IRON AGE LOOM WEIGHTS FROM TALL DAYR ʻALLĀ IN JORDAN

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Introduction

Loom weights are often found in Iron Age Levantine sites. The warp-weighted loom came to this part of the world during the Early Bronze Age. In the Iron Age it was used on a large scale for textile production. Iron Age loom weights are brittle clay balls mostly made of unbaked clay, making it difficult to recognise and recover these objects. It is difficult to reconstruct textile production because textile rarely survives in this region due to adverse soil and climatic conditions. The study of loom weights found in situ gives us the chance to remedy this situation. Barber (1991) published research on loom weights related to textile production in general. For the Levant, research on loom-weights was done by Browning (1988), Friend (1998), Shamir (1996), Sheffer (1981), Sheffer and Tidhar (1991) and Cecchini (2000). This is a case study dealing with a large number of Iron Age loom weights from Tall Dayr ʻAllā in Jordan. The great amount of loom weights recovered and some textile remains from the same period provide an opportunity to classify loom weights from Jordan and to reconstruct textile production in Iron Age Dayr ʻAllā. Tall Dayr ʻAllā (تل ديرعـلاّ) is located on the eastern part of the Jordan Valley, near the entrance of the Wādī az-Zarqā' into the Jordan Valley. The tall rises 25 meters above the surrounding valley and measures 250-200m at its base. From 1960 onwards several excavations have been carried out on the tall, first directed by Dr. H. J. Franken (1969, 1992) and succeeded by Dr. G. van der Kooij, both from the University of Leiden in the Netherlands, and Dr. M. Ibrahim succeeded by Professor Dr. Z. Kafafi from Yarmouk University, Irbid in Jordan. One of the main goals of the excavation is to provide a detailed stratigraphic sequence of the tall, and thus correlating social behaviour of the inhabitants. Such a detailed investigation makes it possible to deal with spatial analysis and the connection with production diffusion and use of artefacts (Kooij and Ibrahim 1989; Petit 1999: 145).

Iron Age Dayr ʻAllā

Phase IX, carbon-14 dated to ca. 800 BC, Iron Age II B, was a period of intensive use, showing a tightly built village and signs of irrigation of the agricultural fields. The phase is only partly excavated. Phase IX started as an architectural complex, without initial small scale buildings. In its final stage of existence the settlement underwent a sudden destruction by an earthquake, accompanied by fires that broke out in many places (Kooij 2002: 64). Two earthquakes followed by a fire destroyed Iron Age Dayr ʻAllā, people had time to leave this place safely, but they left most of their possessions behind. The debris from the fire has been relatively untouched by either erosion or later inhabitants. As a result, the objects belonging to this phase can be securely provenanced and dated (Kooij and Ibrahim 1989: 80-82).

The fire that destroyed Iron Age Dayr ʻAllā left many looms in the place were they were used. The unbaked clay weights were fired and the loom weights were found preserved in situ in the debris. (Kooij and Ibrahim 1989: 80-82). Although the wooden frames of the looms have not survived, 675 clay loom weights do exist indicating that the warp-weighted loom was in general use at Dayr ʻAllā.

In addition to loom weights different tools for textile production were found including spinning-whorls, bone pin beaters, needles, and textile fibres. Thanks to the detailed method of digging used on the Dayr ʻAllā Project, a small piece of textile and some thread were found relating to the loom weights. This unique find makes it possible to say more about the sort of textile produced on the warp-weighted loom in this village in the Levant during the late Iron Age.

Phase IX is of particular interest for textiles and textile production in the Levant region because of the quantity of relevant material recovered from the occupied layer. As suggested by G. van der Kooij (Kooij and Ibrahim 1989: 86-87) Dayr ʻAllā phase IX was inhabited by about 14-15 households during Iron Age II. These 15 households of peasants lived in an unfortified village built of mudbrick. The settlement had a special room (EE 335) in which a text devoted to Balaam Bar Beor was painted on the wall. The language appears to be an early form of Aramaic. The fragments have been published by Hoftijzer and van der Kooij (1976, 1991). The name and figure of Balaam is known from the Old Testament (Numbers: 22-24).The benched room had a religious function. Wenning and Zenger suggest this room to be a local school for prophets devoted to Balaam (1991: 189). Van der Kooij writes: "the room and surroundings show no specific religious activities, no cultic use. ...Ethnoarchaeology adds hardly any information. Historical texts of this kind may have a religious use in a teaching context ("Class room")" (Kooij 2002: 68-69). The excavator, Prof. Dr. H. J. Franken (1999 and 2005), calls this room a cella and suggests a sanctuary in the Iron Age village as the Late Bronze Age village had a sanctuary.

"The combination of the artificial hill (tall) with the building on top, the Balaam text and a number of associated objects justify the present attempt to interpret the ruins as the remains of a Baal hight" (Franken 1999: 193). Franken sees a relation between the textile production and the religious function of the site. The relation between the production of textile and the function of Dayr 'Allā in the Iron Age is a point to be studied separately (Boertien 2005).

Textile Remains from Dayr 'Allā Phase IX

It is known both from written sources and organic remains that four textile fibres were in common usage in this region for thousands of years. Two of these fibres are of animal origin, the others are from plants (Vogelzang-Eastwood 1989: 57).

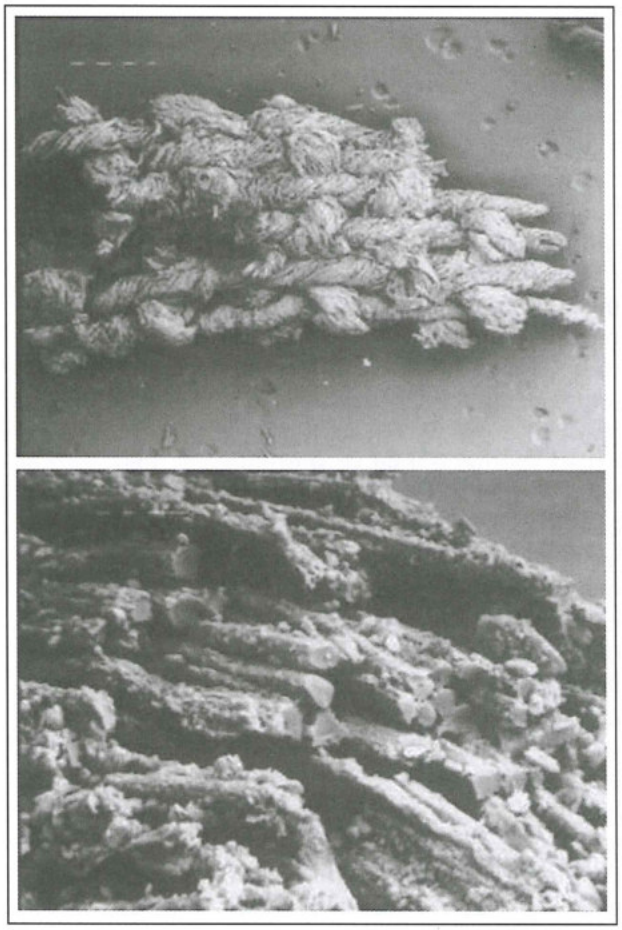
<u>Animal fibres:</u> used to produce textiles in Iron Age Dayr 'Allā were sheep's wool and goat hair. Both are of common use in this region in different periods. Sheep's wool is the most important of these fibres, references are found in Akkadian documents and in the Old Testament to flocks of sheep and to the use of wool for different sorts of male and female garments as well as objects like blankets and spreads. Skeletal remains of sheep (ovis) have been found in Dayr 'Allā phase IX. Goat hair is coarser than sheep's wool and therefore is used for thick outer garments and tents. Up till now the Bedouins of the Levant use goat hair to make their black tents. The coarse hair of the goat is strong and hard making it extremely useful for this purpose. The use of this sort of hair during the 19th century is documented in this region by the work of Dalman (Dalman 1964). In the 20th century P.V.Glob (1911-1985) describes the use of hair for the Arabian Gulf (Glob 1999).

<u>Plant fibres:</u> are in use world wide as material to produce a fine textile. In the Levant flax (Linum Usitatissimum), or the wild form of flax (Linum Bienne L), is the most common plant fibre.

Assyrian texts and Old Testament sources mention linen used for fine garments for both men and women. Browning (1988: 159-162) states that linen was one of the textiles the region had to pay as a tribute to the Assyrians. The Jordan Valley was climatically a good place to grow flax. The region of Bayt Shean is famous for the production of flax in post-Biblical Hebrew literature (Midrash Genesis Rabbah 20, Mishnah Kelim 9: 42). Recent archaeological discoveries have yielded further evidence of linen production in the region. A spindle with linen threads still wrapped around it was found in the 10th century BC stratum at Tall al-Ḥimma (Cahill *et al.* 1989: 36 as cited by Shamir (1996: 142).

Hemp (*Cannabis Sativa*) is known as a fibre to make ropes. "The identification of textiles made out of hemp is one of the unexpected discoveries of Dayr 'Allā" (Vogelzang-Eastwood 1989: 58). The analysis of this textile examined under a Scanning Electron Microscope shows that hemp was used here to make very fine cloth. This opens up many questions because Dayr 'Allā seems to be the only known place in this period in the Levant where fibre-hemp was used to make such a fine cloth. There are no literary and documentary sources for the use of hemp in the Iron Age in the Levant. We do not know where the hemp came from, how it was processed nor how hemp cloth was used (Boertien 2005b). From other periods it is known that hemp is used to make ropes and sacks. In the Middle Ages hemp was used in Europe to make strong water-resistant sails (Bender Jurgensen 1996). The word Canvas (a strong water-resistant cloth) may derive from the word Cannabis. Nowadays it is very fancy to use fine hemp cloth for clothes and lampshades.

<u>The Cloth:</u> in Iron Age Dayr 'Allā a small fragment of fabric, 52x32mm, was found amongst the loom weights (**Fig. 1**), and some weights had threads in the perforation. The finds from square B/A6 and B/A7 were analysed by Dr. W.D. Cook, the Manchester department of textiles. The fragment of cloth in tabby weave was found between the loom weights in a room in the north-east corner of square B/A6 and the north-west corner of B/A7. Here 41 loomweights were found, one weight with



1. The Cloth.

the threads still inside the perforation. In the same room in B/A 6 more loom weights were found: in locus 200 three weights, in locus 204 two more loom weights and one weight was located in locus 250 [1].

The hemp cloth found between the loom weights was very fine, the textile is made of Z-spun hemp thread. The thread count per cm is 24 tpcm (thread per cm) for the warp and 20 tpcm for the weft. The warps being basic for the fabric were harder spun than the wefts and became thinner during the weaving process. Stronger spun, thinner and more crowded threads were therefore treated as the warp (Sheffer and Tidhar 1991: 3). The thread count (24/20) shows that hemp is used here in a very fine thread and the warps are set up close to each other on the loom. This is comparable to the textiles of Kuntillat ʻAjrud (Sheffer and Tidhar 1991).

The fact that there is no sign of wear, or that it has never been washed, indicates that the textile is a fragment of the cloth that had just been woven when the loom was destroyed by fire (Vogelzang-Eastwood 1989: 61).

The Thread: the analysed thread is part of a separate cord used for tying the weights to the warp threads. This cord is made of *Cannabis Sativa* as well and has a diameter of 1.5 x the maximum diameter in the fabric (**Fig. 2**). The same type of fibre is used in both the cord and the fabric, but the twist level in the cord is less than the yarn systems in the fabric fragment. "I would conclude that the thread is part of the separate cord used for tying the weights to the warp threads, and the fabric on the loom burnt and fell on top of the weights." (Dr W.D. Cooke, Dep. of Textiles UMIST Manchester, report June 26th 1989). It is known from written sources that hemp was used for rope and textile, but this is the first time that it has been identified so early in an archaeological context. The scrap of fine hemp textile found between the loom weights shows that this material was made at the site. As a result of the find of fibre hemp in the Jordan Valley during the Iron Age, it seems necessary to re-

2. The Cord.

1. The relation between the different finds in B/A6 and B/A7 is not yet clear, when the stratigraphy of this period is published, more detailed interpretations will be possible.

examine Levantine textile finds in order to confirm the identification of the vegetal fibre types (Boertien forthcoming).

The Warp Weighted Loom

The warp-weighted loom is an invention that did not originate in the Levant. This method of weaving came from Central Europe and went through Anatolia to the southern Levant, where this tradition was introduced in the Early Bronze Age. The basic types of the loom, the horizontal ground loom and the warp-weighted vertical loom, originate in the same region and period - the Neolithic in Anatolia ca. 8500-4300 BC. The horizontal loom spread southward through the Levant into Egypt, and the vertical loom spread westward into Central Europe where the warp-weighted loom was skillfully used during a long period (Barber 1991: 113)[2]. Its use spread to the north where we find this type of loom up to the 1950s in Scandinavia (Hoffmann 1974).

The horizontal ground loom and a variation of this type, the vertical loom, remained the looms of choice in the Levant until the introduction of the warp-weighted loom in the Early Bronze Age (Friend 1998: 2). The warp-weighted loom of this type stayed in use in the Levant up to the Byzantine period (Barber 1994: 84).

