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PROCESSED CEREALS AND PULSES FROM THE LATE BRONZE AGE SITE OF AKROTIRI, THERA; PREPARATIONS PRIOR TO CONSUMPTION: A PRELIMINARY APPROACH TO THEIR STUDY[1]

INTRODUCTION

THIS article is based on a paper delivered at the Symposium for the celebration of the thirty years of the Akrotiri excavations at the Archaeologike Etaireia in Athens in December 1997. The aim of this presentation was to recognize and define the organic material under study, which happens to be very rarely found in archaeological contexts, owing to the exceptional preservation at this very site. Nevertheless, the detection and conservation of this class of plant material was hardly ever performed, least of all in the late 1960s and 1970s. This increases even more the admiration for Professor S. Marinatos and his colleagues, who collected and preserved it. The exceptional finds from this site could have easily dazzled the archaeologists and made them ignore this humble material. Here we reap the pleasure of identifying them in order to further our knowledge about processed foods, just prior to cooking. It is fortunate that the vision of the excavators was not the mere collection of its works of art, which are provided with such abundance at Akrotiri, but the gathering of all available data, in order to reconstruct life as it was in Late Bronze Age Akrotiri. Here we shall merely touch upon the material under study in order to observe, define, and consequently present our uncertainties. Clearly, the study is just starting and there is still a long way to go.

Ground products, such as flour, as we know in archaeology, are organic remains that are rarely detected in archaeological excavations. Their absence does not reflect their absence in prehistoric or even historic times. The finds of implements, which ground or pounded such material, appear as early as the Upper Palaeolithic: we might therefore hypothesize that pounded and ground material pre-dated the domestication of plants. In those early days, grinding stones and mortars converted plant and animal products, as well as mineral substances, into products amenable to be eaten or, otherwise, used. In this paper, we shall not refer to the grinding and pounding implements, as two colleagues, Dr T. Devetzi and Dr A. Moundrea-Agrafioti, are in the process of studying them.

The study of ground and pounded cereals and pulses at Akrotiri is still in its infancy. The difficulty of the first stage is their detection and collection during the excavation. By its very nature the material could often be missed by the inexperienced excavator, as it is not always

[1] I should like to thank a colleague, Angeliki Kossyva, who helped me enormously to complete this work and to make it thoroughly enjoyable. Professor Ch. Doumas helped by making all the material available and providing hospitality at the site itself. Dr Delwen Samuel provided hospitality in London (UCL, Department of Archaeology) in order to check some flour and 'bread' material, and was very generous of her time and facilities. I should also like to thank the Department of Archaeology, UCL for providing the use of laboratory facilities including the use of the SEM, and to pay a tribute to Professor S. Marinatos who had the observational qualities and the perception to collect much of this material for posterity. Thanks are also given to George Landers for reading through the manuscript and to the anonymous reviewer who was kind enough to provide positive criticisms in order to improve the original paper, but all mistakes remain my responsibility. Last but not least, I also wish to thank the British School at Athens, which granted a scholarship to start research on the 'breads' of Akrotiri.

visibly different from the surrounding soil matrix.[2] Only when this material is observed with great attention does one notice minute plant fragments, which need to be fairly dense in order to be detected. At Akrotiri, these samples do not differ radically in colour from the surrounding soil, especially when one is faced with cereal flour.[3] They are only a little darker, owing to the preserved aleurone,[4] compared to the colour of the surrounding soil.

A second observation is the texture of flour, which is velvety and light. The calmest breeze could transport it more readily than soil. One has just to touch modern flour to understand what is meant here by a velvety touch. These differences, therefore, can be more readily detected when the material is found within a structure such as a pit and pot container, but, elsewhere, only the astute observation of the excavator together with the help of an archaeobotanist would detect such material. The presence of this material around millstones, grinding stones, in sacks and so forth, would evade us, especially if small quantities only survive.[5]

As for the other categories referred to in this paper, legume flour and bulgur are easier to discern. The first is much darker in colour than the soil matrix, due to the crushed and charred cotyledons of legumes. Here and there, very tiny fragments of pulses are distinguishable under magnification, whereas bulgur is detected by the presence of dense fragments of cereals, which are seen to have been deliberately pounded/crushed. However, if dispersed, these materials are rarely visible by the naked eye[6] and the same conditions of collection would be applicable, as in flour. Consequently, we might suppose that the quantities of these materials (flour, bulgur, crushed legumes) represent only a small quantity of the crushed/ground materials that originally existed at the site of Akrotiri. Their number is, nevertheless, not negligible, particularly when one thinks that they had been collected in the late 1960s and early 1970s, when archaeobotany was invisible in Greece, except for the work of Jane Renfrew in Thessaly.[7]

Another problem concerning this material is its preservation, for organic materials need certain specific conditions for them to be preserved, such as charring, desiccation, waterlogging, mineralization,[8] or permafrost. In Greece, charring preserves most material, but all the other categories also exist, except for dessication and permafrost, so far. At Akrotiri, as excavation and research progress, the conditions of preservation get more and more complicated, as the charring regimes do not seem as straightforward as they were considered at first. It appears that the last destruction of the site coupled with the deposition of the tephra created small environmental niches, with their own particular preservation conditions. So far as we know

[2] This is a more general problem pertaining to environmental archaeology when the collection of bio-archaeological material is not integrated into the archaeological excavation programme. Very often excavators collect only what they can see by eye, whereas the data are nearly always not visible by naked eye, especially under the conditions of the field. This is why sampling is conducted, in order to counteract the invisibility of much of this category of data. A. Sarpaki, 'The study of palaeodiet in the Aegean: food for thought', in S. J. Vaughan and W. D. E. Coulson (eds), *Palaeodiet in the Aegean* (Oxford, 2000), 115–21.

[3] The hue is even less visible when the cereal flour is produced from hulled grains (e.g. hulled barley) as there are glume impurities, often silicified and/or mineralized, which mask the darker colour difference.

[4] The parts of the cereal grain that turns into flour when ground.

