Milling and Weaving Equipment, including Hand-held Stone Tools, Mortars, Querns, and Stone Vessels, Loom Weights, and Spindle Whorls

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INTRODUCTION

The study of the milling and weaving equipment was carried out over a three-week period at Zeugma in 2002.[1] The objects were examined by hand and measured with rulers and hand-held tapes and calipers.[2] The following abbreviations are used for the object types: **ST** = stone tool; **SM** = stone mortar; **Q** = quern; **SV** = stone vessel; **LW** = loom weight; **SW** = spindle whorl.

The majority of the milling equipment is of a vesicular volcanic rock, described as basalt in the catalogue. It varies in color from light gray to black and has varying concentrations of a white crystalline filling, which is probably postdepositional and the result of lime in the soil. Fine-grained basalt also occurs. There are small, local pockets of basalt and dolerite within 10 to 20 km to the northwest, and 15 to 20 km to the east across the river Euphrates. Larger outcrops are within 50 km to the northwest and southwest. A separate study including petrographic analysis is needed to locate the source of the basalt used at Zeugma; deposits further south in Syria must also be considered, as the stone may have been transported up the river Euphrates. Other identified stone types are limestone, which is found locally, and marble from an unknown source. Several objects are of unidentified stone, including two stone vessels possibly of basalt or diorite, and one mortar probably of dolerite.

Initially, querns were the main focus of this study. It was extended to include the few hand-held stone tools recovered and the mortars, as both of these can be used within the milling process, although this is not their only use and I would not say that the examples from Zeugma were definitely or only used for milling. The most numerous finds are mortars and querns. Although neither corpus is extensive, they do include a range of types. Thirteen mortars were recovered, with three main types: deep and high-sided, suitable for use with a long pestle, nonfooted bowls, and footed bowls, the latter two both with and without spouts. Twenty-seven querns were recovered of which only one (**Q1**) is nonrotary. It is an upper grinding stone and would have been used with the type of lower stone usually referred to as a saddle quern. Querns of this genre have a long history, with a floruit prior to the advent of the rotary quern. The remaining querns include both the larger Pompeian mill and smaller hand-operated querns of various styles. Of the finds that are from datable contexts, nearly all were found in deposits related to the Sasanian attack of the mid-third century A.D. The only exceptions are stone tools **ST2** and **ST4**, from the sixth century and early third century A.D., respectively, and **Q15** from the early to mid-seventh century A.D.

Of the objects used for weaving, only loom weights and spindle whorls were studied. Other objects that may have been used for weaving, like bone spatulas, were studied by other specialists and are published elsewhere in these Zeugma final reports. The majority of the spindle whorls are made of unidentified stone, with many in a soft stone that scratches easily, here tentatively catalogued as soapstone. Some may be serpentine, sources of which exist within 50 to 80 km to the north/northwest and west of Zeugma. Only one bone spindle whorl was found. The loom weights are either ceramic or of baked clay. A few reused sherds have been catalogued as possible loom weights or spindle whorls. As with the milling equipment, the majority of the dated finds are from deposits related to the mid-third-century A.D. destruction, with the exception of the loom weights, which, in marked contrast, are all from the Flavian period.

In trying to gain an overall picture of the milling and weaving equipment presented in this report, we must keep two important factors in mind. First, the conditions of the excavation: the fact that it was a rescue dig, carried out under great time pressure, and one that aimed to examine as wide an area as possible in the limited time allowed. Second, the fact that the corpus published here is not a complete representation of the material available for study, as it does not include the finds from the trenches excavated by other teams working at Zeugma in adjacent areas in 2000.[3]

Despite this, the corpus published here represents an important and interesting assemblage. The rotary querns in particular, in spite of their small number, show a broad range of types, including one of technological importance, Type 003c, which was fitted with a rynd. There are also several which can be said fairly confidently to form a pair as upper and lower grinding stones. It is unfortunate that not enough are from datable contexts to allow an overall stylistic development or pattern to be discerned, though some general remarks have been made in the discussion.

One of the most interesting groups of milling artifacts are those from the destruction levels associated with the mid-third-century A.D. Sasanian attack in the House of the Helmets. Five mortars and two rotary querns, possibly forming a pair, are from good contexts. The mortars include **SM1–3**, all of Type 001, deep and tapering, and probably used with a long pestle. The one exception is **SM2**, of

limestone, which has very little use-wear and was found in the courtyard of the house. It is possible that it was used for storage or even as a decorative feature or planter. Two footed mortars, **SM8** and **SM12**, the latter with a spout, were also found in the courtyard of this house, as was **Q23**, a lower rotary quern. **Q16** was found in Room F. It is not possible to say with precision where these finds would have been used in the house, but they represent a typical domestic assemblage.

While the total number of loom weights might be judged too small to draw any conclusions, given the large area excavated, their dearth, coupled with the period in which they are found, can be taken as evidence for the decline of the warp-weighted loom in favor of the vertical beam loom at Zeugma. Spindle whorls, the most numerous class of object recovered (sixty-five examples), however, range in date from the Early Imperial phase through to the Islamic. While the type of loom may have changed at Zeugma, the method for spinning yarn remained constant.

The following abbreviations are used in the catalogue entries below: L. = length; W. = width; Th. = thickness; D. = diameter; H. = height; Dp. = depth; min. = minimum; max. = maximum; pres. = preserved; est. = estimated; int. = internal; ext. = exterior. All dimensions are in cm unless otherwise noted.

HAND-HELD STONE TOOLS

The small number of objects in this category obviate the need for a typology. All are made of black, fine-grained stone, probably basalt. **ST1–2, 4** have similar characteristics, and they are described as grinders and pounders in the catalogue. These are barrel shaped, subcircular to oval in plan, with convex faces and edges, and with both faces smooth and polished with a slightly pecked central area.

The degree of wear and the depth of the central area vary. **ST2** and **ST4** have similar edges with some pecking and smoothness, whereas **ST1** is encircled by a shallow concave groove. The smooth, polished surfaces are evidence for a grinding and polishing action while the slight pecking on the edges of **ST2** and **ST4** betray a pounding action. The pecked central areas are unusual. These may be the result of a pounding action, but crushing small objects where the force is centered, followed by a circular grinding action, could also have produced this marked use-wear pattern. Alternatively, the surface may have been roughened purposefully to provide a handling grip. The shallow groove on **ST1** might also be for grip. Another possibility is that it was used to secure a strapped handle, although not at the time when the object acquired the use-wear near the groove. **ST3** is an ovoid stone with one thinner side probably worn down by heavy use. Both faces and the thin edge are very smooth and highly polished, betraying a grinding action, perhaps from burnishing. The stone is not easy to handle and would probably have been held with the thicker edge in the palm.

The hand-held stone tools come from datable archaeological contexts. Two appear to have been in use at the time of the mid-third-century A.D. Sasanian attack: **ST1** comes from the upper collapse in the House of the Helmets; **ST3** was found in the destruction debris of Room A on the lower terrace of the House of the Tesserae, together with a pair of rotary querns (**Q17** and **Q26**). These objects suggest that Room A, or one above it, had a utilitarian function in the period leading up to the Sasanian attack. **ST2** was found in the sixth-century collapse of the Southwestern House and **ST4** was found in an early third-century A.D. floor deposit in Room B in the eastern part of the House of the Fountain.

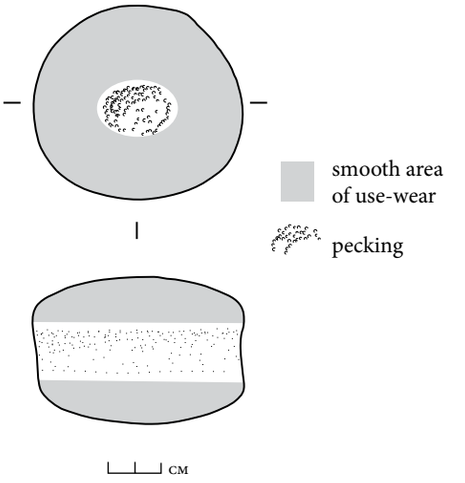

Figure 1. **ST1.**

ST1 WS 2241; context 2035
Grinder and pounder
Fine-grained black basalt, slightly vesicular FIG. 1

Complete. L. max. 7.8 (7.6 in groove), W. max. 7.2 (7 in groove), Th. 5.3.
Barrel shaped, subcircular in plan. Faces: convex with very smooth, slightly polished surfaces, with a slightly pecked, rougher central area. Edge defined by a shallow concave groove around entire object, on center, with a fairly smooth, lightly pecked surface and a very smooth and slightly polished surface to either side.

ST2 WS 94; context 5003
Grinder and pounder
Fine-grained black basalt

Complete. L. 5.7, W. 5, Th. 4.6.
Barrel shaped, oval in plan with a very slightly convex edge. Faces: slightly convex, one very smooth and polished, opposite face smooth with some polish; both have a shallow, lightly pecked center. Edge pecked at one end; also some other patches of pecking and polish.

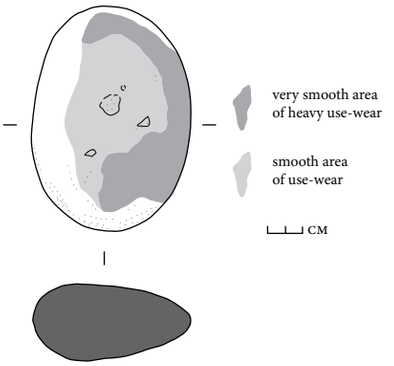

Figure 2. **ST3**.

ST3 WS 439; context 9073
Grinder or burnisher
Fine-grained black basalt FIG. 2

Complete. L. 12.3, W. 8.7, Th. min. 1.1, max. 4.4.
Oval in plan, ovoid in cross section. Convex faces and edges, thicker on one side. Entire surface smooth; extreme use-wear on both faces and the thin edge. Slightly defined areas in the center of each face: one with worn and slightly flattened surface; each very smooth and polished at the edge. One face and half of opposite face burned with a distinct demarcation line.

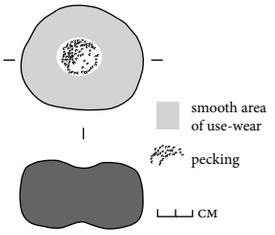

Figure 3. **ST4**.

ST4 WS 242; context 11045
Grinder and pounder
Fine-grained black basalt? FIG. 3

Complete. L. 6.7, W. 5.8, Th. 3.9, hollows D. 2.4, Dp. 0.4, 0.5.
Barrel shaped, suboval in plan with a slightly convex edge. Faces: almost level, slightly convex with very smooth, slightly polished surfaces and a shallow, circular central hollow that is smooth and slightly pecked. Edge has three very smooth, slightly pecked areas.

MORTARS

The typology is based on the most obvious stylistic features and lends itself in some degree to differences in use. Examples of Type 001 are likely to have been used with long pestles, whereas the majority of the other examples are better suited to use with a grinder or pounder, because their mortar hollows are generally fairly shallow and broad. **SM7** is the only example that would suit a pestle, being fairly deep and enclosed, with use-wear consistent with this function.

Type 001: Deep, High-Sided with Internal Depths of 15–25 cm

With the exception of **SM2**, these mortars are of vesicular basalt, and they vary only slightly in overall shape, being narrower at the base, with fairly wide, deep (ca. 21–24 cm), tapering, and concave interior mortar hollows. **SM3** and **SM5** have a shallow relief band around the base of the body, and **SM1** and **SM5** have one just below the rim.

The evidence for use-wear is notable. **SM1** and **SM3**, although only fragments, have a smooth interior surface, and **SM1** has faint striations forming banding. **SM1, 4,** and **5** have heavy use-wear just below the rim, where much of the surface is very smooth and polished. The interior of **SM4** is fairly rough and weathered, with a hole in the bottom, whereas the interior of **SM5** is smooth and even. While all of these could have been used for storage, in each case the use-wear suggests a function as a mortar. A long, heavy pestle, perhaps wooden, was probably used for pounding. The smoothness under the rim may be the result of a pestle being pulled round the interior against the rim, or wear from handling. While the banding on **SM1** could suggest a fragment of a catillus (see Type 002a quern, p. 304), the relief band around the rim and the angle of the interior profile is more typical of a mortar. One example does not have evidence of heavy use-wear. This is **SM2**, half of a roughly shaped limestone vessel with a fairly smooth, concave interior (depth ca. 16 cm), that may have been used as a mortar or possibly for storage.

Three of the mortars were found in the Sasanian destruction deposit in the House of the Helmets and are datable in their final use to the mid-third century A.D. **SM2** and part of **SM1** were recovered from mud-brick collapse in the peristyle courtyard; the other part of **SM1** was found in a neighboring context to the west of the courtyard. **SM3** was found in Room I of the house, from a deposit with a slight chance of contamination. **SM4** and **SM5** come from uninformative contexts in Trench 7.

SM1 WS 2084; context 2012; WS 2214; context 2158
Mortar
Vesicular black basalt

Two joining rim fragments. H. max. pres. 21, W. across rim at ext. 37.5, at int. 28.5, W. rim 5–5.3, Th. max. 10, W. relief band min. 5, max. 5.8.
Rim: slightly convex, sloping into the interior, surface slightly uneven, fairly smooth. The body gradually thickens toward the break. A shallow relief band runs around the exterior just under the rim. Exterior surface: slightly uneven, fairly rough with a chipped, burnt area on the

relief band. Interior surface: even, fairly smooth with very smooth patches, especially below the rim; traces of faint striations forming banding, not scratches.

SM2 WS 2119; context 2012
Mortar
Limestone

Half. H. min. pres. 21, max. pres. 25, L. 22.5, W. max. pres. 13.5, Th. 10, W. rim 4, W. across rim at ext. 27, at int. 18.5, W. across body 30.5, W. across int. hollow just above the floor 7, Dp. int. ca. 16.
Roughly circular in plan. Base: level and uneven. Rim: uneven, a little chipped and slightly higher on one side. Exterior: profile convex–vertical; surface uneven. Interior mortar hollow: conical, tapering to a concave floor, surface uneven. No obvious use-wear. Whole surface: fairly smooth.

SM3 WS 2141; context 2105
Mortar
Slightly vesicular black basalt

Fragment. H. max. pres. ca. 26, Th. base ca. 7.5, W. rim min. 3.8, max. 4.2, Th. body near rim 4.8, at top of int. curve 7.1, near floor of mortar hollow 6.5, Dp. int. ca. 21, W. relief band ca. 3.5.
Full profile preserved. Small section of base intact, probably level when complete; surface uneven, roughly worked but fairly smooth in places. Rim: level, slightly uneven, fairly smooth, worn and burnt in places; faint tool marks of rough lines across it. A shallow, convex relief band runs around the edge at the base; roughly worked, slightly uneven, fairly rough surface. The exterior profile flares out from the top of the relief band to the rim; surface even and fairly smooth. The interior profile is seen in the broken section. It undulates, being slightly convex in the middle with the top of the curve close to the bottom of the mortar hollow, then sloping down again before curving into the floor. The whole interior tapers toward the floor. Interior surface: even and smooth, no heavy use-wear. When complete the mortar would have been slightly conical in shape, smaller at the base.

SM4 WS 646; context 7001
Mortar
Vesicular black basalt FIGS. 4a–b

Almost complete. H. ca. 26.5, D. base 18, Th. base 4.5. Across rim: L. ext. 42.5, W. ext. 41, D. int. 28, W. rim 7–8. Dp. int. 21.5, W. int. just above the floor 14.6.
Roughly circular in plan. Base: level, even, rough. Rim: level, fairly even, worn. Exterior: profile slightly convex, tapering in toward the base; surface even and fairly smooth with some very smooth areas, one quite large over the lower half of the body. Interior tapers to a fairly wide, concave floor; surface even and fairly rough; three-quarters just under the rim is very smooth with polish. The body thickness tapers gradually toward the base. There is a hole in the bottom on one side.

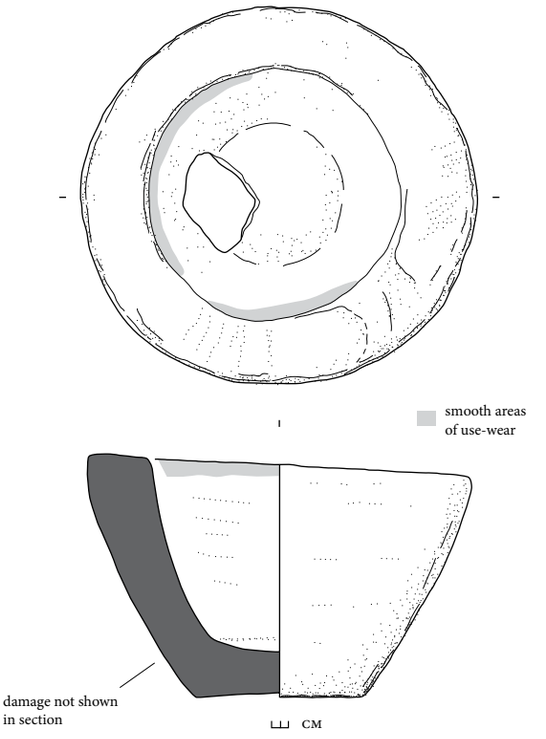

Figure 4a. **SM4.**

Figure 4b. **SM4.**

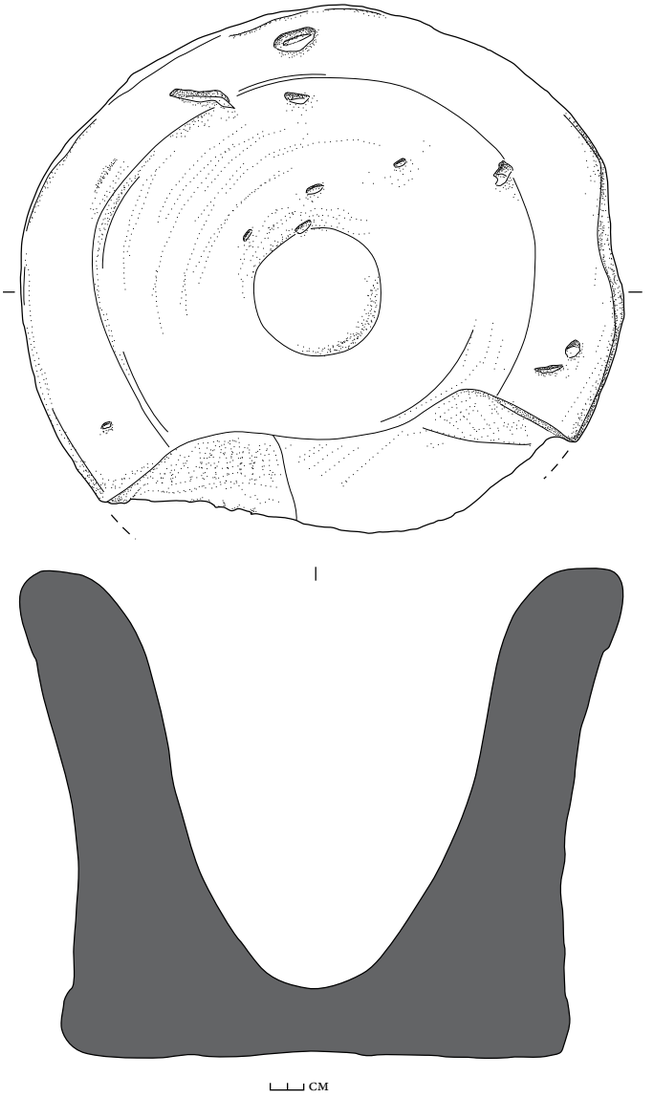

Figure 5a. **SM5**.

SM5 WS 893; context 7304
Mortar
Vesicular black basalt FIGS. 5a–b

Almost complete. H. max. pres. 28–29, base: L. 29, W. 24.5, Th. ca. 3.6, L. across rim at ext. 35, at int. 26, W. rim 4.1–4.4, Th. body 10, Dp. int. 24.2, W. int. just above the floor 7.5, relief band: around rim W. 3.7–5, around base W. ca. 2.7. Broken on one side so total width at the rim not known. Oval in plan. Base: level, surface fairly even, fairly rough. Rim: level then slopes into the interior; surface fairly even and smooth. Exterior profile varies from concave to almost vertical in one place, overall tapers toward the base. Two shallow, slightly convex relief bands run around the exterior, one just below the rim and one just above the base. Exterior surface: even and fairly rough. The interior tapers to a rounded, concave floor; surface even and smooth with a few very smooth, polished areas below the rim. The body thickness is widest just above the base.

Figure 5b. **SM5**.

Type 002: Nonfooted Bowls

Both are of vesicular basalt. **SM6** preserves a full profile, having a heavy, thick bottom with a shallow, solid ring foot. The concave interior slopes steeply and the surface has heavy use-wear, being very smooth and highly polished in one area. **SM7** is a small, oval bowl with a relatively deep (7 cm) concave mortar hollow. The interior edge has a distinct use-wear line, the upper part being fairly smooth and the remainder of the interior very smooth, polished and darker in color, particularly on the floor. This use-wear suggests that a pestle was used with this mortar. Both come from insecure contexts in Trench 2.

SM6 WS 3510; context 2014
Mortar
Vesicular basalt

Fragment. H. max. pres. ca. 15, Th. base 8.9, W. rim 3. Full profile preserved. A shallow, level, solid ring-foot base curves up at the edge into a high convex exterior. Rim: level, sloping into a steep concave mortar hollow; floor not preserved. Interior surface: even and fairly smooth, with a small area extending to just below the rim that is very smooth, polished, and darker in color.

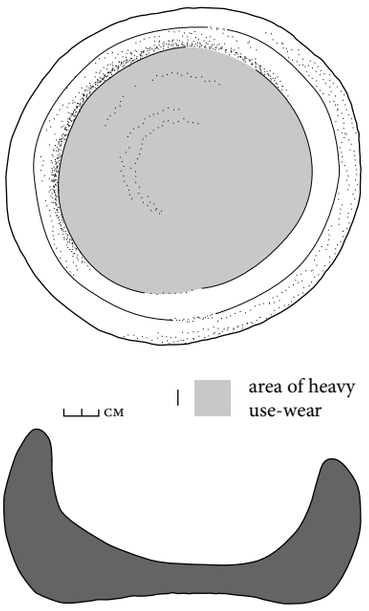

Figure 6a. **SM7**.

Figure 6b. **SM7**.

SM7 WS 2126; context 2038
Mortar
Slightly vesicular black basalt FIGS. 6a–b

Complete. H. min. 7.5, max. 9.5. Base: L. 16, W. 15, Th. min. 1.6, max. 4. Across rim: at ext. L. 18.5, W. 17, at int. L. 16, W. 15, W. rim 1–1.4. Dp. int. ca. 7.
Oval in plan. Base: level–concave; smooth surface, slightly rough in the center and very smooth around the edge. Rim: narrow, convex; surface fairly smooth, slightly chipped. Exterior: profile convex; surface even, fairly smooth with pecked tool marks. One side is slightly taller. Interior: concave with a deep, even curve; surface, smooth for approximately the first 1.5 cm, and the remainder is very smooth, polished and darker in color, especially in the floor. There is a clear use-wear line.

Type 003: Footed Bowls

Two examples are vesicular basalt (**SM9** and **SM10**), and another is dark gray, fine-grained, slightly crystalline stone, possibly dolerite (**SM8**). All three are ca. 11 cm high and each preserves one intact foot set on the edge. **SM9** and **SM10** have no defined edge but an even, concave mortar hollow that slopes down from the rim. **SM8** has a well-defined edge that flares outward slightly before leveling into a slightly concave mortar hollow. All three show definite use-wear, with smooth to very smooth, polished interior surfaces. On **SM9** and **SM10** these surfaces extend up to the rim, while **SM8** has a distinct line of heavy use-wear on the bottom half of the edge.

SM8 was found in the peristyle courtyard of the House of the Helmets in mud-brick collapse associated with the Sasanian destruction of the mid-third century A.D. **SM9** and **SM10** come from uninformative contexts, the former from the robber trench of the eastern wall of Room M in the House of the Bull and the latter from a drainage channel, a site with risk of contamination.

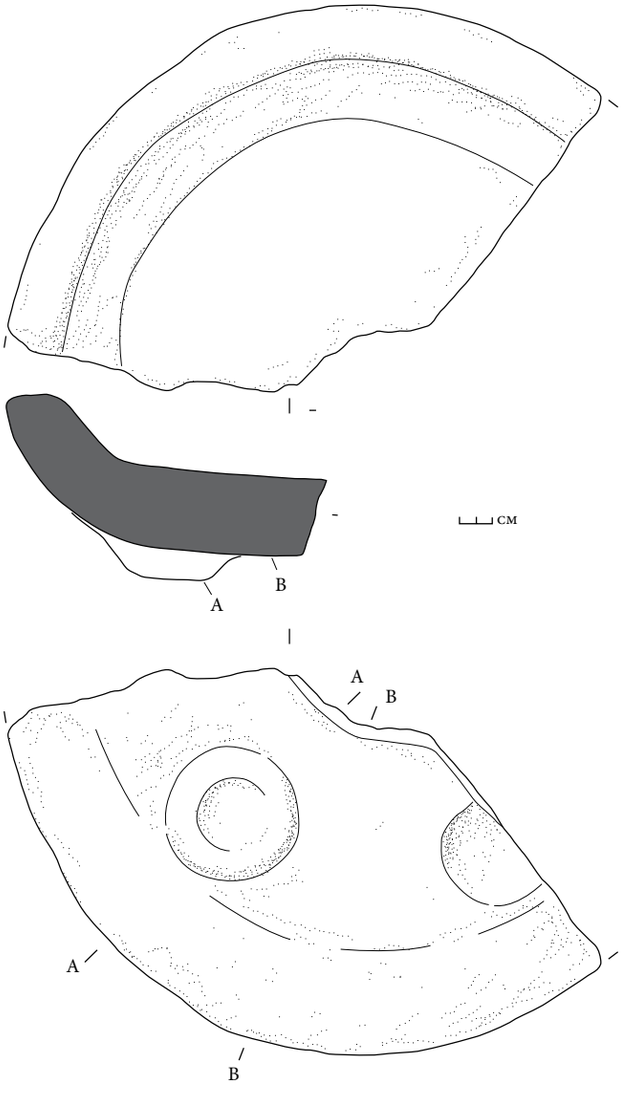

Figure 7a. **SM8**.

Figure 7b. **SM8**.

SM8 WS 2091; context 2025
Mortar
Dolerite? Dark gray, fine-grained FIGS. 7a–b

One-third preserved. H. max. pres. ca. 10.5, L. across rim at ext. ca. 37, at int. 30, W. rim ca. 3–3.6. Body: Th. at rim 4, Th. at foot of rim 4–4.5, Th. at base 4.7, Dp. int. ca. 4.5. Foot: D. 7.5, H. ca. 1.3. Foot scar: L. 6.5, W. 5.