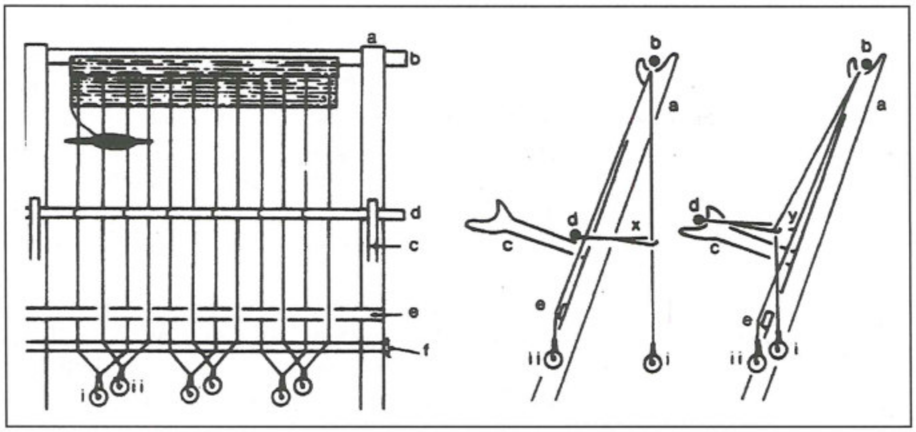
Different ways of weaving were used in the same period, but it is difficult to trace these forms of weaving in the archaeological record. Less known methods of weaving were definitely used to make narrow pieces of cloth or to produce belts. For such small work it is not practical to erect a loom, people mostly use their own body to stretch the warp threads that are attached to a tree or a piece of wood in the house. One of these weaving methods is card weaving, this is a simple technique often used to make long narrow belts[3].

The loom

A warp-weighted loom is made up of two vertical side beams which are about two metres high, and which are placed at an angle normally against a wall. The uprights are supported by a vertical beam. From each upright, usually about chest height, a bracket was forked to support one end of the heddle-rod. Lower down the frame is a shed-rod, which spans the gap between the uprights. All the odd numbered warp threads are hung down perpendicularly behind, but free of, the fixed shed-rod. Groups of thread are then fastened to each loom weight. Each thread is also fastened with a leash to a pre-woven textile band or cord, the so-called starting border or starting cord. This cord or band is attached to the heddle-rod. The even numbered warp threads are tied to a corresponding, but separate row of loom weights. The threads hang over the front of the shed-rod (**Fig. 3**). In order to change the shed the heddle-rod is placed in the fork of the support and the back row (odd numbered) warp threads are thus drawn in front of the even numbered (Vogelzang-Eastwood 1989: 59). The strands could be lengthened, enabling pieces of cloth to be woven which were far longer than the height of the loom. The work progressed from top to bottom, the cloth being gradually rolled around the upper beam (Cecchini 2000: 211). Tapestry weaving which involves the creation of patterns or pictures requires a loom in which only portions of the shed can be opened easily. This is possible on a warp-weighted loom in which the weights also keep the constant tension on groups of warp threads (Browning 1988: 165).

The use and technology of the warp-weighted loom has been described by Hoffmann (1974), Brittnell (1977), Broudy (1979), Sheffer (1981), Browning (1988), Vogelzang-Eastwood (1989), Shamir (1994), Friend (1998), and Cecchini (2000).

2. Weaving techniques are more sophisticated in Central Europe during these early periods. In the Early Bronze Age very fine and coloured cloth was made in Switzerland on the warp-weighted loom.
In about 1000 BC very fine textiles made of coloured wool and linen were woven in Hallstadt and Hallein (Barber 1991). The warp-weighted loom was in use in Central Europe till the Middle Ages, and very fine textiles were made using this loom. In Northern Europe the warp-weighted loom was in use until about 1950, but here more coarse textiles were made with this technique.
3. Possibly in the Iron Age the pottery "buttons" or elliptical pieces of pottery with one or two holes were used for card weaving as suggested by Orit Shamir (1996: 148-149, Fig 221-10, Pl. 11: 11,12,13). These "buttons" would give us an interesting sign of one of these simple ways of weaving. In an experiment Shamir produced a woven strip in the plain weave technique using tablets with two perforations.
Many fabrics with the starting border preserved were found to come from regions where the warp-weighted loom was used (Hoffmann 1964: 15).
The starting border served to keep the warp threads evenly spaced on the loom (Crowfoot 1955: 22), they are divided into two main groups: woven starting borders and corded starting borders (Hoffmann 1964: 154).
It is interesting to note that the starting border in the textiles found in the Iron Age desert site of Kuntillat 'Ajrud, is a variant on the corded starting border, the twined starting cord (Sheffer and Tidhar 1991: 4) used in a very fine linen textile (Sheffer and Tidhar 1991: 5, fig. 9 and 10).
An experiment by a professional weaver has to be done to prove this interesting suggestion. And a detailed study of these pottery "buttons" is needed to research the relation of these artefacts to loom weights and other weaving implements.
This unknown technique is mentioned here to give an impression of how much more textiles could have been produced than we can obviously find.



3. The warp-weighted loom.

The loom weights

The function of the loom weight is to stretch the warp threads on the hanging vertical loom. The weights are attached to bundles of warp threads suspended from a pre-woven band attached to the top beam. This separately woven heading band, or starting border, is a typical distinguishing phenomenon for cloth woven on the warp-weighted loom (Crowfoot 1951: 18, fig. 3 and plate VII: 21; Hoffmann 1964: 151-152, 154 and 178; Hald 1980: 203, 205-208; Browning 1988: 29; Sheffer and Tidhar 1991: 4-5; Raeder Knudsen 1998: 79-84; Cecchini 2000: 211). The weights supply tension and keep the warp threads parallel. The tension is easily adjusted by adding more weights or by retying the warp threads and therefore the warp-weighted loom depends less on precise warping than either the ground or vertical loom (Friend 1998: 4).

"It was sometimes necessary to tie two loom weights to one group of warp threads in order to balance one heavy weight on the other half of the shed" (Hoffmann 1974: 42).

Loom weights differ in shape and piercing. Loom weights without a perforation are known as cigar-shaped loom weights and reels or so called spool shaped loom weights (**Fig. 4**). A problem is that they are often not recognised as loom weights (Cecchini 2000: 214-217).

The unperforated weights are known from Bulgarian Neolithic sites and are comparable to the Macedonian 'waisted weights' (Barber 1991: 98). In Anatolia this type of loom weight is used during the Late Bronze Age at Alishar Hüyük, Tarsus, and Tille Hüyük (Cecchini 200: 217). Weights made of unbaked clay were found in Iron Age I levels at Tall Afish in Syria, and in levels of Iron Age II made of baked clay. This is comparable to the situation in Tall Matsuma and Tall A'mar (Cecchini 2000).

Spool weights are found in the Philistine sites Ashdod, Askelon and Tall Mikne (Ekron) (Stager 1995: 34). In Dayr 'Allā phase IX one spool loom weight was found within a group of perforated weights (For a description of this weight see the chapter Large groups, group XII, and the photograph Fig. 23).

Pierced Loom Weights

The perforated loom weights are divided into two main groups related to the place of the perforation, as introduced by Beck for the description of beads (1928: 51):

1. The horizontally perforated loom weights or pendant form weights. These weights are perforated above the middle of the weight and makes the weight hang as a pendant.
2. The vertically perforated loom weights are pierced in the middle of the weight (**Fig. 4**).

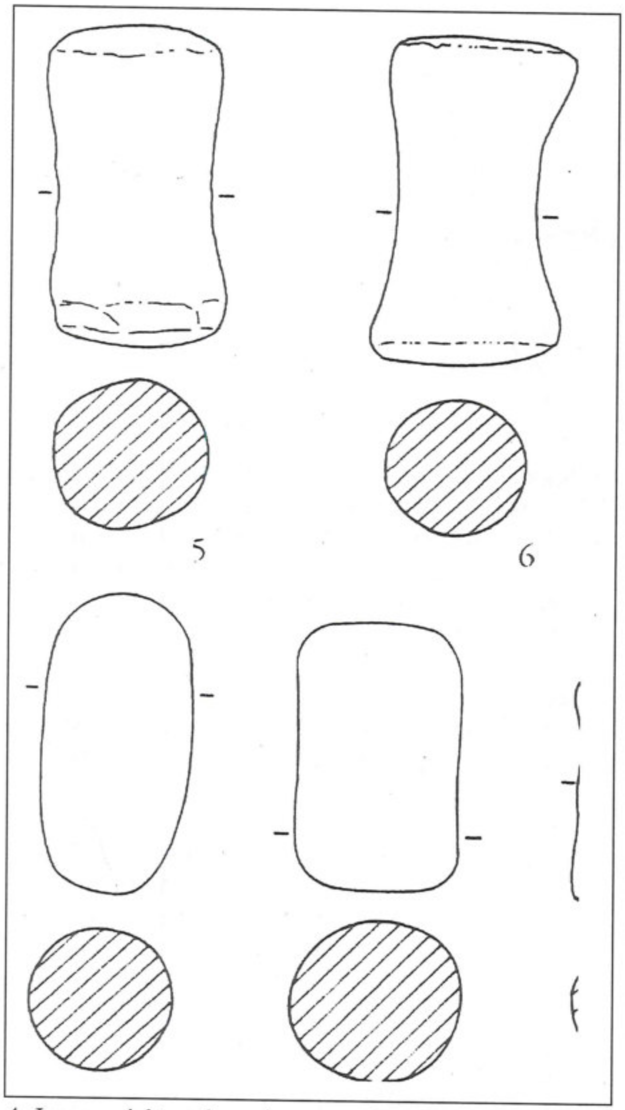
These groups are usually divided by their form into the following types.

The horizontally perforated loom weights: conical loom weight, pyramidal weights, the dome-shaped or beehive-shaped loom weight, the ovoid type, which is an egg-shaped weight, and the oblong loom weight which is a high cylindrical weight.

The vertically perforated weights: The donut-shaped loom weight, (and the bi-conical weight), the spherical or ball-shaped loom weight, the cylindrical or drum-shaped loom weight and the wheel-shaped loom weight (**Fig. 5**).

Collections of loom weights are found from the Early Bronze Age onwards. In the Iron Age the number of loom weights increase (Barber 1991). Examination of loom weights from a number of sites has revealed regional, typological and chronological variation (Vogelzang-Eastwood 1989: 60; Shamir 1996: 139-140; Friend 1998: 8).

Middle and Late Bronze Age weights are made of fired ceramic. The form is conical, dome or cigar shaped (Friend 1998: 8). The weight varies be-



4. Loom weights, schematic presentation.

tween 172-393 grams (Friend 1998: 9). In the Iron Age we find many more loom weights than in earlier periods and their form and weight are clearly different. The Iron Age loom weights are made of unfired local clay. This makes correct registration and a stratigraphic context very important.

Prior to the Iron Age loom weights were usually intentionally fired clay of conical dome or cigar shaped. However in the Iron Age the form and method of manufacture changed and weights were made of poorly fired or unfired clay, in the form of a donut or a ball. The change in shape may have been implemented because the earlier forms, when not well fired, tended to break more frequently at the narrow end near the perforation, the new shape did not have a weak narrow end (Friend 1998: 9). The donut-shaped unbaked loom weights form the largest group at most Levantine sites in Iron Age.

The weight of the Iron Age loom weights is higher than in the periods prior to the Iron Age.

In Dayr 'Allā an Iron Age loom weight has an average weight of 465.9 grams (ranging between 125-2400 grams). In the City of David Jerusalem the range is 22,8-805 grams (Shamir 1996: 143). In Kuntillat 'Ajrud the range is 240-310 grams. (Sheffer and Tidhar 1991: 1-26). The weights of Tall 'Amal range between 90-420 grams (Gal 1988: 283).

