Textile tools from Quartier Mu, Malia, Crete, Greece

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We dedicate this book to Betchen Barber,
the pioneer of the study of Aegean Bronze Age textiles.

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Front cover: clockwise: MM II Quartier Mu, Malia, Crete, map (after Poursat 1996, pl. 81), spindle whorls from Phaistos, Crete (courtesy of P. Militello), Khania, Crete, Late Bronze Age ribbon, reconstructed loom weights in TTTC experiments.
Back cover: Splicing (drawing: Annika Jeppsson)

Contents

Chapter 6.5

Textile tools from Quartier Mu, Malia, Crete, Greece

Jean-Claude Poursat, Françoise Rougemont, Joanne Cutler, Eva Andersson Strand and Marie-Louise Nosch

The palatial settlement of Malia is situated on the north coast of Crete. The buildings of Quartier Mu, excavated by the French School at Athens, were constructed in MM II (18th century BC) above earlier MM IB structures and were contemporary with the first palace at Malia (Poursat 1992, 1996).[1] This area of the town contained two large building complexes, Buildings A and B, as well as a series of much smaller units located around the periphery (Fig. 6.5.1). Five of these smaller buildings have been identified as the combined living quarters and workshops of artisans: the Seal workshop, Founder's workshop, Potter's workshop, South workshop and Building C. Building F may also have been a workshop/living unit, while two further units, Buildings D and E, appear to have been used as storage structures, possibly associated with building complexes A and B.

The entire quarter was destroyed by fire *c.* 1700 BC. The period of use of the buildings is therefore limited to MM II.

Spindle whorls and spinning

No objects recorded as spindle whorls are registered in the TTTC database. However, among the MM II textile tools recorded as loom weights there are nine objects that, from their shape (two cylindrical, three spherical and four spherical lenticular), weight (20–40 g) and dimensions, are likely to have functioned as spindle whorls. Very few spindle whorls dating to the Protopalatial or Neopalatial periods have been found on Crete, and when they are present they are only present in very small numbers. While it is possible that during these periods whorls were made out of a perishable material, such as wood, it is also possible that spinning was not being carried out in the same locations as weaving, which is well attested at Quartier Mu.

Loom weights and weaving

More than 600 loom weights have been recovered from Quartier Mu, the majority (527) dating to MM II (Fig. 6.5.2). Many of the loom weights with an unknown date, most of which come from fills or outdoor spaces where the stratigraphy is unclear, are also likely to date to the MM II use of the area. Others, including four spools found on the surface, may be associated with the adjacent LM IIIA-B settlement area (Quartier Nu). Only three loom weights were recovered from MM IB contexts.