[5] Water flotation of material thought of as flour would be detrimental to it as most of the fine silicified and/or mineralized glume parts would disintegrate and would be washed away together with the 'flour' itself. The only way to save this material is to collect it *en masse* and study it as it is (unwashed) under the microscope.

[6] They are visible only when large quantities are available.

[7] This work was centred on the questions of the beginnings of agriculture; the role of plants for investigating human behaviour was hardly touched upon.

[8] It is common for excavators to find organic remains near metal objects, especially copper/bronze, but also stones with a high lime content have also been known to mineralize textiles. This last example has been detected at Akrotiri. Moreover, at the site, other modes of preservation persist, silicification, for certain plant parts such as awns, glumes, and sometimes embryos of cereals.

there is no evidence of fires from the site and a testimony to this is the lack of charred wood, especially large chunks such as those coming from beams. All large pieces had left their imprints, such as the holes in the walls indicating where the beams and wooden lintels were placed. Even pieces of furniture, such as beds, stools, and tables, have left no evidence of charring. On the other hand charred seeds do occur in some buildings in large quantities, such as the samples from the West House[9] but are not as common in other buildings or sectors, such as Sector Delta or Arvaniti Sector. The reason for this discrepancy is not well understood. Archaeology verifies no conflagrations, but the existence of some charred material indicates some exposure to a source of heat, high enough to char crops but not adequate to char wood.[10] The result of this observation indicates that there persists an inconsistency between the types of organic remains that are preserved at Akrotiri. Firstly, organic materials, which need very high heat such as wood, and especially large logs, are more or less consistently not preserved. Secondly, finer materials such as crops seem to me to be differentially preserved. Thirdly, materials that generally contain a higher level of humidity, such as baskets and wood (very occasionally), do get preserved, often incompletely charred, and have been detected more often lately with the finds from the rescue excavations of the 'wells'.[11] Fourthly, in respect of the second case—crops—when the carbonization is incomplete, the category of material which is charred to such a level as to be identifiable is that which dehydrates, and therefore chars more quickly. In other words those that have a small mass, such as ground/pounded materials and material containing a high percentage of silica such as the product of cereals, the flours, with their inclusions of fragments of lemmas, palaeas, and awns, are consistently found. It has been noted in some cases, and in particular in Sector Delta, that although cereals had been stored whole, the only material which has been preserved was chaff. This observation was made when I helped excavate a pithos jar, which was full of some organic matter. Eventually, it was noted that the pithos held whole barley seeds, whose impressions were clearly visible, but disintegrated immediately when touched, leaving behind parts of the chaff. Had I not participated in the excavation of the sample, the interpretation would have been erroneous, and these would have been described as by-products of threshing. This would have, of course, misled us enormously, as regards storage issues at Akrotiri.

In conclusion we feel confident in saying that little is known about the conditions of preservation of organic remains at Akrotiri, and in particular, about the charring regimes which selectively preserved some categories of material and not others. For seeds to be present in some contexts which were not exposed to fires—according to the excavator's observations—must mean that the site has been exposed to another source of heat,[12] one of which could have been the hot tephra when it covered and sealed the settlement. This, as a consequence, has provided us with selective preservation for some categories of materials and not others; it is even more disconcerting that for other categories of organic material, such as crops, there seems to be unquantifiable differential preservation on the site. This problem renders even more difficult the study of socio-economic issues pertaining to the society at large, which could, otherwise, be erroneously interpreted. The need for us to know the

[9] A. Sarpaki, 'The palaeoethnobotanical study of the West House, Akrotiri, Thera', *BSA* 87 (1992), 219–30; ead., 'Small fields or big fields? This is the question', in D. A. Hardy *et al.* (eds), *Thera and the Aegean World*, ii (London, 1992), 422–32.

[10] For a more extensive discussion on this point see Sarpaki 1992 (n. 9), 423 n. 9.

[11] The 'wells' (or πεσσός) are the areas which have been excavated from 1998–2001 for placing the foundations of the new shelter of the site.

[12] Hearths are not included as a source, because seeds were preserved in storage pottery.

source and the charring regimes is not only restricted to the understanding and quantification of organic remains. It is also very important for evaluating what is found or lost, such as the colours on wall paintings, the preservation of tablets, of textiles and so forth. The need to do some independent EPR (electron paramagnetic resonance)—previously ESR—work in order to determine the temperatures which were obtained at the site is of paramount importance if we are to evaluate what organic remains might potentially be present. If, for example, an area has been submitted to a temperature of 180–200°C, then it could be expected that the area under study would have most—if not all—of the seed remains preserved. Absence of tablets in an area which had not been subjected to temperatures up to 200°C could mean that tablets were present but had been destroyed. Presence and absence would be able to be evaluated and the finds of organic materials and other artefacts (e.g. textiles, tablets and baskets) would be treated as reflecting true situations and/or just preservation accidents.

The Processed Cereals and Pulses

In order to study these plant materials, it is important to be able to define them and to create a typology. At this stage of study, both definition and typology are not yet systematic, but rather empirical. Nevertheless, it provides a first approach. At this actual stage, what we can achieve is to be able to identify the plant material, that is if it is processed wheat, barley, and mixed or even pulse. The second important point is that we can say whether they were fragmented deliberately and not just crushed owing to taphonomical processes or to mechanical damage and human manipulation during excavation. However, the implements or the technique of processing remain to be investigated. For this particular stage, it is believed that experimental archaeology through its multiple experiments would have ways of illuminating the problem. There are several points which interest us and which still await further investigation, such as (*a*) the processing of the crop prior to pounding and/or milling, for example, if the crop was parched or soaked in water.[13] (*b*) The method of processing is of particular interest—whether or not the crop was pounded and subsequently ground—and the time needed for such processing. (*c*) The various grades/types/qualities of flour are another point worth investigating but it is important to find criteria of independently defining them. These criteria would need to be quantifiable and able to be reproduced experimentally. Nevertheless, Meures-Balke and Lüning have conducted several experiments, as well as various other scholars.[14] Meures-Balke and Lüning, in their study of the Linear Pottery Culture, have indicated that a parching of the grain before dehusking was neither necessary nor probable, in view of the examination of the botanical remains.