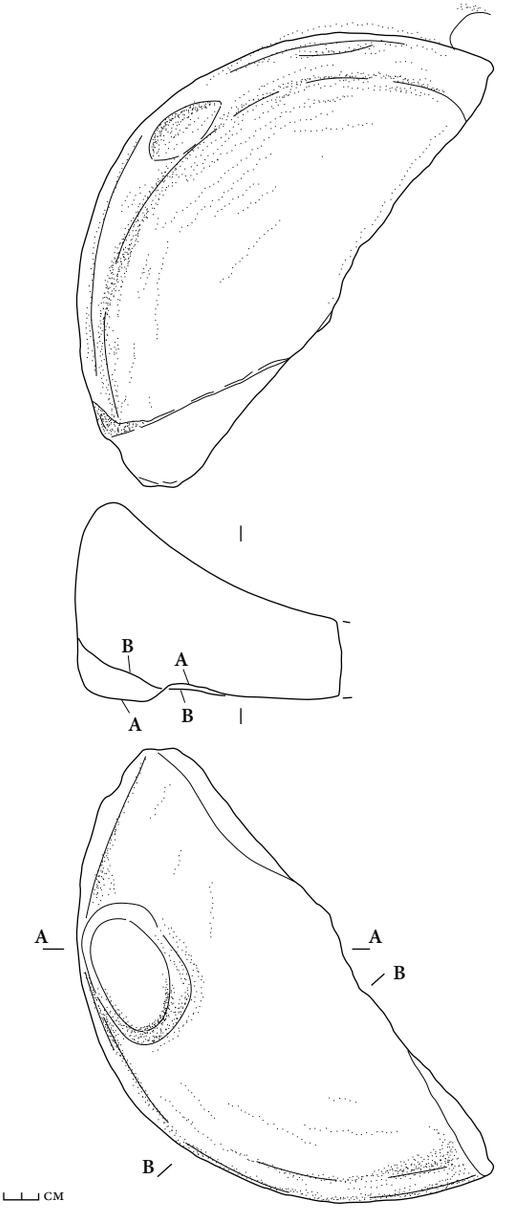

Figure 8a. **SM9**.

Base: slightly convex, almost level. Rim: level, curving over at the edges, surface even and smooth. Exterior: profile convex; surface even, fairly smooth with pecked tool marks. Interior edge: tall and well defined, flaring outward slightly in profile before leveling out into a wide, slightly concave, almost level mortar hollow. The surface on the upper half of the edge is smooth, the bottom half and the floor are very smooth and polished, with a distinct use-wear line showing darker in color on the edge. The surface is slightly rougher with a distinct unevenness along part of the base of the edge. One intact shallow foot set close to the edge; circular in plan, tapering to a smooth, slightly convex base. It is not blended into the profile of the edge. A scar of a second foot is partly preserved. There would probably have been three feet. The whole body is the same thickness throughout, becoming slightly thinner at the base of the edge and at the rim.

Figure 8b. **SM9**.

SM9 WS 2092; context 2354
Mortar
Slightly vesicular black basalt FIGS. 8a–b

Approximately half. H. max. pres. ca. 25, L. across rim at ext. ca. 28, at int. ca. 25, at broken section 30, W. rim 0.8–2.5, Th. body 7.2, Th. at floor 4.2, Dp. int. ca. 7. Foot: L. 8, W. ca. 5. Base: slightly convex, almost level. Rim: pinched, convex, surface fairly rough. Exterior: profile convex; surface fairly even, fairly rough with smoother patches and some tool marks (pecking and irregular grooves). Interior: profile slopes down from the top of the rim, giving a concave mortar hollow with no defined edge; surface very smooth with darker coloring and polish; this use-wear extends right up to the rim. One foot is preserved, set on the edge, making the exterior profile almost straight at this point. It is subrectangular in plan.

SM10 WS 3464; context 13029
Mortar
Vesicular basalt

Approximately one-quarter. H. max. pres. ca. 10.5, W. across rim at ext. 28, at int. 22, W. rim 3.7–4, Th. body max. 5.5, min. 3.1 (toward base). Foot: L. 7.5, W. 4.5, H. ca. 3.
Small part of base intact, exact profile lost. Rim: level, slightly uneven, fairly smooth. Exterior: profile convex;

surface fairly even, fairly rough. Interior: profile concave sloping down fairly steeply from the rim; surface even and smooth to very smooth with the use-wear showing as a darker, polished area that extends up to the rim. One conical foot is preserved, set on the edge, subrectangular in plan. Part of the rim and the inside is burnt.

Type 002a: Nonfooted Spouted Bowls

This type is represented by a large limestone bowl with a very smooth interior surface (**SM11**). It was found in the mid-third-century A.D. destruction layer in the courtyard of the House of the Bull. The exterior surface has a dark line, presumably the result of deposition in burnt debris.

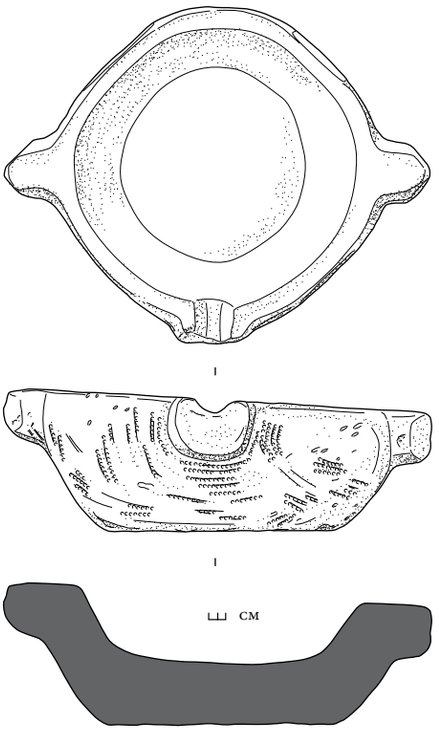

Figure 9. **SM11.**

SM11 WS 2347; context 2278
Mortar
Limestone FIG. 9

Almost complete. Total H. max. ca. 15.2, min. ca. 13.6, base D. ca. 25, Th. min. 6.4, max. 8, W. between ends of handles 46, W. max. pres. of rim ext. to end of spout 36, D. rim ext. 33.5, int. 29.5, W. rim min. 1.5, max. 2, Dp. int. 8. Handles: L. ca. 8, W. min. 5.7, max. 7.5, Th. 6.1. Spout: W. 8.9, total Th. 6, Th. from bottom channel 4.4; spout channel: L. max. pres. 4, W. 3.7, Dp. 1.5.
Circular in plan. Base: flat, slightly pitted and fairly smooth. Rim: flat and smooth. Exterior: profile convex; surface fairly smooth with clear tool marks of score lines. One area has been flattened and smoothed. Interior: edge slightly concave, leveling out into an almost level mortar hollow. The surface is very smooth with heavy use-wear around the bottom of the sides. Two opposing handles protrude from the rim. They are rectangular in plan with pointed ends. A pouring spout protrudes from the rim between the handles, end broken off. A concave channel extends from the interior edge of the rim. The spout and handles are convex on their undersides. Several cracks run through the body.

Type 003a: Footed Spouted Bowl

This type is represented by a mortar of vesicular basalt (**SM12**). Both this and **SM11** have wide, level, shallow interiors and fairly narrow pouring channels. These characteristics are suitable for the grinding of substances into very fine particles, the mixing of liquids, or crushing of substances that will produce a juice. The actual pouring is facilitated on **SM11** by the handles and on **SM12** by the feet, both of which allow these heavy vessels to be raised up while still being stable. **SM12** was found in mud-brick collapse associated with the Sasanian destruction in the peristyle courtyard of the House of the Helmets.

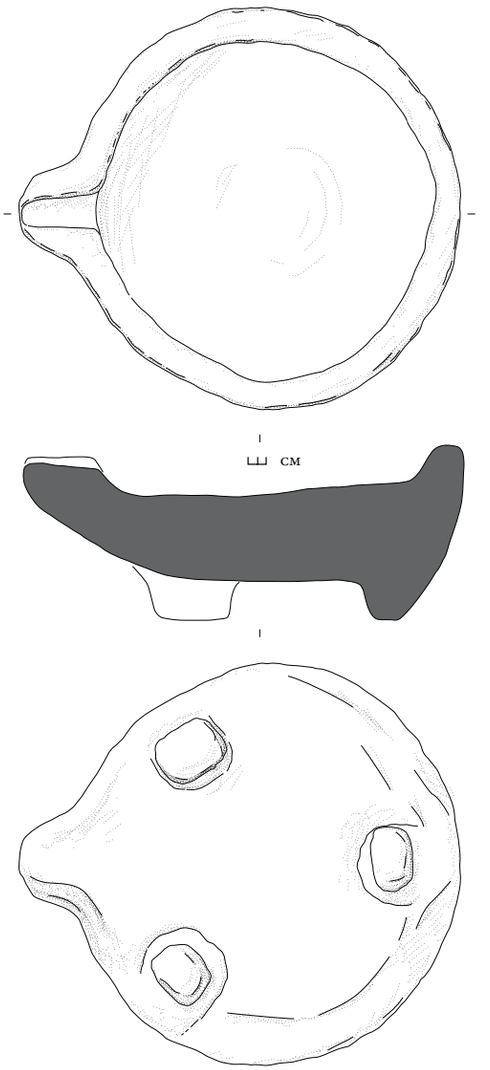

Figure 10a. **SM12.**

Figure 10b. **SM12.**

SM12 WS 2071; context 2012
Mortar
Vesicular dark gray basalt FIGS. 10a–b

Almost complete, fragmentary, nine joining pieces. Total H. at back 18, at front 16, L. rim ext. to end of spout 45.2, across rim: W. ext. 41, L. int. 34.5, W. int. 33.5, W. rim 2.5–3, Dp. int. ca. 4. Spout: W. at rim 11, W. at end 7, Th. ca. 7. Spout channel: L. 9, W. at rim 3.4, W. at end 2.3, Dp. ca. 1. Three feet: each H. ca. 4; ca. min. dimensions of each foot base: L. 6.4, W. 5.6; L. 6, W. 5.6; L. 6.8, W. 4.4.
Subcircular in plan. Exterior: profile convex, leveling out in the center of the base; surface even, fairly rough. Rim level. Interior edge: shallow, slightly concave leveling out into a wide, level mortar hollow that is slightly concave in the center. The interior surface of the hollow and lower part of the edge is smooth, with some very smooth places. It is slightly burnt. A pouring spout, roughly conical in plan, protrudes from the rim. It has a concave channel that extends from the interior edge of the rim. Three feet are set on the edge of the base. All of these are conical, subrectangular, and tapered toward their bases. Two of these are located at the front on either side of the spout. The foot at the rear, opposite the spout, blends with the exterior profile forming a smooth convex line. The back is slightly higher than the front.

Miscellaneous

One fragment of a cylindrical object is only tentatively identified as a mortar (**SM13**). Its context is also insecure, having been found in a level identified as either colluvium or possible collapse from Wall 2227 in the House of the Peopled Plaster. As a mortar, the object best fits the description of Type 001 (see p. 297), but identification as a rotary quern of a slight variant of Type 003 is also possible. While the overall size of the fragment might suggest a catillus, the proportions of the interior surface and the intact end do not support such an identification. It may be an upper stone of a heavy, thick, cylindrical variety, the intact end being the upper face. It would pair with a lower stone of a style that would have a central spindle. As a mortar, the rough area of the interior surface is consistent with evidence for where the bottom of a tapering mortar hollow could have broken through. The intact end may be the base, although the rim is an unusual feature. The preserved exterior profile is vertical and slightly convex, and the surface is fairly rough. The body is thicker at the intact end.

SM13 WS 2256; context 2189
Mortar
Vesicular black basalt

Fragment. H. max. pres. ca. 21, W. across rim at ext. 33, at int. 22.5, W. rim 5–6, H. rim ca. 1.3, W. from rim to edge of interior surface 8.5, interior surface W. max. 8.6, min. 5.8, Th. 16.2 at intact end, Th. 11.8 at broken end.
One end of an object, exact shape indeterminable. The intact end has a curved edge in plan and was probably subcircular when complete. It has a defined, raised, slightly convex rim around the exterior edge; surface slightly uneven, fairly smooth. The surface of this end is uneven and fairly rough. It slopes slightly away from the rim to what may be a perforation or is the bottom of a mortar hollow that has broken through. A small section of the interior surface is preserved. Just below the intact end it is uneven, rough, and chipped; the remainder flares out and is smooth. If this is taken as being a perforation, the fracture in the stone where the surface is rough points to an hourglass profile; however, the center of it would be just below the intact end and the long, flaring part is quite narrow, and there are no striations visible.

QUERNS

There are three types, all vesicular basalt: nonrotary (Type 001: **Q1**); rotary hand- or animal-operated (Type 002: **Q2–8**); rotary hand-operated (Type 003: **Q9–27**). Subtypes within Type 003 draw attention to particular stylistic features that define particular types but also occur in varying combinations; for example Types 003b and 003c both have rims. It should be noted that many of the querns are incomplete and so may not preserve certain stylistic features.

Type 001: Hand-held Loaf-Shaped (Upper Grinding Stone)

Although **Q1** is unstratified, coming from a colluvial wash layer in Trench 15, it has been included in the catalogue because it is the only example of a nonrotary, hand-held quern. It is subrectangular with a flat, fairly smooth grinding face and a convex upper face. Querns of this type vary in size and shape over time, but examples like this are paralleled over a wide area up to at least the Islamic period.

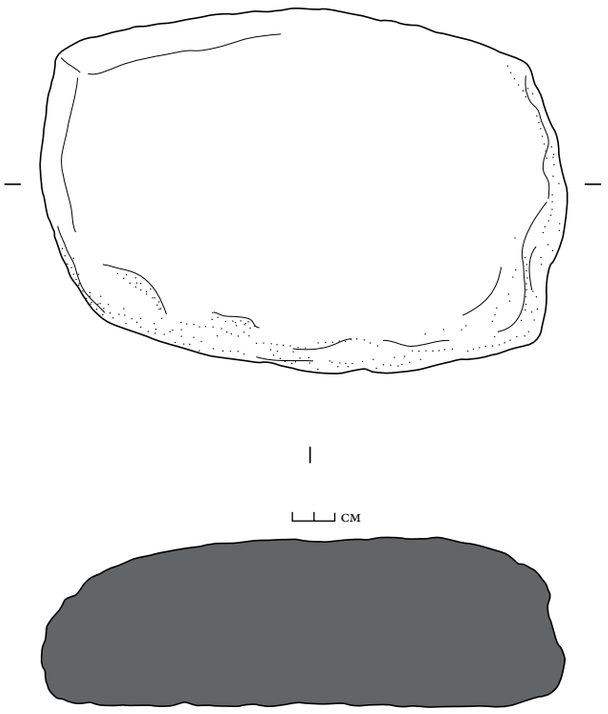

Figure 11. **Q1**.

Q1 WS 590; context 15001
Hand-held quern
Vesicular dark gray basalt FIG. 11

Complete. L. 23.5, W. 16.2 (at center), W. 13 (at ends), Th. 7.7.
Subrectangular in plan, all sides slightly curved. Upper face: convex on longitudinal and latitudinal axis, although one end is slightly chipped and almost straight in profile. The surface is fairly smooth on one side. Grinding face flat, fairly smooth with no heavy use-wear.

Type 002a: Catillus (Upper Grinding Stone)

Type 002 represents the Pompeian mill, so named for the many examples found at Pompeii, and has been separated from Type 003 because it can be operated by hand and by animal. Type 002a (catillus) is the upper grinding stone, and Type 002b (meta) is the lower grinding stone. Excavations beyond Pompeii have revealed that this quern had a very wide distribution throughout the Mediterranean world, even extending into northern Europe. The defining shape for each is that the catillus has an hourglass interior profile that is usually mirrored in varying degrees on the exterior. The meta is a cone with a cylindrical to square base that varies in height. This basic format exists in a wide variety of shapes and sizes, even within Pompeii itself, as Peacock has shown. There are exceptions to this basic shape: for example, Peacock's Type 1, where the catillus is cylindrical on the exterior,[4] and the mills at Volubilis called ring-catillus mills by Williams-Thorpe.[5]

Among the finds published here there are two definite catilli, **Q2** and **Q4**. **Q3** is only a rim fragment and could be from a Type 001 mortar but for reasons given below is catalogued as a Type 002a quern. Unfortunately, **Q2** is unstratified. It is almost half intact, with an incomplete lower half and a preserved total height of ca. 36 cm. **Q4** is from the rubble and mud-brick collapse above the burnt destruction deposit of the mid-third century A.D. in the House of the Bull. It is almost complete, in three joining fragments, with a preserved height of 37.5–39 cm.

On both querns the interior and exterior hourglass profile is not symmetrical. The center of the exterior profile is level with the turning-peg hole of the handle block, while on the interior it is level with the top of the handle block. On both, the interior lower half is longer than the upper half, but neither lower half is intact, and it is hard to say what the original lengths would have been, and whether they were also longer on the exterior profile. For **Q2**, looking at the section, it is likely that on the exterior profile the lower half would have been only slightly longer, and the handle block would therefore have been roughly centered. For **Q4**, as preserved, the lower half extends to the bottom of the handle block. We could restore it to a length where the exterior profile had upper and lower halves of equal length and the handle block is centered. However, unless the surface of the lower half has been worn down excessively, looking at the section, the thickness of the lower half, which is tapering toward the now lost rim, is such that it looks as if the lower half would not have been much longer when complete. In this case the upper half would be longer and the handle block would not be in the center of the exterior but nearer the lower rim. On this catillus the interior hourglass is the classic shape of two inverted cones. On **Q2** the lower half flares out but the upper half is concave, thus forming a bowl, which would provide a slower feed of grain through the central hole than the typical, flared profile. On both querns the handle block protrudes from the body.

Another stylistic feature of **Q4** is that the center of the exterior profile is defined by a raised rib that runs around the body. Moritz comments on this feature when discussing the Pompeian mill but describes it as a groove, and suggests that it was fitted with an iron band that may have connected the pins that were pushed through the turning peg hollows.[6] The term *groove* is slightly misleading, for while the relief rib on **Q4** is in a shallow groove, this is where the stone has been carved out, and it is the rib, not the groove, that is the distinctive feature. In his article on the mills of Pompeii, Peacock refers to it simply as a band and observes that, at the time of writing, in the western Mediterranean it only occured on mills of Orvieto leucitite.[7] The source of the basalt used at Zeugma awaits further investigation, but, as mentioned above, it is likely to be local. Whether the relief band or rib is first found on mills at Pompeii is beyond the scope of the present discussion, but **Q4** is further evidence that this feature continued into the third century A.D. As to its purpose, I think it is unlikely that an iron band was fitted around the center; instead, the band is simply stylistic.[8]

Both **Q2** and **Q4** have use-wear. On **Q2** the interior surface of the lower half is smooth, especially just below the center and at the lower edge, with banding and thin scratches that slope from right to left from the center toward the rim. The interior right side of the handle block is slightly concave and polished. On **Q4** the interior surface of both halves is fairly smooth, with very smooth areas and banding slanting from right to left. This shows that the quern was inverted and the upper half became the grinding face. The direction of the banding shows that these querns were turned in a counterclockwise direction. **Q4** also has banding across the bottom of one handle with wear on the lower half. This is unusual and suggests the possibility that the quern was not inverted until even the handle was grinding against a surface; but which surface? The meta for this quern is almost certainly **Q6** from the same context; however, the maximum width of its 50-cm base is greater than the preserved 43-cm width of the lower half of **Q4**. The catillus cannot have slipped right over the meta so that the handle ground against the surface on which the meta stood, either the floor or a platform, unless it became rather tilted. The edge of the base of the meta is badly chipped, so it is possible that it was originally wider with more of a lip and that the handle ground against this.

Small notches are cut into the body of both querns. A small rectangular slot (L. 4, W. 2.5, Dp. 3) was cut above the center of the handle block on **Q2**. A second slot would have been cut above the opposite handle. A roughly square hollow is located above each handle on **Q4**. In addition, two shallow rectangular slots were cut below the central rib, more or less on opposite sides. The specific function of the notches is unclear, but they may have secured a framework across the top of the catillus. This theory is discussed further in the general discussion of Type 002, below.

A rim fragment, slightly curved in plan, comes from an object with a large diameter (**Q3**). The body has an even thickness, tapering slightly at the rim. The interior surface is smooth and below the rim is very smooth and polished, with horizontal scratches. The use-wear and thickness of this fragment are similar to the lower half of **Q2**. However, it may also be from a Type 001 mortar. It comes from a burnt collapse associated with the mid-third-century A.D. destruction of Room I in the House of the Helmets.

Q2 WS 2117; unstratified
Catillus
Vesicular dark gray-black basalt

Approximately half. Body: H. max. pres. ca. 36, L. int. upper half 12, L. int. lower half 29.5, upper rim W. min. 5, max. 6.5 (at handle), Th. at central perforation 11, Th. lower half min. 3.5, max. 4, Th. max. pres. at lower rim 3.4, W. across upper rim max. ext. 44.5, max. int. 34.5, W. max. central perforation 16.5, W. max. lower rim 24.5. Handle block: ext. L. 20, W. 20, int. L. 11, W. 11 (W. 12 at point of heavy use-wear on the right side), Dp. int. 10–11, turning-peg holes: left D. ca. 4, right D. ca. 3.5. Projection from body: left side 14, top 9, right side 12, bottom 5, L. from top to upper rim 10.5. Rectangular slot: L. 4, W. 2.5, Dp. 3.
Body: exterior surface even, fairly smooth. Upper rim: level, chipped, with faint tool marks of vertical lines. Lower rim: not intact, badly chipped, uneven, and worn.

Hourglass profile with a longer lower half, although the original length of the lower half is unknown. Interior upper half: concave, giving a bowl shape; surface even, fairly rough. Central perforation sharply defined. The interior hourglass profile differs from the exterior profile; center of interior is level with the top of the handle block, center of exterior is level with the turning-peg holes. Upper half thicker than lower; thickest point at the center, then a sharp decrease in the lower half from approximately the exterior center line. Lower half interior: surface even and smooth with thin scratches and banding lines slanting from right to left from the center toward the lower rim. Some areas are very smooth and polished, especially below the center and at the lower rim. Handle block: roughly square; exterior sides: surface fairly smooth. Front and interior sides: surface smooth. Interior back: rough, slightly uneven. Turning-peg holes: subcircular, interior surfaces smooth, especially on the upper part. Right peg hole and right side of block show heavier use-wear, with the interior side being slightly concave and polished. Rectangular slot: cut into the body just below the rim, above and roughly centered to the handle block; interior surface fairly smooth.

Q3 WS 2160; context 2010
Rim fragment of a catillus?
Vesicular black basalt

Fragment. H. max. pres. 12.4, W. across rim ext. 12, int. 11.4, W. rim 3.1, Th. max. 4.
An oblique rim, sloping into the interior, surface fairly even, fairly rough, with some vertical tool marks. Body: of an even thickness, slightly thinner at the rim. In plan the fragment has a slight curve, so when complete the object would have had a large diameter. Exterior surface: even, rough, with some tool marks, horizontal and sloping lines. Interior surface: even, smooth; very smooth and polished with horizontal scratches at the rim. It is also possible that this item could be a mortar of Type 001, described above (p. 297).

Figure 12b. **Q4**.

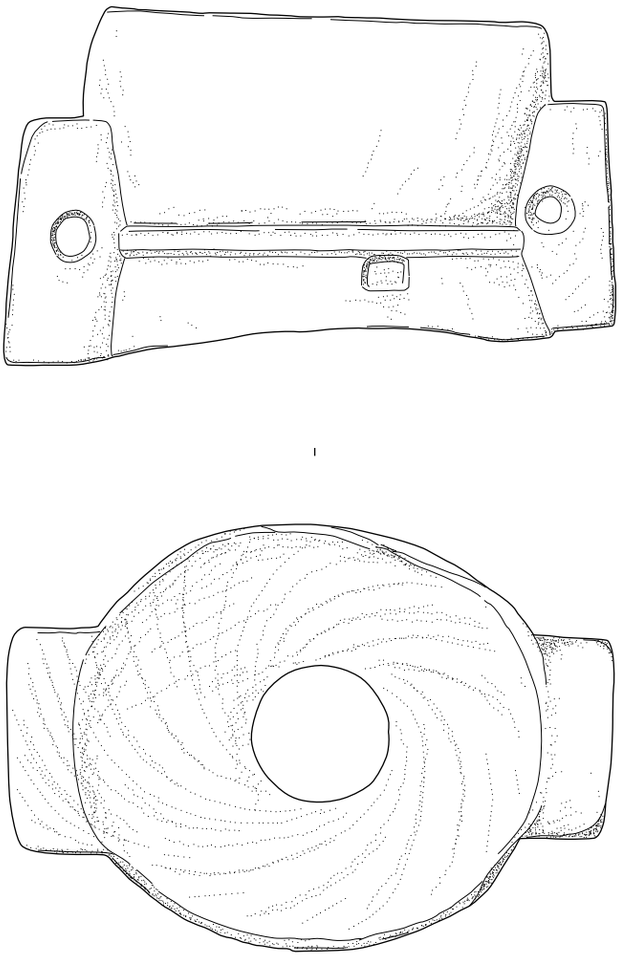

Figure 12a. **Q4**.

Q4 WS 2348; context 2269
Catillus
Vesicular dark gray basalt FIGS. 12a–b

Almost complete; fragmentary, with three joining. Body: H. total min. pres. 37.5, H. max. pres. 39, L. handle to handle 67. Lower half: L. int. 50, W. int. 43. Upper half; L. int. 48 (width not measured), D. central perforation 15.4 (all approximate due to being unable to join and hold fragments cleanly together). The hourglass: L. upper half int. min. 22, max. 25, L. lower half int. min. 20, max. 29 (max. is from the center to the middle of the large handle), L. ext. upper half from the top of the central rib to the rim min. 21.5, max. 23.5, L. ext. lower half from the bottom of the central rib to the rim min. 7, max. 12. W. upper rim min. 2.4, max. 4.3, Th. central perforation min. 14.6, max. 17.6 (taken on broken section), Th. lower rim min. 1.1, max. 2.7, W. ext. central rib min. 2.2, max. 2.9, average 2.4–2.5. Large handle block: ext. L. 27, W. 24, int. L. 15, W. 12.5, Dp. int. 11–11.5, turning-peg holes: left L. 5, W. 4, right D. 4, projection from body: left side 11.5, top 11.5, right side 12, bottom 7.5, L. from top to upper rim 11. Small handle block: ext. L. 25, W.22, int. L. 13.5, W. 11.5, Dp. int. 11–11.5, D. turning-peg holes 4, projection from body: left side 10.5, top 6, right side 10, bottom 6, L. from top to upper rim 7.2. Notches: above large handle L. 3.2, W. 3, Dp. 3, placed 1.8 cm above the handle; above small handle L. 3, W. 2.7, Dp. 2, lies flush with top of handle; two below central rib L. 4.5, W. 3.5, Dp. ca. 1.8 (intact), L. 5.2, W. 2.3, Dp. ca. 1.6 (broken). Position of notches on the body: distance from edge of small handle to notches 15 and 25; from edge of large handle 15 and 31.
Body: upper rim slightly convex, worn, chipped, fairly rough. Lower rim: not intact. Original length of lower half is unknown.

Hourglass shape with different profiles on interior and exterior. Interior hourglass: pronounced; central perforation slightly convex with a fairly rough surface, placed roughly level with the top of the inside of the handles. Exterior hourglass: less pronounced with both halves being slightly convex; center defined by a rib in relief that runs

around the body in a shallow groove and is roughly level with the turning-peg holes. As preserved, the lower half is shorter on the exterior and longer on the interior. It is possible that the two halves were equal on the exterior when complete. The interior shows heavy use-wear; at the large handle it has worn away so the handle is flush with the bottom of the quern and at the small handle only a small part of the lower half remains, a worn, chipped, uneven edge below the handle. However, the broken section of the lower half is tapering in thickness, suggesting that unless this half has been extremely worn down, its original length would probably not have been much longer than it is now. Interior surface: upper and lower halves fairly smooth with very smooth, polished areas and banding slanting from right to left on both. Banding also found on the bottom of the large handle. Handle blocks: rectangular; exterior surface: even, fairly rough with tool marks of horizontal lines running from the body. Interior surface: rough and uneven at the back. Turning-peg holes on large handle: left, circular; right, oval; on small handle: both circular. All are fairly rough with little use-wear. Notches: above each handle, centered, an almost square notch is cut into the body. The one above the small handle lies flush with the top of the handle. On each side, a rectangular notch is cut into the body just below the central rib. They are opposite each other, not placed in the center of the body but closer to a handle on each side.

