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THE ARCHAEOLOGY OF REFUSE DISPOSAL IN NEW KINGDOM EGYPT: PATTERNS OF PRODUCTION AND CONSUMPTION AT EL-AMARNA

Ian Shaw

This article analyses refuse disposal mechanisms at El-Amarna, the well-known site of a Late Bronze Age city in Middle Egypt. After around forty years of increasingly intensive settlement archaeology in Egypt, refuse and middens have received surprisingly little attention, despite their importance in archaeological and cultural analyses and interpretations. This paper uses software simulating artefactual diversity to attempt to identify and categorise different types of refuse deposit at El-Amarna, and therefore to reach a better understanding of trash as a component of the archaeological record of New Kingdom Egypt.

Introduction

The study of refuse disposal and its impact on the archaeological record was first explicitly discussed by Michael Schiffer in the 1970s and 1980s (Schiffer 1976; 1987), and since then the issue has continued to be an important part of discussions of site formation processes and studies of human attitudes to trash and waste products in a wide diversity of archaeological contexts[1].

In contrast, few studies have been explicitly devoted to the study of refuse disposal mechanisms in ancient Egyptian communities. Nearly 40 years ago Michael Hoffman (Hoffman 1974) described the 'social context of trash disposal' at Hierakonpolis in the early dynastic period (*ca*. 3000-2686), and David Dixon (Dixon 1972) produced a brief summary of some of the evidence for later periods, but since then these crucial aspects of ancient Egyptian material culture and social dynamics have been oddly neglected, despite the richness of some of the available urban data[2].

The aim of this paper is therefore to present a more detailed study of the social and economic context of ancient Egyptian refuse disposal, using material exca-

[1] See, for instance, the pioneering work of Rathje/Murphy 1993. Specific case studies include Needham/Spence 1997, Beck/Hill 2004, and Shillito *et alii* 2011.

[2] Although for one recent example of discussion of Egyptian waste disposal see Kemp/Stevens 2010, 499-503.

vated across the Late Bronze Age city of Akhetaten as a case-study. This city – comprising the site now known as El-Amarna – is located roughly midway between Cairo and Luxor. It is the largest surviving city of the pharaonic period (Kemp 1989, 262-273), and temporarily replaced Memphis as the Egyptian capital. The unusually short life of the city (*ca*. 1350-1320) and the general dearth of subsequent settlement at El-Amarna have together ensured remarkable preservation of the remains. Contained within a semi-circular bay of cliffs approximately 10 km long and a maximum of 5 km wide, the city stretches for about 7 km along the eastern bank of the Nile; its total population has been variously estimated at between 20,000 and 50,000 individuals[3]. Over the last 120 years, El-Amarna has been examined by a succession of excavators, each using different methods in their digging, recording, and publication. There were essentially four phases of work: the first scientific excavations, undertaken by Flinders Petrie in 1891-92 (Petrie 1894); the work of the Deutsche Orient-Gesellschaft (German Oriental Society) in 1907 and 1911-14 (Borchardt/Ricke 1980); the Egypt Exploration Society excavations from 1921 to 1937[4]; and finally the work of Barry Kemp from 1977 to the present day[5].

By the late 1930s, the excavation of numerous private houses at El-Amarna (see Borchardt/Ricke 1980) had established a basic corpus of information with great potential in terms of analysing the refuse disposal strategies in an Egyptian New Kingdom city. Subsequently, general discussions of the society and economy of ancient Egypt, from H.W. Fairman (1949) to Harry James (1984, 226-230), used these limited data (along with a few fragments of information from Kahun and Gurob) to make some basic assessments of the ways in which the Egyptians of the New Kingdom dealt with refuse, but no detailed study has yet been attempted. In 2010, Kemp and Stevens observed, in the context of their excavation of the 'grid 12' area of housing in the main city at El-Amarna, that "the management of waste is an aspect of ancient Egyptian society that is not well understood … and it is difficult to get a measure of the impact this had on the quality of life" (Kemp/Stevens 2010, 501).

Forms of refuse at El-Amarna – a brief summary of previous studies

The so-called 'palace rubbish heaps' at El-Amarna (Petrie 1894) and Malkata (Hayes 1951) constitute evidence of large-scale communal dumping while the many pits, beneath and around houses, also suggest widespread individual burying of household refuse, often in pits already dug for a different reason, such as

[3] Kemp 1981, 93-97; Janssen 1983, 282-288.

[4] Peet/Woolley 1923; Frankfort/Pendlebury 1933; Pendlebury 1951.

[5] Numerous publications for Kemp's survey and excavations have appeared, including annual preliminary reports in the *Journal of Egyptian Archaeology*, but see Kemp/Garfi 1993 for a general summary of the site from a 1990s perspective. See Shaw 2000 for a summary of the changing strategies of excavation at the site.