[13] Some experiments have already been conducted for understanding the processing of cereals in the cultures of first farmers in Central Europe, such as for the Linear Pottery Culture (LBK or Linear Bandkeramik), J. Meurers-Balke and J. Lüning, 'Experimente zur Verarbeitung von Spelzgetreuiden', in M. Fansa, B. Renken, and J. Döring (eds), *Experimentelle Archäologie in Deutschland* (Oldenburg, 1990), 93–112. See also iid., 'Some aspects and experiments concerning the processing of glume wheats', in P. Anderson (ed.), *Préhistoire de l'agriculture: nouvelles approches expérimentales et ethnographiques* (Paris, 1992), 341–62. Another interesting article on experiments in milling is M. Währen, 'Brote und Getreidebrei von Twann aus dem 3. Jahrtausend vor Christus', *Archéologie suisse*, 7. 1 (1984), 2–6; see too id., *Brot und Gebäck im Leben und Glauben des Alten Orients* (Bern, 1967).

[14] C. Dickinson, 'Experimental processing and cooking of emmer and spelt wheats and the Roman army diet', in D. Robertson (ed.), *Experimentation and Reconstruction in Environmental Archaeology* (Oxford, 1990), 33–9; ead., 'The identification of cereals from ancient bran fragments', *Circaea*, 4(2), 95–102.

Moreover, other experiments by Yialouri[15] have shown that wetting grain before dehusking it and dehusking hulled grain in large quantities, are the most efficient methods of processing this stage. A conclusion to the same effect was indicated by the experiments conducted by Foxhall.[16]

Point (*b*), the method of processing of cereals and/or pulses, after storage and prior to consumption, is the easier to be explained by comparing the preserved plant remains (flour, bulgur, pulse meal) with the products obtained from the experiments. Working hypotheses can be proposed, as has already been seen, and several probable methods of processing can be investigated through the help of experimental archaeology, by trying to match the experiments as closely as possible with the tools and the technological know-how of the period under study. However, it is important to sound a warning and say that the results of the experiments should not be uncritically incorporated into archaeological reconstruction, but treated as an aid to them.

From the various experiments conducted and published, it seems probable that mortars with wooden pestles could have ground grain, as well as saddle querns.[17] At Akrotiri, it is believed that, probably, dehusking of glume cereals could have been done in stone mortars but with wooden pestles.[18] Experiments for Akrotiri are still due to be made.

Regarding point (*c*), at this stage, the various qualities of flour have not been investigated to any great extent and detail but they have been broadly defined. All organic material that cannot be detected by the naked eye but contains minute fragments of cereals or pulse when examined under a stereoscopic microscope has for the purposes of this exercise been called 'flour'. When the organic material is coarser and the fragments of cereal and pulse can be detected by the naked eye, this has been called bulgur for cereals and fava for pulses.

The Processed Organic Materials

There is no intention to describe the crop processing here, as it is conducted in the field, as various scholars have already adequately covered the issue.[19] The crops at Akrotiri, as already noted, had arrived after being submitted to the various stages of processing. As it is a consumer site, crops arrived after their coarse sifting and were in the ready to store stage. The crop processing stages that are noted, therefore, at the site are:

(i) Cleaning of the crop prior to consumption. This could be done by hand on a flat surface or could be sifted through a fine sieve.

[15] E. Yialouri, 'Processing of cereals during the Neolithic and the Bronze Age: experimental approaches' (in Greek, and English summary), in *Our Bread: From Wheat to Bread* (Athens: ETVA, 1994), 55–76. She did a few experiments, with dehusking hulled grain; the results are very interesting and seem to agree with L. Foxhall and H. A. Forbes, 'Σιτομετρεία: the role of grain as a staple food in Classical Antiquity', *Chiron*, 12 (1982), 41–90. They also concluded that the dehusking of the grain is better accomplished by wetting the grain before dehusking rather than by parching it, and further found that pounding and rubbing on a stone surface but with a wooden pestle produced coarse barley flour (ibid. 77). From Turkey, G. Hillman, 'Traditional husbandry and processing of archaic cereals in recent times: the operations, products and equipment which might feature in Sumerian texts, part I: the glume wheats', *Bulletin on Sumerian Agriculture*, 1 (1984), 114–52, has recorded all the stages of crop processing.

[16] See reference from previous note.

[17] Meurers-Balke and Lüning 1992 (n. 13); Yialouri (n. 15); Foxhall and Forbes (n. 15); Dickinson 1990 (n. 14); Hillman (n. 15).

[18] T. Devetzi, who is studying the mortars, claims that most mortars are found with no pestles and, therefore, hypothesizes that they might have been made of wood. (T. Devetzi, 'Stone vessels–tools' (Greek with English summary), in Ch. Doumas (ed.), *Ακρωτήρι Θήρας, είκοσι χρόνια έρευνας (1967–1987)* (Athens, 1992), 119–28).

[19] e.g. Hillman (n. 15); id., 'Interpretation of ancient plant remains: the application of ethnographic models from Turkey', in W. van Zeist and W. A. Casparie (eds), *Plants and Ancient Man: Studies in Palaeoethnobotany* (Rotterdam, 1984), 141; id., 'Traditional husbandry and processing of archaic cereals in recent times, part II: the free-threshing cereals', *Bulletin on Sumerian Agriculture*, 2 (1985), 1–31; G. E. Jones, 'Interpretations of archaeological plant remains: ethnographic models from Greece', in van Zeist and Casparie, op. cit. 43–61.