Type 002b: Meta (Lower Grinding Stone)

Type 002b is the lower grinding stone for Type 002a. The conical shape fits neatly into the flared, hourglass shape of the catillus. **Q5**, **7–8** are from uninformative contexts, but **Q6** was found in the collapsed rubble and mud-brick overlying the mid-third-century A.D. burnt destruction deposit in the central courtyard and Room O of the House of the Bull and is probably the lower grinding stone for the catillus (**Q4**) from the same context. The broken catillus could be evidence for a fall from an upper story, but the use-wear pattern is consistent with turning by an animal harnessed to a crossbar, and this suggests use at ground level. Of the areas covered by the collapse layer, the central courtyard is the most likely place where the mill was used. It is strange that a mill driven by an animal would be placed in the courtyard of the house, but an iron harness fragment (**IR74**) found in the destruction level supports this conclusion.[9] If Roman soldiers were billeted in houses at Zeugma leading up to the Sasanian attack, it is conceivable that this transformation of functionality involved milling in the courtyard of the House of the Bull.

Q6 has extensive smooth and polished areas on the body, as well as striation grooves and scratches 1–2 mm wide. The surface of the body is also dressed, with seven shallow, vertical grooves radiating out from the base of the top. Grooves provide a cutting edge to help the grinding process. They are also found on the flatter hand querns, where they help feed the meal out to the edge. Moritz considered grooves on metae to be rare, but for evidence he only had two stone reliefs depicting grooved metae.[10] **Q6** has a good parallel in an example with nine grooves from Morgantina.[11] Metae from Volubilis have several grooves on the lower half.[12] Dressing of metae could have been more frequent than surviving metae suggest, since grooves were worn down by use and are therefore only preserved on metae that had been recently dressed.

The most distinctive feature of the Zeugma metae is the shape of the nipple top. Examples from Pompeii have rounded tops,[13] and mills at Morgantina are flat-topped.[14] On the basis of the few published examples discussed below, the nipple top may be a regional style found within the eastern Mediterranean and Middle East, but more evidence is needed to confirm this.

Two metae are only represented by broken nipple tops (**Q7** and **Q8**). Both taper slightly and have a shallow, central hollow in the top. **Q7** has a shallow, fairly rough groove running around the base at the point where the body of the cone starts to flare out. The surfaces of both are fairly smooth with some very smooth areas and a few striations, which on **Q8** are very clear and slope from left to right, showing that the catillus for this meta was turned counterclockwise.

Q5 is two joining fragments from the lower edge of a meta. The surface has vertical tool marks, perhaps from manufacture, but more likely from dressing the stone. The surface has some very smooth, polished areas and striation grooves slanting from right to left and left to right. This shows that the catillus for this meta was turned both clockwise and counterclockwise. The base may have been concave but too little is preserved to be certain. A concave base has parallels in examples from Pompeii[15] and at Sumaqa.[16]

Q5 WS 2179; context 2019
Meta
Vesicular basalt

Approximately half of the lower edge; fragmentary, two joining. Dimensions not available.
Base: possibly slightly concave, shallow; surface rough, uneven. Edge: possibly slightly convex, chipped, uneven and rough. No lip: upper face slopes up into the lower part of the conical body and then is broken off. Exterior surface: even and fairly rough with a few patches that are very smooth and polished. Striations of shallow grooves and lines, most sloping from right to left but some from left to right. Visible tool marks of even vertical lines showing up as lighter gray.

Figure 13. **Q6**.

Q6 WS 2349; context 2269
Meta
Vesicular black basalt FIG. 13

Almost complete. Total H. ca. 34.5. Base: L. 52, W. 50, Th. max. 9, average 6. Nipple top: H. 7.5, D. max. 12.7 (at base), min. 8.3. Hollow: L. 4.5, W. 4, Dp. ca. 1.5, H. body from edge to base of the top 25. Grooves (×7): W. min. 0.3, max. 1–1.5, W. segments at the edge: 25, 20, 16.5, 19 (×2), 18 (×2).
Conical meta with a defined nipple top. Base: subcircular in plan, varying in thickness, surface almost level, a little uneven and rough; edge, profile lost, surface badly chipped, uneven and rough. Body profile is a straight slope on the upper part flaring out slightly into the edge. No catchment lip at the base of the body, although the base may have been wider with a lip. The body has seven shallow, vertical grooves radiating out from the base of the top that divide the body into segments. They are wider at the edge. Nipple top: fairly sharply defined, slightly convex, tapering profile. Top level with a shallow central hollow; interior surface and surrounding rim burnt, a little uneven but smooth. Surface of the top and body: even and smooth with darker coloring, some areas with heavy use-wear being very smooth and polished. Some striations are visible, grooves and scratches 1–2 mm wide.

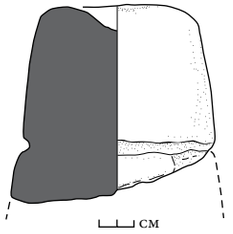

Figure 14. **Q7**.

Q7 WS 634; context 9133
Meta
Vesicular basalt FIG. 14

Fragment preserving nipple top of a conical meta. Total H. pres. 11.1, H. from base of groove to top 8. Broken face: L. 11.4, W. 11.3. Groove: W. 1.1, Dp. 0.5, D. in groove 10, D. above groove 10.6, D. at top 8.5. Hollow: D. 4.5, Dp. 1.5.
Main body: partly intact on one side, surface fairly uneven. Circular in plan, sides tapering slightly into the top, which has a shallow, circular hollow in the center with slightly convex rim, surface a little chipped, even and smooth. Hollow: interior uneven and fairly smooth. A shallow groove runs around the base of the top at the junction where the body flares into the main cone; surface fairly rough. Surface of the top even and smooth, with very smooth patches with faint striations just above the groove. There are three traces of iron, one on the broken face, one on the side just above the groove, and one on the same side but close to the top. The top has broken off cleanly.

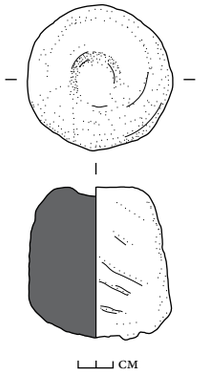

Figure 15a. **Q8**.

Figure 15b. **Q8**.

Q8 WS 755; context 11112
Meta
Vesicular black basalt FIGS. 15a–b

Fragment. H. from break line to top 8.5, H. from center of hollow to base 7.1. Body: D. at base 7.7, D. at top 5.4. Hollow: D. 2.5, Dp. 0.6.
The nipple top of a conical meta. No remains of the main body. Circular in plan; sides tapering very slightly, curving into a level top with a shallow, central, circular hollow that is smooth in one place. The whole surface is fairly smooth with some very smooth patches. There are three diagonal, curving striations on one side, sloping from left to right, showing that the catillus was turned counterclockwise.

Remarks on Quern Type 002

This type of mill is famous from the commercial bakeries of Pompeii and Ostia, where its size made it ideal for large-scale production.[17] Smaller variants of this type are found in domestic contexts, including houses, thermopoliae, and a bakery associated with a private residence; according to Peacock, these had "a different and specialized function" because they were not found in bakeries, and they were turned by people, not animals.[18] It is therefore reasonable to connect these smaller mills to flour production for single households, where by virtue of their size and efficiency they may have been indicators of prosperity and status. For example, at Zeugma, **Q4**, only slightly larger than Peacock's examples (specifically Type 3a), could have functioned as a private mill for a household or for a household connected to a bakery.

The basic operation of these querns is well understood, but the specific purpose of many characteristics remains unknown, including the presence or absence of a hollow in the top of the meta and notches cut in the rim or body of catilli. The use of a spindle, rynd, and hopper are also debateable. Ancient depictions of rotary querns in relief sculpture, wall painting, and graffiti are an invaluable aid for sorting out the functionality of these features.[19]

Many metae have a square or round hollow of varying size in the top. It is generally thought that the hollows had a spindle fixed inside, as shown in ancient depictions.[20] The purpose of a spindle is to keep two quern stones concentric, and while the conical shape of the meta and the body of the catillus might seem to negate this need, I can imagine that a spindle would help in the rotation of the stones. They are heavy and cumbersome and side-to-side movement of the upper stone would have put a strain on the operator, whether human or animal. Such a movement was more likely produced by two people, or by an animal even if harnessed close to the quern. The spindle would have been fixed in order to increase stability, and this is borne out by a general absence of wear in the hollows, and especially by square examples at Morgantina,[21] and at Pompeii, where some are lined with lead.[22]

The hollows in the metae from Zeugma are small and shallow, so a spindle would not be very securely fixed inside. The distinct shape of the nipple top may have been designed to hold an additional support or frame attached to the spindle and fitted over the nipple. **Q7** has a shallow groove around the base of the nipple and traces of iron just above it, near the top. This groove may have held such a frame in place. Alternatively, the groove could have held a rynd. It can also be said that the shape of the nipple itself could help keep the stones concentric, if the upper stone sat so that the perforation was level with the top.

Metae without hollows in the top might imply that spindles were not always fitted. This is quite likely because, as mentioned above, the conical shape of the meta and lower half of the catillus enables a secure rotation. However, if those with small hollows did have an additional fitting to keep the spindle steady, then it is quite likely that such fittings could attach a spindle without the need for a hollow at all. Moritz suggests that a spindle with a bowl-shaped end, like a modern sink plunger, was affixed to metae at Pompeii that had no hollows but had distinct rings just below the top.[23] His theory is quite plausible, but the possibility that rings represent wear from the catillus should not be ignored. It is also possible that such a bowl-shaped end could have been used with the nipple-top metae, with the bowl shaped to fit over the nipple.

On Type 002 querns the only way the spindle could keep the stones tightly concentric is if a crossbar or rynd, either wooden or metal, was fitted across the top. In ancient depictions a crossbar is sometimes shown as part of a wooden framework attached to the handlebars that are pegged in the handle sockets.[24] But a wooden framework need not always be assumed. As mentioned above, **Q4** has two pairs of small notches on opposite sides of the body above the handles and below the central rib. These may have secured a crossbar over the spindle. A wooden or metal bracket attached to the crossbar could have hooked into these notches. But why two pairs? When the stone was inverted, the upper half became the grinding face and a new crossbar fitting had to be cut, since the handle blocks obscured the original ones. Some catilli from Volubilis are not the large hourglass shape but a narrow ring with a convex- to hourglass-shaped interior profile with large regular slots cut into the edge and rim in place of pegged handle blocks.[25] Luquet has reconstructed a spindle and handle arrangement for these querns that is similar to how I imagine the fitting in the notches of **Q4**, although in the Zeugma examples the spindle would have passed through the crossbar, as opposed to Luquet's reconstruction with the crossbar passing through the spindle.[26]

Another fitting that enables tight rotation is a rynd. This is a perforated flat disk or strip that fits over the spindle and helps to regulate the flow of grain. They are used with some small hand querns (see Type 003c), but they are not shown in any of the depictions of Type 002 querns. Whether catilli were fitted with rynds remains debatable.[27] Storck offers a possible reconstruction wherein the upper half of the catillus is stepped in the center and the rynd is slotted underneath and fixed in the top of the meta, thereby keeping the catillus concentric and carrying its weight.[28]

The spindle may also have functioned to suspend the catillus slightly above the meta.[29] This may have been necessary to avoid contact between grinding faces across the entire surface, thereby making the catillus easier to move, and secondly, to allow for adjustments for different grades of meal. Square spindle sockets would have allowed for fairly easy suspension of the catillus, as long as the stone were fitted with either a crossbar or rynd. In order for the crossbar to rotate with the catillus around the spindle, at some point the spindle would have had to become circular in section, either by means of a stepped cut or a gradual

tapering. The point of transition could have served as a suspension platform. A circular spindle cut, at some point, to a thinner diameter could have also worked, as shown in a reconstruction by Storck.[30] Thin discs could be slipped over the spindle, under the crossbar or fitted rynd, in order to make adjustments to the height of the catillus. Alternatively, changes to the height of the catillus could have been made with a spindle perforated by holes for the insertion of adjustable metal or wooden pegs to hold the crossbar in place. This latter scenario is rather unlikely. Meaningful reconstructions and testing of hypotheses could clarify the plausibility of these and other scenarios. In general, catilli without suspension devices seem to offer a more plausible scenario. Spindles would have had to be very strong, and this is not consistent with the size of some of the hollows in the metae. In addition, the requirement for fine incremental adjustments to the height of the catillus would have added unnecessary complexity to a device based on fundamental principles of friction and gravity.

Slots carved on opposite sides of the rim could have had a variety of purposes. Examples are known at Pompeii,[31] where they are above the handle block, and at Morgantina,[32] where they are not above the handle block. Moritz proposes that the crossbar fitted into them for extra stability.[33] White does not think that the slots in the querns from Morgantina, which cut across the entire rim, held a crossbar in place because they are not above the handle blocks.[34] Instead he suggests that they could have secured a lid or a wooden extension to the hopper (the container that held the grain to be milled).[35] The upper half of the Morgantina catilli are very shallow, with those listed in White's catalogue ranging from 5 cm to 13 cm deep, and so a hopper extension would not be surprising. The idea of lids is perfectly acceptable, especially for shallow hoppers, to prevent grain from spilling out during rotation, or to deny unwanted pests access to meal or detritus in the catillus hopper when it was not in operation.

Still, the crossbar should not be ruled out for the Morgantina mill on the basis of the slots' not being above the handle blocks. Apart from White's type 1 saddle quern, all mills in White's typology have slots in the rim. In the type 2 hopper rubber mill, the slots held the handle.[36] Other examples preserve the remains of iron brackets placed over the handle to secure it. A similar method could have been used to secure the position of a crossbar fitted in the slots of the type 3 catillus.

The configuration of the hopper is an additional point of interest for Type 002 querns. The upper half of the catillus forms a built-in hopper, but ancient depictions sometimes show what some believe to be a separate hopper, either slightly off center or centered over the spindle.[37] It is generally thought that a separate hopper would have allowed for a more gradual flow of grain into the catillus, in contrast to grain poured directly into the catillus itself that flows too fast and passes out without being ground very well. In fact, grain dispensed from a hopper probably passed through the mill quicker because of the smaller quantity of grain in the mill. The debate about the specific functionality of hoppers is perhaps best focused on consistency of flow rather than speed. If a catillus was filled with grain, its weight would build up pressure to a natural settling point where the grains would lie at rest. The design of the catillus exacerbates this because the meta blocks the perforation. The size of the latter must allow enough space for the grain to pass without settling. While the rotational movement helps, the flow could still become disrupted. The sculptor Kessidis found that grain accumulated at the top of the meta, forcing the catillus to rise up. This would release the flow but could result in the catillus riding the grain so that it is not ground.

Grain fed into the catillus from a hopper would have been taken up in the mill at an even pace. Moritz suggests that the hopper, when used with Type 002 mills, regulated flow like rynds, and that this is an argument against the use of rynds with these mills.[38] The other obvious advantage of a hopper is the larger carrying capacity, which would have increased efficiency by reducing the need for constant refilling of the catillus. Today traditional grain mills use hoppers, and the flow of the grain is regulated by suspending a chute beneath the hopper. The grain falls down the chute and into the central perforation. The chute, called a shoe, can be raised and lowered, thus speeding up or slowing the flow. It is possible that similar devices were used with the hoppers for the catilli but have just not survived.

As with any new invention, once the rotary principle had been established, the implementation of Type 002 querns led to variations on the basic theme. The following parallels do not amount to a comprehensive list but are, rather, intended as a survey of comparable Type 002 querns. At Morgantina, catilli dated to the third century B.C. have a much shorter upper half, and the handles are level with the bottom of the catillus.[39] At Pompeii, mills from the first century A.D. have profiles with halves of equal length on the interior and exterior.[40] From Byrsa (Carthage), conical metae have a high base and no hollow in the top, while catilli with interior hourglass profiles of equal halves and a more concave exterior profile have handle blocks level with the bottom rim.[41] From Volubilis, Luquet illustrates two types: an hourglass mill with equal halves, central protruding handle blocks and a very narrow interior perforation that is just wider than the spindle; a catillus with a short ring with a convex to slight hourglass interior profile, a vertical exterior, and slots cut into the rim edge for handles.[42] The metae have hollows and are more convex than conical in profile. Williams-Thorpe calls this type a "ring catillus mill" and suggests that the Volubilis mills belong to the first to second century A.D.[43] From Cyrene, two comparable mills (Mills A and B) date from the first to second century A.D.[44] Mill A has a catillus with a concave exterior profile and a convex interior with protruding, central handle blocks. The meta is conical with a concave slope up to a narrow, level top with a hollow; the profile of the top is

not defined enough to be a nipple top, and the profile of the bottom tapers inward slightly. Mill B has a catillus similar to the short rings at Volubilis: a ring with a wider lower diameter, a slightly convex interior and exterior, and pegged handle sockets cut into the body close to the bottom rim. The meta paired with the catillus is shaped almost like a modern baby's pacifier, with a thin circular base and a tall conical body that is concave in profile, slightly wider at the base and almost vertical toward the top, which is narrow with a hollow. Hourglass mills and conical metae are also known from Khirbat al-Karak and Sumaqa (Israel), Mount Nebo (Jordan), Dura-Europos, and Hama (Syria).[45]

Type 003a: Upper Face with Raised Collar around Central Perforation (Upper Grinding Stone)

The raised collar is the defining characteristic of this type. It functioned as a built-in hopper and a device to prevent grain from flying out from the top during the grinding process. Three examples from Trench 18 are almost identical in size and appearance (**Q11–13**). Despite the absence of joins and different findspots within the same trench, they could belong to the same quern. Alternately, **Q11** and **Q12** could have been paired with **Q22**, a lower grinding stone, since all were found in the same deposit of colluvium. **Q13** is from a mid-third-century A.D. layer of destruction debris in Trench 18, in the alley to the north of the House of the Plastered Floor. **Q11** and **Q12** are burnt, but **Q13** is not, and this suggests that the quern may have been broken up and reused as building material in different locations by the time of the Sasanian attack. Another upper grinding stone, **Q19,** was found in the destruction levels inside.

Use-wear on **Q11–13** support a functional connection. The grinding faces are flat with use-wear of smooth, polished areas and striations. **Q11** has an upright turning hollow close to the edge that has worn right through to the grinding face. The collars of **Q12** and **Q13** are shallow raised rings set slightly back from the edge of the perforation. The surface of the upper faces slopes down from the collar to the perforation, forming a built-in hopper 3.4 cm deep on **Q12** and 2.5 cm deep on **Q13**. The perforation is slightly convex on **Q12** with use-wear on the lower half, whereas on **Q13** it is oblique, sloping out to the grinding face, with use-wear over the whole surface. A slightly different profile suggests that these may have belonged to different querns, but profiles are not always consistent throughout. Taken as part of the same quern or separate ones, the perforations would have been quite large when complete (figs. 18a–b); they would be large enough for a spindle and still allow room for grain to feed through.

Q9 was found in a thick layer of mud-brick collapse overlying a mid-third-century A.D. burnt destruction layer in Room F on the upper terrace of Trench 13. The findspot suggests that it had already been discarded and reused as building material by the time of the Sasanian attack. In contrast to **Q12** and **Q13** the upper face slopes down to the perforation directly from the top of the collar so that the latter is not as distinct and the depth of the built-in hopper is only ca. 2 cm. The perforation itself is badly preserved, and the profile is slightly unusual. A concave step was cut into the body at the bottom of the slope of the hopper. It is possible that this step is not part of the perforation but rather the remains of a hollow on the edge of the perforation, thereby making this quern a combination of Types 003a and 003c. Hollows like this are discussed under Type 003c. All of the above have tool marks in the form of horizontal and vertical lines across the upper face and or edge. **Q9** also has score lines at the edge of the grinding face.

Q10 and **Q27** (Type 003g) were found in context 15071, the make-up for surface 15015 in Trench 15. **Q10** is slightly concave, thinner and lighter than the rest, with a convex edge and a grinding face. The upper face is level and slopes up slightly to a tall collar that forms a rim around the edge of the perforation. The profile of the perforation is convex, flaring out quite sharply toward the grinding face. The last section is slightly chipped and stepped back slightly, although the surface is still fairly smooth. While only a small section of the perforation is intact, the curve suggests that the hole was fairly narrow, but wider toward the grinding face. The collar does not provide a hopper in precisely the same way that the other querns of this type do, but its height and the small diameter of the perforation at the top could have made up for this.[46] A fairly short spindle on a lower stone would have provided enough of a pivot, and this could explain the additional wear in the stepped lower part. It is also conceivable that this feature was part of the original design, as it allows room for a spindle and it would have helped the flow of grain. The cutting is not consistent with one required for a rynd.

Q9 WS 4146; context 13007
Upper grinding stone
Vesicular dark gray basalt

Approximately one-quarter. W. edge to collar on upper face 7, W. collar 2–2.5, Th. at edge 8.4, Th. at collar 8, Th. at center 6, W. hollow?/perforation 2.3, Dp. hollow?/perforation 1.9.
Burnt. Edge: oblique, sloping into the upper face, surface fairly even and rough, a little chipped, with faint vertical tool marks. Upper face: level, a little uneven; surface rough, smooth in places, a little chipped. Grinding face: slightly concave, even; surface a little rough at the edge with gray scoring tool lines visible; smooth in some places with a few striation scratches. Raised collar: slightly convex in profile sloping into the perforation on one side, surface fairly smooth.

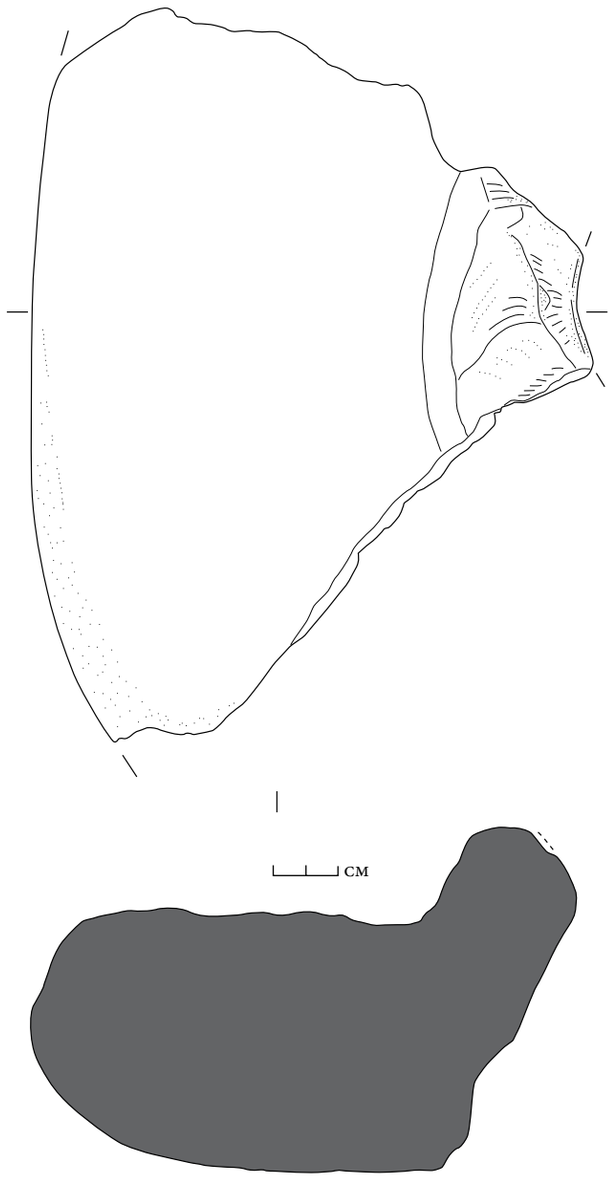

Figure 16. **Q10**.

Q10 CONTEXT 15071
Upper grinding stone
Vesicular dark gray basalt FIG. 16

Approximately one-quarter. W. edge to perforation on grinding face 13, W. edge to collar on upper face 11, W. collar 4.3, H. collar 3, Th. at edge 6.5, Th. body max. 7.4, Th. at collar and perforation 10.8. Perforation: W. at rim 3.5, W. at grinding face 1.6.
Edge: convex, even, surface fairly smooth. Upper face: almost level, sloping up slightly to a high collar; surface even, fairly rough. Grinding face: slightly concave, surface even, smooth with polished areas and a few striations 1–2 mm wide. High, raised collar around edge of the perforation, probably convex. Perforation partially preserved; overall profile convex, flaring out toward the grinding face. The last third just above the grinding face is stepped out, wider, with a surface slightly chipped but fairly smooth. There is a gray concretion on parts of the exterior surface, possibly a result of being used in a floor make-up.

Q11 WS 3451; context 18000
Upper grinding stone
Vesicular black basalt

Fragment. L. max. pres. 10, W. edge to turning hollow on upper face min. 4, W. grinding face min. 4.5, Th. edge 9.2. Turning hollow: W. at upper face 4, W. at center 2.5, W. at grinding face 3.7.
The exterior is burnt. Edge: almost vertical, slightly convex, surface rough. The surfaces of both faces are only intact along the edge. Upper face: level, surface rough. Grinding face: flat; surface even, fairly smooth with smooth polished areas with striations. Edge and upper face have tool marks, light gray grooves. Upright turning hollow: set in the upper face, worn right through into the grinding face, slightly convex profile and a fairly rough surface.

Figure 17. **Q12**.

Q12 WS 3452; context 18000
Upper grinding stone
Vesicular black basalt FIG. 17

Approximately one-quarter preserved in two joining fragments. W. edge to perforation on grinding face 13–14.5, W. edge to collar on upper face min. 7.2, max. 8, W. collar to perforation 4–4.2, W. collar min. 2.5, max. 2.9, H. collar 0.5–1, Th. edge 8.9, Th. at collar 10–10.5, Th. at perforation 7.5. Perforation: W. at upper face 6, W. at center 6.1, W. at grinding face 5.3.

The exterior appears burnt. Edge: vertical to slightly convex. Upper face: almost level, sloping up very slightly from the edge to the collar and down 3.4 cm from the collar to the perforation. Surface of upper face and edge: fairly even, weathered and rough with smoother patches. Tool marks in the form of shallow grooves are preserved across the upper face from the perforation and continue down the edge. Grinding face: flat; surface even, fairly rough with many small patches that are highly polished and smooth. Some striations, deeper and wider, 2 mm, around the perforation; thin scratches, 1 mm wide, at the outer edge. Raised collar: very worn, rough surface; perhaps originally level. Perforation: preserved on one fragment; slightly convex, surface fairly rough on upper half, smooth and polished on lower half, and slightly chipped at the grinding face.

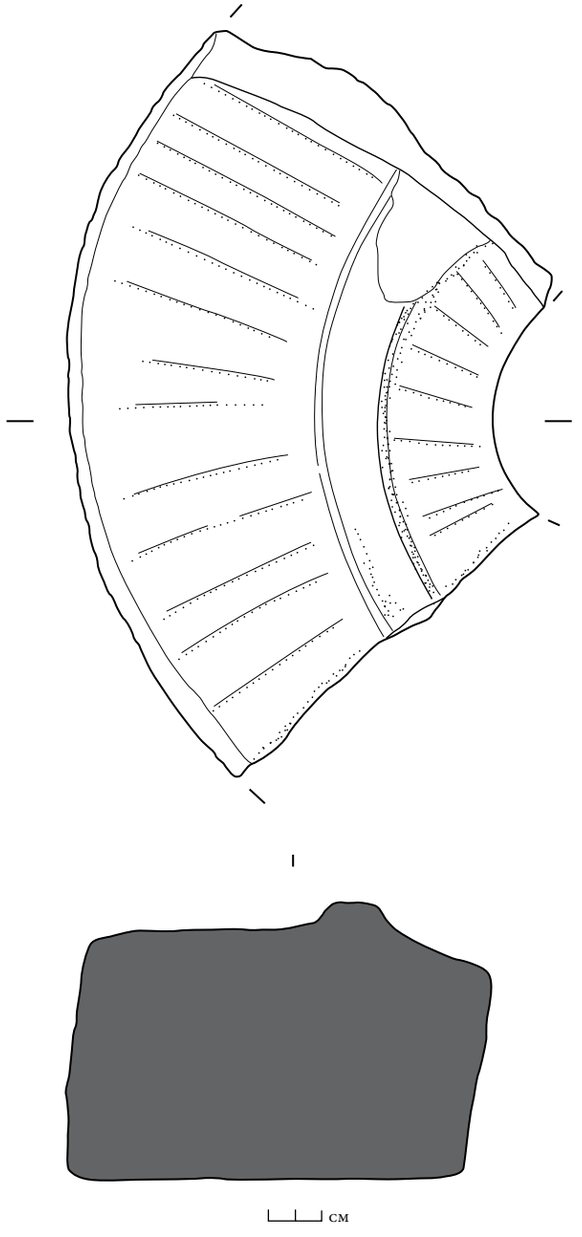

Figure 18a. **Q13**.