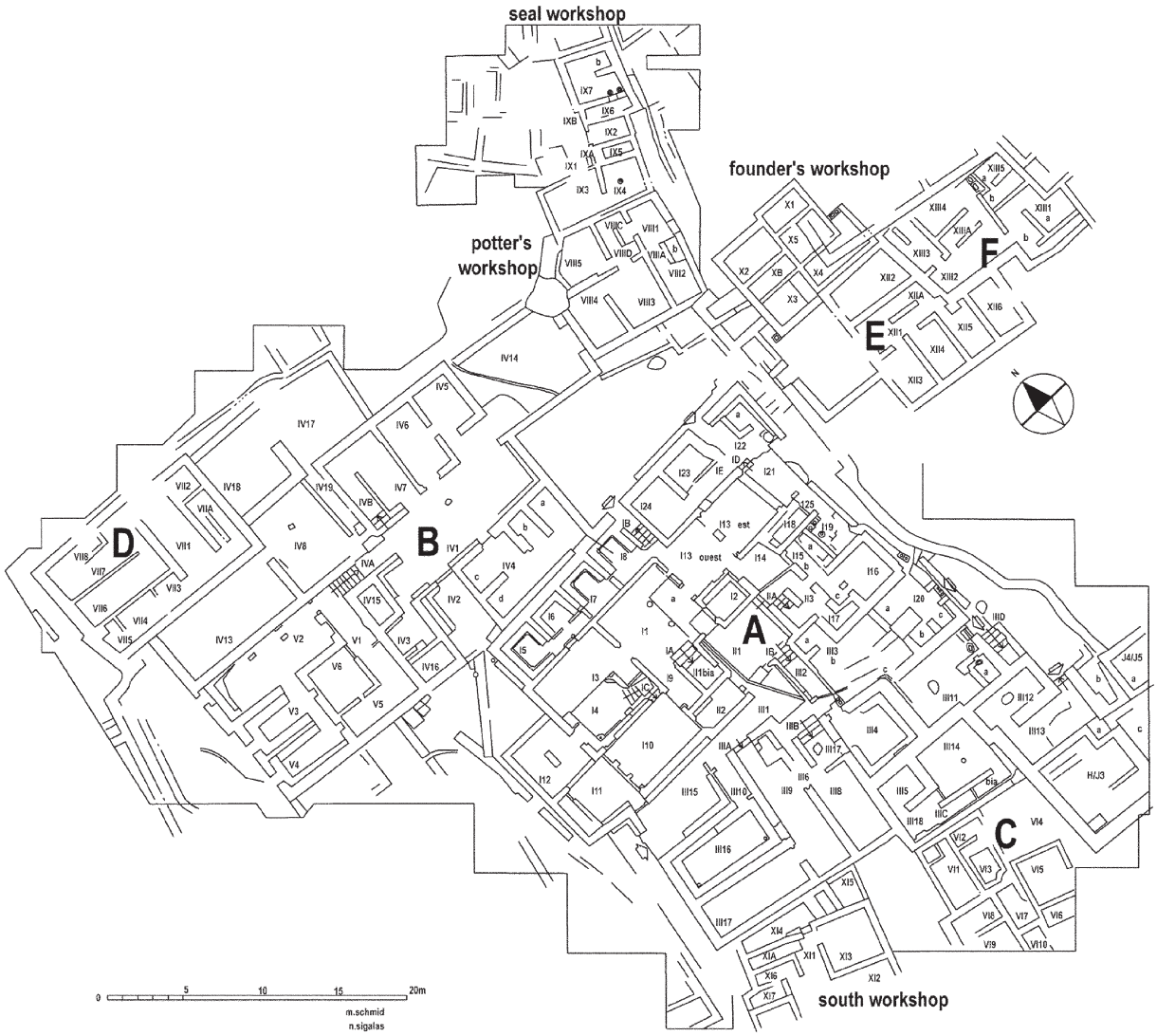

Fig. 6.5.1. MM II Quartier Mu, plan (plan: after Poursat 1996, pl. 81).

	MM IB	MM I–II	MM II	LM III	Unknown	Total
Spherical			267		25	**292**
Spherical lenticular			15		1	**16**
Discord	1		106	1	21	**129**
Pyramidal	1		37		30	**68**
Biconical			1			**1**
Conical			1		2	**3**
Cuboid			5		1	**6**
Cylindrical		2	38		5	**45**
Rectangular, flat			6		4	**10**
Rectangular, thick	1		5		5	**11**
Torus			17		8	**25**
Torus (small hole diam)			25		2	**27**
Spool					4	**4**
Other			4			**4**
Total	**3**	**2**	**527**	**1**	**108**	**641**

Fig. 6.5.2. Loom weights, by type and date.

A number of different loom weight types are present; the most common shapes, however, are spherical, discoid and pyramidal (Figs. 6.5.2 and 6.5.3). One of the discoid weights and 21 of the torus weights are made of stone, the rest of the loom weights are made of clay. In addition to the objects that were intentionally manufactured as loom weights, a further 134 naturally pierced pebbles (132 from MM II contexts and two of unknown date) are also likely to have been used on the loom (Poursat 2012).

Of the 527 loom weights from MM II contexts, 472 were found within the individual buildings. All of the buildings contained loom weights. Low numbers of weights were recovered from each of the small workshop units and

from Buildings B, E and F; substantially larger numbers were found in Buildings A and D (Fig. 6.5.4). Within each of the individual buildings, more than one type of loom weight was present. The majority of the loom weights were found scattered over the ground floors of the buildings, and are likely to have fallen from rooms above. Unlike the lower storey rooms, the upper floors were almost certainly provided with windows (Schmid 1996, 79–80). Most of the living quarters and work areas were situated on the upper floors, and it is probable that weaving also took place in the upper storey rooms.

Building A

Building A (sectors I–III), the largest complex in Quartier Mu, contained several storage areas and rooms with a ceremonial function as well as an archival deposit (Poursat 1992). Loom weights were recovered from many of the rooms within the building; the majority appear to have fallen from an upper floor. Of the 162 loom weights found in MM II contexts, 143 had a recordable weight and thickness (Fig. 6.5.5). The weights of these loom weights range between 20 g and 1040 g, with the majority weighing between 50 g and 300 g. Two clusters relating to loom weights with a weight of 75–150 g are visible: one corresponding to discoid loom weights with a thickness of 1.5–2.3 cm and the other representing spherical loom weights with a thickness of 4.0–5.2 cm. Two of the spherical lenticular weights, weighing 20 g and 35 g, would not work well as loom weights and it is more likely that they are spindle whorls.

In most cases, only low numbers of loom weights were recovered from the individual rooms in Building A, but Rooms I 8 and III 1 contained 30 and 25 loom weights respectively. In contrast to the majority of the loom weights found within the building, the group of 30 weights (27 spherical, two torus and one cylindrical) recovered from Room I 8 were

