Germany) dated to the end of the 14th century, Spitzers (1997, 162) calculates that a man in a period of 10 years with 250 working days would have produced 200 beads per day, or one bead in three to four minutes. In our case study from Seville, it was clear that the technique used was different, and that more than one person would have been involved in the job. Although there are no data to estimate the bead daily production in such a workshop one can try to estimate how many beads and rosaries could have resulted from the bone waste assemblage recovered in C/ San Luis nº 93. For that purpose, we will use the strips’ ends.

Since we do not know if those pieces are the proximal or distal part of the strip their total number of 989 needs to be divided by two. That results in a minimum number of 494.5 strips. Adding the two complete strips described as Group 3 one ends up with 496.5 strips. From the length of the latter it may be estimated that these strips measured approximately 12-15cm. But since the spongy ends were to be discarded it can be concluded that the useful central part was just around 10cm long. The length of the blank cylinders is about 1cm. Hence, from each strip 10 cylinders could have been cut. In this case that means 4965 cylinders to be shaped as beads. Since a Rosary has 59 beads it is easy to conclude that from 4965 beads at least 84 rosaries can be made.

Final remarks

According to the documentary evidence (Romero Mensaque 1998; 2000), by the end of the 17th century there was a popular movement of opposition to the static religion practised in churches and chapels in Seville (Spain). The citizens created informal associations of devotees or brotherhoods in different quarters of the city that dedicated much of their time to penitence and praying of the Holy Rosary, which was understood as an exercise of piety and devotion towards the Virgin Mary. “Popular Rosaries” were celebrated in the streets at several times during the day and there were usually two processions, one at dusk and another two hours before dawn, in which men and women participated separately. Praying of the Rosary marked the religious life of the neighbourhoods of the city with a regular dynamism. It became also an identity sign for each neighbourhood, an element of early social configuration around religion that was more evident in marginal quarters.

Within this historical background it is not surprising that workshops dedicated to the manufacture of beads for rosaries proliferated in the city of Seville at this chronological period until the end of the 18th century. Then, the French Revolution opened up a period of liberation of religious ideals and consequently a decrease in the kind of ritual manifestations or symbols that previously were so much in fashion.

The finds discussed probably constitute the occasional refuse from a local artisan whose work was orientated to the production of these tiny items. An interesting question that remains unanswered is if the beads were strung together into rosaries in that workshop or if on the contrary they were sold to other craftsmen who were specialised in that trade. Commercialisation and distribution of the final products could have been done in other quarters of the city far from the production place. Finally, it is hoped that as the number of urban excavations in the Iberian Peninsula increases, more bone processing waste assemblages will turn up, allowing better understanding and assessment of the economic and social roles bone crafts had in the daily life of late medieval and modern cities, aspects not always recorded in the documentary evidence.

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