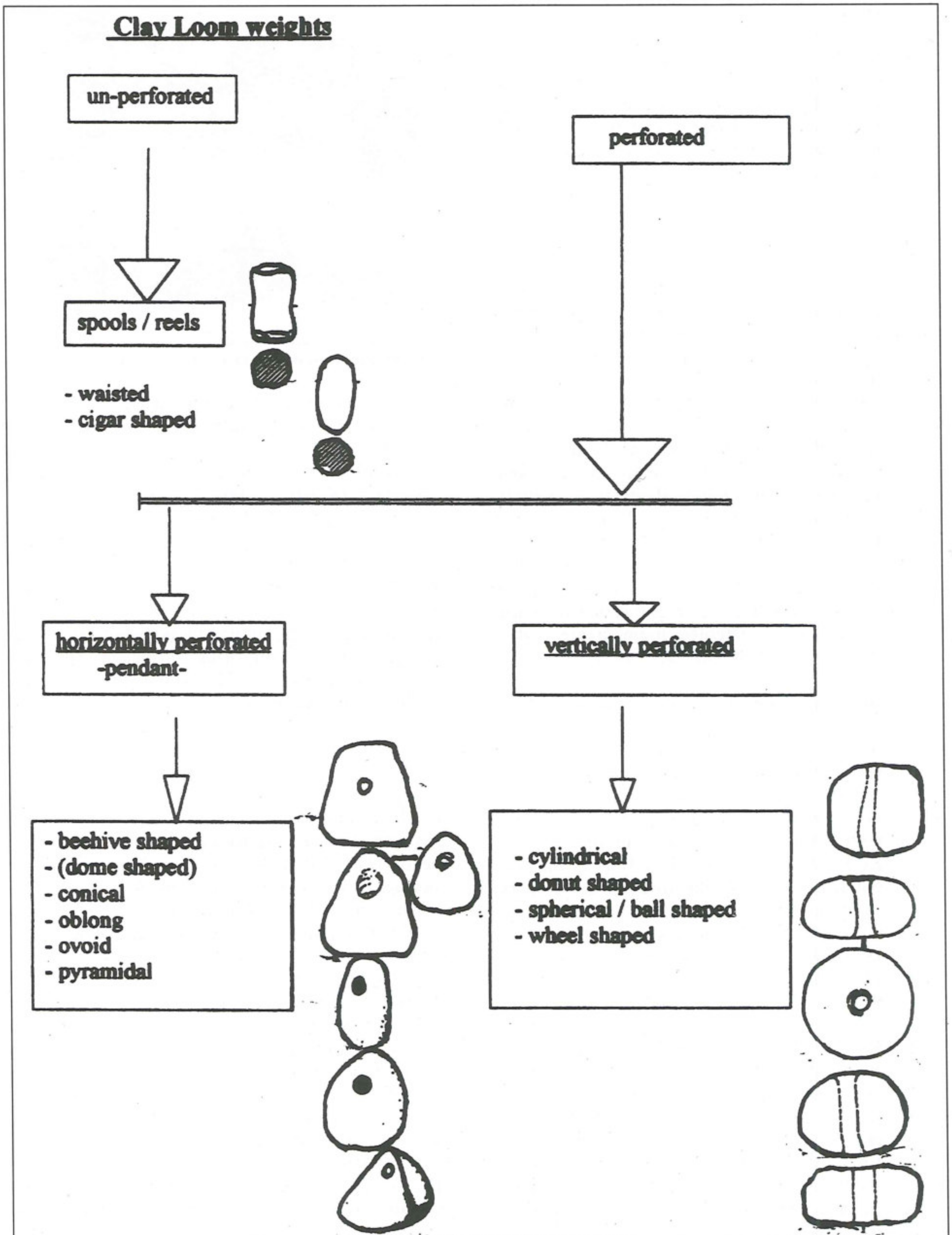
In Syria pierced baked or partially baked loom weights are characteristic for the Iron Age II period. At Tall Afish hundreds of loom weights are found. They are spherical, donut shaped or flattened cylinders. The weights range between 50/60 and 460/470 grams. Very few are conical or nearly conical, pyramidal or ovoid with a horizontal perforation. A small number of unbaked clay loom weights were also found (Cecchini 2000: 222).

Later in the Persian period loom weights are smaller and lighter (less than 100 gram) biconical (Shamir1996: 151) or donut shaped, ovoid, pyramidal or dome shaped and baked (Shamir 1997: 2) or pyramidal and baked (Friend 1998: 10) or ovoid and made of unbaked clay as in Dayr 'Allā. The loom weights from Hurvat Nimra mark a transition between the originally Iron Age donut shaped loom weights and the pyramidal loom weights of the Greek and Roman period (Shamir 1992: 6). In the Hellenistic period the dominant type is pyramidal with a weight of around 100-200 grams.

The publication of the loom weights from Syria is very interesting because there was a gap of information about the weaving tradition in Syria. Barber and Shamir suggested that the warp weighted loom was absent in this region (Barber 1991: 91-101, 300-302; Shamir 1996: 140, 145)! It is only recently in the Aegean area that Late Bronze Age terracotta objects in the form of reels have begun to be recognised as loom weights (Discussion in Cecchini 2000: 214 notes 21).

In Iron Age the unperforated reels are fewer in number than the spheroid perforated loom weights but their existence or coexistence is certain (Cecchini 2000: 222). The finds from Tall in Northern Syria are very interesting in relation to the finds from Tall Dayr 'Allā because in the collection of Iron Age Dayr 'Allā 14.6% of the loom weights is spheroid. This is a large number compared to other Iron Age II sites, such as at Jerusalem 3% (Shamir 1996: 136), none in Kuntillat 'Ajrud (Sheffer and Tidhar 1991: 11), and at Tall Taanek 2 of the 92 Iron Age loom weights are spheroid (Friend 1998: 36-58).

In Iron Age Dayr 'Allā one spool shaped loom weight was found within a group of loom weights



5. Spool loom weights from Northern Syria (after Cecchini 2000: 212).

in group XII (B/E9 locus 24).

If the form of the loom weights is dependent on tradition then a northern influence could be suggested and relating them to the language used in the Balaam (Bal'am) inscription and the imported grinding stones in Tall Dayr 'Allā from the north or north-east (Petit 1999: 157). It is interesting that the types used in Iron Age Dayr 'Allā show a relation to the type of loom weights used in the Iron Age in Northern Syria, as described by Cecchini in her publication on the textile industry in Tall (Cecchini 2000).

These facts would plea for connections with Damascus. But it is too early to point in this direction, we will have to wait for more published material from Syria, and hope for textile remains to be found and analysed.

Weight variation among loom weights from the same assemblage is a common phenomenon. Possibly the number of threads tied to each weight was not always the same and it was thus not necessary to make each loom weight identical in weight. More numerous warp threads could have been tied through a heavier loom weight while a lighter one would bear fewer threads (Shamir 1996: 143; Broudy 1979: 26; Hoffmann 1974: 314). Weight variations of more than 200 grams between the weights on a warp-weighted loom create a distortion in the textile (Shamir 1996: 143).

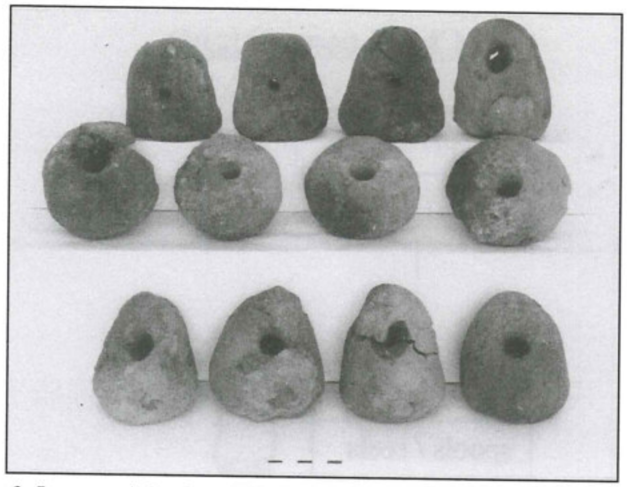
The Iron Age Loom Weights from Tall Dayr 'Allā

In Dayr 'Allā phase IX 675 loom weights were registered, 589 of these weights could be studied by the author (86 recorded loom weights were not traceable because they were taken out of the collection for exhibition and were lost) (**Fig. 6**).

The material: From a technical analysis of the pottery from Dayr 'Allā by the Institute for Pottery Technology in Leiden, it is known that in this region the local banded Lisan clay was used for pottery making. The local clay has been analysed by Kalsbeek (1969: 73-80) and Franken (1969, 1985 and 1992: 105-114).

The clay on which the tall stands is built up from thin clay deposits (banded clay) which vary in structure and composition. The colours of these layers vary from light grey to yellow, blue and greenish to pink or brown-red. In between these layers one may find thin layers of very fine sand. The amount of iron oxide (in the form of visible grains) is high as seen in the pottery of the village (Franken 1992: 106-107). This gives the clay a red to pinkish colour.

In the banded lisan clay two groups of non-



6. Loom weights from Tall Dayr 'Allā, Iron Age.

plastic materials can be differentiated:

1. A combination of quartz-sand and organic material.
2. A combination of quartz-sand, lime and organic material (Kalsbeek 1969: 73-80).

Quartz-sand washed down by the az-Zarqā' river occurs in abundance in the vicinity of Dayr 'Allā. 'Temper indicates the non-plastic elements in a clay, which are considered to have been added by the potter....... fillers are used inter alia to open the clay for texture and/or workability, to control drying shrinkage and firing shrinkage' (Franken and Steiner 1990: 79). The amount of iron oxide (in the form of visible grains) is high as seen in the pottery of the village (Franken 1992: 106-107).

Apparently the potters dug this clay close to the tall and soaked it for some time but often not long enough to let the clay break up or 'dissolve' completely (Franken 1992: 106). The use of impure clay does not necessarily point to lack of skill of the thrower, but may be due, at least in part, to shortage of water (Kalsbeek 1969: 74).

The clay in Dayr 'Allā is a bit salty. The loom weights had a light scum visible after drying, as described for pottery by Orton (1994: 116).

The Find Spot: The weights from Dayr 'Allā phase IX show that different types of loom weights were used on one loom. To determine a group of loom weights belonging to one loom, square and locus are taken as selection criteria. This narrow definition of a loom was necessary because the stratigraphy of the Iron Age is not yet published and making the interpretation of the different locus numbers impossible. Using the criteria of the findspot defined as square and locus gave the opportunity to recognise the looms without a detailed stratigraphy.

This method limited the numbers in the groups and the number of groups because often locus numbers are changed while digging. Without a detailed stratigraphy it is impossible to reconstruct the related locus numbers correctly.

A 'large group' is a collection of loom weights containing more than 10 weights from one square and locus number. The choice of 10 weights in a large group is based on the fact that this number makes weaving on the warp-weighted loom still possible[4]. When using less than 10 weights the cloth will be to narrow (less than 20cm). This would not be worth all the work of warping the loom and having it occupy space. If such a narrow piece of fabric were wanted other weaving methods would be chosen. Because the site has such a large collection of weights it was possible to define different large groups representing a loom.

Typology of Iron Age Clay Loom Weights from Tall Dayr 'Allā

The classical classifications are shape descriptions based on the work of Beck (1928) made for the description of beads and pendants [5]. Most authors (Hoffmann 1974; Barber 1991; Browning 1988: 193-194; Shamir 1996: 136; Friend 1998: 8) follow the shape description as mentioned above.

This study presents a typology based on technical, rather than on morphological variables. A classification based on technical criteria is fundamentally different from a typology based on shape descriptions. Similar shapes may have been made in different ways and that results in a slightly different typology than usually presented. In a techno-analytical typology one type may have different shape variants, and similar shapes may have been made in completely different ways. The production technique for making loom weights is the starting point for the typology. When the production process demands separate and conscious actions to make a special form in the piece of clay this is counted as a proceeding to make a new or different type. If different gestures are used to make a weight these proceedings give a separate type. For instance a conical loom weight with a flat base and a conical weight with a rounded base (the sack form) are different types in a shape descriptive classification but in a typology based on technical criteria both belong to the same type.

When the weight is formed in the palm of the hand this gives a rounded base, the so-called sack form. Here both are called a conical loom weight.

Because the flat base was the result of working on a flat surface, the hard surface gives a flat side to the loom weight. The difference in shape resulted from the place where the loom weight was made and not from different production techniques.

This also applies for donut shaped loom weights with a flat side. These are often large weights made of wet clay that could not be held in the hand while making the weight. They need the support of a surface and this gives the flat side to a weight.

In a technical typology a difference has to be made between a conical loom weight and a beehive shaped loom weight because the beehive shaped weights have a flattened top. To flatten the top is a separate series of gestures and this gives a new type.

The mixed forms in the collection of Phase IX show a special relation between three types of loom weights related to the production process. The wheel form and the cylindrical loom weight are made out of a donut form. In the collection of Dayr 'Allā this is visible in different artefacts that show both, or even the three forms, in one weight. In the category of smaller weights this leads to a mixed type that does not occur when the loom weight is larger. This is because the forming techniques of larger weights are principally different. 4.3 % of the loom weights from phase IX show a mixed form (For a detailed description see the experiment in the Appendix to this article).

The method of production leaves more traces in the loom weights than previously expected. Because the Iron Age loom weights are made of clay and thus formed in a different way than beads a new approach was chosen. The basic division related to perforation was followed and the well-known descriptive names of the different types are

4. From experiments with loom weights from various sites it is known that about 20 warp threads are tied to a cord in the loom weight. (Shamir 1996: 144; Sheffer 1980; Kelm and Mazar 1995: 163; Shamir 1994: 282; Broudy 1979: 26; Hoffmann 1974: 314) These numbers make weaving still possible without disordering the warp in such a way that holes would appear in the textile.
Using 10 loom weights gives 10x20 threads in the fabric, compared to the thread count of the textiles from Kuntillat 'Ajrud (Sheffer and Tidhar 1991: 5-19) this is an average count (20 tpc), it gives a piece of cloth with a width of about 20cm.

5. In the literature concerning this subject most authors base their typology on Beck (1928): a classification and nomenclature of beads and pendants. Glenda Friend does not mention Beck but she based her typology on the work of Shamir (Friend 1998: 1). These typologies are based on the form of an artefact and not on the manufacturing techniques that the different materials demand from the maker. "A classification based on technical criteria... is fundamentally different from a classification based merely on shape description. ...Technical analysis attempt to explain phenomena, instead of only describing them, this simplifies the typological work and increases its significance" B. van As. (1984: 144).

used as far as possible. In the Appendix to this article Experiment Making Loom Weights is presented. The differences in shape are discussed based on production factors.