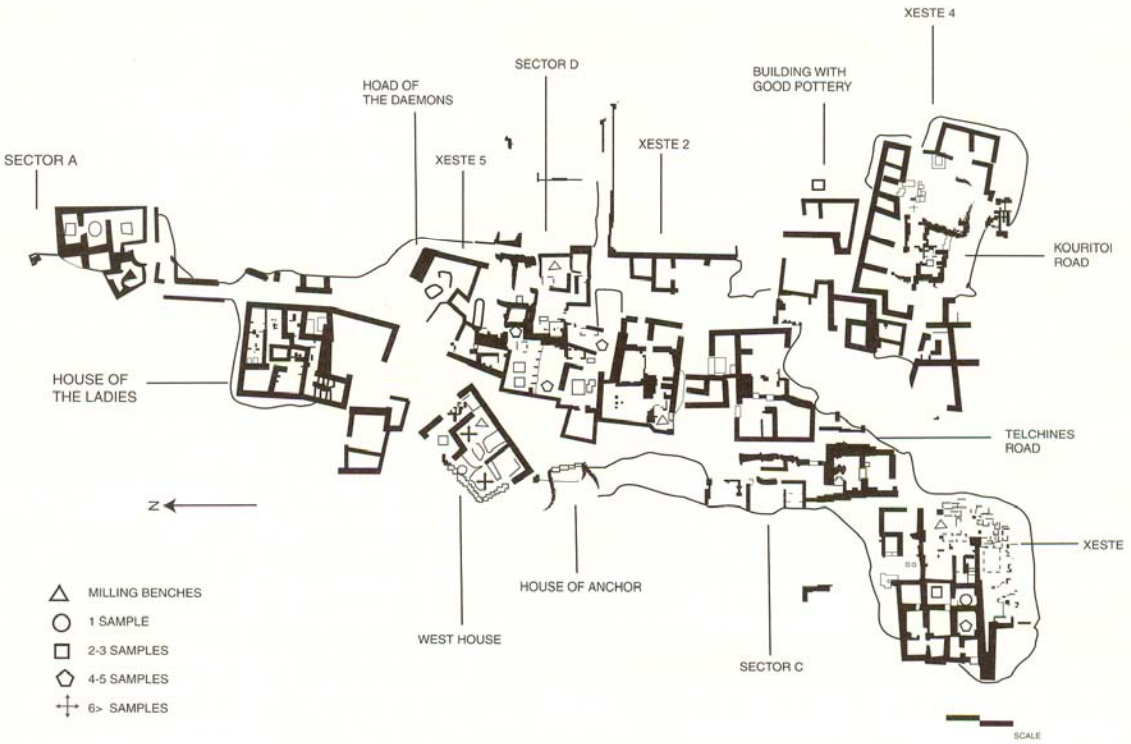

FIG. 1. The plan and distribution of processed plant materials at the site of Akrotiri.

(ii) Pounding cereals and pulses in order to reduce them to bulgur and fava.
(iii) Grinding cereals and pulses to reduce them to flour.
(iv) Cooking.

In this paper, we shall not deal with stored crops (stage i)[20] but with archaeobotanical material, which has been found in stages (ii)–(iv). The finds of material from the site of Akrotiri can be seen distributed on the map (FIG. 1) and listed in TABLE 1. For the West House they are listed in TABLE 2. In order to compare the archaeobotanical finds in general—stored products—to the category mentioned here see TABLE 3, where it is surprising to note that such a high proportion (about a third) of the stored products were processed to such an extent as being prepared ready to eat.

At Akrotiri, the processed plant materials that have been detected are (*a*) bulgur[21] (FIGS. 2 *a*, 3), (*b*) fava,[22] (*c*) pulse flour,[23] (*d*) wheat flour, (*e*) barley flour (FIG. 2 *b*), and (*f*) mixture of

[20] This has already been dealt with for the West House in A. Sarpaki, 'The Palaeoethnobotany of the West House, Akrotiri, Thera: A Case Study' (Ph.D. diss., Sheffield, 1987); cf. eid., 'A palaeoethnobotanical study of the West House, Akrotiri, Thera', *BSA* 87 (1992), 219–30. The next house to be studied in detail, although there has been a short interlude with the preliminary study of the 'wells' (πεσσοί), will be the House of the Ladies.

[21] Generally speaking 'bulgur' is understood as cracked wheat but here we refer to it as cracked barley too.

[22] Fava (legume meal) is detected when studying the cracked pulses under a stereoscope microscope and recording that the cotyledons are split into two, the testa is missing, but the cotyledons are bruised in such a way (fragments broken off) as is detectable from the mechanical damage affecting them during excavation. Very often, when pulses are stored whole but charring destroys the testa, some cotyledons still continue to be attached to each other—often with fragments of testa adhering to them—but most important is the fact that the cotyledons are not cracked, especially when they are stored in pottery.

[23] Pulse flour is identifiable from fava as being crushed legumes very finely ground but still detectable under a microscope.

TABLE 1. Akrotiri, Thera: Processed (ground/pounded) material from the settlement

	Wheat flour	Barley flour	Legume flour	Bread-like matter[a]
Arvaniti				
Storeroom of pithoi		1		
Storeroom 1		3		
Storeroom 2		1	1 (;)	
Storeroom 3,3		2 + 1 (;)		
Sector Γ				
Bronos 1			1 (;)	
Bronos 1α[b]				1 (;)[c]
Bronos 1, room 2		1		
Sector Δ				
Δ1		1		1 (;)
Δ1α		5		
Δ2[d]		5		1 (;)
Δ8 α[f]	1	4[e]		
Δ9, 1		3		1 (;)
Δ16[g]	1	6	1 (;)	2 (;)
Xeste 1				
1α		2		
Xeste 3				
Room 6				1 (;)
Room 7		1		1 (;)
Room 11				4 (;)
'well' 48				2 (;)
Xeste 4				
Area of good pottery		2		
TOTAL	2	37	3	14

a The term 'bread' is used here in a wide sense and includes hard tack, biscuits, and so forth. In short it refers to all amorphous mass made of plant material into a dough.
b It was studied for my Ph.D. (see n. 20).
c It could be 'bread' made from pulses or, at least, it could contain a high percentage of them.
d Two samples looked like flour but it was decided, owing to their very high inclusion of awns and low organic content that they could be by-products of flour, sifting (by-products of pounding); and might have been used for mattresses, cushions, and the like.
e It is flour of both barley and wheat, as there are awns of the two genera.
f Δ8 α, M26, ΨO2, 11.7.1994. Δ 16, 22.9.1971, Π33.
g Δ 16, 22.9.1971, vessel Π33.

