2 Archaeological Evidence from the Levant

2.1 Spinning

Spinning is the process by which fibres are stretched and twisted together in order to obtain a single and continuous yarn. Twisting can be performed both in a clockwise or counterclockwise direction, and the resulting yarn is generally defined as an s-twist or z-twist type.[1] As mentioned in the above section, vegetable fibres possess particular types of natural twist; linen and nettle are both of s-twist type and cotton and hemp are z-twist, but animal fibres such as wool do not have a natural twist and can be spun in either direction.[2] The final thread spun into a yarn tends to lose its twist (e.g. s-twist), which requires it to be joined to a second yarn spun in the same direction as itself. The two threads are therefore 'plied' by twisting them together in the opposite direction of the individual threads (in fig. 1 they are spun in s-twist, and plied in Z direction, to secure the twist).

Spinning is usually performed using a spindle, which is essentially a rod (made of wood or other materials, as discussed below) to which the fibres to be spun are attached, while the rod is rotated manually to twist the fibres. A spindle whorl, a disc in its basic form, attached to the spindle, may also be added to increase the speed and regularity of the spinning. The size and heaviness of the spindle, as well as the diameter and weight

1 This nomenclature refers to the direction of the spirals of the thread when held in a vertical position: if these spirals have the same shape as the central part of the letter S, they have an s-twist. Otherwise, if the spirals follow the same direction as the central part of the letter Z, they are defined as z-twist.

2 Most wool yarns appear to have a z-twist. According to Peyronel (2004, 45) it may depend on the probability that most of the spinners were right-handed, with the minority of s-twisted fibres having been spun by left-handed people. It could also depend on different methods of spinning.

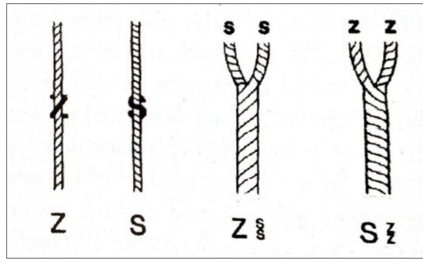

Figure 1. Spinning directions (Gleba 2008, fig. 17)

of the spindle whorl, determine the thickness of the yarn obtained, as several experiments by the CTR in Copenhagen have proved.

Generally, a smaller and lighter spindle whorl creates fine yarns, while heavier spindle whorls are required for thicker yarns. The natural characteristics of particular fibres can also determine the choice of spindle whorls. For example, wool, which is an elastic fibre, usually requires a heavier weight during spinning than vegetable fibres, which require large but light spindle whorls. Spinning cotton requires extremely light and quite small spindle whorls, otherwise the thin and short fibres would break.

The first spinners probably used their fingers to twist the fibre, but the need to keep the yarn in tension and to wrap it somewhere soon led to the use of a stick manually rotated. Spindle whorls were introduced after the spindle itself and this innovation lead to a significant decrease in the time needed to spin a yarn. There exist various spinning techniques, which relate to how the spinning instruments are used (Crowfoot 1931, 9-43; Forbes 1956, 152-4; Barber 1991, 42-51; Peyronel 2004, 41):

- hand-held spindle: a simple rod with a spindle whorl is rotated in the right hand while the left controls the supply of wool (Forbes 1956, 154);
- grasped spindle: a slightly twisted (or spliced) yarn is passed through a ring or a forked stick and spun on a large spindle rotated with both hands. This method is represented in some paintings found on the walls of Egyptian tombs of the 12th and 18th Dynasties (Forbes 1956, 153);
- suspended spindle: the fibres are attached to the spindle and unrolled regularly while the spindle is rotated by turning it between the fingers. The spindle can rotate free on the ground, in a bowl, or hanging in the air. This method allows the length of the yarn to increase, along with the momentum of the spindle. The yarn produced is uniform, durable and thin. This method works well for the spinning of long fibres, which would be difficult with a hand-held spindle (Forbes 1956, 154; Peyronel 2004, 41);
- drop spindle: similar to the previous method. The spinner pulls fibres through her hands and then turns the spindle on her thigh to twist

> the fibres and to give speed to the spindle, which is left turning in the air. The speed is quite fast and the resulting yarn is thin, as the twisting and stretching actions are performed contemporaneously (Forbes 1956, 154).

In addition to these different techniques, spinning can also be classified on the basis of the location of the spindle whorl on the spindle shaft. It is believed that the Egyptian and Mesopotamian cultures (the latter with some degree of uncertainty) used a spindle whorl placed near the upper edge of the spindle (high-whorl spindle). It appears that cultures of the Western Mediterranean and parts of Anatolia, however, normally attached spindle whorls at the bottom of the spindle shaft (low-whorl spindle) (Cecchini 2011, 198; Sauvage 2013, 208).[3] Although these seem to have been the most common practices, there were probably other traditions, which may have varied across populations and time periods.[4] The choice of the position of the spindle whorl does not affect the qualities of the resulting spun yarn, therefore the position is simply culturally determined. However, certain techniques of spinning or plying might prefer various traditions of spindle whorl placement (see fig. 2).

Splicing is a method for producing a continuous thread from separate fibres, simply by twisting them together at the points of junction. It consists of arranging bundles of linen fibres, of about 60-65 cm long, one alongside the other with the edges overlapping by a few centimetres (about 7-8 cm) (Barber 1991, 47; Vogelsang-Eastwood 2000, 73). Then, the ends of these are twisted so they remain joined to each other, allowing for the creation of a continuous yarn. This twist can be created by rolling the fibres in the palms of the hands or on the thighs. Then, they can be spun to add an extra twist, or joined to another yarn and spun together, making certain that the two yarn junction points, which are rather weak, fall in different segments and do not overlap. It is therefore not spinning proper, but rather twist-

3 In support of this hypothesis, there are few iconographic proofs: a panel from Mari (Barber 1991, 56; Breniquet 2008, 292), a fragment of relief from Susa of the Neo-Elamite period (Porada 1965, 68, fig. 43) and some Syro-Hittite reliefs, in which it is shown that the spun yarn is wrapped around the upper part of the spindle. *Contra* see Peyronel 2004, 45.

4 Today in Morocco, for example, two different spindles and two very different techniques are used, depending on whether a thick or a thin yarn is desired. To obtain a thin yarn, a smaller spindle (33 cm, max. 1.1 cm, weight 43 g), which has a spindle whorl at the top and a hook for fixing the fibres, is used; it is turned on the thigh and allowed to rotate in the air (drop spindle). Often a second small spindle whorl is added to the centre of the rod to increase the moment of inertia until enough yarn is wound around the spindle. To obtain a thicker yarn a larger spindle is used (50.5 cm, max. 1.3 cm, weight 41 g). It is pointed at both ends, with the spindle whorl(s) attached to the lower part of the spindle. The spindle is rotated by hand on the floor. As we see in this case, the weight is not a decisive factor for yarn quality but rather the technique used is.

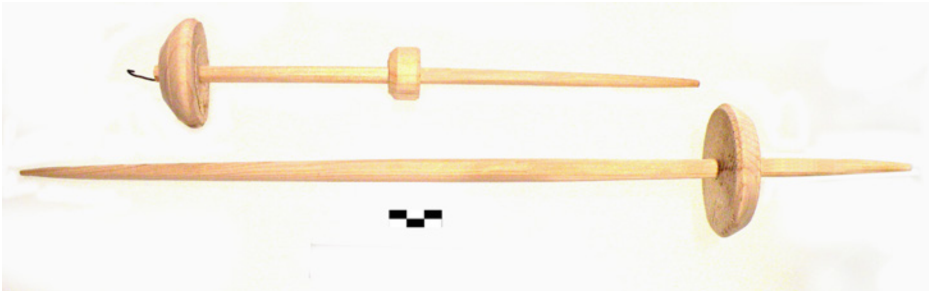

Figure 2. Moroccan spindles for the spinning of wool

ing that makes the spliced yarn more resistant. To adhere to each other, the junction points, in addition to twisting, require a 'glue' that can be obtained by simply wetting the linen with saliva. Human saliva, together with the pectin present in the fibres, forms a collagen and provides a better adhesive than plain water.

Splicing is a technique typically used on flax (or hemp) due to the remarkable length of the fibres provided by these plants, which are too long to be spun without the aid of a distaff, which was not introduced into Egypt until Roman times (Crowfoot 1931, 29; Kemp, Vogelsang-Eastwood 2001, 70). The length of flax and hemp fibres makes splicing a convenient method for their preparation, but it is not a necessary or convenient technique for the much shorter wool fibres. The method of splicing is generally linked to Ancient Egypt and was carefully studied and illustrated first by Barber and then by Vogelsang-Eastwood (Barber 1991, 44-9; Vogelsang-Eastwood 2000, 68-81). The first example of linen fabric that preserves evidence of the splicing technique is a fragment from the Fayum dating to the fifth millennium BC (Caton-Thompson, Gardner 1934, 46; Barber 1991, 48). In recent years, evidence for splicing has also been found in some preserved samples of Neolithic European fabrics, which suggests that this technique was more widespread in antiquity than has been so far been imagined.[5]

The process of splicing may be represented in the spinning scenes preserved on several tombs from Middle Kingdom period Egypt. For example, in the tomb of Daga (Davies 1913, 28, pl. XXXVII; Barber 1991, 46; Kemp, Vogelsang-Eastwood 2001, 70) the figure on the left is probably crushing the fibres by making them pass through two wooden sticks and piling them in a stack in front of the second figure. The second person involved seems to be joining two fibres by making them rotate with her hand on her thigh.

5 Several Italian fabrics were examined by M. Gleba, who noted the presence of this technique. See Rast-Eicher 2005, 121.

A third figure, poorly preserved in the painting, seems also to be joining fibres together but only turning them between the palms of her hands. A spinning scene follows this process where the spinner is standing up, with a folded leg, and is probably plying the yarns coming out of a spinning bowl, whose supply is controlled by the last figure, seated behind the spinner.

A similar process is also seen on the walls of the tomb of Khety in Beni Hasan (Newberry 1893a, 47, pl. XIII; Barber 1991, 46) and on those of Djehutyhotep of el-Bersheh (Newberry, Fraser 1893a, 34-8, pls. XXIV, XXVI; Barber 1991, 46; Vogelsang-Eastwood 2000, 70-1). This last one is particularly interesting, even if badly preserved, as it includes a scene similar to that on the tomb of Daga, as already described. Djehutyhotep's tomb, however, includes one more figure, a woman (on the left side) crouched down in front of a large ball of yarn, preparing it by carrying the thread through her mouth. The thread obtained from this ball of yarn is inserted into a spinning bowl and is then spun by a second figure. It seems a reasonable interpretation to see the figure on the left as splicing the fibres by wetting them with saliva to make them sticky and make their joints stronger. Furthermore, a wooden model from the tomb of Meket-Ra shows three women sitting on the floor engaged in this operation, rotating the fibres on their left knees with their hands (Winlock 1955, 29-33, 88-9, pls. 24-27, 66-67).

The junction points, as noted by Vogelsang-Eastwood, are extremely difficult to recognise, as they can easily be confused with a plied yarn.[6] In Egyptian materials, which are characterised by advanced techniques and of a uniformly high quality, the effects of splicing are difficult to see. If Egyptian fabric is carefully analysed, however, certain points where the thread appears more tightly twisted than otherwise occur at regular intervals; these areas suggest junction points. Studied under an electron microscope, these points are characterised by compact fibres, whereas, in a regular thread, fibres appear irregular and separated. Another feature visible under magnification that may signal the use of the splicing technique is the presence in the yarn of dark fragments of the outer bark, which was usually removed from the fibres but which probably aided cohesion.[7]

6 I would like to thank M. Gleba for her kindness in helping me learn to identify *splicing*.

7 M. Gleba, personal communication.

2.1.1 Spindles

Spindles[8] are very rarely preserved in the archaeological record as they were generally made of perishable materials. In fact, spindles made of precious materials such as bone, ivory or metal are almost exclusively recovered. Many of these objects come from graves; spindles made of rare materials were probably status symbols rather than being tools of everyday use. In the Near East, the first documented spindles date to the third millennium BC and are made of precious metals such as gold, silver, copper and an alloy of gold and silver.[9] A single wooden spindle, with the yarn still coiled around it, comes from Troy and is dated to the Bronze Age, while other two, made of bone and ivory, come from Layers VI and VII (Götze 1902, 340, 390, 400; Balfanz 1995, 107-9; Völling 2008, 257-8).

In the 2nd millennium, especially in the Late Bronze Age, spindles made of ivory and bone, often decorated on one end with the shape of a pomegranate, were used throughout the Levant. Some of these were formed by a sequence of perforated cylinders – such as one example from Megiddo (Loud 1948, 168, pl. 197: 2) – while others consisted of several elements held together by a tenon joint and a mortise; however, most spindles were formed from a single piece of material. Generally, these objects have rich geometric decoration on the shaft, divided into stripes with lattice or chevron motifs, or with parallel incised strips. Two more spindles have been found at Megiddo in addition to the one already mentioned. The first one, from Tomb 1122 (Guy, Engberg 1938, 170, pl. 81: 1, length 20.2 cm), has two spindle whorls inserted on the tenon that unites the two halves of the object; the second one, from a domestic context, exhibits two spindle whorls placed toward the thinner end (Lamon, Shipton 1939, pl. 95: 38, length 25.2 cm).

The site that has brought forth the largest number of bone and ivory spindles is Ugarit (modern Ras Shamra). In total, four spindles have been found (none of which are intact) with domed or discoid spindle whorls. The first one is a rod made of ivory[10] with one end broken and the other one flattened (Gachet-Bizollon 2007, 115-16, 120, 260, pl. 19: 136; Gachet 1987, 251-2, 263 no. 39; 1992, 87 fig. 4g; Xella 1984, 99). This is decorated with two groups of horizontal and parallel incisions, which surround a

8 Only shafts found with spindle whorls are considered as such. There is no certainty that every preserved rod was used as a spindle. Sauvage (2013, 207-9; 2014, 186-90, 205) proposes to designate similar objects as part of a 'spinning kit', including staffs that could have be used as spindles or distaffs by adding or removing the spindle whorl.

9 See in particular those from Kish (Mackay 1925, 168, pls. XL: 3.3, LVIII.1), Abu Salabikh (Postgate, Moon 1982, 131, 134, pl. Vc), Alaca Höyük (Koşay, Akok 1951, 168-9, pl. 124), Horoztepe (Özgüç, Akok 1958, 45, 51-2, 54, figs. 25-6, e.g. VIII), Karataş-Semayük (Mellink 1969, 323, pl. 74.23), Tepe Hissar (Schmidt 1937, 119-20, 137, 406, pl. XXIX H 2171)

10 L. 22.1 cm, diameter between 0.85 cm and 1.27 cm.

broad band with a lattice pattern. At about one-third of the way down the length of the spindle, close to the intact end, there is a dome-shaped spindle whorl, which is decorated with oblique incisions enclosed in a frame. This spindle date to LB II.