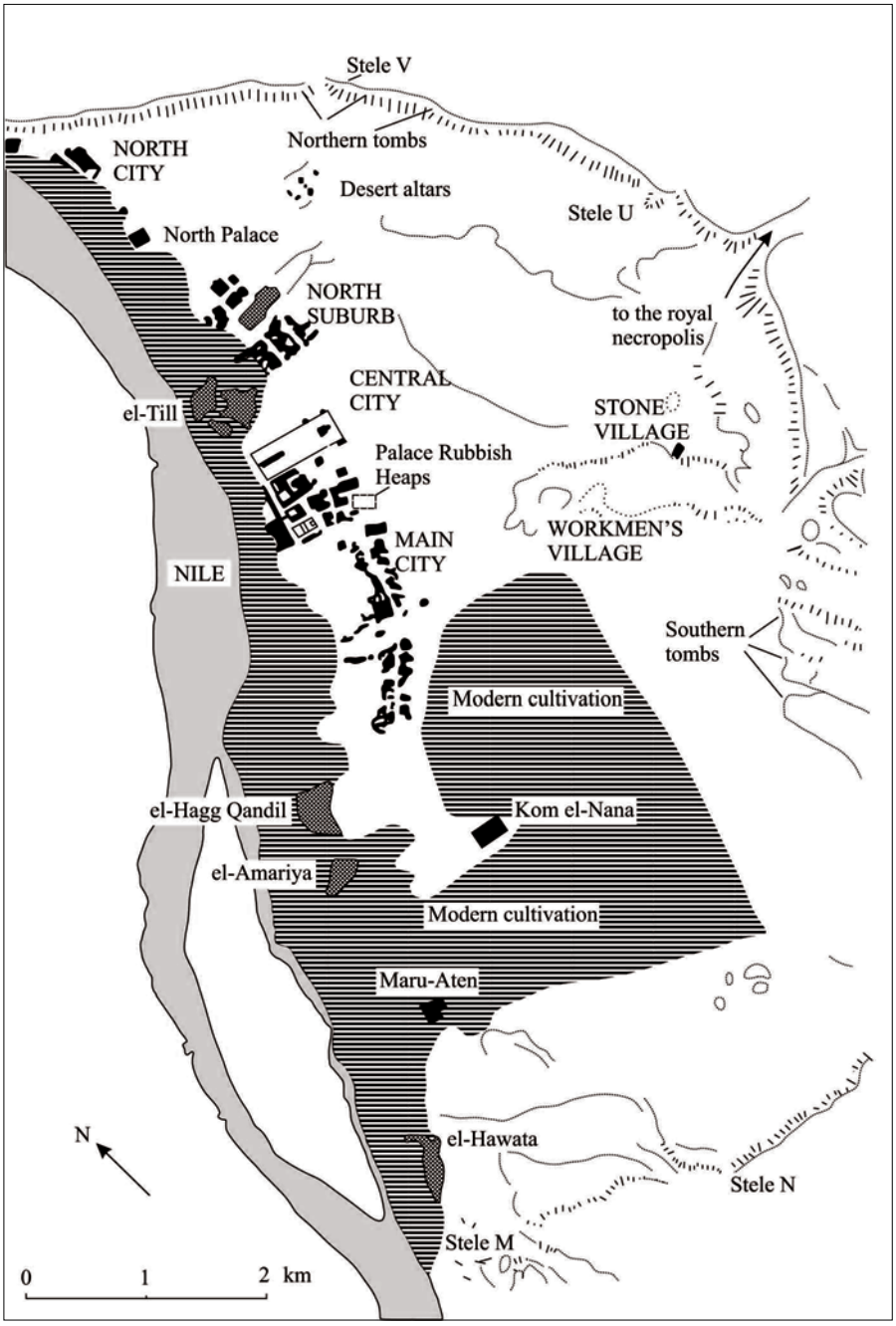

Fig. 1 Plan of the ancient city at El-Amarna (map: N. Nielsen).

wells[6], silos, or marl-quarries. Small pits for disposal of household refuse are also well-documented at other New Kingdom sites such as Gurob (Thomas 1981, 13-14) and Memphis (Jeffreys 1986), and the excavated material from Kom Rabi'a (Memphis) includes refuse deposits from a disused silo and an open courtyard (Jeffreys 1986).

Mention is sometimes made of the fact that the northwestern quarter of the north suburb at El-Amarna was built on top of earlier rubbish deposits. In Pendlebury's preliminary report on the north suburb excavations he provides this description: "It is clear that for some time after the construction of the larger houses the whole area within was an open common, used mainly for rubbish pits. On the increase in population this waste land was given up, the rubbish pits were filled in and small tenements erected over the whole area. It was by no means rare to find a whole wall collapsed and sunk into a pit, while the owner of [house] T35.18 actually disinfected an old rubbish pit in his grounds, by burning, and then built a corn bin on top of it" (Pendlebury 1931, 233). This suggested instance of disinfection of rubbish by burning has been much repeated[7], although James (1984, 229) argues that the purpose of the burning was to compress the rubbish rather than to disinfect. However, a third, more likely, explanation of the ash below the corn bin at T35.18 is to be found in the comments of Robert Miller regarding a similar context in the 'workmen's village' at El-Amarna (Miller 1987). In a discussion of loose ash found below quernstones at the village, Miller points out that there is a reasonable amount of evidence to indicate that ash was deliberately placed under querns and silos, as a form of desiccating insecticide. The attitude to refuse observed in the northwestern quarter of the north suburb seems in fact to have been common practice throughout the city and it must be assumed that layers of refuse were gradually deposited over a large proportion of the occupied surface of El-Amarna, varying only in their thickness and constituents. Since the city at El-Amarna may have existed for as little as twenty or thirty years in the late 18th Dynasty (*ca*. 1350-1325), the archaeological situation in terms of refuse deposition is particularly interesting. This is accentuated by the fact that there is a generally minimal amount of post-18th-Dynasty occupation at the site. Refuse deposits at El-Amarna are therefore likely to be unusual, first because they represent a relatively short period of human activity, compared with other urban sites at Memphis and Elephantine for instance, and secondly because the most recent period of deposition is less likely to have been disturbed by later activity.

Traditionally, the understanding of refuse mechanisms relies to a large extent on the ability to distinguish between three categories of refuse defined nearly forty years ago by Schiffer (1976): *de facto* refuse (tools and materials abandoned at an

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[6] The well beside houses U37.1-3 contained a variety of artefacts, including sculpture and ring-bezels (Frankfort/Pendlebury 1933, 13-14). The large well beside house Q48.4, excavated in the 1987 season, contained a re-used or discarded limestone door-jamb inscribed with a hymn to Akhenaten, which had fallen in after the abandonment of the well.

