Whither Environmental Archaeology?

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14 Food for an Egyptian City: Tell el-Amarna

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14.1 Food for an Egyptian City
by Barry J. Kemp

INTRODUCTION

Anyone with a background in European or American archaeology who comes to look at the archaeology of Egypt can be forgiven for bewilderment at finding a vacuum at the centre of the subject. Yes, there are tombs and temples galore, wall carvings and paintings which look like a ready-made ethnographic record of ancient society, and museum showcases and library shelves of excavation reports replete with artefacts in perishable as well as durable materials. The vacuum lies in the use to which the products of archaeology are put. Egyptology is a scholarly edifice nearly two centuries old whose model of study is still essentially that of nineteenth century compartmentalized thinking: narrative history of the royal families, art history, theological systems, literature, and anecdotal images of daily life. Archaeology particularly supplies the fodder for the latter category, and has done so since the days of Flinders Petrie who saw in the myriad finds from his excavations the material for tableaux of changing styles. For areas of the world less weighed down with great art and voluminous ancient records, archaeology has been able to develop as a vigorous analytical discipline at the heart of modern attempts at understanding how societies worked. In Egypt, on the other hand, archaeology which looks beyond exploration and discovery is still in its infancy. Past neglect has, in fact, left the field wide open to significant advances from the use of archaeological data to reconstruct the interrelationship between humanity and the environment in ancient Egypt, and, in so doing, to learn much more about that society’s social and economic structure.

Ideally the traditional sources and expert assessment of data from archaeological fieldwork should simply complement one another. This rarely happens in practice, however. More often an attempt at combining the two exposes a disjunction. On the one hand ancient texts and pictures, which were never intended to be explanatory in textbook fashion, turn out to be insufficiently precise when technical questions are asked of them. On the other hand expert study of field material from Egypt is still too undeveloped to match the complexity that processes connected with farming and food seem to have had in ancient Egypt. Although most ancient Egyptians must have been peasants, they lived in a society permeated with an administration dedicated to moving commodities about and recording them with complex systems of enumeration, and also turning a proportion into luxuries for the elite. One is not dealing with a subsistence economy.

The way ahead nevertheless involves a recognition of mutuality. It is necessary for the Egyptologist to see that the interpretation of traditional sources can attain a level of reality only through taking into account the findings of environmental archaeologists. For the latter the traditional sources are the key to the complexities which the ancient Egyptians erected on their farming base. They raise questions which might not otherwise have been apparent and, in so doing, create agendas for research. Two of the expert papers in this volume, those of Luff and Samuel, are based on material from fieldwork at the Egyptian site of Tell el-Amarna, where I am field director for the Egypt Exploration Society’s long-standing expedition. Part of what I have to say is intended to set the scene for their papers, describing parts of the city and outlining the kind of society which it served. But I have also tried to convey something of the attraction – to me irresistible – of trying to apply some of the written and pictorial sources to a real archaeological site, and of the frustrations that this brings about. The jagged edges and loose ends and gaps which are then revealed to lie between traditional sources and archaeological findings are the fuel of debate and give research of this kind an exciting future.

THE BROAD ECONOMIC PICTURE OF NEW KINGDOM EGYPT

In recent years one particularly fruitful area of debate
and investigation has been the relationship between centralized and private production of commodities and their distribution (e.g. Janssen 1975a, 1979; Kemp 1989: 232-60; Castle 1992). The period of time known as the New Kingdom (1540 to 1070 BC) has proved to be the most accessible, on account of the richness and variety of its sources. Attention has focused particularly on the extent to which the state (by which one means king and temples together) provided for the population at large. On the one side is much evidence to show that the king and the main temples played a major role in the economy. Part of the evidence is documentary. Administrative papyri and more formal texts carved on temple walls show the state owning large tracts of land and other resources (including gold mines), means of collection and redistribution through fleets of boats and professional traders, and opportunities for disbursements partly through calendars of feasts and partly through the carefully administered issuing of rations to officials and workers by whom largesse of this kind was highly esteemed. Archaeology completes the picture by providing examples of huge storage facilities for commodities attached to temples and to palaces (some of the examples coming from Amarna). At the same time, sources which illustrate the lives of the "official" class (mostly scenes and texts from their tombs) emphasize loyalty to and dependence on the king, and imply that position and wealth were the rewards of service to the state. Possession and enjoyment of one's own landed estate was a legitimate part of this picture, but signs of trading and of being a merchant and thus of owning material prosperity to one's own initiatives are rare and normally ambiguous. It is thus possible to construct a picture of Egypt's economy in the New Kingdom as being divided between a large state sector and numerous landed estates which could have been almost closed systems for the peasants who lived on and around them. But this is not the full picture.

The importance of state institutions is not in doubt and is, indeed, well illustrated at Amarna. The debate centres on the lengths to which possessors of surplus commodities went in trading them to enhance their own wealth, and the extent to which craftsmen worked independently. Both together could have created a significant layer of economic activity between the state sector and localized exchanges between peasants. The difficulty of carrying the debate forward using traditional sources, let alone of resolving it, rests not only on the shortage of sufficient documents generally, but also on the fact that most of those that we do have derive primarily from the state sector or from contexts in which decorum demanded that dependence on Pharaoh was stressed.

The general view that has been formed of the economy (as well of many other aspects) of New-Kingdom Egypt owes much to documents from a single site, Deir el-Medina at Western Thebes (Bierbrier 1982; Valbelle 1985; Janssen 1975b). Tucked away in a narrow valley behind the great Ramesside mortuary temples, this village housed a community of workmen and artists and their families, as well as the few officials in charge, whose task was to cut and to decorate the tombs in the Valley of the Kings. The site survived in a surprisingly good condition until modern times, preserving not only the walled village and its sixty-six or so houses, but also an extensive cemetery which rose up the valley sides, and a group of chapels on which the religious life of the community was centred. Although the community was in existence for the entire period of the New Kingdom, it was only during the latter part that the inhabitants regularly took to recording many daily transactions in ink on potsherds and flakes of limestone. From the same period a considerable number of papyri have survived as well. Together these written sources form a substantial archive, indeed, by far the largest of its kind from the period.

The Deir el-Medina inhabitants, although employed by the state, were allowed considerable autonomy in conducting their lives. They were paid in commodities in the form of a monthly ration drawn from various of the large temples in the area. The standard rations were measures of emmer wheat and barley amounting normally for a workman to 4 khar of emmer and 1.5 of barley per month (equivalent to about 310 and 115 litres respectively). Vegetables, fish, and firewood were provided, and from time to time they also received fats, oil, cloth, meat, Asiatic beer, and so on. Families built up surplus wealth which they used to purchase other commodities through barter, the exchanges often being with fellow villagers. From the numerous records of such transactions it is possible to build up a detailed list of the prices of things. The impression that is created is of the state as the main supplier, with private enterprise largely limited to neighbourly haggles. Even so, some of the villagers' tombs were quite well provided for, showing that opportunities must have existed for the accumulation of wealth (Janssen 1975b: 533-8; 1977), funded perhaps by work on private tombs or by the sale of goods manufactured at home, and perhaps also from the produce of plots of agricultural land (McDowell 1992). The Deir el-Medina village in Ramesside times offers a likely model for how the Workmen's Village on the outskirts of Amarna was maintained, but one perhaps too parochial to be a reliable guide for a major city such as Amarna proper. Here one would expect a population of several tens of thousands, amongst them very rich families who derived an income from an agricultural estate in the country and who thus had substantial surpluses to trade. Documents from such households are very rare indeed, and it is essentially this gap in the evidence that leaves scope for major differences of interpretation.

