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Loom Weights of the Persian Period from Khirbat Burin, Israel

Introduction

A salvage excavation in the western part of Khirbat Burin, directed by Uzi 'Ad ('Ad 2013) on behalf of the Israel Antiquities Authority, was undertaken from December 2009 to January 2010 in the wake of construction works for a mobile phone antenna (Fig. 1).

Khirbat Burin is located in the northern Sharon – the internal plain of central Israel, on a hill in the midst of the agricultural areas. It is next to an ancient crossroad: the longitudinal road that branches off of the Via Maris and the lateral roads that linked Nablus (*Neopolis*) with the ancient settlement on which the city Netanya is situated today, and with Caesarea (Fig. 2).

Burin is indicated as a small village on the Jacotin map (1799) and as a ruin by *The Survey of Western Palestine* from 1880. A survey that was performed at the site in the 1980s documented potsherds that dated to the Iron Age II, Persian, Hellenistic, Roman, Byzantine and medieval periods ('Ad 2013). Six excavations had been conducted along the slope and northern and eastern fringes of Khirbat Burin in the years between 1998 and 2001, prior to the widening of a nearby road. Buildings and installations that ranged in date from the Hellenistic to the Ottoman periods and pottery from the Persian period were exposed.

The current excavation yielded architectural remains and installations dating from the Persian (5th–4th centuries BC, stratum VII) to the Mamluk periods (13th–5th centuries CE). Also exposed was part of a large Persian-period building, a building with several rooms probably from the early Roman period (1st century CE) including a refuse pit and a large tabun from the late Roman period (2nd–3rd centuries CE). A large, impressive building with a water cistern from the early Islamic period (7th–9th centuries CE) was also found. Another large building and the remains of three structures, one above the other, from the Mamluk period (13th–14th centuries CE) complete the stratigraphy.

The eight occupation layers attest to the importance of the site's location and to its being a tell. An analysis of the finds shows that throughout all of the periods the settlement was rural and its economy was based mainly on agriculture.

At the bottom of the lower area of the Persian period were walls and a floor founded on fill (thickness in excess of 1.5 m), the purpose of which was to raise the level of the area prior to the construction of the building.

Numerous fragments of pottery vessels, basalt grinding bowls, shards of tabuns (ovens) and 73 clay loom weights were discovered above the floor of a courtyard in a burnt layer (Fig. 3). The loom weights were near a wall. The source of the fire was probably the tabuns or destruction of some other kind. Apparently, one of the building's walls (exposed length in excess of 7 m) continued east and west beyond the limits of the excavation. The dimensions of the walls and the effort invested in levelling the area indicate that the building occupied a large area ('Ad 2013).

The pottery from the destruction layers provide a date in the 4th century BCE. All this may provide evidence of a relatively short life for the Stratum VII buildings, which appear to cease to function in the mid-late 4th century, probably close to the time of Alexander the Great's conquest of the Persian Empire (Gendelman forthcoming).

Fig. 1. Khirbat Burin (Photo: Sky View).

Fig. 2. Khirbat Burin location (Drawing: Shaked Shamir).

The loom weights

Thirty six of the 73 loom weights were preserved and registered. The others were very fragile and were disintegrated. All the loom weights are made of brown, unfired clay (Fig. 3). They were burnt in the fire with the wooden beams of the loom. All are biconical and (Fig. 4) vertically perforated. The weight ranges from 23.9-41.7 g (Table 1), with an average of 31±4.3 g. The diameters range from 3.3-4.7 cm with an average of 3.8±0.4 cm and the heights range from 2.6-3.8 with an average of 3.1±0.4 cm (Table 1).

The courtyard was probably used for household activities as indicated by the hearth and grinding bowls. It is large enough to hold a loom. The loom weights were found near a wall and were scattered in two rows of approximately 78 cm, indicating the width of the loom.

Fig. 3. The loom weights (No. DSCF 2767) in situ (Photo: U. 'Ad, Courtesy of the Israel Antiquities Authority).

Discussion

Material:

Most of the clay loom weights of the Persian period were not fired, similarly to those of the Iron Age. In the Hellenistic-Roman periods they were usually fired.