Q13 WS 3470; context 18054
Upper grinding stone
Vesicular dark gray basalt FIGS. 18a–b

Approximately one-quarter preserved in three joining fragments. W. edge to perforation on grinding face min. 13.5, max. 14.5, W. edge to collar on upper face 8.5, W. collar to perforation 4.4, W. collar 2.5, Th. edge 9.2, Th. at collar 10.2, Th. at perforation 7.5. Perforation: W. at upper face 7.3, W. at center 8, W. at grinding face 8.9.
Edge: vertical, slightly convex. Upper face: level up to the collar then slopes down to the perforation, the angle giving an approximate depth of 2.5 cm. Surface of upper face and edge even, fairly rough, with clear tool marks of shallow grooves visible as pale gray lines that run across the upper face from the perforation and continue down the edge. Grinding face: flat and smooth; on one fragment it is concreted, others have very smooth patches and some striations. Raised collar: level, surface chipped. Perforation: oblique profile, sloping out to the grinding face, surface very smooth, polished. This quern is almost identical to **Q12**.

Figure 18b. **Q13** *(one of three fragments).*

Type 003b: Upper Face with Raised Rim around Edge (Upper Grinding Stone)

On this type the upper face slopes down to the perforation from the edge of a raised, level rim that runs around the edge. As with the collar on Type 003a, the rim has the effect of creating a built-in hopper, the approximate depths of which are 4.5 cm on **Q14** and 6.5 cm on **Q15**. Both have short, convex perforations and concave grinding faces, although that of **Q15** is a very slight curve. Only a quarter of each is intact so it is hard to determine the size of the perforation. On **Q14** only a very small part of the surface is preserved. It is one of the few examples preserving an intact turning hollow, in this case set in the edge and subsquare,

with a taper. The preserved width of the perforation of **Q15** suggests a small diameter. A short perforation means that the grain will pass through quite quickly, although the rate would be slowed by a narrow diameter. There is room for a thin spindle, which would have restricted flow even further. **Q14** comes from a collapse deposit connected to the mid-third-century A.D. Sasanian attack. **Q15** probably saw secondary use as building material, since it was found in collapsed building debris overlying the early to mid-seventh-century A.D. destruction levels of the Late Imperial Peristyle House, the construction of which is dated to the latter half of the fourth century A.D.[47]

Q14 WS 2372; context 2011
Upper grinding stone
Vesicular basalt

Approximately one-quarter. W. edge to perforation on grinding face 17.3, W. perforation to rim on upper face 10, W. rim min. 6.8, max. 7.7 (at the turning hollow), Th. edge min. 8.3 (at turning hollow), max. 9, Th. at base of rim on body 5.5, Th. at perforation 1.1. Turning hollow: L. 3.5, W. 3, Dp. 3.7.
Edge: oblique, sloping into upper face. Raised, level rim around the outside edge of upper face; latter then slopes down to the perforation, the angle giving an approximate depth of 4.5 cm. Surface of upper face and edge: even, fairly rough. Grinding face: concave, sloping up to the perforation; surface smooth, even, with very smooth, polished areas around the edge. Striations visible, thin scratches near the edge, wider grooves near the perforation, up to 5 mm apart. Perforation: convex in profile, only a small section intact. Turning hollow set in the edge, subsquare, tapering.

Q15 WS 626; context 7060
Upper grinding stone
Vesicular dark gray basalt FIG. 19

One-quarter. W. edge to perforation on grinding face 18.5–19, W. perforation to rim on upper face 8, W. rim 10.3, Th. edge 10.6, Th. base of rim on body 8.5–8.9, Th. at perforation min. 3.1, max. 4.7. Perforation: W. at upper face 2.7, W. at center 2.7, W. at grinding face ca. 3.5.
Edge: slightly convex. Wide, raised, level, slightly convex rim around the outside edge of upper face, latter then slopes down to the perforation, the angle giving an approximate depth of 6.5 cm. Surface: upper face and edge even and rough. Grinding face: slightly concave, sloping up to the perforation; surface smooth with slight polish and three clear striations, scratches, near the edge. Perforation: convex in profile, surface uneven, rough.

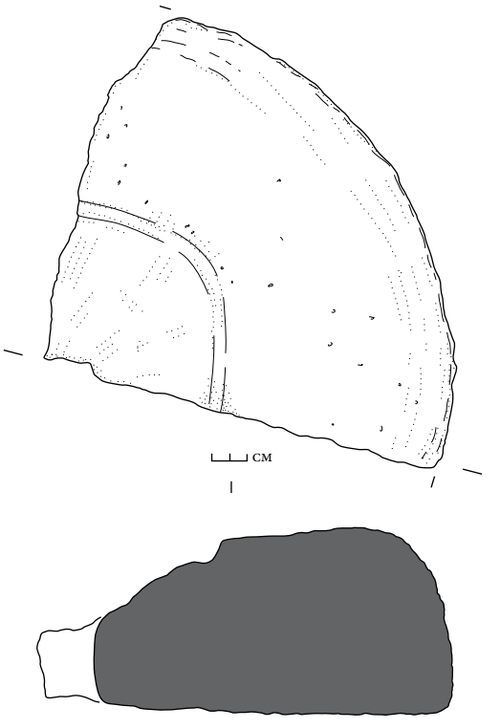

Figure 19. **Q15.**

Type 003c: Upper Face with Raised Rim around Edge and Hollow on Either Side of Central Perforation (Upper Grinding Stone)

This type is one of the most interesting and more complex varieties found at Zeugma. As in Type 003b there is a rim around the edge, and the upper face then slopes down to a short perforation (1.5–2 cm). On either side of the perforation is a shallow hollow set in the upper face.

Q16 and **Q17** are very similar and really define the type. They are almost half intact and are large, with preserved lengths of 41.5 cm (**Q16**) and 43 cm. **Q18** is only a fragment but has similar proportions to the others. They all have an oblique — almost vertical — edge, sloping into the upper face, and a concave grinding face, sloping up to the perforation. **Q16** and **Q17** have intact turning hollows for the handles. In the former it is a subcircular, tapering hollow set in the edge, and in the latter it is a rectangular hollow set in the rim on the upper face. **Q16** and **Q18** preserve only one hollow at the perforation. On the latter the aperture is rectangular leading into the perforation. On **Q16** it has a shallow groove that runs from its edge into the perforation. On **Q17** one hollow is intact, set 3 cm back from the perforation, while the opposite one is visible in the broken section of a joining fragment.

Two examples have traces of iron from fittings that were fixed in the hollows, probably for rynds (**Q16** and **Q17**). Rynds had three principal functions: to keep upper and lower stones concentric by means of a central hole through which passed the spindle; to help control the flow of grain

into the perforation by covering part of it; to raise and lower the upper stone to produce different grades of meal. **Q16** and **Q17** have short and wide perforations (D. ca. 7.5 cm and 10 cm, respectively), and grain would have rushed through these without a rynd or a fat spindle on the lower stone. Grain passing too quickly through the perforation will build up on the surface of the lower stone and start to settle and stick between the grinding surfaces. This problem is worsened when the slope of the grinding face is not steep.

Rynds were affixed to mills in varying ways. Sometimes they were inserted into slots cut into the edge of the perforation, or else simply jammed in the perforation.[48] Runnels has observed a progression whereby the rynd was placed in the upper face in Roman times, halfway down the perforation in the Medieval period, and in the grinding face of the upper quern in the modern era.[49]

The rynds were made of wood or iron and fixed in place with iron rivets. The shape of rynds used on **Q16** and **Q17** is unknown, but they may have had arms that reached into the hollows. On **Q16** these could have been roughly T-shaped so as to fit into the groove and the hollow. On **Q17** they would have been bent to reach into the hollows, which are not level with the perforation. The rynd may have been fixed in lead. The central plates could be either a flat, rectangular strip across the perforation with a gap on either side for the passage of grain, as seen on a Romano-British quern in Wales,[50] or they could have been circular, matching the shape of the perforation, with perhaps spokes or additional holes for the passage of grain. It is also possible that iron fittings were used for the attachment of a separate hopper to the rynd.

A rynd could only enable the upper stone to be raised or lowered if the lower stone was perforated and the spindle passed through it to rest on an adjustable platform. A rynd fixed in the upper stone would have shared the weight of the upper stone with a spindle. An adjustment to the spindle from below would have changed the height of the stone.[51] In this arrangement the rynd was slotted tightly over the top of the spindle, rather than simply balanced on it, otherwise the upper and lower stones would not remain in a concentric position. An alternative design would be a tapered or stepped spindle, with the weight of the upper stone focused on the rynd. It is not certain that the Zeugma querns were operated in this manner, but the possibility that lower grinding stones **Q23** and **Q26**, both perforated Type 003g, may have been paired with **Q16** and **Q17**, respectively, at least allows such a conjecture.

Q16 was found in Room F of the House of the Helmets, in the upper destruction levels of the mid-third-century A.D. Sasanian attack. **Q17** was found in a layer of mud-brick collapse overlying the mid-third-century A.D. destruction levels in Room A of the House of the Tesserae. **Q18** is from an uninformative context in Trench 18.

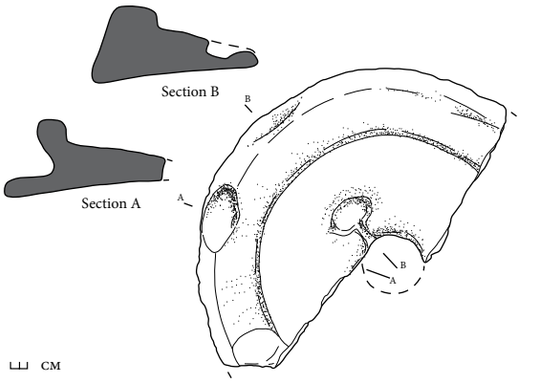

Figure 20a. **Q16**.

Figure 20b. **Q16**.

Q16 WS 2072; context 2012
Upper grinding stone
Vesicular black basalt FIGS. 20a–b

Approximately half. L. max. pres. grinding face 41.5, L. max. pres. upper face 38, W. edge to perforation on grinding face 18.5–19, W. perforation to rim on upper face min. 11, max. 12.5, W. rim to edge of hollow 6, W. rim min. 3 (at the turning hollow), max. 5.3, H. rim 2.3, Th. edge 7.6–8.2, Th. at base of rim 4.9–5.2, Th. at perforation 2. Perforation: W. at upper face 7.4, W. at center 6.2, W. at grinding face 7. Hollow on upper face: L. 5, W. 3, Dp. 1.8. Groove from hollow to perforation: L. 2.5, W. 1.8, Dp. ca. 0.4. Turning hollow: L. 7, W. 6.5, Dp. 4.6.

This may be the upper stone for **Q23**. Edge: oblique, sloping into the upper face; surface even, smooth and rough in places. High, pronounced, narrow rim around the outside edge of upper face; latter slightly convex sloping down to the perforation, the angle giving an approximate depth of 5 cm. Rim: level to convex in profile, slight indentation in the outer edge where the turning hollow is set in the edge. Surface of rim and upper face: even and fairly smooth. Grinding face: concave, sloping up to the perforation; surface even and smooth with a few very smooth patches; along much of the edge the surface is very smooth, highly polished with clear striations from thin scratches, 0.5–1 mm wide. Perforation: convex in profile, surface smooth. Set in the upper face, close to the perforation, is a roughly oval, shallow hollow with a shallow groove running from it into the perforation. The surface is slightly rough, and there are traces of iron in the bottom and side of the hollow from fittings. A subcircular, tapering, concave, fairly rough turning hollow is set into the edge.

Q17 WS 64; context 9073
Upper grinding stone
Vesicular black basalt

Almost half preserved in nine joining and two nonjoining fragments. L. max. pres. grinding face 43, L. max. pres. upper face 41, W. edge to perforation on grinding face 18.5, W. perforation to rim on upper face 10.5, W. rim 7.2, Th. edge 9.4, Th. at perforation 2, W. perforation 9.3. Hollow in upper face: D. 2.5, Dp. 2, distance from perforation 3. Turning hollow: L. 5, W. 2.5, Dp. 3, estimated complete L. 5.5.
This is probably the upper stone for **Q26**. Burnt. Edge: oblique, almost vertical in places, sloping into the upper face; surface even, rough with vertical tool marks of pale gray lines. Upper face slopes down to the perforation from a rim around the outside edge. Rim: level to convex in profile and badly preserved. Surface of whole upper face: rough. Grinding face: concave sloping up to the perforation; surface even and smooth with very smooth, polished patches, especially toward the edge, and striations of thin lines and shallow grooves. Perforation: slightly convex in profile, surface rough but fairly smooth on one fragment. On either side of the perforation is a shallow hollow. One is only preserved in the broken section on one fragment. One is circular, preserved in two joining fragments. Both have reddish staining from iron fittings. The rim has the remains of a rectangular turning hollow set into the top of it, for an upright handle. It is broken across two joining fragments and is not preserved on one.

Q18 WS 4147; context 18014
Upper grinding stone
Vesicular basalt

Fragment. W. edge to perforation on grinding face 18.2, W. perforation to rim on upper face 8, W. rim 9.4, Th. edge 8.9, Th. at base of rim on body 5.2, Th. at perforation 1.5. Probable hollow in upper face: L.5, W. 1.5, Dp. 1.7.
Edge: oblique, sloping into the upper face. Wide, raised, level rim around the outside edge of upper face; latter then slopes down to the perforation, the angle giving an approximate depth of 4.9 cm. Surface of upper face and edge: even and fairly smooth. Grinding face: slightly concave, surface even, smooth with very smooth polished patches, especially along the edge, with thin scratched striations. Perforation mostly lost, but would have been convex in profile. In the upper face is a section through a rectangular hollow that leads into the perforation. It does not look natural, and the sides are fairly smooth. If this were not intentionally cut then this quern would be a Type 003b.

Remarks on Quern Types 003a–c

These types fall within what Curwen and Runnels call the hopper type from the late Roman period.[52] Of those illustrated by Curwen, numbers 19 and 20 resemble Type 003a, with a collar around the perforation and an upper face that slopes from the collar to the perforation edge.[53] Examples from sites in the southern Argolid are like Zeugma Types 003b and 003c, with a rim around the outer edge and square or rectangular cuttings in the upper face (cf. **Q18**), possibly for rynds or handles.[54] Upper grinding stones of this sort have also been found at Tel 'Ira.[55] These are flat and thin with a collar set very close to the edge of the perforation and a narrow, flat to slightly sloping surface area leading to the perforation. A complete example (reg. no. 4386/50) is paired with a lower stone that has a central boss, like our Type 003f, and a handle socket that pierces a semicircular protuberance. A similar handle socket is seen on a quern without a collar from Sumaqa.[56]

Three examples from dated contexts at Zeugma (**Q9**, **Q13**, **Q17**) show that this type was already in use in the mid-third century A.D. The early to mid-seventh-century A.D. destruction context for **Q15** suggests that the hopper-style quern remained in use for some time. The date for the introduction of the type remains unknown, but an example from a house at Ephesos dated to Augustus or slightly later suggests that the type may have been common from at least the early Roman period.[57]

Type 003d: Upper Face Plain with Vertical Handle Hollow? (Upper Grinding Stone)

This is the simplest kind of all Type 003 querns at Zeugma. The edge is vertical to slightly convex, the grinding face is concave, with an upper face that slopes down to the slightly convex perforation. Although a hopper was not incorporated in the design, the depth and width of the perforation would have allowed space for a spindle and the pouring of grain. **Q19** was found in destruction layers dated to the mid-third century A.D. in Rooms H and I in the House of the Plastered Floor.

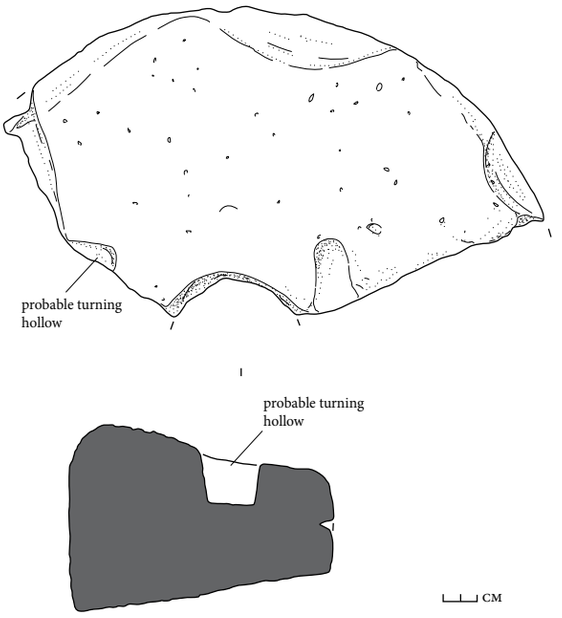

Figure 21. **Q19**.

Q19 WS 3465; context 18088
Upper grinding stone
Vesicular black basalt FIG. 21

Approximately one-quarter preserved. W. edge to perforation on grinding face and upper face 14.5–15, Th. edge 9.5–10, Th. at perforation min. 4.1, max. 5.5. Perforation: W. at upper face ca. 7, W. at center ca. 6.5, W. at grinding face 8, turning hollow: W. at upper face 3.3, W. at base 2.7, Dp. 3.3. Edge: vertical to slightly convex, curving into the upper face; surface uneven, rough with some tool marks of gray vertical grooves. Upper face slopes down to the perforation; surface uneven, rough with several large holes. When complete the upper face would have been concave. Grinding face: concave sloping up to the perforation, surface even, fairly rough with some smooth, polished areas and a few thin scratches toward the edge. Perforation: slightly convex in profile, surface uneven, rough. Due to the slope of the upper face the perforation is longer on one side. There is a section through a probable turning hollow on one broken face, set closer to the perforation than the edge. The cut is subsquare with an uneven, rough surface. The upper face is burnt along the edge.

Type 003e: Upper Face with Central Hollow (Lower Grinding Stone)

The unstratified context (colluvium) for the single complete example that represents this type at Zeugma is unfortunate. The upper grinding face is convex, almost conical and has a central hollow that would have held an iron spindle probably fixed in lead or wood. Curwen calls this an early type dating from pre-Roman to early Roman times.[58] The type is also known among pre-Roman Iberic querns.[59]

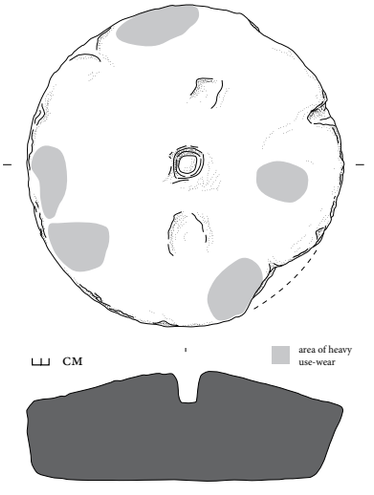

Figure 22a. **Q20**.

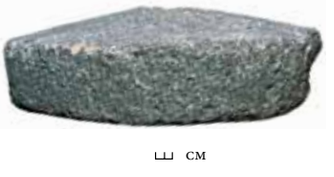

Figure 22b. **Q20**.

Q20 WS 2352; context 2000
Lower grinding stone
Vesicular dark gray basalt FIGS. 22a–b

Almost complete. Grinding face: L. 36, W. 35.2. Base: L. 33, W. 32, W. edge to central hollow 16.5–17, Th. edge 7.2–9, Th. at center ca. 12. Central hollow: L. 3.4, W. 3, Dp. 3.2.
Subcircular in plan. Edge: vertical to oblique, sloping into the base, surface even, smooth; one large chipped area. Base: level, even, fairly smooth. Grinding face: convex, almost conical, sloping up to a small, central hollow, surface even, fairly smooth with very smooth patches and some striations. Central hollow: roughly circular in plan, straight-sided, surface fairly rough.

Type 003f: Upper Face with Central Boss (Lower Grinding Stone)

This type is defined by a central boss in the middle of the grinding face, usually domed or slightly conical in shape, that would dovetail into the perforation of the upper grinding stone to provide a pivot to keep the stones concentric. The design concept resembles the Type 002b meta. In the examples from Zeugma, the boss is broken away, although on **Q21** a small area on one side is partly intact and has a fairly smooth surface, which suggests the quern was still used even after the boss had been lost. Both examples preserve tool marks: **Q22** has vertical grooves on its edge; **Q21** has pecking and random straight score lines on the base. The grinding face of **Q21** preserves signs of dressing in the form of straight and slightly curving, thin, shallow grooves grouped in blocks at different angles that divide the surface into irregular segments. There are even a few across the scar of the boss, and this further suggests that the quern was used after the boss had broken away.

Q21 and **Q25** (Type 003g) were found built into a drain in Trench 7, and they suggest the presence of two rotary querns in use at an earlier phase in this area. **Q22** may be the lower stone for **Q11–13** (see pp. 312–313). The dimensions for each support this pairing. The width from the edge to the boss on **Q22** is 15–16 cm and the boss at its base is L. 10.6, W. 10.3. On both **Q12** and **Q13** the width from the edge to the perforation on the grinding face is 13/13.5–14.5 cm. The profile of the perforation on both shows that it is wider at the grinding face (estimated D. 10.8), such that it could fit over the boss. Both have flat grinding faces, and this is consistent with the flat face of **Q22**.

I have found only three published parallels for Type 003f.[60] From Gezer (Israel), Macalister describes grinding stones where "a conical tenon in the middle of the face of the lower stone fits into a similar-shaped mortice in the upper."[61] The majority are small (9–14 cm wide) and were

probably not used for grinding grain. An almost complete quern and two central boss fragments, roughly conical and level on top, are known from Tel 'Ira (Israel).[62] From Mount Nebo (Jordan), a lower grinding stone is 35 cm in diameter and 7.5 cm thick, with a central knob 7 cm high and 5 cm in diameter near the top.[63] Without more published examples it is hard to draw any conclusions regarding the overall geographical and temporal spread of this type. Its apparent absence in the western Mediterranean and northern Europe suggests an evolution in the eastern Mediterranean and Near East. Chronologically, apart from the Hellenistic example from Gezer, it seems to be more common from the Byzantine period onwards, although the Zeugma examples demonstrate use in Roman imperial times.

Q21 WS 877; context 7211
Lower grinding stone
Vesicular dark gray-black basalt FIGS 23a–b

Almost complete. Grinding face and base L. 42, W. 41, W. edge to central boss 15–15.5, Th. edge 9.7. Central boss: L. 11.7, W. 10.7, H. max. pres. ca. 1.2.
Slightly oval in plan. Edge: vertical, slightly convex in places, surface even, fairly rough. Base: flat, fairly even, rough with some tool marks, pecking and random straight score lines. Grinding face: almost flat, slopes very slightly up to the edge of central boss; surface even, fairly smooth with many areas that are very smooth and polished with striation scratches 0.1–2 mm wide; the area around the base of the boss is smooth. There are clear tool marks of straight and slightly curving thin, shallow, light gray grooves. They do not radiate out like spokes from the boss, but are grouped in blocks at different angles, dividing the surface into irregular segments. Central boss: slightly off center, subcircular in plan. It has broken away, leaving a scar, and the highest part of the remaining surface area is smooth.

Q22 WS 3440; context 18000
Lower grinding stone
Vesicular black basalt FIGS. 24a–b

Approximately one-third preserved. W. edge to central boss min. 15, max. 16, Th. edge min. 10.2, max. 11.5, Th. max. of whole ca. 14. Central boss: L. 10.6, W. 10.3, H. max. pres. 2.3.
Edge: vertical to slightly convex, surface even, rough with tool marks of vertical gray grooves. Base: level, slightly uneven, surface roughly finished. Grinding face: flat, even, fairly smooth, several very smooth, polished areas, especially around the edge, with striations. It does not slope up to the central boss, at the base of which it is largely worn and rough but smooth in places with quite deep striations, 1–2 mm wide. Central boss: subcircular in plan, broken off leaving an uneven surface.

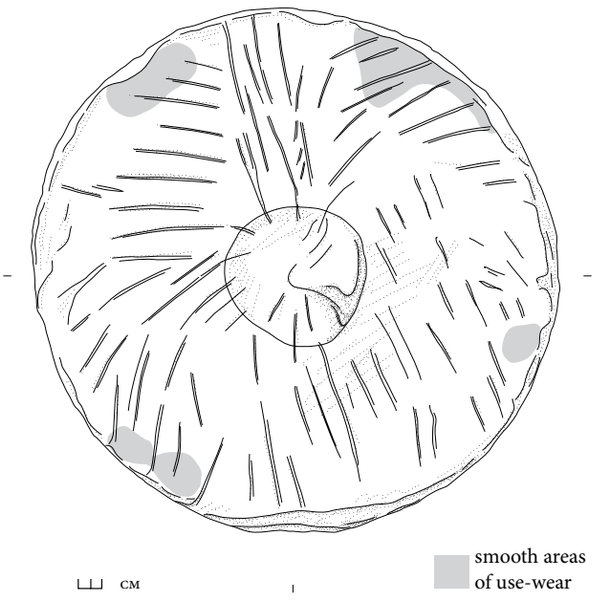

Figure 23a. **Q21.**

Figure 23b. **Q21.**

Type 003g: With Central Perforation (Lower Grinding Stone)

There is some variation within this type, especially in terms of size: **Q26** and **Q27** are large and thick, **Q23** and **Q25** are large and thin, and **Q24** is medium and fairly thick.

Q26 has clear tool marks of shallow gray grooves that radiate out from the perforation to the edge. These are a form of dressing rather than manufacture marks. They would create a good cutting surface to improve the grinding process and would help feed the meal down the slope of the grinding face to the edge. The surface of the perforation is rough, which is expected for a lower grinding stone. As mentioned above, **Q26** is probably the lower grinding stone for **Q17** from the same destruction deposit in the House of the Tesserae. The width of the edge to the perforation on both is 18.5 cm, the approximate diameter of the perfora-

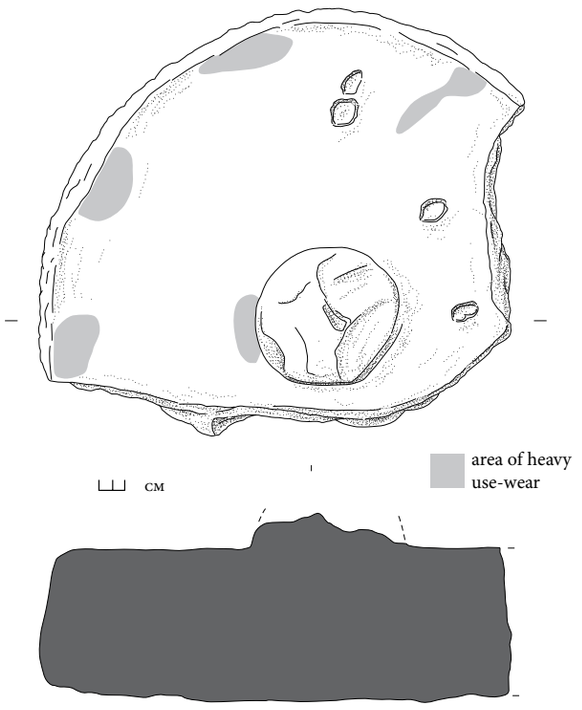

Figure 24a. **Q22**.