THE CITY OF AMARNA

Amarna was created by royal decree in the mid-fourteenth century BC, on an uninhabited desert location on the east bank of the Nile, approximately 170 miles
Fig. 14.1 Map of the main part of the city of Amarna.
(270 km) south of Cairo (Fig. 14.1; for background see Aldred 1988; Redford 1984; Kemp 1989: 261–317). Its founder was King Akhenaten and his vision was of a holy city given over to the cult of the sun, the Aten, which he was endeavouring to promote to the exclusion of all others. At the same time the city was to serve as the principal royal residence and centre of administration, so coming close to the modern idea of a capital city. When the vision failed to outlast for long the death of its founder, the new city was mostly abandoned, within less than twenty years of its foundation. This odd episode has left us with a major archaeological site (Kemp and Garfi 1993). Most of its buildings had been constructed from mud brick, and these subsequently decayed over a period of probably several centuries to create a generally shallow archaeological site. Where the city ran beside the river modern cultivation has destroyed or buried it, but, on the desert, perhaps as much as two thirds of the city has survived, all of it visible in outline and giving an unrivalled view of an Egyptian royal city at a time of great national prosperity.

In constructing Amarna and in providing its institutions with revenues Akhenaten was using, perhaps on a scale not hitherto attempted, the power which kings had to assess the wealth of existing temples and other institutions and to redirect it towards ends which could be claimed to represent an enhanced level of piety. Akhenaten began his reformation at Thebes early in his reign, issuing decrees which directed huge food resources towards the cult of the Aten, not only at Thebes itself, but also as it was being established throughout the land in the form of “altars of the sun” (Spalinger 1991: 28–9). For the subsequent move to Amarna a complete slice of the Nile Valley, some 13 km from east to west and 20 km from north to south, was taken over and allocated to the Aten, forming the territory of Akhetaten (“Horizon of the Sun’s Disk”) which comprised the city which we now call Amarna together with its surroundings. Its foundation decrees refer specifically to the fields and villages that this tract contained, which would have provided the Aten with a core estate of prime farmland. Foodstuffs and other commodities must also have come in from further afield. In some cases, as with wine in labelled amphorae, the labels themselves identify an exotic source; at other times, as with incense which was widely used in temple ritual and thus an important object of trade, scientific analysis of material has pointed to sources abroad; with basic agricultural produce there is a strong but ultimately unprovable likelihood that more distant estates in private and institutional ownership in the Nile Valley and Delta sent part of their produce to the city (for transport ships and traders attached to Aten temples, see Leprohon 1988: 49–50). In practice, however, excavated evidence from Amarna is useful primarily in trying to reconstruct the pattern of production, distribution, and consumption of commodities within the city itself, irrespective of their ultimate origin.

In the present state of knowledge, which consists of many rather disjointed fragments, the most productive strategy is to compare evidence of various kinds from four parts of Amarna: the Central City (especially the part south of the Great Aten Temple), two isolated religious enclosures (Maru-Aten and Kom el-Nana), the private housing areas of the Main City and North Suburb, and the Workmen’s Village. The data available come from excavations past and present, modern surface surveys, and a corpus of minor documentary texts (mostly commodity labels). Also of use are ancient depictions of parts of the city which are to be found on the walls of some of the rock tombs of Amarna’s leading citizens (Davies 1903–8).

**SIGNIFICANT AREAS AT AMARNA**

**The Central City**

The heart of the city was a zone of royal buildings named by the original excavators of the 1930s the Central City, and containing a huge ceremonial palace and the Aten cult’s two principal temples, all three buildings distinguished by the presence of colossal stone architecture (Pendlebury 1951). It is within and beside the enclosure surrounding one of them, the Great Aten Temple, that we can begin to pick up in the archaeological record what the newly created institutional support actually entailed (Fig. 14.4). The Great Aten Temple’s enclosure, measuring 760x270m, contained, at either end, a monumental stone shrine consisting principally of courtyards open to the sky and hence to the direct worship of the Aten, the sun’s disk. Each courtyard was filled with stone offering-tables, simple rectangular blocks measuring about 100x80cm, which numbered around 150 in the case of the Sanctuary shrine at the rear, and perhaps more than 750 in the Gem-pa-Aten shrine at the front. In an open area on the south side of the latter spread a field of no less than 920 further offering-tables of mud brick, bringing the total to an extraordinary 1820. The Great Aten Temple was clearly designed to suck in “offerings” on a lavish scale. What these offerings included was specified on a large quartzite stela which stood in front of the Sanctuary shrine. Only a few fragments survived to modern times and remain unpublished; amongst them one can recognize references to cattle and to grain (cf. Griffith 1893: 306). The importance of food-offerings in the regular ritual at the temple is vividly illustrated in wall scenes carved in some of the Amarna rock tombs (Fig. 14.2). A few of them contain remarkably detailed depictions of the Aten temples and their cult, showing the simultaneous use of the mass of offering-tables. They stand piled high with offerings of bread, vegetables, whole geese, and joints of beef, topped with bowls of burning incense.

This temple had a smaller counterpart (the Small Aten Temple) at the southern end of the Central City which consisted of a succession of three rectangular courtyards within a mud-brick enclosure measuring approximately
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200x100m. Offering-tables are again conspicuous, a group of 56 of mud brick lying just inside the main gateway in the outer court, and probably about 150 largely filling the stone sanctuary building in the rear court which closely resembled the sanctuary of the Great Aten Temple. In between the temples lay the King’s House, a residence of modest size linked by a bridge to a colossal ceremonial palace across the city’s main central road and provided with a substantial block of storage chambers, in part, at least, intended for the storage of cereals (to judge from the partition walls which divided some of the chambers into bins). Finally in spaces between the King’s House and Great Aten Temple and out to the east spread administrative buildings and sprawling compounds where commodities were produced and stored. Indeed, much of the Central City only makes sense when it is realized how great was the extent to which the Egyptian state depended on the accumulation of commodities of all kinds stored always close at hand.

Maru-Aten and Kom el-Nana
Outside the city proper a number of religious and ceremonial centres were built which are probably to be identified with a number of solar shrines known from written sources. These shrines belonged to female members of the king’s household. Two large examples lay to the south of the city. One of them, Maru-Aten, was

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Fig. 14.2 Scene from the tomb of Panehsy, showing part of an idealised Aten temple at Amarna (after Davies 1903–8 II: Pl. XVIII)
perfunctorily dug in 1922, and proved to consist of two large enclosed gardens containing shrines but no visible means of provisioning itself (Peet and Woolley 1923: Ch. V). The other, Kom el-Nana, is in the course of being excavated by the Egypt Exploration Society. It has many resemblances to Maru-Aten, but also differed, particularly in possessing a large building given over to the production of bread and probably beer, and possibly other commodities as well.

Housing in the Main City and North Suburb

To the north and south of the Central City stretched substantial areas of private housing of which large parts were excavated in campaigns in the early part of this century (key reports are Frankfort and Pendlebury 1933; Borchardt and Ricke 1980). As measured by size and relative density the houses cover a wide spectrum of society stretching from the poor to the highest of officials, a few of whose houses can be ascribed to named individuals. Houses of all sizes show a striking consistency of basic plan, but wealth and status were expressed also in ancillary elements which could fill a substantial surrounding compound (Kemp 1977; Shaw 1992). Amongst these elements can be recognized grain silos, bakehouses, workshops, and sheds where probably animals were kept. The results of older excavations are primarily plans of buildings and lists of the most significant finds. Less valuable material was normally discarded but survives to some extent either still lying on the ground or within easily recognizable spoil heaps. The scope for gathering useful data from previously excavated areas thus remains considerable.