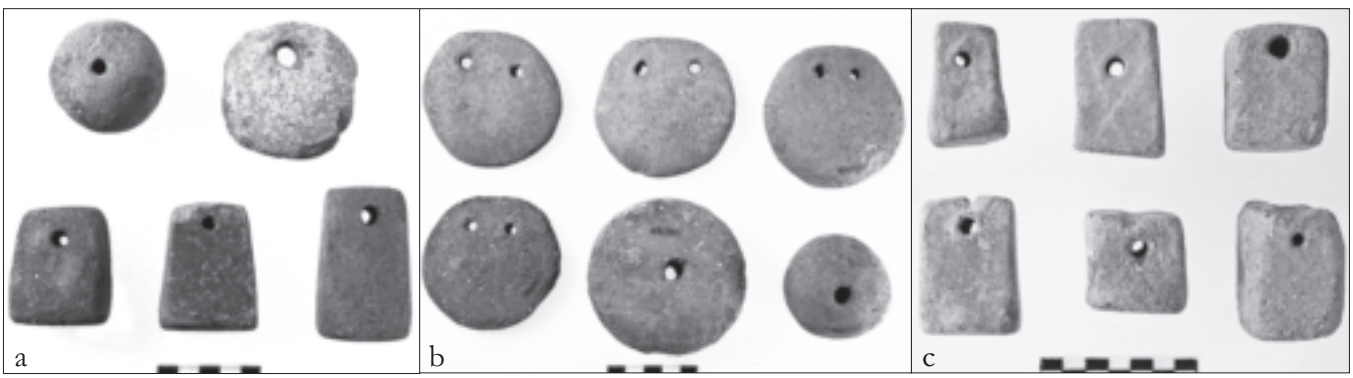

Fig. 6.5.3. Textile tools: a) spherical, discoid and pyramidal loom weights b) spherical, discoid and torus (small hole diameter) loom weights c) pyramidal and rectangular loom weights (photos: EfA/J. C. Poursat).

	Seal workshop	Potter's workshop	Founder's workshop	South workshop	Building A	Building B	Building C	Building D	Building E	Building F	Total
Spherical		13	2	2	75	18	11	126	8		**255**
Spherical lenticular	1				3	4	1	1			**10**
Discord		14	2	3	47	4	4	5	4		**83**
Pyramidal		3	1	1	13	4	7	2		1	**32**
Biconical					1						**1**
Conical		1									**1**
Cuboid			1		2	1					**4**
Cylindrical		1	1		7	6	1	20			**36**
Rectangular, flat					4		1				**5**
Rectangular, thick			1		2					1	**4**
Torus		1		2	4	3		4		1	**15**
Torus (small hole diam)				2	2		17			1	**22**
Other					2			2			**4**
Total	**1**	**33**	**8**	**10**	**162**	**40**	**42**	**160**	**12**	**1**	**472**

Fig. 6.5.4. Loom weights from individual buildings, MM II, by type.

in situ, in what appears to have been a storage area. Twenty-eight of these had a recordable weight and thickness (Fig. 6.5.7). Except for the two torus weights (weighing 620 g and 1040 g and made of stone), all of the loom weights weigh between 105 g and 185 g, with a thickness of 4.0–5.5 cm.

Excluding the two, much heavier, torus weights, all the remaining loom weights would function well with very thin thread requiring *c.* 10 g tension, and all except the heaviest spherical weight (weighing 185 g) would also work well with very thin thread needing *c.* 5 g tension. Only five of the 26 spherical/cylindrical loom weights would be optimal for use with thin thread requiring *c.* 15 g tension, and none would function well with thread needing *c.* 20 g tension or more. Used in a tabby weave with thread needing *c.* 5 g tension, the majority of the loom weights would give a warp thread count of *c.* 9–12 threads per centimetre, whereas with thread requiring *c.* 10 g tension, the resulting fabric would have a narrower thread count range of *c.* 5–7 threads per centimetre (Fig. 6.5.7). In a twill weave, the thread counts would be approximately double. Since all the spherical/cylindrical loom weights would function well with thread needing *c.* 10 g tension, with only a small variation in the thread count per centimetre in the finished fabric, the group would appear to be best suited for use with this type of thread and would work well together in the same loom setup. However, in both a tabby and a twill weave the resulting textile would have been extremely open if the fabric was balanced and it is therefore likely that in either a tabby or a twill the textile would have been weft faced.

The 25 loom weights from Room III 1 (11 spherical, eight discoid, four cylindrical, one pyramidal and one torus) are likely to have fallen from an upper storey. It is therefore not possible to say whether they were originally part of the same group. However, an analysis of the loom weights suggests that they fall into more than one category. All of the loom weights had a recordable weight and thickness (Fig. 6.5.8). The discoid loom weights weigh 90–140 g, with a thickness of 1.7–2.5 g; they would function well with thread needing *c.* 5–10 g tension. Used with thread requiring *c.* 5 g tension they could produce a tabby fabric with *c.* 18–24 warp threads per centimetre; with thread needing *c.* 10 g tension the thread count would be *c.* 10–12 threads per centimetre. The narrower thread count range for *c.* 10 g tension thread suggests that the discoid weights would be optimal for use with this type of thread. With the exception of the stone torus weight and the heaviest

Fig. 6.5.5. Loom weights, MM II, Building A: type and weight/thickness. Please note that some markers represent more than one loom weight.

