Anadolu Araştırmaları
Anatolian Research

İSTANBUL UNIVERSITY PRESS

AnAr, 30, 211–234
DOI: 10.26650/anar.2024.30.1452219 Research Article

Hopper–Rubbers or Olynthus Mills from Şarhöyük/ Dorylaion: Recent Evidence on Typology and Chronology

Mahmut Bilge Baştürk[1]

[1]Anadolu University, Faculty of Humanities, Department of Archaeology, Eskişehir, Türkiye

ORCID ID: M.B.B. 0000-0003-4421-6084

Corresponding author:
Mahmut Bilge Baştürk,
Anadolu Üniversitesi, Edebiyat Fakültesi Arkeoloji Bölümü, Eskişehir, Türkiye
E-mail: bilgebasturk@gmail.com

Submitted: 13.03.2024
Revision Requested: 03.06.2024
Last Revision Received: 06.06.2024
Accepted: 06.06.2024

Citation: Baştürk, M.B. (2024). Hopper–rubbers or olynthus mills from Şarhöyük/ Dorylaion: recent evidence on typology and chronology. *Anadolu Araştırmaları-Anatolian Research, 30*, 211–234. https://doi.org/10.26650/anar.2024.30.1452219

ABSTRACT
Şarhöyük/Dorylaion (Dorylaeum) is one of the largest mounds in central Anatolia and boasts a stratigraphical sequence that spans from the Late Chalcolithic period to the end of the 12th century AD. This paper focuses on a particular set of discoveries made at Şarhöyük, namely the Olynthus millstones, or the hopper-rubbers, which are generally considered as an important development stage from basic grinding mills to complex grinding techniques. Most of the millstones discovered were found in the Hellenistic layers, either in situ or in secondary contexts. With the exception of the mill with hand grips, all other samples that can be classified based on a certain typology belong to the Olynthus Mills group with Vertical Holes for Pivot, commonly referred to as Frankel's Type II.4 or Bombardieri's Type IIID.3e. However, it is plausible to suggest subtypes within this group. The aim of this study is to analyse a specific 'eastern type' Olynthus mill and the timeframe of its usage based on archaeological data from Şarhöyük/Dorylaion and its surrounding region.
Keywords: Dorylaion/Dorylaeum, Hopper-rubber,Olynthus mill, Mediterranean, Hellenistic, Achaemenid

This work is licensed under Creative Commons Attribution-NonCommercial 4.0 International License

Introduction

Şarhöyük, located approximately 2 km northeast of modern Eskişehir city centre, is one of the largest mounds in the region with a diameter of approximately 400 x 450 m and a height of 17 m above the modern plain level, covering a vast area of an outer town and a necropolis (Fig. 1). Known to the archaeological world since late 1880's and identified with the ancient city of Dorylaion (Dorylaeum) (Ramsay 1890, 168; Cox and Cameron 1937, XII), Şarhöyük has a history of systematic excavations since 1989, beginning with Prof. Dr. Muhibbe Darga, taken over by Prof. Dr. Taciser Tüfekçi Sivas in 2005, and being carried on by the author since 2015 (Tüfekçi Sivas 2018; Baştürk 2019). According to recent data, nine cultural periods have been identified:

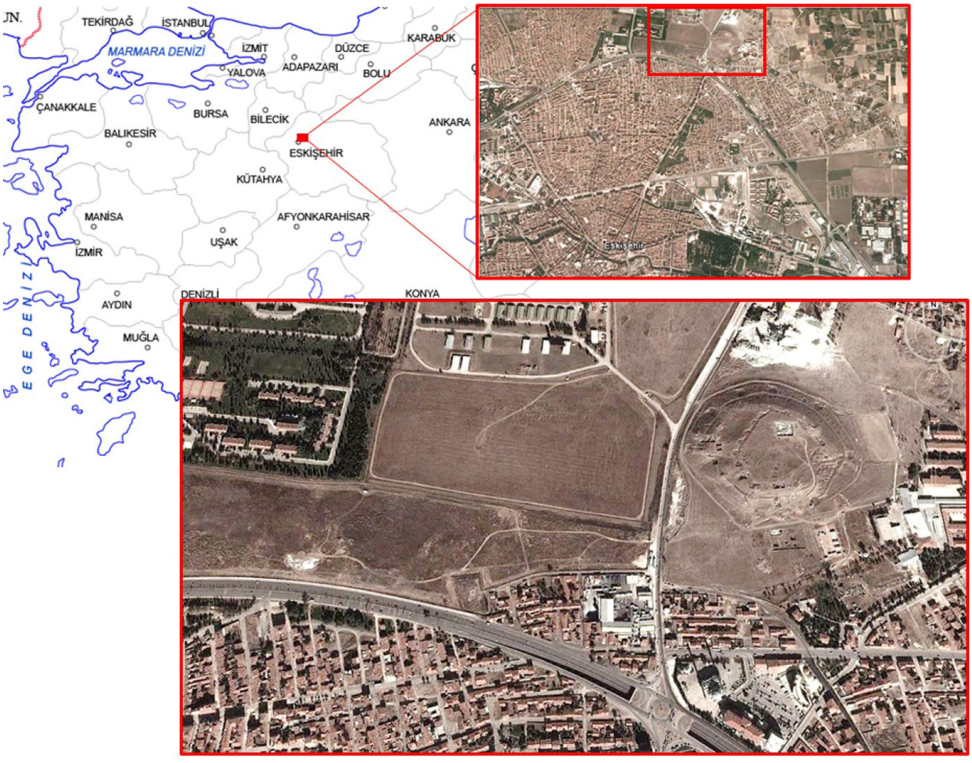


Figure 1: Location of Şarhöyük/Dorylaion.

ŞH 0 Late 19th century–Turkish War of Independence Trenches (early 20th century)

ŞH I Late Roman/Byzantine period

ŞH II Roman period

ŞH III Hellenistic period

ŞH IV Iron Age

ŞH V Late Bronze Age

ŞH VI Middle Bronze Age

ŞH VII Early Bronze Age (no architectural layers)

ŞH VIII Late Chalcolithic period (no architectural layers)

The hopper-rubber millstones discussed below were unearthed in the Hellenistic layers (ŞH III), one of the best studied periods on the mound, as a result of long-term excavations. Architectural data belonging to the Hellenistic period were unearthed on the western slope, above the Middle and Late Phrygian layers; in the central sector, where a large Hellenistic quarter (Yedidağ 2019, 582-594) was brought to light beneath the Byzantine and Roman foundations; and on the southern slope, where the Byzantine and Roman period destruction was detected to be minimal. Despite continuous building activities and a series of faint sub-stratigraphical formations, a temporary but detailed periodisation of the Hellenistic period can be presented as follows, with the help of the excavations carried out on the southern slope:

ŞH III.1 Late Hellenistic–Early Roman

ŞH III.2 Late Hellenistic

ŞH III.3 Middle–Late Hellenistic

ŞH III.4 Early–Middle Hellenistic

ŞH III.5 Early Hellenistic

ŞH III.6.1 Early Hellenistic

ŞH III.6.2 Late Classical to Early Hellenistic Transition

Hopper–Rubbers or the ‘Olynthus Mill’

Although this type of mill has been found in archaeological excavations since the mid-1800’s, Flinders Petrie (1888, 27) was the first to define the device as an instrument for grinding. The working principles have been examined by several scholars, mainly based on the reliefs of a Megarian bowl from Thebes (Kourouniotis 1917; Moritz 1958). Childe (1943, 22) was the first to suggest a term for the implement: *‘The hopper-rubbers… I propose to call*

the device'. The term 'Olynthus mill' was coined by Moritz (1958, 46) as a result of earlier detailed studies of this type of mill at this site. The initial comprehensive study was conducted by Frankel (2003), who discusses the terminology and working principles and puts immense effort into creating an extensive typology for the tool. Frankel follows Moritz and utilises the term Olynthus mill, which most scholars currently use. Bombardieri (2010) provided the most recent and comprehensive contribution to the typology of grinding stones and mills, naming the tool as 'the Olynthus Hopper Mill'. While Frankel's typology is commonly used to define different forms of the device, I tend to use both Frankel's and Bombardieri's classifications. However, the term hopper-rubber may also be valid as it emphasises the device's structure and avoids any regional assumptions about its origins.