The second spindle is a smooth rod made of ivory with a flat horizontal end that is decorated with carved horizontal lines and is hollow lengthwise to form a mortise (Gachet-Bizollon 2007, 115-16, 120, 260, pl. 19.137; Gachet 1987, 250, 263 no. 40; 1992, 87 fig. 4h; Xella 1984, 99). The other end bears a tenon in which the shape of pomegranate is carefully carved. A spindle whorl in the shape of a flattened disc is positioned half-way down the rod, however, the part normally inserted into the mortise is missing, so the original length of the spindle is unknown. The preserved object measures 22.1 cm, with a maximum diameter of 1.35 cm. This spindle is also datable to the LB II as it comes from the same deposit as the first, which may have been a grave unidentified by Schaeffer (Sauvage 2014, 187).

Remains of another spindle were found in Lattakia (Gachet-Bizollon 2007, 115-16, 120, 261, pl. 19, no. 139). This consists of a small rod, perhaps of ivory, broken into five fragments, of which it was possible to reconnect three pieces. The thicker end was decorated with a series of horizontal and parallel lines, like a section of the rod, while the other end was decorated with two groups of horizontal lines and by a band, partially missing, of lattice decoration. The spindle whorl was set close to the thicker end and is dome-shaped (length 13.3 cm, diameter 0.5 cm).

Aside from the few examples that still preserve their spindle whorls on the shaft, small rods very similar to spindles in form, material and decoration are attested in the Levant[11] throughout the Late Bronze and Iron Ages. They mostly have diameters between 0.7 and 1.3 cm, are decorated with geometric patterns on the shaft, and in some cases have a pomegranate-shaped end. As no spindle whorl has been found attached to the shafts of these objects, it is possible that they could alternatively have served the function of pins or distaffs (Peyronel 2004, 55, 329; Cecchini 1992, 9; Sauvage 2014, 205).

The various types of rods can be divided into three basic categories (Peyronel 2004, 315):

1. single small rods with or without carved ends, the shaft appearing with or without incised geometric patterns;
2. small rods with a separate upper carved end attached to the shaft by a tenon, with or without carved decoration;

11 For a detailed analysis of bone and ivory spindles and small rods see Sauvage (2014, 184-226).

3. small composite rods made up of two or more pieces joined together by tenons; with or without separate ends; the ends either carved or left uncarved.

The site that has produced the largest group of these rods for the Late Bronze Age is Ugarit and its harbor Minet el-Beida, with more than a hundred rods and rod fragments. The simplest type is composed of a single piece, the shaft of which is left entirely smooth except for two rings carved at both flat ends (Gachet-Bizollon 2007, 20, 145). It is generally not a perfect cylinder, but rather a short rod that tapers towards each of the ends. The decoration is more developed on certain examples, which are carved at one end, but these cases are not so numerous and, as most of the rods are incomplete, we do not know if both ends were originally decorated. Usually decorations consisted of geometric or 'lattice' patterns, oblique lines or the motif of 'overlapping scales,' and were normally divided into bands surrounded by groups of ring lines (Gachet-Bizollon 2007, pl. 21: 170, 181; pl. 22: 190, 194). From this site come also numerous pomegranate-shaped ends, which were attached to the rods by the mortise and tenon system (Yon et al. 1983, 212e; Gachet-Bizollon 2007, 118). At Ugarit, rods were found in graves as well as in domestic contexts, and they were frequently associated with other materials related to textile activity (Sauvage 2014, 204).

The Palestinian area has also produced numerous 'sticks' of bone, from both graves and domestic contexts. For example, Megiddo testifies to the production of all types of rods, from the simplest ones to the most elaborate ones, comparable to the assemblage from Ugarit. There are smooth rods with some ring carving at their ends (Loud 1948, pl. 197: 1), some with similar carving along the shaft, others are decorated with lattice-patterned bands. Decoration is often composed of oblique and zigzag lines, arranged either all over the body of the instrument (Loud 1948, pl. 197: 7, 8, 9; Guy, Engberg 1938, pl. 95: 50) or just at the ends (Loud 1948, pl. 197: 4, 5, 13), which are generally flat and left undecorated. No pomegranate-shaped rod ends have been discovered in Bronze Age contexts in Palestine, but there are examples dating to the Iron Age. Only one rod from this area bears evidence of a tenon, via which one of its ends must have been attached (Guy, Engberg 1938, pl. 156: 13).

Several well-preserved rods have been excavated at Lachish, many of which have a carefully carved pomegranate-shaped or cylindrical top. There are also simple rods, similar to those already described at Megiddo and Ugarit, decorated with circular carved lines, lattice motifs and with flat ends. Most of these were found in the storage rooms of the LB II temple (Tufnell 1940, pl. XX: 23-28), others were recovered from grave contexts (Tufnell 1958, pl. 28: 15, tomb 501; pl. 28: 7, pl. 54: 2, tomb 216). They measure between 13.2 cm and 23.7 cm in length.

In the Iron Age, there was a general decline in the quality of the execution of spindles in the Palestinian area, while the products of Syria remained richly decorated and abundant. The city of Hama has produced many of these rods, some of them intact, most broken.[12] Some rods were found in the city's destruction layers, dated to the middle of the eighth century BC. Several fragments of these objects were found in Building V, along with spindle whorls and loom weights (Riis, Buhl 1990, 207-8). Many textile-related instruments come from the tombs, which held cremated remains; the necropolis was in use during all four phases of the site occupation. The shafts of these rods tend to taper to one end and their length varies between 21.2 and 24.8 cm. None of these objects have been found with a spindle whorl still in place. Some of the examples have a carved end in the form of a pomegranate (Riis 1948, 173), while others exhibit the remains of both tenon and mortise, which indicate that other elements were once attached. The carved decoration is often extensive and features the same decorative motifs that were used in the Late Bronze Age period, such as the alternation of patterned bands with bands of oblique lines, or a series of incised rings. The central part of the shaft is usually left devoid of decoration. This style of spindles and pins is not restricted to the Near East, but it is spread throughout the Mediterranean area, first making its way to Cyprus and the Italian peninsula, and then, appearing to a lesser degree in the Aegean area and in Egypt.[13]

The objects here examined were probably related to textile production or were found in close association with spindle whorls or loom weights. Their use as spindles is, however, not certain, as there were no spindle whorls preserved upon these shafts. In levels III-IV of the necropolis of Hama the rods were not associated with spindle whorls, unless the whorls were made of perishable materials. It seems, therefore, that some of these instruments could have been used for other functions. Certain examples with tapered tips could have been employed as pins, and it is possible that certain rods might have been used as distaffs, as proposed by Cecchini (1992, 9-10) and Sauvage (2014, 222-3). The presence of distaffs in Syria during the Iron Age is evidenced by certain Syro-Hittite stelae, which make this hypothesis quite reasonable.[14]

12 Riis, Buhl 1990, 205, 207, 208, 210-13, 215-17, 222-3, 228, 230, 235-40, 242, 244-7, 249, 252, 254, 256, figs. 96, 97 and 99; Riis 1948, 34, 35, 148, 173, 178, figs. 17, 21 and 227; Fugmann 1958, 167, 219, 220, 225, 254-8, figs. 188, 245, 268 and 325; Ingholt 1940, 77, 103-4, pl. XXVI.

13 For example see the very good article of Borgna (2003, 524-42). As for Egypt, there is the case of Gurob (Barber 1991, 65).

14 For example see the stela from Bonatz 2000, C21, C22, C23, C24, C25, C26, C27; also Pritchard 1969, 633 and Orthmann 1971, pl. 43i.

2.1.2 Spindle Whorls

A spindle whorl is a perforated disc that allows a shaft to be inserted through it, extending the rotary movement of the spindle, and providing greater moment of inertia. Spindle whorls can be of different shapes and materials, according to the type of yarn that is desired. A small and thick disc rotates faster than a wider and thinner one, but the movement continues for a shorter time. The weight must also be taken into account: a stone disc will weigh more than a pottery, bone or wooden disc, which will have a different effect on the fibres that will be obtained. In general, in order to achieve a very thin wool yarn, the spindle whorl should weigh between 10 and 30/35 g, while it may range between 50 and 100g when spinning thicker threads or for plying yarns (Peyronel 2004, 46).

Recent experimental tests carried out by the CTR have shown how objects weighing only 4 g can be used as spindle whorls[15] (Andersson Strand 2010, 208-9). Though these measurements do not themselves put an end to the 'spindle whorl/bead' debate, they help to expand the corpus of textile-related objects and tools, on the basis of experimental evidence. In order to distinguish between a beasd and a spindle whorl, it is useful to consider the diameter of the hole in the preserved object, which, in the case of spindle whorls, must be large enough to allow for the insertion of the spindle. This is not a piece of decisive evidence however, as beads may have had quite wide holes too. On the other hand, spindle whorls could have been mounted through a tenon/mortise system (not directly onto the shaft),[16] which decreases the minimum diameter of the required aperture. In general terms, a spindle whorl is an object pierced by a hole with a diameter between 0.4 and 1.5 cm, but these measurements are only guidelines.

Spindle whorls were made in various shapes, from simple perforated discs to cylinders, cones, truncated cones and so on. There are even cross-shaped spindle whorls attested, which nevertheless produced the desired effects. Due to the scope of this work, which considers spindle whorls included in an array of different excavation reports, it has been decided to use a very simple typology to describe the shapes of the spindle whorls

15 As for flax, which typically requires very large spindle whorls in order to create a long-enduring and rotating movement, there has not been enough experimental data gathered as yet.

16 This type of spindle has been found in the tombs of Megiddo (Guy, Engberg 1938, pl. 84).

attested across the Levant.[17] Seven main types can be distinguished:[18]

1. Discoidal: This category includes all spindle whorls having a disc shape, including most of the spindle whorls made from re-used ceramic fragments.
2. Lenticular (or flattened globular): thicker than the discoidal type, with typically convex edges.
3. Cylindrical: a spindle whorl whose height is equal to or greater than its diameter, with a straight or convex profile. This group covers most of the Egyptian spindle whorls, even if they could also be included in the discoidal category.
4. Dome-shaped: flat-based spindle whorls with dome-shaped tops. This category also includes variations of this type; in addition to the classic 'high' dome-shaped type there exist more flattened examples.
5. Conical: spindle-whorls with flat bases and straight edges that tend to narrow toward the top. It is not always easy to distinguish these from certain dome-shaped examples, with less-curved edges. Inserting spindle whorls into this type rather than in another is, sometimes, a subjective choice. Under this category is also included a typical Late Bronze Age artefact that is conical in shape but with a concave profile, which is generally called a 'button' in site reports.
6. Truncated Cone: similar to the Conical type, but with a flat top.
7. Biconical: spindle whorl whose maximum diameter is about half of its height and which supports two symmetrical cones.

17 This work does not intend to provide an exhaustive analysis of all archaeological reports and related publications from the Levantine area in order to find all evidence related to textile production. It aims to outline the chronological development of spinning and weaving techniques, which allows us to build a model with which it is possible to compare the Egyptian evidence. In order to accomplish this, certain sites of the Syrian and Palestinian areas have been taken as 'representative', selected on the basis of their publication history and related studies of their textile instruments. Notice that evidence for the older periods is rare and scattered, while the Iron Age is fairly well-documented, especially for sites of the Southern Levant. To the selected sites, some in-depth studies will be added, such as Peyronel (2004) and Shamir (1996), which allow for a more widespread view of the situation.

18 The typology proposed by Gleba (2008, 105) is here adopted but slightly modified to fit the different geographic context.

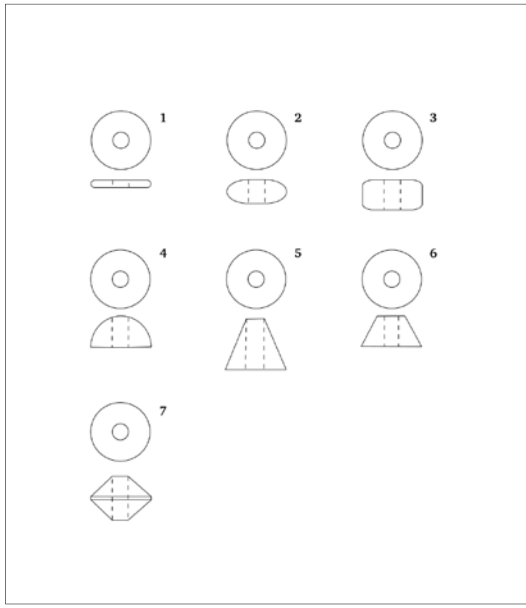

Figure 3. Spindle whorls typology

The first spindle whorls appeared in the Neolithic levels of Near Eastern sites such as Jericho, from where two stone spindle whorls came (Wheeler 1982, 626) of discoidal and lenticular shape, dating to the Pre-Pottery Neolithic (PPN). In the Pottery Neolithic (PN) levels, clay spindle whorls began to appear. At Jericho, only nine pottery and two stone spindle whorls have been found, all of discoidal type. 18 additional discoidal objects made from re-used ceramic fragments[19] were also recovered, appearing at first to be variously buttons, jar stoppers or even toys.[20] The function of these objects continues to be much debated, although some experiments conducted by Shamir (1996, 146) have proved that many of these objects could have functioned as spindle whorls.

19 In the Aegean the situation is comparable, as the first traces of spindle-whorls are attested already around the seventh millennium BC, some made of perforated and flattened stones, and later obtained from rounded pieces. Clay and stone spindle whorls, as well as those made from reused sherds were found in the Neolithic levels of Sesklo, Dimini, Tsangli, Tsani and other sites in Thessaly, as well as at Knossos (late Neolithic levels), at Sitagroi and in the Cyclades at Saliagos. The use of spindle whorls obtained from rounded and perforated sherds continued throughout the prehistoric period in Greece, even though they were less frequent than in the initial stages (Barber 1991, 54 fn. 10; Carington Smith 1975, 119).