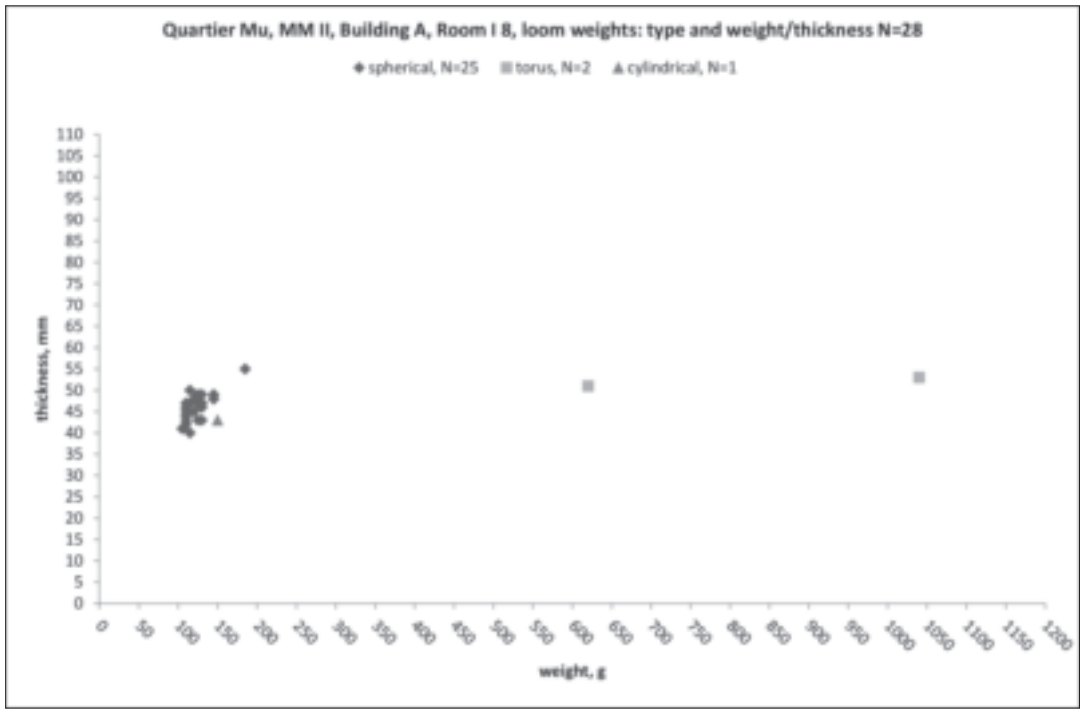

Fig. 6.5.6. Loom weights, MM II, Building A, Room I 8: type and weight/thickness. Please note that some markers represent more than one loom weight.

cylindrical weight, the remaining loom weights (11 spherical and three cylindrical) weigh 100–235 g and would also function well with very thin thread requiring *c.* 10 g tension. The warp thread count would vary between *c.* 6 and 11 threads per centimetre in a tabby, so the fabric produced would have fewer threads per centimetre than a fabric produced with the discoid weights. In a balanced tabby weave, both fabrics would have been very open, however, and are therefore likely to have been weft faced. In a twill weave using four rows of loom weights, the thread count would be approximately double; this would also be likely to be a weft-faced textile, since the fabric would otherwise be very open.

In Room I 11 of Building A, three loom weights were found *in situ* in a closet, along with 65 naturally pierced pebbles. The 62 pebbles with a recordable weight and thickness mostly lie within the same weight/thickness range as the loom weights that were recovered from the building as a whole (Fig. 6.5.9), and it is likely that they were also used on the loom.

Building B

Of the 40 loom weights recovered from MM II contexts in Building B (sectors IV and V), 37 had a recordable weight and thickness (Fig. 6.5.10). Four of these, with a weight of 34–40 g, are more likely to be spindle whorls (one spherical, two spherical lenticular and one cylindrical). The weights of the remaining loom weights range between 55 g and 240 g, and their thickness varies between 1.8 cm and 6.6 cm. The weight range of the loom weights is therefore more limited than the weight range of the loom weights from Building A. The majority would be optimal for use with very thin thread, needing *c.* 5-10 g tension.

As in Building A, the majority of the loom weights from Building B appear to have fallen from above. However, nine loom weights of different types (five spherical, two discoid and

Warp thr/cm	5 g, N=25	10 g, N=26	15 g, N=5
3 thr			
4 thr			4
5 thr		14	1
6 thr		10	
7 thr		2	
8 thr			
9 thr	2		
10 thr	10		
11 thr	6		
12 thr	6		
13 thr			
14 thr	1		

Fig. 6.5.7. Loom weights, MM II, Building A, Room I 8 (excluding two stone torus weights): weight tension/number of threads per cm in a tabby. The total number of analysed loom weights is 26.

Fig. 6.5.8. Loom weights, MM II, Building A, Room III 1: type and weight/thickness.