Type and Weight:

The light weight biconical loom weight is the dominant shape of Persian period. Similar objects have been found in Jerusalem (Shamir 1996,139, 144), Maresha (Shamir 1997), Horbat Rogem, Horbat Mesura and Horbat Ha-Ro'a (Shamir 2004), Tell Shiqmona (Elgavish 1968, Pl. LXIII:166) and Tel Michal (Singer-Avitz 1989, 359). Some were also found in the Occupied Territories at Qadum (Stern and Magen 1982, 193-194) (see location map of Persian-period loom weights in Shamir 1997, 6), Khirbet Abu et-Twein (Mazar 1981, 23) and Khirbet Nimra (Shamir 1997).

The weight of a loom weight is an important functional parameter for the operation of the warp-

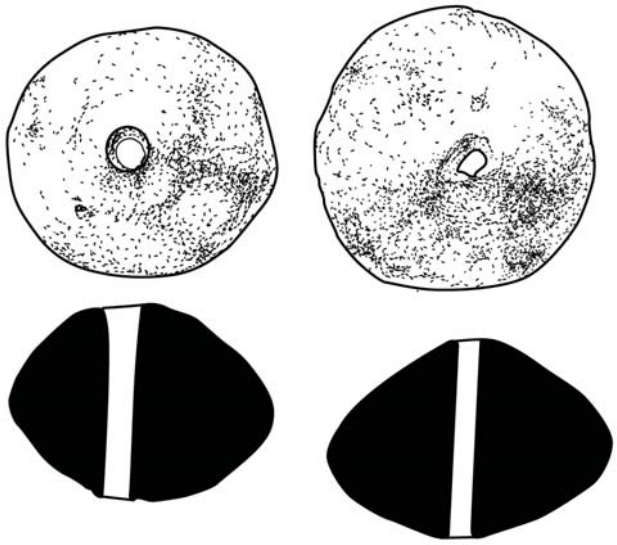

Fig. 4. The loom weights (No. AS797-10) (Drawing: Marina Shuiska, Courtesy of the Israel Antiquities Authority).

Table 1. Weight, height and diameter measurement of the thirty six loom weights from Khirbat Burin.
*** Where there are two diameters it is because they are not always exactly round.**

No.	Weight (gr)	Height (mm)	Diameter* (mm)
1	23.9	28.5	32.7
2	24.1		
3	24.7		
4	24.8		
5	25.4	34.0	37.22-39.92
6	26.3	36.6	34.42-37.82
7	26.6	31.5	39.1
8	27.8		
9	27.9		
10	28.1		
11	28.3		
12	28.3		
13	28.4	25.5	38.2
14	28.9		
15	29.1		
16	30.6	26.0	37.7
17	31.1		
18	31.4	28.6	34.74-35.61

No.	Weight (gr)	Height (mm)	Diameter* (mm)
19	31.7	30.6	35.11-38.47
20	32.1		
21	32.4		
22	32.5		
23	32.5		
24	32.8		
25	32.9	29.1	37.5
26	33.1	29.0	33.1
27	33.4		
28	33.6		
29	33.8		
30	34.1		
31	34.7		
32	36.1	31.6	38.71-39.54
33	36.3	33.6	44.3
34	37.2	38.1	36.34-37.84
35	38.7		
36	41.7	34.1	47.3

weighted loom (Mårtensson *et al*. 2009, 382). It is in fact the most critical element affecting performance and consequently indicating respective needs and preference in textiles. The tension applied to the warp threads is particularly decisive for the qualities of the woven textile, inasmuch as it is directly related to the properties of the thread, the weave pattern and the desired result regarding textile form, density or strength (Papadopoulou 2012, 60).

Loom weights of the Persian period are very light, usually 20-50 g (Shamir 2004), in contrast to the heavy loom weights of the Middle Bronze Age II up until the Iron Age and Hellenistic-Roman periods (Shamir 1994) which weigh *c.* 100-800 g. In general, light loom weights were used for fine textiles with very thin threads, while the heavier ones were used to produce thicker/heavier or coarser textiles (Shamir 1997; Andersson Strand 2012, 211). Across the region many of the Persian-period loom weights came from public buildings, although some were found in private houses (Shamir 1995). There is no indication of which material was used for weaving but the materials that were available are wool, goat hair and linen.