20 For a more detailed discussion, see Della Lena Guidiccioni, Fiorelli (forthcoming) with related bibliography.

A similar situation has been attested in Ugarit level VB, where several spindle whorls made from reused ceramic fragments have been found, with only a single example of a purpose-made spindle whorl formed of clay (De Contenson 1992, 136, fig. 163). In the following level (VA) were found 20 spindle whorls made from reused sherds and only 6 biconical clay spindle whorls (De Contenson 1992, 137-8). Unlike Jericho, however, it is only at this stage that stone spindle whorls, usually of a discoidal or dome shape, begin to be attested (De Contenson 1992, 99-103, fig. 129). The peak in the use of reused ceramic fragments at Ras Shamra is in the Chalcolithic Age, with 44 examples from level IV C, 61 from IV B, then declining in IV A with only 4 examples. Conversely, purpose-made clay spindle whorls number only 8 across all time periods at this site, but these take a wide variety of forms: lenticular, biconical, conical and dome-shaped. Alongside clay examples were used good-quality, but not numerous, stone spindle whorls, several made from steatite (De Contenson 1992, 107-13, fig. 137).

2.1.2.1 Early Bronze Age

Syria

The evidence of Early Bronze Age Ugarit shows a strong continuity with its prehistoric levels, as the production of spindle whorls from reused pottery sherds continued, contrary to the developments in other Syrian sites. In fact, the oldest level (IIIC) produced 23 reused pottery sherds (De Contenson 1992, 140-1, fig. 58), while 18 were found in the most recent level (IIIB) (De Contenson 1992, 145, fig. 161). Purpose-made clay spindle whorls were still present (11 in the IIIC and 5 in IIIB), but their forms do not show a great variety, since most of the examples have a lenticular shape and only in some cases biconical, discoidal or conical shapes. There are no truncated cones or cylindrical shapes, which appear frequently in this period at Tell Mardikh (ancient Ebla) and Hama (Peyronel 2004, 120). The production of stone spindle whorls in Ugarit continued, but in smaller numbers: there are 8 spindle whorls from throughout the Early Bronze Age, all disc-shaped and all made from limestone and steatite (De Contenson 1992, 118-21).

From the levels at Hama dating to before the fourth millennium (L3-L2) comes evidence for clay spindle whorls being used beside those made of stone (all limestone and biconical in shape) (Fugmann 1958, 16-17, fig. 13). In the following Bronze Age phases, in which private residential contexts were excavated, many types of spindle whorls made from various materials are attested, suggesting the production of stone and clay whorls in fairly equal numbers. In phase K, at level K8 (EB) spindle whorls made from reused pottery fragments have been found (Fugmann 1958, fig. 37), but always in small quantities. Spindle whorls of reused materials are present until the Iron Age levels at Hama, but seemingly in fewer numbers when compared to other contemporary sites.[21] The most common whorl shapes in the Early Bronze Age were the dome and biconical, in both clay and stone. From the later phases of the Bronze Age at Hama (Level J) (Fugmann 1958, 54-75) all shapes increased in number, dome-shaped spindle whorls continued, but to these were added biconical, truncated cone, lenticular, cylindrical, and conical shapes. The most common were the truncated cone or almost cylindrical shapes. Production in clay continued to coexist with that of stone, especially steatite and limestone, and only rarely calcite and quartz (Fugmann 1958, 71). From at least level J8 (EB IV A) (Fugmann 1958, 54, fig. 58), some bone spindle whorls started to appear, but they do not seem to have been particularly numerous until the Iron Age levels.

At Ebla, 39 spindle whorls were found in the Early Bronze Age layers, of which almost all are made of stone, except for three made of terracotta and two of bone (Peyronel 2004, 104; 2016, 190). Stone spindle whorls are, in general, most often fashioned from a greyish stone of the gabbro-diorite family; but limestone, steatite and, more rarely, basalt examples are well documented. The strong presence of stone spindle whorls, as compared with ceramic examples, seems to have been a common trend in the Syria-Palestine area during the Bronze Age; this is the reverse of the contemporary situation in Cyprus and the Anatolian region (Peyronel 2004, 105).[22] The two bone spindle whorls found at Ebla are large and dome-shaped, obtained using the natural shape of the proximal ends of the humerus or femur bones of selected animals (Peyronel 2004, 106). All EBA spindle whorls from Ebla have a dome-shaped form with straight or convex edges and a weight between 6 and 20 g (Peyronel 2004, 111-12), which shows a preference for light spindle whorls and, thus, fine yarns. Two spindle whorls made of precious materials come from a tomb of the royal necropolis, giving evidence for the use of spinning equipment as funeral offerings since this time (Peyronel 2007, 27).

21 The total count of spindle whorls obtained from reused ceramic fragments is unfortunately not a reliable number because it depends on the interpretation, particular to the excavator, provided for this category of objects. At many sites, their apparent absence might be attributable to a decision regarding which finds 'deserve' publication, which could have excluded them.

22 Ugarit seems to have therefore closer points of contact with the Anatolian world and above all to Cyprus, than with the Syro-Palestinian area.

Palestine

In the Early Bronze Levels of Jericho a large number of spindle whorls, with those made of stone predominating, were found: 49 stone whorls, 12 of terracotta, 16 made of reused sherds, two of unspecified materials and 2 of bone. The most widespread type is the discoidal form (in cases of both reused sherds and those made of other materials); there are a few cylindrical spindle whorls and one dome-shaped example made of bone. The tombs at Jericho have brought forth spinning tools, used as grave goods already in the EBA, although not many in number. There are discoid spindle whorls made of bone from Tomb G57, a terracotta spindle whorl made from ceramic fragments from G58, and a truncated-cone spindle whorl made of stone from grave D12, associated with two other perforated stone discs (Kenyon 1960, 124-5, fig. 40).

The Early Bronze levels of Megiddo have not produced numerous examples of spindle whorls, but most of those that exist are of either terracotta or stone, especially basalt and limestone (Loud 1948, pl. 171: 10). The attested forms are cylindrical, dome-shaped and lenticular for both materials; there is also one whorl made from a reused pottery sherd and one dome-shaped spindle whorl made of bone (Sass 2000, 376).

In the EB Ib level at Beth Shean there were two different types of spindle whorls, both quite controversial. The first type is made from reused pottery fragments perforated in the middle; 6 of these have been found complete and 3 with incomplete perforations, alongside a handmade terracotta ring that showed evidence of burning (Mazar, Rotem 2012, 350). The second type consists of circular stone weights, 27 of which have been found in the Early Bronze level IB, but are notably completely absent in the later levels of Early Bronze Age III. These weights were mostly produced in basalt, to a lesser extent in limestone and only rarely in tuff. Another group of objects from Beth Shean consists of even smaller limestone weights with an average diameter between 3.3 and 4 cm and with a perforated hole, the diameter of which measures between 0.5 and 0.9 cm. The excavator considered these objects to be spindle whorls, while for the larger examples mentioned above suggested a multifunctional solution, as whorls and/or loom-weights (Mazar, Rotem 2012, 378, fig. 9.9).

Tell ʻAbu al-Kharāz (Fischer 2008, 112, fig. 6) produced a cylindrical spindle whorl made of basalt that dates to BA II, with a fragment of the spindle shaft still attached. It is likely that many similar small objects made of basalt should be recognised as spindle whorls, but this issue will be discussed further in the section dedicated to perforated discs made of stone.

Figure 4. Spindle from Tell Abu al-Kharaz (Fischer 2009, 112, fig. 6)

2.1.2.2 Middle Bronze Age

Syria

The Middle Bronze Age levels of Hama are less well-preserved than the Early Bronze Age levels at the site, nevertheless they have produced a large number of steatite spindle whorls (specifically Area H, square F11, which contained 31 dome-shaped and conical spindle-whorls); they are usually domed or cone-shaped but also of discoidal shape. Most of them are made of clay or bone, but there are also attested one bone disc-shaped spindle whorl and one from a reused sherd (Fugmann 1958, 89, 104, 108, figs. 109, 127, 132 and 139), demonstrating the persistence of this type of artefact despite its rarity.

Middle Bronze Age spindle whorls from Ebla are not very numerous (55) and form a fairly homogeneous group of types and materials (Peyronel 2004, 161). Most of these whorls are made of stone (steatite or basalt, fewer in limestone), many of bone and just a small number of clay, two of which are made from reused fragments. These latter specimens confirm that this category was not very extensive at Ebla. Bone spindle whorls began to appear at Ebla in quite large numbers, as in other contemporary Levantine contexts, and were mostly flat and dome-shaped (Peyronel 2016, 191) although pyramidal, truncated, and cylindrical spindle whorls also exist.

Palestine

Spindle whorls from the Middle Bronze Age layers of Megiddo are slightly more numerous than in older phases. They are made of clay and stone, and from this period onward, also of bone. The most common shape is the domed one, but there are also some truncated conical and discoidal spindle whorls as well as two examples made from perforated sherds (Loud 1948, pl. 171; Sass 2000, 374). Some bone spindle-whorls have geometric decoration on the domed surface (Loud 1948, pl. 171). The frequent presence of spindle whorls or objects related to textile sphere in the tombs at Megiddo must be noted. The first spindle whorls from graves are dated to MB II and are made of clay and could be biconical, lenticular or ovoid in shape. Generally, each grave contained one or two spindle-whorls at the most, but some held more numerous examples (Guy, Engberg 1938, 170). The most common material for spindle whorls found in tombs is bone and the most common shapes are domed and conical.

The Middle Bronze Age town levels of Jericho are very much eroded and, consequently, spindle whorls come, in many cases, from tombs. There are 7 stone spindle whorls, 10 made of clay, 9 obtained from reused sherds, 6 made of bone and 3 of wood (Wheeler 1982, 626). The last ones are very important because they give evidence for the use of wood to make these artefacts and remind us that the amount of spindle whorls at each site is always underestimated, as wooden ones are almost always lost. All three wooden whorls come from graves, where particular environmental conditions have allowed the preservation of organic materials. Two are dome-shaped and one is conical (Kenyon 1965, 223, 462, fig. 102). The other spindle whorls of this period have a discoidal shape and in some rare cases a biconical shape, while those made of bone have a dome-shape and all come from tombs (Kenyon 1965, fig. 102).

Spindle whorls at Hazor are attested from the Middle Bronze Age to the Hellenistic period. From the Middle Bronze Age, almost exclusively dome-shaped spindle whorls are known, which are more or less flat, all of which are made of bone (Yadin 1958, pls. CII, CLX; 1960, pls. LXXIX, CXXVI; 1961, pl. CCXCIX). Lenticular and truncated-conical spindle whorls are very rare at the site. To these may be added various single-hole 'buttons', also made of bone, noted in the site report but for which measurements and weights are not provided; therefore, their function can only be hypothesised. Most of the spindle whorls come from scattered contexts and are associated neither with each other nor with other textile-related instruments. One exception to this is provided by an excavated room dating to MB II with two infant burials under the floor where two dome-shaped bone spindle whorls and two bone 'buttons' were found (Yadin 1960, pls. CXXVI: 19-21, CLXXIX: 19, 21). The absence of clay or stone spindle whorls at Hazor is noteworthy, except for some of the perforated stone discs, which will be discussed later.

Several spindle whorls have been recovered from the Middle Bronze Age levels of Beth Shean. These are made from perforated sherds, two of which are incomplete (Yahalom-Mack 2007, 661-2). There are also several fragments with two holes, which have been interpreted as 'buttons' or weaving tablets, but this latter explanation seems quite unlikely. Several stone spindle whorls, in particular 9 from the MB II layers are also attested. Basalt and limestone are the materials used, and calcite in one case. Most of the Beth Shean spindle whorls are disc-shaped, but there are also some cases of biconical shape. To these examples must be added 6 very light dome-shaped bone spindle whorls/buttons (between 6 and 12 grams) (Yahalom-Mack, Mazar 2006, 496-7).

2.1.2.3 Late Bronze

Syria

The Late Bronze Age levels of Hama have returned few spindle whorls: those found are generally dome-shaped and made of limestone, basalt or clay. There are no spindle whorls made of bone recovered at Hama (Fugmann 1958, 131, fig. 161).

From the Late Bronze Age private dwellings of Ugarit, 51 stone spindle whorls have been excavated; they are almost exclusively made of steatite, except for one made of gabbro (Elliott 1991, 41-5). The whorls are dome-shaped or conical with concave sides (buttons), as is typical of the Late Bronze Age, as stated above (Peyronel 2004, 178). Furthermore, a wide production of bone/ivory spindle whorls that are generally dome-shaped and sometimes have a decorated surface is attested at Ugarit (Gachet 2007, 260-75). Sauvage (2013, 189) has recently studied 11 of these spindle whorls. They are made of bone or stone; one of them notably is inscribed in Ugaritic with the word 'spindle'. They lack information regarding their context of provenance, but more likely they all come from domestic or funerary Late Bronze contexts. The shapes are mainly domed and conical – these latter being largely convex (button) – and show signs of their manufacturing and turning. Many of these whorls have a hole that narrows slightly towards the top, with a difference of about 1 mm between the base and the top end of the hole. Most of these stone spindle whorls are made from steatite, some from serpentinite and a few from limestone. Some spindle whorls show a geometric decoration on the top cap, both radially and circular. No clay spindle whorls have been identified so far at Ugarit. It is possible that some of the so-called 'pearls' made out of faience were actually used as spindle whorls, as they have wide diameters (up to 6 cm) (Sauvage 2013, fig. 11:9).

Palestine

Spindle whorls from Late Bronze Age Megiddo are definitely more numerous, predominantly made from bone and stones such as limestone, rarely from clay. Spindle whorls obtained from perforated ceramic fragments are not attested at Megiddo. The prevailing form is always the dome shape, but there are also examples of biconical whorls and an example with concave/convex walls (Loud 1948, pl. 172; Sass 2000, 374, 377). Certain examples have engraved decorations such as concentric circles, while others have one or two radial (deep) incisions on the dome, which do not appear to be decorative, and which might have been added for maintaining the position of thread during the spinning phase. Many spindle whorls were found in funerary contexts at Megiddo. Most of them are to be attributed to LB II levels, with a notable increase in quantity as compared with the previous levels (Guy, Engberg 1938, 170). The most common material is still bone, but stone and terracotta spindle whorls are also attested; the most frequent shapes are domed, button and conical. It should also be noticed that a bone spindle with two spindle whorls attached to the shaft was found in a tomb, with numerous other bone fragments, which may also once have been spindles (Guy, Engberg 1938, 84). Some of the tombs at Megiddo can be very interesting for the association of different types of textile-related material.