Fig. 6.5.9. Loom weights and pebbles, Building A: type and weight/thickness. Please note that some markers represent more than one loom weight/pebble.

two cylindrical) from Room IV 5 were found *in situ*, together with 25 naturally pierced pebbles. The loom weights and pebbles were found lying in the shape of a square, suggesting that they may originally have been stored in a box or a chest. The room appears to have been used for storage (being one in a row of storage magazines), but did not contain anything other than the loom weights and pebbles. It is possible that perishable materials such as finished textiles or raw fibre may also have been stored here, but have not survived. In this respect, it is interesting to note that a Cretan Hieroglyphic tablet (HM 1676) with a

Fig. 6.5.10. Loom weights and pebbles, MM II, Building B: type and weight/thickness. Please note that some markers represent more than one loom weight/pebble.

suspension hole pierced through it was found in the doorway of Room IV 5, possibly having fallen from an upper floor (Poursat 1990, 27; Godart and Olivier 1978, 70). On one side of the tablet, the Cretan hieroglyphic sign P41 occurs twice; this sign takes the same form as the Linear A logogram *54 and the Linear B TELA textile logogram. A sign that has been interpreted as the equivalent of the Linear B wool unit, LANA, is also present (Younger 2005). Younger has proposed that the entry should be read as, 'TA <-PE>+CLOTH LANA = 3 double minas CLOTH', thus possibly recording the assessment of the amount of TA<-PE> cloth made from one unit of wool, with TA<-PE> perhaps representing the Minoan predecessor of the Mycenaean *te-pa* variety of cloth (Younger 2005). Whether or not this interpretation is accepted, the presence of the hieroglyphic sign P41 does suggest the possibility that the tablet may be associated with the recording of textiles.

All of the pebbles had a recordable weight and thickness. Their weight varies between 40 g and 250 g, and their thickness ranges from 1.8 cm to 6.5 cm. (Fig. 6.5.10).

The pebbles found in storage lie within a similar weight/thickness range as the loom weights from Building B, and could have been used in various combinations with the loom weights recovered from the building.

Building D

Building D (sector VII), which appears to have been a storage structure, contained 160 loom weights. These were all found *in situ*, in Rooms VII 3 and VII 4. The majority of the loom weights (126) are spherical in shape.

Room VII 3 contained 119 loom weights (94 spherical, 13 cylindrical, four discoid, four torus, two pyramidal, one spherical lenticular and one 'other'). All except one of these had a recordable weight and a thickness (Fig. 6.5.11).

The four, thinner, discoid loom weights would not work well with the other loom weights in the group, since they would produce a higher number of warp threads per centimetre. Similarly, the six loom weights weighing more than 450 g could not optimally be used with the other weights. Only two of the remaining loom weights would function well with thread requiring *c.* 5 g tension (Fig. 6.5.12). Forty-six of the weights could be used with very thin thread needing *c.* 10 g tension, the majority of which would give a warp thread count of between 7 and 12 threads per centimetre in a tabby. Over 100 of the weights would work well with thin thread requiring *c.* 15 g or 20 g tension. With thread needing

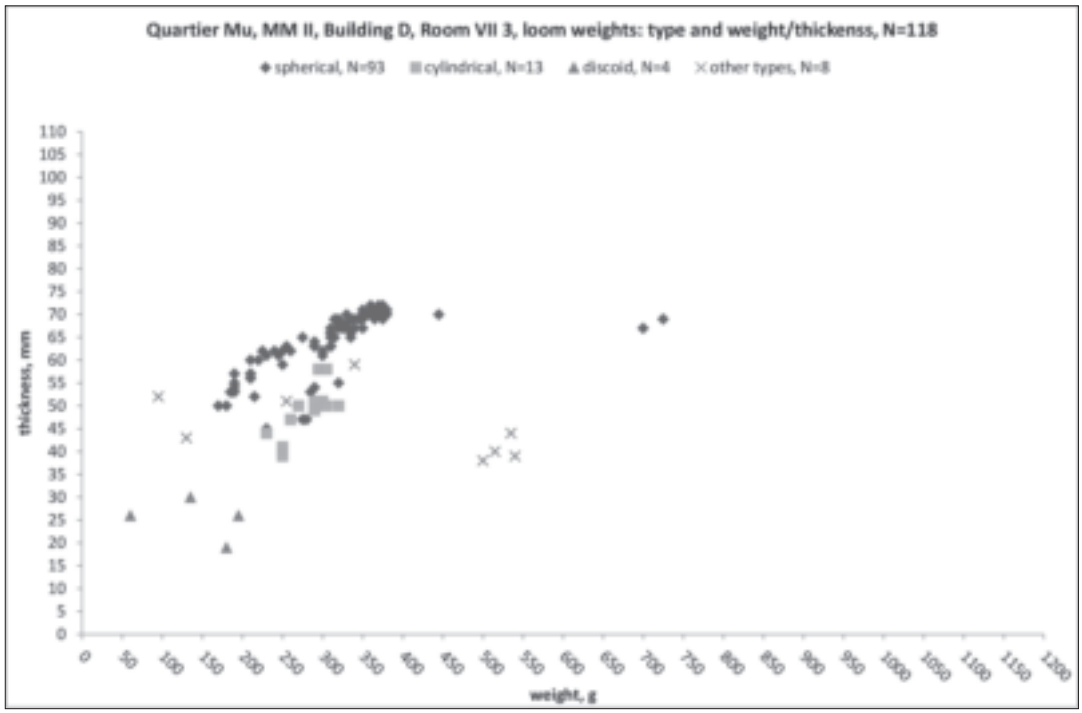

Fig. 6.5.11. Loom weights, MM II, Building D, Room VII 3: type and weight/thickness. Please note that some markers represent more than one loom weight.