With the exception of those lacking slots for a rod or with hand grips (discussed below), the Olynthus mill is a lever-operated device consisting of two primary components: an upper stone in the shape of a square or rectangle with a corresponding depression carved out of the top, and a larger block positioned beneath the first to facilitate grain grinding. The depression, also known as a 'hopper', features a narrow slit at the bottom that serves as a funnel for directing grain into the grinding process. A lever is inserted into the slots cut into the longer axis of the stone to generate a back-and-forth movement. When the lever is attached to a vertical pivot point, it increases the length of the lever and the angle of the horizontal oscillation.

Olynthus Mills Unearted at Şarhöyük/ Dorylaion: Typological Features

During more than 30 years of excavation at Şarhöyük/Dorylaion, more than 40 pieces of Olynthus millstones have been recovered, some of them intact, some partially preserved, and some as tiny pieces barely surviving. Here, I will attempt to classify the general typological characteristics of the samples from Şarhöyük and then proceed to present the intact and in situ finds accordingly, working with those samples that can be confidently assigned to a particular type. The discussion on regional and chronological aspects will be presented accordingly.

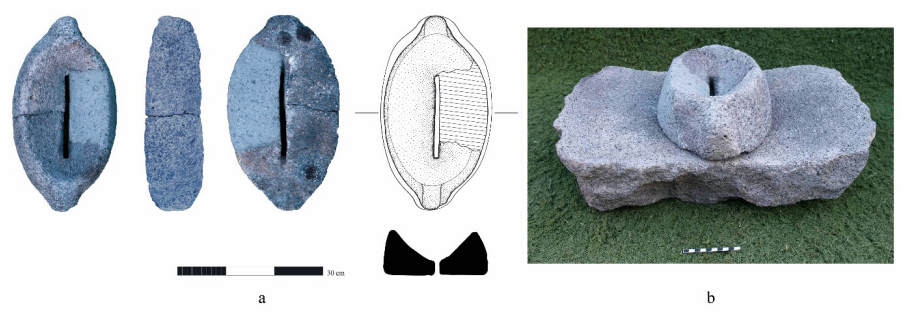


Figure 2: Olynthus Mill with hand grips (ŞH–O 1). a. repaired finding and drawing; b. hand grip mill placed on a grinding stone from the same layer.

Olynthus Mill with Hand Grips (Fig. 2)

A rare type of Olynthus mill (Figure 2a) was discovered in the central Hellenistic quarter within the Late Hellenistic layers (ŞH III.2). The basalt artefact was not found in its original position because it was potentially repurposed as a slab on a wall that was subsequently destroyed by a pit in the later period (ŞH III.1). The mill, which has an elliptical shape with two gripping projections on the longer sides, was fractured and only partly preserved (subsequently reconstructed by the excavation team). The elliptical hopper narrows towards the slit. The sample, classified as ŞH–O 1 (Şarhöyük – Olynthus 1), may have been used with the frequently found flat and concave grinding stones in the Hellenistic layers, as suggested by its slightly convex bottom (Fig. 2b).

Olynthus Mills with Vertical Holes for Pivot (ŞH–O 2)

A subtype of the lever-operated Olynthus mill is the 'Upper Stone with Vertical Hole for Pivot' (Frankel 2003, 12; Bombardieri 2010, 181-182). This type features a horizontal projection, or spur, adjacent to one of the handle slots, serving as a bolster for the horizontal rod fixed to the vertical pivot. Frankel's typology is grounded in limited evidence due to the lack of attention to these artefacts in excavation reports or publications (Frankel 2003, 1). Most of the findings have been undervalued—and still are—having been published with a distant image or even without one, and suffering from a lack of necessary drawings or figures. Consequently, any typological endeavour is hampered by the limited dataset, which largely consists of only a few photos. In this regard, I shall attempt to add the profiles of the finds, where available, to improve the typological aspects of this peculiar form.

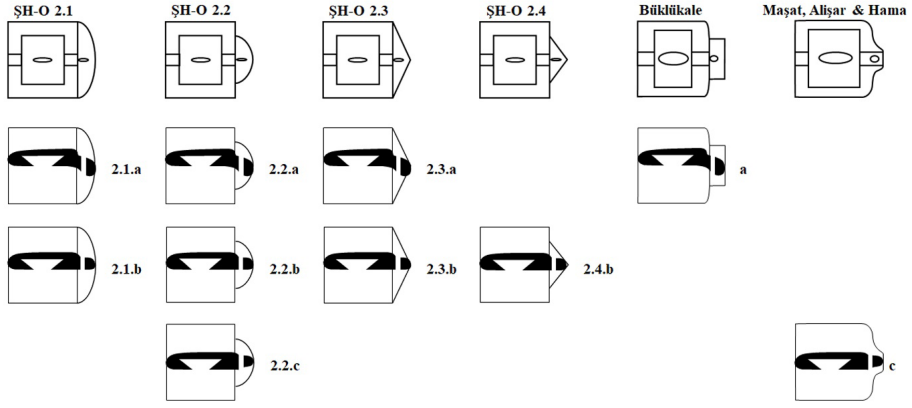


Figure 3: Typology of Olynthus mills with protrusions from Şarhöyük/Dorylaion with variations from other settlements.

This category of Olynthus mills, specifically Frankel's Type II.4 and Bombardieri Type IIID.3e, is one of the less common types compared with the standard ones. Nevertheless, findings from Şarhöyük/Dorylaion and the surrounding area may challenge this notion. To date, all recovered specimens from Şarhöyük with a specific typology belong to this type, and recent evidence from the region supports the idea that Şarhöyük is no exception. Thus, the typology of the lever operated hopper-rubbers from the site was formed according to the shape of the projections (Fig. 3): semi-circular (ŞH–O 2.1), narrow semi-circular (ŞH–O 2.2), triangular (ŞH–O 2.3), and narrow triangular (ŞH–O 2.4).

ŞH–O 2.1 features a semicircular extension that typically measures one-fifth of the width of the primary block. This projection extends from the edges of the block with a natural curve. Two samples have been defined so far as belonging to this type. The second type, ŞH–O 2.2, seems to be a better worked modification of this, with the semicircular protrusion applied narrower, creating shoulders on each side. The edges of the semicircular protrusion are left in line with the borders of the hopper. This type represents the majority of samples from Şarhöyük, with at least five well-defined samples. ŞH–O 2.3 is a more sophisticated version of those with semicircular projections. The broad projection is shaped like a triangle, projecting most of the time at a length equal to one-fifth of the width of the block. Three samples are proven to be in this typology. The most challenging type to identify is ŞH–O 2.4, characterised by narrow triangular protrusions. Only one sample was successfully identified, whereas other potential candidates were too fragmented to receive a typological evaluation. This could be attributed to the physical weakness of the form or the fact that the form was produced in fewer numbers because of its fragile structural integrity.

Another typological classification is based on the cross-sectional shape of the form, specifically the protrusion (see Fig. 3). To make this classification, it is necessary to have the entire artefact in an intact condition, at least the entire projection with the part where it protrudes from the main body. As mentioned previously, comparisons with items superficially photographed will not suffice. Therefore, it is essential to include proper section drawings or profile photos to ensure a comprehensive evaluation. There are three main types of sections present in the analysed samples, and these are differentiated by adding lowercase letters to type numbers (such as ŞH–O 2.1.a, or ŞH–O 2.3.b).

The initial subtype (a) of the cross-sections exhibits a downward extension from the primary body (Fig. 3). It is widely believed that the wear of the stone over time is responsible for this, but the samples examined suggest that this profile is a deliberate choice. First, the cutting marks on these stones clearly indicate that the downward protrusion is intentional. Additionally, in certain examples (such as Fig. 8d), the pivot hole is positioned behind the downward protrusion, clearly indicating that the grinding surface had to be positioned at some distance from this point. Second, if the abrasion on the lower surface is the result of

long-term use, then we have to accept that a number of samples, or most of them in the case of Şarhöyük, were not resourcefully used. Some samples from different sites show a very steep downward extension, sometimes twice the total thickness of the main block. Of course, there is some degree of wear on any used millstone, but this should not be more than half the thickness of the stone itself, if it is produced to operate efficiently. Regardless of whether it was intentional or the result of abrasion, it is clear that the upper stone had to be placed on the lower stone in a different way because of the deep hollow surface: it may have had to be placed forward, between the pivot and the body, closer to the pivot. Such positioning will naturally decrease the angle of oscillation; however, it will have a smaller friction surface. Or, the worn stones had to be discarded after a certain degree of abrasion unknown to us, which I think is not plausible and demonstrable.