Figure 24b. **Q22**.

tion of **Q17** is 9.3 cm while that of **Q26** is 8 × 7.5 cm at the grinding face. The grinding face of **Q17** is slightly concave, which would marry with the convex face of **Q26**. One other point that supports the pairing of these querns is the use-wear on **Q26**. The surface around the perforation is rough, but given that the perforation of **Q17** is wider, it may be that the grain would have fallen onto the surface immediately around the perforation of **Q26**, but would not be ground. All this confirms that these two could have been paired at Zeugma.

The spindle that would have been set in the perforation of **Q26** could have been iron or wooden. In reconstructing it we must look at the profile of the perforation, which must be blocked or else the grain will simply pour straight through. There are two likely reconstructions: the spindle protruded from a stopper that filled the perforation, or the spindle was a straight rod, 4 cm in diameter, that fitted tightly in the center of the perforation, with the gap filled with packing.[64] It is also clear that **Q17** had a rynd fitted with a hole for the spindle. A perforated lower stone, in conjunction with an upper stone fitted with a rynd, could allow for an adjustment of the grade in grinding. Another advantage of a perforation in the lower stone is that the spindle could pass right through and be pushed into the ground to stabilize the quern.

Several factors support the identification of **Q23–25** as lower stones of Type 003g. The roughness of the level face, which would be the upper face if they were upper grinding stones, is not suitable for handling, and so more appropriate for the base of a lower stone, where friction was necessary to keep the quern steady. The slope of the grinding face on **Q23** and **Q25** is the wrong angle for an upper stone, since it slopes up to the perforation. The nearly level slope of the grinding face on **Q24** could be suitable for an upper stone, but the level face and the roughness of the perforation support identification as a lower stone. The perforation profiles are ideal for a spindle, as they are narrower at the grinding face. The small diameters of **Q24** and **Q25** would have needed very little packing, while that of **Q23**, even if larger, may have had a fat spindle in addition to packing. The absence of obvious use-wear of the type created from the passage of grain and friction against the spindle is another factor that supports the identity of these three examples as lower grinding stones of Type 003g. It could be argued that the flaring profile of the perforations indicates use as an upper stone because it would provide the same effect as a built-in hopper, but as demonstrated above, other considerations prevail. In addition, the profile is more likely to be simply the result of the method for boring the hole.

Q27 is one of two querns from context 15071, the make-up for surface 15015. The other is **Q10**, an upper grinding stone. It is conceivable that these may be fragments from a pair. **Q23** comes from a destruction level over the western corridor of the peristyle courtyard in the House of the Helmets. It is possible that this may be the lower stone for **Q16**, of Type 003c, which is from an upper destruction level in Room F. Both contexts are associated with the mid-third-century A.D. Sasanian attack. **Q25** comes from a masonry drain in Trench 7 and was presumably reused as building material.

Q23 WS 2112; context 2129
Lower grinding stone
Slightly vesicular black basalt

Approximately half preserved in two joining fragments. L. max. pres. grinding face 44.5, L. max. pres. opposite face 46.5, W. edge to perforation on grinding face 23.5, on opposite face 20.5, Th. edge min. 6.5, max. 7.5, Th. max. on body 8.3 (at perforation). Perforation: W. max. pres. at grinding face ca. 8, W. at opposite face 13.
Edge: convex to vertical, surface uneven, chipped and smooth. Grinding face: almost flat, very slightly concave

sloping up to the perforation; surface even, smooth, with 80 percent very smooth and polished. Some striations are visible, of 2 mm width at the edge of the perforation and 0.5–1 mm width at the edge. There are traces of tool marks; vertical lines from the perforation to the edge. Opposite face: level, slightly convex, roughly worked, surface uneven, fairly rough, with smooth patches. Perforation: convex in profile, surface uneven, worn and fairly rough but smoother in places. On one fragment the perforation has broken off at the grinding face and is very worn at the opposite face so the exact profile is lost, but it appears to be flaring out toward the opposite face, leaving a smaller hole at the grinding face.

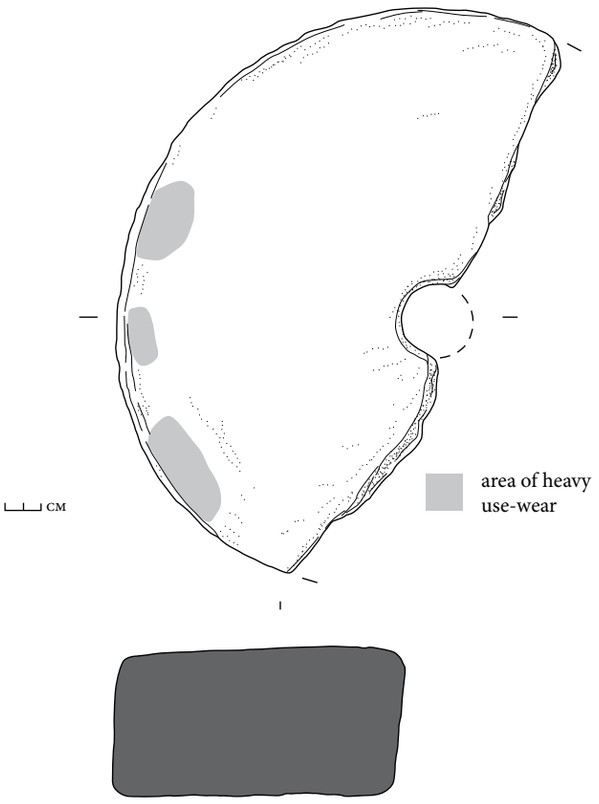

Figure 25. **Q24**.

Q24 WS 2346; context 2181
Lower grinding stone
Vesicular dark gray basalt with white fillings FIG. 25

Approximately half preserved in two joining fragments. L. max. pres. grinding face 32, L. max. pres. opposite face 31, W. edge to perforation at both faces 14.5, Th. edge min. 6.5, max. 7.8, Th. at perforation min. 7, max. 7.4. Perforation: W. at grinding face 5, W. at center 4, W. at opposite face 5.1.

Edge: vertical, slightly oblique sloping into the grinding face, surface fairly even, fairly rough. Grinding face: level, very slightly convex in places; surface even, fairly smooth, with very smooth patches around the edge with slight polish, and a few, thin striations. Opposite face: slightly concave, level in places; surface uneven and rough but smooth in places. There are some burnt patches. Perforation: vertical to slightly convex in profile, surface uneven and rough. Type 003g is the best fit, although the attribution is not entirely secure.

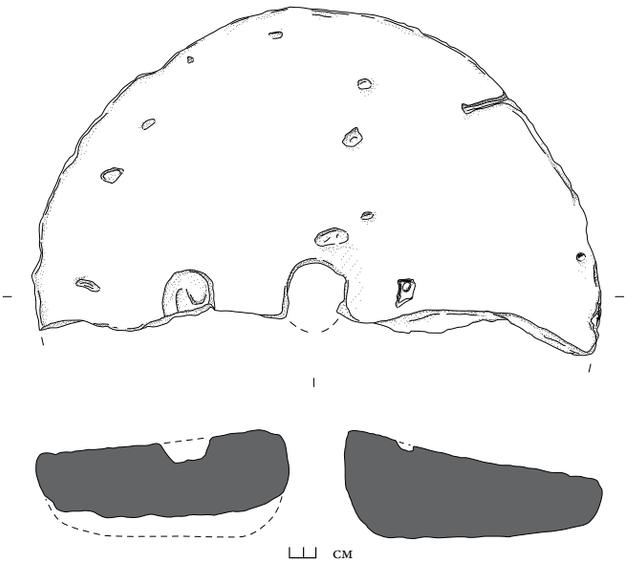

Figure 26. **Q25**.

Q25 WS 892; context 7211
Lower grinding stone
Vesicular dark gray basalt FIG. 26

Half preserved. L. max. pres. across the broken section 48.7, W. edge to perforation on grinding face 21.5–22.5, on opposite face 21.7–23, W. at widest point of perforation 19, Th. edge min. 4.8, max. 6.6, Th. body max. 8.2 (at perforation). Perforation: W. at grinding face 5.9, W. at center 4.8, W. at opposite face 7.

Edge: vertical to slightly convex, surface slightly uneven, fairly rough. Grinding face: slightly conical, sloping up to the perforation; surface: even, fairly smooth with a few smooth patches across the whole surface. There are some striations, 2 mm wide. Opposite face: almost level, roughly worked, with a rough surface that is smooth in places and slightly burnt in the center. It is heavily chipped on one side so that the perforation is now shorter on this side. Perforation: slightly convex in profile, flaring into the opposite face on one side. The surface is rough with some smooth areas. This and the grinding face have several large, natural holes in the surface.

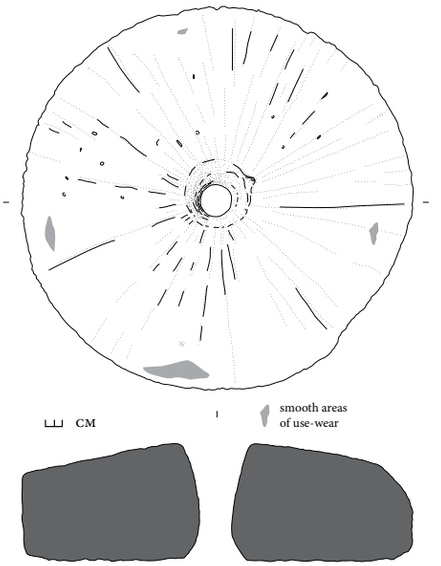

Figure 27a. **Q26**.

Figure 27b. **Q26**.

Q26 WS 63; context 9073
Lower grinding stone
Vesicular black basalt FIGS. 27a–b

Almost completely preserved in 11 joining and several non-joining fragments (some may be from **Q17**, perhaps the matching upper grinding stone). Grinding face: L. 43.5, W 41.5, D. base 41.5, W. edge to perforation on grinding face 18.5, Th. edge min. 8.5, max. 10.5, Th. at perforation 12.8. Perforation: at grinding face L. 8, W. 7.5, at center D. ca. 4, at base L. 7.5, W. 7.
Burnt. Subcircular in plan. Edge: vertical to slightly oblique, sloping into the base; surface even and rough. Base: almost level, slightly uneven, very rough. Grinding face: slightly convex, sloping up to the perforation; surface: even, fairly smooth with some very smooth, polished areas, and clear striations around the edge. Around the edge of the perforation the surface is rough. There are clear tool marks of shallow, gray grooves radiating out from the perforation across the grinding face and continuing over the edge. Perforation: convex to hourglass in profile, surface rough, slightly chipped.

Q27 CONTEXT 15071
Lower grinding stone
Vesicular dark gray basalt

Almost one-quarter. W. edge to perforation scar on opposite face 17, Th. edge 9.7–10.1, Th. at perforation scar 10.8. Edge: slightly convex, surface even, fairly rough. Grinding face: almost level, slopes up to the perforation slightly; surface a little uneven, worn with a few very smooth patches and some concretion. Opposite face: level, uneven and rough. The perforation is almost just a scar, partly intact at the opposite face, possibly hourglass in profile, surface chipped, rough, and concreted. Type 003g is the best fit, although the attribution is not entirely secure.

Remarks on Rotary Quern Types 002–003

Table 1 gives a rough overview of the size and shape of Type 003 querns. CP-edge is the radius as measured from the edge to the perforation or center, and thereby an indicator of overall diameter; Th-edge is the thickness at the edge; Th-CP is the thickness at the perforation.

Type	Cat. no.	CP-edge (radius)	Th-edge	Th-CP	Grinding face
003a	**Q9**	None	8.4	6?	slightly concave
003a	**Q10**	13	6.5	10.8	slightly concave
003a?	**Q11**	none	9.2	-	flat
003a	**Q12**	14.5	8.8	7.5	flat
003a	**Q13**	14.5	9.2	7.5	flat
003b	**Q14**	17.3	9	1.1	concave
003b	**Q15**	18.5	10.6	4.7	slightly concave
003c	**Q16**	19	8.2	2	concave
003c	**Q17**	18.5	9.4	2	concave
003c	**Q18**	18.2	8.9	1.5	slightly concave
003d	**Q19**	14.5	10	5.5	concave
003e	**Q20**	17 (hollow)	9	-	convex
003f	**Q21**	16 (boss)	9.7	-	almost flat
003f	**Q22**	15.5 (boss)	11.5	-	flat
003g	**Q23**	23.5	7.5	7	almost flat
003g?	**Q24**	14.5	7.8	7.4	level / slightly convex
003g	**Q25**	22.5	4.8	7.7	slightly convex
003g	**Q26**	18.5	10.5	12.8	slightly convex
003g	**Q27**	broken	10.1	-	almost level

Table 1. Summary of rough dimensions and grinding face profile for Type 003 querns. All dimensions in cm.

From the Roman period onward, rotary hand querns evolve in the following ways: The diameter increases, the thickness lessens, and the surfaces become flatter.[65] The general trend toward a flatter, larger quern is also true for the Zeugma querns, most of which belong to Roman and later phases. All are fairly large in diameter, with the majority having a radius of 14.5–19 cm. Among Types 003b and

003c, the thinner examples are also those with the larger radii (over 17 cm). **Q23** and **Q25** are noticeably larger, with radii over 20 cm. These are also the thinnest querns, less than 8 cm thick overall, with almost flat or slightly convex grinding faces. Most of the querns are fairly thick at the edge, ranging from 7.8 to 11.5 cm. Although those of Type 003b and 003c are thin at the center, they still need to be thick at the edges, where the main grinding pressure is exerted, in order to be heavy enough for grinding. Most of the grinding faces of the upper stones are still concave or slightly concave.

In terms of use-wear, the heaviest wear is generally found along the outer edge of the grinding face, where the surface is often smooth and polished. Patches of heavy wear are sometimes found on the main surface area. Striations tend to be wider and deeper grooves, up to 2 mm wide, near the perforation and merely thin scratches along the edge, when they appear on the main surface area. This pattern of wear reflects the grinding process. Larger striations occur at the perforation, where the grain was still whole or only slightly broken, and thin scratches occur along the edge, where the meal is crushed under the added weight of the stone.[66]

Scholarship has concentrated on larger Pompeian mills, especially when they are found in bakeries, with information about hand querns often not reported in detail. Although no bakeries such as those at Pompeii or Ostia have been excavated at Zeugma, a city of such size and importance will certainly have had commercial milling establishments. The Zeugma corpus shows that grain was also being ground at home, on both small hand-operated rotary querns and possibly on the larger Pompeian-style mills. Williams-Thorpe notes that in the eastern Mediterranean, Pompeian mills are usually larger than those in the west, with metae that are 50 cm or more in width.[67] Our single intact example of this type (**Q6**) supports this. As more examples like these from Zeugma are published, the observation that these mills are very rare in Turkey in the Roman period may gradually be dispelled.[68]

STONE VESSELS

These vessels resemble mortars. The smooth interiors suggest that they may have been used for grinding, but the wear is even across the whole surface, and this is more indicative of manufacture. They are also very well shaped, and this allows for classification as table ware. Only one example (**SV1**) has decoration — simple incised linear decoration on the rim and top of the handles.

SV1 was found in an upper collapse layer associated with the mid-third-century A.D. destruction that covered the courtyard and Room 2O in the House of the Bull. **SV2** comes from a collapse layer overlying the destruction level dated from the sixth to seventh century A.D. in the Late Imperial Peristyle House. **SV3** was found in destruction debris of the mid-third-century A.D. Sasanian attack, lying on a mosaic pavement in Room D of the House of the Fountain. **SV4** is unstratified.

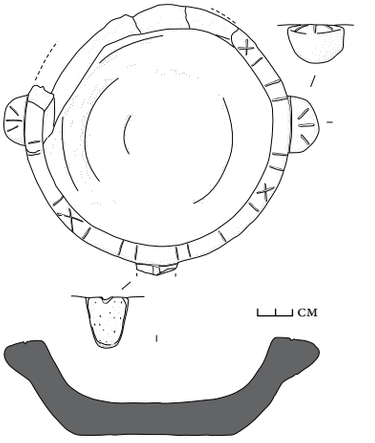

Figure 28. **SV1.**

SV1 WS 2322; context 2269
Bowl
White marble FIG. 28

Four joining fragments preserve almost complete vessel with parts of three handles. H. 5.3, D. max. 14.7, D. int. 12.8,

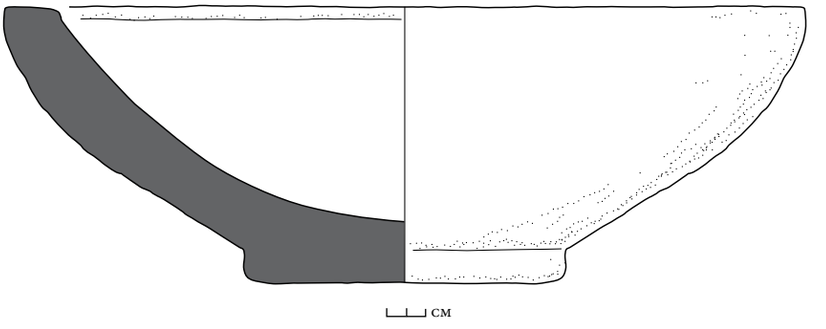

Figure 29. **SV2.**

D. base 8.9, Th. floor 1.6, Th. max. wall (at edge of base) 2, W. (across handles ends) ca. 17.5 W. rim 1.1, Dp. int. 3.5. Handles: (intact) H. 2.4, W. 3.2, Th. 1.5 (broken) H. 2.9, W. 2.2.
Subcircular in plan. Exterior convex; base and rim flat. Concave interior with flat floor. Polished on all sides; burnt on interior along broken edge and on one handle. Parts of three handles preserved, evenly spaced about rim; fourth entirely missing at break on rim. Two opposing handles are small, convex, semicircular lugs with tops level with rim, where a narrow incised line runs along exterior edge. Third handle (missing) only present as a scar, but clearly wider, more conical in shape, and without incised line at rim. Incised linear decoration on rim and top of handles; rim segmented by vertical lines; three pairs marked by an X at center. The lug handles are each decorated with a central vertical line flanked by one diagonal line on each side.

SV2 WS 3501; context 7060
Bowl
Green, black, and white crystalline basalt or diorite? FIG. 29

One-quarter circumference preserved in a single fragment. H. 14.4, H. foot 1.5, D. base ca. 16, D. rim ca. 40, D. int. ca. 34.4, W. rim 2.6, Th. max. wall (at foot) 4.3, Dp. int. ca. 11.
Convex exterior with a solid, ring-foot base and level rim. Exterior surface even, fairly smooth with pecked tool marks. Base: slightly uneven with very smooth patches. Rim: very smooth and polished. Wide concave interior; smooth and polished, except for a shallow groove just below the rim. Groove: indistinct in places; surface pecked and slightly rough.

SV3 WS 16; context 11073
Bowl
Black quartzite?

Five joining fragments preserve one-quarter. W. foot 3, H. foot 0.2–3, W. rim 1.3, wall Th. min. 1.9, max. 3.7, floor Th. min. 2.1, max. (on inside edge of ring base) 2.6, Dp. int. 3. Handle: L. 8.7, W. 2, Th. 2.5, groove W. 0.7, Dp. 0.2.
Exterior: convex, curving up sharply from a wide, shallow, ring-foot to a narrow, flat rim. Surfaces: even and fairly smooth; exterior slightly pecked; rim smooth and polished. Base: almost level, very slightly concave, sloping from the interior edge of the ring-foot; surface a little uneven, pecked and fairly rough. Interior: well-defined, short, almost vertical wall becoming concave and sloping into an almost level floor. The junction where the wall becomes concave is defined by a slight band. Interior surface: even, smooth, and slightly polished. A subrectangular handle with slightly curved ends lies level with the rim. A shallow groove runs along half of the handle on the side next to the rim, thus defining the edge of the rim. The top of the handle, including the groove, is smooth and polished. The remaining surface is even and fairly smooth, with slight pecking marks.

SV4 WS 3078; context 15001
Bowl?
Mottled green and black, crystalline basalt or diorite?

Fragment. W. ext. 21, int. 16.5, W. rim 3.1. Wall: Th. at break 2.8, Th. at rim 3.5.
Rim fragment, complete profile lost. Exterior: convex, becoming vertical just below the rim. Surface of vertical section is a distinct flat, smoother band. Remaining exterior surface even and pecked with some concretion. Rim: level and smooth. Interior: concave, smooth.

LOOM WEIGHTS

Loom weights are mainly used with the warp-weighted loom to provide tension for the warp.[69] Two of the four types are well known (Types 001 and 002), with good general parallels over a wide area and time. Type 003 examples are roughly shaped, flat discs of reused ceramic, plausibly identified as weights, but not with certainty for function with a loom. Surprisingly few loom weights were recovered, given the large area excavated. Half of the total are from three contexts in Trench 2, which covered several residential units. The dearth of loom weights may also reflect a change in the later history of the site from the warp-weighted loom to a preference for the vertical two-beam loom, where weights were not used.[70]

General parallels for Zeugma Types 001–002 include Type 6 pyramidal loom weights from Olynthos,[71] and pyramidal types a, c, f from Knossos.[72] The majority of pyramidal loom weights from Corinth (first century A.D.) have two perforations. Only three are similar to Zeugma Type 002.[73] General parallels for lentoid and pyramidal loom weights are found at Hama, Syria.[74] Examples from the general region of Zeugma suggest that lentoid and pyramidal types at Zeugma could belong as early as the Hellenistic foundation of the city in the early third century B.C. For example, at Asvan Kale, lentoid loom weights from Hellenistic destruction levels are not later than 66 B.C.[75] At Tarsus, pyramidal and lentoid loom weights date from the fourth to second centuries B.C.[76]

Type 001: Lentoid

This is the most common type at Zeugma. They are made of baked clay with small black and white inclusions, and are creamy buff/beige in color. They are roughly circular to oval in plan and lentoid in section, with a single central perforation. **LW2** and **LW8** are scratched, possibly from wear by threads. Others with chipped edges and cracks might also suggest use-wear from weights in contact on the loom. Seven examples are from two contexts.

Leveling layers for a floor in the House of the Peopled Plaster appear to have preserved loom weights that may have belonged to a set. **LW1** and **LW2** are from one of two

leveling layers for floor 2178 in Room D. **LW3–7** were found in what was probably another leveling layer for the same floor. Both leveling layers date to Flavian/Trajanic times, and this suggests the presence of a functioning loom in this house no later than this period. The heaviest in this group (**LW1** and **LW2**) weigh 335 grams (complete) and 331 grams (95 percent), respectively. **LW7** weighs 282 grams (complete), and the others have weights ranging from ca. 210 to ca. 284 grams. **LW8** comes from a make-up level for floor 7021 in Room 7B of Trench 7A, also dated to the Flavian period. **LW9** is unstratified.

LW1 SF 2278; context 2279
Loom weight
Baked clay, creamy buff color, with small black and white inclusions

Complete. L. 9.8, W. 9.4, Th. max. 4.1, min. 3.6. Perforation: one end L. 2.7, W. 2.4, one end D. ca. 2.4, center D. ca. 1.5. 335 grams.
Roughly circular to oval in plan. Edge slightly chipped. Both faces are a little uneven and chipped; exterior surface smooth. Perforation: central, longitudinal, suboval, with an almost vertical profile, sloping a little on one side. Interior surface: smooth, even on the pulled side and a little uneven on the opposite side.

LW2 SF 2279; context 2279
Loom weight
Baked clay, pale, creamy buff, with small black and white inclusions

Almost complete (95 percent). L. 9.3, W. 8.8, Th. 4.3. Perforation: one end L. 2.3, W. 2.1, end at scratched face L. 2.2, W. 2. 331 grams.
Roughly circular in plan. Edge heavily chipped on one side, remainder slightly chipped. One face has a deep scratch on one side of the perforation; exterior surface smooth. Perforation: central, longitudinal, oval, with an oblique and straight profile; interior surface uneven, smooth in places with a few very faint scratch lines. The edges are smooth and a little uneven.

LW3 SF 2363; context 2495
Loom weight
Baked clay, creamy buff, small, white stone inclusions

Two-thirds preserved. D. ca. 8, Th. 3.8, D. perforation 1.5. 183 grams (ca. 284 grams complete).
Roughly circular in plan. Edge and both faces heavily chipped and bashed, and part of the perforation lost. Exterior surface: a little uneven. Perforation: central, longitudinal, circular with an almost vertical, very slightly oblique profile; interior surface even and fairly smooth.

LW4 SF 2364; context 2495
Loom weight
Baked clay, creamy buff with small white stone inclusions

Three-quarters preserved in two joining fragments. D. ca. 8.3, Th. 3.7. Perforation: W. at one end 2.1, W. at chipped face 1.9, W. at center 1.4. 188 grams (ca. 250 grams complete).
Circular in plan. Edge slightly chipped, and one face chipped at the edge of the perforation, which is lost on one side. Both faces slightly flattened; exterior surface fairly even. Perforation: longitudinal, slightly off center; vertical to convex in profile; interior surface a little uneven in places and fairly smooth. Pull by threads may account for convex profiles.

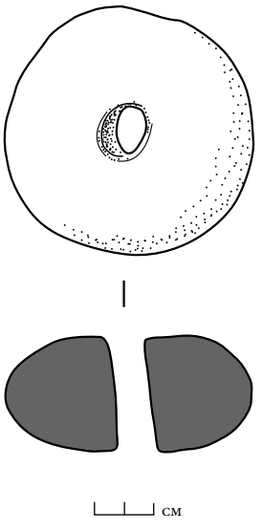

Figure 30. **LW5**.

LW5 SF 2366; context 2495
Loom weight
Baked clay, creamy buff with small black and white inclusions FIG. 30

Complete. L. 8.3, W. 8.1, Th. 3.7–3.9. Perforation: one end L. 2.1, W. 1.9, one end L. 2.1, W. 1.4. 242 grams.
Subcircular in plan. Exterior surface: a little uneven and smooth. Perforation: central, longitudinal, oval with a straight, tapering profile; interior surface a little uneven and smooth.

LW6 SF 2367; context 2495
Loom weight
Baked clay, creamy buff color with small black and white inclusions

Almost completely preserved (90 percent) in four joining fragments. D. ca. 7.9, Th. 3.8. Perforation: L. 1.7, W. 1.3. 190 grams (ca. 210 grams complete).
Roughly circular in plan. Part of the perforation and body are lost, and half of one face is worn and rougher and chipped around the edge of the perforation. Edge: slightly

chipped, exterior surface a little uneven and smooth. Perforation: central, longitudinal, oval, very slightly convex in profile; interior surface a little uneven and smooth.

LW7 SF 2368; context 2495
Loom weight
Baked clay, creamy buff color with small black and white inclusions

Complete. L. 8.8, W. 8.2, Th. min. 3.9, max. 4.2. Perforation: one end L. 2, W. 1.6, one end L. 1.8, W. 1.4. 282 grams.
Roughly circular in plan. Edge slightly chipped, one face cracked. Exterior surface: fairly even and smooth. Perforation: central, longitudinal, oval, with an almost vertical profile, being wider at one end. The interior surface is even on one side, a little uneven on the other side and smooth.

LW8 SF 509; context 7023
Loom weight
Baked clay, creamy, a few tiny, white stone inclusions

Three-quarters preserved. D. ca. 7.9, W. 7, Th. 3.2. Perforation: one end L. 2, W. 1.8, one end L. 1.9, W. 1.7. 157 grams (ca. 209 grams complete).
Roughly circular in plan. Edge heavily chipped and bashed on one side. Both faces are slightly flattened and have several thin parallel scratches running from the edge of the perforation to the edge and randomly across the surface. One face has a deep groove across it. Exterior surface: smooth with a few chips. Perforation: central, longitudinal, oval, with an almost vertical profile, being wider at one end. The interior surface is a little uneven on one side but is otherwise smooth and even and has thin, vertical scratches running up to the edge of the perforation.