[7] See Frankfort/Pendlebury 1933, 3; Fairman 1949, 39; Dixon 1972, 649.

activity area but still usable), primary refuse (intentional discard of items at or near the end of their use life, but crucially still in the area where they were being used), and secondary refuse (disposal of items in areas other than where they were used). To these Hodder has recently suggested adding a fourth type of refuse, in the context of complex urban tell sites: 'tertiary refuse', which he defines as "all the items of refuse that become incorporated into deposits as background constituents of the deposit matrix" (Hodder 2012, 73).

A classic ethnographic study of refuse disposal undertaken by Hayden and Cannon, using data from three late 20th-century villages in the Maya highlands in the 1980s, stresses the need for archaeologists to understand the specific refuse mechanisms of the community with which they are concerned (see Hayden/Cannon 1983). However, the need to differentiate between types of refuse deposit exposes one of the greatest weaknesses of the data excavated at El-Amarna by the German and British expeditions between 1907 and 1937, since the published and archival records of these archaeologists appear to allow little scope for making reliable identifications between different types of refuse context. Another familiar problem with the study of refuse at El-Amarna is the patchy preservation and recording of organic material, particularly in the 1907-37 excavations in the city. A whole range of activities, including food preparation, leatherworking, and woodworking, can sometimes be under-represented or entirely missed from among the many deposits of refuse recorded by these early 20th-century expeditions (see Shaw 2000). Furthermore, the evidence of current and recent excavations at El-Amarna confirms that much of the craftwork actually took place in courtyards and open areas, which are precisely the areas that tend to be neglected by the 1907-37 excavators (see Stevens/Eccleston 2007, 153).

Not surprisingly perhaps, the main conclusion reached by Hayden and Cannon in their Maya case-study is that it is not sufficient to examine a single deposit from a household and its immediate surrounding area: the whole of the surviving refuse from a specific household should ideally be tracked down and examined if the picture of the inhabitants' behaviour is to be accurately reconstructed. This and other studies (such as Hammond/Hammond 1981) demonstrate above all that secondary refuse exists in a multitude of different forms of deposit and results from a series of decisions which vary according to special cultural and environmental conditions. In other words, it is difficult to formulate even very general cross-cultural observations about refuse disposal.

There was a large amount of *de facto* and primary refuse spread over both courtyards and interior floors of houses at El-Amarna. Peet and Woolley's stratigraphic sections in building N49.18 and in the River Temple at El-Amarna revealed many levels of primary refuse (Peet/Woolley 1923, 12-14, 127), and the excavations at the workmen's village during the 1980s included a trench beneath Long Wall Street 7, which "brought to light shallow deposits of rubbish and ash" (Kemp 1984, 5). The city survey in Kemp's 1986 season at El-Amarna contributed further evidence in the form of a "thin covering of Amarna period rubbish" exposed by modern marl diggers working in the area between the north sub-

urb and the Great Temple *temenos* (Kemp 1987a, 103). Most recently, the excavation of the Grid 12/Ranefer area of housing in the main city (also described as the 'south suburb' in earlier publications) at El-Amarna, in the 2002-06 seasons, has yielded the most detailed data yet concerning patterns of use and disposal of raw and manufactured materials[8].

Patterns of refuse and diversity at El-Amarna

In the main city at El-Amarna, the combination of household, neighbourhood, and suburban strategies of refuse disposal makes it a much more difficult task to trace the disposal of refuse deriving from a single household or even a neighbourhood. Schiffer points out that "artifact diversity is a strong line of evidence that can be used in many cases to differentiate various refuse sources" (Schiffer 1987, 282).

The measurement and analysis of diversity are invariably complicated by the problem of sample size. If two archaeological sites or assemblages contain roughly the same number of artefacts and one shows a higher diversity of types, then it can be argued that a greater variety of human activities must have taken place in the site or assemblage with the higher diversity. However, if one site has produced a much higher quantity of artefacts than the other, it is then difficult to assess whether the increased diversity is caused by differences in human behaviour or simply by the statistical effect of the greater sample size. The clear statistical relationship between quantity of artefacts and diversity of types is so strong and overriding that it tends to obscure the more subtle reasons for variations in diversity.

The program used here to simulate diversity among artefact types in different refuse deposits at El-Amarna was first used by Keith Kintigh (1984) to solve this kind of sample size problem. Kintigh's method, which was initially used to study diversity among prehistoric hunter-gatherer sites, proceeds in four basic stages. First, the percentages of artefact types within the whole set of data are calculated. Secondly, these percentages, which Kintigh describes as the 'underlying frequency distribution', are inserted into a program that uses them as the basis for the construction of hypothetical assemblages of different sizes. Each assemblage is a set of randomly selected artefact types and its level of diversity is directly dependent on the underlying frequency distribution. The third stage of the method is to create a histogram of the levels of diversity for each of the simulated 700-object assemblages. This histogram then provides the data for line-plots such as those in Fig. 2. The longest column in the histogram indicates the number of different artefactual elements or types which is most often produced from a given sample size. Thus, 18% of the simulated assemblages of 700 El-Amarna craft-products contained 30 different types of product, while the upper and lower intervals of an 80% confidence interval were 32 and 28 respectively.

The fourth stage in the process is represented by a combined line-graph and scat-

[8] See Kemp/Stevens 2010, I, 499-503 for discussion of 'waste management' in this excavated section of the main city.

tergram, plotting sample sizes against the diversity of artefact types at each site in question. The central line in the graph (consisting of asterisks) shows the diversity that the computer simulations most often predicted for each level of sample size. The lines above and below the central line mark the boundaries of the '80% confidence interval': in other words, all of the levels of diversity between the lines were reached by 80% of the simulations of each sample size[9]. A scattergram of 'real' diversities is superimposed on this predictive line-plot[10]. The next two sections below apply this approach to refuse deposits in two specific areas of the city at El-Amarna: the 'workmen's village' and the 'main city'.