There is always a variation in the repeat 'item' as described for pottery production by B. van As (1984: 136). Small variations in form are due to this phenomenon and are to be neglected in a typology.

The Loom Weights

The 589 studied loom weights are separated into 7 main groups, a group of mixed types and the rest.

*Horizontally Perforated Loom Weights, pendant form (***Fig. 7***)*

1.Conical loom weight (average of 62 weights)

height	8.4cm
diameter	7.5cm
perforation	2.0cm
weight	433.5g

The clay is mostly impure and often not well mixed. This shows that no special attention was given to the composition of the clay used for these weights. 62 conical loom weights are found. This is 10.5% of the total amount of loom weights in Iron Age Dayr 'Allā. 23 weights came from square B/E9, group XII and XIII.

Conical loom weights often appear in small groups within larger groups of other types of loom weights. Within these large groups the conical loom weights have an average of 20.16% of the weights, ranging between 52.8 % in group XII and 5.8% in group X.

2. Beehive shaped loom weight (average of 8 weights)

height	7.8cm
diameter	7.4cm
perforation	1.4cm
weight	424.3g

The clay is impure and contains much iron ore and small organic material. The beehive shaped loom weight is seldom found in collections dated to the Iron Age in the Levant. In Dayr 'Allā phase IX only 8 (1.4%) loom weights of this type were found. It is a pendant form with a narrow perforation in the middle of the weight. The differences with the conical weight is the flat top, and the position and the size of the very small perforation. Group XII has 4 beehive shaped weights and group XIII has one weight of this type (B/E9) In group II are two beehive shaped loom weights (B/A8). And in group IX one more beehive shaped loom-weight was found (B/C8).

The beehive shaped loom weight looks like weights used to produce fine linen found in Europe (Switzerland) (Barber 1991: 96, fig. 3.18). This type of weight is perforated with a stick, and possibly a stick or a rod were used to attach the weight to the warp-threads.

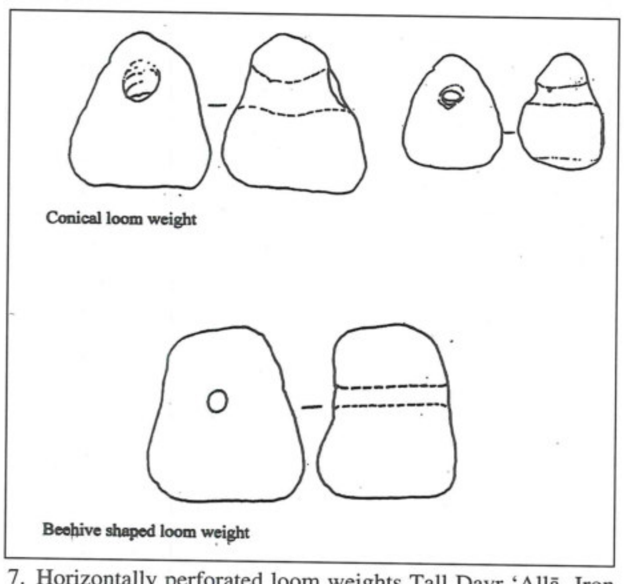
The idea of the stick in this form of weight is provided by the loom-weight-stamp published by McLaughlin (**Fig. 8**). The weights from Dayr 'Allā do show traces of a stick used in the beehive shaped loom weight (**Fig. 9**) [6]. (See also **Fig. 23**).

Vertically Perforated Loom Weights (**Fig. 10**)

1. Donut-shaped loom weight (average of 322 weights)

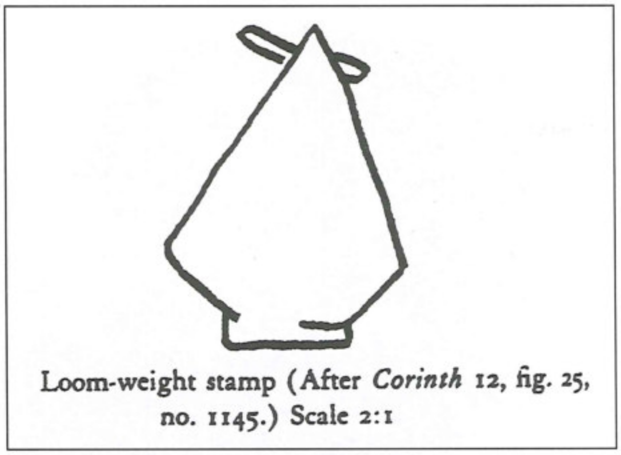
height	5.1cm
diameter	8.0cm
perforation	2.1cm
weight	335gram

The width varies more than 1cm from the height. The clay used for the small models (diameter under 9cm) is impure and medium mixed (**Fig. 11**). The clay contains the natural amount of organic material and grit, so no special attention is given to the clay. The amount of iron oxide in the visible grains is high. The donut is the most popular loom weight in Iron Age Palestine. In Iron Age Dayr 'Allā 325 donut shaped loom weights were registered.



7. Horizontally perforated loom weights Tall Dayr 'Allā, Iron Age.

6. The suggestion was done by McLaughlin (1981) based on the work of Davidson and Thompson (1943) regarding the loom weights from Athens now in the British Museum. Some of these loom weights have a metal ring in the narrow perforation, but such rings are not found in the Levant.



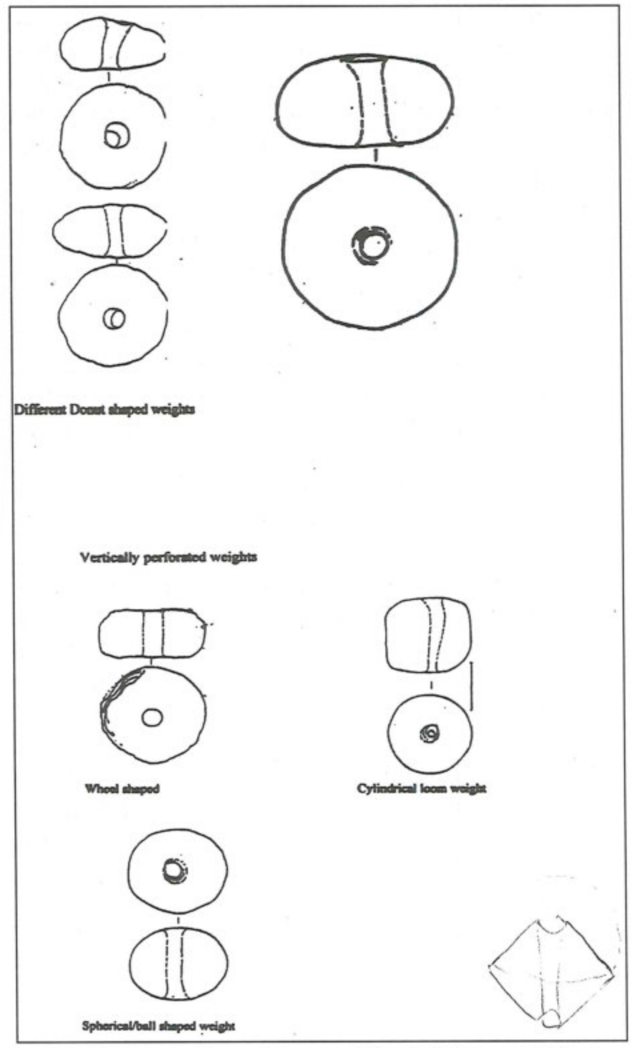
8. Loom weight stamp.

9. Beehive shaped loom weight and 2 conical weights.

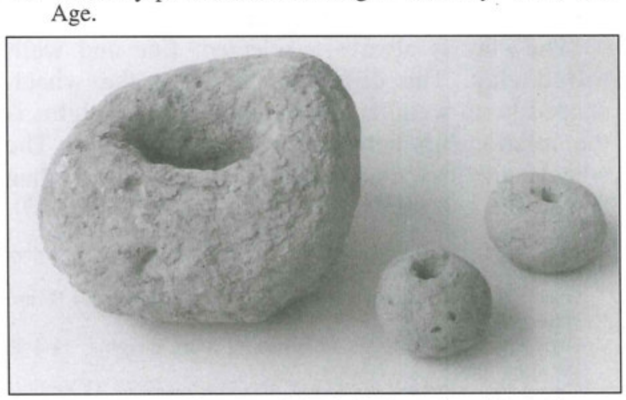
If a donut is large, over 9cm, it is often made of fine selected yellow clay, well-mixed and used wet.

The general idea is that this kind of loom weight was made around the finger. This may be true for weights with a diameter between 6 and 9cm, because a coil of about 3cm thick and 15-18cm long can be worked around the finger of a hand. When a weight is smaller, the perforation cannot be made with a finger, because the perforation would be too wide (about 1.8-2cm). But when the diameter of a weight is larger than 9cm, it is impossible to work this long coil (longer than 15-18cm) around a finger, as experiments have shown. The partly flat donut is made of fine (selected) wet clay. Using the wet clay the perforation is always from one side.

Big loom weights of this type are perforated whilst on a hard surface. Sometimes a stick is used which left visible traces in the hole of the weight. It is possible to pierce the weight with a finger. If the weight is kept in the hand whilst piercing then both sides will be rounded, the so-called "bi-conical" form. When using a hard working surface part of the weight will be flat (Detailed description in the Appendix to this article).



10. Vertically perforated loom weights Tall Dayr 'Allā, Iron Age.



11. Donut shaped loom weight, ball shaped weight and extra large donut loom weight of 2400 grams (group II).

2. Spherical/ ball shaped loom weight (averages 86 weights)

height	6.0cm
diameter	7.8cm
perforation	2.1cm
weight	441.5gram

In this kind of loom weight the width and height never varies more than 0.75 % from each other. The clay used for this model is mostly a fine and well-mixed selected clay. It is surprising that rather large stones are often found in this weight, causing problems while drying. 20% of the 86 spherical loom weights have a flat side caused by the use of very wet clay. It is difficult to form a good ball from rather dry clay, and using wet clay gives a nice and smooth ball, but it is difficult to dry this model while keeping the shape. Spherical loom weights often occur in large groups and within these group they form a high percentage (**Fig. 11**).[7]

3. Cylindrical loom weight (averages 23 weights)

height	6.0cm
diameter	7.5cm
perforation	1.5cm
weight	452.6gram

The difference between height and width is not more than 0.8%. Cylinders are more than 5.5cm high and about 7.5cm wide (**Fig. 12**). The clay is a fine yellowish or banded clay. A cylindrical or drum-shaped weight is always made on a stick, it has a narrow perforation made by a thin stick or a reed cane. The cylindrical or drum-shaped loom weight is easy to make, by rolling a spherical or donut-shaped weight over a flat surface while the weight is still attached to the stick. This type occurs in a small amount within large groups.[8]

4. Wheel-shaped loom weight (averages 41 weights)

height	5.1cm
diameter	8.3cm
perforation	2.0cm
weight	439.2gram

The clay is always a selected, fine and well-mixed clay. The difference between the wheel-shaped loom weights and the cylindrical weights is the relationship between width and height. The wheels are less than 5.5cm high and more than 8cm wide, and they do look like a wheel (**Fig. 13**).

12. The cylindrical loom weight.

The wheel-shaped loom weight is often found in different parts of the site. It is easy to make this loom weight repeatedly uniform. They are formed around a stick. If there is a dome around the perforation this means that the clay has been worked out in the direction of the stick. When the wheel was turned to smooth the surface it has a slight groove in the surface of the wheel. They are mostly used in combination with other models. For this type of loom weight the amount of weights associated with one loom is striking [9].

This kind of weight is not commonly known in Iron Age Palestine. The only place where this shape has been reported is Tall Qasilah, on the coastal plain. Orit Shamir (1994) describes these loom weights and calls them "cylindrical". 66% of the weights are "cylindrical", wheel-shaped, and the rest of the weights have the donut form.

7. Percentages of spherical/ ball shaped loom weights.
Group II (B/A8 locus 55) has 33 loom weights, 5.4 % are spherical.
Group VIII (B/C6 locus 117) has 29 loom weights, 34.4 % are spherical.
Group IX (B/C8 locus 75) has 52 loom weights, 15.6% are spherical.
Group XI (B/D7 locus 54) has 14 loom weights, 25% are spherical.
B/C6 locus 114 has 9 loom weights, 11.1 % are spherical.

8. Percentages of cylindrical loom weights
Group II (B/A8 locus 55) has 33 weights and 9% are cylindrical weights.
Group IX (B/C8 locus 75) has 52 loom weights and 13.7% are cylindrical weights
Group X (B/D7 locus 52) has 18 weights and 22.2% are cylindrical shaped loom weights
Group XI (B/D7 locus 54) has 14 weights and 6.2% cylindrical shaped loom weights.

9. Percentages of wheel-shaped loom weights
Group II (B/A8 locus 55) has 33 weight and only 7.6 % are wheel-shaped loom weights.
Group IV (B/A10 locus 26) has 10 weights and 60% are wheel-shaped loom weights.
Group VIII (B/C 6 locus 117) has 29 weights and 17.5% are wheel-shaped loom weights.
Group IX (B/C8 locus 75) has 52 loom weights and 16% are wheel-shaped loom weights
Group X (B/D7 locus 52) has 18 weights and only 5.5% are wheel-shaped loom weights
Group XI (B/D7 locus 54) has 14 weights and 43.7 % are wheel-shaped loom weights.
B/C 6 locus114 has 9 weights and 11.5% are wheel-shaped loom weights.