The second profile type has flat bottoms (b). The protrusions on these samples lie in the same plane as the main body. The entire upper millstone comes into contact with the lower stone, and unlike the previous type mentioned, the positioning of the upper stone is not restricted. This permits a longer lever and an increased oscillation angle. Nevertheless, the completely flat surface proves to be a handicap: it also increases the frictional surface.

The third type seems to attempt to regulate the handicap mentioned above. In type (c), the protrusion is clearly carved out above the surface level. Still supporting the horizontal rod, this design reduces both the total weight of the device and the area of contact, limiting the friction area to the grinding surface.

Archaeological Contexts of Olynthus Mills from Dorylaion

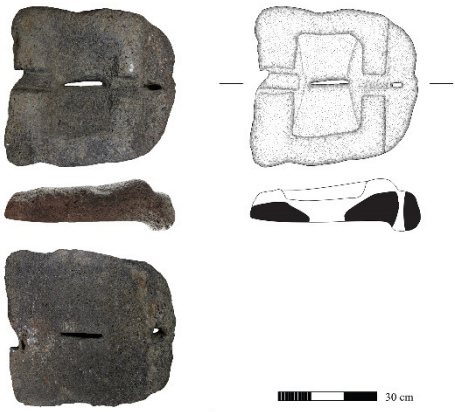
The majority of hopper-rubber millstones found at Şarhöyük/Dorylaion were discovered in the Hellenistic layers, with only a few being utilised in the Byzantine (ŞH I.2) cist graves. Those that remain intact, however, all stem from the Hellenistic era (ŞH III), but from different subphases and contexts.

Olynthus Mill Upper Stone from the Late Hellenistic Period (Fig. 4)

The upper stone of an Olynthus mill was unearthed in the latest phase of the Hellenistic occupation (ŞH III.2), in an area very close to the surface soil and destructed by the later layers. The stone was found covering a pithos, which was buried into the ground up to its mouth (Fig. 4a). Although the evidence from the context is not sufficient, the general appearance gives clues about a workshop or storage space, frequently attested in the other Hellenistic sectors and layers of the mound.



a



b

Figure 4: Olynthus mill upper stone (ŞH–O 2.1.a) covering pithos from the Late Hellenistic period. a. unearthed millstone in the field; b. photographs and drawing of the millstone.

The basalt stone (Fig. 5b) has a square form with a semi-circular protrusion extending downwards (ŞH–O 2.1.a). The rectangular hopper deepens down to the narrow slit at an angle of approximately 45°. It is clear that the stone was in use for a long time and may have been mistreated, for it bears marks of hacks and chips all around. One may easily suggest that the stone was discarded from its intended function and was employed as it was found; however, using such a heavy piece as a lid is neither pragmatical nor rational. Thus, the finding may well have served as a millstone somewhere around, but the archaeological data set is incomprehensible.



Figure 5: Olynthus mill upper stone (ŞH–O 2.2.b) from Middle/Late Hellenistic period. a. unearthed millstone in the field; b. photographs and drawing of the millstone.

Olynthus Mill Upper Stone from Middle/Late Hellenistic Period (Fig. 5)

Another Olynthus mill upper stone was found being used in a wall (Fig. 5a) belonging to the Middle / Late Hellenistic phase (ŞH III.3) of the Hellenistic quarter in the central sector of Şarhöyük. This sublayer represents the transition from the well-organised Early Hellenistic quarter to a slightly dispersed settlement arrangement. The walls of the room in relation with a hearth and a series of pits were destroyed by Byzantine burials cutting into them.

It is difficult to correlate this basalt stone (Fig. 5b) with a certain type; however, the narrow semicircular protrusion and flat bottom surface associate it with the second type (ŞH–O 2.2.b). The size is smaller than that of the other excavated ones. The hopper is trapezoidal and does not show any right angles or straight lines; however, some preliminary cutting marks indicate that the hopper was intended to be rectangular. It is obvious that the work on the stone was not finished, but the wear and scuff traces under the bottom suggest that it was not discarded because of the rudimentary workmanship: it was used for a time, then somehow ended up in a wall construction.

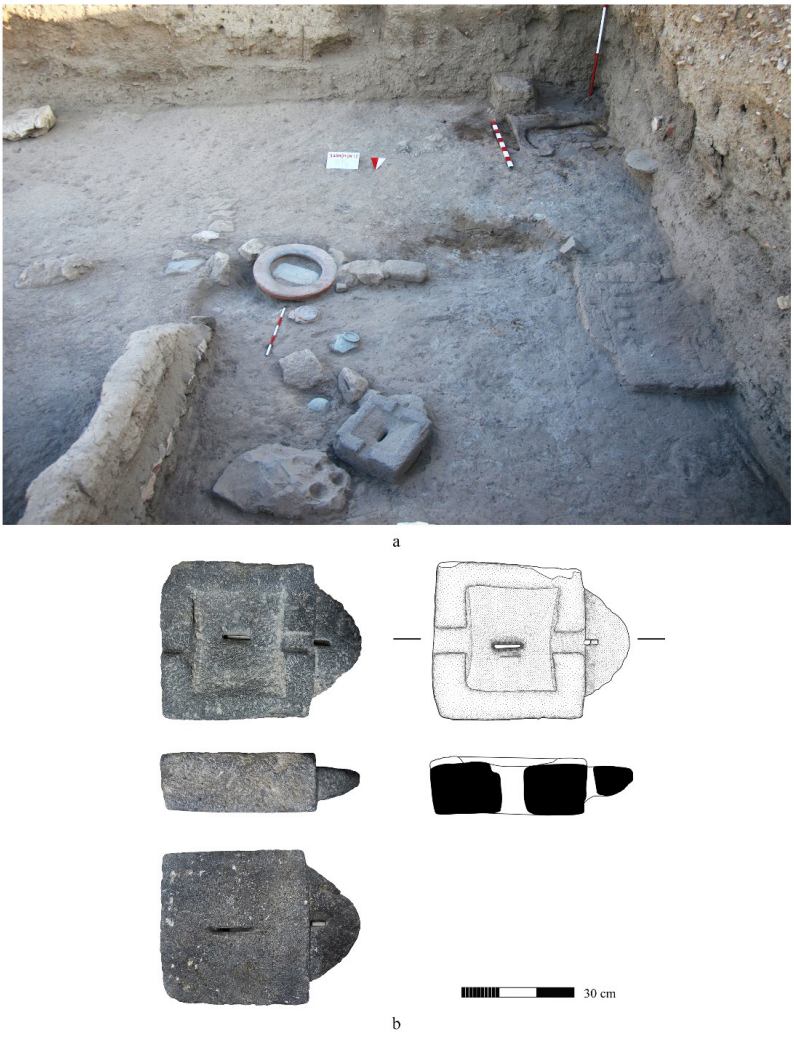
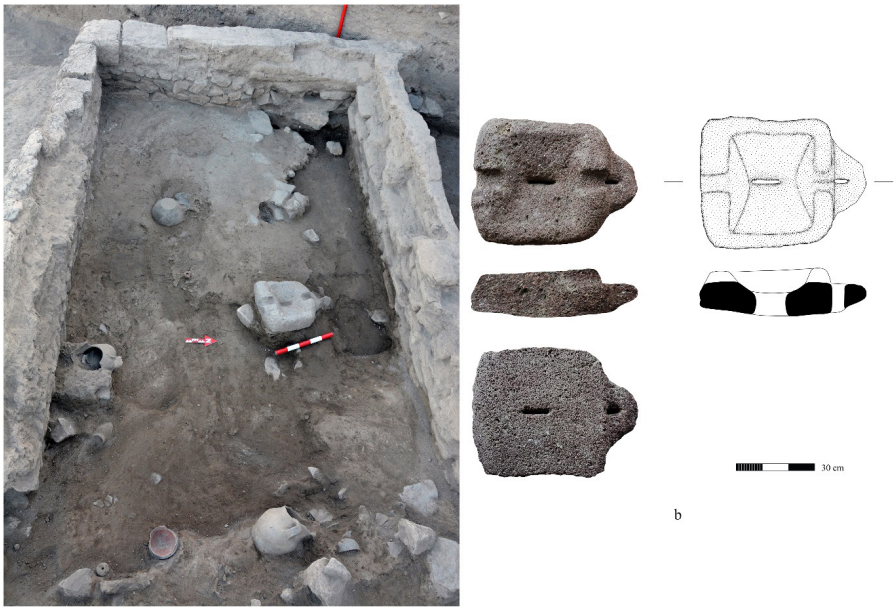


Figure 6: Olynthus mill upper stone (ŞH–O 2.2.c) from Early Hellenistic workshop or kitchen. a. unearthed millstone in the field; b. photographs and drawing of the millstone.