Refuse patterns in the 'workmen's village' at El-Amarna

The so-called workmen's village, excavated in 1921–22 (Peet/Woolley 1923) and 1979–86 (Kemp 1984; 1985; 1986; 1987a), lies in a valley directly east of the central city at El-Amarna. This walled settlement of mud-brick houses, surrounded by extramural animal pens and funerary chapels, with its own intricate internal socioeconomic patterns and chronology, was built to house a separate community (probably established and organized by the state, although its precise role is not known: see Kemp 1987b).

Table 1 compares the secondary refuse, outside the village, with the recorded artefacts from the 1921–2 excavations of houses and streets inside the village, as well as the 1980s excavation of two village houses, demonstrating some striking differences between all four of these contexts. The refuse outside the village is dominated by jewellery, raw materials, jar-labels, and jar-seals, whereas the deposits in the streets contain a much smaller percentage of jewellery, and the dominant categories are instead textile production and furniture. Even after taking into account the differences due to excavation strategy[11], the diversity of activity-types represented in the 'street refuse' is much greater than that of the extramural refuse. Only two different types of craftwork appear in the extramural refuse (textile and faience production) as opposed to five different elements in the streets (textile production, metalworking, leatherworking, stoneworking, and woodworking).

Figure 2 compares the diversity of activities in the streets and in the extramural refuse with the simulated diversity for sample sizes from 0 to 1400, showing that, whereas the diversity of behaviour evidenced in the village streets (21 different

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[9] A modified version of Kintigh's program is also available; it uses upper and lower percentiles (e.g. 5% and 95%), rather than + or – standard deviations, to create the confidence interval.

[10] See Shaw 1995 for previous application of Kintigh's diversity simulation to El-Amarna data.

[11] It should be noted, for instance, that if the frequencies of artefacts in the streets are combined, in a 4:1 ratio, with the material from Woolley's spoil heaps, the resultant hypothesized frequency for the streets is much more similar to the profile outside the village, suggesting that some of the differences may be a result of different excavation methods rather than actual behavioural differences. See Shaw 2000 for fuller discussion of the ways in which excavation strategies have affected spatial patterning of materials at El-Amarna.

activities) is well above that which would normally be expected for a sample of 116 artefacts, the diversity of activities in the extramural refuse (totalling 16) is significantly below the 80% confidence interval. These results suggest that the extramural village refuse is more specialized than that in the streets. This situation is interestingly in contrast to that described by Beck and Hill in a case-study of household refuse at Dalupa (a modern village in the Philippines), where they argue that "artifact richness and density increase significantly with the number of contributing households" (Beck/Hill 2004, 327). The Dalupa study seems to back up Schiffer's assertion that "highly specialized activities, such as ceramic or lithic manufacture, contribute a low-diversity stream of refuse ... On the other hand, great diversity is found in secondary refuse deposits containing refuse streams from a settlement's entire range of activities" (Schiffer 1987, 282). On the basis of the Dalupa data, the secondary (extramural) trash at the El-Amarna village might be expected to derive from a larger number of households than the primary (street) trash, yet the reverse seems to be the case. What, then, has produced this apparent reversal of expectation? A few clear deductions can be drawn from Table 1 and Figure 2. If we make the reasonable assumption that refuse was not carried into households from the outside, i.e. that the flow of refuse is virtually always outwards, away from the source, then all the types of craftwork represented in the interiors of the village and main city houses must have actually taken place, to some degree, indoors[12].

The rest of the deposits can generally only indicate where refuse deriving from different types of activity was deposited rather than where such activities took place. The same assumption (that refuse is either left where an activity took place or removed further away from the house) suggests that leatherworking and stoneworking were primarily practised in the streets of the village. A further conclusion which may be drawn concerning village refuse mechanisms is that, on the whole, only waste material from spinning and weaving found its way onto the extramural rubbish heaps excavated to the south of the village. All other debris from craftwork seems to have either stayed on the house floor or simply been swept out onto the streets[13]. A useful item of contextual evidence is the presence of pegs in the outer walls of village houses. These were almost certainly connected with the spinning and weaving process[14]. This is, therefore, an activity which must have taken place both inside the village houses and in the streets, evi-

[12] One exception to this rule might be the bringing of broken tools inside for repair.

[13] There is also strong evidence from the 1985–86 excavations in the southwest corner of the village that at least one large pile of refuse accumulated within the walls of the village (Kemp 1986, 28–33). Included within this midden were large quantities of matting, as well as many artefacts relating to spinning and weaving. It is possible that the mats were actually being manufactured in this corner of the village and that the excavated fragments of matting constitute the remains of a last batch.

[14] See Herbert Winlock's description of a weaving-room model from the tomb of Meketra: Winlock 1955, 29-32.

dently producing such a large quantity of debris as to necessitate regular dumping outside the village walls.

Table 1 therefore provides two different kinds of information regarding the villagers' behaviour. Firstly, the combined material from all of the houses constitutes a collection of *de facto* refuse while the material in the streets evidently consists of a mixture of *de facto* and primary refuse. The sample of extramural refuse, on the other hand, is a collection of specialized secondary refuse dominated by waste products and broken/discarded artefacts relating to textile production. Refuse disposal at the village therefore actually seems to have varied according to the particular activity and types of material involved.