Tomb 1122 (Guy, Engberg 1938, 20, pl. 84)
- 1 spindle+ 3 bone rods
- Two dome-shaped spindle whorls on a bone spindle
- 12 dome-shaped and ‘button’ bone spindle whorls
- 1 dome-shaped steatite spindle whorls
- 1 bronze pin

Tomb 877B1 (Guy, Engberg 1938, 95)
- 1 bone rod
- 4 dome-shaped and ‘button’ bone spindle whorls
- 4 ivory spindle whorls

Tomb 979 C1 (Guy, Engberg 1938, 100)
- 2 bone rods
- 1 dome-shaped steatite spindle whorl
- 6 dome-shaped bone spindle whorls
- Bone pomegranate element (perhaps once mounted on a spindle shaft)[23]

23 For a discussion of these themes see Sauvage 2014, 214-15.

Another very interesting context at Megiddo is Room 2012, where three caches were found, each wrapped in a cloth bag with silver and personal items. In one of these bags, 9 bone spindle whorls were found (Paice 2004, 368).

Two dome-shaped spindle whorls made of bone are attested in the LB I layers at Hazor. This type has already been shown to have been the most prevalent type of whorl at this city in the earlier periods.[24] There are at least 7 dome-shaped bone spindle whorls and one of lenticular shape in the LB II levels.[25] A multiple-tomb context of LB II has produced three dome-shaped spindle whorls made of bone (Yadin 1960, pl. CXXXVII: 26-8). Aside from the bone examples, three dome-shaped stone spindle whorls and one of ceramic (made from a reused fragment) are also attested.[26] A spindle whorl was found in a domestic context at Hazor, in the same locus as a needle, which is a clue that various fabric-related activities were performed in the same room (Yadin 1961, B 5011, pl. CC: 28).

In general, the Late Bronze Age layers at Beth Shean have produced few spindle whorls. Several spindle whorls obtained from reused pottery fragments come from the LB I levels (Yahalom-Mack 2007, 661-2). Stone spindle whorls are rarer at this site, as there is only one example for LB I and one for LB II: one has a discoidal shape and the other a biconical shape. Just one bone spindle whorl comes from the LB I layers, while the LB II layers revealed five. Four of these five were found in Area Q and have domed or biconical shapes (Yahalom-Mack et al. 2006, 496-7).

2.1.2.4 Iron Age

Syria

In the urban Iron Age levels of Hama numerous spindle whorls made of stone, especially limestone and steatite, have been found; clay and bone examples also appear, but to a lesser degree (Fugmann 1958, 138, 176, figs. 165, 216). The main shapes seen are the domed and the conical types. It is worth mentioning that from *Batiment* V there are several elements linked to the textile sphere, namely seven stone spindle whorls, three bone whorls, 34 cylindrical weights and a rod/spindle made of bone (Fugmann 1958, 248-51, fig. 325). In the contemporary levels of the necropolis (FE I-III) there are numerous spindle whorls, 84 in total, sometimes associated with bone rods (Riis 1948, 171-2, figs. 208-216; Peyronel 2004, 340-2).

24 Yadin 1958, pls. CXLII: 19, CLXVI: 15; 1960, pls. CXXVI: 28, CLXXIX: 22.

25 Yadin 1958, pls. CX: 13, CLX: 9, LXXXVI: 21, LXXXIX: 17; 1960, pls. CXXXVII: 26, CXXXVII: 28; 1961, pl. CC: 29.

26 Yadin 1958, pl. XCV: 19; 1960, pls. CXXVII: 34, CXLVI: 30.

Most spindle whorls are made of bone, but there are also some pottery and stone examples (particularly of steatite). The most archaic shapes are the domed type with a groove at the base, alongside the conical and lenticular shapes that appear only in Period I, while the discoid type appears in Periods I-II. The dome-shape type and its variations is certainly the most widespread and the longest enduring type. All periods of the Hama necropolis are represented by tombs containing spindle whorls, usually small quantities, one or two, except G IX 169, which has produced 12 spindle whorls made of bone.

At Tell Afis different types of spindle whorls are attested for the Iron Age levels, especially for Iron Age levels II-III. Most of the spindle whorls are made of stone, especially steatite, but also of limestone and basalt (Mazzoni 2008, 54, fig. 3). Terracotta spindle whorls are fewer than those made of stone and only rarely are bone spindle whorls attested (Cecchini 1998, 280-1, 291, 293; D'Amore 1998, 373). The domed type predominates, but there are also rare truncated conical samples. Some pieces of perforated sherds are also present (Degli Esposti 1998, 246), albeit in smaller quantities compared to contemporary Palestinian sites.

From the Iron Age levels of Ebla come 84 spindle whorls, with 61 examples from the following Persian period (Peyronel 2004, 331). The Iron Age spindle whorls are almost all made of steatite/chlorite, although a small number are made of limestone, basalt and gray bituminous stone with a single example made of sandstone. In two cases, the spindle whorls have not been completed; both are perforated, roughly cut and only partially smoothed, which allows us the rare chance to study the type and the processing sequence used. There are also five clay spindle whorls. The domed type in varying sizes is the dominant shape for this period but there is a biconical example, which remains the only one of its kind at the site and is dated to Iron Age III, as well as one of the discoid type. Many spindle whorls bear incised geometric marks and decorations (Peyronel 2004, 334).

In the Iron Age levels of Tell Mishrifeh/Qatna spindle whorls have been found, which should probably be dated to the Iron II-III (Besana 2005, 117, pls. XXXI-XXXII). Most of the spindle whorls are made of stone, especially of steatite/chlorite as at Ebla, together with examples of calcarenite and a specimen made of basalt. Clay spindle whorls are also well represented, both purpose-made and those obtained from reused pottery fragments. The shapes are various although there is a clear predominance of truncated conical and conical shapes; there are two dome-shaped forms, two discoidal examples and one globular/biconical spindle whorl.

Palestine

As previously noticed, at Hazor the most common type of spindle whorl from the Middle Bronze Age down through the Iron Age is the dome-shaped, more or less flat type. In the Iron Age levels II-III the dome-shaped bone spindle whorl, of which several samples are attested,[27] continues to prevail. Other types do appear in bone, such as conical, discoidal and truncated cone spindle whorls.[28] The same types appear in stone spindle whorls, especially limestone, and there is even an example made of hematite (Yadin 1961, pl. CCXVI: 22). Compared to the previous levels it seems that a larger variety of shapes was present during the Iron Age for both stone and bone whorls.

Stone spindle whorls from the Iron Age are particularly numerous at Megiddo, especially limestone and steatite examples,[29] and more rarely calcite, alabaster and basalt. Also frequent are clay and bone spindle whorls, the latter in particular during phases IV (1000-800) and III (800-650). The most common types are, as usual, the dome-shape as well as lenticular, cylindrical and conical. It is possible to observe a remarkable preference for the dome-shape in bone and the conical-shape in steatite. Spindle whorls made from pierced sherds are also common in this period (Sass 2000, 376), but still quite rare when compared to other sites like Beth Shean. From the Iron Age levels at Megiddo came spindle whorls with engraved decorations, such as lower radial lines (M 3279) (Lamon, Shipton 1939, pl. 93: 2), others with lateral engravings (Lamon, Shipton 1939, M5145, pl. 95: 38), one of which has three engraved lines (Lamon, Shipton 1939, M 922, pl. 95: 38).

Tell Abu al-Kharaz has produced a quite remarkable number of spindle whorls for the Iron Age, especially for IA II. Stone spindle whorls have been found in wide numbers, particularly in limestone and, to a lesser extent, in basalt. Sandstone and calcite examples are rarer (Fischer 2013, 40, 58, 82, 89, 338). Pottery, bone and ivory spindle whorls are not common (Fischer 2013, 161, 190, 247, 338), although spindle whorls made from reused pottery fragments are frequently found (Fischer 2013, 259, 360). The most attested types are the lenticular and conical forms, while the domed ones come in second place at al-Kharaz, although they are very common at other sites, such as Hazor. Only one example of a bone spindle whorl of biconical shape is attested (Fischer 2013, 341).

27 Yadin 1958, pl. LXXIV; 1960, pl. LXXVIII: 28, e.g. PS: 32, CLXXXVI: 12; 1961, pls. CLXXXVIII: 14, CCCLXI: 8.

28 Yadin 1960, pls. CV: 31, CLXVI: 7; 1961, pls. CLXXXVIII, CLXXIII: 10, CCCLIX: 17.

29 Lamon, Shipton 1939, pls. 93-95; Peyronel 2004, 351; Sass 2000, 374-7, figs. 12: 17-19.

Conclusions

This brief presentation of the main published examples of spindle whorls makes it possible to draw some conclusions. First, spinning with spindle and spindle whorl is attested at least from the Pre-Pottery Neolithic Period, as evidenced by the production of stone spindle whorls. Later, with the introduction of ceramics, clay spindle whorls appear, as do those made from perforated ceramic fragments. The production of spindle whorls from ceramic fragments is particularly common during the Pottery Neolithic Period in northern Syria (and Anatolia), and on a smaller scale in Palestine. Although the making of spindle whorls from broken pottery continues to be attested in a minor way in the Middle and Late Bronze Ages, it sees a resurgence during the Iron Age in many Palestinian sites.

Stone spindle whorls remain widespread throughout the Early Bronze Age, especially those made of steatite/chlorite, limestone and, more rarely, basalt. It is not possible to trace a clear line of development for stone spindle whorls because the archaeological sites taken into account show extremely variable situations in Syria: at Ugarit they are very rare, whereas at Ebla stone is the predominant material and Hama is in an intermediate position. In Palestine, however, stone whorls absolutely predominate over other materials. In later phases, stone spindle whorls continue to be the most attested, except at Hazor where they are clearly outnumbered by those made of bone. It is possible that the choice to use stone spindle whorls rather than ceramic ones, especially at Ebla, is linked to the technical requirements of fabric production, and depend on the fineness of the desired fibre or yarn.

Bone spindle whorls began to appear in the Early Bronze Age levels of Hama, Ebla, Jericho and Megiddo and were of discoidal and domed types. Starting from the Middle Bronze Age, the production both in Syria and in Palestine increased and the domed type became the most frequent shape, while in the Late Bronze Age, the concave/button profile type also appeared frequently. Many of these spindle whorls have been found in burial contexts, where bone is definitely the predominant material.

Pottery spindle whorls are generally rarer than those made of stone, but they are still present in all periods and are characterised by a great variety of shapes. In the Early Bronze Age, ceramic spindle whorls are quite numerous at all sites, where they equal the production of those made of stone. In Syria, during the Middle Bronze Age a decline in clay whorls is attested, but not for Palestine; in Jericho they are prevalent compared to those made of stone. In Late Bronze Age, there are definitely fewer ceramic examples than those made of stone, while they seem to be numerous again in Iron Age levels in both Syria and Palestine.

The three spindle whorls made of wood preserved in tombs from MBA Jericho remind us that wood likely played a significant role in the material culture of ancient textile work. Unfortunately, it is not possible to quantify how regularly wood was used in spindle whorl manufacture because of the nearly complete loss of the organic materials.

2.1.3 Spinning Bowls

Spinning bowls are bowls of varying shapes, but all provided with handmade internal 'loops' that are applied to the inner walls of the bowl before firing. The loops usually appear in pairs, but single loops are known, and certain examples possess up to four internal loops. The first known examples of spinning bowls were found in Jordan and date to the Ghassulian period (Shamir 2014, 146). Much later specimens come from Crete, dating to the Early Minoan II Period. Similar objects have been found in Myrtos (Warren 1972, 153, 207, 209) (EM II) and in the Middle Minoan Period contexts of Drakones, Phaistos, Palaikastro, Kômmos and Archane (Barber 1991, 74).

The first archeological and iconographical attestations of spinning bowls in Egypt date to the 11th Dynasty and this type of object remained in use until the middle of the first millennium BC (Vogelsang-Eastwood 1989, 78; Allen 1997, 33-6). The oldest archaeological evidence dates to the 12th Dynasty and was found at Abu Ghalib (a site in the northern Delta area) and at Kahun in the Fayyum. The Abu Ghalib bowls (one complete specimen and one fragmentary) are made of pottery with a ring base and an everted rim; inside are two loops connected to the centre of the bowl. The loops are roughly manufactured and show deep carvings in their lower parts. The only published spinning bowl from Kahun has a straight profile and a flat base; the inner loops attach to the walls of the bowl and to the bottom without connecting to each other. Petrie noted certain stone examples of spinning bowls from Kahun, which were of quite rough manufacture with two inner loops, or more rarely, one (Petrie 1890, 25, pl. XIII: 58).[30]

The largest preserved group of spinning bowls comes from Tell el-Amarna and date to the reign of Akhenaton (Dothan 1963, 101). While stone spinning bowls are known from the city, only bowls made of ceramic have been excavated from the worker's village connected to it. They were generally manufactured in marl clay[31] without additional surface treatments. Firing produced a white surface, but it is still possible to see a pinkish colour on the interior. Bowls made from Nile silt are rarely attested. It is also interest-

30 The bowl in the plate seems to have rings, quite separated from each other, attached to the sidewalls of the bowl.

31 Standard System Denomination of Vienna. I thank Dr. A. Salvador for providing me with these specifications.

ing that at Amarna, the clay used to make spinning bowls has been shown to have been imported from other sites (Vogelsang-Eastwood 2000, 292). Production from Nile silt would likely have been easier and cheaper, but perhaps clay was imported due to the excessive porosity of the local products. Notably, at Amarna all bowls have two rings inside, as opposed to the many variations found in other Egyptian and Palestinian sites. The morphological variation within the Amarna corpus is very slight, with diameters from 26 to 30 cm, rims folded outwards and flat, slightly rounded bases. This homogeneity has allowed the excavators to recognise a series of rims that may have been specifically related to spinning bowls, although the illustrations provided in the publication show a range of shapes with flat or looped bases and folded, everted or flat rims.[32] A unique type is represented by a bowl with the rings attached to the inner edge of the bowl rather than to its bottom (Kemp, Vogelsand 2001, 293).

The bowls recovered from the worker's village of Deir el-Medina date to the 19th-20th Dynasties and are made of pottery, although fired better than other contemporary bowls (Dothan 1963, 103). At this site various shapes are present, with flat bases, ring-shaped bases or ring bases with thick centres, to which were once added various types of rims. The main type of spinning bowl has two loops in the middle of the bottom, another variation has three loops, which (unlike those versions with two loops) have several engravings under each loop. A fragmentary limestone spinning bowl is also known: it has a ring base and three inner loops, just one of which is fully preserved (Nagel 1938, 183-4).