The Workmen’s Village

This is an isolated site which is tucked away almost invisibly from the city in a side valley in a low plateau which runs out from the cliffs towards the city and divides the desert plain into two unequal parts (Peet and Woolley 1923: Chs. III, IV; Kemp 1987a). It consists of a square walled village carefully divided into blocks of seventy-three near-identical houses by narrow streets. On the ground outside, the occupants dumped huge quantities of refuse and also developed a number of activities, part ritual and focused on a series of chapels, and part not have been done by people based in the main city. It was far enough away from the main city to suggest that its inhabitants were engaged on distinctive work for the state, yet not so far that this work, whatever it was, could not have been done by people based in the main city. Clearly the community’s isolation was an important characteristic to maintain, implying a very distinctive status. In its isolation and in certain other respects, particularly its chapels, it has an obvious parallel in Deir el-Medina, though lacking the latter’s prosperity. Thus it is an easy step to suggest that it housed a community of workmen who were engaged in cutting the rock tombs at Amarna, both those for the royal family and those for the courtiers and officials. Objections can be made to this interpretation, but, in the end, whatever task we ascribe to the heads of the households it seems inescapable that the village was a creation of the state, and the parallel with Deir el-Medina remains in the way that it was likely maintained, by regular deliveries of basic foods and of water. The source of the latter was established in the 1986 field season by following back to its source – a huge well on the edge of the city – a trail of potsherds from amphorae used to carry the water (Rose 1987: 124–6).

At the Workmen’s Village an important task of archaeology is to explore the boundary between dependence on the state and self-sufficiency.

RESEARCH INTO AMARNA’S FOOD SUPPLY

The principal evidence that I want to use to illustrate what happens when one tries to juxtapose various kinds of source material relates to cattle and to grain; for these two commodities form the subject matter of the two papers on Egypt in this volume. That they probably also represented the largest share of the state’s economic sector is indicated by the fact that one of the key figures in the king’s administration at Amarna, the “Chief Servitor of the Aten”, Panehsy, held amongst his titles those of “Superintendent of the cattle of the Aten” and “Superintendent of the granaries of the Aten”, without reference to other commodities (for his tomb, no. 6 at Amarna, see Davies 1903–8: II).

MEAT FROM THE TEMPLES

Cattle in ancient Egypt were a prized source of meat and could reach high values in live sales (Janssen 1975b: 172–7, 524–7). Furthermore, by tradition, hugely fattened cattle were especially demonstrative of temple wealth: one recently published scene from Akhenaten’s Theban temples depicts cattle so grossly overfed that they have to be pulled along on six-wheeled flatbed wagons (Redford 1988: 10, Pl. 31). Whereas the evidence for the importance of cattle in the offering-cult of the Aten is quite explicit, none of the sources, whether formal texts and tomb scenes or labels from pottery jars, implies that the Aten cult and its supporting administration dealt to a significant extent with other mammals whose presence in the city is attested from the finding of their bones, viz. goats and pigs. However, animals also had a part in Akhenaten’s natural theology, for in them, as in all aspects of nature, the power of the sun-god was manifested. Cattle took pride of place here, too, most conspicuously in Akhenaten’s retention of the cult of the Mnevis bull, a sacred bull whose cult at Heliopolis was
a traditional element in solar religion. This is known from the king’s declaration of intent to make a tomb for this animal at Amarna, although so far no archaeological evidence – neither tomb nor shrine – for the Mnevis bull has actually been found. That animals, and especially cattle, fitted into a formal and probably symbolically laden setting is illustrated at the North Palace, which was provided with highly visible animal houses one of which was fitted out with limestone feeding troughs carved with pictures of fat cattle and horned desert game (Newton 1924: 296, Pl. XXX).

The tomb scenes consistently depict, within the sacred enclosure of a somewhat idealized Aten temple, a separate slaughter-court, easily identifiable from its tethering-stones, butchered carcasses, and flayed hide (Fig. 14.2). In a unique scene in the tomb of the high priest Meryra, which attempts to take in something of the surrounding city as well, a byre is shown, with feeding-troughs and tethering-stones, and men hand-feeding fat tethered oxen (Davies 1903-8, I: PIs. XXV, XXIX). Although the scenes of the temples in use appear to conflate details from both the Great and the Small Aten Temples, certain elements seem more appropriate to the former than to the latter. One of these is the slaughter-court, which has been identified with a square enclosure within the great temenos, on account of tethering-stones found inside as well as its location in respect to other elements common to the tomb scenes and to the general ground plan (Pendlebury 1951: 10). It lay almost opposite a side entrance in the southern temenos wall which gave access to an open area of ground on which were situated several separate buildings connected with the organization of temple offerings. One of these was an isolated house and compound belonging to Panehsy, the priest already mentioned who was also in charge of the granary of the Aten and the cattle of the Aten. Unsuitable though it might seem to us, the discharge of his latter responsibility seems to have led to the accumulation of the waste from butchery around his house, for its excavator noted (in 1926): “remains of cattle, horns and bones, cropped up everywhere” (Frankfort 1927: 212; much of this material must still lie in Frankfort’s readily visible dumps). An adjacent building provided with stone floors and brick mangers ($40.1), and in which cattle bones were also found, could well have acted as a series of holding pens if not as a major byre.

It had long been a practice in Egypt for temple offerings, once they had been presented to the deity, to be shared out to priests and other recipients on a carefully calculated basis (Gardiner 1938: 87–88; Helck 1960–4: [464–7]). In the case of meat two basically different means of disposal were available, one as fresh joints, the other through preservation. However, although the disbursement of temple offerings for human consumption seems well established over a long period of Egyptian history, specifically attested instances of the practice in the New Kingdom are uncommon (Leprohon 1988: 49, 51, n. 55 quotes supporting texts from Amarna tombs). One is provided by an ostrakon from the reign of Rameses IV (c. 1160 BC) which mentions that, on a particular day, nine portions of meat and eleven head of cattle, said to be “of the Opet Festival”, were delivered to the workmen at Deir el-Medina; nine head of cattle followed seven days later, and five more twelve days later (Janssen 1979: 514–15). Janssen points out that the timings of the deliveries make it unlikely that the theoretically equally correct translation “for the Opet Festival” is sustainable, for this festival had already been celebrated. Thus here we have joints and live cattle derived from one of the great festivals celebrated in the mortuary temples being used to supplement the regular state rations of the workmen.

Since the Great Aten Temple at Amarna and its environs was a major centre of festival cattle this practice makes it one possible source for the joints eaten at the Workmen’s Village, something which perhaps has some bearing on the nature of the butchery marks on cattle bones from here discussed in Luff’s chapter. However, to judge from the range of body parts represented amongst these bones, the practice did not extend to the supply of live cattle in this case.

Not all butchered meat was destined for immediate consumption, however. Preserved joints of meat were one of several commodities which, at this period, were transported and stored in pottery vessels which, in special circumstances, bore ink labels identifying contents and providing other information. Along with meat, the commonest labelled commodity was wine, and for them two distinctly different vessel types were used at Amarna: tall amphorae for wine, and wide-mouthed, wide-bellied jars without handles for meat (Fig. 14.3). This distinction was not universally maintained in Egypt, however. Excavations at the palace site at Malkata (Western Thebes), which belonged to Akhenaten’s father Amenhotep III, have brought to light labels and sealings from amphorae which identify, in addition to wine, the contents as dressed meat, as well as fat (including mutton fat) and fowl (Leahy 1978; Hope 1977), whilst the pottery record from the excavations at Malkata shows that the meat-jar type of vessel was not in common use at all. This is curious and might signify a regional variation in practice. Even at Amarna some meat labels derive from amphorae rather than from meat jars. The excavations of the 1930s across the Central City at Amarna recovered several hundred labels from commodity jars. As Figure 14.4 shows, the majority of meat-jar labels were found in and around the western part of a series of adjoining compounds (Q41 group) which lay to the south of the western half of the Great Aten Temple enclosure, and included a set of long parallel storage chambers, or magazines.