Table 1 also potentially indicates where certain activities are more likely to have taken place. Thus textile production, woodworking, and metalworking (and also, to a much lesser degree, stoneworking and the production of faience items)[15] must have taken place within the village houses. Leatherworking, stoneworking, and textile production all appear to have taken place to some extent in the village streets. Although the location of refuse from leatherworking and stoneworking suggests that most of the work took place in the street, we cannot altogether rule out the practice of some stoneworking indoors. Howard Hecker's analysis of the floor deposits in the 'main chapel' (a religious building outside the southeast corner of the village) provides evidence of small limestone flakes embedded in the lowermost floor surfaces and perhaps deriving from shaping of blocks (Hecker 1986, 85). This, however, is a religious rather than a strictly domestic setting: it is likely that in an actual house the inconvenience of piles of sharp stone flakes underfoot might have rendered stoneworking an undesirable activity[16].

An intriguing question concerning refuse disposal at the village is that of the composition of the extramural dumps. These might have been expected to resemble a heterogeneous deposit, such as the 'palace rubbish heaps' in the central city, whereas they actually appear to contain a much more limited range of activities than either the streets or the houses. This is however not an unexpected situation, given the high organic content of the extramural dumps. The main source of the extramural refuse was agricultural activity (pig-keeping and vegetable-growing)

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[15] The evidence for glass and faience production consists primarily of fritting pans, fragments of waste material, and clay moulds. Ullrich (1985) points out that Petrie found lumps of frit, raw glass, glass rods, green frit, and Egyptian blue all in close association with moulds and crucibles. He therefore suggests that "this strengthens the hypothesis that glass, green frit and Egyptian blue were produced at one factory" (Ullrich 1985, 7). More recently, the excavations of Paul Nicholson in the vicinity of Petrie's 'glassworking' area in the Main City at El-Amarna have provided crucial new evidence regarding the production and working of glass (Nicholson 2007). See also the work of Andy Boyce on the patterning of faience production within neighbourhoods of the city (Boyce 1995).

[16] The same point is made by Hardy-Smith and Edwards (2004, 283) with regard to PPNB households in the Levant, where "it was no longer possible to ignore accumulations or refuse and artifacts underfoot, particularly the razor-sharp products of lithic reduction without suffering significant discomfort".

outside the village, rather than the craft activities in the streets and houses[17]. The lack of refuse from craftwork in the extramural refuse may be an indication that the scale of craftwork in the village was so small that only textile production generated sufficient debris to necessitate regular removal of waste. On the other hand, it is also possible that large amounts of refuse were tolerated in the village streets, especially in view of the existence of the rubbish dump which was evidently allowed to accumulate in the southwestern corner of the village (Kemp 1987b, 27). The refuse patterns at two urban sites roughly contemporary with El-Amarna (Site J at Malkata and Kom Rabi'a at Memphis) suggest a tendency for craft refuse to be concentrated directly beside houses rather than being conveyed to large communal dumps (Shaw 1998). The high organic content of the village extramural refuse may indicate a general pattern of the dumping of organic refuse away from the immediate vicinity of houses: it is possible that the 'palace rubbish heaps' in the main city may originally have also had a high organic content. Although the village extramural refuse is dominated by organic material (the study of which is not included in this paper), the non-organic artefacts are dominated by the same four categories as the material across most of the city: jewellery, raw materials, ostraca, and clay sealings. The proportion of jewellery, at 54.7%, is similar to the average for the two recently excavated houses Gate Street 8 and 9, inside the village (see Table 1). If we ignore, for the moment, the fact that the village as a whole seems to have been characterized by an unusually low proportion of jewellery compared with the main city (jewellery only accounted for 13.4% of the 1921–22 excavated village material), all the village deposits seem to have similar percentages of jewellery. This suggests that, as with the refuse deriving from textile production, the broken faience jewellery was discarded at random all over the interior and exterior of the village. However, the proportion of labelled ostraca and clay sealings in the extramural refuse is 15.7%, a figure that contrasts strikingly with a mere 2.7% in the streets and 8.5% in Gate Street 8 and 9 combined. The implication is very straightforward: small fragments of faience could accumulate in the houses and streets without causing any great discomfort to the inhabitants, but it was evidently thought to be essential that large potsherds should be regularly transferred to the extramural dumps.

Refuse patterns in the main city at El-Amarna

The use of material from both 1907-37 and current excavations provides a fairly balanced picture of the refuse disposal mechanisms at work in the village. However, the picture in the actual city at El-Amarna is more difficult to interpret. Nearly 80% of the artefacts excavated in the city between 1907 and 1937 have no

[17] See Kemp 1985, vii and Renfrew 1985, 182. Some of the organic content of the extramural refuse probably derived from agricultural activity inside the village. The evidence for animal husbandry in the village itself consists of animal pens (in the southwest corner and in houses West Street 3 and 23 and Main Street 11) and eleven houses containing limestone feeding troughs, like those found in the pens outside the village (Kemp 1987a, 41–42).