Warp thr/cm	5 g, N=2	10 g, N=46	15 g, N=106	20 g, N=103	25 g, N=89	30 g, N=74	35 g, N=38	40 g, N=3	45 g, N=1
3 thr				1	8	58	37	3	1
4 thr		1	1	19	68	16	1		
5 thr			20	66	13				
6 thr		1	23	16					
7 thr	1	12	50	1					
8 thr		10	10						
9 thr		4	2						
10 thr		6							
11 thr		5							
12 thr	1	6							
13 thr		1							

Fig. 6.5.12. Loom weights, MM II, Building D, Room VII 3: weight tension/number of threads per cm in a tabby. The total number of analysed loom weights is 108.

c. 15 g tension the majority could produce a tabby with *c.* 5–8 threads per centimetre, while with thread requiring *c.* 20 g tension, most would be suitable for making a fabric with *c.* 4–6 threads per centimetre. Eighty-nine of the loom weights could be used with thread needing *c.* 25 g tension, to produce a tabby fabric with *c.* 3–5 threads per centimetre. A number of the weights could also be used with thread requiring *c.* 30 g or 35 g tension, to produce a tabby with *c.* 3–4 warp threads per centimetre. Only a few weights could be used with thread needing *c.* 40–45 g tension. In a twill weave, the thread counts would be approximately double.

Twenty-eight pierced pebbles were additionally found in Room VII 3. With the exception of one pebble weighing 1170 g, these have a weight of between 100 g and 380 g and a thickness of 2.7–7.0 cm. They therefore lie within the weight/thickness range of the loom weights recovered from this room and it would be possible to use the pebbles together with the loom weights in various loom setups.

Room VII 4 contained 41 loom weights (32 spherical, seven cylindrical, one discoid and one 'other'), 35 of which had a recordable weight and thickness (31 spherical and four cylindrical). These weigh 175–380 g and their thickness varies from 4.7 cm to 7.2 cm (Fig. 6.5.13).

They therefore fall within the same weight/thickness range as a large number of the loom weights recovered from Room VII 3.

The loom weights from Room VII 4 would have been suitable for use in the manufacture of a very similar range of fabrics to those that could have been made with the loom weights from Room VII 3, with very similar warp thread counts (Fig. 6.5.14). All of them could be used with thread needing *c.* 15 g tension, and the majority would give a thread count of *c.* 5–7 threads per centimetre in a tabby weave; 34 could also be used in a setup with thread requiring *c.* 20 g tension, and could produce a tabby fabric with *c.* 3–6 threads per centimetre. A number could additionally be used with thread needing *c.* 10 g and *c.* 30–35 g tension. The loom weights stored in Rooms VII 3 and VII 4 could therefore have been used together in various loom setups.

Potter's workshop

Thirty-three loom weights were scattered over the ground floor area of the Potter's workshop, and appear to have fallen from the upper floor. Thirty-one of these had a recordable weight and thickness (12 spherical, 14 discoid, three pyramidal, one conical and one torus). With the exception of the stone torus weight weighing 1400 g, the loom

Fig. 6.5.13. Loom weights, MM II, Building D, Room VII 4: type and weight/thickness. Please note that some markers represent more than one loom weight.

Warp thr/cm	10 g, N=19	15 g, N=35	20 g, N=34	25 g, N=25	30 g, N=21	35 g, N=4
3 thr			1	4	15	4
4 thr		1	12	18	6	
5 thr		13	18	3		
6 thr	1	8	3			
7 thr	6	10				
8 thr	7	2				
9 thr	2	1				
10 thr						
11 thr	1					
12 thr	1					
13 thr	1					

Fig. 6.5.14. Loom weights, MM II, Building D, Room VII 4: weight tension/number of threads per cm in a tabby. The total number of analysed loom weights is 35.

weights weigh 70–230 g, with a thickness of 1.8–6.2 cm (Fig. 6.5.15). The loom weights of all types would be best suited for use with very thin threads requiring *c.* 5–10 g tension. The thicker, spherical weights would produce a more open or weft faced fabric than the discoid weights, however.

Building C

The 42 loom weights from Building C, all with a recordable weight and thickness, were scattered over the ground floor, as if they had fallen from above. They have a weight range of 50–405 g, with a thickness varying from 1.6 cm to 6 cm (Fig. 6.5.16).