13. The wheel-shaped loom weights.

The average weight of the wheel-shaped loom weights in Tall Qasilah is 340.8 grams, which is comparable to Dayr 'Allā. The average diameter in Tall Qasilah is 8.35cm which is about the same as the wheel-shaped weights from Dayr 'Allā. The average height in Tall Qasilah is 5.35cm. This height is slightly higher than the ones from Tall Dayr 'Allā (5.1cm), but are not as high as the cylindrical weights (6cm).

The clay used in Tall Qasilah is not selected and thus contains stones and organic material. The clay used in Dayr 'Allā for this type of weight is fine and a selected well-mixed banded clay.

5. Mixed forms (averages of 26 weights)

height	5.1cm
diameter	7.6cm
perforation	1.7cm
weight	350.1g

There is a special relationhip between the three types of loom weights: the wheel form, the cylindrical and the donut form. Their relationship is the result of the production process. When a weight of a medium size and a stick or a finger is used to form the weight, only the final steps make the difference in type. This gives in the category of smaller weights a mixed type that does not occur when the loom weight is larger, because in the case of a larger weight the forming techniques are principally different. As in the above description for the donut shaped weight.

Mixed forms are seen in the collection of Iron Age Dayr 'Allā within different groups of loom weights (**Figs. 14, 15**). For a description of the forming process of the weights see the chapter on experiments. (Appendix to this article).

Rest Groups

In this category loom weights are mentioned that do not belong to one of the major types of this period. The group contains 21 loom weights. The spool/reel shaped imperforated loom weight from B/E9 locus 24. The 3 oblong loom weights: a high cylindrical weight with a horizontal perforation.

14. Mixed forms.

15. Mixed forms.

Two were found in B/D9: one specimen was found in locus 18 and the other one in locus 9. And 1 oblong weight was recovered in B/D8 locus 6. Three loom weights belong to the ovoid type, which is an egg-shaped weight with a horizontal perforation, comparable to the ovoid weights described by Shamir (1996: 136). All these ovoid shaped weights were found in square B/D9 (loci 18, 25 and 43). Amorph are 14 weights that were damaged and not identifiable as a type (**Fig. 16**).

Large Groups Arranged by Square and Locus

Here, 15 large groups of weights representing a loom will be discussed. The numbers used are the square and locus numbers as mentioned on the topplan published by G.v.d. Kooij (1989, 2002) (**Fig. 17**).

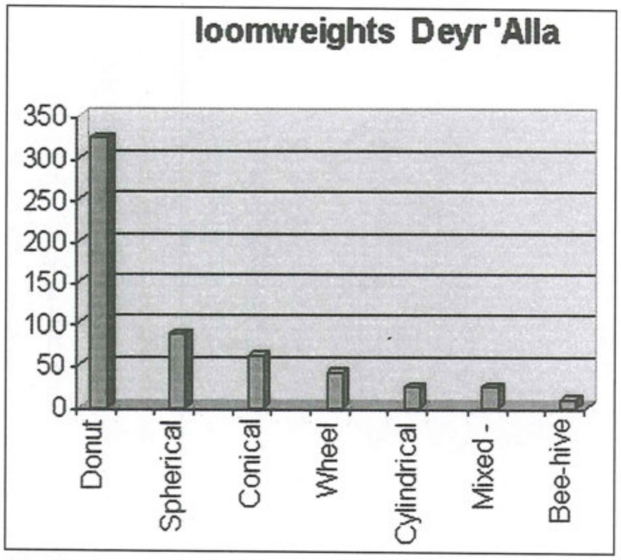
Group I

B/A7 locus 60 and B/A6 locus 122, this is a small room with an entrance to a courtyard at the

Type	Number	Weight range in gram
Donut	27	240-665
Spherical/ball	7	290-600
Conical	3	185-610
Wheel	1	270
Mixed type	3	330-440
Total	41	Total average weight 357

Iron Age Loom weights Dayr 'Allā phase IX

Iron Age Loomweights Deyr 'Alla phase IX		
Type	Number	Percentage
Donut	322	54.8 %
Spherical/ ball shaped	86	14.6 %
Conical	62	10.5 %
Wheel	41	6.9 %
Cylindrical	23	3.9 %
Mixed -type	26	4.3 %
Beehive	8	1.4 %
Spool shaped un-perforated (rest group)	1	0.2%
Oblong (rest groups)	3	0.5 %
Ovoid (rest groups)	3	0.5 %
Amorph (rest groups)	14	2.4 %
Total	589	100 %



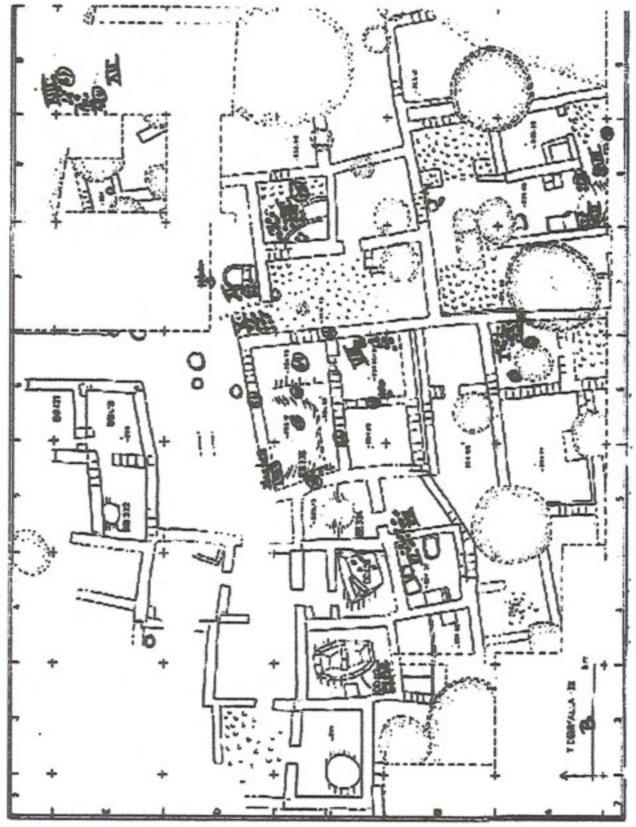
16. Diagram of the loom weights from Tall Dayr 'Allā phase IX (Iron Age II) n=589.

south. The loom stood in the North-East corner (**Fig 18**). The cloth fragment and the thread inside a loom weight were found in this locus.

Group II

Type	Number	Weight range in gr.
Donut	19	160-2400
Spherical/ball	3	140-180
Conical	3	335-400
Wheel	3	330-350
Cylindrical	3	260-380
Beehive shaped	2	360-460
Total	33	Total average weight 379

B/A8 locus 55, the loom stood next to a bin made of clay plaster with potsherds in a storeroom that also contained jars, a dish and a jug-stand. The room has been reconstructed and is described in Kooij and Ibrahim (1989: 82-85). In the publication these loom weights are referred to as "Some forty wheel-shaped loom weights lay against the west wall, one of which was extremely large". The loom weights are of different types and not only wheel-shaped as recorded by Kooij and Ibrahim 1989: 85. (The extra large weight **Fig. 12**).
B/A8 locus 55



17. Top plan of Iron Age Dayr 'Allā.

18. The 41 loom weights in rows of group I (BA6 and BA7).

Group III

B/A8 locus 63 this collection may have belonged to locus 55 "The weights found further to the east probably belong here" (Kooij and Ibrahim 1989: 85). But they seem to be amongst a small collection stored between the broken pots for the production

Type	Number	Weight range in gram
Donut	6	335-405
Spherical/ball	3	320-335
Conical	2	130-390
Total	11	Total average weight 311

of yoghurt, dung for burning as well as a number of storage jars with burnt contents (Kooij and Ibrahim 1989: 84).

If these weights belonged to locus 55 then more loom weights should have been scattered around all over the place. But the top plan of this section shows that these weights lay together in a circle, between the pots where they might have been kept in a basket (**Fig. 19**).
B/A8 locus 63

Group IV
B/A 10 locus 26, this square is not yet published, and no top plan is available. Unknown interpretation.
B/A 10 locus 26

Type	Number	Weight range in gram
Donut	2	320
Spherical/ball	2	275-295
Wheel	6	335-475
Total	10	Total average weight 327

Group V
B/B3 locus 38, is the southern part of room number DD417 where there is a mudbrick-lined pit.

Type	Number	Weight range in gram
Donut	9	225-435
Spherical/ball	1	285
Conical	2	360
Total	12	Total average weight 232

Group VI

Type	Number	Weight range in gram
Donut	11	220-520
Spherical/ball	3	515-575
Total	14	Total average weight 382

B/B4 locus 83, is a small room, south of room DD409, with mudbrick constructions and basins.

Group VII

Type	Number	Weight range in gram
Donut	10	200-390
Spherical/ball	2	490-530
Conical	1	1550
Total	13	Total average weight 320

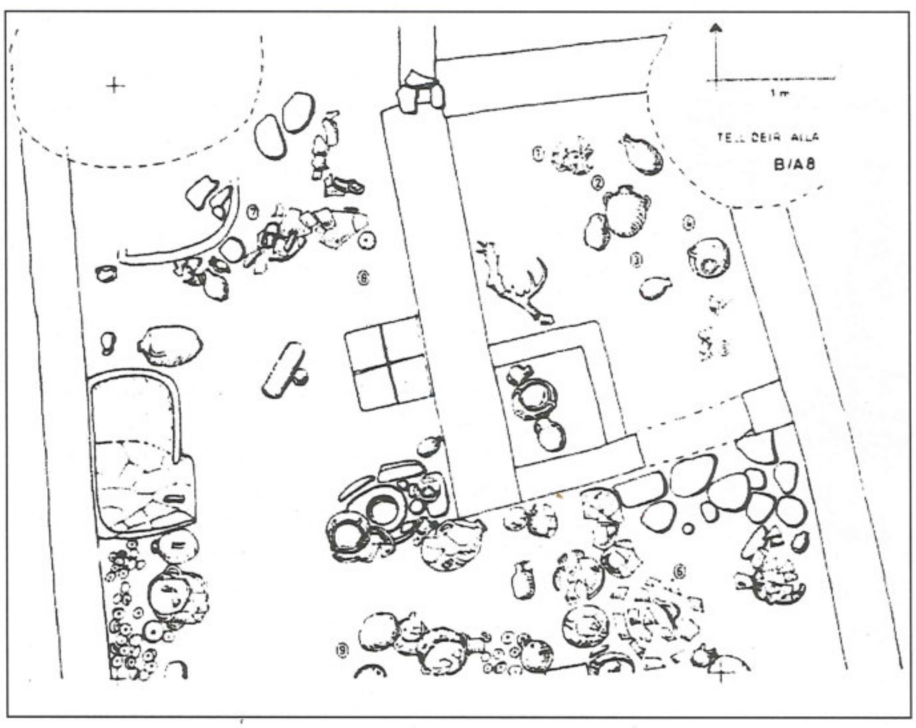
B/B5 locus 129, is a small open courtyard next to the above room. It seems that the loom weights of these two looms were scattered around the room and the courtyard. The looms probably stood on the roof and fell down with the roof-material.

Group VIII

Type	Number	Weight range in gram
Donut	15	205-465
Spherical/ball	6	265-525
Wheel	4	270-430
Mixed type	4	415-275
Total	29	Total average weight 353

B/C6 locus 117, is a small room belonging to the complex with the benched room and associated with Bal'am text and drawings on the plastered wall (**Fig. 20**) (Room EE335 in Fig. 17/Top plan).

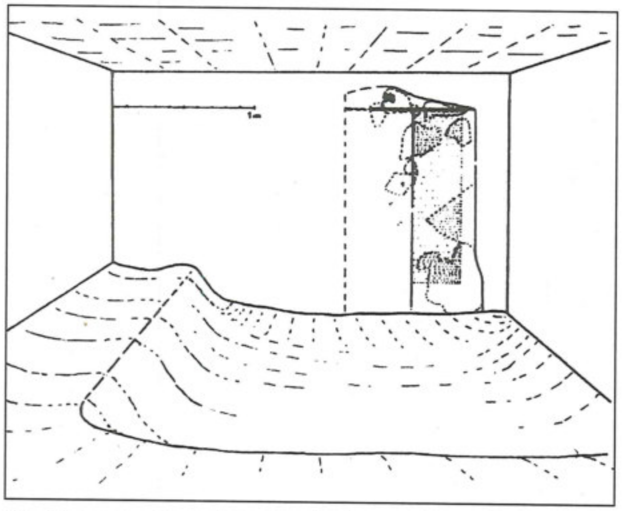
Group IX
B/C8 locus 75, is a room with a pavement of cob-



19. Reconstruction of the rooms in BA8 (Group II and III) (Kooij and Ibrahim 1989: 82).

Type	Number	Weight range in gr.
Donut	15	190-550
Spherical/ball	6	125-500
Conical	1	460
Wheel	16	405-595
Cylindrical	8	425-640
Beehive shaped	1	250
Mixed type	5	335-490
Total	52	Total average weight 370

bles, next to the cobble-paved courtyard with a large amount of plant matter. This plant matter was only macroscopically analysed and is defined as layers of reed laid down on a muddy pavement (Kooij 2002: 68). The plant matter has to be analysed. It could be hemp left in the open air on the cobbled pavement of the yard for ratting (Boertien 2005b). The loom weights scattered around suggest that the loom stood on the roof of this building and fell inside with the roof material (**Fig. 21**).



