The rotary quern is one of the most advanced lever mill in use in the ancient world. Every mill of this type is composed of two discoidal querns, the upper one movable and the lower one stationary, usually made of basalt and functioning by friction. Over the last few decades, the research on this field has been especially focused on the western Mediterranean where the two querns are apparently always separated by a system of supports (rynd and spindle) to adjust the gap between them and produce fine or course flour.

The site of Tell Barri, in the Khabur Valley (Syria), has revealed 21 rotary mills that suggest a new field of studies. They come from different contexts dating between the second and thirteenth c. AD. This paper analyses the different types and operational processes to argue for their use and determine a possible connection with the ones found in the Western Mediterranean.

Keywords
Mills, rotary mills, Tell Barri, querns, milling technology, grinding, grindstones
1. Introduction

What kind of civilisation would the humans achieve without the introduction of the milling process?

Due to its importance in the human life, its introduction was attributed to the gods: Pliny considered Ceres the responsible of teaching the agriculture and the grinding to the human beings, that is the reason why She was considered a goddess. The milling technology follows the evolution of the human progression since the first domestication of the cereals: Hand mills, Assyrian mills, Olynthus querns and Rotary Mills are the main types of tools identified for the milling process.

This paper is only focused on the rotary mills found in the site of Tell Barri, in the Khabur Valley (in north-eastern Syria), to analyse the features of the tools and argue for their use.

The rotary mill is composed of a stationary lower quern and a movable upper one, both circular, usually made of basalt and functioning by friction (fig. 1).

The excavations at Tell Barri has produced 21 rotary mills which date between the second and thirteenth c. AD.

2. The Tenon and Mortise type

The first type presented is the so called Tenon and Mortise type. The upper movable quern has a circular perforation on its centre (the mortise) while the lower stone distinguishes by a protrusion at the centre of one of its faces (the tenon). The perforation and the protrusion perfectly match in order to avoid the detachment of the tenon from the mortise during the rotation; this made the circular movement stable and increased the speediness of the system (fig. 2).

Nine querns pertaining to this type have been found at Tell Barri: four upper (E.707, 3606, 4585, 6649) (fig. 3) and five lower (912, 2885, 6334, 6336, 6817) (fig. 4). They date between the end of the second c. AD and the beginning of the fifth c. AD.

The mortise also functioned as a hopper to contain the grain that gradually slid on the grinding surface due to the movement: the upper quern E.707 is characterized by a raised circular collar set around the hopper in order to hold a larger quantity of grain in it.

The tenon and mortise mill could be easily managed by a single operator: once the mortise was filled with the grain, the rotation was applied by the use of an exception is witnessed by the mills in limestone from the Aisne Valley, at Vendresse-Beaulne (north-eastern France): Naze et Al. 2011, pp. 269-283.

All the other types of milling tools found in the same site as mortars, hand mills, saddle querns, Assyrian and Olynthus querns have been studied and published by L. Bombardieri: Bombardieri 2005, 2010.

For this mill type and the others of this paper, see the catalogue below for details on the measures and features of the devises.

The querns 707 and 6817 were found in pits; 912 on the ground level; 3606 and 4585 in deposit levels; 6334, 6336 and 6649 were found on the floor but not in situ; 2285 was found in situ.
Figure 2
Fascitiello M., Intersection between an upper and a lower quern of the Tenon and Mortise type. Basalt. Max diam. 42cm. Late 2nd c. AD – early 3rd c. AD. Found at Tell Barri

Figure 3
Fascitiello M.,
Upper querns belonging to the Tenon and Mortise type. Basalt. Diam. between 36 and 44cm. Late 2nd c. AD – early 5th c. AD. Found at Tell Barri
Figure 4
Fascitiello M., Lower querns belonging to the Tenon and Mortise type.
Basalt. Diam. between 35 and 44 cm. Late 2nd c. AD – early 5th c. AD. Found at Tell Barri

Figure 5
Fascitiello M., Back side of the upper quern E. 4585.
Basalt. Max diam. 42 cm. Late 2nd c. AD. Found at Tell Barri
a handle. No trace of it was found during the excavations; they were probably made of wood or metal. The hole where the handle was inserted is still visible on the edge of every tool of this type: it has a circular shape and a double-cone section. On two of the upper querns (E.4585, 6649) the hole for the handle is located beyond the circular edge of the mill, on an extension that made the rotation easier to be operated; on the grinding surface, the extension is slightly raised, fitting with the edge of the stationary quern, in order to give more stability and speed to the rotation (fig. 5). The mortise E.6649 is featured by two holes set along the edge of the hopper. They were filled with two pieces of iron (one still visible) that probably are the remains of a support to give more stability to the movement.