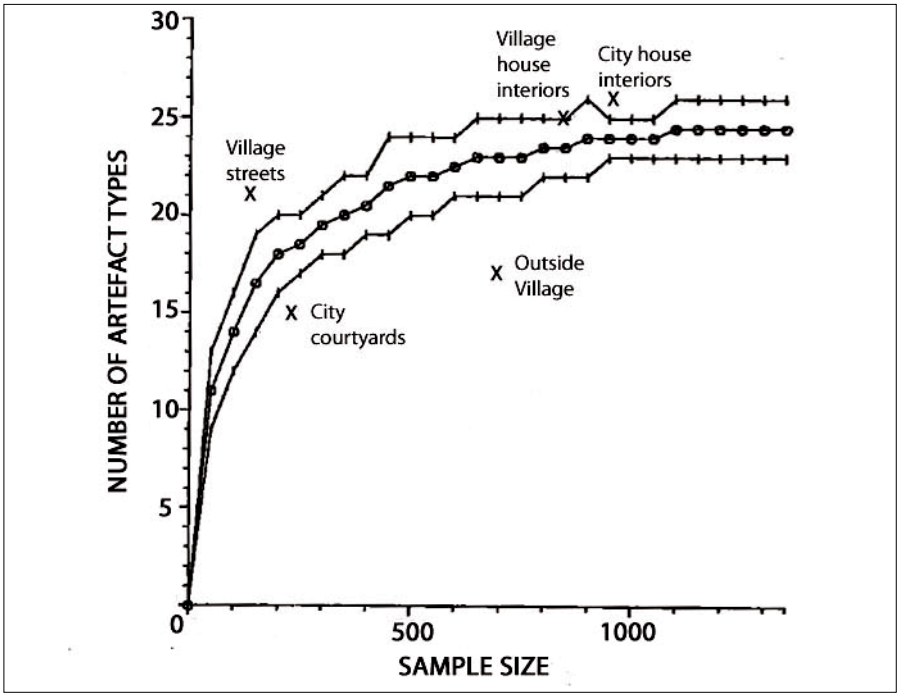

Fig. 2. Diversity of types of artefact in El-Amarna refuse deposits.

known intra-household context (see Shaw 1987, Fig. 6.3) – we know the building from which they were excavated but we have no idea as to the part of the house or surrounding compound from which they derive. Only 3.5% of the artefacts are specifically identified as having been found in a refuse-pit or courtyard. A significant number of artefacts must have been excavated from rubbish pits, judging from descriptions in the field notes and diaries, but they are almost always lumped together with all the other material from the floor deposits in the published object lists. Although some of the 1907-37 excavators record certain artefacts in the courtyards of large houses, most of these extensive open areas are still unexcavated, providing ideal targets for the current excavations at El-Amarna[18].

Considering the tendency of 1907-37 El-Amarna excavators to ignore deposits outside houses, it is quite possible that the percentage of the material excavated from yards, pits, or streets during those three decades was not much higher than

[18] As noted above, Kemp and Stevens (2010) have undertaken meticulous excavations of a group of households and surrounding streets and open areas, in the Main city at El-Amarna. They even specifically identify an area in the middle of the 'grid 12' housing as a 'midan' or public square (Kemp/Stevens 2010, 499).

Table 1. Percentages of different types of refuse in four different Workmen's villages contexts at El-Amarna.

Artefact/activity types	Two village houses (1980s excavations)	Village houses (1920s excavations)	Village streets (1920s excavations)	Extra-mural village refuse (1980s excavations)
Fittings	7,7	12,8	7,2	2,8
Furniture	3,4	14,3	18,8	0,4
Storage	13,5	5,4	8	0,3
Clothing	0	3,3	5,1	0,1
Rope/basketry	1	4,6	2,2	0
Labels and seals	2,4	5,8	2,2	15,7
Toiletries	0,3	2,7	2,2	0,3
Gaming	0	0,2	0	0,1
Agriculture	0	0,7	0,7	0
Hunting	0	0,1	0	0
Measuring	0	0	0	0
Food remains	0	3,2	2,2	0
Food preparation	1,7	3,6	2,2	0,4
Faience production	0	0,3	0	0,1
Textile production	1,7	9,4	15,9	1,8
Woodworking	0,3	1,5	2,2	0
Leatherworking	0	0,5	0,7	0
Metalworking	1	0,8	6,5	0
Stoneworking	0	0,2	1,4	0
Generic tools	0,3	3,5	2,2	1,2
Writing/painting	0,3	0,8	0,7	0,1
Raw materials	19,9	7	4,3	18,3
Art	1,3	2,5	1,4	2,1
Models	0	0,9	1,4	0,4
Funerary artefacts	0,3	0,3	0	0
Jewellery	44,8	13,4	8,7	54,7

Artefact/activity types	Inside main city houses (1920s excavations)	Courtyard/refuse pit (1920s excavations)	Silos/granaries (1920s excavations)	Outbuildings (1920s excavations)
Fittings	3,2	3,7	2,2	2,4
Furniture	0,3	15,1	0	1,2
Storage	1,6	1,8	6,7	1,2
Clothing	0,1	0,5	2,2	0
Rope/basketry	0,03	0	0	0
Labels and seals	7,3	16,1	15,6	4,8
Toiletries	0,1	0	0	1,2
Gaming	0	0	2,2	0
Agriculture	0	0	0	0
Hunting	0,03	0	0	1,2
Measuring	0,1	0,5	0	0
Food remains	0	0,5	0	0
Food preparation	0,1	0,5	0	0
Faience production	1,2	0	0	4,8
Textile production	0,4	0	0	3,6
Woodworking	0,03	1,4	6,7	1,2
Leatherworking	0,2	0	0	1,2
Metalworking	0,2	0	0	0
Stoneworking	0,3	0	0	0
Generic tools	0,5	7,3	4,4	17,9
Writing/painting	0,03	0,9	0	7,1
Raw materials	5,6	12,8	6,7	26,2
Art	7,9	7,8	13,3	1,2
Models	0,2	0	0	0
Funerary artefacts	0	0,9	2,2	0
Jewellery	70,3	30,3	37,8	25

Table 2. Percentages of artefacts from different refuse contexts in the city at El-Amarna.

3.5%. It is this dearth of extramural material that undermines the reliability of Table 2, comparing activities inside main city houses with those in their yards and refuse pits. Since the original total city assemblage in *ca*. 1350 must have included a very high percentage of extramural material, the 3.5% of material recorded by the pre-1937 excavators can constitute only a very slight indication of the composition of extramural refuse.