20. Reconstruction of the benched room (room EE335) with the Bal'am plaster text (Kooij and Ibrahim 1989: 64).

21. The loom weights of group IX (B/C8 75) — the loom probably stood on the roof of the building.

Group X

Type	Number	Weight range in gr.
Donut	10	220-465
Wheel	1	430
Cylindrical	3	420-480
Mixed type	2	405-570
Total	16	Total average weight 378

B/D7 locus 52, the entrance (North side) to the cobble stone paved courtyard. The loom stood in the entrance next to bread ovens, at the Northeast corner of the benched room where the Bal'am text was found.

Group XI

Type	Number	Weight range in gr.
Donut	4	305-460
Spherical/ball	4	355-520
Wheel	7	450-500
Mixed type	2	500-520
Total	17	Total average weight 393

B/D7 locus 54, is the courtyard as described above. This loom stood on the unpaved part of the yard next to a mudbrick construction.

Group XII

Type	Number	Weight range in gr.
Donut	12	255-480
Conical	17	320-500
Beehive shaped	4	460-500
Spool (un-perforated weight)	1	430
Total	34	Total average weight 347

B/E9 locus 24, roofed room partly paved with cobblestones. There were three rows of weights. The loom stood next to a large cooking pot. This group contains a special weight: An imperforated spool/reel shaped weight found together with the perforated weights. The spool: Height 8.5; Diameter 7-6cm; Weight 430 gram. It was made of the same banded clay, though not so well mixed and contained grit. The form is comparable to the spools found in Northern Syria (Cecchini 2000: 212) (**Fig. 5**). In group XII three fragments are found made from the same sort of clay but these fragments could not be clearly identified. They may have been three more spool shaped weights. The donut shaped weights in this group are of the common type but the conical and beehive shaped loom weights used in this group look very much the same as the loom weights from Northern Syria (Cecchini 2000: 224) compared to **Fig. 23**

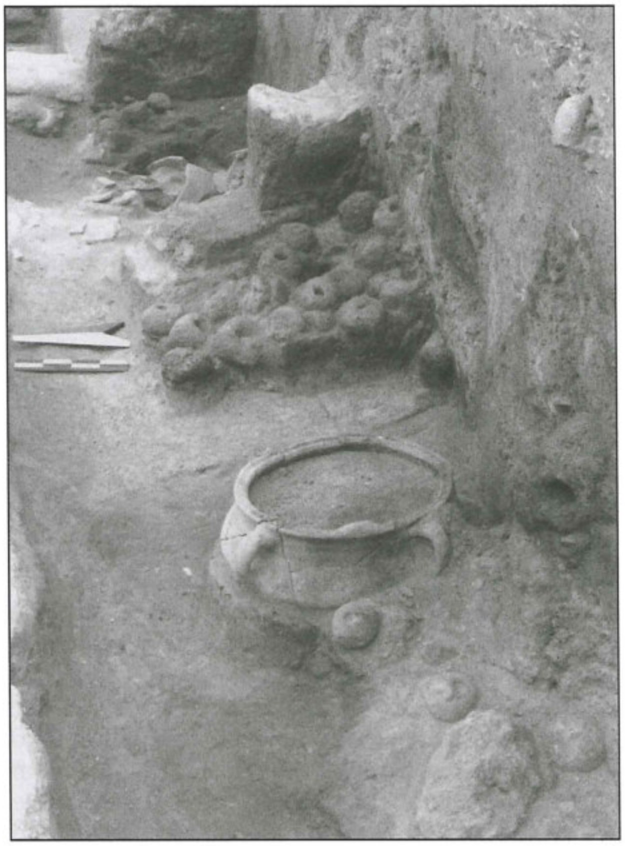
The upper row shows some of the conical weights together with a beehive shaped weight. The row in the middle shows some donut shaped weights. The last row shows the spool shaped imperforated weight in the middle and a conical weight on both sides (**Fig. 22**).

Group XIII

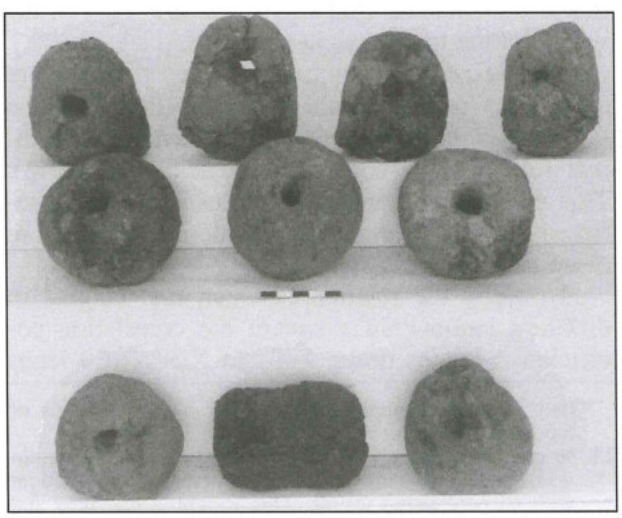
B/E9 locus 67, is a roofed room partly covered

Type	Number	Weight range in gr.
Donut	7	400-540
Conical	6	355-520
Beehive shaped	1	445
Total	14	Total average weight 379

with cobble stones. The loom stood next to a lined shallow mudbrick pit (Comparable to room DD417), and near a small mudbrick table/ construction filled with line seed.



22. The loom weights of group XII. (B/E9 24).



23. Some of the loom weights from group XII (B/E9 locus 24).

Group XIV

Type	Number	Weight range in gr.
Donut	68	190-460
Spherical/ball	12	225-1050
Conical	2	445-575
Cylindrical	8	260-575
Mixed	8	240-305
Total	98	Total average weight 267

D/D7 locus 123=D/C7 locus 100, not on the plan of Iron Age Dayr 'Allā. This very large group of weights is found together with carbonised organic material (**Fig. 24**) (not yet analysed). The connection between the different loci is not clear.

Group XV

B*8 locus 9 Not on the plan of Dayr 'Allā phase IX. This group was found with carbonised organic material that has not yet been analysed. The group is very interesting because of the strange forms and mixed types used.

Type	Number	Weight range in gr.
Donut	13	300-400
Spherical/ball	4	129-310
Conical	5	330-450
Mixed type	1	470
Amorph	1	270
Total	24	Total average weight 338

The Relationship between Different Types of Loom Weights Within a Group

The calculations are based on the 15 large groups of loom weights from phase IX. Browning (1988) states that there is a relationship between the donut and the conical loom weight. He states that when they are used in a household the relationship is 1:5. In Dayr 'Allā this relationship is 1:6 but more differences in form are seen than at in Tall Battash.

Working in an analogue way the pendant-like loom weights (with a horizontal perforation) and the centrally perforated (vertical perforation) weights that are to be compared within a group of

24. The loom weight of group XIV during the excavation.

weights.

The result for Dayr 'Allā phase IX is horizontal perforation: vertical perforation 1:7. The interrelation can be shown by the correlation coefficient for the shape of the loom weights from Iron Age Dayr 'Allā. A correlation coefficient of 0.70 indicates an interesting relation that has to be studied (Velde 1996: 50-51). The general conclusion is that none of these relations in shape is very important.

These statistics give some extra information:

1. The correlation coefficient for the donut and the conical loom weight is 0.59.
   Conclusion: There is a slight relation between these types.
2. The correlation coefficient between conical loom weight and the beehive shaped loom weight is 0.22.
   Conclusion: There is no relation between these horizontal perforated types.
3. The correlation coefficient between the wheel form and the spherical loom weights is 0.40.
   Conclusion: There is a slight relation.
4. The correlation coefficient between the cylindrical and the wheel form loom weight is 0.54.
   Conclusion: This points to a slight relation.

The general conclusion must be that there is no special relation within different types of loom weight used on the warp-weighted loom.

The Weight of Loom Weights

The average weight of loom weights used on a loom in Dayr 'Allā is 8kg. The average weight of a loom weight in phase IX is 465.9g.

Often the weights used within one loom are supposed to be similar, but differences are recorded. Barber mentions the possibility that heavier weights were used at each end of a loom to strengthen the side selvedges (Barber 1991: 96). Hoffmann records that sometimes two weights were tied to one bunch of threads to balance the shed, and that there are weavers using much heavier weights tied to each end to strengthen the side selvedges, which get a lot of wear. She records differences of about 450g between the weights on the loom and the last two for the selvedges (Hoffmann 1974: 42, 65). In Iron Age Dayr 'Allā this phenomenon was not visible.

Because some of the studied large groups contained extra large weights the influence of weight was studied[10]. A donut type loom weight of 2400 grams was found in group II (B/A8 locus 55). The height is 10cm, the diameter is 18cm and the perforation has a diameter of 6.5cm.The influence in the figures of this extra large weight is limited because all donuts (the huge weight included) have an average weight of 335 gram without this extra big weight this would be an average weight of 325 gram. Within group II the average weight of all loom weights is 379.3 (the huge weight included), without the large weight it would be 307 gram. An extra large <u>conical weight</u> was found in group VII (B/B5 129) the weight is 1550 grams. The height is 11.5cm, the diameter is 13cm, and the perforation diameter is 3cm. This conical weight shows signs of use in the perforation.

The weights in this locus have an average weight of 320 grams when the huge weight is counted. Without this extra large weight the average weight would be 201 grams, which is very low considering the average weight of Iron Age loom weights is normally is 300-400 gram (Shamir 1996: 140). This shows that the huge weights are to be counted within the loom weights till we know what their function was and if this function is related to the loom weights. In group XIV (D/D7 locus 123) <u>a huge spherical weight</u> was found. The diameter is 16cm, the height is 7.5cm and the weight is 1050 grams. The heaviest weight was found in square B*8 locus 11: <u>a conical weight</u>, the diameter of which is 14cm, the height is 17cm, the perforation diameter is 5cm, and the weight is 2740 gram[11]. The relation between the large loom weights and the normal sized weights in the same locus was studied but no special relationship could be found in the weight or in the type. This clarifies that it is difficult to find significant influence of the weight of the loom weight used within a loom.

The weight of a loom weight and the measure of the perforation could have a relation to the thread used, but these parameters do not have a direct relation (the correlation coefficient is 0.48). This means that there is no interesting relation between the weight of a loom weight and the measure of the perforation.

To study the relation between the weights in different loci within a square the correlation coefficient between group XII and XIII (B/E9 locus

10. Within the collection of Dayr 'Alla 4 very large and heavy weights are found. Dr. G. van der Kooij (personal communication) suggested that these weights are not loom weights, this indeed is not sure.
    But because these huge weights are found within the collections of loom weights (in the same square and locus) and are registered as part of the same find (find-number), they will be counted as part of the different groups of loom weights.
11. In the same square B*8 in locus 14 an undefined weight was found, the diameter 14cm and the height is 10.4cm with no perforation visible. This weight is damaged and thus not represented in this group.

24 and B/E9 locus 67) was calculated. The result is a correlation of 0.08, which makes clear that there is no statistical relation between these two large groups of loom weights. This means that different types of weights were used within one household.

Conclusions

The 589 studied loom weights from Iron Age Dayr 'Allā make clear that research on loom weights has to be based on loom weights from sites with large numbers of weights. Then conclusions can be made out of the average numbers and weights belonging to the same loom and household can be studied.

From the study of the large Dayr 'Allā collection it is clear that there is no correlation between form and function of the loom weights on the warp-weighted loom. Crowfoot (1951: 29) and Browning (1988) suggested that there was a correlation between form and function but this can not be proved in the Iron Age collection of Dayr 'Allā. This means that the type of used loom weights does not give us the opportunity to find out what sort of textiles were made.

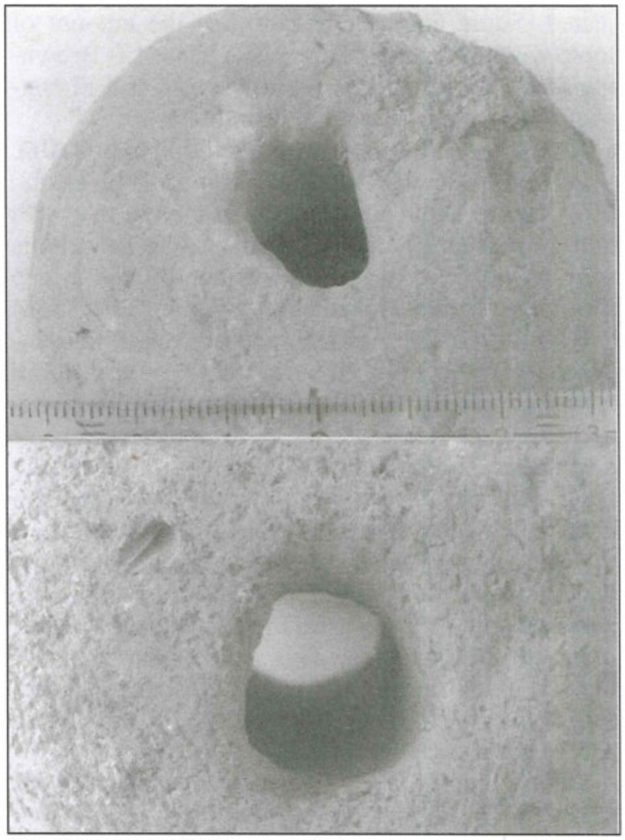
There is no statistical correlation between the form and the number of loom weights used on this type of loom. In Dayr 'Allā the average set of loom weights is 22.2 weights. The weights have been used for a long period, this is visible from the use traces of threads occasionally left on the unbaked weights (Appendix to this article) (**Figs. 25, 26**).