In the case of wine jars (which had their own concentration, around a set of buildings to the east which seems to have included a military barracks), we can be fairly sure that we are dealing with a product imported into Amarna, although in saying this we should confine this term to the city proper and not use it as a synonym for
Akhetaten which, as noted at the beginning, included a large swathe of agricultural land on the west bank of the Nile, where it is possible that vines were grown (as they are today). Not only is the desert ground less suited to viticulture, there is the fact that many of the labels state their place of origin, principally the western Nile Delta, but also including the oases (Pendlebury 1951: 165-8; Kitchen 1992 supplies general background). With the meat jars, however, it is much more likely that, in view of the evidence already mentioned, they were actually packed in the large building in square Q41, although the empty jars themselves, of specialist manufacture, were probably imported to Amarna from a place of manufacture outside.

The labels normally include several kinds of information, as illustrated by the following two examples:

Regnal year 7, 3rd month of summer. The depot "Soul of 'Ra lives' (an epithet of the Aten)". Preserved meat: intestines, of the daily offerings, provided by the butcher Wepet (Pendlebury 1951: Pl. XCII, nos. 204-6 combined).

Regnal year 11. Preserved meat of the festival of the Aten (life, prosperity, health!), being the birthday of the Aten. The preparation-room of the Estate of the Aten (life, prosperity, health!), under the authority of the retainer Tutu (ibid.: Pl. XCI, no. 186).

Potentially these vessels and their labels are a rich source of knowledge of a meat trade made characteristically complex through administrative process (Pendlebury 1951: 169-75; Helck 1960-4: [837--9]). What follows is, I hope, a fair example of scholarly discussion which points towards certain conclusions. Readers will, however, note
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Over 150 stone offering-tables

KEY
- meat label from 1930s excavations
- quernstone from 1992 survey
- sherds from bread moulds

Great Aten Temple

KEY
- meat label from 1930s excavations
- quernstone from 1992 survey
- sherds from bread moulds

Fig. 14.4 Map of the Central City of Amarna, showing distribution of meat jar labels, pottery bread moulds, and quernstones from D. Sanuel's 1992 quern survey.

The number of places where an assumption as to how something was done or a choice of meaning in a text is made. Vessels and labels were the product of a series of actions; the process of interpretation assumes that this is reversible knowledge. Yet either/or choices face us at several points, and a wrong choice inadvertently made could flaw the rest of the logic chain. This is true for much archaeological reasoning, but, because texts tend to possess a certain mystique, it is worth stating as a reminder that similar uncertainty attaches itself to them, too.

There is, to begin with, the size and shape of the vessel type. Meat jars were large biconical vessels with broad mouths, characteristically 65cm high and with an internal mouth diameter of 25cm (Fig. 14.3). Amphorae were designed for ease of sealing: the tall narrow neck was stoppered with a bung of reeds or similar material, covered with a saucer, and then encased in a mud seal which continued down to the neck of the vessel (Hope 1978). They were evidently very suitable for storing and transporting liquids. Meat jars, by contrast, had wide mouths without separate neck and were, so one would imagine, more difficult to seal effectively. The distinctive heavy rounded rim would seem ideal for holding a rope in place which could have secured a cloth cover, but this would obviously not have been airtight or have prevented spillage in the case of a liquid. In whatever way they were filled they would have been very heavy, but two means of moving them were available: rolling them for short distances whilst tilting them slightly on their bases, and the well attested practice of carrying vessels in string bags suspended from a wooden pole, as well as on the back of a donkey.
The dates on the labels of these jars are sometimes expressed to the exact day, sometimes to the month, and sometimes only to the year (as was customary with the wine labels), as if, with the latter, it was expected that jars would retain their contents for several years. With the first of the two quoted labels the recipient would know what kind of meat the jar contained. Often we ourselves have to content with meanings which are not very reliably established, although in this case, unlike as the translation "intestines" might seem, the basis is sound (Gardiner 1947, II: 252*-3*). The second of the labels, is, however, the more common, where only the general term "preserved meat" was used, sometimes qualified with the expression "good" or "very good". One technique of preservation frequently illustrated in tombs and temples shows pieces of meat strung from a line and evidently drying to become the equivalent of biltong (Ikram, unpub.; Darby, et al. 1977: 152-4, Figs. 3.40-3.42; from the Amarna Period Lauffray 1980: Fig. 1, Pl. XVI). One would expect that the process involved first removing the meat from the bone, the dried strips being finally packed in layers into the jars. By this time the individual cuts could have lost their identity to the extent that the general term "preserved meat" was adequate. The Egyptian vocabulary was, however, quite rich in words for specific parts of cattle, and this is illustrated by a few labels from the Central City which are lists of different cuts, the largest originally enumerating at least ten of them (Pendlebury 1951: 172-3, Pl. LXXXIV, no. 9). Here again the term "preserved meat" is used, but with some of the cuts, especially "tail", it is hard to imagine that the bone was actually removed. Should we then consider that salting was used to preserve them?

Unlike many of the wine-jar labels where a geographic source is given, the place of origin of the meat is expressed only as an institution without saying where that institution was situated. More than one is named, but they are, however, linked by a common feature, the name of a festival, which is often "birthday of the Aten" and more uncommonly "the everlasting festival", "the festival of the Aten", and "the daily festival", all perhaps poetic variations of the same thing, namely a daily festival to celebrate the rising of the sun. The phrasing suffers from the same grammatical ambiguity as was mentioned above in connection with Deir el-Medina evidence ("of" and "for" the festivals being equally possible), but, as there, the overall context makes better sense if the former preposition is used in translation, so that the meat is derived from rather than intended for the festivals. Thus part of the daily meat-offering in the Great Aten Temple, derived from cattle slaughtered on the spot, would be preserved and packed into the jars in the Q41 complex, ready either for storage there or for dispatch elsewhere.

This implies that the different terms used for place of origin are themselves either synonyms for or subdivisions of the various elements which made up the western part of the Q41 complex. One of these is apparently a general term for provisioning institutions, shena (storehouse or depot are conventional translations), which could, so other sources tell us, encompass commodities other than food. It occurs in the labels in three variants: The depot of abundant provisions (wer-djefait), secondly (as in the first quoted example) the depot "Soul of 'Ra lives" (kaen-Ra-ankh), and the depot of the Great House (per-aa, which could, at this period, refer to the king in person, the phrase being the origin of the Hebrew word Pharaoh, and potentially at this period applicable to everything). The other basic term, akhyt, is found almost exclusively in meat-jar labels, but one exception where the label mentions "notched sycamore-figs" instead of meat (Pendlebury 1951: 172, no. 316) cautions against the specific translation "abattoir". "Still-room" was the original preferred translation (ibid.: 171-2); here I have used "preparation room". Like the depots, preparation rooms had individual names: "Soul of 'Ra lives", "estate of the Aten" and "the estate of 'Aten lives", "the estate of the Great House", and "the estate of the Queen", whilst in other cases the only qualifier added is the fact that it is under the charge of a named official. It will be noticed that the name "Soul of 'Ra lives" is shared by both types of building, a helpful link in the search for order within this set of names (it is applied to an akhyt. Peet and Woolley 1923: 167, Pl. LXIV, nos. 75, 77, 79, 80, on a closed group of storage jars found in the isolated site of Maru-Aten, where one variant, no. 82, identical in other respects to the others, substitutes the phrase "Estate of the Aten"; the ostracon, Pendlebury 1951: 172, Pl. LXXXIV, no. 9, seems to make a similar link).

One way of explaining this evidence, bearing in mind the degree of concentration of meat labels in one part of the site (Fig. 14.4), is to regard one set of terms as nesting within the other. Thus the whole building complex was the shena, its proper name perhaps "Abundant of provisions", but also referred to by means of epithets. It contained a series of preparation-rooms (akhyt) which were separately administered and, in some cases, owned separately, by the queen. This is not far from the conclusions reached by the original editor of these texts (Fairman, in Pendlebury 1951: 171-2, 211-2). The practice of dividing a large administrative operation into a series of units and of delegating responsibility for each to a separate official is well attested in ancient Egypt. Applied to the plan of the building where most of the labels were found, it is tempting to see the individual akhyts as the long parallel chambers which are a conspicuous part of the building.