Olynthus Mill Upper Stone from Early Hellenistic Workshop or Kitchen (Fig. 6)

The basalt upper stone of an Olynthus mill was unearthed in the central Hellenistic quarter in a layer dated to the later phase of the Early Hellenistic period (ŞH III.5). Although the layer was slightly destroyed by the subsequent phase, the architectural features of the context consisting of numerous and various sherds, two hearths, iron objects, and small pithoi suggest a small workshop or kitchen rather than a domestic chamber (Fig. 6a). The millstone lay on the floor next to another small and plain grinding stone, a smaller stone slab with a socket, and a larger stone block. The millstone can be considered *in situ*; however, there are some issues to be addressed. The larger stone next to it does not show the necessary features of a lower stone of an Olynthus mill, it has no flat surface for grinding, it is not a vesicular volcanic rock, and there are no traces of a higher platform, or even a table, to properly operate this type of Olynthus mill with a rod. If the millstone was in use here, it would have been in its secondary location, where it would have been used as a grindstone rather than a mill. Alternatively, it could have been used just as a pole base supporting the roof or canopy.

The stone, with a narrow semicircular projection carved above the bottom surface, is a good example of its type (ŞH–O 2.2.c). The millstone was beautifully finished with straight edges and smooth surfaces. However, it is also interesting to see such a shallow hopper on such a decent work.



a b

Figure 7: Olynthus mill upper stone (ŞH–O 2.2.c) from Early Hellenistic workshop or storehouse. a. unearthed millstone in the field; b. photographs and drawing of the millstone.

Olynthus Mill Upper Stone from Early Hellenistic Workshop or Warehouse (Fig. 7)

The last intact Olynthus millstone presented here comes from a house with two construction phases (Fig. 7a), dated to the earliest phase of the Hellenistic period. Pottery evidence suggests that the mudbrick house (ŞH III.6.2) with stone foundations was constructed towards the end of the fourth century BC as a relatively large dwelling, directly cutting into the Late Achaemenid (ŞH IV.1) layers (Baştürk and Baştürk 2021, 29-37). Sometime after the initial construction phase, the house underwent a series of modifications: secondary mudbrick walls without stone foundations were added to divide the space, and the room was repurposed as a workshop or depot for daily activities. The last phase of the house (ŞH III.6.1) can be securely dated to around 280 BC with the help of a number of intact vessels (local and imported), multiple pottery sherds of kitchen ware, coarse service vessels and small storage jars, a lamp, and a coin of Lysimachus from the floor, all recovered *in situ* from the same context and sealed by an earthquake (Baştürk and Baştürk 2021, 30). The context also contained 15 loom weights, two iron knives, uncertain iron objects, and a bone handle, making one think that the room was functioning as a warehouse or small workshop for daily routine. The upper stone was unearthed in the middle of the room, lying on the floor, surrounded by the abovementioned findings. Several small stones were found in the room, concentrated in the northwest corner, suggesting that they were part of an installation for operating the Olynthus mill, and the upper stone rolled off the installation during the seismic shock. However, the possibility of the mill operating in that corner remains a speculation, as no lower stones have been found suitable for grinding. One may also propose that the millstone was stored there for future use somewhere else, or it was used as a pole base after the space had been rearranged. The archaeological evidence is insufficient to fully support any of these hypotheses.

The basalt stone is of Type ŞH–O 2.2.c, similar to the previous sample, with a narrow semicircular projection carved above the bottom surface (Fig. 7b). However, unlike the previous one, the bottom surface was worn in a convex profile, suggesting that it was used on a concave lower stone.

Olynthus Millstones from Various Hellenistic Contexts (Fig. 8–9)

Over 40 pieces of Olynthus millstones have been excavated to date, but only 20 with a particular typology or obvious shape were selected for this study. Most come from Hellenistic layers, while some of them (Figs. 9f, 10c) were found to be used in Byzantine cist burials cutting into the Hellenistic walls.

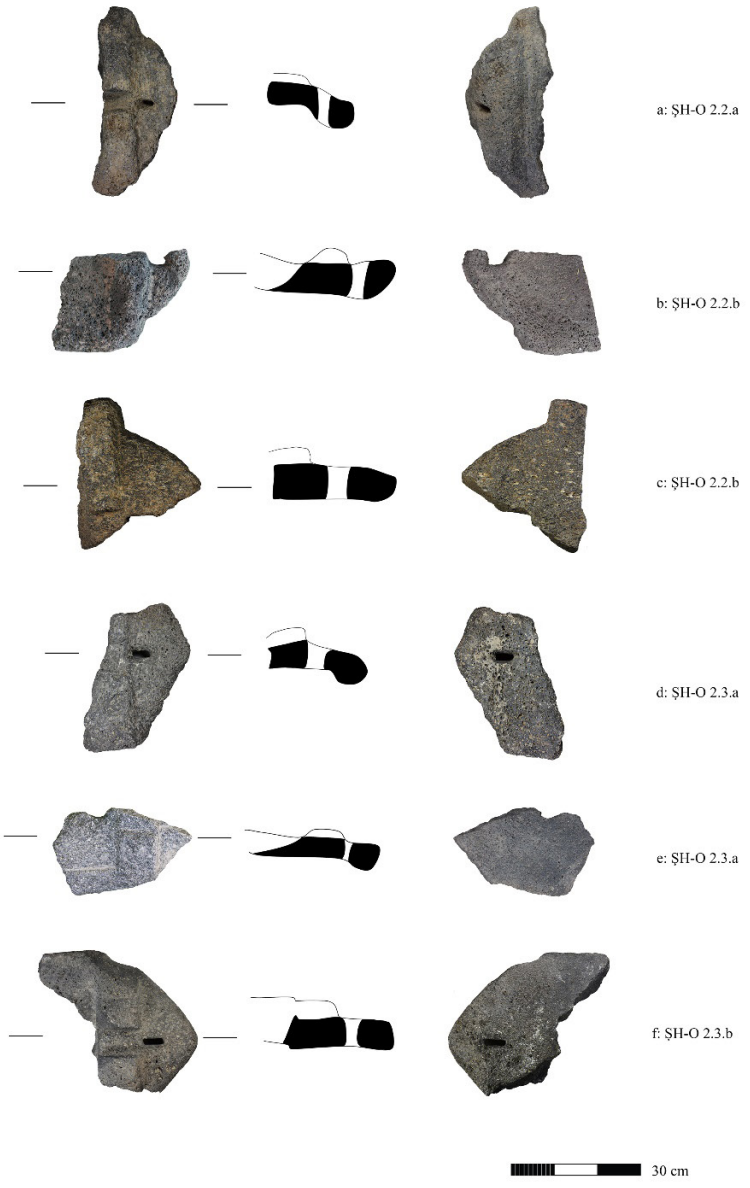


Figure 8: Olynthus mill upper stone samples of certain types.