In one household different types of loom weights were used. There is no special inter-relationship between the used weights on a loom, neither in weight nor in type. It is interesting that the types used in Iron Age Dayr 'Allā show a relation to the type of loom weights used in the Iron Age in Northern Syria, as described by Cecchini in her publication on the textile industry in Tall (2000).

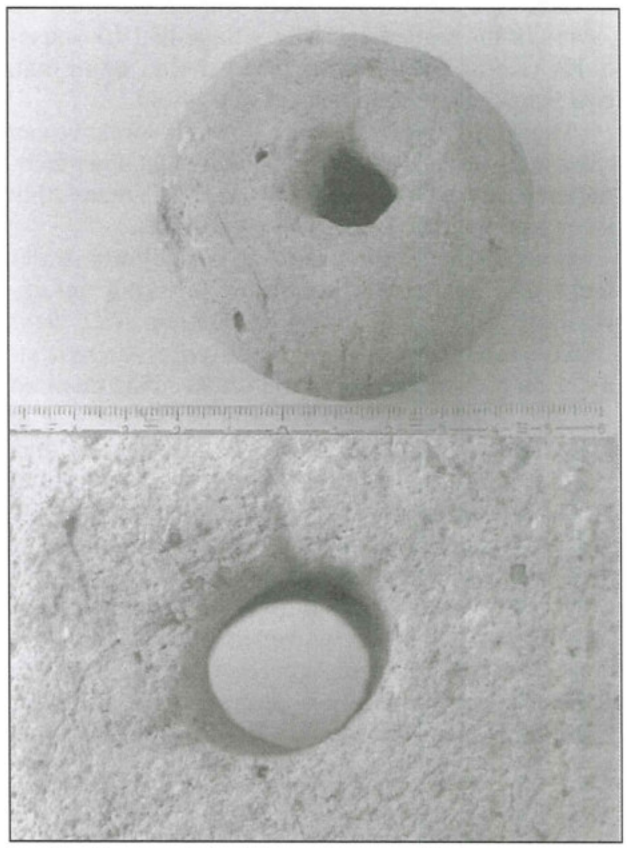
The type of a loom weight does not indicate the sort of textile produced but it might indicate a regional tradition for manufacturing the loom weights.

Household Production Only?

Another important point is whether weaving was done only for household use or that it also had commercial value. G. van der Kooij states that: "The fact that at the moment of the earthquake, only a few looms were in use, makes it possible that textiles were only made for home use when needed" (Kooij and Ibrahim 1989: 88). However, because of the amount of loom weights found in the village of phase IX, till now 675 loom weights are registered, (and even more are expected) this idea has to be re-



25. Traces of use in loom weights.



26. Used loom weights (Macro-photograph).

jected. Some numbers to compare the amount of loom weights found in Dayr 'Allā phase IX: Browning (1988) counted 288 loom weights at Tall Battash and he writes about textile industry.

In Tall as-Sa'īdiya, not far from Tall Dayr 'Allā, Pritchard (1985: 16-18 and 35-38) and Tubb (1988, 1998) write about a production for own use with 215 loom weights. In Jerusalem 186 loom weights were found, 97 of these weights were found in one room, the 'Bullae House'. Orit Shamir (1996: 153) calls this domestic weaving activity rather than industrial production. Kenyon found 128 loom weights in Jerusalem in and around one building, and Margreet Steiner (1994: 122) interpreted this as a commercial production. This means that Iron Age Dayr 'Allā has three times more loom weights than other Iron Age sites in the Levant.

The interpretation of the amount of loom weights related to the rate of production is often a problem but in Dayr 'Allā each household had more than two looms. This means that the production of textile was an important economical factor for the community. The fact that a special fibre was made stresses this point.

When the village was destroyed there were about 675 loom weights in the different houses or on the roofs and in the courtyards. That means that in Iron Age Dayr 'Allā there were more than 30 looms in the settlement. The village had 15 households (Kooij and Ibrahim 1989) that is more than two warp-weighted looms per household.[12]

The warp-weighted loom is the only loom we can trace in the excavation, but it is likely that other techniques to make cloth were also used. This means that the amount of textile could be even higher.

Concluding: In this Iron Age agricultural settlement the inhabitants combined working in agriculture, trade and textile production. Tall Dayr 'Allā is located in an agriculturally fertile environment on a cross road of trade routes. This position and the amount of loom weights per household in this village makes it reasonable to suggest that during the Iron Age external contacts seem normal and almost essential. Because the inhabitants of the village were dependent on usual tools and their own craft more than on luxury goods and treasures (Petit 1999: 162). There must have been a form of distribution of textiles woven in the village. It is reasonable to see Iron Age Dayr 'Allā as an important textile production centre, where different kinds of textile were produced and sold. Iron Age Dayr 'Allā situated on an important commercial crossroad was part of a trading and exchange network in which the textiles probably played an important role. The production of the special fine hemp cloth possibly strengthened the position of the small village within this network. It is clear that the production of textile in this village was on a household production level for a (local) market.

Reanalysing textile material from the Levant is necessary to distinguish between linen and hemp in the textile finds. The use of a scanning electron microscope and knowledge of textile plant fibres is indispensable. When more detailed information is available then the special hemp-textile made in Iron Age Dayr 'Allā could lead to distribution patterns of textile production in the Levant.

Where was Weaving Done Within the Village?

Weaving could be done at different places in or near the house. The warp-weighted loom needs some space to stand next to a wall, a beam or a construction made to stand against.

To weave fine textile or patterned cloth much light is needed, that is the reason why the description of Kooij is not very logical. In his view the rooms are dark and dusty, and this was the place were weaving was done (Picking up the threads 1989: 88). But for weaving much light is needed. The finds show that other places were used for setting up the loom, such as on the roof (Browning 1988: 133; Steiner 2001: 100) or in the courtyard of the house. Inside the house is a possible place to weave if there were windows and/or a door opening and/or enough light shining through the thin mats on the roof (Kooij 2002: 70-71). If the house is roofed than it is possible to use the roof, as a place to make textile and the courtyard seems a suitable place.

The plan of phase IX shows that some looms stood inside a room, such as the looms of group I, II, V, XII and XIII. Sometimes loom weights were in storage, such as group III. Looms stood on the roof as suggested by group VI, VII and IX. And the looms stood in the courtyard, such as the two looms near the bread ovens group X and XI. In conclusion, in Iron Age Dayr 'Allā the looms stood inside the house, in the courtyard and on the roof.

In this publication I focused on loom weights. But besides loom weights the rest of the artefacts used to produce textile will have to be studied. Especially the spinning whorls, bone spatulae, (sword

12. 675 loom weights were found in Iron Age Dayr 'Allā. The average number for a loom is 22.2 loom weights. 675: 22.2 = 30.40 looms. There are 14-15 households 30.40: 15 = 2.02. This suggests that there were two looms in each household in Iron Age Dayr 'Allā.

beaters) and pin beaters used for beating up and /or pattern weaving. These are of interest in relation to the loom weights (Crowfoot 1941, 1944, 1945; Tufnell 1953: 397; Hoffmann 1974: 320). To make a comprehensive reconstruction of the textile production of this village in the late Iron Age the connection between the different tools used in textile production have to be studied in relation to the use of space. This will be possible when the detailed stratigraphic information of Tall Dayr 'Allā phase IX is published.

Acknowledgements

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APPENDIX

Experiment Making Loom Weights

Introduction

Iron Age loom weights show a great variety in form, and thus to make a typology based on technological information technical information about manufacturing loom weights was needed. While studying the collection from Dayr 'Allā it became clear that it was sometimes difficult to distinguish between marks of manufacture and traces of use. An experiment was needed to gather information on the marks manufacturing leaves on different types of raw loom weights. The perforation often showed signs that could not have been understood. The author therefore decided to perform a small experiment.

The Experiment

From technical analysis on the pottery from Dayr 'Allā done by the Institute for Pottery Technology in Leiden it is known that in this region the local banded Lisan clay was used for pottery-making.

In this clay two groups of non-plastic materials can be differentiated:

1. A combination of quartz-sand and organic material.
2. A combination of quartz-sand, lime and organic material (Kalsbeek 1969: 73-80).

Quartz-sand washed down by the az-Zarqā' river occurs in abundance in the vicinity of Dayr 'Allā.

Temper indicates non-plastic elements in a clay, which are considered to have been added by the potter (Franken and Steiner 1990: 79)

The temper used in loom weights is often organic, together with the small and large stones, it is probable that the clay was not specifically cleaned or selected before it was used for the loom weights.

For the experiment local clay was used without a special temper. The clay was collected from a clay-bed 20 minutes walk southeast of the tall. No extra temper was added because the clay collected contained the above mentioned components and it was a good plastic clay as described by Kalsbeek (1969: 74) [13]. The experiment was carried out in 1999 when the temperature was 18-25° C. 22 loom weights were made, based on shapes of the loom weights found in Tall Dayr 'Allā phase IX.

The 'problem' in the collection from the Iron Age showed us that some models had typical drying cracks. The drying process of thick parts takes a long time and the escaping air between the clay-particles damages the surface of the clay. To study these phenomena two different groups were made.

The kneading and drying process of clays was studied to distinguish between damage related to the way of making the loom weights and damage caused by use. Two different groups of weights were made. (See step 4 of the working scheme).

In Group I the clay was kneaded, while the new loom weights dried the thick loom weights showed the expected cracks. In Group II, more kneading was done to work out the air from the clay. Kneading the clay thoroughly is really necessary to produce workable clay.

Working Scheme

1. Collecting the clay.
2. Crushing the lumps of hard clay.
3. Adding water and mixing the clay.
4. Kneading (thoroughly) into a lump of plastic clay, two different groups were distinguished.
5. Preparing clay balls.
6. Shaping the balls into different types of loom weights.

13. The following test showed that the clay was good plastic clay. 'A simple test can be done on natural clay found near an excavated site, to find out about the plasticity of the material. After mixing some clay with water until it is kneadable, a roll is made 15cm long and 1cm in diameter. One lifts the roll holding one end between the fingers, while the other end can swing freely. If the clay roll breaks of, the clay is not plastic. If the roll does not break, and if it is possible to wind the free end like a snail's shell, without causing the clay to crack, it is a very good plastic or unctuous clay'.

7. Perforating the loom weights.
8. Smoothing the surface.
9. Drying the object.
10. Traces of use.
11. Firing the weights.
12. Disintegrating of raw clay loom weights.

Collecting the clay

The clay used is the local banded lisan marl from a source 20 minutes walk south-east of Tall Dayr 'Allā. The clay was not specially selected. Some stones, sand and organic materials were left in the clay as known from the loom weights of this period. (See the chapter The loom weights from Iron Age Dayr 'Allā 'The material').

Crushing the lumps of hard clay

Crushing was needed to make a workable mixture. The clay showed different colours from grey to brown, and from red to pink and yellow. Small pieces of iron ore were visible as small red spots.

Adding water and mixing the clay

The original loom weights showed signs of being made of a dry clay mixture. Therefore we decided to keep the clay rather dry. But for some models more water had to be added while working.

Kneading the clay

In the Iron Age collection a difference could be observed in the way the clay was treated. A small number of loom weights were made of nicely selected and thoroughly kneaded fine clay that resulted in a smooth structured loom weight. But most loom weights are made of clay that suggested nonchalance in selecting and working before use. These weights contained big stones and sand or organic material in different amounts.

Here a difference was made for two series of loom weights. Group I was made of a medium mixed and kneaded clay, to make 9 loom weights of different type. And group II made of well-mixed and kneaded clay for 13 loom weights of different type. For both groups this was done in a different way, for the first group the clay was slightly mixed and kneaded and the clay for the second group was mixed very well and kneaded thoroughly.

I. Kneading and mixing the clay medium for the first group of loom weights in the experiment.
II. Kneading and mixing the clay thoroughly for the second amount of loom weights to make a difference with group I.

Preparing the clay balls

Each piece of clay weighed about 350 grams (this is the average weight of Iron Age loom weights (Shamir 1996: 140). At the time of the experiment the numbers of the loom weights from Tall Dayr 'Allā phase IX were not yet available).

Shaping the loom weights

While making the loom weights it became clear that some shapes are very logical to make. A piece of clay is easily formed in the hand to a coil, while forming the fore finger, middle finger and thumb of the right hand automatically press the clay together while placing the piece of clay on the left hand, then a conical form stands between both hands! (**Fig. 27**).