wheat and barley. As has been mentioned, the identifications, so far, have been macroscopic (stereoscope microscope), and although fragments of legume cotyledons can be fairly easily detectable, the information imparted is general and it can only indicate that it is a legume. More details as to their species are most of the time impossible. As regards the cereals, as flour often preserves some of the chaff of the grain in hulled cereals, minute

TABLE 2. Akrotiri, Thera: Processed (ground/pounded) material from the West House

	Wheat Flour	Barley Flour	Legume Flour (?)	Barley 'bulgur'	'Bread'	'Fava'
Ground Floor						
Room 3Γ		2		1		3
Room 5		1	1;	5		
Room 6			2	1		
First Floor						
Room 6	1	1				
Area 7				1	1	
TOTAL	1	4	3	8	1	3

TABLE 3. West House: number of studied archaeobotanical samples

Ground Floor	(N)
Room 3_	7
Room 4	3
Room 5	20
Room 6	15
First Floor	
Room 3	5
Room 4	1
Room 5	1
Room 6	3
Room 7	7
TOTAL (n)	62

plant parts remain in the product after sifting, which give away information as to the species of the cereal. At Akrotiri fragments of the awns (FIG. 3) were retained in the flour and by studying the material under a stereoscope microscope, it was noted that the most common flour was barley flour. So far, forty-five samples of barley flour have been collected from the site of Akrotiri—including the finds from the West House—and only three of wheat. Interestingly enough, two samples from Sector Delta, Δ 8a[24] and Δ 16 seem to have been mixed wheat and barley, whereas in the West House room 6 (first floor) wheat and barley flour were stored side by side, perhaps facilitating mingling when the occasion demanded it.

Flour made from legumes seems also to have been present at Akrotiri with six samples (TABLES 1–2). The West House seems to differ from the other buildings by the finds of eight samples of bulgur (πληγούρι in Greek, when it comes from cracked wheat).

[24] Δ 8a, M26, 11.7.1994; Δ16, 22.9.1971, Π33.

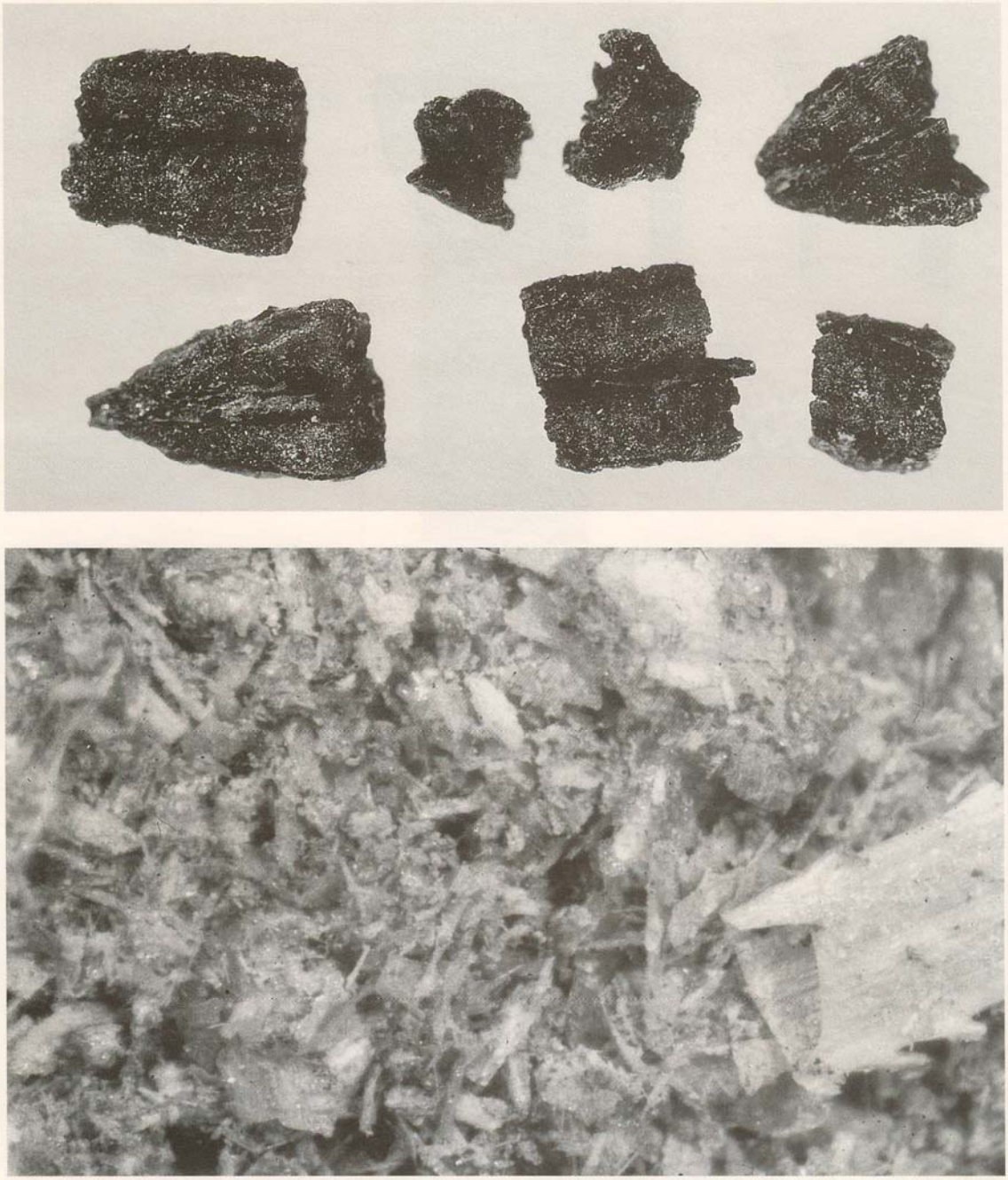

FIG. 2. (*a*) Cracked barley ('bulgur') from Akrotiri. (*b*) Barley flour with awn.