The grinding surface of the mortises is smooth but the top is coarse and irregular, except for the mortise E.707 which has a regular upper surface embellished with a triangular decoration between the hole for the handle and the raised collar around the hopper.

The height of the moving upper quern ranges from 7.5 and 10 cm while the diameter is between 36 and 44 cm. The mortise can have a cylindrical section (E.3606), a double-cone section (E.4585) or a truncated cone section (E.707); it is circular at the base while it can be circular (E.707) or almost circular (E.3606) at the top; the inner surface is smooth due to the friction with the tenon during the rotation. The diameter of the hopper falls between 11 and 13 cm.

Regarding the stationary mill, the height is between 8 and 11.6 cm while the diameter is between 35 and 44 cm. It can have a truncated cone section (E.912, E.6336) or a double cone section (E.6334); the grinding surface is smooth due to the friction with the mortise; the height of the tenon is between 3 and 7.5 cm.

A question on the functioning of this mill is necessary: where was this tool located during the grinding? On the floor, on a table or on a platform?

The lower surface of the stationary quern is always coarse and irregular. This is the reason why it couldn’t be located on a table or on the floor, otherwise it wouldn’t have had enough stability to be managed. Studying the features of the lower querns, they are supposed to be installed into a low mud-bricks platform so that the mill had more stability during the movement.

Similar tools have been found in the Near East in contexts dating between the Chalcolithic Age and the seventh/eighth c. AD and beyond.8 Some of the researchers on this field have doubted on the function of these instruments as rotary mills for the Prehistoric contexts, suggesting their use as potter’s wheels, instead.9

The instruments of this type from Tell Barri are surely rotary querns. In fact, the mills E.6334 and E.6336 come from the same sector of a domestic complex which dates to the second half of the second c. AD and surely used for grinding and storing food.10 Even the hole of the handle, visible on different tools suggests the same function, as the raised circular collar set around the hopper of the E.707 to hold a larger quantity of grain in it.

Only future studies will clarify if these instruments besides the ones from Tell Barri are rotary mills or potter’s wheels.

2.1. A possible variation of the Tenon and Mortise quern

Different proposals have been made for the six upper querns E.438, 915, 1228, 1538, 6087, 6372 that seem to have similarities with the ones just presented (fig. 6).11

Their shape brings to mind the upper querns of the Tenon and Mortise type but the size is different: the height is between 3 and 6.7 cm, the mortise has...
The dating of this type found at Tell Barri is about the eleventh/twelfth c. AD that can be connected to the Islamic presence on the site. Similar tools have been found at Gezev (600-1100 d.C.) and Ramat Hanadiv (dating between the Byzantine and the Islamic period).13

A few questions for future studies are necessary: can this mill type be considered a variation of the tenon and mortise quern? If so, when did this change take place?


---

**Figure 6**
Fascitiello M., Upper querns belonging to a supposed variation of the Tenon and Mortise type. Basalt. Diam. between 22 and 50 cm. 11th/12th c. AD. Found at Tell Barri.
Rotary querns from Tell Barri (Syria): chronology, use and function

This mill type is the most common rotary hand mill in use in the Mediterranean Basin. Apparently it was introduced in south-east Spain between the end of the sixth and the beginning of the fifth c. BC. It seems this device first spread in central and northern Spain (fourth c. BC) then, quickly, from west to east. In southern France the oldest tools date back to the fourth-third c. BC; no hand-mills were found before the third c. BC in Sicily, while in northern Italy they appeared in the second-first c. BC. It has been shown that

3. The device E. 1041

A different mill type found at Tell Barri is represented by the device E.1041 (fig. 9).