Since the building around which most of the meat-jar labels were found was not residential but a large depot we have to assume that most of the meat jars packed and labelled here were destined to be collected or sent away, either according to an official arrangement or perhaps through actual sale. That meat was actually sold from
major suppliers is probably reflected in a papyrus from a slightly later period and from Thebes which deals with sales to "traders" of meat joints in return for silver and where it is often hypothesized that the seller is a temple (Janssen 1979: 515, n. 28, with refs.). Whatever the mechanism of distribution, we should thus expect to find labelled meat jars elsewhere at Amarna. This is so, though the numbers are disappointingly few. The most important group, already mentioned, was found at Maru-Aten, a kind of walled sacred garden containing altars and shrines to the Aten, but lacking a provisioning compound. Two rooms of one small building (MIV) were found to contain the remains of a store of provisions in pottery jars, presumably for a feast. The publication unfortunately lacks almost all details; all that we know is that there were a great many jars with wine labels, and ten with meat labels from the akh'yt of "Soul of 'Ra-lives"" (Peet and Woolley 1923: 167, Pl. LXIV, nos. 75-84, with the substituted name mentioned above). Even so, this information is helpful in explaining one way by which this rather distant institution was maintained. A strange find at Maru-Aten does, however, suggest that a few live cattle were also present. In the course of excavating a set of small buildings that looked like houses two complete cattle skeletons were found, evidently lying on a floor and buried in rubble (Peet and Woolley 1923: 114, Pl. XXIX, and archive photographs). They had not necessarily been at Maru-Aten to provide meat, however, for artistic scenes of idealized gardens included young cattle whose presence was evidently a symbol of the vigour of nature.

Ink labels from the Workmen's Village are not numerous, despite the huge quantities of sherds which the expedition examined over eight excavating seasons. Amongst them are five with meat labels (Leahy 1985: nos. 9, 61, 100; two more remain unpublished, one of them from an amphora rather than from a meat jar). The trail of evidence does not quite peter out here, however; for unlabelled jars of this kind were common at the Workmen's Village. That labelled examples are infrequent is presumably because, bearing their various pieces of information, they came only from official sources and represented a mark of privilege. At Amarna this official source could have been a single place, the building complex Q41. Meat from private sources, or obtained from the state through a less prestigious channel, might have been kept in the numerous unlabelled jars of this type, but this is hard to prove (unless, in the future, it becomes possible to test significant numbers for invisible organic residues). For one is bound to ask: were they always or at least mainly intended for meat, or to what extent could they have been used for other purposes? Their shape made them ideal for bulk storage, and they have often been found in past excavations buried to their necks in the ground. There has to be the suspicion, therefore, that they were used for storing other things as well, and it is always possible that they were available for purchase empty, either new or second-hand. Even so, the numbers of unlabelled meat jars present at the Workmen's Village are sufficiently large for the assumption to be made that a proportion of them had arrived there conveying meat to the village.

The village middens produced a large quantity of mammal bones which have provided the material for Luff's paper on butchery marks. From the bones alone it can be deduced that goats and pigs, and probably a few cows, were actually kept at the village, whilst joints of beef were brought in from outside. This last aspect fits the picture provided by the parallel case of Deir el-Medina, whose community received periodic distributions of meat joints, and also reveals a possible destination for some of the meat-offerings from the Aten temple. In the case of pigs the bone evidence for local husbandry is amply borne out by the site's archaeology, in the form of several sets of well-constructed pig pens spread across the ground outside the walled village in a manner which suggests multiple owners (Fig. 14.5). The care taken in their building implies that pig-rearing was a significant industry for the villagers, and makes it into a strong piece of evidence for regarding the villagers as partially responsible for their own incomes.

So far only very small samples of bones from the main residential parts of the city are available for study, one from old excavation dumps in the North Suburb and one from a 1987 excavation of a small house in the Main City (P47.33). They show that meat from the three principal mammal groups (cattle, goat, and pig) was reaching the general populace there. Although it is quite likely that some of the cattle meat derived from temple offerings (the situation with regard to meat jars is the same in the city as at the Workmen's Village) much of the total meat supply could well have originated from the households of officials whose economic position was intermediate between the state and poorer families.

One element within the compounds which regularly surrounded their houses is often identified as a cattle byre. In many cases the identification has to remain a matter of supposition, for the buildings in question were simply walled areas over which a roof had sometimes been supported on square brick piers, but occasionally extra features point towards the keeping of animals. One attached to house Q44.1 had a row of mangers facing a long room with a cobbled floor (Newton 1924: 291, Pl. XXVI.1). This could have been for horses, but, in another case (Q46.1), actual tethering-stones were found, which the artistic evidence leads one to think would be more in keeping with the presence of cattle (Borchhardt and Riche 1980: 25-6, Taf. 2C, Plan 2). Private cattle byres are very much to be expected in view of both the ancient ideal as to what constituted a proper estate (the written evidence for this is discussed by Shaw 1992), and excavated evidence which shows that domestic compounds aimed for a degree of self-sufficiency. Collectively this would have represented a significant sector of the city's
Fig. 14.5 Two views of a group of pig pens at the Workmen's Village, Amarna.
economy, but is also one poorly represented by excavated documents which, when they do turn up, tend to be more than usually ambiguous. As an example, one can quote an ostraco which lists portions of meat and which was found in the North Suburb (house S33.1). It gives as the place of origin simply the preparation-room (akhnyt) of the High Priest (Frankfort and Pendlebury 1933: 68, 107, Pl. LVII, no. 4 = ostraco 30/42), but, whilst this might be referring to a private preparation-room on his own estate, it could also be an abbreviated version of the formula of the meat-jar labels of the Central City. Understanding more of the scale of this intermediate sector of meat provision is one of the priorities of future research and requires further and far more detailed examination of the compounds surrounding the larger houses and the location and study of middens likely to have belonged to them.

It is possible to consider that the cattle consumed at Amarna spent their entire lives in byres within the city, although this would have required a constant import of fodder. However, the city also possessed farmland across the river, and both the temples and city-based officials are likely to have had farming interests in places much further away. Two very different conditions for cattle-rearing are involved, and the difference might be expected to show up in the pathology of cattle bones and teeth. An investigation with this in mind, and based on samples from the Main City in particular, might throw much-needed light on the pattern of cattle husbandry organized for urban meat supply in Egypt.

The presence of pig in the general city bone repertoire raises a question of archaeological identification, for, amidst the huge number of houses dug in the past, nothing has been found which resembles the specialist pig pens of the Workmen's Village. Yet it seems too much to expect that the whole city was supplied from the latter source. Unless the source of supply were outside the city altogether, the explanation might be that many households kept a few pigs for slaughter, and that these animals to some extent roamed free, consuming garbage in the streets and inside the compounds of larger houses, and were also given a place in outbuildings which had no special design. At the Workmen's Village, on the other hand, the more intensive raising of pigs for sale largely outside the community justified the devotion of more energy to building special facilities for keeping them.

The evidence for meat at Amarna points to a plurality of sources, part state (via the Great Aten Temple) and part private, the pattern of supply much affected by the status and value of the various kinds of animal. Within this general framework there is much that we do not know. It is to be hoped that the study of further groups of bones and relevant archaeological contexts will gradually clarify the picture, but the demonstration by Luff that butchers, like artists, leave something akin to a signature in the marks of their handiwork is an encourage-
texts from the New Kingdom that have survived. Finding translations for them has proved to be particularly difficult. As yet the number of reliably identified cereal samples from New-Kingdom settlements is tiny, far too small to test whether the regular recognition of two main cereal types in administrative texts reflected how things were generally in society, or whether a wider repertoire might have been available to which some of these less frequently used terms apply. It is important to bear in mind that the New Kingdom (and, for the north of Egypt, the preceding Hyksos Period) was a time of change, involving much closer contact than previously between Egypt and the Near East. People, things, and words from this area found a home in Egypt, the horse and chariot being perhaps the most familiar. If not before, Egyptians must now have become acquainted with Near Eastern cereals, including free-threshing wheat which had long been grown in the region, for, as a result of imperial policies, cereals were now imported into Egypt (Helck 1971: 370-1). The few Egyptian texts which mention imports use words which are also applied to cereals grown in Egypt, but the botanical implications of this cannot be assessed on present evidence. Even if future research reveals a greater variety of cereals in use in the New Kingdom, however, the bulk of the evidence is likely to continue to demonstrate the peculiar attachment which the Egyptians had to emmer and barley.