Several years ago the author reconstructed a warp-weighted loom and wool threads were reproduced that were similar to those found at Masada. Using light loom weights (20-40 g) similar to those from Maresha (Shamir 1997; Shamir forthcoming a), it was found that the weaving could be accomplished with a maximum of three warp threads tied to each loom weight. Mårtensson *et al*. (2009, 396) and Andersson Strand (2012, 211) estimated a tension of 20-30 g per warp thread. This calculation is not suitable for Khirbat Burin. Gleba and Cutler (2012, 118) estimated 5 g for very fine thread. This may indicate the desire to produce very fine and relatively dense textiles or pattern-weaving (Gleba and Cutler 2012, 118). The following calculation was done to elucidate the use of the loom:

> Each loom weight from Khirbat Burin: 27 g.
> 5g tension for each thread = 5.4 threads
> 5.4 x 73 loom weights = 394 threads
> 394 threads over 78 cm (width of the loom) = *c.* 5 threads per cm

We cannot compare this calculation to textiles from the Persian Period because they have not survived in Israel, but woollen textiles from the Iron Age II (9th century BC) are usually 3-20 warp threads per cm in woollen textiles and 8-40 warp threads per cm in linen textiles; but the loom weights that weigh approximately 250g (*e.g.* Kuntillet 'Ajrud, Sheffer and Tidhar 2012, 292-297) and linen threads are usually 10-30 warp threads per cm (*e.g.* Kadesh Barnea, Shamir 2007, 258).

The rows of loom weights found in certain sites, such as those mentioned below and by Barber (1991, 93-103), enable us to reconstruct the width of the loom, and hence the maximum width of the cloth that could be woven on it (Barber 1991, 103). By examining the table presented by Barber (1991, 387-389), which gives the various widths of warp-weighted looms and the number of loom weights from those looms, it can be demonstrated that there is no correlation between these two parameters. The distribution pattern of rows of loom weights found at sites such as Tell Amal, Tell Beth-Shean, Tell Es-Sa'idiyeh and Tell Deir Alla undoubtedly points to their belonging to looms. At Tell Amal, two-metre long parallel rows of loom weights were found *in situ* (Levy and Edelstein 1972, 331-335; 342; Shamir 2013). At Beth Shean most of the loom weights were found in two concentrations along the eastern wall of the central hall of Building 28636. In the southernmost concentration, the weights extended along 1.5 m, probably indicating the width of the loom. The loom weights were probably arranged in two rows. The charred beam (made of olive wood) found nearby may have belonged to the loom (Shamir 2006).

A metre-long parallel row of 62 loom weights was found *in situ* at Tell Es-Sa'idiyeh, in House 6 of Stratum 5 (Pritchard 1985, 17-19; Figs 2-3). Phase IX at Tell Deir Alla yielded three parallel rows of loom weights dating to the 9th century BC (Vogelsang-Eastwood 1990, 60). At Troy (Blegen *et al.* 1950, 350), a row of loom weights 1.1 m long was found *in situ*. At Gordion in Anatolia, 21 loom weights, some still bearing threads, were found lying in three rows (Brown 1980, 62; 86). All this data enables us to reconstruct the width of the cloth which is almost identical to the width of the loom.

Schierer conducted an experiment (1987; 2005, 103), after a discovery of 36 loom weights in rows at Gars-Thunau in Austria, in which she tried to destroy the loom and the textile by burning the threads. She concluded that a loom was very likely to have stood on the spot in which it was being worked on. This was probably also the situation at Khirbat Burin where the area suffered from a fire that caused loom weights to fall from the loom in two rows.

No three rows of loom weights, indicating twill weaving, have been found in Israel and the few twill textiles from the Roman period which have been discovered were imported. The weave was found in small quantities among woollen textiles (32 out of 1635 textiles from Roman period sites) (Shamir forthcoming b, 105). Despite the fact that looms capable of weaving

twill existed in this period and even before, twill has not been found in Israel that dates prior to the Roman period.

Summary and conclusion

The discovery at Khirbat Burin is one of several finds of loom weights arranged in rows and contributes further information on the loom weights in the Persian period which are characterised by conical shape and light weight. Their distribution at the site can indicate the width of the loom, as in this case. The weaving could have been carried out using a maximum of three warp threads tied to each loom weight producing fine textiles with thin threads.

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