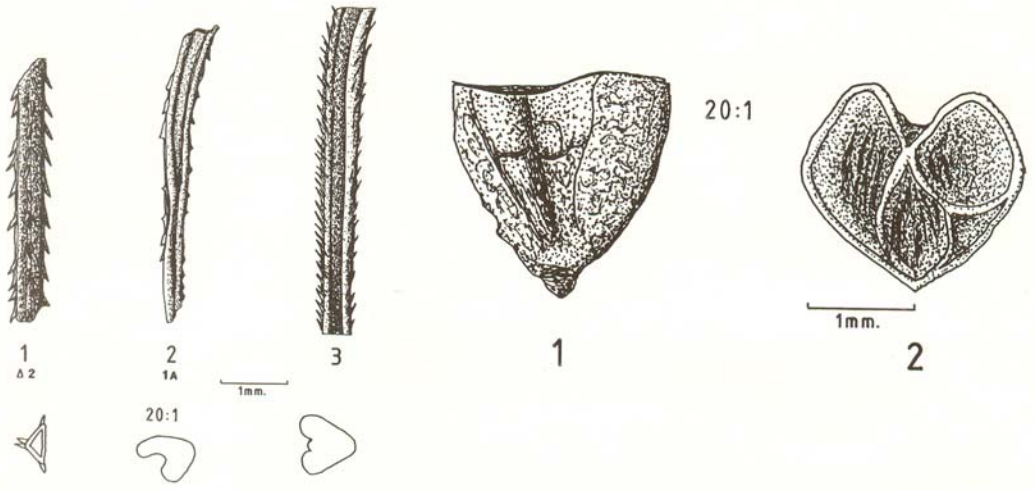

FIG. 3. Awns (1 = barley; 2, 3 = wheat) and fragment of cracked barley, 'bulgur' (1 = ventral view; 2 = transverse section) from Akrotiri.

THE ORGANIZATION OF STORED GROUND PRODUCTS: SOME PRELIMINARY IDEAS

It is worth noting the presence of 'milling' areas at the site of Akrotiri (FIG. 1) in conjunction to the finds of processed materials.[25] Sector Delta has provided us with a milling area, Δ 15 and a possible other at Δ 18, which is near to an important room/shrine Δ 2.[26] The Arvaniti Area (Sector A), storage rooms 1, 2, 3,3 has to its west the Milling Area (FIG. 4) and although it belongs to a nearby building to Sector A, its closeness to what seems to be flour magazines is worth noting. Xeste 3 is also believed to have its milling area in room 2.

At Akrotiri organized milling installations were found (FIG. 5), which could provide a large production of milled products (both cereals, legumes, and, perhaps, even other milled products such as condiments and aromatic plants), every working day. This induces us to wonder whether there was an organized class of millers and/or milling merchants. The only area, which has been described as a possible shop for selling flour, is Arvaniti, storage room 1, as the east window is long enough to provide visibility to customers at street level. Therefore we are faced with the question of what milling benches represent as regards production. Were they specialized areas of production signalling a particular class of crafstmen/craftswoman, namely millers? Were they signalling a particular type of household with a high need for milled products? Was it a sign of status? For there

[25] It is very important to remember that the site of Akrotiri is not fully excavated, not even the part in the plan shown here. The only areas which have been excavated to the ground floor are the West House, the House of the Ladies, and Xeste 3. In the first, a grinding-bench has been found, whereas the entrance of the House of the Ladies has not been excavated owing to problems of the building's stability, and the possible find of a bench there, although it must be considered fairly unlikely, could not be totally excluded. Xeste 3, on the other hand has an installation that A. Moundrea-Agrafioti 'Μυλώνες και διαδικασίες άλεσης στο Ακρωτήρι' (unpublished conference for the 30 years of Akrotiri) has called a milling bench. In this case, two of the three buildings seem to have private milling benches.

[26] In this room were found the lively *Spring Fresco* and many cooking vessels (see Ch. Doumas, *The Wall Paintings of Thera* (Athens, 1992); A. Sarpaki, 'Plants chosen to be depicted on Theran wall paintings: tentative interpretations', in S. Sherratt (ed.), *The Wall Paintings of Thera* (Athens, 2000), 657–80, esp. 659–60). See also the fairly numerous samples of flour found in that room (TABLE 1).