Table 2 shows that a number of craft activities may have typically taken place inside the city houses at El-Amarna, but only one of these (woodworking) definitely produced refuse deposits in the courtyards of the houses. The implication is that most of the refuse from textile production, faience manufacture, stoneworking, leatherworking, and metalworking either remained inside the main city houses or was transported beyond the confines of the courtyard (perhaps to communal dumps like the palace rubbish heaps). There has been almost no excavation of streets in the main city, therefore it is quite likely that in these unexamined deposits lies a similar range of material to that in the streets of the village. It is possible, on the other hand, that the refuse disposal mechanisms in operation in the main city were very different to those in the village. Since the population of the main city was obviously more diverse (with a greater variety of house-sizes and specialized occupations), there were therefore potentially many different combinations of types and quantities of refuse as well as different sizes of courtyards and widths of streets (important parameters in urban waste disposal).

Figure 2 above compares the diversity of activities inside a cross-section of the houses in the main city with the diversity in their courtyards and rubbish pits. The sample of 946 artefacts from within the houses includes 26 types of activity while the 218 artefacts from yards and pits include 15 types. The diversity within the houses is therefore, like the refuse in the village streets, well above that which might be expected for such a sample size. The diversity in yards and pits, on the other hand, equates with the extramural refuse at the village, falling below the 80% confidence interval of sample size 218. Tables 1 and 2 amplify the situation, showing a close similarity between the diversity of craftwork practised in the main city house-interiors and that in the village streets. The picture is slightly complicated by the fact that production of faience items dominates the craftwork inside main city houses while apparently hardly occurring at all either in the village or the main city courtyards. Kemp and Stevens, however, have provided ample evidence of faience production in courtyards in the main city that have been recently excavated (Kemp/Stevens 2010, 396-397, 481-485). This suggests that the apparent lack of faience production in courtyards is primarily a result of inadequate 1907-37 excavation methods rather than being a real indication of patterns of craft location and refuse disposal.

The ‘Palace rubbish heaps’ and other large-scale refuse deposits in the city at El-Amarna.

The shortcomings of the published reports on artefactual material from the main city are offset, in a small way, by the many references, scattered throughout the

excavators' reports, to specific examples of refuse pits and heaps. The well-known 'palace rubbish heaps', beside building R42.10 (the so-called 'Police Station') in the centre of the city, were first investigated by Petrie (Petrie 1894, 15-17), but this extensive, centrally located zone of refuse has been examined many times since the 1891-2 season[19]. The matrix of the dump consists of potsherds, but there are still surface traces of refuse deriving from stone-working, faience and glass production, and metalworking. Apart from charcoal and some human bones mentioned by Petrie, the palace rubbish heaps have so far yielded little organic material.

The area south of building R42.10 and east of the 'Government Buildings' is clearly visible, on the aerial photographs of the central city, as a dark patch of secondary refuse. Petrie relates how he failed to find any rubbish heaps in the immediate vicinity of the large complex, west of the *Sikket es-Sultan* in the central city, which he had identified as the 'Palace' (i.e. the structures now know as the Great Palace). When he finally came upon the heaps beside R42.10 (covering, at that time, an area of about 200×130 m, and still having an average depth of about half a metre), he surmised that this vast open area must have been the nearest dumping ground not only for the Palace but also for many of the other institutions and occupants of the central city.

While it is safe to say that the refuse from neighbouring buildings in the central city must have been deposited across this area, it is unlikely that much (if any) of the material could really have derived from the Palace. There are numerous other smaller deposits that are nearer to the Palace and more accessible than this area. It might also be hypothesized that if, as seems quite likely, the Palace extended westwards as far as the harbour and river, a large proportion of 'Palace rubbish' was perhaps deposited in the Nile. Petrie's description of how he 'turned over' the huge zone of debris leaves little doubt that a large proportion of his published small finds must have derived from this provenance. He points out, for instance, that it was here that he found "nearly all the broken rings etc., with cartouches". These rubbish heaps also produced 1329 of the total of 1341 Mycenaean sherds found by Petrie, and 750 of his 788 fragments of glass vases. Petrie suggests that these vases must derive from nearby "glass-making factories", of which he claimed to have found extensive remains elsewhere[20]. It may therefore be gleaned from Petrie's publication that the 'palace rubbish heaps' originally consisted mainly of fragments of faience, glass, and Mycenaean pottery[21].

The area was examined again, thirty years later, in Peet and Woolley's first season. Eric Peet states that their main aim was to ascertain whether the large num-

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[19] E.g. Dixon 1972, 649; James 1984, 229; Peet 1921, 183; Shaw 1987, 204-209.

[20] Although it might well be argued that fragments of finished vases would be more likely to derive from elite residential contexts, and indeed an area of kilns relating to the production of glass and faience were excavated by Paul Nicholson (2007) in an area designated O45.1 to the southwest of the central city.

[21] Petrie 1894, 15-17; Petrie also notes the existence of "several scattered human bones" among the pottery.