It was very surprising to see that the most 'illogical' form of loom weight came into being in such a simple way. The conical loom weight with a rounded bottom stood on the palm of the hand, while the same pressed coil placed on a flat underground gave the shape of the conical loom weight with a flat bottom. The distinction between the two conical loom weight-forms appeared to be of less interest, it actually is the same form, made on different surfaces.

The beehive form is related to the conical form. It is basically made from the same pressed coil, but now the bottom and the upper part of the weight are flattened. This type always has a very small perforation half way through the loom weight. An intermediary has to be attached to this weight such as a loop or a stick or a rod to fasten the warp threads to this loom weight.

The donut form loom weight is easily made, forming a coil and winding it around a finger, this gives

27. Forming the conical loom weight.

a donut form with a diameter of max. 6-9cm. A coil of about 15-18cm and 3cm high can still be worked around the finger, but longer or thicker roles are impossible to be used in this way.

Big loom weights of this type, (with a diameter over 9cm) are made in a different way, a spherical piece of clay is perforated with a stick, traces of such sticks are found in the loom weights of Dayr 'Allā. The donut is smoothed with wet hands to make a regular form and often these larger donuts have a flat side even after smoothing. The big loom weights show signs of this way of making and regularly some clay is pressed out the hole at one side and it is smoothed and pressed away on the donut. It is clear that larger donuts are worked out in a different way than the smaller ones.

To make a real spherical form appeared to be difficult, a clay ball of 350 grams is not very easily formed into a smooth ball. Perforating these balls with a stick had the difficulty of misforming the ball. Friend (1998: 9) suggests that "the ball shape was easier to make" but it is difficult to make a good ball-shaped weight. The ball-shaped weights have an additional problem in that whilst drying deep cracks occurred. These cracks could be repaired in the leather-hard clay.

The cylindrical form develops from the ball shaped form. Working on a hard surface a spherical form quickly develops into a cylinder, it is even more practical to make a cylinder, a clay-ball placed on a hard surface and then rolled on this surface while forming, will turn into a cylinder. Perforating the cylindrical weight is not easy, as is the perforation of the spherical weight because both forms have a long way to pierce through.

The wheel form develops from working around a stick. A clay ball with a stick in the centre is transformed into a wheel-form when working on a hard surface and when the clay is smoothed in the direction of the stick. The typical form of the wheel-formed loom weight 'grows' out of the clay lump while pressing the clay in the direction of the stick and making it flat around the stick. This gives the wheel its typical form, a slight depression in the wheel occurs when smoothing and then a truncation often is the result. When the weight is turned and the wheel rolls over the surface of this weight is nicely smoothed while the perforation widens in a conical form. This is typical for these weights.

Pulling out the stick leaves traces in the loom weights (the so-called truncated top, thus it is not a typological difference) the pulling often changes the form of the wheel in an asymmetric wheel. The wheel form appeared to be a quick way of making a loom weight, it can be large and heavy without the problems the spherical and cylindrical weights have, because this form is thinner, the hole is not so long and the problems while drying are less.

The mixed forms in the collection of Phase IX show a special relation between three types of loom weights related to the production process. When a weight is of a medium size (less than 9cm in diameter) and it is formed holding the clay in the hand forming the weight around a stick or the finger, only the final steps make the difference in type. This leads in the category of medium weights to a mixed type, because in the case of a larger weight the forming techniques are principally different.

The wheel form and the cylindrical loom weight are made out of a donut form, in the collection of Deyr 'Allā this is visible in different species that show both or even the three forms in one weight.

4.3 % of the 589 loom weights from phase IX show a mixed form:

- 5 loom weights are partly a donut and partly a wheel formed weight.
- 6 loom weights are donuts worked out as a cylinder.
- 9 loom weights are spherical and worked out as a cylinder.
- 2 loom weights are spherical and donut in one
- 2 weight is a combination of a conical and a donut form
- 1 donut/triangle formed huge weight
- 1 weight shows 3 forms in one, a donut/cylinder that is partly spherical.

From the above experiment this is logical, because when working on a flat surface the weights with a diameter between 5 and 7.5cm are very much related by their measurement and the forming techniques used. All these weights have a hole with a diameter of 2cm, they are partially made in the same way, only the last steps in the forming process differ and that causes the difference in form. The 'mixed type' shows this fact clearly.

Perforating the Loom Weights

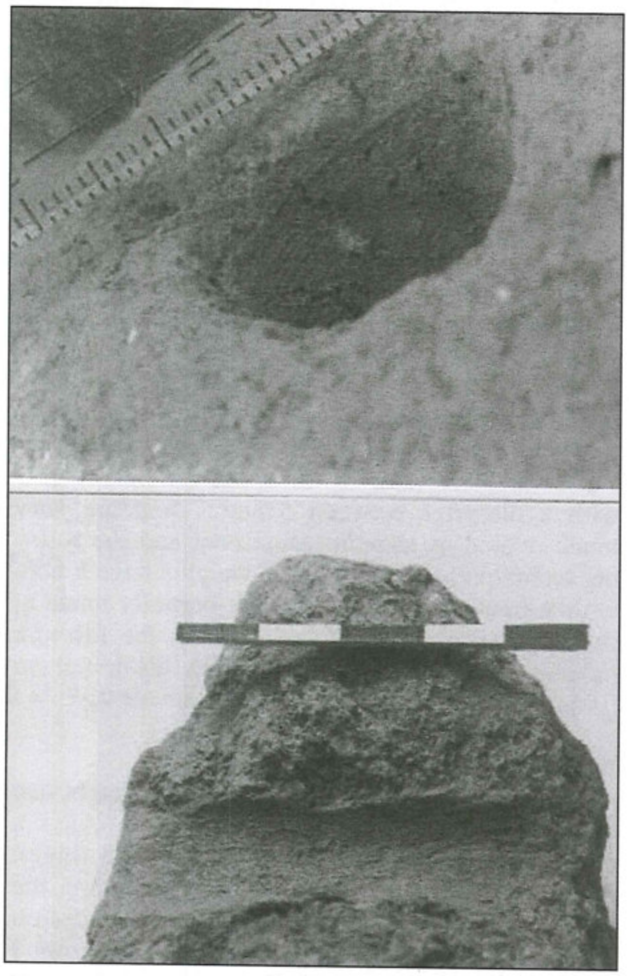
The hole in the middle of the loom weight can be made in two ways. While making the object a coil of clay is wrapped around a stick or a finger, or the hole is made afterwards by perforating the weight with a stick. This leaves different traces on the clay. We can distinguish between a horizontal perforation above the middle of the weight. This gives the pendant form, as seen in the conical and beehive shaped weights and a vertical perforation in the middle of the weight seen in most donut, ball, cylindrical and wheel-shaped weights.

With a stick a weight can be perforated from one side, this often gives characteristic traces in the wet clay that are still visible in the dry material and on the weight (**Fig. 28**). Sometimes the clay is worked from one side and comes out of the hole, often signs of smoothing are visible.

A perforation can be made from two sides and leaves typical traces inside the loom weight. Before the stick is taken out of the weight it can be turned around, this often results in a hole with a conical form at one side. The size of the perforation depends on the way the hole is made. Perforations wider than 2.5cm in diameter are always made from two sides.

Smoothing the surface

When leather hard the weights could be smoothed easily with wet hands. Small cracks can thus be mended.



28. Traces of manufacture in loom weights from Tall Dayr 'Allā.

Drying the loom weights

Loom weights are thick clay artefacts and to prevent cracks they have to dry slowly. Drying in the sun as described by Shamir (1994: 37, 1996: 136) and suggested by Bienkowski (Bienkowski 1995: 89) is impossible. Drying has to be done in the shade as potters do with their pots. When drying to quick deep cracks as reported by Rye (1981: 21-24, fig. 46) for the rim of pots will develop [14]. The loom weights in the experiment were dried in the shade. After two days they were turned over. At a temperature of 18-25 °C it took 8 days for the weights to dry thoroughly.

Even during the slow drying process in the shade, the thick loom weights of group I cracked, because the drying process of thick parts takes a long time and the escaping air between the clay-particles damages the surface of the clay. Often very deep cracks appeared during the drying process, especially in or around the perforation in the spherical and cylindrical weights. When this happened it was clear that kneading the clay thoroughly is really necessary to produce a good loom weight.

In group II, more kneading was done to work the air out of the clay. It is important to distinguish between cracks that occurred whilst drying and cracks related to firing. Firing cracks develop related to the temper used in clay. As reported for the re-baked loom weights by Albright (1943: 118) they make the weight brittle. Because Iron Age loom weights were not meant to be baked, a lot of this sort of damage is visible in the collection of Dayr 'Allā. Here the destruction fire baked the loom weights by accident.

The experiment showed that deep cracks are difficult to avoid for the relatively thick weights. The form of the cracks is comparable to the description for pottery in Rye (1981: 66 and figure 46). The edges of cracks that form during drying tend to be irregular, frayed, and rough as a consequence of slow development. If a crack results from drying the edges will tend to remain in alignment on the surface. Drying problems give long and deep sharp cracks extending vertically.

This sort of damage can be seen in the thick loom weights within the collection of Dayr 'Allā. Here the spherical, donut and wheel-shaped weights sometimes show surface cracks, due to the drying process and thus not related to use.

In conical loom weights sometimes cracks occur around the perforation, especially when the hole is

14. The drying rate is related to the nature of the packing of clay minerals, which govern the size and distribution of capillaries through which water reaches the surface where it can evaporate. Because clays and bodies shrink during drying, stresses are created when one part dries more quickly than another and cracks develop (Rye 1988: 21-24).

more than 2cm in diameter.

Traces of use

The loom weights are very hard after drying. Threads of wool and linen were pulled through different types of loom weights for several hours. The loom weights were then examined under a magnifying glass and no signs of usage were visible. Trying to make traces of use in the weights did not succeed in this experiment. This corresponds to the experiment done by Orith Shamir. Her conclusion was that grooves do not always form (Shamir 1996: 143). Because loom weights do not move that much on a loom it will take a very long time to produce grooves of usage, even in unbaked weights. The fact that these traces have been found in the collection from Dayr 'Allā shows that the weights have been used very intensively and for a very long period. Grooves in loom weights that originate from usage can be distinguished from other damage by the place and the form.

Usage gives a smooth broad curve at one side of the weight. That is the place where the weight pulls the bunch of threads due to gravitational pull (**Figs. 25** and **26**).

Firing the loom weights

Albright (1943: 118) did a firing experiment: Re-baking loom weights in a controlled fire with a temperature of 970° C resulted in cracks around the perforation and after a day this caused disintegration of the weight.

The loom weights of Dayr 'Allā phase IX are made of unfired clay, but many loom weights of this layer are "fired" in the fire that destroyed the village after the earthquake. The question was what happens to raw loom weights when occasionally fired in an uncontrolled fire.

Eight loom weights from the experiment were fired in an open fire. The fire was kept burning during 1.5 hour, and the loom weights were kept in the hot ashes for half an hour longer. The temperature in such a fire is max 1000° C, organic material burns out and the colour of the clay turns to red/brown and sometimes black due to the fluctuating temperature and different oxygen rates. If the temperature is low and it rises slowly the colour hardly changes. Most of the weights did not collapse in this fire, even the ones from the first group made of medium mixed and kneaded clay. The high temperatures reached during the accidental firing can make the weights brittle.

The result of firing the weights from the experiment showed the same sort of changes, in colour and structure and eventually damages comparable to the weight from the Iron Age. The destruction fire of Iron Age Dayr 'Allā caused the same sort of firing traces as seen on the loom weights in the experiment.

Disintegrating

From literature by Shamir (1996: 136) and Hoffmann (1974: 314) and from experience at different archaeological digs it is known that unfired clay loom weights disintegrate when getting wet. When left lying in the rain they turn to clay. In this experiment this fact was proved. Some unbaked, but dry loom weights were wetted and fell to pieces when wetted again they turned to clay [15].

Conclusions

The experiment made clear that the loom weights of Dayr 'Allā were used unbaked and were not intended to be fired. Often the clay was used just as it was found containing organic material and stones. As known from ceramic production, drying the weights has to be done slowly and not in the full sun. Describing weights as sundried is not correct.

The production of loom weights shows that the form is not so diverse as most authors report. The experiment showed that the development of the form could be explained by the production method. This means that a different typology is needed in which the form is related to the way of production.

Bi-conical weights are not a special type of loom weight but belong to the donut form weights. Perforation is often done with a stick, the so called truncated top is the result of taking the stick out of the hole and does not point to a different type. The conical loom weight is very easy to make.

The spherical/ ball shaped weight is problematic while drying and it is not as easy and fast to make this type of loom weight as often suggested.

Weights with a diameter between 5-7.5cm are very much related in the way they were produced and this results in a group of loom weights with a mixed type. Traces of use are visible in loom weights only when they are used for a very long time.

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15. This experiment was based on personal communication (1996) with Loes Dumas, object registrar on the Tall Dayr 'Allā project. She said that when a bucket with unfired loom weights was accidentally left in the rain, this bucket after a day turned to a bucket filled with clay. In this way tens of loom weights were lost.

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