It has a deep elliptical hopper, a hole for the handle on the edge and its diameter is 37 cm. The grinding surface is featured by two regular sockets (3 × 2.5 cm; 1.8 cm deep) which housed the rynd. This is part of the system of supports to sustain the weight of the upper stone and adjust the gap between the upper and the lower mill to produce fine or course flour. The rynd joins a vertical pivot (the spindle) inserted in a hole located at the centre of the lower mill (fig. 10). The device E.1041 comes from a deposit level excavated in a context of the sixth c. AD.

---

15 Pecorella 1993, pp. 21-23.
16 Recent studies have revealed local variations and different rotary hand mill types: Quesada Sanz et al. 2014, pp. 83-118.
second c. BC, followed the Roman armies in their conquests eastwards.

Returning to the mill found in Tell Barri, how did it come from so far?

Giving an answer to this question is very complicated at the moment. Only future researches could eventually give us a better idea of its possible spread in the Near East.

---

4. The quern type with “grain container”

The last mill type presented is probably the most controversial one: it is featured by a grain container carved into the lower grinding surface (fig. 11). It is possible to distinguish two variations.

The upper moving querns E.2974 and E.5914 are characterized by the lack of hopper and the presence of a handle at the centre of the upper surface (fig. 12).

This suggests that the upper mill had to be lifted to feed the devise: probably the grain had to be set at the centre of the stationary quern to be ground. The position of the handle implies two possibilities for the movement: either a “T” shaped handle for a semi-rotary motion or a “L” shaped handle for a rotary or alternative motion. Considering the features of this mill type, personally, a “T” shaped handle would probably be easier to be operated.

On the other hand, the querns E.3602 and E.6226 (fig. 13) differ from the previous ones for the presence of a narrow hopper (diameter 3.7 and 6 cm) at the centre and the lack of any handle.

---

20 For alternative motion it is meant an angle between 180° and 270°.

---

**Figure 11**
Fascitiello M., Back side of the upper quern with grain container E. 6226. Basalt. Max diam. 32.5 cm. 3rd – 5th c. AD. Found at Tell Barri

**Figure 12**
Fascitiello M., Two upper querns with grain container featured by a handle in their center. Max diam. 33 cm. Basalt. 2nd and 6th c. AD. Found at Tell Barri
The presence of a hopper means that the operator did not need to lift the upper quern to feed the system and the lack of handle makes me think that the instrument described a semi-rotary motion applied by the operator’s hands placed on the opposite sides of the tool.21

All the querns of this type have similar proportions (the diameter is between 32 and 36.5 cm) and come from deposit levels dating between the second and sixth c. AD.

At this point the question is: how was the grinding lower quern?

From my research on the rotary hand mills from Tell Barri, I have noticed that the tool E.6428 (fig. 14) would perfectly match with the upper mills just presented.22

It was found in its original location (fig. 15), in a kitchen of a domestic complex which dates between the end of the second and the beginning of

21 No traces of grooves along the edge of these tools were found to suppose the presence of any cords used to support a handle.

22 This association is suggested by the diameter and the inclination of the grinding surface, the same as the upper mills.
the third c. AD.\textsuperscript{23} This stationary mill is part of a L-shaped platform made of four fired-bricks; this is a multifunctional working area used for preparing and cooking food (traces of a fire were found).

The place where the stationary quern E.6428 was found, along two of the walls of the kitchen, in the corner of the room, may suggest that the operator just moved the upper mill by following an alternative motion\textsuperscript{24}. If this assumption would be confirmed by other findings, the hypothetical connection between the upper mills with grain container and the lower stationary mill E.6428 would be more certain. Unfortunately, at this point of the research, this association has been suggested by the general features of the tools but, unfortunately, none among the upper mills with grain container comes from the same archaeological context as the stationary mill E.6428. Regarding the place where rotary querns were located during the grinding process, the position of this mill on a low platform set on the floor shows that the operator had to work knelling. This finding does not exclude that other mill types couldn’t be positioned on higher platforms, supports or tables so that the operator could work in a standing position.

\textsuperscript{23} This context is presented here for the first time.