LW9 SF 137; context 9000
Loom weight
Baked clay, creamy beige color, slightly gray in places, possibly burnt, with small white and tiny black stone inclusions.

Complete. L. 8.3, W. 8, Th. min. 5, max. 5.3. Perforation: one end L. 2.5, W. 1.8, one end D. 1.5. 298 grams.
Subcircular in plan. One face flatter; the other more convex. Exterior surface: uneven and smooth with a few chips and a crack across one side. Perforation: central, longitudinal, oval, with a straight, tapering profile; interior surface a little uneven and smooth.

Type 002: Pyramidal

These examples are shaped like truncated pyramids, with four tapering sides and square or rectangular bases and tops. They have a single, latitudinal perforation through the narrow end. The holes are slightly oval and much smaller than those on the Type 001 weights. These holes might seem rather small for several warp threads, but they were usually threaded with a separate ring or loop onto which threads were tied, as illustrated on a sixth-century B.C. lekythos.[77] A thin layer of clay sometimes forms a lip around the edge of the hole, where the weight was perforated when the clay was still soft. Smooth surfaces may reflect handling when the threads were tied on. As with Type 001, they are chipped on the edges, perhaps from knocking against each other on the loom. One example has traces of red-orange paint around the hole (**LW11**). **LW10** comes from an undated cut for construction of a drain. **LW11** and **LW16** (Miscellaneous) were found in contexts in Trench 19 dated to the first century A.D. by ceramics. Below this, a floor (context 19002) had been laid in the mid-second century B.C., and this provides a working time frame for use of these objects.

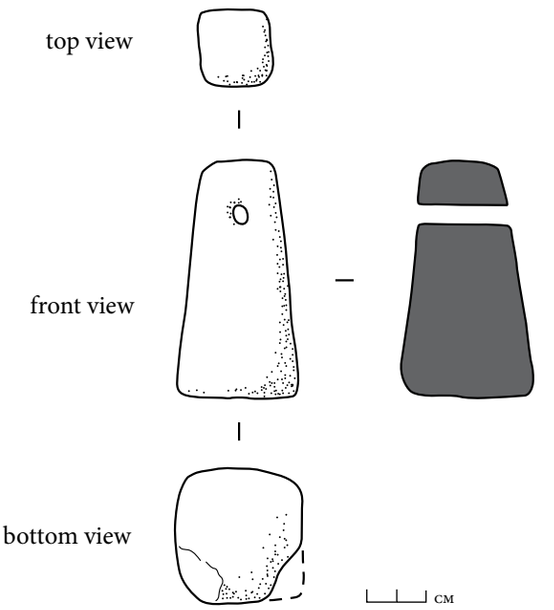

Figure 31. **LW10.**

LW10 SF 3657; context 15134
Loom weight
Ceramic FIG. 31

Almost complete (95 percent). L. 7.8; base: L. 4.4, W. 4; top: L. 2.4, W. 2.4. Perforation: one end L. 0.8, W. 0.7, one end L. 1, W. 0.7, L. from top of hole to top 1.3. 148 grams.
Base: rectangular, almost flat; body tapering to a square, level top; edges and corners convex. Exterior surface: on sides smooth; base and top fairly smooth. Slightly cracked and chipped on sides and edges; one corner broken off.

Narrow end has latitudinal perforation, hole oval, pulled slightly to one side. There is a slight uneven lip around part of the edge of the hole, consisting of a thin layer of clay.

LW11 SF 3417; context 19008
Loom weight
Ceramic

Almost complete (98 percent). L. (at center of top) 6.5, L. long side 6.6, L. short side 5.9. Base: L. 3.5, W. 3.5. Top: L. 1.4, W. 1.1. Perforation: L. 0.6, W. 0.5, L. from top of perforation to top on long side 1.6, on short side 0.9. 106 grams.
Base: subsquare, flat; body tapering to a rectangular, slightly convex, sloping top. Body: longer on one side, slightly bulbous at the bottom of the short side. Exterior surface: smooth, very smooth on long side. Edge and upper part of one side chipped. Narrow end has latitudinal perforation along the line of the slope of the top, hole slightly oval. On the long side the top of the hole has a slight chip, and on the short side the interior of the hole has two shallow grooves at the top. There is a slight broken lip around the edge of the hole on the long side, consisting of a thin layer of clay. Traces of red-orange paint around the edges of the hole.

Type 003: Flat, Reused Ceramic

This object class has been included with the loom weights since they are similar in form to Type 001 — circular with a single central perforation. In fact, they may have been put to a variety of purposes, like pot lids or toys. For example, **LW13** could have functioned as a spindle whorl — its perforation is almost circular and slightly tapered in profile — but its weight (199 grams) seems excessive for spinning even heavy wool or twine.[78]

All examples of this type are isolated finds. None is from a useful context. The lightest is **LW12**, at just over 59 grams when complete; others are in the range of the Type 001 and Type 002 weights.

LW12 SF 2047; context 2006
Loom weight
Reused ceramic

Almost complete (95 percent). L. 6.5, W. 6.4, Th. min. 1.3, max. 1.6. Perforation: one end L. 1.7, W. 1.3, one end L. 1.6, W. 1.5, center D. ca. 0.8. 59 grams.
Roughly circular in plan. Faces: one convex, one concave. Edge: uneven and chipped, exterior surface fairly rough. Perforation: central, longitudinal, oval, convex in profile. The edges of the hole are uneven and chipped and there are a few short scratches. The interior surface is smooth and uneven in one area.

LW13 SF 744; context 7000
Loom weight
Reused ceramic

Complete. L. 8.7, W. 8, Th. 2.6. Perforation: one end L. 1.1, W. 0.9, one end D. 0.9, W. max. groove 2.5, D. small impressions 0.4. 199 grams.
Subcircular in plan. Faces: level, slightly uneven, chipped around the perforation. Edge roughly shaped. One face has two thin grooves across the surface and five small circular impressions. Perforation: central, longitudinal, oval to circular, almost vertical, being slightly wider at one end.

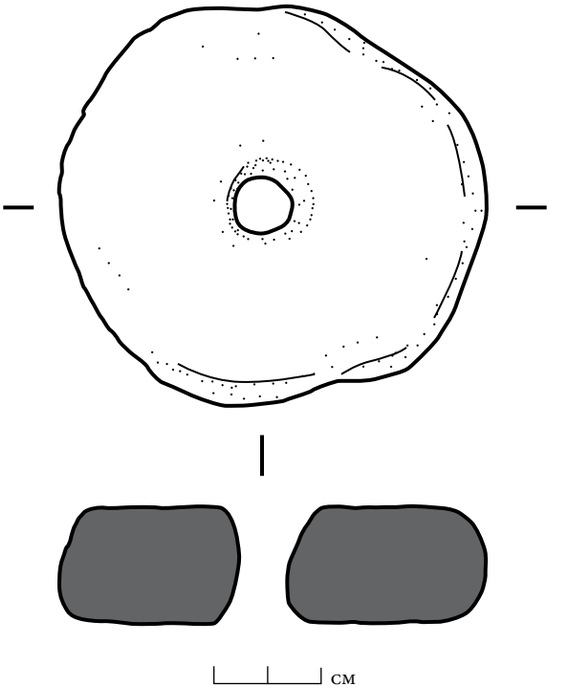

Figure 32. **LW14.**

LW14 SF 600; context 15002
Loom weight
Reused? ceramic FIG. 32

Complete. L. 7.8, W. 7.5, Th. min. 2, max. 2.2. Perforation: D. one end 1.6, one end 1.7, center ca. 1.1. 139 grams.
Subcircular in plan. Faces: level, one chipped. Edge: convex, uneven, and chipped. Perforation: central, longitudinal, circular, convex in profile, and slightly wider at one end; interior surface a little uneven and smooth.

LW15 SF 4150; context 15296
Loom weight
Reused ceramic

Three-quarters. L. 9.2, W. 7, Th. 2.2. Perforation: one end L. 1, W. 0.8, one end L. 1.1, W. not preserved, D. center 0.3. 152 grams (ca. 202 grams complete).

Subcircular in plan. Part of one side has broken off. Both faces level, badly chipped. Edge: roughly shaped, uneven, and chipped. Perforation: central, oval, longitudinal, hourglass in profile with one longer half.

Miscellaneous

LW16 is a barrel shaped, subcircular ceramic object with two small tapering hollows in opposite faces, but without a connection between them. It weighs 210 grams (95 percent complete) and may have been intended for use as a loom weight. It comes from a silt layer dated by ceramics to the first century A.D., and overlies the rubble layer in which **LW11** was found.

LW16 SF 3415; context 19006
Unfinished loom weight?
Ceramic

Almost complete (95 percent). L. 7.4, W. 7.2, Th. 4.2. One hollow: L. 0.9, W. 0.8, Dp. 1.1; one hollow: D. 0.7 Dp. 1.4. 210 grams.
Barrel shaped, subcircular in plan. One face and half of the edge are intact and convex, remainder chipped and uneven. Exterior surface: fairly rough. In the center of the uneven face is a short, uneven, tapering hollow. In the opposite face, slightly off center, is another tapering hollow with a fairly smooth interior.

SPINDLE WHORLS

Whorls provided weight and momentum to the spindle. This is especially important in drop spinning, wherein the spindle falls and hangs steady as it twirls. For this process, the weight of the whorl is the most crucial factor, and the weight of the whorl must be appropriate to the weight of the yarn to be spun. For example, if a whorl is too heavy, the spindle drops too fast before the thread has a chance to twist, and with short fibers the thread could break as the fibers would be pulled past each other too fast to be caught in the twist.[79]

With the exception of one example in bone (**L59**), all spindle whorls in the catalogue are stone. Examples in soft stone were identified as soapstone, but in most cases the type of stone was not identifiable, and for these only the color is noted in the catalogue. Nearly all are circular in plan, but exceptions include **SW4, 18, 30, 31, 38, 57, 64** (subcircular), **SW63,** and **SW65** (almost circular).

In deciding if an object is a whorl as opposed to, for example, a bead, three main factors were considered: diameter, weight, and size of perforation. The general parameters for these are a diameter of at least 2 cm, a lower weight of 10 grams, an upper weight of 150 grams, and a perforation of 0.3–0.8 cm.[80] But some whorls fall outside these limits. For example, Barber mentions whorls used in the Middle East during the Islamic period with diameters of 0.8 cm and a weight of less than 1 gram.[81]

The Zeugma catalogue that follows uses an arbitrary grouping by weight: very light, 6 grams and under; medium, 7–9 grams; heavy, 10 grams or more. Types 002, 003, and 004 are all fairly short, between 0.6 and 1.1 cm. Only in Type 001 is there a change in height in relation to diameter and weight.

For whorls classified as very light, apart from **SW9** (D. 2.7 cm), most are less than 2.5 cm in diameter, and apart from **SW40** (H. 1.1 cm), most are 1 cm or less in height. For whorls of medium weight, more than half are 2.5 cm and larger in diameter, the maximum being 2.8 cm, the rest between 2.3 and 2.5 cm. One example, **SW59** (bone), is 1.7 cm in diameter. Regarding height, only two examples of Type 001 are less than 1 cm — most are between 1 and 1.1 cm high. For the heavy whorls, four are 2.4 cm in diameter and the rest are larger, up to 3 cm. For heights of Type 001, four examples are 1.1 cm, most are greater than 1.2 cm, and the maximum is 1.8 cm. Accordingly, for Type 001 there is a general pattern whereby increased weight is proportional to increased diameter and height.

Weight (g)	Count
4	5
5	6
6	9
7	7
8	9
9	7
10	10
11	4
12	4
13	2
15	2

Table 2. Table showing number of whorls by weight.

The range of weights in the Zeugma whorls suggests that a variety of yarns were being spun; the very light whorls show that some of these yarns were very fine.[82] This is an important indicator for textile production at Zeugma. For every weaver several spinners were required to keep up a good supply of yarn. Finer textiles require more spinning, since these had more threads per centimeter, and this required longer lengths of yarn.

Spinning is also affected by the ratio between the weight and the diameter: of two whorls of the same weight, the one with the smaller diameter will spin faster. So the type of yarn being produced will also dictate the type of whorl chosen, and Barber notes that "the whorl of smaller diameter will be selected to produce a tightly spun thread with many twists per unit of length, and the whorl of larger diameter will be used to make looser thread, with fewer twists."[83]

The size of the perforation in the catalogued examples ranges from 0.35 to 0.8 cm in diameter. There are 17 examples where the diameter of one or both ends is less than 0.5

SW#	Context	Type	Weight	Diameter	Height	Hole
1	1010	001	9	2.5	1.0	0.5
2	US	001	4	2.2	0.8	0.35–0.4
3	2000	001	15	2.8	1.6	0.6
4	2000	001	8	2.7×2.6	0.9	0.5
5	2000	001	9	2.7	1.0	0.5
6	2001	001	9	2.5	1.3	0.7–0.5
7	2001	001	5	2.5	0.7	0.5
8	2001	001	12	2.7	1.3	0.5–0.6
9	2002	001	6	2.7	0.7	0.4–0.6
10	2006	001	6	2.3	0.9	0.5–0.55
11	2006	001	8	2.3	1.2	0.5
12	2012	001	12	2.7	1.3	0.55
13	2012	001	9	2.3	1.3	0.5
14	2013	001	7	2.5	1.2	0.5–0.6×0.55
15	2035	001	4	2.3	0.8	0.4
16	2043	001	10	2.8	1.1	0.6
17	2089	001	11	2.4	1.8	0.5–0.6
18	2129	001	8	2.4×2.3	1.1	0.5
19	2195	001	9	2.35	1.2	0.55–0.6
20	2241	001	4	2.2	1.0	0.35–0.4
21	2269	001	5	2.3	0.8	0.4
22	4008	001	8	2.45	1.1	0.55–0.6
23	US	001	5	2.5	0.8	0.5
24	7000	001	4	2.1	0.8	0.35–0.4
25	7110	001	7	2.6	0.95	0.5
26	7201	001	8	2.4	1.1	0.5
27	7201	001	8	2.8	1.15	0.5
28	9000	001	4	2.2	0.7	0.5
29	9076	001	7	2.4	1.2	0.55–0.6
30	9076	001	10	2.6×2.5	1.2	0.55
31	9112	001	10	2.5	1.2	0.5–0.6
32	9175	001	10	2.7	1.1	0.5–0.55
33	9175	001	10	2.75	1.2	0.5
34	9175	001	6	2.2	1.0	0.5
35	9179	001	6	2.25	1.0	0.5
36	9195	001	10	2.4	1.5	0.55–0.6
37	9197	001	6	2.3	1.0	0.55–0.6
38	9227	001	6	2.45	0.8	0.5–0.55
39	9231	001	12	2.75	1.3	0.5
40	9231	001	6	2.3	1.1	0.5–0.55
41	11066	001	8	2.4	1.3	0.4–0.5
42	11104	001	10	2.4	1.5	0.5–0.55
43	12001	001	11	2.6	1.4	0.55–0.6
44	13007	001	5	2.4	0.8	0.45–0.5
45	15295	001	9	2.8	1.0	0.45–0.55
46	US	001	6	2.5	0.8	0.4
47	US	001	11	3.0	1.3	0.45–0.4
48	18001	001	11	2.75	1.1	0.55–0.6
49	18001	001	13	2.6	1.5	0.55–0.6
50	18054	001	8	2.5	1.1	0.5–0.55
51	18070	001	10	2.7	1.1	0.55
52	18108	001	6	2.3	0.8	0.55
53	18108	001	10	2.4	1.3	0.5–0.55
54	2013	002	9	2.7	0.8	0.8–0.85
55	2178	002	5	2.3	0.7	0.4–0.5
56	US	003	12	2.9	1.0	0.6
57	2023	003	8	2.5×2.4	0.9	0.5×0.45
58	7023	003	7	2.7	0.7	0.35–0.4
59	7036	003	7	1.7	1.1	0.6
60	7060	003	10	3.0	0.7	0.4–0.5
61	7214	003	7	2.7	0.6	0.55–0.6
62	9073	003	13	2.7	1.1	0.6
63	9138	003	15	2.9	1.1	0.6
64	9001	004	5	2.0	0.7	0.6–0.7
65	9076	004	7	2.5	0.6	0.4

Table 3. Spindle whorls, showing weight in grams and maximum diameter. For the perforation (Hole), the top dimension is given first and then the bottom dimension, if different. US = unstratified.

cm, 48 where the diameter is between 0.5 and 0.7 cm, and 1 (**SW54**) measuring 0.8–0.85 cm. The ratio of weight to size of perforation reveals a general trend at Zeugma wherein the lighter whorls have a smaller hole.

Another diagnostic feature for whorls is the position and profile of the perforation. In the Zeugma examples, most are positioned centrally, but the profiles are vertical, oblique, slightly convex, or tapering. To work with a minimum of wobble, the perforation must be central. In her study of prehistoric whorls from Cyprus, Crewe found that the ideal profile is straight or slightly conical, that is, wider at one end. Conical is the perfect perforation shape for spindles that taper slightly. Slightly convex or hourglass-shaped profiles were also acceptable, since the gap in the spindle can be filled, but if the angle between the center and the apertures is more than 20 degrees, the whorl becomes unstable.[84] Thirty-four of our whorls have a slightly tapered perforation, with apertures .005 to .01 cm wider than the center, although two examples are .02 cm wider (**SW6** and **SW9**). The rest are straight. All are central.

Apart from those less than 10 grams in weight, which is more than half the total, all the whorls adhere to the parameters just detailed. Almost all very light examples conform in diameter, and so a classification as whorls seems reasonable. In addition, with the exception of two examples (**SW55** Type 002 and **SW64** Type 004), most of the light whorls meet the criteria for Type 001, which might suggest that a conical shape is better for light whorls.

Catalogue descriptions focus on the following diagnostic features: the shape of the edge (where the lower body meets the base), decoration, and surface wear.

Edge: Thirty-four whorls have a convex edge. Type 001: **SW1, 4, 5, 7–11, 16, 19, 22–24, 26, 28, 32, 36, 39, 40, 42, 45, 46, 50**; Type 001, very thin: **SW2, 15, 20, 27, 44, 52** (fig. 35). Type 002: **SW55**; Type 003: **SW56, 57, 59–61**; Type 004: **SW64**. Thirteen whorls have a beveled edge that flares out-

ward. Type 001: **SW6, 13, 14, 17, 33–35, 37, 41, 49, 53**; Type 003: **SW 58, 63**. The remainder have edges that vary in profile.

Convex, beveled, and vertical sections are found on **SW38**. Beveled and convex sections are found on **SW3, 12, 18, 21, 25, 29–31, 43, 47** (Type 001), **SW57, 62** (Type 002), and **SW54** (Type 003). **SW48, 51** (Type 001) have convex and flattened sections. **SW65** (Type 004) has an edge that tapers toward the top and is divided into three rings. A few whorls have distinct facets on the edge, including **SW30** (fig. 38) and **SW31**. Sometimes the facets have thin horizontal or oblique scratches, perhaps traces of tools used to shape the edge during manufacture, since harder stones may not have sustained traces of thread wear.

Decoration: With the exception of one example with oblique lines in a rope pattern on **SW65**, incised rings are the only form of decoration on the Zeugma whorls (figs. 33–4). These usually appear on the body just below the top and above the edge and are usually single lines, although double sets of lines sometimes appear. A few examples have rings on the edge or on the base. Most lines are lightly incised, but a few are quite deep, and cut into the profile of the body, for example, **SW33** (fig. 40). **SW59** (fig. 47a–b), made of bone, has a deeply incised ring above the edge, another on the top, and two rings on the base. This is the sole example with a raised rim around the perforation.

Some whorls also preserve band rings and surface rings. Neither are incised. Band rings are wider than the incised ring decoration and usually appear as distinct bands of color separated by thinner rings, for example, **SW6** (fig. 33; see also figs. 37, 43, 46). Surface rings are sets of very thin, closely spaced, faint rings, like the faint black rings on **SW33** (fig. 40). Band rings and surface rings may be vestiges of the manufacture process, but they may also reflect the natural qualities of the stone.

Surface wear: The majority of the whorls are polished and smooth; some have worn areas, especially on the base. Perforations have bore lines and are generally smooth and polished. Nearly all the whorls are chipped to some degree, usually around the edges of the perforation and at the edge. While some of this wear is postdepositional, some of it also reflects use in the spinning process: Perforations can be chipped from insertion of the spindle, spindles can fall if thread breaks, and they can be damaged from storage in the same container.

About one-third of the Zeugma whorls come from dated contexts, but there are no obvious indications of change over time. The earliest belong to the Early Imperial times: **SW55** (Type 002) from the House of the Peopled Plaster and **SW58** (Type 003) from Room B in Trench 7A. Most of the dated whorls come from destruction levels in houses destroyed in the mid -third-century A.D. Sasanian attack—the House of the Helmets: **SW12, 13, 15, 18** (Type 001), **SW57** (Type 003); the House of the Bull: **SW21** (Type 001); the House of the Tesserae: **SW29, 30, 37** (Type 001), **SW62** (Type 003), **SW65** (Type 004); the House of the Hoards: **SW31–34**, **SW36**, **SW39**, **SW40** (Type 001), **SW63** (Type 003). Four others of Type 001 were found in destruction levels of the same date: **SW44** from Room F of the upper terrace in Trench 13, **SW51** from Room B, and **SW52** and **SW53** from Room A, in the Mud-brick House.

A few whorls were found in later contexts: **SW35** on a floor covered by destruction deposits dated to the later fourth century A.D. in the House of the Hoards; **SW22** from a deposit in Trench 4 dated to the first half of the sixth century A.D.; **SW26**, **SW27**, **SW59**, **SW61** from deposits dated to the late sixth to early seventh century A.D. in the Late Imperial Peristyle House; **SW1**, possibly Early Islamic from Trench 1.

The groups of whorls in the House of the Tesserae, the House of the Hoards, and the House of the Helmets provide a snapshot of the weaving industry at Zeugma. Each group has a range of weights: 6–13 grams in the House of the Tesserae; 6–15 grams in the House of the Hoards; 4–12 grams in the House of the Helmets. This shows that different types of raw materials were being spun. In addition, whorls from the House of the Helmets provide evidence for spinning in a private household, whereas in Trench 9, weaving may have taken place in a workshop setting.[85] In support of this conclusion is a large iron comb used for flax — the bast being pulled through the comb to separate and clean the fibers for spinning.[86]

Conical and hemispherical spindle whorls have a broad chronological and geographical range. Parallels for Zeugma types from Hellenistic and Roman times are as follows. At Corinth, objects catalogued as buttons are similar to our Type 001 and 003 spindle whorls. Bone and ivory examples from the first century A.D. appear to be more elaborate versions of **SW59**. Numbers 2526–8, 2532–4, 2536 (bone and ivory) and 2593–6 (steatite) are either undecorated or incised with rings, and are similar to the Zeugma whorls in stone. On the basis of size, often elaborate decoration, and the sheer number found, the Corinth finds were catalogued as buttons, with a note that some may be whorls.[87] Zeugma Type 003 has parallels at Tel Michal (Israel), where hemispherical and flat whorls found in Persian and Hellenistic strata are slightly taller. Tel Michal number 11, described as triangular, is a Zeugma Type 001; number 12 is bone, others are diorite, weighing between 6 and 15 grams. Tel Michal whorls from Persian levels have one or two incised grooves near the base, but the Hellenistic whorls are plain. Among flat examples, Tel Michal number 14 is limestone and Roman in date, similar to our **SW64**.[88] Steatite examples from the Hellenistic period to the fourth/fifth century A.D. at Hama (Syria) are semicircular and conical types that correspond to Zeugma Types 001 and 003, with one incised example similar to our **SW54**.[89] Other parallels can be found at Knossos,[90] Shiloh (Israel),[91] Asvan Kale (Turkey),[92] and Tarsus.[93]

Type 001: Conical

This is the most common type, with 53 examples (**SW1–SW53**). The illustrated examples reveal some of the minor differences in shape.

SW1 SF 1027; context 1010
Spindle whorl
Brown stone

Almost complete. D. 2.5, H. 1, D. perforation 0.5; 9 grams.
Edge: convex. Base: almost flat, slopes slightly. Exterior surface: slightly scratched, a small chip on the edge. Perforation: smooth, polished, with faint bore lines. Undecorated.

SW2 SF 2173; unstratified
Spindle whorl
Dark gray soapstone?

Almost complete. D. 2.2, H. 0.8, D. perforation top 0.35, base 0.4; 4 grams.
Edge: very thin, convex, and slightly chipped. Base: slightly convex, smooth, slightly polished; two very faint incised rings around the perforation, inner one only three-quarters complete. Body has two sets of two closely spaced incised rings, one just above the edge and one below the top, with a very slight band ring between. Perforation: smooth, polished with faint bore lines.

SW3 SF 2000; context 2000
Spindle whorl
Brown-black stone

Almost complete. D at edge 2.8, D. base 2.5, H. 1 6, Th. edge 0.4, D. perforation 0.6; 15 grams.
Edge: beveled, flaring out on the lower part, with three incised rings; the upper part is slightly convex, almost straight. Base: slightly convex with a well-defined band ring around the perforation, and the surface here slopes up to the hole. The remaining surface has several incised rings; nine are clearly visible. Body has an incised ring above the edge and below the top and four band rings between. Perforation: smooth, polished, with faint bore lines, the top edge is slightly chipped.

SW4 SF 2070; context 2000
Spindle whorl
Black stone

Almost complete. L. 2.7, W. 2.6, H. 0.9, D. perforation 0.5; 8 grams.
Edge: convex. Base: almost flat, surface dark with a lighter, slight band ring around the edge and some polish around the perforation. Body: smooth, polished, and scratched. Perforation: smooth, polished, with faint bore lines; chipped at edge and top. Undecorated.

SW5 SF 2095; context 2000
Spindle whorl
Gray-black soapstone?

Almost complete. D. 2.7, H. 1, D. perforation 0.5, W. of rim at top 0.2; 9 grams.
Edge: convex. Base: almost flat, slightly concave, surface polished with a few chips at the edge. Body: smooth, polished with an incised ring above the edge. Perforation: smooth with clear bore lines, a level rim around the top.

Figure 33. Left to right: **SW21, SW34, SW6, SW33**.

SW6 SF 2015; context 2001
Spindle whorl
Gray-black soapstone? FIG. 33

Almost complete. D. at edge 2.5, D. base 2.2, H. 1.3, D. perforation 0.5; 9 grams.
Edge: beveled, flaring out; defined by circular grooves that fade out in two places; chipped. Base: almost flat, very slightly convex with a raised rim around the edge of the perforation. Body: slightly convex; one deep incised ring just below the top; clear, faint surface rings and wide dark-gray band rings with black, thin rings between. Perforation: chipped with clear bore lines.

SW7 SF 2018; context 2001
Spindle whorl
Black stone

Almost complete. D. 2.5, H. 0.7, D. perforation 0.5; 5 grams.
Edge: convex. Base: flat, chipped at edge. Base and body are smooth, polished, and scratched. Body has two faint, incomplete, incised rings, one just above the edge and one below the top. Perforation: smooth.

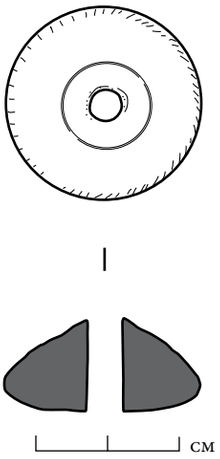

Figure 34. **SW8**.