bers of Mycenaean sherds were definitely deposited during the mid-14th century or later. In the event, only one inscribed object (1923/21: a hollow cylindrical fragment of blue glass bearing the cartouche of Nefertiti in darker blue) was found, and the only other objects of which record was made were three Mycenaean sherds and two fragments of multi-coloured glass. Peet points out that "An examination of the mounds soon revealed the fact that not much remained to be done there. Their original form is no longer recognizable, the work of Petrie's sifters having transformed them into a group of small sharp heaps. We did, however, sift certain portions which seem to have been missed" (Peet 1921, 183).
About 30 years later, John Pendlebury describes the rubbish heaps as "thoroughly explored by Petrie" and lists only a few objects (almost all Mycenaean sherds) found as a result of casual strolls across the area, over a number of seasons (Pendlebury 1951, 142). There are other more specialized large-scale refuse deposits in the main city. Petrie's plan of the site shows a cluster of 'moulds' (in the northwestern corner of the main city, adjacent to the cultivation) that seems to be refuse deriving from intensive localized manufacture of faience jewellery. At the same time, the many thousands of clay moulds scattered across the north suburb and main city indicate small-scale domestic production[22]. In a preliminary report on the main city excavations, Woolley (1922, 64) describes "a centre of glass and glaze manufacture" (perhaps referring to houses M50.13–14 in the main city), but the description of these houses in the final publication suggests that this is simply another example of small-scale domestic production (Peet/Woolley 1923, 18-19). The area labelled 'ushabtis' on Petrie's plan (located to the west of the Great Temple, on the opposite side of the main city thoroughfare) evidently consisted of a large number of fragments of ushabtis (funerary figurines) and other sculpture (Petrie 1894). This refuse was presumably generated by a major state-run sculptors' workshop – perhaps a large-scale version of the smaller ateliers dispersed among the main city population, such as structures P47.1–3 (the famous studio of Thutmose; see Krauss 1983), O49.14, and O47.16a–20.

Discussion

Since refuse is almost everywhere, it might be argued that the study of trash disposal at a Late Bronze Age city such as El-Amarna is somewhat open-ended, in that all survey and excavation at the site may be dealing to some extent with refuse material. Nevertheless, it is clearly important to understand the mechanisms of refuse distribution, since they are closely entwined with the organization of production and consumption. The allusions to 'palace rubbish heaps' and reused pits merely scratch at the surface of a complex aspect of Egyptian urbanism that is connected with the locations and intensity of various types of craftwork.
The analyses of different deposits of refuse at the El-Amarna 'workmen's village', as discussed above, have demonstrated that it is possible – even when rely-

[22] Boyce 1995; Shortland 2000; Shortland *et alii* 2001.

ing primarily on early 20th-century excavation records – to distinguish, to some extent, between *de facto*, primary, and secondary refuse in one part of the city at least, and that the mechanisms of refuse disposal at the village seem to be at least partially determined by the particular activities and types of material involved. The study of refuse patterns at El-Amarna is almost inseparable from the general question of the socioeconomic organization of this major Late Bronze Age city. Large-scale agglomerations of relatively heterogeneous refuse such as the 'palace rubbish heaps', together with examples of public wells, suggest that there were at least a few groups of households, or neighbourhoods, interlinked by their use of shared amenities. Extensive areas of specialized refuse, on the other hand, imply that some sections of the population were mass-producing certain items, probably under the control of a central authority.

As some of the discussion above has indicated, one of the most useful aspects of the explicit study of Egyptian refuse disposal patterns lies in the area of craftwork studies, whereby specific types of production, e.g. textile manufacture or carpentry, can be assigned to particular locations inside and outside residential housing. By analysing the positions of particular types or mixtures of refuse, it is possible to theorise more accurately as to which types of technology were conducted primarily in external or internal locations.

The study of refuse deposition patterns in the main city at El-Amarna is significantly hampered, as noted above, by the relative lack of material from contexts either corresponding to streets or courtyards. This has certainly begun to be remedied in recent years, with the excavations undertaken by Kemp and Stevens in the southern part of the main city (Kemp/Stevens 2010), but it is nevertheless essential to attempt to understand patterns of production and consumption across the whole of the main city, from the northernmost settlement area (the elite villas of the 'north city') to the diverse range of large, medium, and small houses making up the area sometimes described as the 'south suburb', which were mostly excavated between 1907 and 1937. Both modern and pre-modern archaeological data can clearly contribute to the further elucidation of the nature of trash disposal at El-Amarna and other Late Bronze Age settlements.

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Ian Shaw
University of Liverpool
Department of Archaeology, Classics and Egyptology
School of Histories, Languages and Cultures
12-14 Abercromby Square
Liverpool L69 7WZ
United Kingdom
Liverpool
ishaw@liv.ac.uk

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TRANSLITERATIONS

The editors urge the authors to use the following standards of transliteration from Russian, Bulgarian, and Greek in their contributions:

Russian:

Аа = a	Зз = z	Пп = p	Чч = ch
Бб = b	Ии = i	Рр = r	Шш = sh
Вв = v	Йй = y	Сс = s	Щщ = shch
Гг = g	Кк = k	Тт = t	Ъъ = ’(apostrophe)
Дд = d	Лл = l	Уу = u	Ыы = y
Ее = ye, e (1)	Мм = m	Фф = f	Ээ = e
Ёё = yё, ё (1)	Нн = n	Хх = kh	Юю = yu
Жж = zh	Оо = o	Цц = ts	Яя = ya

(1) ye initially, after vowels, and after Ъ and ъ; e elswhere; when written as ё in Russian, transliterate accordingly as yё or ё.

Bulgarian:

Аа = a	Жж = zh	Мм = m	Тт = t	Шш = sh
Бб = b	Зз = z	Нн = n	Уу = u	Щщ = sht
Вв = v	Ии = i	Оо = o	Фф = f	Ъъ = |
Гг = g	Йй = y	Пп = p	Хх = kh	ь = ’(apostrophe)
Дд = d	Кк = k	Рр = r	Цц = ts	Юю = yu
Ее = e	Лл = l	Сс = s	Чч = ch	Яя = ya

Greek:

Αα = a	Εε = e	Ιι = i	Νν = n	Ρρ = r	Φφ = f
Ββ = b	Ζζ = z	Κκ = k	Ξξ = x	Σσ, ς = s	Χχ = ch
Γγ = g	Ηη = ê	Λλ = l	Οο = o	Ττ = t	Ψψ = ps
Δδ = d	Θθ = th	Μμ = m	Ππ = p	Υυ = u	Ωω = ô

The spiritus asper is to be rendered as h.