Two spinning bowls made of chalk come from Lisht and date to the 20th-21st Dynasties, only one of which is complete. Both bowls have two loops on the inside – in one case they join in the middle, in the other they remain separated. The engravings under the loops seem deeper than in other bowls (Dothan 1963, 103).[33]

Spinning bowls are attested in Palestine from the Late Bronze Age onward and remain in use until the middle of the first millennium. The oldest examples come from Tell el-^{c}Ajjul, but there are examples known also from Beth Shean and Tell Jerishe. The majority of the examples date to the Iron I Period, particularly those from Beth Shean, where numerous examples were recovered from Layer VI (James 1966).[34] A bowl with four loops arranged in two rows is a unique example (Dothan 1963, 99). Another rich

32 It is not clear if only the refolded edge is useful for the purpose of identification.

33 For a more complete list of Egyptian spinning bowls, see Allen 1997, 35.

34 Especially in the outlying rooms of Building 1500, figs. 31, 49, 50, 51, 53, 55, 56. Recently 6 other bowls were found which can be dated back to the 13th-12th centuries, all with two rings, thick walls, flat bases and no decorations. The rings have deep engravings on the inside (Martin 2009, 445).

selection of spinning bowls comes from Tell Qasile, where ten bowls were found, divided between levels XII (12th-11th centuries) and level VII (8th century). They all have ring bases and two central loops connected to each other (Dothan 1963, 99). As the appearance of spinning bowls in Palestine (with the exception of the two Ghassulian Period examples corresponds to the Egyptian conquest of these territories, it seems probable that spinning bowls were introduced (or re-introduced) to this area from Egypt. The period of their most extensive use, however, was the Iron Age, when Egyptian influence in Palestine had waned.

In the Aegean area, the discovery of spinning bowls dating to the Early Minoan Period at Myrtos is rather problematic, as the most ancient Egyptian attestations date to the 11th Dynasty (which roughly corresponds to Middle Minoan I); therefore, the Cretan materials are earlier than any examples from Egypt. It is highly likely that the two areas developed spinning bowls independently and, if an origin had to be established, it seems more probable that spinning bowls were invented in the Levant or Egypt.[35] Several scholars indicate that these tools were developed alongside the production of linen, which needs to remain damp during the spinning process for better fibre adhesion. An aqueous solution, or any solution containing substances that support better adhesion,[36] could be contained in the bowl and applied to the fibre as it was spun or doubled. Otherwise, the bowls could be used to keep the plying threads apart or to keep the yarn in tension (Vogelsang-Eastwood 1989, 85-6). It is interesting to notice the presence of stone spinning bowls in Egypt (used alongside ceramic examples) which instead are not attested in Palestine (Dothan 1963, 108).

2.2 Weaving

A fabric is produced through the intersection of two systems of threads; one of the two systems, the warp, is the base system that must be kept in tension during weaving and is parallel to the sides of the loom. The other system, the weft, runs perpendicularly to the weft across the loom, passing alternately over and under the threads of the warp. A fabric can be ‘open’, with few threads per square centimetre, or it can be ‘dense’, with a high number of threads per square centimetre. In a ‘balanced’ fabric, there is an equal number of weft and warp threads within a square centimetre of material. When the number of warp threads is higher, a warp-

35 Also for Peyronel 2004, 57. See chapter 5.5

36 Also the experimental part carried out by Vogelsang-Eastwood on the mixture of water and flour – which proved how utmost useful this mixture was to the production of a weaving thread – is interesting (Kemp, Vogelsang-Eastwood 2001, 79).

faced fabric is created; in turn, a higher number of weft threads creates a weft-faced fabric (tapestry is an example of a weft-faced fabric). Weft and warp threads may vary in quality and consistency, however the warp generally requires resistant and non-elastic threads to ensure its tension. One of the simplest types of weaves is the 'tabby weave' in which the weft passes alternately over and under the warp threads; there exist several variations of this style. Another weave is the 'twill' in which the weft passes over and under the warp threads following a regular outline, which creates a diagonal effect, with several possible patterns. Additional weft threads may also be woven in to create particular decorations.

In order to weave it is necessary to keep the warp in tension and one of the simplest loom designs is the back-strap loom, which is still used in parts of Central and South America and in South-East Asia. One end of the warp is tied to the waist of the weaver by a belt and the other end of the warp is attached to a tree or a pole. The weaver reaches the desired amount of tension by simply reclining backwards to the appropriate angle (Barber 1991, 80). The yarns are kept apart and organised by wooden sticks. In the basic weave, two sets of threads are created: those in which the weft thread run over the warp, and those where the weft runs under the warp. The temporary space which is created between these two sets of threads is called shed, and it allows to pass the weft in just one movement. In order to create this shed, a shed-bar is generally inserted between the upper and lower group of warp threads. The weft (as in the case of other looms) is inserted in the 'shed' of the warp by a shuttle or bobbin that passed from one side of the loom to the other, unrolling the spun yarn as it goes. The second step consist in switching the two sets of warp threads, raising up those that were under in the previous passage, and lowering those that were up. In this way, a counter shed is created. In order to create the counter-shed, it is not possible to simply insert another shed-bar since it would interfere with the operation of the first one. It is necessary to use a hand-held bar – which is not inserted into the warp and which can be of any shape. To this hand-held bar is tied every thread of the warp of the previous inferior series, so as to allow the counter-shed to open, once the hand-held bar is lifted (Barber 1991, 82; Peyronel 2004, 61).

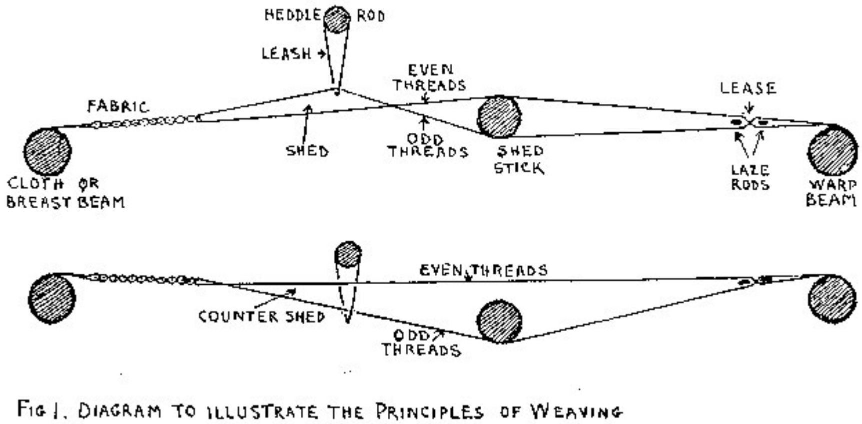

Figure 5. Scheme of creation of shed and counter-shed (Roth 1918, fig. 1)

As weft threads are woven across the warp, each additional thread is beaten by a stick or a comb to bring it closer to the weft thread in the previous row, and this is how, one row after another, a fabric is woven. This simple loom allows for the production of fabrics of small dimensions (approximately 60 to 80 centimetres wide); in order to produce larger fabrics without resorting to complicated devices it is necessary to use more stable and structured systems. In the ancient world three main types of looms were used: the horizontal ground-loom, the vertical two-beam loom and the vertical warp-weighted loom.

The horizontal ground-loom was likely the first invented of these ancient looms, and consists of two wooden beams to which the ends of the warp are attached. These beams are kept off the ground surface by small vertical supporting poles.

The first known evidence of a horizontal loom comes from Egypt, where it is represented on a bowl from the site of Badari, which dates to the Late Neolithic period, or the beginning of the fourth millennium BC (Brunton, Caton-Thompson 1928, 38). The loom is depicted as seen from above, with two structural beams with the warp stretched between them, standing on four small support poles. The heddles and a partially-woven piece of fabric seem to also be represented. The most detailed visual sources for this type of loom come from Egypt, where it is represented on tomb paintings as well as by wooden models, which will be discussed in more detail later. In the Near East, the first loom representation come from Susa and also date to the fourth millennium BC (Völling 2008, 121). This consist of a cylinder seal

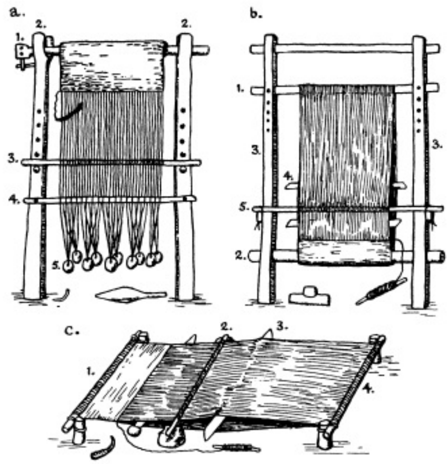

Figure 6. Looms - warp-weighted, two-beam, ground loom (Crowfoot 1937, 37, fig. 1)

from Susa on which two women crouch beside a loom with part of a fabric already woven; a third standing figure seems to be engaged in setting up a second loom (Amiet 1972, nr. 673; Peyronel 2004, 62). Other seals from the early city of Uruk may relate to looms but possess quite schematic representations, which do not allow much information to be recovered. At the end of the third millennium BC written sources of the Sumerian Ur III Dynasty regularly describe a type of horizontal loom (Peyronel 2004, 62).

The vertical two-beam loom appears for the first time in Egypt in tomb-paintings of the New Kingdom. It is worth noting that it is only through the analysis of iconographic and textual sources that there has been the chance to identify the different types of looms. The climate of Egypt is more favourable than most for the preservation of organic materials, still it is unlikely that the discovery of a complete loom will be made. The structure of a vertical two-beam loom consists of two vertical poles supporting a beam placed horizontally on top and one on the bottom to which the warp was attached. Weaving was carried out by moving from the bottom towards the top of the loom. A loom arranged in this way allowed the weaver to work seated and individually (except upon looms of great width), whereas the horizontal ground loom required the presence of two weavers. It is unclear where and when the vertical two-beam loom was invented, but it seems likely that this occurred in an area where both warp-weighted and horizontal loom techniques were known, such as the Syro-Palestinian region, but this is very difficult to prove (Barber 1991, 113; Peyronel 2004, 64).

The vertical warp-weighted loom has an advantage for modern study in comparison with other looms, as it regularly left evidence (loom weights) in the archaeological record. While the vertical two-beam loom attached its warp to a beam placed horizontally at the bottom of the loom, the vertical warp-weighted loom provides tension by weights attached to groups of threads and weaving is carried out from the top towards the bottom. Thus, the weaver must stand in order to work. Upon the structure of the warp-weighted loom, at about 1 meter off the ground, were fixed wedges with forked edges, upon which was laid another pole (the heddle rod), which allowed the warp yarns to be raised. Another pole, the shed-rod, was fixed at the bottom of the loom in order to separate alternate warp threads passing in front or behind it (Peyronel 2004, 64). A wooden beater was used to tighten the weft as well as certain tools made of bone used to fix small details (pin-beaters). On this kind of loom, it is necessary to create a separate 'starting border'. This can consist of a rope or a tabby strip and it can be made first on another loom or through card weaving (Gleba 2008, 123). The use of the warp-weighted loom is certainly very ancient, as a representation on a ceramic fragment discovered in Kars testifies, itself datable to approximately 3000 BC (Völling 2008, 122, fig. 43).

Card weaving is a very simple system that creates decorated bands that can serve as belts, fabric borders or the starting border for a warp-weighted loom. It requires two stable elements separated from each other and each fixed to a support in order to keep the warp in tension. These two elements do not require to be placed at a great distance, nor to be part of a frame. Between them a series of pierced cards are placed, which allow the two orders of warp threads to be separated, and therefore the shed to be created. Through rotation, the counter shed for the weft is created but, due to the different types of rotation that can be applied, the simple technique of card weaving can create various decorations (in more complex loom types this function is carried out by the heddles). Often, but not necessarily, a comb spacer or a pierced bar is placed behind the cards to separate the single threads.

Cards can be made of wood, bone, leather or ceramic and generally do not exceed 5 centimetres in length or width (Gleba 2008, 139). They generally take a regular geometric shape – square, rectangular, triangular or hexagonal – and they may be pieced with anywhere between two to six holes, according to the motif that is desired. The most widespread type of card appears to be the square type, one with a hole at each corner. The most ancient examples from the Near East come from Susa and date to the third millennium BC, but only some of the forty cards that have been recovered actually seem effective for weaving (Barber 1991, 119). In Egypt, card-like tools used for weaving are not attested until the Coptic period.[37] That cards could be used with a warp-weighted loom system seems probable, at least on the basis of the European evidence, which in turn suggests that weaving cards bear a relation to certain types of spools (Gleba 2008, 141).

2.2.1 Loom Weights

The function of loom weights is to pull the warp threads taught and cause them to remain hanging in parallel. Simple stones can be used, however many cultures have developed specific objects meant for this purpose. It is not always possible to prove that stones or other objects were used specifically as weights for weaving unless they are found in groups. There are three contexts in which loom weights are mainly discovered (Barber 1991, 101). The first and the richest in information is when the weights were still fixed to the loom at the moment of abandonment, they fell to the floor as a result of the destruction of the organic parts of the loom, but still maintained their original position.[38] From the postholes and from the burnt remains of the loom beams there might be a chance to recreate the dimensions of the loom. Furthermore, from well-preserved rows of weights, the width and the complexity of the fabric being woven might be hinted at; as well, the area where they are found can be identified as a context of textile production. When not in use on the loom, loom weights were generally kept in groups inside vases, baskets and other perishable containers and these contexts too are sometimes discovered intact. Unfortunately, it seems that weaving activities were often carried out on the upper floors of buildings and, thus, loom weights are frequently recovered from collapsed layers, which is an obstacle to the reconstruction of original assemblages.

How the weights were fixed to the loom is still an open discussion, since it is possible that the warp threads were not tied directly to the weights. In fact, loom weights could have been attached through an intermediate object such as a rope, a metal ring or a wooden rod, which could also have served to keep them in position (Gleba 2008, 128; Fischer 2008, 110). The weight is the essential piece of information provided by a loom weight, as it relates to the quality of the material produced. Loom weights can range in size from about 10 grams (used for finer textiles) up to 1 kilogram

37 Some scholars considered the possibility that weaving cards were in use also during the New Kingdom, based on an analysis of the weaving techniques present in certain preserved fabrics (Barber 1991, 119), but this theory is now generally rejected. Cf. Vogelsang-Eastwood 2000, 276.

38 For example in Troy Level IIg (initial Early Bronze Age) in Room 206 several clay loom weights were found between two pole holes arranged in 3/4 rows as if they had just fallen off the loom (Blegen 1963, 72, fig. 3.14).

for thicker fabrics (Gleba 2008, 134). The number of weights related to a single loom is almost impossible to define in a general way, because it changes according to the weight of the loom weights, the type of fibre used, the quality of the fibre and the fabric being produced, the number of warp yarns attached to each weight, and so on. The archaeological data also shows considerable variation: loom weights are often found in groups of about ten to thirty or forty weights placed in multiple rows.