SW8 SF 2048; context 2001
Spindle whorl
Black stone FIG. 34

Almost complete. D. 2.7, H. 1.3, D. perforation at top 0.5, at base 0.6; 12 grams.
Edge: convex. Base: very slightly convex. Body has an incised ring below the top and an incised line around part of the edge; surface is smooth, polished, scratched, and chipped. Perforation: fairly smooth, polished with some bore lines.

SW9 SF 2013; context 2002
Spindle whorl
Black stone

Two-thirds preserved. D. 2.7, H. 0.7, D. perforation at top 0.4, at base 0.6; 6 grams.
Edge: convex, badly chipped, part broken off. Base: flat. Body: smooth, polished, scratched, and worn. Perforation: chipped at top, interior smooth, polished, with faint bore lines. Undecorated.

SW10 SF 2064; context 2006
Spindle whorl
Gray-black soapstone?

Almost complete. D. 2.3, H. 0.9, D. perforation at top 0.5, at base 0.55; 6 grams.
Edge: convex, chipped. Base: flat in the middle where there is a wide, slightly raised band ring around the perforation, then base slopes up to the edge. Three incised rings: one on the edge, two just above the edge. Two darker band rings on the body. Whole surface is smooth, slightly polished. Perforation: smooth with faint bore lines, edges chipped.

SW11 SF 2065; context 2006
Spindle whorl
Gray-black soapstone?

Complete. D. 2.3, H. 1.2, D. perforation 0.5; 8 grams.
Edge: convex. Base: flat with a slight band ring around the perforation and faint surface rings; surface slightly scratched. Body has two incomplete incised rings, one around the edge and one just below the top; surface: smooth and polished.

SW12 SF 2081; context 2012
Spindle whorl
Brown-black stone

Almost complete. D. at edge 2.7, D. base 2.4, H. 1.3, D. perforation 0.55; 12 grams.
Edge: slightly beveled, flaring out and convex in places, chipped. Base: flat, smooth, and polished with slight band rings showing up as dark black/brown with a thin black line between. Body: scratched, less polished. Perforation: smooth with faint bore lines, chipped around the top. Undecorated.

SW13 SF 2101; context 2012
Spindle whorl
Black stone

Almost complete. D. at edge 2.3, D. base 2, H. 1.3, D. perforation 0.5; 9 grams.
Edge: beveled, flaring out sharply, chipped. Base: flat, smooth, polished, and heavily scratched. Three incised rings on the edge and one faint ring just above it. Body: convex to straight in profile with three wide band rings giving the surface a faceted appearance; two slightly irregular, incised rings just below the top; surface smooth, highly polished. Perforation: smooth, polished with bore lines, edges chipped.

SW14 SF 2066; context 2013
Spindle whorl
Gray-green soapstone?

Almost complete. D. at edge 2.5, D. base 2.2, H. 1.2, D. perforation at top 0.5, at base L. 0.6, W. 0.55, Th. edge 0.4; 7 grams.
Edge: lower part beveled, flaring out sharply, defined by a shallow groove, upper part beveled flaring out less sharply. Base: flat with a slightly raised band ring around the perforation. Body has an incised ring just above the edge, a spiraling line of three rings around the perforation, and two band rings. Whole surface: smooth, polished, and chipped in several places. Perforation: smooth with very faint bore lines.

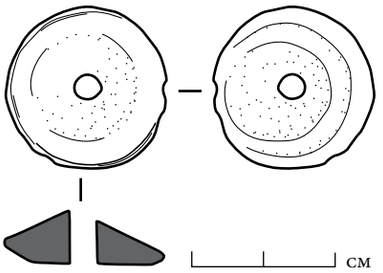

Figure 35. **SW15.**

SW15 SF 2115; context 2035
Spindle whorl
Gray-green soapstone? FIG. 35

Complete. D. 2.3, H. 0.8, D. perforation 0.4; 4 grams.
Edge: convex. Base: flat, beveled on one side, sloping up to the edge; three dark gray, incomplete band rings with thin black lines between; two small, worn dents in the edge at the beveled side. Body has two closely set incised rings just above the edge, with a band ring above. Whole surface: smooth, polished, and scratched. Perforation: smooth, polished, with faint bore lines.

SW16 SF 2123; context 2043
Spindle whorl
Black-green stone

Almost complete. D. 2.8, H. 1.1, D. perforation 0.6; 10 grams.
Edge: convex, chipped. Base: almost flat, slightly concave in places with two band rings. Body has a slight band ring just above the edge. Whole surface: smooth, polished; body scratched. Perforation: smooth, polished, with faint bore lines, edges chipped. Undecorated.

SW17 SF 2303; context 2089
Spindle whorl
Marble with dark blue-gray with black veins?

Almost complete. D. at edge 2.4, D. base 2.1, H. 1.8, D. perforation at top 0.5, at base 0.6; 11 grams.
Edge: beveled, flaring out, chipped. Base: flat, sloping up very slightly to the perforation in one place, with a deep gash across it; single band ring close to the edge. Body has an uneven, broken, incised ring just above the edge, one incomplete ring just below the top and three more on the body. Perforation has deep bore lines, chipped edges.

SW18 SF 2159; context 2129
Spindle whorl
Black stone

Almost complete. At edge: L. 2.4, W. 2.3, base: L. 2.2, W. 2.1, H. 1.1, D. perforation 0.5; 8 grams.
Edge: beveled-convex, chipped. Base: almost flat, heavily scratched with a single band ring close to the edge that is darker in color and more polished. Body has an incised ring just above the edge; surface covered with scratched rings. Perforation: smooth, with faint bore lines, top edge chipped.

Figure 36. **SW19** *(left),* **SW39** *(right).*

SW19 SF 2365; context 2195
Spindle whorl
Black stone FIG. 36

Almost complete. D. 2.35, H. 1.2, D. perforation at top 0.55, at base 0.6; 9 grams.
Edge: convex. Base: flat, smooth, polished, chipped. Body: more convex in profile with a worn surface. Perforation: smooth, slightly polished, with faint bore lines, chipped at top edge. Undecorated.

SW20 SF 2251; context 2241
Spindle whorl
Gray-black stone

Complete. D. 2.2, H. 1, D. perforation at top 0.35, at base 0.4; 4 grams.
Edge: thin, convex. Base: almost flat with a slightly raised band ring around the perforation darker black in color. Body has two incised rings, one just above the edge and one just below the top. Whole surface: smooth, polished, with faint surface rings. Perforation: smooth, with faint bore lines.

SW21 SF 2320; context 2269
Spindle whorl
Black soapstone FIG. 33

Almost complete. D 2.3, H. 0.8, D. perforation 0.4; 5 grams.
Edge: thin, three-quarters beveled, remainder convex. Base: flat with two faint, incised rings. Body has two wide incised rings, one just above the edge and one just below the top, which show up as gray. Whole surface: smooth and polished; body scratched. Perforation: smooth, with faint bore lines, chipped at top edge.

SW22 SF 1; context 4008
Spindle whorl
Dark gray stone

Almost complete. D. 2.45, H. 1.1, D. perforation at top 0.55, at base 0.6; 8 grams.
Edge: convex. Base: almost flat, chipped at edge. Perforation: smooth, slightly polished, with faint bore lines, chipped at top edge. Undecorated.

SW23 SF 416; unstratified
Spindle whorl
Gray-black stone

Almost complete. D. 2.5, H. 0.8, D. perforation 0.5; 5 grams.
Edge: convex. Base: almost flat, slightly concave, with a few deep scratches. Body has an incised ring just above the edge. Perforation: smooth, chipped at top edge.

SW24 SF 734; context 7000
Spindle whorl
Gray-black soapstone?

Complete. D. 2.1, H. 0.8, D. perforation at top 0.35, at base 0.4; 4 grams.
Edge: convex. Base: almost flat, a band ring around the perforation that is lighter in color; smooth and polished. Body has two incised rings just above the edge and two just below the top. Perforation: smooth, with faint bore lines.

SW25 SF 608; context 7110
Spindle whorl
Mottled green-black stone

Almost complete. D. at edge 2.6, D. base 2.3, H. 0.95, D. perforation 0.5; 7 grams.
Edge: convex in one place, and beveled, flaring out sharply in the rest; chipped. Base: almost flat, slopes slightly. Body has an incised ring just above the edge and a very faint incised ring below the top; surface smooth, polished. Perforation: smooth, polished, with faint bore lines.

SW26 SF 630; context 7201
Spindle whorl
Black stone

Almost complete. D. at edge 2.4, D. base 2.2, H. 1.1, D. perforation 0.5; 8 grams.
Edge: convex. Base: flat, very smooth, polished, and heavily scratched with vertical lines across most of the face. Body has an incised ring just above the edge, fading out in one place. Perforation: smooth, polished, with faint bore lines; chipped at top and outer edge.

SW27 SF 632; context 7201
Spindle whorl
Black and brown stone

Ninety percent preserved. D. 2.8, H. 1.15, D. perforation 0.5; 8 grams.
Edge: very thin, convex. Base: flat, smooth, scratched. Body has an incised ring just above the edge; surface covered with vertical and slightly angled scratches. Perforation: heavily chipped at top and outer edges.

SW28 SF 34; context 9000
Spindle whorl
Black and brown stone

Complete. D. 2.2, H. 0.7, D. perforation 0.5; 4 grams.
Edge: convex. Base: flat. Whole surface: smooth, polished, worn, with some scratches. Perforation: smooth, slightly polished, with faint bore lines. Undecorated.

SW29 SF 702; context 9076
Spindle whorl
Black stone

Almost complete. D. at edge 2.4, D. base ca. 2.15, H. 1.2, D. perforation at top 0.55, at base 0.6, W. rim 0.2; 7 grams.
Edge: convex, lower part slightly beveled, flaring out in places, chipped. Base: slightly convex with a faint band ring around the perforation and faint surface rings. Body has an incised ring above the edge that is incomplete, and one below the top, and two faint band rings. Whole surface: smooth, polished, quite worn and scratched. Perforation: smooth, polished, with faint bore lines; chipped at edges; narrow, level rim around the top.

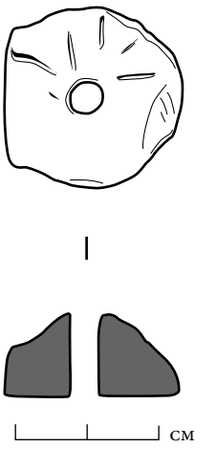

Figure 37. **SW30**.

SW30 SF 704; context 9076
Spindle whorl
Black stone

FIG. 37

Almost complete. At edge: L. 2.6, W. 2.5; base: L. 2.5, W. 2.3, H. 1.2; D. perforation 0.55; 10 grams.
Edge: convex; slightly beveled in one place; three faceted areas, one is almost straight and two flare outward and extend over the body, covered with short, oblique scratches slanting from right to left. Body: similar scratches in places; smooth, polished. Base: flat, smooth, polished, heavily scratched and chipped at edge. Perforation: smooth, polished, a few bore lines; top edge chipped. Undecorated.

SW31 SF 384; context 9112
Spindle whorl
Black stone

Almost complete. D. at edge 2.5, D. base 2.4, H. 1.2, D. perforation at top 0.5, at base 0.6, Th. edge 0.4, Th. edge at facet 0.5; 10 grams.
Edge: convex; two facets, one beveled, flaring out, covered in horizontal scratches, one almost straight with a few random scratches. Base: almost flat, slightly concave, smooth, heavily scratched and chipped at edge. Body: smooth, polished, worn, and scratched. Perforation: smooth, polished, with a few faint bore lines; top edge chipped. Undecorated.

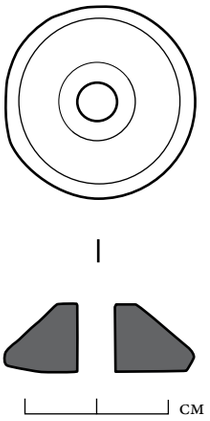

Figure 38. **SW32.**

SW32 SF 461; context 9175
Spindle whorl
Dark brown stone FIG. 38

Complete. D. at edge 2.7, D. base 2.5, H. 1.1, D. perforation at top 0.5, at base 0.55, W. rim 0.3, Th. edge 0.2; 10 grams.
Edge: convex, almost beveled in places. Base: almost flat, sloping slightly with one band ring that fades into the edge on one side. Body has one incised ring above the edge and one below the top and one slightly raised band ring on the lower half. Whole surface: smooth, polished, scratched. Perforation: smooth, polished, with faint bore lines; level rim around the top.

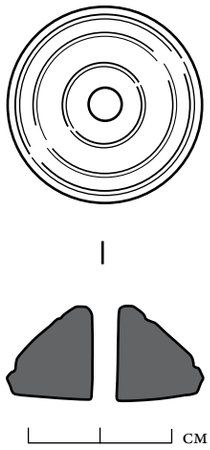

Figure 39. **SW33.**

SW33 SF 709; context 9175
Spindle whorl
Black stone FIGS. 33, 39

Almost complete. D. at edge 2.75, D. base 2.5, H. 1.2, D. perforation 0.5, W. rim 0.2, Th. edge 0.25; 10 grams.
Edge: beveled, flaring out sharply, chipped. Base: almost flat, slightly convex; two band rings, several thin surface rings and faint angled lines that slope from the perforation to the edge. Body has two deep incised rings, one above the edge that has a slight tail extension that slopes down to the edge and one below the top, that break the profile of the body. There are also clear surface rings and a band ring. Whole surface: smooth, polished. Perforation: smooth, polished, with clear bore lines; level rim around the top, chipped.

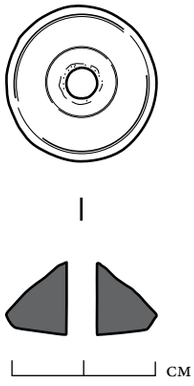

Figure 40. **SW34.**

SW34 SF 722; context 9175
Spindle whorl
Black stone FIGS. 33, 40

Almost complete. D. at edge 2.2, D. base 2, H. 1, D. perforation 0.5, Th. edge 0.3; 6 grams.
Edge: sharply beveled, flaring out. Base: slightly convex, dark gray, with three black band rings, the outer one partly incised. Body: slightly convex; slight band rings; one incised ring above the edge and below the top and a third

incomplete ring right on the edge. Whole surface has faint surface rings and is smooth. Perforation: smooth, with clear bore lines. The edges of the perforation, body, and edge are chipped.

SW35 SF 466; context 9179
Spindle whorl
Black stone

Almost complete. D. at edge 2.25, D. base 2.1, H. 1, D. perforation 0.5, W. rim 0.2, Th. edge 0.3; 6 grams.
Edge: sharply beveled. Base: almost flat, slightly convex. Body: slightly convex with slight band rings and two incised rings, one above the edge, one below the top. Whole surface has faint surface rings; the base is dark gray and smooth while the body is black, smooth, and polished. Perforation: chipped at edge; flat rim around the top.

SW36 SF 820; context 9195
Spindle whorl
Gray-black stone FIG. 41

Almost complete. D. at edge 2.4, D. base 2.3, H. 1.5, D. perforation at top 0.55, at base 0.6; 10 grams.
Edge: convex. Base: almost flat, chipped, with two clear band rings; outer one dark gray, smooth, and polished, inner one gray, sloping slightly up to the perforation. Body: smooth, polished, and worn, with faint surface rings. Perforation: smooth, polished, with clear bore lines; chipped at top edge. Undecorated.

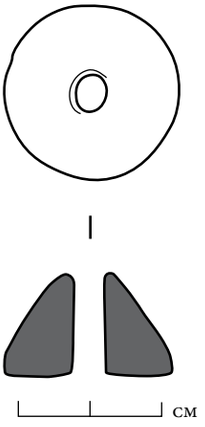

Figure 41. **SW36**.

SW37 SF 484; context 9197
Spindle whorl
Black stone

Complete. D. at edge 2.3, D. base 2.1, H. 1, D. perforation at top 0.55, at base 0.6, W. rim 0.15–2; 6 grams.
Edge: sharply beveled, flaring out. Base: almost flat, slightly concave, smooth, and scratched. Body has an incised ring above the edge and below the top and faint surface rings; surface smooth and polished. Perforation: smooth, with clear bore lines and a flat rim around the top.

SW38 SF 795; context 9227
Spindle whorl
Gray soapstone?

Almost complete. D. at edge 2.45, base: L. 2.4, W. 2.3, H. 0.8, D. perforation at top 0.5, at base 0.55; 6 grams.
The edge varies in profile, being convex, vertical, and beveled, flaring out and in. Base: flat, chipped. Whole surface: smooth, polished, worn, and scratched. Perforation: smooth, polished, with faint bore lines, and a very slight, level rim around the top. Undecorated.

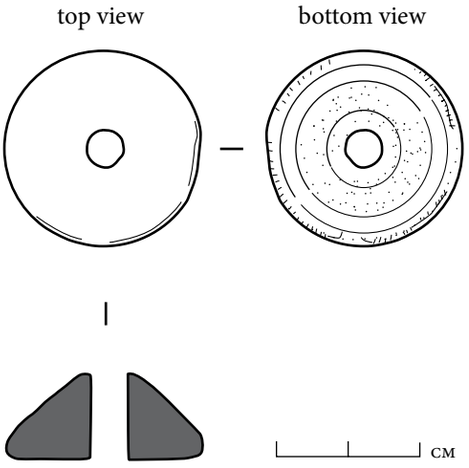

Figure 42. **SW39**.

SW39 SF 816; context 9231
Spindle whorl
Gray-black marble? FIGS. 36, 42

Almost complete. D. at edge 2.75, D. base 2.6, H. 1.3, D. perforation 0.5; 12 grams.
Edge: convex, chipped. Base: flat with clear surface rings and two band rings, the outer one light gray, the inner one dark gray. Body: worn with faint surface rings. Whole surface: smooth, polished. Perforation: smooth, polished, with clear bore lines; chipped at top edge. Undecorated.

SW40 SF 817; context 9231
Spindle whorl
Gray-green-black soapstone?

Almost complete. D. 2.3, H. 1.1, D. perforation at top 0.5, at base 0.55; 6 grams.
Edge: convex. Base: almost flat, slightly convex with a raised band ring around the perforation and clear surface rings. Body has an incised ring above the edge and below the top. Whole surface: smooth, polished, worn, and a little scratched. Perforation: smooth, polished, with faint bore lines; chipped at top edge.

SW41 SF 13; context 11066
Spindle whorl
Gray-black stone

Almost complete. D. at edge 2.4, D. base 2.2, H. 1.3, D. perforation at top 0.4, at base 0.5; 8 grams.
Edge: beveled, flaring out, with faint surface rings, chipped. Three-quarters of the base slopes up to the perforation and has clear surface rings. One area is very worn, lighter in color, and forms a ring around but mainly to one side of the perforation. Body has one deep incised ring just above the base and one ring below the top. Whole surface: smooth, polished, and badly scratched. Perforation: smooth, polished, with bore lines; chipped at top edge.

SW42 SF 579; context 11104
Spindle whorl
Gray-black stone

Almost complete. D. at edge 2.4, D. base 2.2, H. 1.5, D. perforation at top 0.5, at base 0.55; 10 grams.
Edge: convex, chipped. Base: flat with a slight band ring of darker color near the edge. Body has a faint incised ring just above the edge, three-quarters complete. Whole surface: smooth, polished, and scratched. Perforation: smooth, with bore lines; chipped at top edge.

SW43 SF 3685; context 12001
Spindle whorl
Black stone

Almost complete. D. at edge 2.6, D. base 2.4, H. 1.4, D. perforation at top 0.55, at base 0.6; 11 grams.
Edge: convex-beveled. Base: flat. Body has three incised rings, one just above the edge and two below the top, the lower one slightly thinner. There are at least six band rings and faint surface rings. Whole surface: smooth and polished. Perforation: smooth, with bore lines; chipped edges.

SW44 SF 849; context 13007
Spindle whorl
Gray-black soapstone?

Almost complete. D. 2.4, H. 0.8, D. perforation at top 0.45, at base 0.5; 5 grams.
Edge: thin, convex. Base: almost flat, chipped, with a slightly raised black band ring around the perforation, giving two wide dark gray rings. Body: slightly concave; narrow black band rings with gray rings between; an incised ring just above the edge and a wider ring below the top. Whole surface: smooth, polished, with faint surface rings and scratches. Perforation: smooth, slightly polished, with clear bore lines; chipped at top edge.

SW45 SF 3672; context 15295
Spindle whorl
Gray-green stone soapstone?

Four-fifths preserved. D. 2.8, H. 1, D. perforation at top 0.45, at base 0.55; 9 grams.
Edge: convex, chipped. Base: flat with a large scratch that cuts into the perforation edge. Whole surface: smooth and scratched. Perforation: smooth, polished, with faint bore lines; chipped at top edge. Undecorated.

SW46 SF 871; unstratified
Spindle whorl
Gray-stone stone

Almost complete. D. 2.5, H. 0.8, D. perforation 0.4;
6 grams.
Edge: convex, chipped. Base: flat, concreted. Body: smooth, polished. Perforation: smooth, slightly polished, with very faint bore lines. Undecorated.

SW47 SF 936; unstratified
Spindle whorl
Brown-black stone

Almost complete. D. 3, H. 1.3, D. perforation at top 0.45, at base 0.4; 11 grams.
Edge: very thin, convex-beveled, heavily chipped. Base: slightly concave, smooth, and scratched. Body has an incised ring just above the edge that fades out in one section and another ring just below the top. Perforation: smooth, with clear bore lines; a level rim around the top.

SW48 SF 875; context 18001
Spindle whorl
Black stone

Almost complete. D. 2.5, H. 1.1, D. perforation at top 0.55, at base 0.6; 11 grams.
Edge: convex, flattened in places, chipped. Base: slightly concave with a band ring around three-quarters of the edge, and a worn, slightly irregular area around and to one side of the perforation. The surface is smooth and covered with thin straight scratches from edge to edge across the central worn area and groups of short, oblique scratches on the remainder of the band ring. Body has traces of an incised ring just above the edge and three-quarters of a ring below the top. Surface body and perforation: smooth and polished. There are faint bore lines.

SW49 SF 912; context 18001
Spindle whorl
Black stone

Complete. D. at edge 2.6, D. base 2.3, H. 1.5, D. perforation at top 0.55, at base 0.6, Th. edge 0.4; 13 grams.

Half of the edge is slightly beveled, flaring out, and half is stepped, with a lower, short, sharp bevel then an upper, slight bevel, both flaring out; two faint incised rings, lower being incomplete. Base: flat, smooth, with a slight band ring around the edge; surface covered with scratches: one deep scratch and many straight scratches from edge to edge and one area at the edge with short, oblique scratches. Body has an incised ring above the edge that fades out in one place and a ring below the top; surface smooth, polished, and scratched. Perforation: smooth, with clear bore lines; worn and chipped at top edge.

SW50 SF 3469; context 18054
Spindle whorl
Black stone

Almost complete. D. 2.5, H. 1.1, D. perforation at top 0.5, at base 0.55; 8 grams.
Edge: convex. Base: almost flat, with a band ring around the perforation that is unpolished and lighter in color, and a polished outer ring. The surface is scratched with short lines radiating out from the perforation. Body: smooth, polished, with a large chip on one side. Perforation: smooth, slightly polished, with faint bore lines. Undecorated.

SW51 SF 3391; context 18070
Spindle whorl
Black stone

Almost complete. D. at edge 2.7, D. base 2.4, H. 1.1, D. perforation 0.55; 10 grams.
Edge: convex, with one flattened facet that is covered with oblique scratches; chipped. Base: almost flat, slightly concave; surface smooth, with thin scratches that form a diamond pattern around the perforation. Body: smooth, polished, and slightly scratched. Perforation: smooth, slightly polished, with a few faint bore lines. Undecorated.

SW52 SF 872; context 18108
Spindle whorl
Gray-green soapstone

Almost complete. D. 2.3, H. 0.8, D. perforation 0.55; 6 grams.
Edge: convex, chipped. Base: almost flat, a little uneven; chipped. Body covered with irregular, deep, vertical scratches radiating out from the top to the edge. Whole surface: very worn. Perforation: smooth, polished, with a few faint bore lines.

SW53 SF 3460; context 18108
Spindle whorl
Black stone

Almost complete. D. at edge 2.4, D. base 2.2, H. 1.3, D. perforation at top 0.5, at base 0.55, Th. edge 0.3; 10 grams.
Edge: sharp, beveled, flaring out. Base: almost flat, with a wide band ring around and on one side of the perforation. Body has an incomplete incised ring just above the edge. Whole surface: smooth and polished, base scratched and chipped. Perforation: smooth, polished, with clear bore lines, and a slight level, chipped rim at the top.

Type 002: Flattened Cone

There are just two examples, **SW54** and **SW55**. The distinguishing feature is that the profile of the body is a straight slope but then the top has been sliced off, creating a flattened, conical shape. **SW54** is the best example, being flat on top, while **SW55** is slightly convex and indeed is almost a Type 003. Some Type 001 whorls are also slightly flattened but have not been classed as Type 002 because they are taller and the flattened area is more of a narrow rim around the perforation.

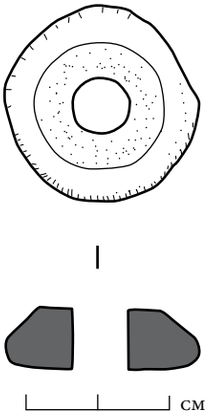

Figure 43. **SW54**.

SW54 SF 2104; context 2013
Spindle whorl
Black stone FIGS. 43, 45

Almost complete. At edge: L. 2.7, W. 2.6, D. base 2.5, H. max. 0.8, min. 0.7, D. perforation at top 0.8, at base 0.85, W. rim 0.5; 9 grams.
Edge: convex, with one sharply beveled section, flaring out, heavily scratched. Base: flat, smooth, slightly polished, chipped. Body: smooth, polished. Top: flat, sloping slightly, forming a wide rim around the perforation; heavily scratched. Perforation: smooth, with faint bore lines. Undecorated.

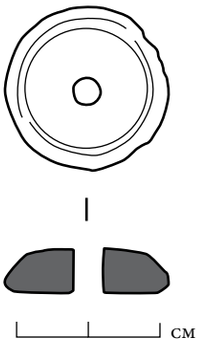

Figure 44. **SW55**.

SW55 SF 2239; context 2178
Spindle whorl
Gray-black stone FIG. 44

Almost complete. D. 2.3, H. 0.7, W. top 1.8, D. perforation at top 0.4, at base 0.5; 5 grams.
Edge: convex. Body slopes inward and then the top is slightly convex. Base: flat, with a slight band ring around the edge, lighter in color; chipped on edge. Body has two incised rings just below the top; surface darker and more polished on the top. Whole surface: smooth, scratched. Perforation: smooth, with faint bore lines.

Type 003: Convex

There are eight examples, **SW56–SW63**. These have an overall convex profile although some do level off across the top, for example **SW61**, **SW63**.

SW56 SF 2267; unstratified
Spindle whorl
Black soapstone?

Almost complete. D. 2.9, H. 1, D. perforation 0.6; 12 grams.
Edge: convex. Base: almost flat, sloping slightly into the perforation, chipped; surface smooth and scratched. Body has two incised rings below the perforation and faint surface rings below. Perforation: smooth, polished, with faint bore lines.

SW57 SF 2094; context 2023
Spindle whorl
Black stone

Almost complete. At edge: L. 2.5, W. 2.4, W. base 2, H. 0.9; perforation: L. 0.5, W. 0.45; 8 grams.
Edge: half slightly beveled, flaring out; rest convex. Base: flat, chipped, and heavily scratched. Body has a slight central band ring. Whole surface: smooth, polished; chipped on body and edge. Perforation: smooth, polished, with a few faint bore lines.

Figure 45. From left: **SW58, SW63, SW54**.