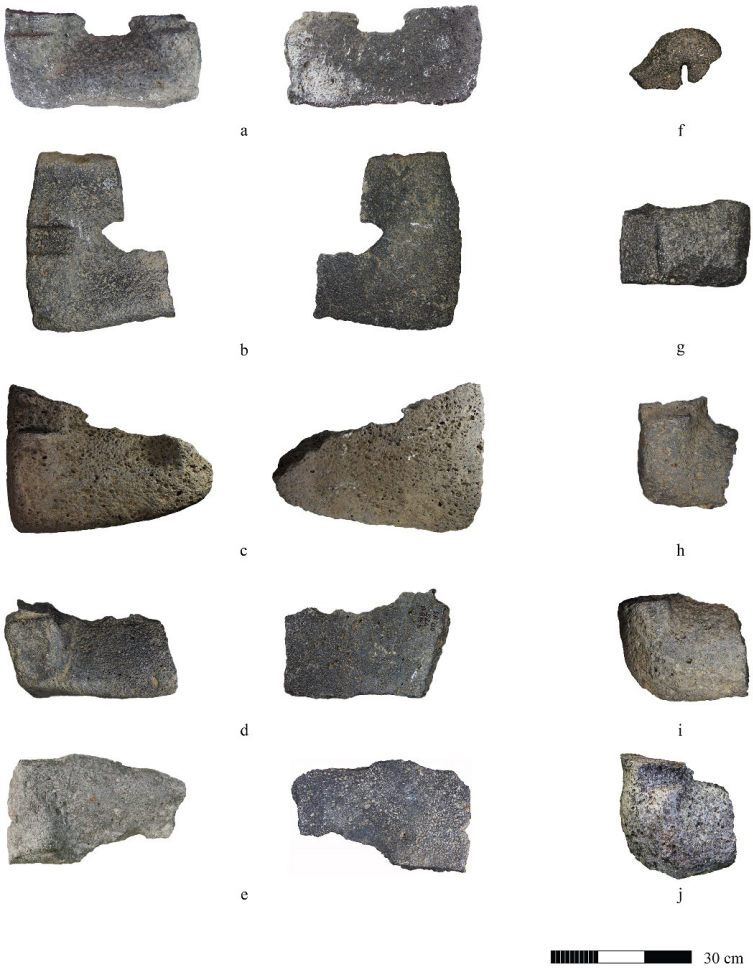


Figure 9: Miscellaneous Olynthus millstone samples without a certain type.

The samples featuring triangular protrusions (Fig. 8d–e) exhibited superior finishing compared with those with semicircular projections (Fig. 8a–c). Two primary block shapes are evident: square (Figs. 4, 6, 7, 9a, 9d) and slightly tapered on the protrusion side (Figs. 5, 9b, 9c, 9e). The well-crafted ones, such as Fig. 6 above, have unexpectedly shallower hoppers than the other samples (Figs. 8e, 9d). All hoppers except one sample were rectangular in shape: Figure 9a appears to have a butterfly-shaped hopper; however, it is difficult to confirm whether this is an intentional design or a manufacturing error as the other half of the hopper and the protrusion are missing. None of the examples have striation on the lower surface of the upper stones.

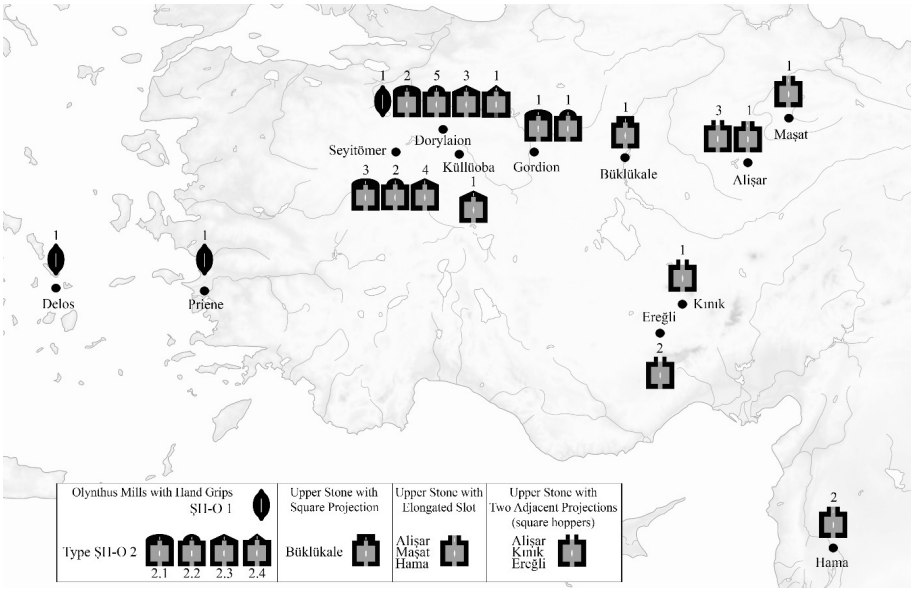


Figure 10: Typological distribution and comparison of Olynthus millstone types from Şarhöyük/Dorylaion. Numerals on the symbols of the types indicate the number of findings.

Discussion (Fig. 10)

The origin of Olynthus mill remains uncertain as their first appearance has yet to be determined. The archaeological evidence is clear that the Olynthus mill has its origins in the eastern Mediterranean. However, uncertainty surrounds the location of its invention, as it remains unclear whether it was created on the Greek mainland or in Anatolia. The earliest samples identified by archaeological layers date back to 425–400 BC in Athens, with similar ones found in Olynthus dating to the fifth century BC (Alanzo and Frankel 2017, 5).

The earliest type of Olynthus mill is also a matter of debate; it probably was a transformation from the basic hand grip saddle-querns to the mill with a hopper and hand grips (Frankel 2003, 8; Bombardieri 2005, 499). However, this device could have also been used as a smaller and portable type of the standard implement (Frankel 2003, 8; 17–18).

Only a few samples of Olynthus mills with hand grips (Bombardieri 2010, Type IIID.4) are known, all from the southern Aegean coasts and islands. Four samples are known to be compared to the Şarhöyük/Dorylaion sample: from Priene, Delos, Thera, and Rhodes. The finding from Thera, with its rectangular shape and striations on its lower surface, stands apart from the other two from Delos and Priene (Frankel 2003, 8), and the Rhodes sample is also rectangular in shape (Alanzo and Frankel 2017, 4). The Priene sample is comparable due to its size and dimensions, as well as its elliptical shape (Wiegand and Schrader 1904,

392-393, abb. 523); however, the hopper of this sample is circular, which slightly differs from the Şarhöyük sample. Interestingly, the closest parallel to the Şarhöyük sample appears to be the one from Delos, in terms of the shaping of the stone and the hopper, but it is only half preserved (Deonna 1938, 125-126, n. B5626, pl. XLIX: 368). The emergence of this type has been suggested to have occurred in the South Aegean based on the distribution of the finds. However, in light of the above-mentioned example from Şarhöyük/Dorylaion, a reconsideration is necessary. Even though the find was not *in situ*, having been found reused in a destroyed layer from the Late Hellenistic period, it serves as important information to include western central Anatolia in the discussion. It is plausible that it may have arrived here because of Dorylaion's significant role in the trade network between the east and west (Darga 2006; DeVries 2005; French 2013, A2, 3; Erpehlivan 2022). Numerous examples of high-quality imported pottery and rare metal artefacts are found in the Middle and Late Phrygian/Late Achaemenian levels of Dorylaion (Kaya 2019; Baştürk and Baştürk 2021), and the road upon which Dorylaion is situated may have been in use since the Early Bronze Age (Efe 2007; Massa 2016).

It is also not clear how the transition from the earlier standard Olynthus mills, which did not use a lever, to the Olynthus mills with a slot for the lever occurred. Despite the lack of certainty (Alanzo and Frankel 2017, 3), I am inclined to follow Bombardieri's hypothesis, which suggests that the development of the lever-operated Olynthus mill resulted from contacts between the Assyrian mill and the hand grip hopper saddle quern (Bombardieri 2005, 499). However, determining the origin of the Olynthus mills would be a challenge to the chronological and geographical framework of this article. Perhaps the only certain fact is that Olynthus millstones, which possess protrusions connecting the pivot and main body, came into existence somewhere in the eastern Mediterranean region.

Although 'Olynthus mills with vertical holes for pivot' are usually categorised under the same type (Frankel Type II.4 and Bombardieri Type IIID.3e), they can be analysed independently based on the shape of the projection. The initial set seems to have originated from the standard Olynthus millstone with slots for the lever or emerged simultaneously with the invention of slots: in these examples, the slot on the pivot side of the stone has been extended forward, resulting in a rectangular and simple longer slot. The hole is almost circular and is located towards the centre of the slot rather than at the front of the stone. This type has been found in Hama, Alişar, and Maşat Höyük (Fig. 11).