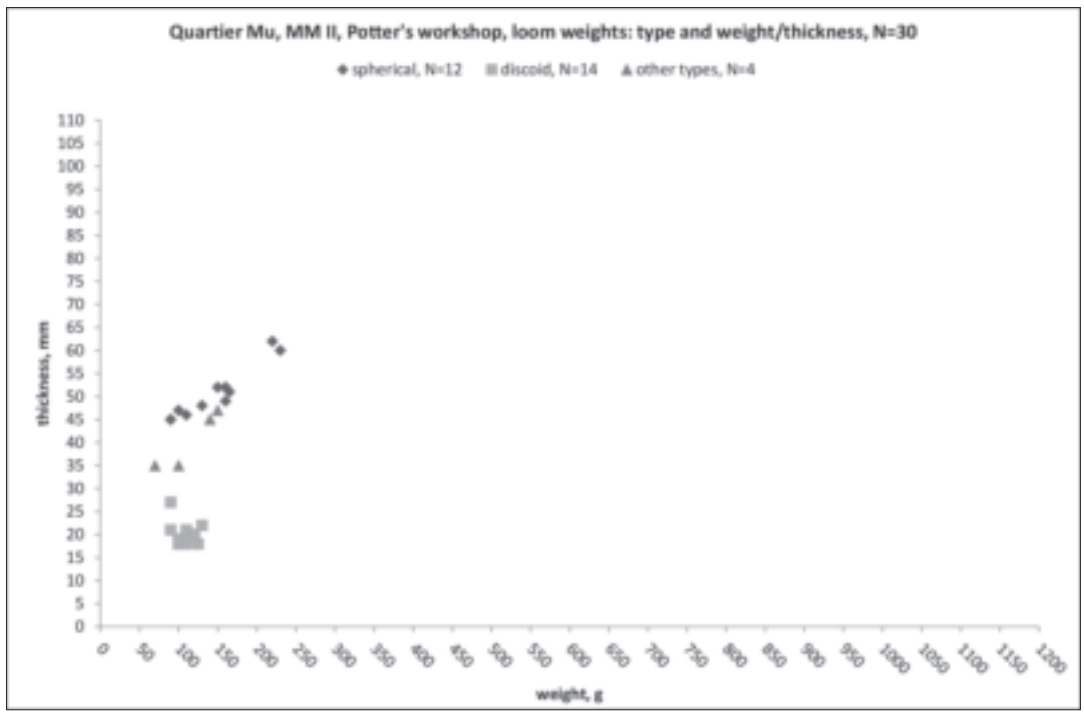

Fig. 6.5.15. Loom weights, MM II, the Potter's workshop: type and weight/thickness (excluding 1400 g torus weight). Please note that some markers represent more than one loom weight.

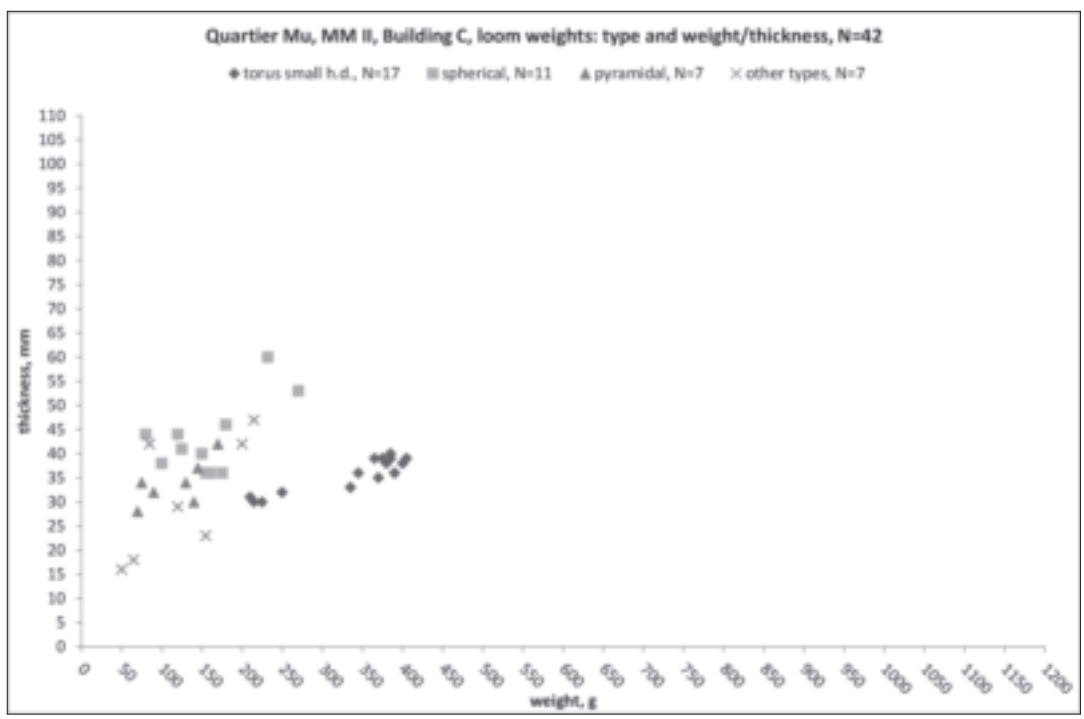

Fig. 6.5.16. Loom weights, MM II, Building C: type and weight/thickness. Please note that some markers represent more than one loom weight.