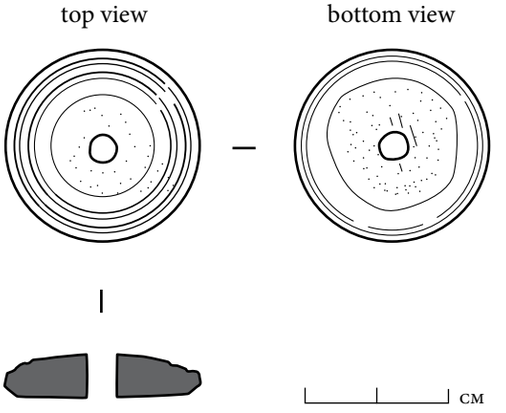

Figure 46. **SW58**.

SW58 SF 513; context 7023
Spindle whorl
Gray-black soapstone? FIGS. 45, 46

Almost complete. D. 2.7, H. 0.7, D. perforation at top 0.35, at base 0.4; 7 grams.
Edge: beveled, flaring out; one narrow band ring on the edge and two band rings that are very lightly incised just above or on the edge. Base: almost flat, sloping slightly, chipped; three band rings showing up as lighter wide bands with thin dark rings between, and clear surface rings. Body has two incised rings on the lower part and two band rings around the perforation; surface smooth, slightly polished. Perforation: smooth, with faint bore lines.

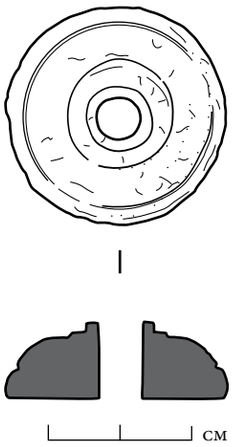

Figure 47a. **SW59**.

Figure 47b. **SW59**.

SW59 SF 497; context 7036
Spindle whorl
Bone FIGS. 47a–b

Almost complete. D. 3, H. 1.1, D. top 1.7, D. perforation 0.6; rings on base: D. outer max. 2.4, min. 2.1, D. inner max. 1.7, min. 1.4; D. ring on body around perforation 1.4; H. rim 0.1; 7 grams.
Edge: convex. Base: flat, with two deep, incised rings dividing the surface into three wide bands. Body: profile slightly convex with a deep incised ring just above the edge. Top: a deep incised ring makes a slight step to the base of the vertical rim around the perforation. Whole surface: worn, with the original surface lost except for a small polished area on the top of the rim.

SW60 SF 640; context 7060
Spindle whorl
Black stone

Almost complete. D. 3, H. 0.7, D. perforation at top 0.4, at base 0.5; 10 grams.
Edge: convex, chipped. Base: almost flat, slightly convex, with a band ring around the perforation, the outer band is darker and polished. Body has a faint incised ring just above the edge and a dark band ring around the perforation. Whole surface: smooth, slightly polished. Perforation: smooth, with faint bore lines.

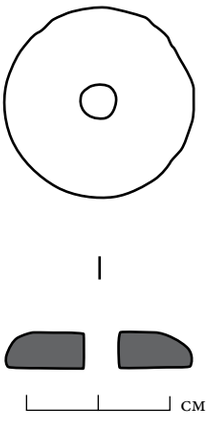

Figure 48. **SW61**.

SW61 SF 881; context 7214
Spindle whorl
Black stone FIG. 48

Almost complete. D. 2.7, H. 0.6, D. perforation at top 0.55, at base 0.6; 7 grams.
Edge: convex. Base: flat, with a very slight band ring, chipped at edge. The profile of the body levels out around the perforation. Whole surface: smooth and lightly polished. Perforation: smooth. Undecorated.

SW62 SF 99; context 9073
Spindle whorl
Black stone

Almost complete. D. at edge 2.7, D. base 2.3, H. 1.1, D. perforation 0.6, W. rim 0.5; 13 grams.
Edge: convex, beveled in places. Base: flat. The profile of the body levels out sharply on top, forming a rim around the perforation. Whole surface: smooth, polished, worn, and slightly chipped. Perforation: smooth, polished, with bore lines. Undecorated.

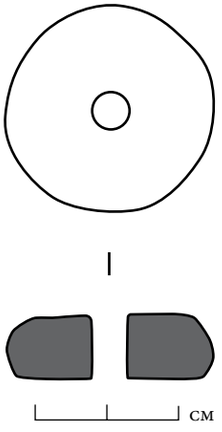

Figure 49. **SW63**.

SW63 SF 430; context 9138
Spindle whorl
Gray-black stone FIGS. 45, 49

Complete. D. at edge 2.9, D. base 2.6, H. 1.1, D. perforation 0.6; 15 grams.
Edge: convex. Base: flat. The profile of the body levels out on top. Whole surface: smooth, polished, worn, and scratched. Perforation: smooth, polished, with faint bore lines. Undecorated.

Type 004: Flat

The last two are flat on top. **SW64** has a slightly convex edge. **SW65** is a unique example within the corpus, having two incised rings around the edge that give the impression of three stacked discs. It also tapers toward the top.

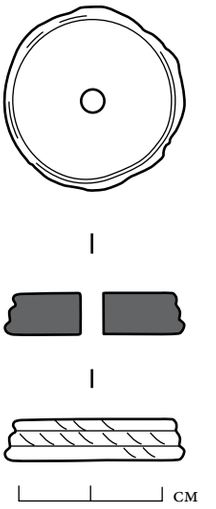

Figure 50. **SW65**.

SW64 SF 35; context 9001
Spindle whorl
Black stone

Complete. D. 2, H. 0.7, D. perforation at top 0.6, at base 0.7; 5 grams.
Edge: almost vertical, slightly convex. Top and base are flat. Surface: smooth, polished, and scratched. Perforation: smooth, polished with faint bore lines. Undecorated.

SW65 SF 703; context 9076
Spindle whorl
Black stone FIG. 50

Almost complete. D. at base 2.5, D. at center 2.4, D. at top 2.3, H. 0.6, D. perforation 0.4; 7 grams.
Top and base: flat, undecorated. Edge has two incised rings, which give the effect of three stacked, flat discs that decrease in diameter as the edge tapers toward the top. Exterior profile of each disc is convex. The edge of the center disc has incised oblique lines, slanting from left to right in a rope pattern; top and bottom disc have a few oblique incisions. Edge is slightly chipped.

NOTES

1. I would like to thank Dr. Don Evely and Dr. Andrew Wilson for their general advice and comments; Dr. Elizabeth Barber for reading the weaving text and her invaluable comments and advice; Mr. Richard Martin for explaining certain aspects of weaving and spinning, and dear Griff for shedding light on some matters concerning the working of the Pompeian mill. Mr. Chris Doherty of RLAHA, Oxford, gave geological advice and comment. Special thanks to the sculptor Mr. Gelas Kessidis, for sharing his firsthand knowledge of the Pompeian mill. I would also like to thank the many friends and family who have listened patiently and given support, especially Dr. I. Bradfer-Burdet and Dr. A. Jones. Finally I would like to thank the members, especially Frans Rutten, of the International Molinological Society (TIMS) who listened patiently and with great interest, and gave many thought-provoking ideas concerning rotary querns.
2. Small finds (= numbers with the prefix "SF," including worked stone, with the prefix "WS") and contexts published here come from trenches excavated by Oxford Archaeology for the Packard Humanities Institute rescue excavations at Zeugma in 2000: Trenches 1, 2, 4, 5, 7, 9, 10, 11, 12, 13, 15, 18, and 19. Finds recovered from other areas in 2000 will be published separately by their respective excavators: the Gaziantep Museum, the University of Nantes, and the Zeugma Initiative Group.
3. From the corpus of objects published here, the following objects were not catalogued: SF 90 (x 2) and SF 4320 (unstratified spindle whorls); SF 2350 (unidentified worked stone object). The following objects were not available for study: SF 3711 (marble vessel); SF 975 (mortar fragment); SF 3413 (worked stone); SF 3079 (mortar); SF 3666, 4351, 4459, 4477 (spindle whorls).
4. Peacock 1986, fig. 2.
5. Williams-Thorpe 1988, 260.
6. Moritz 1958, 80.
7. Peacock 1986, 211.
8. I discussed this point with Mr. Gelas Kessidis, a sculptor who made a copy of a Pompeian mill for a museum display devoted to milling in Thessaloniki, Greece. When cutting the catillus, he first found the center of the block of stone and then cut the perforation, which needs to be centered exactly for the quern to function. He then worked in from the sides, using the center line as a guide; this guide became the center of the hourglass shape. He chose to leave the central line as a relief band rather than cut it down, because he felt it had a decorative quality. Additional notes from the sculptor are as follows: It took between three to five months to make the mill (one month to find the stone, two months to cut the basic shape, and the remainder to match the grinding surfaces). The grinding surfaces were made very slowly, so as to avoid overgrinding, which would have ruined the mill. Two men were required to lift the upper stone on and off to test the match and smooth the grinding surfaces, with water and sand poured between the meta and catillus. While rotary querns of this type would have been manufactured more quickly in antiquity, the experiment of modern replication reveals that specialized skill and knowledge was required, and that some expense would have been required for purchase of the finished product in the marketplace.
9. For **IR74**, see Scott, this volume.
10. Moritz 1958, 79.
11. White 1963, 203 (number 23).
12. Etienne 1960, pl. 60.
13. Peacock 1986, 211.
14. Dar 1999, 55–6, pl. 78 (not in situ; date uncertain, perhaps from third- and fourth-century A.D. occupation, but in an area with later Medieval activity.
15. Peacock 1986, 207–10 (Types 2a, 2c, 2d, 3b, 3c, 3d, 3e).
16. Peacock 1986, 209–11, without elaboration about a specific alternative use: Types 2b and Type 3a (average diameter and height = 38.6 cm and 40 cm, respectively).
17. Moritz 1958: chapter 11 includes several.
18. Moritz 1958, fig. 8; see also Peacock 1986, fig. 1.
19. White 1963, fig.10.
20. Moritz 1958, pls. 5b and 7a, fig. 9.
21. White 1963, 204 (number 24).
22. Peacock 1986, 211.
23. Moritz 1958, 85, pl. 6a.
24. Blumner 1912, figs. 16–8, 21.
25. Etienne 1960, pls. 68.1, 75.2.
26. Luquet 1966, fig. 2.
27. Moritz (1958, 85–8) covers the essential points of the debate.
28. Storck 1952, 79, fig. 42.
29. Moritz 1958, 89.
30. Storck 1952, 81, fig. 43.
31. Moritz 1958, 80, pls. 5a, 9b.
32. White 1963, 203.
33. Moritz 1958, 80. One example (pl. 9b) has slots cut across the outer part of the rim, with the inside of the rim intact. In addition, the top of the handle block appears to be level with the rim. Perhaps on this example there would be no need for an elaborate wooden framework, just the turning handles and a separate crossbar.
34. White 1967, 203 n. 32.
35. White 1963, 203.
36. White 1967, fig. 9.
37. Blumner 1912, figs. 15a, 16–8 (the example in figure 17, the Zethus sarcophagus in Museo Chiaramonti, appears to be tied on to the crossbar). Compare the querns in Blumner's fig. 15a, without hoppers, spindles, or crossbars.
38. Moritz 1958, 86.
39. White 1963, 205, fig. 6, from a house complex (type 3).
40. Peacock 1986, fig. 2. **Q4** though smaller, is similar in style to Peacock's types 3b and 2d, which have protruding handles; 3b also has a raised rib on the exterior.
41. Lancel 1982, II: fig. 113.
42. Luquet 1966, fig. 3.
43. Williams-Thorpe 1988, 260–1.
44. Riley 1980–1, 55–6. From an unknown context in the gardens of the Department of Antiquities, Cyrene.
45. Khirbat al-Karak: Nipple top meta not later than first half of the fifth century A.D., with base diameter 57 cm, height of body 33 cm, and a hollow on top, L. 4.5, W. 4.5, Dp. 2 (Delougaz and Haines 1960, 23, 26, pls. 22.11, 49.6). Sumaqa: from the third to sixth century A.D., a conical meta with fairly wide lip paired with a catillus with hourglass interior and handle block at center of exterior, lower diameter 70 cm and height ca. 80 cm; another catillus fragment has a raised double rib on the exterior, not centered but on the upper half (Dar 1999, 51–69, pls. 78–9). Mt. Nebo: from the basilica complex, sixth to eighth century A.D., an hourglass catillus with protruding handle blocks, a shallow rib around the middle, and shallow notches on the exterior are visible in one side cut into the body (cat. 166); possible nipple-top meta (cat. 167) (Saller 1941, I: 46, 78, 83, 297, pl. 60, figs. 1.8–9). Dura-Europos: Hourglass mill from porch of House C, second century A.D. (Rostovtzeff et al. 1944, 150, fig. 70). Hama: second to fifth century A.D., catillus no. 63 (47.5 cm tall, 65.5 cm diameter) with concave exterior profile and centered, protruding handle blocks; metae ca. 60–72 cm high and 50–6 cm in diameter, with conical bodies but no nipple tops (nos. 61 and 6A 975 have radial grooves on the body) (Ploug 1985, 3.1: 203, figs. 35e–f, 47c–e).
46. **Q10** is assigned to Type 003a, although later querns sometimes have a collar around the very edge of the perforation as opposed

to a hopper in the upper face: cf. Curwen 1937, 146; Runnels 1990, 151; Williams-Thorpe 1993, 270.
47. See discussion of Trench 7 in the chapter by Tobin in volume 1.
48. Watts 2002, figs. 10, 11.
49. Runnels 1990, 151.
50. Watts 2002, pl. 4.
51. See the drawing of a modern Scottish quern: Curwen 1937, fig. 39.
52. Curwen 1937, 144; see also Runnels 1990, 149. The Zeugma querns assigned to Types 003a–003c are fragments; features like hollows or slots for a rynd may be lost.
53. Curwen 1937, 143, figs. 19, 21.
54. Runnels 1990, figs. 3–5.
55. Fischer and Tal 1999, 422, figs. 10.1: 15–6. Stratum II, fourth to seventh centuries A.D.
56. Dar et al. 1999, 35, 40, pl. 64. From a refuse pit of the second half of the fourth century to the sixth century A.D., inside complex number 2, built during the second or early third century A.D.
57. Williams-Thorpe 1993, 270.
58. Curwen 1937, 140–4.
59. Childe 1943, 20, fig. 1.
60. Lower grinding stones of this type do not appear in Curwen 1937.
61. Macalister 1912, 36. Third and Fourth Semitic periods. A larger basalt example of an upper stone (dia. 23 cm) found in the Hellenistic stratum is proposed as a grain grinder (p. 37, fig. 229d). The example illustrated in figure 228 appears to be upside down—the stone with the tenon is above the stone with the mortice.
62. Fischer and Tal 1999. From the Byzantine monastic complex in stratum II. Fourth to seventh century A.D. Quern = reg. nos. 4386/50, 4742/50: fig. 10.2:2. Boss fragments: p. 422, figs. 10.1:16–7, 20–1.
63. Saller 1941, 113–4, 297. Cat. no. 169, from the southern monastery, occupied into the early thirteenth century.
64. I have seen modern querns in Jordan where the perforation is wadded with material, and in Libya, where it is filled with a sandy cement-like mixture.
65. Curwen 1937, 142–4; see also Runnels 1990, 151; Moritz 1958, 117.
66. For grinding experiments with rotary querns, see Curwen 1941, 28–31; Jorgensen 2002, 191–3.
67. Williams-Thorpe 1993, 271.
68. Williams-Thorpe 1993, 271.
69. For a general description of this type of loom, see Crowfoot 1940, 36–47; Hoffmann 1964, 323; Wild 1970, 68.
70. The warp-weighted loom does continue in some areas, e.g., a group of lentoid loom weights from Sorte Muld II, Bornholm, in Denmark, dated to the fourth and fifth century A.D.: Hoffmann 1964, fig. 131. Cf. Cocking 1992, 406.
71. Wilson 1930, fig. 284 (no specific contexts or date are given; see fig. 286 for a range of sizes and weights, although the actual dimensions are not detailed).
72. Sackett 1992, pl. 333. Those of Type C are thought possibly too heavy to be weights. Cocking 1992, 406. However, several threads can be attched to a single weight, thereby spreading the weight and lessening the strain on individual threads. This also allows for the fact that there is an inevitable degree of variation amongst the weights due to manufacture processes, and tying several threads to one weight helps keep an even tension.
73. Davidson 1952, 162, pl. 77 (cat. 1202–4): they are slightly taller, ranging from 11.3 cm (1204) to 13.2 cm (1202). No weight is given.
74. Ploug 1985, esp. 231–5, figs. 560–q, 58a–c.
75. Mitchell 1980, 243–244, 229, figs. 116.27–8, 117.29–30.
76. Goldman 1950, I: figs. 267.2–4, 6, 10, and esp. 19, 20. Some, e.g., fig. 267.6, are later, from the late second/third century A.D.
77. Hoffmann 1964, fig. 130.
78. Still, Shamir (1996, 151) managed to spin with a whorl of 195.5 grams, and suggests that heavy whorls were used for making the warp threads for a loom since "a heavy whorl causes tight spinning suitable for the warp."
79. For spindle whorls in general, see Crewe 1998; Barber 1991.
80. Barber 1991, 51–2; see also Crewe 1998, 13.
81. Barber 1991, 51.
82. Silk and/or cotton should not be ruled out. Although silk from Chinese domestic *Bombyx mori* unwinds directly off the cocoon without being spun, poorer quality silk from cocoons that don't unwind properly could have been spun like wool.
83. Barber 1991, 53.
84. Crewe 1998, 12.
85. See discussion of Trench 9 in the chapter by Tobin in volume 1.
86. **IR69–73**: See Scott on the iron finds, this volume.
87. Davidson 1952, 296–304, pls. 123–4 (see also 172, pl. 78, no. 1222, flat stone disc with perforation). For buttons in general, see Elderkin 1928.
88. Avitz-Singer 1989, 359, fig. 31.7.
89. Ploug 1985, fig. 51f. Other examples on Ploug's fig. 51 have a beveled edge (h and i), convex shape (g and j), and an incised groove (i and j).
90. Sackett 1992, 401.
91. Andersen 1969, 98, 101–2, pls. 15, 17 (nos. 275, 345–6).
92. Mitchell 1980, 232, fig. 116, nos. 20, 22, 24, 25, similar to Zeugma Type 001.
93. Goldman 1950, I: 387, 396, figs. 261.1–2, figs. 272.52–79. Steatite, bone, and clay whorls, Hellenistic and Roman in date.

BIBLIOGRAPHY

Andersen, F.G. 1985. *Shiloh: The Danish Excavations at Tall Sailun, Palestine, in 1926, 1929, 1932 and 1963.* Vol. II, *The Remains from the Hellenistic to the Mamluk Periods*. Copenhagen: The National Museum of Denmark.

Avitz-Singer, L. 1989. "Stone and Clay Objects." In *Excavations at Tel Michal, Israel*, edited by Z.G. Herzog, G. Rapp, Jr., and O. Negbi, 350–60. Emery and Claire Yass Publications in Archaeology Monograph Series 8. Minneapolis: The University of Minnesota Press.

Bakker, J.T., ed. 1999. *The Mills-Bakeries of Ostia: Description and Interpretation.* Amsterdam: J.C. Gieben.

Barber, E.J.W. 1991. *Prehistoric Textiles.* Princeton: Princeton University Press.

Bennett, R., and J. Elton. 1898. *History of Corn Milling.* Vol. 1, *Handstones, Slave and Cattle Mills*. London: Simpkin, Marshall & Company.

Blumner, H. 1912. *Technologie und Terminologie der Gewerbe und Kunste bei Griechen und Romern.* Berlin: B.G. Teubner.

Childe, V.G. 1943. "Rotary Querns on the Continent and in the Mediterranean Basin." *Antiquity* XVII:19–26.

Crewe, L. 1998. *Spindle Whorls: A Study of Form, Function and Decoration in Prehistoric Bronze Age Cyprus.* Studies in Mediterranean Archaeology and Literature Pocket-Book 149. Jonsered: Paul Astroms Forlag.

Crowfoot, G.M. 1940. "Of the Warp-weighted Loom." *BSA* 37:36–47.

Curtis, R.I. 2001. *Ancient Food Technology.* Vol. 5, *Technology and Change in History*. Leiden: Brill.

Curwen, E.C. 1937. "Querns." *Anitquity* 11:133–51.

———. 1941. "More About Querns." *Antiquity* 15:15–32.

Dar, S. 1999. *Sumaqa: A Roman and Byzantine Jewish Village on Mount Carmel, Israel.* BAR-IS 815. Oxford: Archaeopress.

Davidson, G.R. 1952. *Corinth.* Vol. XII, *The Minor Objects*. Princeton: American School of Classical Studies at Athens.

Delougaz, P., and R.C. Haines. 1960. *A Byzantine Church at Khirbat Al-Karak.* OIP 85. Chicago: University of Chicago Press.

Deonna, W. 1938. "Les meules rotative." In *Le mobilier delien*, by W. Deonna, 131–5. Explorations Archéologiques de Dèlos 18. Paris: Éditions de Boccard.

Elderkin, K. 1928. "Buttons and Greek Garments" *AJA* 32:333–45.

Etienne, R. 1960. *Le Quartier Nord-est de Volubilis.* Vol. 1, *Texte*; Vol. 2, *Planches*. Paris: Éditions de Boccard.

Fischer, M., and O. Tal. 1999. "Stone Artefacts from the Byzantine Period." In *Tel 'Ira: A Stronghold in the Biblical Negev,* edited by I. Beit-Arieh, 421–7. Emery and Claire Yass Publications in Archaeology Monograph Series 15. Tel Aviv: Sonia and Marco Nadler Institute of Archaeology, Tel Aviv University.

Frankel, R. 2003. "The Olynthus Mill, Its Origin, and Diffusion: Typology and Distribution." *AJA* 107.1:1–21.

Goldman, H. 1950. "The Miscellaneous Finds." In *Excavations at Gözle Kule, Tarsus.* Vol. 1, *Text: The Hellenistic and Roman Periods*, edited by H. Goldman, 387–403. Princeton: Princeton University Press.

Henig, M. 1984. "Objects of Metal, Stone and Bone." In *Excavations at Carthage: The British Mission.* Vol. 1.1, by H.R. Hurst and S.P. Roskams, 182–93. Sheffield: University of Sheffield.

———. 1994. "Objects Mainly of Metal, Bone and Stone." In *Excavations at Carthage: The British Mission*. Vol. 2.1, by H.R. Hurst, 261–81. Oxford: Oxford University Press.

Henig, M., and M.G. Fulford 1984. "Terracotta Figurines, Spindlewhorls and Other Small Objects." In *Excavations at Carthage: The British Mission.* Vol. 1.2, by M.G. Fulford and D.P.S. Peacock, 247–52. Sheffield: University of Sheffield.

Hoffmann, M. 1964. *The Warp-Weighted Loom: Studies in the History and Technology of an Ancient Implement*. Studia Norvegica 14. Oslo: Universitetsforlaget.

Jorgensen, A.B. 2002. "Investigations of Danish Rotary Querns from the Iron Age: Archaeological Evidence and Practical Experiments." In *Moudre et Broyer.* Vol. 2, *Archeologie et Histoire*, edited by H. Procopiou and R. Treuil, 183–94. Paris: Éditions du CTHS.

Koutsoukou, A. 1997. "Miscellaneous Finds." In *The Great Temple of Amman: The Excavations*, edited by A. Koutsoukou, K.W. Russell, M. Najjar, and A. Momani, 135–56. Amman: American Center of Oriental Research.

Lancel, S. 1982. *Byrsa II: Rapports preliminaires sur les fouilles 1977–1978: Niveaux et vestiges puniques*. Palais Farnese: École Francaise de Rome.

Lloyd, J.A., ed. 1977. *Excavations at Sidi Khrebish Benghazi (Berenice).* Vol. I, *Buildings, Coins, Inscriptions, Architectural Decoration*. *LibAnt* Suppl. 5. Tripoli: Department of Antiquities.

Luquet, A. 1966. "Blé et meunerie à Volubilis" *BAMaroc* VI:301–16.

Macalister, R.A.S. 1912. *The Excavation of Gezer.* Vol. 2. London: John Murray.

Mitchell, S. 1980. *Asvan Kale Keban: Rescue Excavations, Eastern Anatolia*. Vol. 1, *The Hellenistic, Roman and Islamic Sites.* BAR-IS 80. Oxford: British Archaeological Reports.

Moritz, L.A. 1958. *Grain-Mills and Flour in Classical Antiquity*. Oxford: Clarendon Press.

Peacock, D.P.S. 1980. "The Roman Millstone Trade: A Petrological Sketch." *WorldArch* 12:43–53.

———. 1986. "The Production of Roman Millstones near Orvieto, Umbria, Italy." *AntJ* 66:45–51.

———. 1989. "The Mills of Pompeii." *Antiquity* 63:205–14.

Ploug, G. 1985. *Hama: Fouilles et Recherches de la Fondation Carlsberg 1931–1938.* Vol. 3, pt. 1, *The Graeco-Roman Town.* Copenhagen: Nationalmuseet.

Riley, J.A. 1980–81. "Imported Grain Mills at Cyrene." *LibSt* 12:55–9.

Robinson, D.M. 1941. *Excavations at Olynthos.* Pt. 10, *Metal and Minor Miscellaneous Finds: An Original Contribution to Greek Life.* Oxford: Oxford University Press.

Rostovtzeff, M.I., A.R. Bellinger, F.E. Brown, and C.B. Welles, eds. 1944. *The Excavations at Dura-Europos: Preliminary Report of the Ninth Season of Work 1935–1936*. Pt. 1, *The Agora and Bazaar*. New Haven: Yale University Press.

Runnels, C. 1990. "Rotary Querns in Greece". *JRA* 3:147–54.

Sackett, L.H, and J. Cocking. 1992. "Other Finds in Stone, Clay and Faience." In *Knossos from Greek City to Roman Colony: Excavations at the Unexplored Mansion.* Vol. 2, by L.H. Sackett, 391–414. *BSA* Suppl. 21. London: Thames and Hudson.

Saller, S.J. 1941. *The Memorial of Moses on Mount Nebo*. Pt. 1, *The Text*; Pt. 2, *The Plates*. Jerusalem: The Franciscan Press.

Salles, J.-F., and M.-J. Chavane. 1993. "Les Petits Objets." In *Kition-Bamboula.* Vol. 4, *Les Niveaux hellénistiques,* edited by J-F. Salles, 331–9. Paris: Éditions Recherche sur les civilisations.

Shamir, O. 1996. "Loomweights and Whorls." In *Excavations at the City of David*. Vol. 4, *Various Reports*, edited by D.T. Ariel and A. de Groot, 135–70. Qedem 35. Jerusalem: Hebrew University.

Storck, J., and W.D. Teague. 1952. *Flour for Man's Bread.* Minneapolis: University of Minnesota Press.

Tolun, N., comp., and C. Erentoz, ed. 1962. *Geological Map of Turkey, Hatay Sheet, Scale 1:500,000*. Ankara: Institute of Mineral Research and Exploration; Turkish Geological Survey.

Watts, M. 2002. *The Archaeology of Mills and Milling.* Stroud: Tempus.

White, D. 1963. "A Survey of Millstones from Morgantina." *AJA* 67:199–206.

Wild, J.P. 1970. *Textile Manufacture in the Northern Roman Provinces*. Cambridge: Cambridge University Press.

Williams-Thorpe, O. 1988. "Provenancing and Archaeology of Roman Millstones from the Mediterranean Area." *JAS* 15:253–305.
Williams-Thorpe, O., and R.S. Thorpe. 1991. "The Import of Millstones to Roman Mallorca." *JRA* 4 1991:152–9.
———. 1993. "Geochemistry and Trade of Eastern Mediterranean Millstones from the Neolithic to Roman Periods." *JAS* 20:263–320.
Wilson, L.M. 1930. "The Loom Weights." In *Excavations at Olynthos.* Pt. 2, *Architecture and Sculpture: Houses and Other Buildings*, by D.M. Robinson, 118–28. Oxford: Oxford University Press.