\textsuperscript{24} The relation between the rotary or alternative motion and the mill’s location was approached for the first time by M. Py, studying the mills from Lattes: PY 1992, p. 225. The same subject has been analyzed in Chartrain 2015, p. 450, fig. 13.
5. The catalogue of the rotary mills from Tell Barri

E. 438
Upper moving quern of a tenon and mortise mill. The upper surface is irregular and coarse. The grinding lower surface is flat and smooth. The hopper has a cylindrical section and a circular shape. The hole which held the handle has a truncated cone section and a circular shape; it is located on the edge. Made of basalt. Intact. Chronology unknown.
Measures: 35×25 cm; H. 4,6 cm; Ø 37 cm; Ø hopper 3 cm; Ø hole of the handle at the top 2 cm; Ø hole of the handle at the bottom 3,5 cm.

E. 707
Upper moving quern of a tenon and mortise mill. Circular shape with a rectangular extension where the hole for the handle is located; this hole has a cylindrical section and is oval-shaped. Regular upper surface embellished by a triangular decoration between the hole for the handle and the raised collar around the hopper. The hopper has a truncated cone section and a circular shape. The grinding lower surface is flat and featured by furrows in order to improve the grinding. Made of basalt. Intact. Chronology unknown.
Measures: Ø 42 cm; H 7,5 cm; hole for the handle 4,5×3,5 cm; Ø hopper at the bottom 14 cm; Ø hopper at the top 11 cm.

E. 912
Lower stationary quern of a tenon and mortise mill. The grinding surface is regular and partially smooth. The tenon has a truncated cone section and it is smooth due to the rotary motion. The lower surface is course. Made of basalt. Intact. Chronology unknown.
Measures: Ø 35 cm; H 6 cm; H tenon 7 cm; Ø tenon at the top 9 cm; Ø tenon at the bottom 10 cm.

E. 915
Upper moving quern of a tenon and mortise mill. The upper surface is irregular and coarse; the lower one is flat and featured by furrows, in order to improve the grinding. The hopper has a double-cone section. Made of basalt. Partially preserved. Chronology unknown.
Measures: 39×19 cm; Ø 39 cm; H 6; Ø hopper about 3 cm.

E. 1041
Upper moving quern of a rotary mill. The upper surface is regular. The hopper is oval-shaped. The hole for the handle is preserved on its edge; it has a circular shape and a truncated cone section. The lower grinding surface is flat and smooth; it is characterised by two regular sockets (3×2,5 cm; 1,8 cm deep) where a piece of iron (the rynd) was inserted to support the upper quern. The rynd is joined to a spindle set in the lower quern; this equipment is essential for the stability and adjustment of the rotary mill. Made of basalt. Intact. 6th c. AD.
Measures: Ø 37 cm; H 6,4 cm; hopper 11,5×15 cm; Ø hole for the handle at the top 3,5 cm, at the bottom 2,2 cm.

E. 1228
Upper moving quern of a tenon and mortise mill. The upper surface is somewhat irregular and coarse; the lower one is flat and smooth. The hole for the handle has a circular shape and a double cone section. Made of basalt. Partially preserved. Chronology unknown.
Measures: 16×14,5 cm; H 6 cm; Ø about 22 cm; Ø hole for the handle at the top 3,5 cm; Ø hole for the handle at the base 2,8 cm.

E. 1538
Upper moving quern of a tenon and mortise mill. The upper surface is regular and partially smooth. The hopper has a truncated cone section and a circular shape. The grinding surface is flat and smooth. Made of basalt. Partially preserved. Chronology unknown.
Measures: 21×26 cm; H 6,7 cm; Ø 50 cm; Ø hopper 5 cm.
E. 2885
Lower stationary quern of a tenon and mortise mill. The upper surface is regular and smooth; the lower one is irregular and course. The tenon is thin and has a truncated cone section. Made of basalt. Intact. 3rd c. AD.
Measures: Ø 38 cm; H 5.2 cm; Ø tenon at the top 7.5 cm; Ø tenon at the base 11.5 cm; H tenon 2 cm.