Each loom weight can be used with threads that require different amounts of tension, simply by varying the number of threads held by one particular weight. The minimum number of threads per weight is generally considered to be 10, with a maximum of 20-25 (Andersson Strand 2012, 211). Loom weights of medium weight would have been quite adaptable to a large number of different fabrics, while extremely light or heavy loom weights would have been used only for the production of specific textiles. One can expect, therefore, to find large amounts of medium weight and only rarely very light and very heavy loom weights. It is interesting, though, that numerous batches of light weights, as well as groups of heavy weights are known to researchers, often in the same context of medium weights (Andersson Strand 2012, 211). Ethnographic data collected by M. Hoffmann showed that weights of differing individual mass could be used contemporaneously on the same loom, and that more threads were related to the heavier weights and fewer to the lighter weights, in a proportional way (Hoffmann 1964, 42). In another place, M. Hoffman observed that the two lateral weights were much heavier than all the other weights, perhaps to reinforce the lateral selvedges (Hoffmann 1964, 65).

Experiments at the CTR have shown that both the weight and the thickness of individual loom weights have an effect on the fabric that is produced, confirming the ethnographic data (Cutler 2012, 152). Thickness, together with weight, influences the quantity of threads attached to a single loom weight and their proximity within a fabric. The width of the finished fabric will be determined by both width of the starting border and the total width of the weights in each row. As pertains to the distribution of loom weights, two rows of weights were needed to produce a tabby weave, and, to create more complex fabrics, more rows were necessary.

As it is the aim of this work to consider loom weights found in various excavation reports, it has been decided to use a simplified typology to describe the different kinds of loom weights attested across the Levant.

Ten main types can be distinguished:[39]

1. Bell-shaped: weight with a circular base, with a rounded top and a perforation that runs parallel to the base. The hole is usually at the top of the weight.
2. Spheroidal: rounded weights with no carination, with a vertical hole (Peyronel 2004, 224).
3. Biconical: weights whose maximum diameter is about half of their height, carinated, and with a vertical hole.
4. Cylindrical: weight with a circular base and a centred vertical hole.
5. Ring or donut-shaped: weight with a circular base and a vertical hole. Compared to cylindrical weights, these weights are flatter, they have a wide centre hole and are rather irregular in shape.
6. Conical: weight with a circular base ending in a small tip; the hole is in a horizontal position and can be placed at the centre or towards the top of the object.
7. Discoidal: weight with a circular base with a flat or slightly convex surface, quite thin with a suspension hole toward the edge (typical of the Aegean area).
8. Pyramidal: square-based weight with the hole placed at the top; frequent for the Hellenistic and Roman periods.
9. Pear-shaped: irregular weight with a circular base, perforated vertically and narrower at the top.
10. Bobbins/spools: cylindrical loom weights, sometimes with a slightly concave central part, non-perforated; they appear at the beginning of the Iron Age.

39 The typology proposed by Gleba (2008, 129) is here adopted but slightly modified to fit the different geographic context.

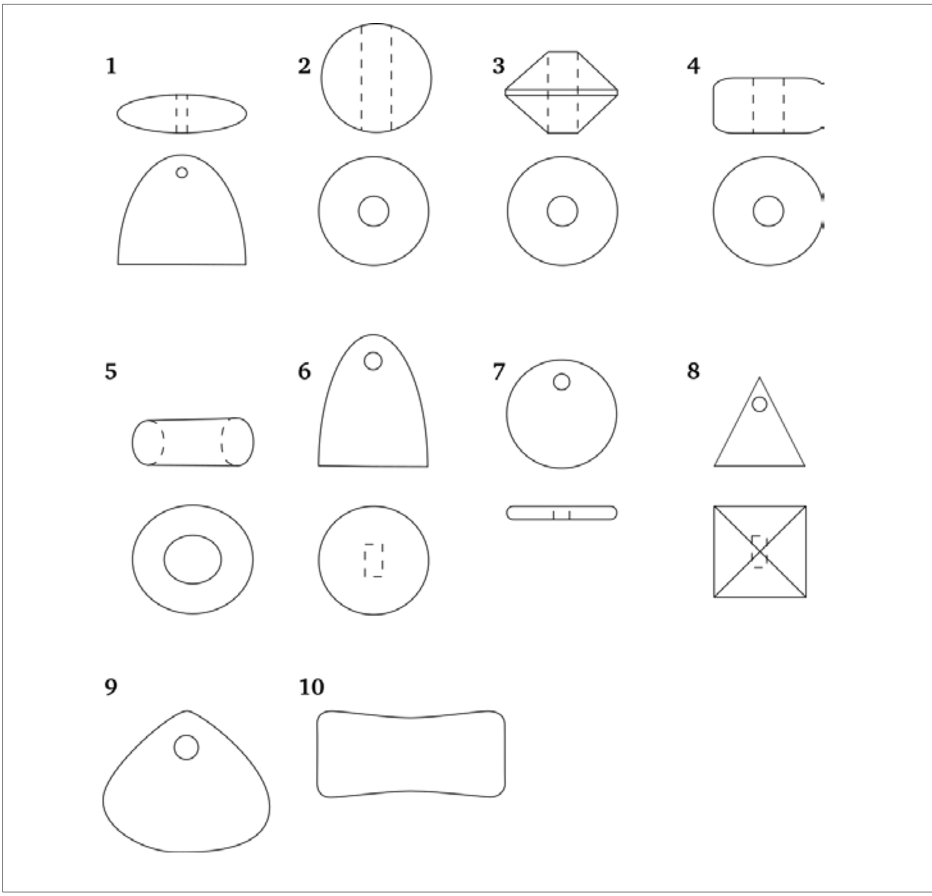

Figure 7. Loom weights typology

The earliest loom weights[40] known from the Near East come from the Anatolia, especially from Çatal Höyük, where some clay weights appear to date to the Neolithic levels. From the Chalcolithic period onward the evidence becomes more numerous and certain (Mellaart 1962, 56).

40 In the Aegean the most ancient attestation of a loom weight dates to the Neolithic; it comes from Corinth; and it is a truncated pyramid, horizontally pierced just under the top (Barber 1991, 99; Carington Smith 1975, 123). In the Late Neolithic phase, loom weights spread throughout Greece, but most finds are from Northern sites. In Crete, loom weights are well-attested from the Middle Neolithic period onward, as demonstrated by two groups of weights in low-fired clay of a rectangular shape and with double holes (Evans et al. 1964, 180, 234-5, pl. 56; McDonald, Wilkie 1992, 675).

At Ugarit the so-called *galets à encoches* (De Contenson 1992, fig. 128, pl. CXII) may be classified as potential loom weights. Similar pebbles (of various shapes) with wide lateral grooves characterise levels VB and VA (Neolithic levels of approximately 7000-6000 BC). The production material is limestone or stoneware and they are quite numerous, although only one of these objects has been pierced. While the theory that these *galets* were loom weights is attractive, they were not found in relation to other tools related to textile production, so their interpretation remains somewhat uncertain. It is interesting that in Chalcolithic phase IV C at Ugarit a small bobbin or spool has been found (De Contenson 1992, 138, fig. 157), which is similar to those typical of the Iron Age and the function of which is still under discussion.

2.2.1.1 Early Bronze

If the so-called "pierced discs" which will be discussed further on are excluded, the first good evidence for loom weights in the Levant appears in levels dating to the Early Bronze Age. Loom weights are attested in the urban levels of the city of Hama (Fugmann 1958, 40, 56, 62, 71, 74, 127, 251), although the publication does not provide many details about them, neither their individual descriptions nor quantity (Fugmann 1958, 40). From the Early Bronze IV phase onward, limestone and basalt loom weights are attested; their main shapes are conical, globular and donut (Fugmann 1958, 56, 61, 64, 71).

Braun (2013, 101) reports that in Megiddo various stone loom weights and basalt rings are known from EB I levels, however it is not clear if these objects were actually used as loom weights or should rather be inserted in the uncertain category of 'pierced discs'. The discovery of a group of these objects in a *cache* in Section B/V/1 of the East Slope is interesting, however, as it suggests that these objects might have been weights tied to a loom (Braun 2013, pls. 32-33). The limestone loom weight described by Sass (Sass 2000, 370) is more securely recognizable: it has a conical shape, but flat, and is perforated on the upper side.

2.2.1.2 Middle Bronze-Late Bronze

Syria

Loom weights appear to have existed in levels from Middle Bronze Age Hama and ceramic examples are noted in the site report but little specific information is provided. A flattened conical-shaped loom weight with an upper hole made of basalt is, however, known from the site (Fugmann

1958, 189, fig. 132). The same type is also observed in the levels of the Late Bronze Age along with a similar object slightly more square in shape (Fugmann 1958, fig. 153).

No loom weights have been recovered from the Early Bronze Age phases at Ebla, while for the levels of Middle Bronze Age date only two examples were found and they are made of low-fired clay in a conical/bell-shape. Certain pierced discs must be mentioned, which Peyronel excludes from use with a warp-weighted loom because of their remarkably heavy weight, which makes them unsuitable weaving tools. It seems therefore that there is little evidence to suggest the use of the warp-weighted loom at Ebla during the EBA and MBA periods, and the few objects similar to loom weights that have been recovered should be considered counterweights for other purposes, not linked to the textile production (Peyronel 2004, 199).

No loom weights were recovered from the Early and Middle Bronze Age periods at Ugarit, however some objects identified as weights did come from the Late Bronze Age levels. These objects are made of baked clay with a discoidal shape and a perforation close to the edge (Yon 1987, figs. 5, 66, 76). This type, typical of the Aegean world during the Early and Middle Minoan Periods (Warren 1972, 212, 220-2; Gleba, Cutler 2012, 115; Cutler 2012, 147), was widespread in the Eastern Mediterranean area and especially prevalent on the Anatolian coast between the Middle and Late Bronze Ages (Gleba, Cutler 2012, 115). At Ugarit, stone weights similar to the baked clay discoids mentioned above were manufactured, but the material does not find any match in the Aegean world (Elliott 1991, fig. 12:7-9).

Some loom weights made of unbaked clay were found at Tell Afis (Cecchini 2000, 213 note 14, fig. 5:60) and are dated to the final levels of the Late Bronze II; they have a conical shape and are perforated. Their numbers are rather low however, especially when compared to the number of weights discovered in the Iron Age levels.

Palestine

The amount of preserved loom weights from the Middle Bronze Age (XIIIb-IX) levels at Megiddo is rather considerable and the most numerous type among them is the conical shape with a horizontal hole (Loud 1948, 169-70; Peyronel 2004, 202). They are all made of baked clay except for two made of stone; 8 examples show the impression of a seal (Loud 1948, 164). There exist additional fragmentary conical examples in unbaked clay (Sass 2000, 372). There are 26 weights, which come from a single context and are conical or bell-shaped, of varying dimensions (Stratum X area BB, L. 3036, Loud 1948, pl. 170). Some loom weights come from funerary contexts at Megiddo, but no association with other weaving tools is witnessed and they are always deposited individually, never in groups (Peyronel 2004, 203).

The clay loom weights of Jericho only began to appear in the Middle Bronze Age layers of the site, from which 58 conical or globular weights are attested, often with flat bases and horizontal perforations near the top (Wheeler 1982, 623) and a length of about 10 cm. Some examples have been found in groups, such as the context "Reg. 697" which includes ten weights, some of which bear traces of bugging, due to yarn friction. Another context, "Reg. 354" includes 14 weights (Wheeler 1982, 624). Unfortunately, the mass of individual weights is not given and no further information can be obtained. All weights known from Jericho come from area H, where several domestic installations have been found.

The first loom weights in evidence at Hazor are made of basalt and have a donut shape (Yadin 1960, pl. CXXVI: 9; pl. CXXVI: 10). Ceramic loom weights, roughly made, are attested only from the Late Bronze I period (Yadin 1958, pl. CXXIV: 15).

At Beth Shean, from the Intermediate Bronze Age layers there is only one basalt donut weight that cannot be attributed with certainty to textile activities. From the layers of the Middle Bronze Age three weights in unbaked clay and four in baked clay are attested, all of which have conical shapes and a horizontal hole placed towards the top of the weight. One of these weights shows a sort of narrowing at the height of its hole (Yahalom-Mack 2007, 664). No loom weights were found in the Late Bronze Age layers of Beth Shean.

2.2.1.3 Iron Age

Beginning in the Iron Age, there was a considerable increase in the production of loom weights, as well as the introduction of a new type, the so-called bobbins/spools. These cylindrical objects are not perforated, are sometimes slightly concave on the long side, and are produced in unbaked or partially baked clay, which has certainly compromised their preservation and evidence in many archaeological contexts.

Syria

At Hama, a more numerous and more varied loom weight industry (than in previous periods) is attested; weights are generally made of baked clay and the most common shapes are the conical ones with horizontal perforation and donut ones with vertical perforation (Riis, Buhl 1990, pl. 96: 729). Alongside these types, there is also a good number of cylindrical spool/bobbin weights made of clay, 34 of which come from Batiment V, 32 of which were recovered from one room, 'Room G' (Fugmann 1958, 252).

There are 981 loom weights recovered from first millennium contexts at Ebla, and almost all of these belong to the Persian period, while actual evidence from the Iron Age II-III levels proper are more sporadic. The most ancient examples come from pit fillings in "Area G," they are spherical and/or donut-shaped, each with a weight less than 200 g (Peyronel 2004, 234).

At Tell Afis, the first cylindrical spool/bobbin weights appear in levels dating to the Iron Age I and come from different areas of the site (Areas G, N, E, D). They are generally made of unbaked clay and measure approximately 9-11 cm in length with an average weight of 250 g (minimum 100 g and not more than 500 g) (Cecchini 2011, 196). The production of these objects continued through the IA II period, though in seemingly decreased numbers and with a change: along with the unbaked clay loom weights examples, spools that were baked at low temperatures in cylindrical shapes and with a slightly concave central part began to appear; one of these weights still bears signs of impressions made by threads (Cecchini 2000, 219). It is worth noting the presence of a possible area of textile production outside the northern city walls (area B3), consisting of a platform, a posthole and a rectangular pit containing numerous spool-type weights, some made of unbaked clay and some lightly fired (Scigliuzzo 2005, 43-5). Aside from these were found a series of ceramic dolium rims re-shaped into cylindrical forms, which may have been used as loom weights, although they could have served other purposes (Cecchini 2000, 219; *contra* Peyronel 2004, 308).[41] Many of these weights have been found in rather conspicuous batches, for example in Room A1 in Area E4, where were found 26 weights of the III phase (along with 4 spindle-whorls) and 23 in the phase IIIc (Venturi 2007, 150, 156, fig. 36). In the Iron Age II period Afis also witnessed the introduction of loom weights of the donut-shaped type, vertically pierced, which replaced the use of cylindrical weights in the IA III, along with other new shapes: biconical, spherical, pyramidal or bell-shaped weights with horizontal holes (Cecchini 2000, 222). Their weight ranges between 50-60 g and 460-470 g. Conical examples with horizontal holes are always very rare (Cecchini 2000, 223, fig. 5).