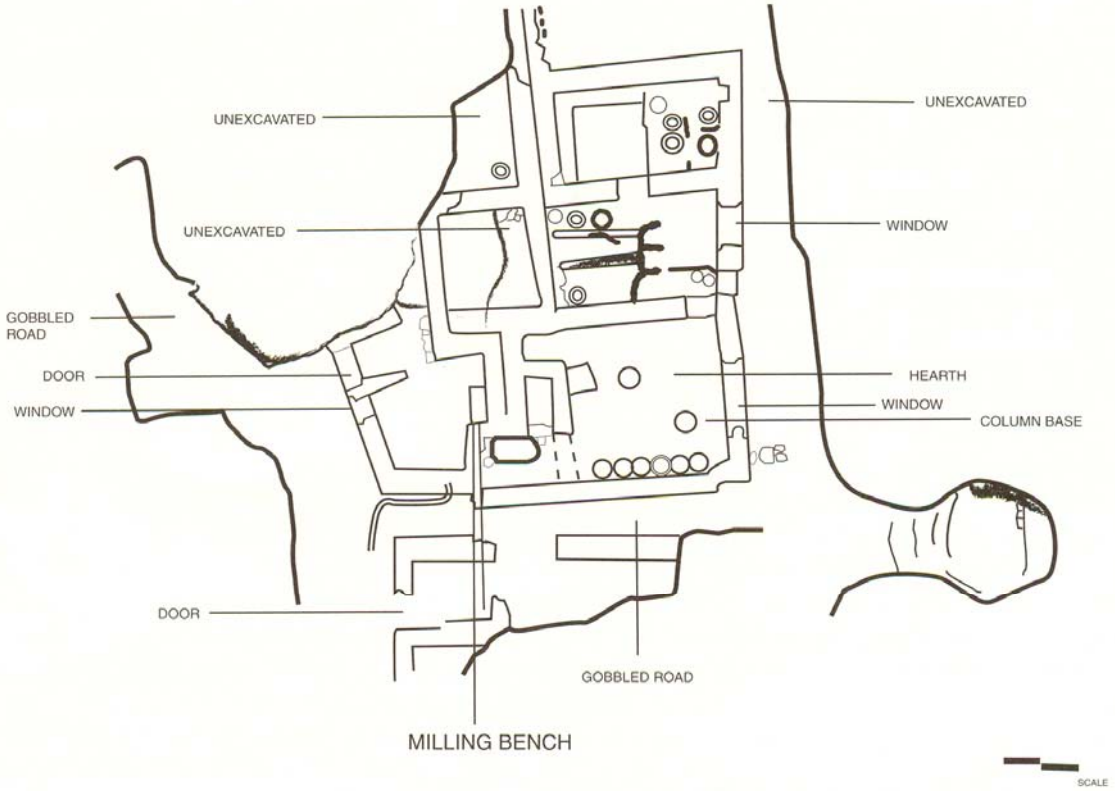

FIG. 4. The Milling Area in connection to Arvaniti (Sector A).

FIG. 5. The bench-milling area of the West House.

were several quernstones found at Akrotiri; for example, besides the milling bench of the West House there were another two triangular querns found in the house,[27] one in room 3, and the other in room 6, both on the first floor. Were the quernstones and the milling benches used for grinding the same product, or was the bench used by different personnel and for other purposes? At the moment, answers cannot be provided, nor do we know whether benches existed in all households, as most of the houses have not been excavated down to the ground floor.[28] However, the quantities of ground/pounded organic matter found at Akrotiri are fairly numerous (73 samples), although, on the one hand, not all the ground floors have been excavated, and, on the other, several samples have been left *in situ* on the site. The latter have not been included in the numbers mentioned here.

In the West House, 62 samples of plant remains have been studied, out of which twenty (about 1 in 3) had been submitted to some kind of processing on a quernstone or in a mortar, or even both. This implies that the inhabitants of Akrotiri often processed their crops some time before consumption (TABLES 1–3, FIG. 2). This is explainable if the material was prepared for making bread (flour) or soups (broth).[29] The legumes, on the other hand, one assumes, would have been well pounded, before consumption, for good reason, as they must have been trying to avoid lathyrism[30] by extracting the legume testa, and thus avoiding the neurotoxic amino acid BOAA that causes the disease. Furthermore, they tend to need less cooking and are digested better when the testa is removed. This explains the persistence of fava consumption in modern Greek diet, throughout Greece and especially in the Cyclades, where legume consumption is quite high.

In some buildings, such as at the West House, a milling bench is connected to a 'household' and the inhabitants have the use of two more quernstones for grinding the materials that they need. The estimation of the storage, as we had calculated from the volumetric potential of pottery, represents the storage needs of a nuclear household. The bench, in this case, signals the needs of a household, if this is a typical situation of the site, a fact that we still do not know at present. Nevertheless, milling benches are also connected to other social structures, which do not represent households and seem to be more trade-oriented, such as the big storage apothekai (storage rooms) at Sector A. If this observation is correct, and the quantities of stored flour are great, this automatically means that there must have been a high consumption of flour.[31] It either suggests that the inhabitants, apart from grinding their own flour, also bartered for more which has socio-economic consequences hard at present to determine—or that a section of the population depended on bartered processed foods for their existence. These could have been social classes that depended on their crafts (e.g. metallurgy, textiles) for subsistence. It could also mean that some authority, secular and/or religious, distributed or bartered processed food in exchange for some service. At present, we can only conjecture.

[27] Devetzi (n. 18), 125. These are not typical quernstones and are more elaborate and decorative, but it is interesting to note that the flour of room 6 was also found in the same room.

[28] At Akrotiri, understandably, benches have only been found on ground floors.

[29] Cracked wheat (πληγούρι) today is used instead of rice or potatoes in some Greek dishes, but it could also be used in soups (τραχανάς).

[30] J. Hansen, 'Palaeoethnobotany and palaeodiet in the Aegean region: notes on legume toxicity and related pathologies', in Vaughan and Coulson (n. 2), 13–27, and esp. 22–3. Although some scholars claim that forms of cooking involving high temperatures appear to deprive the Lathyrus spp. of their harmful effects, yet others insist that neurolathyrism was still present in some frequency amongst people who were roasting and boiling and making legume flour. Fava beans seem to have been eaten in small quantity at Akrotiri, so there is no reason to discuss the problem of favism, caused by these legumes.

[31] It is well known that storage of flour is not viable for long periods of time, as either insects and/or mosses attack it, or it becomes mouldy. We know that cereals and legumes are preserved better and longer if the seed is not bruised (and for legumes if it preserves its testa); if not ground/pounded they can be stored for periods of 1–2 years.