On the output side of administrative texts there was a plethora of words for types of bread and cakes. By the late New Kingdom it is possible to list no less than eighty-one, although some are clearly sub-types (Helck 1960-4: 666-80). It is clear from artistic and textual evidence as well as from the survival of actual examples in New Kingdom-tombs that several variables served to distinguish one type from another: shape and colour, added ingredients, method of preparation, and whether the context was religious or secular. Examples of ancient loaves seem to be preserved only in tombs, and only then in a small number of desert cemeteries (primarily Western Thebes and Saqqara). They cannot be considered a representative sample of available types, and in this case we may be permanently prevented from investigating changes that might have occurred during the period, for bread itself has not been found on settlement sites, even those in desert locations. One change is suggested by the way that secular documents from the 19th Dynasty onwards use an entirely new term for a kind of bread which was clearly baked on a large scale. The word, kershet, which was still in use when Herodotus visited Egypt and which he transcribed into Greek as kyllestis (Gardiner 1947, II: *228-9; Lloyd 1976: 334), is written in a way which denotes a word of foreign origin, and whether it derives from Western Asia or from Africa is disputed (Helck 1971: 530-1). What, one wonders, prompted the introduction of this word?

A few of the longer texts cover cereal processing (Helck 1960-4: 620-41; Spalinger 1986). Quantities of grain are drawn from granaries, turned over to millers, the resulting quantities of flour are measured, and bread and beer produced according to different “strengths” (which must be loaf size in the case of bread). This information, much of it quantified, ought to be of enormous value in reconstructing ancient practice, but, by themselves, these texts exemplify the problem of reversibility mentioned earlier. They also require, for elucidation, an additional mode of research beyond archaeobotany and the close study of archaeological contexts, namely, experimental work.

ADMINISTERED CEREALS AT AMARNA

Already at Amarna we have a major series of buildings and areas which were the settings for the large-scale processing of cereals made known to us from administrative texts, although to link the two directly does require that an assumption be made. In organizing the economic base for his new temples Akhenaten kept to the tradition of lavish food offerings. Thus the few surviving fragments of the great offering-list from the Great Aten Temple evidently included bread/beer entries (Griffith 1893: 306) and cattle and other commodities, and fragments from his Karnak temples are likewise traditional in their content (Saad and Manniche 1971; Helck 1973, 1975: 139-41). This is extremely helpful because it implies that temple offering-lists and calendars of feasts which are better preserved but date from the reigns of other New Kingdom-Pharaohs depict a broadly similar pattern to that followed at Amarna. The same implication is present also in the archaeology at Amarna (see below), which matches closely what some of these other sources have to say. The largest surviving set of lists (seventy-one of them, covering daily offerings and periodic festivals) is on the walls of the mortuary temple of Rameses III of the 20th Dynasty at Thebes, whose thirty-one year reign (c. 1184-1153) began some 160 years after Akhenaten’s death (Nelson 1934; Helck 1960-4: 368-412; Fig. 14.6). It is known to have been, however, a copy of the lists on the walls of the mortuary temple of his great ancestor, Rameses II (1289-1224 BC), which brings us much closer to the reign of Akhenaten. The most numerous kind of offering is bread, with more than 5500 loaves offered every day, as well as 204 jars of beer. Not all of the loaves were of the same kind. In general across all the feasts the most common were called bit and pesen, a pairing which occurs in many other texts (Helck 1960-4: 641-8, 746-9; Janssen 1975b: 471-2, 490-1). Both were written using hieroglyphic signs for loaves of different shapes, that for bit depicting a loaf with a narrow tapering profile, and that for pesen having a circular outline (Fig. 14.6).

The ground to the south of the Great Aten Temple was partly occupied, as already noted, by a large set of interlocking compounds in part of which most of the meat-jar labels have been found. Another part, along the north
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**Fig. 14.6** Section of offering-list from Rameses III's mortuary temple at Medinet Habu (after Nelson 1934: 47, Fig. 19).

side and closest to the Temple, had specialized in the production of bread baked in pottery moulds, an operation which had been carried out in something like 110 baking chambers, each a vaulted room measuring about 11 × 4 metres, equipped with a bank of ovens at the back, implying a total of between two and three hundred ovens. The scale of output (as well as the main clue as to its nature) is provided by the huge quantities of discarded pottery bread moulds which not only spread over a sizable area of the desert to the east, but engulf the rows of baking chambers as well, implying that originally stacks of moulds filled the corridors and covered the roofs. The identification of these vessels as bread moulds is firmly based on artistic and written evidence extending back over many centuries, including blocks with wall scenes from Aten temples from both Amarna (Fig. 14.7) and Karnak. In the New Kingdom the moulds were generally tall cylinders, sometimes with a slight taper, producing loaves that would resemble the hieroglyphic sign used in writing *bit*-bread (Fig. 14.3; Jacquet-Gordon 1981). They are rare in the residential parts of Amarna, but they occur in large numbers beside the Great Aten Temple, beside the Small Aten Temple (and associated with a similar kind of production building), in the newly discovered outlying temple at Kom el-Nana, and, replicating the temple association in miniature, in an annexe attached to one of the private chapels at the Workmen's Village at Amarna (Kemp 1987b). They can also be picked up in and around the brick administrative section of the Ramesseum, the mortuary temple of Rameses II at Western Thebes. The obvious religious context leads to the conclusion that mould-baked bread was, in the New King-
dom, “festival bread”. The answer to why this should have been so perhaps lies in the fine quality ascribed to bread baked in pottery moulds, not only in recent times, but in Classical Greece as well, where special white loaves were baked in pottery moulds in honour of religious festivals (Davies 1977: 209–10, also 309–10).

If this was all the evidence, the agreement of sources would be satisfyingly neat. Several facts, however, introduce complexity. One is that all the varieties of bread and cake in the offering-lists are given specific names, or “strengths”, and, in the case of both bit and pesen, several values (Fig. 14.6). This implies that pottery moulds, which were themselves made on wooden moulds, came in several fixed sizes. It ought to be easy to check this, but the moulds were made from a very soft and friable fabric which easily breaks into sherds which are then very difficult to reconstruct. Nevertheless, it does seem that, at least at the level of individual temple bakeries, there were overall differences in the diameters of moulds (Rose, pers. comm.). Once further work has been done to establish sizes the next step will be to try to relate them to the Egyptian scale of baking values, using experimental data.

Several specimens of ancient loaves, some from the New Kingdom, have been found in tombs and in a variety of shapes. One is a narrow cone with a rounded end (Darby, et al. 1977: 520). Superficially the examples look like products of bread moulds but they are, in fact, normally hand-made (Samuel, pers. comm.). If we go back to the offering-lists we will also find a category of bread the name of which means literally “white bread” with an accompanying hieroglyphic sign which often has the shape of a narrow-based triangle, although in the Medinet Habu lists the shape is more like a narrow rectangle pinched in the middle (Fig. 14.6). It is a major element in the Medinet Habu lists, though baked on fewer occasions than bit- and pesen-loaves, and it had an association with offerings extending far into the past, beyond the beginning of the New Kingdom. The Medinet Habu determinative notwithstanding, why could not “white bread” have been the name of the mould-baked loaves? For the correct interpretation of the archaeology at Amarna getting the name of the bread right scarcely matters. It is worth briefly pursuing, however, because it illustrates a facet of society which affects the environmental evidence as much as it does other areas of life, namely, the weight of tradition; it also illustrates something which, in time, one comes to accept as normal, namely, the way that a collection evidence from different sources never quite makes sense.