The 17 torus loom weights with a small hole diameter represent the majority of the loom weights of this type from the site as a whole. None of them would work well with thread needing *c.* 5 g tension; only four would be suitable for use with thread requiring *c.* 10 g tension (Fig. 6.5.17). All of them would function well with *c.* 15–20 g tension thread, and 13–14 would also be suitable for use with thread needing *c.* 25–35 g tension thread. Eight of these could additionally function with thread requiring *c.* 40 g tension. In a tabby weave with thread needing *c.* 15 g tension, the loom weights could produce a fabric with *c.* 9–14 threads per centimetre; with thread needing *c.* 20 g tension the thread count would be *c.* 7–11 threads per centimetre. In a twill weave, the thread count would be approximately double. Used with thread needing *c.* 15–40 g tension, this type of loom weight could be used to produce a denser fabric than it would be possible to make with any of the other main loom weight types found in Quartier Mu.

Other buildings

The 12 loom weights from Building E had also fallen from a floor above. Ten of these (eight spherical and two discoid) had a recordable

Warp thr/cm	10 g, N=4	15 g, N=17	20 g, N=17	25 g, N=14	30 g, N=13	35 g, N=13	40 g, N=8
4 thr							
5 thr						1	6
6 thr				1	1	12	2
7 thr			3		12		
8 thr			1	12			
9 thr		2	2	1			
10 thr		1	7				
11 thr		1	4				
12 thr		1					
13 thr		7					
14 thr	1	5					
15 thr	2						
16 thr	1						

Fig. 6.5.17. Torus loom weights with small hole diameter, MM II, Building C: weight tension/number of threads per cm in a tabby. The total number of analysed loom weights is 17.

Fig. 6.5.18. Loom weights, MM II, other buildings: type and weight/thickness.

weight and thickness (Fig. 6.5.18). The ground floor of this building consists of a series or rooms which appear to have been storage magazines, but no *in situ* material was recovered from them (Poursat 1992, 48). The upper storey rooms also appear to have been used for storage. The few loom weights from the remaining buildings similarly appear to have fallen from an upper storey (see Fig. 6.5.18 for those with a recordable weight and thickness).

Summary

Although a large number of loom weights were recovered from Quartier Mu, it is not possible to suggest how many looms were actually being used. In most cases, only a few loom weights were found together and even if they could have been used in the same loom setup, it is likely that these sets of weights would have contained more loom weights. It is also likely that the width of the fabric to be woven differed, depending on the type of textile to be produced.

In Building A, the loom weights from Room I 8 and Room III 1 would be best suited for the manufacture of textiles using very thin threads, that could be either dense or open/weft faced, depending on the loom weights used. The loom weights from Room III 1 would not all function optimally in the same loom setup and it is likely that (excluding the two heavier weights) they belong to two different sets.

The range of loom weights from Building B also suggest a varied production, but the majority would be best suited for a production of fabrics with very thin thread needing a tension of *c.* 5–10 g.

In contrast to the two main concentrations of loom weights from Building A, the two groups of loom weights stored in Rooms VII 3 and VII 4 of Building D would have been most suitable for use with thread needing *c.* 15–25 g tension. Various combinations of weights from these two rooms would function very well together in a range of loom setups.

The group of torus loom weights with a small hole diameter from Building C would function best with thread needing *c.* 15–20 g tension and the fabric produced would be relatively dense. It would be possible to weave balanced tabby fabrics (with the same number and type of warp and weft threads per centimetre^2) with this type of loom weight. In a twill weave, the fabric could even be warp faced (more warp threads than weft).

In the Potter's workshop, the majority of the loom weights are either spherical or discoid. It would not be optimal to use these two types of loom weight in the same setup, but they would function very well in two different loom setups. It is therefore likely that at least two different types of fabric were being produced in this workshop. Although produced with the same type of thread, the fabrics would visually be very different; for example, in a tabby weave, one would be more open or weft faced and the other would be denser, with a high number of warp threads per centimetre.

Only 12 loom weights were found scattered across the ground floor of Building E (a probable storage magazine), but they give the impression of a varied production. Loom weights were also only recovered in low numbers from the other buildings. However, the loom weights from the Founder's workshop and the South workshop are of different types, which suggest that the weavers may also have produced different types of textiles in these workshops; not only with very thin threads needing *c.* 5–10 g tension, but also with thin to medium threads needing *c.* 15–25 g tension.

Different types of fabric therefore appear to have been produced in different buildings, and even in different rooms within the buildings. In some locations, such as the Potter's workshop and Building A, it is most likely that fabrics with very thin threads were being manufactured. The loom weights stored in Building D, however, would have been more suitable for use with thicker thread.

Of the nine possible spindle whorls, it is important to note that only one, weighing 20 g, would have been optimal for producing the thinner thread types likely to have been used in Quartier Mu. It is clear that much of the warp yarn used in Quartier Mu was thin or very thin. For this, it would also have been necessary to have had access to raw material that was well prepared and of a good quality. Production of this thread would have been time consuming and would have demanded specialist knowledge.

Note

1 A more comprehensive analysis of the textile tools from Quartier Mu can be found in (Cutler *et al.* 2013).

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