	Site	Period	Usage / Preservation	N. of finds	Total N.	Regional Total
Phrygian Group	Dorylaion	Early Hellenistic	in situ (lacking installations) / intact	1	44	56
	Dorylaion	Early Hellenistic	in situ (lacking installations) / intact	1		
	Dorylaion	Early Hellenistic	in situ (lacking installations) / intact	1		
	Dorylaion	Late Hellenistic	re-used / intact	1		
	Dorylaion	Late Hellenistic	re-used / fractured	28		
	Dorylaion	Late Roman / Bizantine	re-used / fractured	12		
	Seyitömer	Early Hellenistic	re-used(?) / intact	9	9	
	Gordion	Hellenistic	re-used(?) / intact	2	2	
	Küllüoba	Late Hellenistic / Early Roman	? / intact	1	1	
Central Anatolia	Büklükale	Early Hellenistic	re-used(?) / intact	1	3	11
	Büklükale	Early Hellenistic	re-used(?) / fractured	2		
	Alişar	Iron Age / Early Hellenistic	re-used(?) / intact	4	4	
	Maşat	Iron Age (?)	? / intact	1	1	
	Kınık	L.Achaemenid / Early Hellenistic	in situ (lacking installations) / intact	1	1	
	Ereğli Museum	?	? / intact	2	2	
Northern Syria	Hama	Iron Age / Early Hellenistic	? / intact	2	2	2

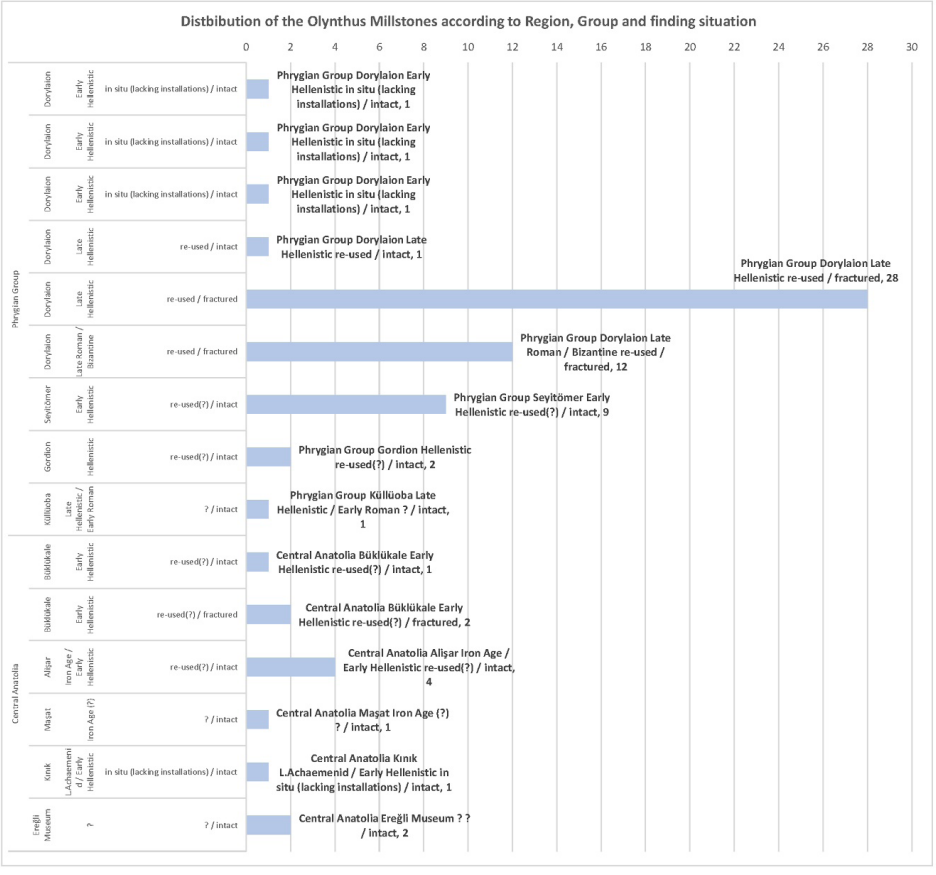


Figure 11: Comparison of Olynthus millstones according to region, group, and finding situation.

The dating of the two samples from Hama is problematic. The layer that was previously classified as Iron Age (Fugman 1958, 140, fig. 165: 4D17, 198, fig. 245: 8A98) underwent a later revision as the Iron Age – Hellenistic transition (Riis and Buhl 1990, 76-78, fig. 37: 112-113). At Alişar, there is one example of the same type with a similar dating problem (von der Osten 1937, fig. 93: M6). The 'Alişar V' layer, from which the find came, was initially dated to the Iron Age (Medo–Persian / Phygian). However, *'we are not able to seperate sharply the Hellenistic remains from the latest deposits of Stratum V'* (Schmidt 1931, 141). Von der Osten groups Phrygian, Medo–Persian, and Hellenistic periods successively together, separating Hellenistic from Roman and Byzantine periods in his chronological table, where Hellenistic is presented as belonging to Alişar VI, but not Alişar V. Perhaps the most logical approach is to place Alisar Level V between the seventh century BC and the year 0, as the table indicates (von der Osten 1937, 463, fig. 289). Another exact match of this type has been discovered at Maşat Höyük. It was not unearthed by excavation, but rather found by chance on the surface (Bombardieri 2010, 90, tav. 106: 3-5). No evidence of a Hellenistic occupation at Maşat Höyük has been reported yet; thus, we must accept that the observed device belongs to the Iron Age or the 'Phrygian period' until further excavations are conducted.

At this point, perhaps there should be a brief mention of another type, the upper stones with two adjacent projections (Frankel's Type II.5). Although the type is widespread from the Black Sea coasts (Zolotaia Balka, Kamensko Gorodishe and Neapolis) to the Aegean (Thasos and Ephesus), there is a strict distinction based on the shape of the hoppers: those on the maritime trade network appear to be very similar in appearance (Frankel 2003, 13), and the most distinctive feature is the butterfly hoppers they have (Bombardieri type IIID.3l). However, there is a series of findings bearing two adjacent protrusions again, but with the traditional square hoppers (Bombardieri Type IIID.3d). These come from the eastern and southern parts of central Anatolia, located to the north and south of the Kızılırmak (Halys) River (Fig. 11). Alişar presents three of these (von der Osten and Schmidt 1930, figs. 106-107; Schmidt 1931, fig. 199; von der Osten 1937, fig. 93: M 2, 4, 5), with the same chronological problems mentioned above. New evidence suggests that Alişar is not the only place where this type was used. One more recent sample of Olynthus millstones with two protrusions, accompanied by a curved lower grinding stone, was obtained from Kınık Höyük (D'Alfonso *et al*. 2014, 569, 571-572; Highcock *et al*. 2015, 116-117, fig. 6–10). The context KH–P IIIA (lv. A1.2) is dated between the fourth and mid-second centuries BC, Late Achaemenid / Hellenistic period (D'Alfonso and Castellano 2018, 87-88; Trameri and D'Alfonso 2020, 67-68). Although they were not found in a systematic excavation, there are two other Olynthus millstones of the same type in the Konya Ereğli Museum, just to the south of Kınık Höyük (first mentioned in Matsumura 2017, 129, without a typological definition).

The similarities between the two aforementioned types indicates a correlation in their developmental stages. The millstones featuring two protrusions for the pivot appear to have resulted from a basic innovation: the elongated slot. The coexistence of the two types at Alişar Höyük and the rudimentary finish on them suggest that they may have developed simultaneously. Meanwhile, it is possible that the butterfly hopper type, which is unique to the Aegean coasts of Anatolia and the northern coasts of the Black Sea, originated from maritime interactions during Greek colonisation. Their connexion with central Anatolia remains unclear, but an interaction via the Anatolian coasts of the Black Sea would not be surprising. We need to await the detailed publications of the materials and chronology from the Anatolian Black Sea coast, for instance from Kurul Fortress, where Late Hellenistic domestic quarters are reported to have housed Olynthus mills (Akçay and Bulut 2022). Until then, this will remain speculation.

The types outlined above may have potentially been modified on the way to western central Anatolia. Büklükale, located on the Kızılırmak (Halys) River, offers a good example of an Olynthus mill with a vertical hole for the pivot on a square projection, and the same excavation has yielded several other fragments of Olynthus millstones. The instrument was found on the floor of a room dated to the Hellenistic period (Matsumura 2017). For the time being, this sample may be regarded as marking the shift from central Anatolian types to the northwestern central Anatolian cluster in terms of geography and typology.