Baking bread in moulds can be traced back to the late prehistoric period. For a long time, down to the end of the Old Kingdom, in fact, the moulds were thick and broad and designed to produce loaves in the shape of flat cones (Jacquet-Gordon 1981). The archaeological contexts are also overwhelmingly domestic. At the same time, scenes of tomb and temple offerings depict what appear to be tall and slightly tapering loaves with rounded ends, very similar to those depicted in later times (Darby, et al. 1977: 518–9). One has to accept, in view of the mismatch in shape with the moulds of that time, that these loaves were made by hand. By the Middle Kingdom the shape of moulds had changed to produce a narrow, sometimes almost rod-like loaf. It is at this time also the term “white bread” is first encountered. This is likely to be, however, a coincidence, for again the contexts of Middle Kingdom bread moulds are overwhelmingly domestic. At one of the Middle Kingdom pyramids where the pottery of the adjacent brick buildings, some of which will have been given over to the offering cult, has been studied in detail, bread moulds formed only a tiny percentage (Arnold 1988; the type is not in the corpus of pottery from the pyramid of Senusret I at Lisht, Arnold 1988). One gains the impression, therefore, that the long tapering offering-loaves, which picked up the term “white bread”, represent a tradition of fine-quality hand-made loaves which survived through the New Kingdom, whilst mould-baked bread, which for perhaps two thousand years had been produced for daily consumption, underwent a transformation or perhaps a restriction in association in the New Kingdom, becoming festival bread. Whether this was the result of a change in the technique of production (perhaps related to the switch to emmer as the commoner crop), which turned out a better-quality of loaf, is not known. Again the sources create an agenda for future research.

The large bakeries adjacent to the three Amarna temples must have had a huge output, sufficient for a substantial number of people. If we want to enquire as to what, even to a rough order of magnitude, the output might have been, a straightforward technical question has to be faced: how were the ovens used? The majority were of the simplest construction, with a cylindrical interior about 60cm across and no floor to separate contents from the fire, which frequently left the ovens about one quarter full of very fine ash; a small minority were square and brick-built. The same temple offering-lists which enumerate so many bit-loaves also include other kinds of bread, notably pesen-loaves which, so the hieroglyphic determinative tells us, were circular, and thus probably also flat and fairly thin. Such loaves can readily be baked in cylindrical ovens by sticking them to the sides (Samuel 1989: 255, Figure 12.1), or on shallow pottery bread trays which occur in domestic contexts at Amarna, though not very commonly. As for the pottery moulds, one group at Amarna was found in a square oven (Kemp 1987b), but this is unlikely to have been the norm, for contextual association between bread moulds and rooms with only cylindrical ovens is very strong indeed. The simplest interpretation is that the moulds were stood upright in the oven, in groups of as many as twenty. This is actually how they appear in a scene of baking on a carved block originally from Amarna (Fig. 14.7). If five bakers were done in one day, the lower figure of two hundred ovens
for the Great Aten Temple bakery would have the capacity for an output of twenty thousand loaves, considerably in excess of the offerings at Medinet Habu. Figures produced by calculations of this kind assume that a reasonable degree of efficiency in the utilization of the facilities was achieved. This was not necessarily so; their size might incorporate a degree of surplus capacity simply because a modern notion of efficiency was not present. Even so, we have to reckon with a prodigious manufacture of festival bread, which employed several hundred people and fed several thousand.

As with the meat, we are really obliged to assume that the output of the temple bakeries was actually consumed by part of the population of the city, for whom entitlement to offerings would have been a reward for service. Through what formality this was achieved we have no direct source to guide us, but it is tempting to regard the actual route of distribution of the loaves as having included a short time during which they were placed in batches on the fields of offering-tables within and beside the temples, a method of distribution itself requiring considerable numbers of people.

The grain for bread-making had to be imported, either from farmlands across the river which fell within the formal limits of the city, or from more distant estates. The most detailed of the cityscapes in the Amarna tombs (Meryra) depicts grain stored in two ways: in large flat-topped heaps evidently in the open (presumably in walled compounds and as a temporary measure), and in compartments in a set of long storage chambers (Davies 1903–8, I: Pls. XXV, XXXI). Just such a compartmentalized building, on a large scale, filled part of the grounds of the King’s House, which lay between the two Aten temples in the Central City.

Between the storage of grain and the baking of loaves came milling to make flour. Evidence for the location of this activity in connection with the Great Aten Temple bakeries has only recently come to light, through the quern and mortar survey carried out by Delwen Samuel in 1992. The ancient Egyptians ground their grain with saddle-querns made of quartzite (or quartzose sandstone) or granite (Samuel 1989), which previous excavators at Amarna felt were of so little value that they discarded. As a result the environs of excavated buildings were often left littered with whole or fragmentary querns, as well as limestone mortars which also had their place in grain processing for the preliminary stage of dehusking. The 1992 survey, although limited to the excavated parts of the city, collected over seven hundred specimens. Many derive from areas of private housing, but, within the Central City, a notable concentration was found over the eastern part of building Q41.10, part of the huge compound to which the bakery beside the Great Aten Temple was really an annexe (Fig. 14.4). This suggests that some

Fig. 14.7 Bakery scene from a carved wall block from an Amarna building, later reused at Hermopolis (after Cooney 1965: 73)
Fig. 14.8 A. Quern emplacement in a courtyard attached to an Amarna house, no. P46.33. The drawing (B) shows how it was probably used, based on ancient depictions and modern experiment.
of the rooms or spaces in this part formed a grindery or series of milling sheds, although it has to be admitted that the tiny-scale 1930s plans show few features that could have accommodated them. Although there is no hint of this in the administrative texts, it is possible that the dehusking in mortars was done separately, for this concentration of querns is not matched by one of mortars.

A part of another building (R42.9D, belonging to a different complex, Fig. 14.4) was discovered in the 1930s to have been equipped with rows of mortars of this kind (Pendlebury 1951: Pl. L.4; re-excavated in 1992), but it is not clear if this was connected to the operations centred on the Great Aten Temple.

CEREALS AND PRIVATE HOUSEHOLDS AT AMARNA

Festival bread and royal largesse, despite its evident scale, can still have been only a supplement to the basic provision of bread to the city. This can be judged from the administrative texts, it is possible that the dehusking in mortars was done separately, for this concentration of querns is not matched by one of mortars.

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As already explained, it represents a settlement of specialists of state workers who were charged with the responsibility for preparing bread and beer for the city. This can be judged from the administrative texts, it is possible that the dehusking in mortars was done separately, for this concentration of querns is not matched by one of mortars.

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understanding of processes. In reality a proper study of ancient Egypt’s agricultural base and food supply, using the actual remains which are so abundant and often remarkably well preserved, has scarcely begun. It is not too much to say that an integrative approach which uses to the full the traditional sources but which is nonetheless based on environmental and related archaeological evidence should now be one of the main aims in excavations on Egyptian settlement sites.

References


The production, exchange, and processing of cereals formed the basis of the ancient Egyptian economy (Kemp, 1989: 127). From sowing grain to distribution and consumption of cereal foods, cereal resources were the primary source of wealth for the elite, their major occupation of ordinary people, and they were the dietary staple for all. An analysis of the place of cereals in ancient Egyptian culture, as with any pre-industrial stratified agricultural society, must therefore take into account the complexity of the subject. Touching as it does on so many aspects of ancient society, the study of cereals in ancient Egypt is ideally suited to a multi-disciplinary approach.