At Qatna, 232 loom weights were found in the excavations conducted between 1999 and 2005 (Besana 2005, 81). Most of these (136 total) are of the cylindrical spool type, narrowing in the middle, almost all of which were baked at low temperatures. Their relevance to the textile-production sphere is proven by some traces of wear due to friction caused by yarn on at least two examples (nos. 38, 51). A peculiar element of the loom weights from this site is decoration with tiny dots on the edges of 45 spools, the function of which is unclear. Although they vary in number, the dots have a diameter of about 1 mm, they are not deep and are arranged in four regular rows (Besana 2005, 85). The other type well-attested at Qatna is

41 A similar practice was also identified at Tell Mastuma, not far from Afis, where 25 spool weights were identified, as well as several re-shaped dolium rims (Cecchini 2000, 219).

the donut-shaped loom weight with a vertical hole through it. 51 examples are known (plus one cylindrical example) made of unbaked clay. There are also 43 weights with horizontal perforations, these are divided into various types such as conical, truncated conical, bell-shaped and pear-shaped.

From an open courtyard in area H (IA II) at Qatna come 128 weights, which have a spool or truncated conical shape with through-hole. The spools measure on average 5.5 cm in diameter and 8-9 cm in length, they are cylindrical and have a slight concavity towards the middle; they were baked, some at quite low temperatures. The truncated cone weights have a base diameter of 5.5 cm and a height of 8.5 cm on average (Besana 2002, 45-6). Not far from this courtyard were found six fragments of bone implements, these may have perhaps once been spindles. It is therefore possible that Area H was a locus of intense textile activity, perhaps on an industrial scale. In Area J, donut-shaped loom weights were the type most frequently found. They were scattered through various fill layers of the excavated area and not concentrated in a single context, suggesting that the range of textile production was domestic rather than industrial (Besana 2005, 91).

Palestine

Loom weights are known from the levels of Iron IIC period onward at Tell Keisan (Nodet 1980, 319). 85 weights of unbaked clay were found in several batches, some of them related to traces of charred wood, possibly identifiable with the remains of a loom. The shapes seen at this site are quite similar to those at other sites, globular and donut weights for the most part, with a few spool weights. Three groups of loom weights stand out from the rest: 39 weights were found in Locus 310, of which 36 have an average weight of 700 g and 3 weight at least 450 g. The second group (of 20 weights) was found in Locus 414; all but one of these have an average weight of 390 g, the outlier weighs 200 g. The third group consists of 17 weights of approximately 480 g each, and 8 weights of 250 g. The differences in mass between loom weights within each of these three groups is remarkable, suggesting the production of different fabrics. The publication, however, gives only averaged values, so it is not impossible that the disparity in mass between individual loom weights was actually less pronounced. Considering the materials in their entirety, in fact, three types of weights can be distinguished according to their weight (and not two, as the author suggests). A first group has a weight of between 200 and 250 g and it is composed of 9 examples; a second group has a weight between 390 and 480 g and is made of 40 examples; a third group weighs approximately 700 g and is composed of 36 examples. Although this data is not exact,[42] we can surmise that textile production at ancient Tell Keisan was orientated towards medium-low quality fabrics, as there were recovered only a small number of weights suitable for finer production. The fact that most loom weights were of an intermediate weight is in line with the observations previously made regarding the multi-functionality of loom weights with an intermediate weight.

As for the site of Megiddo, most of the loom weights found there relate to Iron Age contexts. It should, however, be stated that a basic continuity can be seen for certain types of loom weights starting in the MBA, through all stages of Late Bronze Age and continuing into the Early Iron Age (Peyronel 2004, 251). It is, however, only in the Iron Age II Period at Megiddo that the finds of loom weights become very numerous. More than 81 pottery loom weights were listed by Paice and dated to level VI (IA I), almost all coming from the area CC. In particular, a group of perforated cylindrical weights was found in Room 2069 in Area AA and another large group came from an open area, Locus 1750 (Paice 2004, 59-60, fig. 33). Loud recorded a spool-type weight, slightly concave in the middle, in the layer VIA (IA I) (Loud 1948, pl. 170: 26), which belonged to a domestic structure. The 17 weights catalogued by Sass (2000, 372-4) are of a different type: most of them are donut-shaped with a central hole and are made of unbaked clay dating back to IA II; there is also one with an incomplete perforation.

The Iron Age Levels of Jericho have produced 7 donut loom weights with conical shapes, from a disturbed context. This causes their designation as 'Iron Age' to be rather suspect, since they could actually be related to the Middle Bronze age. A further 20 weights – 19 donut shaped and 1 conical – were found on the surface (Wheeler 1982, 623).

At Hazor, donut-shaped weights appear to only a slight degree in the excavation reports, although there seem to have been numerous spheroidal loom weights, often found in groups (Yadin 1958, 18, 44-5). A large batch of spheroidal weights has been found in a collapsed context, over the ruins of what was supposed to be the ceiling of the Pillared storeroom (Building 1, stratum V Area A) (Yadin 1958, 18, pl. VII: 3-4; Peyronel 2004, 265). A second group of loom weights was found together (9 in locum V, stratum 3066 area B dated to the 8th century) (Yadin 1958, pl. LXXII: 14-18), consisting mainly of unbaked, or sometimes lightly baked, clay spool weights; a spinning bowl was also been found in the same context (Yadin 1958, 45, pls. LXXI: 6, CXIII: 10).

At the site of Beth Shean 115 loom weights were recovered in Areas P and S, in IA II layers. There were 109 of these recovered from Layer P-7 of building 28636 (Yahalom-Mack et al. 2006, 476, 478). These were

42 Because the given data (the exact weight of each loom weight) has been 'filtered' by the author of the site report, and the 'raw' data left unreported.

found grouped together in two clusters near a charred pole, which may have been part of a loom. These loom weights take a donut shape for the most part, they are pierced vertically and can vary considerably in size and weight (from 43.28 to 630.11 g). One conical weight was found in another context. 10 bell-shaped weights made of gypsum have been also found, they are pierced horizontally at the thinner edge. Similar loom weights have been found at Tell ʻAmal and Tell el-Hammah and are typical of this region in the IA II period (Yahalom-Mack et al. 2006, 477-83). A further two hundred cylinder-shaped weights made of clay and one hundred conical weights made of limestone and basalt were found in the IA II levels at Beth Shean (James 1966, figs. 118:14, 17). On the basis of the chronological revision only a few clay examples can be traced back to the previous phase (Peyronel 2004, 260). Another hundred conical stone weights with horizontal holes were also found in levels dating to the IA II, all grouped within a couple loci (48 and 83) and made of gypsum, basalt or limestone. The discovery of clusters of loom weights inside some buildings, often in significant quantities, suggests that large-scale textile production activity was concentrated in these areas of the site (Peyronel 2004, 260).

The evidence related to the presence of the warp-weighted loom during the Iron Age at Tell Abu al-Kharaz is plentiful, especially in Levels XIII and XIV, which date to the IA II. Weights are not described as per their shape in the site report, however, some deductions are possible on the basis of the few weights that were drawn. First, the initial phases of the Iron Age exhibit few loom weights, but a type of spool defined as 'Aegean' can be recognised. A basalt spool is unusual (Fischer 2013, 147, 284, fig. 846). There is evidence for cylindrical weights but not for donut shaped weights, which appear only in the IA II (Fischer 2013, 343, fig. 369). Phase XII, which is the transition between IA I and II at Tell Abu al-Kharaz, testifies to the persistence of unbaked clay spool weights, but also to the appearance of donut-shaped weights and biconical weights (Fischer 2013, 75, 136, 368, figs. 64, 115 and 125). With phase XIII, the presence of loom weights, mostly donut shaped, becomes overwhelmingly clear, with different clusters of materials from single contexts. Particularly noteworthy is Court L 194-1 in Area 7, where 110 globular and donut-shaped loom weights were found; they were associated with other textile production materials, such as bone shuttles and spindle whorls. In the eastern part of the court other loom weights were identified, making it very likely that weaving took place on a large-scale in this environment (Fischer 2013, 162, fig. 181).

Domestic structures dating to phase XIV (IA IIB) have been found in Area 7, some of which have provided several groups of loom weights, notably Houses 1, 2, and 3, while Houses 4 and 5 provide only sporadic evidence. An interesting discovery concerns 40 unbaked clay donut weights stored inside a jar in House 1 (Fischer 2013, 203, 207, figs. 186 and 187A). Spool weights, after a phase of coexistence with donut- shaped weights in the transition between Iron I and Iron II, seem no longer to be attested in Iron II levels. 64 weights with conical, globular or donut shape, all made of unbaked clay, were in use during Iron II C. They have notable weight variations with the lightest group ranging from 189-272 g to the heaviest group weighing between 413-640 g (Rinner 2009, 148).

Conclusions

In conclusion, the warp-weighted loom seems to have appeared in the Levant at the beginning of the Early Bronze Age, when it occurs at certain sites such as Hama. At the same time, it seems to be absent at other Syrian sites such as Ebla or Tell Afis.[43] In the Southern Levant, evidence for this type of loom is more substantial at sites such as Megiddo, Tell Abu al-Kharaz and Jericho (Nigro, Sala 2010, 4; Fischer 2008). It is possible that part of the evidence for the warp weighted loom should be sought in the category of the so-called ‘perforated discs’, which will be discussed later on. However, except for a few cases, it seems that in Syria the warp-weighted loom, even if well-known, was not the main type in use during the entire Bronze Age. The evidence for its use seldom appeared during the Middle Bronze and the Late Bronze Ages, with loom weights rarely attested at Ebla, Afis, Ugarit and Hama, which certainly reflect a different situation when compared to the evidence that comes from the Palestinian region.

Various discoveries have been made at the big sites of Megiddo, Jericho, Beth Shean and Gezer, but other groups of loom weights are known from sites such as Tell Ta‘anach, Tell Ifshar, Tell Beit Mirsim, Tell el-Far’ah N, Tell el-Ajjul, and others (Peyronel 2004, 205). During the Late Bronze Age, the evidence for loom weights becomes extremely rare in both Palestine and Syria, with some weights still present, but definitely in lower numbers than in the previous and subsequent levels. No loom weight comes from the Late Bronze Age layers of Beth Shean, for example, except for a few examples of the stone discs whose purpose is still discussed. The same situation is confirmed at Hazor, Megiddo (which has 4 conical weights which probably drifted from MB layers), and Lachish. In the MBA layers of Tell Ta’anach 76 conical weights were found, compared to 3 weights recovered from the Late Bronze I and II layers (Yahalom-Mack 2007, 668). It seems therefore possible that the warp-weighted loom was used to a much lesser extent during the Late Bronze Age in Syria and Palestine, perhaps due to the introduction of the vertical two-beam loom. From a morphological point of view, loom weights do seem to have been quite standardised during the Bronze Age, with a predominance of conical and

43 It should always be kept in mind that the published excavation documentation is much more numerous for Palestinian contexts and this could undermine our understanding of the spread and use of the warp-weighted loom.

bell-shaped types with horizontal holes, and the sporadic attestation of donut weights.

At the beginning of the Iron Age, there is a change in weaving techniques, with a renewal of the warp-weighted loom. At many sites, the Iron I Period marks the introduction or return of loom weights, in particular a new and long-debated shape; the bobbin or spool-type, which appeared in Syria and southern coastal sites at the beginning of the Iron Age, as evidenced at Tell Afis (Cecchini 2011, 196). These were also already present during the Bronze Age in the Aegean and in Anatolia, where the bobbin/spool-type loom weights remained in regular use throughout the entire Bronze Age. This fact leads us to consider the re-adoption of the warp-weighted loom in the Levant as a result of the arrival of exogenous populations, Anatolian, Aegean, or more likely, Cypriot (Cecchini 2000, 216-17; Fischer 2014, 478-9). This type is first joined by, but then replaced by, the donut-shaped type, which becomes the prevalent shape throughout the Syro-Palestinian area beginning in the Iron II Period. In addition, conical types with horizontal perforations were also present, in some cases in regional varieties such as those from Beth Shean and Tell ‘Amal, where stone weights were produced in these shapes (Yahalom-Mack, et al. 2006, 482).

2.2.2 Perforated Stone Discs

This category of objects is rather unclear and has not been well-defined in the secondary literature. Under this heading fall a large number of stone objects that have a hole through their middles, or slightly off-centre and which could have served several functions. The shapes of these objects are extremely varied, as almost every perforated pebble can be included in this category, from those 3-4 cm in size to examples that are 20 cm in diameter; their surfaces are sometimes smoothed, but often left rough and unworked. In the various excavation reports these objects are known generically as ‘perforated stone discs or weights’ and have been interpreted as ‘digging sticks’, ‘pivot(s) for drilling’, ‘weights’ (weights or counterweights across the various sources), and also as potential loom weights.

The chronological span of these objects of different shapes and sizes is wide; they are in evidence from the levels of the PPNB in Jericho and appear in Iron Age layers. The materials used for their production are few, with basalt being generally used and only secondarily limestone. It is possible that this group of objects, due to their heterogeneity, have indeed served all the functions suggested above, as their simple design allows them to have been of multi-purpose use. It is also possible that actual spindle-whorls and loom weights might be recognised from amongst this group of objects, distinguishable at least in some cases on the basis of their morphology, weight and context. Unfortunately, many excavation reports do not provide detailed descriptions of all such simple objects of daily life, and usually only rarely provide extensive information regarding their sizes or weights, and this fact hinders the identification of particular functional categories. The same objects are also considered differently depending on the particular historical period to which they belong. For example, the Iron Age exhibits intensive production of so-called 'donut' loom weights in clay, as well as similarly shaped objects made of stone. When these stone 'donuts' are recovered from older contexts however, their designation as loom weights is considered uncertain, since (although it is possible) it is not known whether stone 'donuts' functioned exclusively as loom weights in all periods.