North-western Central Anatolia: Dorylaion, Gordion, Seyitömer, and Küllüoba

The Dorylaion typology has already been comprehensively described. In addition, similar types have been observed in the surrounding area of Dorylaion. Gordion, approximately 150 km to the east of Dorylaion, is one of the settlements where the same implements have been unearthed: the Körte brothers discovered two of them during their initial excavations. Young's team uncovered a minimum of three, one of which was identified as 'a wheat grinding stone – the slot and handle grinder channel type', while another was drawn (Wells 2012, 230). Two noteworthy examples from Gordion have been properly published thus far: one exhibits a semicircular projection (Wells 2012, 230, fig. 140), which serves as a good representation of ŞH–O 2.1.c; the protrusion on the other is a narrow semicircular variant (Körte and Körte 1904, 176, abb. 158), which corresponds to the characteristics of ŞH–O 2.2. Both examples can be attributed to the Hellenistic period. Probably many more samples are in the excavation archive for further study and publication (Wells 2012, 230, footnote 207), which hold significant importance in comprehending the eastern contacts of Dorylaion.

To the west of Dorylaion, Seyitömer is an additional important site where comparable findings were discovered. Following Dorylaion, this site has yielded the largest number of Olynthus mills with a vertical pivot hole. Unfortunately, we do not have the cross-sections of

all of them, but all those published so far show triangular or semi-circular projections parallel to the Dorylaion typology. There are additional instances at Seyitömer where the projection is on the longer side, which have yet to be discovered at Dorylaion. All samples come from the Early Hellenistic layers and lack any installations or implements to operate the devices properly. Thus, these were proposed to be utilised during the Achaemenid era, but discarded thereafter (Yıldırım 2022).

The excavations at Küllüoba, located approximately 35 km southeast of Dorylaion, have made a new contribution to this repertoire. The author was kindly informed by the director of the excavation that an unpublished Olynthus-type upper millstone was found on the surface, possibly in relation to faint traces of the IB (Late Hellenistic – Early Roman layer) (for the stratigraphical sequence at Küllüoba, see Türkteki *et al*. 2021, 108). The sample is a good match to ŞH–O 2.3 with its triangular projection.

The region where all four mounds are located is rich in volcanic eruptive rocks. For example, it is probable that the vast Karacaören Vulcanite located approximately 10 km to the south of Şarhöyük provided a boundless quantity of basalt raw material containing gas bubbles (Kandemir and Anar 2018, 22, pafta İ24) which was then utilised to produce all of the millstones at Dorylaion. Similar formations are commonly observed in northwestern central Anatolia.

Conclusion

The Olynthus millstones found at Şarhöyük/Dorylaion are undoubtedly a distinct subgroup of the 'Olynthus mills with vertical holes for pivot' (Frankel Type II.4, Bombardieri Type IIID.3e). Although there are some local variations, a regional unity can be observed in examples from Dorylaion, Gordion, Seyitömer, and Küllüoba (northwestern central Anatolia). At the moment, it appears that triangular or semicircular projections are peculiar to this region. The number of Olynthus millstones unearthed in this region is significantly higher than that in other areas, which alone is worthy of further attention (Fig. 10). For this regional unity between the Sakarya (Sangarios) river and the Porsuk (Tymbris) basin, I suggest using the term 'Phrygian Group'. This suggestion is purely geographical and does not have any cultural connotations. It aims to outline a particular type of millstone, acknowledging that it is not the sole variant in the region. For example, Eskişehir Archaeological Museum houses an interesting collection of hopper-rubber samples of various types, including some without slots.

It is challenging to trace the origin or typological phases of the Olynthus mills. The type with the elongated slots seems to have appeared between the northeastern Mediterranean coasts and eastern central Anatolia, almost simultaneously. It is difficult to assert a geographical connexion between Hama (northern Syria) and the Alişar – Maşat samples;

however, the typological similarity is obvious. The type with two projections for the pivot (with square hoppers) are limited to central Anatolia. There may be a connexion between these and those with butterfly hoppers, but we are currently unable to bridge the geographical gap, especially in coastal regions. The 'Phrygian group' constitutes a unique cluster with its individual subtypes, differing from any other groups currently.

As previously discussed, almost all examples of 'Olynthus mills with vertical holes for pivots' are found in Hellenistic layers (for comparison, see Fig. 11). Although there are clues suggesting that this instrument was in use during the last quarter of the fourth century BC, none of the finds, even those that can be interpreted as *in situ*, have been uncovered in contexts showing the device in operation. Evidence from the layers succeeding the Early Hellenistic period is significantly deficient: most of the millstones seem to have been employed in secondary or tertiary functions, whether broken or intact, mostly embedded in walls. Thus, assertions like 'Olynthus mills still in use in a Roman layer' should be approached with caution, unless presented with detailed and definite archaeological contexts. This is, of course, related to the technological developments that arrive or emerge in each settlement, and for Dorylaion the archaeological evidence so far suggests that the Olynthus mills fell off with the introduction of the rotary mills in the Late Hellenistic period.

The emergence of the Phrygian Group in the Early Hellenistic layers raises the question of when they came into use. The advanced typological variations within the Phrygian Group indicate derivation from other types, potentially influenced by more eastern forms. It is plausible to propose that the Late Achaemenid era marked the inception of this technology. Three settlements within this group (Dorylaion, Gordion and Seyitömer) house Achaemenian layers, but none have yielded any samples of Olynthus millstones from 6th or 5th century. Furthermore, other Anatolian settlements with firm Achaemenian strata are reported to be lacking these archaeological findings. Therefore, it may be practical to suggest an early or mid-fourth century date for their appearance, but further evidence is needed.

The final and perhaps most important conclusion of the study is how much less value is attributed to these findings than it should be. The author is more than sure that many similar artefacts are housed in the storage facilities and gardens of the excavations and museums, waiting to be properly studied.

Acknowledgments: I am deeply grateful to L. Bombardieri, for sharing his studies generously; to L. D'Alfonso and Kınık Höyük Excavation Project, for providing invaluable information about their sample with great generosity; and to M. Türkteki, director of the Küllüoba excavations, for informing me about the unpublished material from the site. I am also thankful to K. Çakır, Director of Şehit Cuma Dağ Natural History Museum of MTA (Mineral Research and Exploration General Directorate of Turkey), for sharing his experience and knowledge on the evaluation of extrusive rocks, and providing necessary documents about the geological formations in the region. Many thanks to R. Bozkurt from Konya Ereğli Museum, for providing me the visuals of their samples. I would like to thank to E. Yurt, Director of the Eskişehir Eti Archaeology Museum, and specialist Z. Bürkük, for their sincere assistance for the museum studies. Also, many thanks to H. Alanyalı, who spared some his own time of library research for me. Thanks to S. Çalışkan-Türkan and B. Köse (Kumpas Çizim) for the drawings provided on the site and in the laboratory.

Ethics Committee Approval: N/A.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author have no conflict of interest to declare.

Grant Support: Şarhöyük / Dorylaion Excavations are supported by Scientific Research Projects Commission of Anadolu University (BAP 2304E031).

References

Akçay, A. & Bulut, A.E. (2022). Kurul Kalesi'nde Mekânsal Organizasyon, Mimari Malzeme ve Yapı Fonksiyonları Üzerine Bir Değerlendirme. *Anadolu Araştırmaları*, 7, 175-224.

Alanzo, N. & Frankel, R. (2017). A Survey of Ancient Grain Milling Systems in the Mediterranean. In Buchsenschutz, O., Lepareux–Couturier S., Fronteau, G. (Eds.), *Les meules du Néolithique à l'époque médiévale : technique, culture, diffusion*. Suppléments à la Revue archéologique de l'Est 43 (pp. 461-478).

Baştürk, M.B. (2019). Stratigraphic Sequence at Şarhöyük/Dorylaion: An Overview. In Tsetskhladze, G. R., Baştürk, M.B., Hargrave, J. (Eds.), *Phrygia in Antiquity: From the Bronze Age to the Byzantine Period*, (pp. 561-580), Colloquia Antiqua 24, Leuven: Peeters Publishers.

Baştürk, M.B., & Baştürk, E. (2021). A Bronze Bowl with Swivelling Handle from Şarhöyük – Dorylaion. *OLBA*, 29, 25-46.