E. 2974
Upper moving quern with grain container. The upper surface is flat and somewhat smooth. At the centre of the tool a fragmentary iron handle is still visible. Lower grinding surface, regular and smooth, which surrounds an inner circular space used to contain grain during the grinding. Made of basalt. Broken in three pieces; reassembled. 2nd – 3rd c. AD.
Measures: Ø 33 cm; H 4.5 cm; Ø handle 3.5 cm; Ø inner circular space 19.5 cm; depth inner circular space 1.3 cm; width grinding surface 6.8 cm.

E. 3602
Upper moving quern with grain container. The upper surface is regular and coarse. The hopper has a double cone section, a circular shape and is not exactly set at the centre of the tool. The lower surface is coarse and not well preserved. No handle. Made of basalt. Broken in four pieces; reassembled. Late 5th c. AD.
Measures: Ø 36.5 cm; H 7 cm; Ø hopper at the top 6 cm, at the bottom 5.5×4.5 cm.

E. 3606
Upper moving quern of a tenon and mortise mill. The upper surface is irregular and coarse. The hopper has a cylindrical section, a circular shape at the bottom, an almost circular shape at the top. The hole for the handle has a double cone section. The lower surface is flat and smooth. Made of basalt. Intact. Late 4th – early 5th c. AD.
Measures: Ø 41.5 cm; H between 9 and 7 cm; Ø hopper at the top 12.5×10 cm; Ø hopper at the bottom 11 cm; Ø hole for the handle 5 cm.

E. 4585
Upper moving quern of a tenon and mortise mill. The upper surface is coarse; the hopper has a double cone section. The grinding lower surface is flat and smooth. The hole for the handle has a double cone section; it is located over the circular edge of the mill, on an extension. On the grinding surface, the extension is slightly raised, fitting with the edge of the stationary quern in order to give stability to the rotation. Made of basalt. Partially preserved. Late 2nd c. AD.
Measures: 41×30 cm; H 10 cm; Ø 42 cm; Ø hopper 13 cm; Ø hole for the handle at the top 4 cm, at the bottom 3 cm.

E. 5914
Upper moving quern with grain container. The upper surface is regular and somewhat smooth. At the centre of the tool a fragmentary iron handle is still visible. The lower grinding surface is flat and smooth; it surrounds an inner circular space used to contain grain during the grinding. Made of basalt. Partially preserved. 5th – 6th c. AD.
Measures: 32×17.5 cm; Ø 32 cm; H 6 cm; Ø handle 4 cm; Ø inner space 24 cm; depth inner circular space 1.6 cm; width grinding surface 7 cm.

E. 6087
Upper moving quern of a tenon and mortise mill. The upper surface is regular and somewhat smooth. The hopper has a truncated cone section. The grinding surface is flat and smooth. Made of basalt. Intact. 12th – 13th c. AD.
Measures: 18×29 cm; H 3.7 cm; Ø 38 cm; Ø handle 6 cm.

E. 6226
Upper moving quern with grain container. The upper surface is regular and slightly rounded. The hopper has a circular shape and a double cone section. The lower surface, regular and smooth, surrounds an inner circular space used to contain grain during the grinding. Made of basalt. Intact. 3rd – 5th c. AD.
Upper moving quern of a tenon and mortise mill. The upper surface is somewhat irregular. The hopper has a cylindrical section, circular shape at the bottom, almost circular at the top. Along the edge of the hopper there are two holes, filled in with two pieces of iron (one still visible), used for holding the lower and the moving mill together, probably with a system of cords. The hole for the handle has a truncated cone section; it is located on an extension. On the grinding surface, the extension is slightly raised, fitting with the edge of the stationary quern in order to give stability to the rotation. The lower surface is flat and smooth. Made of basalt. Intact. Late 2nd – early 3rd c. AD.

Measures: Ø 32,5 cm; H 5 cm; Ø hopper 3,7 cm; Ø inner circular space 16,5; depth of the inner circular space 1,6 cm; width grinding surface 8 cm.

6. Conclusions

The rotary quern is one of the most advanced lever mills in use in the ancient world and this paper gives a better idea of the sophistication and complexity of this device, as well as an idea on the variety of rotary hand mills in use and their different mode of operations.

It could be hoped that this work, with the different rotary querns in use at Tell Barri, is the base for future research on this field, especially in the Near East.
BIBLIOGRAPHY