Some examples from the major Levantine sites are here provided, around which our discussion of "perforated stone discs" used in spinning and weaving, can be structured. The first pierced stone objects from Jericho were found in levels dating to the PPNB, with various interpretations provided by the excavators (digging sticks, mace heads and fly-wheel weights from semi-rotatory drills), although no suggestions related to textile activity (Dorrell 1983, 534). A total of 15 discs have been found in these early levels, 10 of which are in limestone, one in basalt, with the others not specified. 9 of these objects are well-rounded and symmetrical, while the other 6 are more irregular and have an off-center hole. In the levels of the following Pottery Neolithic (PN) only 6 stone weights were found, 4 of which are of limestone.

Only 2 perforated stone discs were found in the Proto-urban levels of Jericho, while 8 were recovered from the Early Bronze Age layers (Dorrell 1983, 558). In the transitional levels between the Early Bronze Age and the Middle Bronze Age, 4 such objects were found (Dorrell 1983, 562), some of which with incomplete perforation. 13 examples were recovered from Middle Bronze Age layers, almost all made of limestone. One of these shows traces around its hole left by a semi-rotary drill bit. One of the most attractive theories is that some of these perforated stone discs related to the drill technology itself, and were used with the tool, as pivots. In fact, there are certain objects, which have been found that bear numerous holes on their surface, not all of them completed through the object. However, for those with a single hole, it is not possible to narrow down their use more; they can still be linked to handicraft or textile contexts, or both if one subscribes to the 'multifunctional-use' theory.

As seen mentioned above, in the Iron Age levels from Hazor several discs were found grouped together, the 9 from locus 3066 stratum V Area B which dates to the 8th century BC, but before the Assyrian Conquest of 732 BC (Yadin 1958, pl. LXXII: 14-18) and were found together with a spinning bowl.[44] These weights are made of stone, mostly from basalt

44 It is described as "A flat bowl, with a hole in the base made before firing". Apparently not a spinning bowl (Yadin 1958, 45, pls. LXXI: 6, CXIII: 10).

and measuring between 5 and 10 cm in diameter. Of special interest is artefact C 10315 (Yadin 1958, pl. LXXXVII: 26, CLX: 7) made of polished basalt and dated to the LB II, as it shows a central groove that suggests threads were affixed to it.

There are not many perforated stone discs reported in the publications of Megiddo. Braun (2013, 101) reported that various weights including stone-frame weights and basalt rings are known from EB I levels, but provides no further information. Sass (2000, 376) reported three examples from IA II levels, two in basalt and one in limestone. There are some rare examples from tombs, such as a disc made of basalt from Grave 1102 of the Early Bronze Age and two similar discs, also of basalt, from Late Bronze Age tombs (877 C1, 63B). Finally, two perforated rings come from (undated) Tomb 80 (Guy, Engberg 1938, pl. 173-4).

At Beth Shean, under the section describing stone ring-weights are listed a number of circular stone weights, of which 27 are known from Early Bronze Age level IB, but which are completely lacking in levels dating to the Early Bronze III (Mazar, Rotem 2012, 362). The small scale weights made of limestone, with an average diameter between 3.3 and 4 cm and a hole diameter between 0.5 and 0.9 cm are interpreted as spindle whorls. In the MB II layers, 9 perforated discs have been found, all in basalt except one which is in limestone. They measure from 8 to 17 cm in diameter, apparently too large to be related to textile production (Yahalom-Mack 2007, 639). Several stone rings, all made of basalt except one made of limestone, were found in the transition layers between the Late Bronze and Early Iron ages. They had similar diameters of those of Middle Bronze date (Yahalom-Mack, Panitz-Cohen 2009, 725).

In Hama, the oldest perforated disc dates to Level 1 of the site (fourth millennium) is of basalt and 22 cm in diameter (Fugmann 1958, 17). Its weight is unrecorded, but even if it was known, this object could hardly have been associated with the use of a loom given to its dimension. Weights found in the later period layers at Hama are of different dimensions, though generally around 10 cm of diameter, similar to those coming from the other Palestinian contexts under examination here. Perforated stone discs seem very numerous and present in almost all levels of the Bronze Age, which is sign of great continuity in their use, whatever exactly it may have been. The material from which most were made is basalt, with limestone used to a lesser degree. In level J7 (2400-2300 BC) several of these discs were found in domestic contexts, but not in close association with spindle-whorls or the loom weights made of limestone, which were present in large numbers (Fugmann 1958, 56). On the other hand, in level J5 (c. 2200 BC) in *pièce* 1 and 4 both perforated stone discs and loom weights were found (Fugmann 1958, 62, 66), in this instance linking their use with textile production. Unlike loom weights, perforated stone discs continued to be used during the Late Bronze Age at Hama, although for the most part their total amounts within layers are lacking, making statistical comparison difficult. The production of perforated stone discs continued uninterrupted until Iron Age levels (Fugmann 1958, 138, 143) without modification, continuing the dichotomy between elaborately-worked weights and rather rough pebbles.

The most interesting case, and which can be used as a model for a functional study of rings or perforated discs, is undoubtedly the series of artefacts from the Early Bronze Age phases of Tell ʻAbū al-Kharāz. At this site, the remains of at least two warp-weighted looms as well as spindle whorls still attached to spindles have been found (Fischer 2008, 109-10). This implies that the adoption of the warp-weighted loom had taken place in the Jordanian-Palestinian by the Early Bronze Age II, or c. 3000 BC (Fischer 2008, 116). As for the archaeological evidence, the two looms (L316 and 328) were placed in one room and had approximately the same dimensions. One of the two looms was in use at the time of the destruction of the house, as 8 weights (7 of basalt and 1 limestone) were found in a row, they may have been hooked to each other by a wooden stick. The loom measured about one meter in width (between the two side poles) and probably stood 1 meter tall. In association with the loom 2 other basalt weights or spindle whorls were found, several bone spatula or shuttles, as well as an awl and a copper knife.

The Tell ʻAbu al-Kharāz weights or spindle-whorls have ring or cylindrical shapes and can be divided into two types (Fischer 2008, 112). Examples from Group 1 take a circular shape, have a central hole, polished surface and weigh between 20 and 60 g (an amount which includes the spindle whorls which are still attached to their spindle). It is highly likely that this group of objects was mainly created for spinning, but their use with looms used for weaving very thin threads is still possible. The second group of apparent weights (Group 2) is a little less homogeneous than the first, in both surface finish and shape; they have an average weight of 90 g. Experimental tests have lead to the conclusion that these were not used as spindle whorls, because they oscillate excessively; if they do relate to textile activities, they are better suited to use as loom weights.[45] Similar objects to these are also attested in the later stages of this site, but show a significant decrease from the Middle Bronze Age onward. During the Iron Age a clear predominance of clay loom weights is seen.

In conclusion, the available data does not allow a precise identification of the stone materials connected to textile production, but it is possible to outline certain facts that may allow some steps forward. Firstly, the production of stone weights that are characterised by a regular circular shape, a central perforation, a treated surface, a diameter (up to 6 cm) and that are fairly lightweight has been verified in at least two sites (Tell

45 Materials similar to those of both groups were recorded also at Qiryat Ata (types 3 and 4) (Shamir 2003, 210).

'Abu al-Kharāz and Beth Shean) during the Bronze Age. These objects, as evidenced by the recovery of one with the fragment of a wooden stick still inserted through it, probably were used as spindle whorls, alongside the more classic shapes discussed in section 2.1.2. The second group identified at Tell Abū al-Kharāz could have served as loom weights, which is suggested by the weights found *in situ* in a row (the exact dimensions and weights of which are unknown). However, these objects are more difficult to establish with certainty as loom weights, as they could simply be counterweights. The discovery of looms already in the early stages of the Early Bronze Age makes it more likely, however, that many of these objects should be linked to weaving. Definite proof for the identification of these objects as loom weights is provided only by the context of discovery; through association with other tools for textile production, or when these 'discs' are found in groups or rows that allow the presence of a loom to be recognised.

2.2.3 Other Tools Linked to Textile Production: Spatulae

The earliest examples of bone 'spatulae' come from level III (c. 8000-7600 BC) of the site of Mureybet on the Middle Euphrates (Doyen 1986, 47-51). The objects designated as spatulae are oblong, flat, very thin and measure between 10 and 12 cm long, 1.5 and 2 cm wide, 0.1 and 0.02 cm thick; they exhibit one rounded and one sharp end and were obtained from the ribs of animals. A long debate has characterised the identification of their function, earlier they were supposed to be tools related to writing and the preparation of wax tablets, or leather-working tools, it has also been suggested that they were used in the manufacture and repair of nets, or as part of cosmetic/toilet kit. The proposal to recognise these objects as instruments related to the manufacture of textiles began to be voiced from the '50s onward (Tufnell 1953, 397; Crowfoot 1957, 461-2), but their exact function has not yet been determined, as they lack contexts that allow us to prove their use in one way over other. Across the Levant, several flattened objects made of bone of lanceolate shape with one pointed and one rounded tip have been found: they can be defined as spatulae and in many cases these exhibit thin parallel marks near the tip and on one side of the object.[46]

Only two spatulae have been recovered from Qatna, one almost complete and one with only one tip preserved; these were found in association with some bovine ribs lightly shaped as well as some unprocessed ones (Besana 2005, 133), suggesting the presence of a tool-making workshop.

46 Generally they are made from flat bones, such as the ribs and shoulder blades of sheep, goats or cows as they are better suited to produce these kind of objects; bone awls and tips are also obtained from the diaphysis of long and metapodial bones, while the humerus and femural condyles were used to produce rounded objects such as spindle-whorls (Peyronel 2016, 2).

A similar context was also found at Tell Afis, where four spatulae were found in room L. 534 of Area D along with other bone finds (Cecchini 1992, 14). Furthermore, several similar bone instruments were found. These were usually flat, between 10-12 cm long, 1.5-2 cm wide and 0.1-0.2 cm thick, with a sharp tip and the other end rounded. Spatulae were usually obtained from animal ribs and have a polished surface, while the tip has traces of usage (Cecchini 2000, 223). All of them come from Iron Age levels prior to the Assyrian conquest, and therefore the idea that they were used in conjunction with newly-introduced fibres such as cotton and silk can be excluded (cf. Doyen 1986, 49-51). In some cases, spatulae from Afis are decorated with circles and dots, as are the Levantine examples. Spatulae are interpreted by Cecchini (2000, 229) as tools related to very fine and tight textile weaving, and likely they were tools used to tighten the weft and untie knots. Furthermore, Cecchini underlines the inconsistent appearance of loom weights and spatulae together in the same contexts, and writes that this suggests that their function was not linked to the warp-weighted loom.

The 12 bone spatulae of Tell Mardikh date to IA II-III (Peyronel 2004, 360). In many cases, they have been found in primary contexts associated with clay loom weights. Their original lengths were probably between 9 and 15 cm, although many of the discovered tools were fragmentary and could have had different dimensions from those included in this range. They are usually around 2 cm wide with a thickness from 0.2-0.3 cm. In the lengthwise direction, the profile is generally flat or slightly curved, while the cross-section tends to be ellipsoidal and flattened, with rounded edges (Peyronel 2004, 357). The process of manufacture from the ribs of cattle and goats involved cutting the rib in a transversal direction, so as to obtain a flat instrument with a smooth side and one with the trabeculae still evident. This cut was followed by the smoothing and polishing of the surface. One end was shaped as a lanceolate or sharp edge and the other end was left flat or carved into a slightly rounded shape. According to Peyronel (2004, 357) the spatulae were generally smoothed during production, so the smooth surface that characterises them is the result of their preparation and not the use of the tool. Peyronel suggests that spatulae were used in relation to weaving and indicates a Cypriot origin, as they are well known in Late Bronze Age contexts there (Peyronel 2004, 371).

In Hama bone spatulae are known from the grave goods of the cremation necropolis. One such tool was found in an urn containing fragments of a spindle, three bone spindle-whorls and a comb made of bone, all of which are tools that relate to weaving or body care (Riis 1948, 178, 239, fig. 224).

Several spatulae (38) come from Megiddo, with shapes ranging from quite wide to rather short examples with pen-nib points and concave or straight sides, while the other end is generally rounded (Lamon, Shipton 1939, pls. 95-6; Loud 1948, pl. 199). Most of these come from level III, i.e. after the Assyrian destruction of 732 BC, but the first examples began to appear in the VII-V levels, which date from the LB II until the beginning of IA II, but they nevertheless remain rare. The production of this type of artefact continues into the Persian period.

Lachish has brought forth 16 bone spatulae from its Iron Age levels with (if preserved) sharp tips and rounded ends. Most of them come from the Iron II A and B levels but production continued into the Iron II C and the following periods (Sass 2004, 2011-13).

Beth Shean provides evidence of 9 bone spatulae, 7 from Early Bronze I and II Early Bronze III, all with smooth surfaces and slightly concave interiors. Some have small traces of wear near the tip and measure from 2.5 cm (for broken examples) to 11 cm in length, but most of them are about 9 cm long. The width varies from 1.4 cm to 2.5 cm, while the thickness ranges from 0.2 to 0.4 cm. There were also spatulae found in the LB II strata and in the transition from the Late Bronze Age to Iron Age I A (Yahalom-Mack et al. 2006, 497; Panitz-Cohen, Yahalom-Mack 2009, 740).

In conclusion, the production of bone spatulae with lanceloate shape is generally attributed to the Iron Age period. There is a tendency, however, not to assume that the tools from earlier periods served the same functions as similar tools from the Iron Age. According to Peyronel, spatulae dating to the Early Bronze Age are linked to an older tradition of production in bone, that of tools (drills, bits, blades) and personal ornaments. It is only with the Middle Bronze Age that a production geared more to the textile sphere (spindles, spindle-whorls and spatulae) as well as pins and toilette items began (Peyronel 2004, 79). However, the Bronze Age spatulae from Beth Shean do appear to be of the same type and function (based on signs of wear) as those from the Iron Age and following periods, which indicates continuity in the use of this tool for the weaving process. A clear intensification of the production of bone spatulae occurs towards the final phase of the Late Bronze Age and the beginning of Iron I, through all the Levant. The Iron II and III periods see the greater spread of this tool, which persisted into the Persian and Hellenistic-Roman periods.

Although the relation between bone spatulae and textile production is generally accepted by most researchers, certain scholars have occasionally considered the appearance of the bone tools alongside the introduction of the warp-weighted loom. This theory actually clashes with the evidence described above as well as with the Egyptian evidence, which shows that bone spatulae of the same shape as described above are very well attested throughout the Pharaonic period, whereas the warp-weighted loom is not. It seems possible, as suggested by Cecchini (2000, 229), that bone spatulae relate to fine textile work in general, and not to specific weaving techniques and looms. Thus, the identification of the precise function of these tools remains a topic for debate, reliant on further detailed studies and their discovery at more sites, in order to provide a reliable chronological and geographical pattern of their spread.