Bombardieri, L. (2005). Mulini assiri a scanalatura e mulini a tramoggia. In Pecorella, P.E, Benoit, R.P. (Eds.), *Tell Barri / Kahat. La campagna del 2002. Relazione preliminare*, (pp. 156-179), Firenze University Press.

Bombardieri, L. (2010). *Pietre da Macina, Macine per Mulini. Definizione e sviluppo delle tecniche per la macinazione nell'area del Vicino Oriente e del Mediterraneo orientale antico*. Oxford: BAR International Series.

Childe, G.V. (1943). Rotary Querns on the Continent and in the Mediterranean Basin. *Antiquity*, 17, 19-26.

Cox C.W.M. & Cameron, A. (1937). *Monuments from Dorylaeum and Nacolea* (Monumenta Asiae Minoris Antiqua 5), Manchester University Press.

D'Alfonso, L. & Castellano, L. (2018). Kınık Höyük in South Cappadocia. *Altorientalische Forschungen*, 45(1), 84-93.

D'Alfonso, L., Gorrini, M. E., Mora, C. (2014). Archaeological Excavations at Kınık Höyük. Preliminary Report of the Third Campaign (2013), *Athenaeum*, 102/2, 565-585.

Darga, M. (2006). Şarhöyük–Dorylaion Kazılarından İki Buluntu: Dörtgen Kerpiç Odalar ve Damgalı Amphora Kulpları. In Erkanal–Öktü, A., Özgen, E., Günel, S., Ökse, A.T., Hüryılmaz, H., Tekin, T., Çınardalı–Karaaslan, N., Uysal, B., Karaduman, F.A., Engin, A., Spieß, R., Aykurt, A., Tuncel, R., Deniz, U., Rennie, A. (Eds.), *Hayat Erkanal'a Armağan: Kültürlerin Yansıması / Studies in Honor of Hayat Erkanal, Cultural Reflections* (pp. 241-248), İstanbul: Homer Kitapevi.

Deonna, W. (1938). *Le Mobilier Delien* (Dèlos 18), Paris: E. de Boccard.

Devries, K. (2005). Greek pottery and Gordion chronology. In Kealhofer, L. (Ed.), *The Archaeology of Midas and the Phrygians* (pp. 36-55), Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.

Efe, T. (2007): The theories of the 'Great Caravan Route' between Cilicia and Troy: the Early Bronze Age III period in inland western Anatolia. *Anatolian Studies* 57, 47-64.

Erpehlivan, H. (2022). A Trade Route from the Propontis to Phrygia: assessing the economic status of Kios between the Archaic and the Early Hellenistic Periods. *Oxford Journal of Archaeology*, 42, 71-88.

Flinders Petrie, W.M. (1888). *Tanis II, Nebesheh, and Defennen (Tampanhes) (Memoir of the Egypt Exploration Society 4)*, London: Trubner & Co.

Frankel, R. (2003). The Olynthus Mill, Its Origin, and Diffusion: Typology and Distribution, *American Journal of Archaeology*, 107/1, 1-21.

French, D.H. (2013). *Roman Roads and Milestones of Asia Minor, Vol. 3 Milestones Fasc. 3.4: Pontus et Bithynia (with northern Galatia)*, Ankara: British Institute at Ankara.

Fugmann, E. (1958). *Hama. Fouilles et recherches 1931–1938 II, L'architecture des périodes pré–hellénistiques*, Copenhagen: National Museum.

Highcock, N., Crabtree, P., Campana, V.D., Capardoni, M., Lanaro, A., Matessi, A., Miller, N.F., Strosahal, P., Trameri, A., D'Alfonso, L. (2015). Kınık Höyük, Niğde: A New Archaeological Project in Southern Cappadocia. In Steadman, S.R., Mcmahon, G. (Eds.), *The Archaeology of Anatolia Recent Discoveries (2011–2014)* Volume I (pp. 98-127), Newcastle: Cambridge Scholars Publishing.

Kandemir, Ö. & Anar, F. (2018). *Türkiye Jeoloji Haritaları Serisi. Eskişehir – İ 24 Paftası*. Maden Tetkik Arama Genel Müdürlüğü, Ankara: MTA.

Kaya, Y. (2019). *İç Kuzeybatı Anadolu Bölgesi Demir Çağ Seramik Gelenekleri* (M.A. thesis, Bilecik University).

Kourouniotis, K. (1917). Κίναιδοι μυλωθροὶ, *Αρχαιολογική Εφημερίς (Archaiologike Ephimeris)* 3-4, 151-157.

Körte, G. & Körte, A. (1904). *Gordion Ergebnisse der Ausgrabung im Jahre 1900* (Berlin).

Massa, M. (2016). *Networks before Empires: Cultural Transfers in West and Central Anatolia during the Early Bronze Age* (Ph.D. thesis, University College London).

Matsumura, K. (2017). A Hopper–Rubber or Olynthus Mill from Büklükale: Its Stratigrafical Setting and Dating. In Adak–Adıbelli, I., Ilgezdi–Bertram, G., Matsumura, K., Baştürk, E., Koyuncu, C., Kızılarslanoğlu, H.A., Yedidağ, T.Y., Topaloğlu–Uzunel, A. (Eds.), *Barış Salman Anı Kitabı* (pp. 127-139), İstanbul: Ege Yayınları.

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

Ramsay, W.M. (1890). *The Historical Geography of Asia Minor*, London: John Murray.

Riis, P.J. & Buhl, M.L. (1990). *Hama. Fouilles et Recherches 1931–1938 II, 2: Les Objets de la Période dite Syro–Hittite (Âge du Fer)*, Copenhagen: National Museum.

Robinson, D.M. & Graham, J.W. (1938). *Excavations at Olynthus, Vol. 8. The Hellenic House* Baltimore: John Hopkins Press.

Schmidt, E.F. (1931): *Anatolia through the Ages. Discoveries at the Alishar Mound 1927–29*, OIP 11. Chicago: The University of Chicago Press.

Tüfekçi–Sivas, T. (2018). Excavations at Dorylaion/Şarhöyük in Phrygia Epiktetos. In Tsetskhladze, G.R. (Ed.) *Pessinus and its Regional Setting* (pp. 99-128) Leuven: Peeters Publishers.

Türkteki, M., Sarı, D., Şahin, F., Türkteki, S., Tuna, Y. (2021). Anadolu'da Bir İlk Tunç Çağı Kenti: Küllüoba, Genel Değerlendirme ve 2020 Yılı Çalışmaları. *Lycus*, 3, 105-128.

Trameri, A. & D'Alfonso, L. (2020). The "Sacred City" of Kınık Höyük: Continuity and Change in Cappadocia (Turkey) between the Late Achaemenid and Late Hellenistic Periods. In Held, W. (Ed.). *The Transition from the Achaemenid to the Hellenistic Period in the Levant, Cyprus, and Cilicia: Cultural Interruption or Continuity? Symposion at Philipps–Universität Marburg, October 12–15, 2017*, (pp. 65-81), Marburg: eigenverlag des Archäologischen Seminars der Philipps-Universität.

von der Osten, H.H. (1937): *The Alishar Hüyük. Seasons of 1930–32, Part 3.* OIP 30, Chicago: The University of Chicago Press.

von der Osten H.H. & Schmidt, E.F. (1930): *The Alishar Hüyük. Season of 1927, Part 1*. OIP 6, Chicago: The University of Chicago Press.

Wells, M.G. (2012): *A cosmopolitan village: the Hellenistic settlement at Gordion* (Ph.D. thesis, University of Minnesota).

Wiegand, T. & Schrader, H. (1934): *Priene: Ergebnisse der Ausgrabungen und Untersuchungen in den Jahren 1895–1898, Band 1*, Berlin: Reimer.

Yedidağ, T.Y. (2019): Şarhöyük (Dorylaion) during the Hellenistic Period. In Tsetskhladze, G. R., Baştürk, M.B., Hargrave, J. (Eds.), *Phrygia in Antiquity: From the Bronze Age to the Byzantine Period*, Colloquia Antiqua 24, (pp. 582-294), Leuven: Peeters Publishers.

Yıldırım, Ö.C. (2022): Seyitömer Höyük Olynthus Değirmenleri. In: Ünan, S. (Ed.), Seyitömer Höyük Kurtarma Kazısı 1989 – 2021 (pp. 745-753), Ankara: Bilgin Kültür Sanat Yayınları.