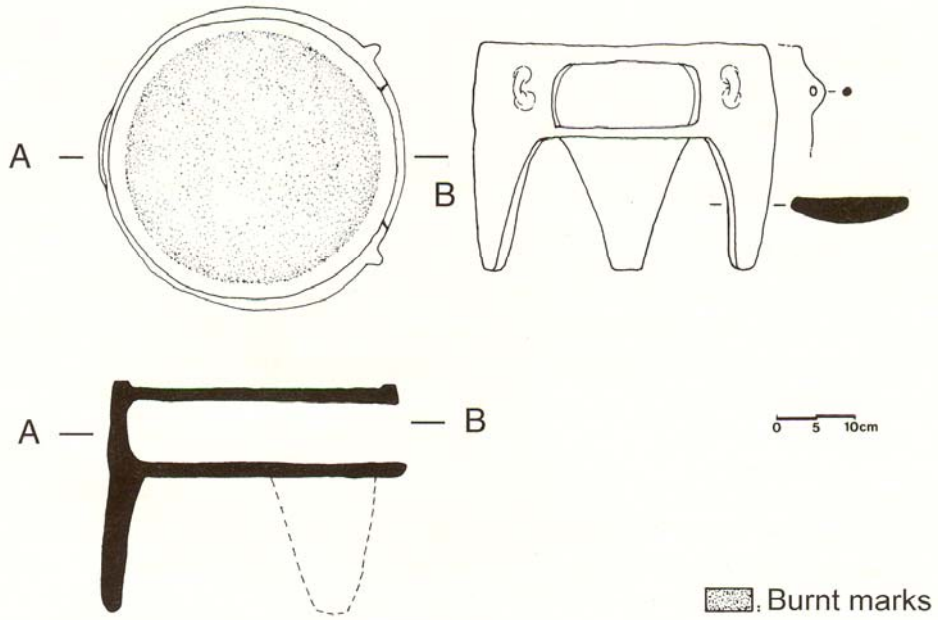

FIG. 6 Small portable oven, National Archaeological Museum, Athens, No. 1376 from Akrotiri, Thera, found east of rooms Δ 3 and Δ 8.

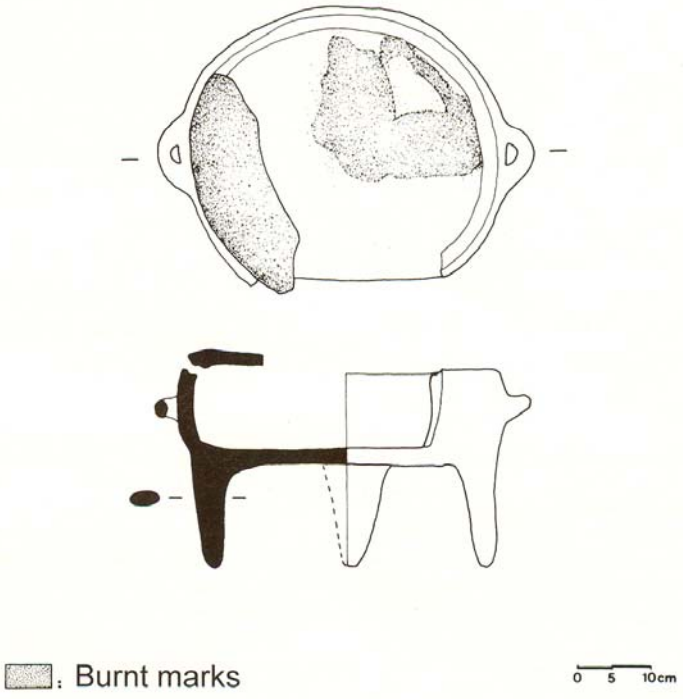

FIG. 7. Small portable oven, Akrotiri registers No. 2605. Its sherds were found dispersed at Arvaniti, Apotheke 3,1, as well as apotheke 2, so it might have originally belonged to the first floor.

Allbaugh's study has shown that, in post-Second-World-War Crete, the consumption of cereal per adult was approximately 2½ kg per week.[32] At LBA Akrotiri, what could it have been? It is very probable that bulgur, fava, and even flour were used in foods. There are indications for a mixture within other ingredients, as in the sample of the West House, where fishbones were found mixed with cereals. Another use of flour would also have been in the making of bread, which, in my opinion would have probably been a type of pitta bread.[33] Briefly, this is based on the assumption that the species of cereal (barley, einkorn and emmer[34]) would not make good baked bread, as their gluten content is minimal. At Akrotiri, moreover, there is a lack of ovens, so baked foods, as we know them, would not have been a common occurrence. The only exceptions are two small portable ovens (FIGS. 6–7), whose function, amongst other uses,[35] could have been to cook pitta bread on their flat top.

EPILOGUE

It is, therefore, apparent that at Akrotiri, we have been excessively fortunate, due to the conditions of the destruction of the site, but also due to taphonomical reasons, in finding plant materials which are very close to the stage of consumption (pounded/ground cereals and pulses). Fava,[36] bulgur, barley, and wheat flours as well as legume flour have been studied. The finds of flour are exceedingly important, as they seem to be unique in Aegean archaeology and, one could even claim, in world archaeology. Egypt, which has provided us with a multitude of several types of foods and bread, has not yet procured us with this material. Beyond defining the pounded/ground materials found at Akrotiri and studying their distribution in the site itself, more work needs to be made on the quality of flour and the 'breads'[37] of this site.

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[32] L. G. Allbaugh, *Crete: A Case Study of an Underdeveloped Area* (Princeton, NJ, 1953).

[33] A. Sarpaki, 'Bread in the Aegean in prehistory', paper delivered at the XIII International Congress of Prehistory and Protohistoric Sciences, Forlì, Italy, 8–14 September 1996 (forthcoming), Abstracts, 1. 63–4. The 'breads' of Akrotiri are under study by the present author together with Delwen Samuel.

[34] Emmer has been found in very small numbers so far, and always as a contaminant within other crop plants.

[35] They are very similar to braziers (μαγκάλια in the Cretan dialect) which were used as multiple function utensils, such as for heating and 'fast' cooking, for grilling chestnuts, baking potatoes, etc. The fuel used was crushed olive stones (called πυρήνας in the west of Crete), which are the by-product of olive-oil production.

[36] Fava has already been found at LBA Thebes, see G. Jones, 'An early find of "fava" from Thebes', *BSA* 88 (1993), 103–4; bulgur was also found at the prehistoric settlement of Mesimeriani Toumba (Thrace); pers. comm. by T. Valamoti, who is studying the material (forthcoming).

[37] I have started microscopic examination of the amorphous substances which seem to come from plant remains; for convenience they have been termed 'bread'. So, for our present purpose, 'bread' is the term used for an organic material (plant) made into a dough.