The unusual nature of the evidence also encourages an inter-disciplinary methodology. Quite apart from the type of archaeological and epigraphic evidence one might expect from the Bronze Age Near East, ancient Egyptians commonly depicted scenes from daily life for their tombs, and they lived in a country whose arid climate preserves organic material outstandingly well. This provides the archaeologist with a rare opportunity to search for evidence relating to all stages of cereal manipulation, from the unprocessed grain to the final food product.

Integration of the wealth of evidence from ancient Egypt is also encouraged by the potential which such an approach has to offer. A detailed and informed understanding of the past can be built up through the examination of different types of data. The gaps which always occur in the archaeological record can be examined from a variety of directions. This offers an alternative to the quest for more data through further excavation. Aspects which remain unknown may be addressed using informed inference from a number of sources. A wide variety of evidence brought to bear on a particular set of research questions improves the chances of developing, and testing, hypotheses about the past. Where similar conclusions are reached independently from different sources of data, the entire analysis is strengthened, while contradiction between different types of evidence requires theories to be adjusted. Integration is therefore likely to provide greater insight than the consideration of individual data sets in isolation.

Although in theory there is a wide range of archaeological data, and a variety of ways to analyse them, the assemblages available for any study depend on a combination of excavation strategy, taphonomy and preservation, and availability of technical expertise. As a result, the methodology of integration will differ. One type of integration could be called "contextual", where different types of artefacts (be they environmental or human-made, such as bones, ceramics, or inscriptions) are recovered from the same defined contexts. Their co-occurrence in these same contexts allows the different artefacts to be compared. The link between the disparate types of material, in other words, is the common contexts in which they occur.

Another method of integration might be called "the-
matics", where different data sets are gathered over different scales of distribution, and each assemblage, be it of restricted distribution, such as a borehole, or broadly based, such as a site-wide survey, is related to the others by linkage to a common theme, activity, or process. In practice, the nature of any integrated approach probably encompasses both these methods to some degree, depending on the archaeological assemblages which are available. These terms are simply a convenient descriptive and conceptual device.

My own research into the place of cereals in ancient Egypt aims to use a multi-disciplinary approach to explore those aspects concerned with the preparation of harvested, stored cereal into staple foods. (See Samuel, 1993a for a survey of potential methodologies.) We know from documentary, artistic, and archaeobotanical evidence that the main crops of ancient Egypt were emmer and barley. Documentary and artistic evidence also show that the staple food in ancient Egypt was bread and beer. The types of data which I am using vary greatly in scale, from artistic depictions of widely differing dates and geographical locations within Egypt, to site-wide artefact survey, to intensive examination of specific individual deposits. Their integration, therefore, is based on the "thematic" model, where the common link between assemblages is their relation to ancient Egyptian baking and brewing. Since the primary source of archaeological evidence for this project comes from the single period site of Amarna, the study focuses on a particular time in the long history of ancient Egypt, that of the New Kingdom (ca. 1550–1070 BC).

The nature of this site, and its history of excavation, has dictated the type and distribution of available material relevant to the study of cereal processing. I will describe aspects of the site which have a bearing on this subject, and then present three different types of evidence for baking and brewing which have been recovered from Amarna. The examples are chosen to illustrate the varied scope of data available, and the thematic approach to integration which I have used. The recovery of archaeobotanical material at Amarna relevant to cereal processing has been relatively restricted. Recovered food residues are more abundant, and somewhat more widely distributed. Quern stones have been located across the site of Amarna, and provide information of a broader scale, though less specific context. Although analysis of these sources of evidence is not complete at the time of writing, a complex pattern is beginning to emerge.

AMARNA, THE SETTING

Amarna is an excellent place to apply inter-disciplinary studies. This site was, for a brief period, the capital of ancient Egypt, a huge city with all the range of buildings and activities which that entails. Although some of the original architecture, especially in the stretch adjacent to the Nile, is lost under modern cultivation, a very large area survives. It is virtually unique in the archaeological record because, despite its large size, it was occupied for a very brief span of time, perhaps as little as 15 years.

In addition, its position on the edge of the Eastern desert means that preservation is often very good. The areas which survive are well above the floodplain, and precipitation in this region is minimal. At the Workmen's village, on a low spur of hills about 1 kilometre from the easternmost edge of the main city, preservation can be outstanding due to complete desiccation, and a protected position in a small valley where the surface is not scoured by wind, but covered by drifting sand. The taphonomy of preservation is variable; often, but not consistently, organic material survives in abundance. Where it does, wood, cloth, small plant parts of all kinds – including seeds, fruits, leaves, and flowers – bone, matting: a wealth of material has been retrieved during excavations carried out both recently (Kemp, 1984, 1985, 1986, 1987) and in the early 1920s (Peet and Woolley, 1923). (See contribution by Barry Kemp, above, for more details about the Workmen's Village.)

Amarna has had a chequered history of excavation. In the 19th century, much of the western stretches were turned over in a hunt for treasure, and this kind of disturbance has affected the Workmen's village in more recent times as well. German teams before the First World War and British teams in the 1920s and 30s excavated extensively throughout the remaining parts of the city, but there is still much which remains untouched. These early archaeological investigations were very much products of their time. The primary interest was in architecture, site layout, and artistically interesting or valuable small finds. Large areas were rapidly cleared, general plans were often but not consistently made, and objects of intrinsic value were kept. Vast amounts of material were left behind, either in the spoil heaps or lying about on the surface.

The current excavation program includes re-examination of areas which were dug by earlier expeditions. Systematic clearance of spoil heaps in the Smaller Aten Temple has revealed a large number of artefacts, including important architectural elements. During casual strolls across previously excavated areas of the site, one constantly comes across an amazing variety of objects, including parts of stone furniture, stone tools, and occasional fragments of sculpture.

The philosophy of the current excavation is radically different to those of the past. Where earlier directors went for the broad picture, and the hasty clearance of vast areas, the emphasis now is on intensive, detailed study of relatively small areas, complemented by a number of different surveys covering all or substantial parts of the site. Numerous specialists work at Amarna, a reflection of the diverse material available. Recent excavation has concentrated on the Workmen's village, a house and potter's workshop in the Main City, and currently, a
large temple site which contains work rooms believed to have been connected with bread and beer making.

ARCHAEOBOTANY

Classic archaeobotanical analysis is one way to examine the role of cereals and cereal foods. The most common way that plant remains are preserved in the archaeological record, especially in the Near East, is through charring. Uncharred plant material decays as it is exposed to seasonal rainfall. Remains must therefore be exposed to the filtering agent of fire (Hillman, 1981: 139–140), creating a differential record of preservation early in the process of deposition. At Amarna, however, and at the Workmen’s village in particular, organics are preserved through desiccation and a wide variety of plant parts survives. Plant remains (and other organics) can be found in the same place where they were originally handled and deposited. This provides a rare opportunity to relate directly the composition and extent of archaeobotanical remains to the context in which they are found.

This is the great advantage of many of the Amarna deposits. In practice, the collection of plant remains during recent excavations is a cautionary tale. The Workmen’s village was dug by the present team between 1978 and 1986. I arrived at Amarna in 1987 as the first long-term archaeobotanist, after excavations had moved to a site in the Main City. Although samples had been diligently collected for future archaeobotanical analysis, many turn out to be lacking in primary plant deposits: those remains discarded in place, as a direct result of day-to-day activities carried out within the village. The mud which is bonded to plant remains from many samples indicates that unfortunately the remains derive not from activities involving their direct use, but from tempe in the organic-rich mud plaster which crumbled over these emplacements as houses disintegrated. One reason for the lack of primary plant material is the widespread illicit disturbance of deposits throughout the site. Had an archaeobotanist been on the team while excavation was in progress, it would have been possible to monitor the archaeobotanical material retrieved through sampling, and to ensure that collection was in fact targeting primary deposits of archaeobotanical material.

Material already published (Samuel, 1989) is, however, an example of the potential of primary deposition at its best. A sample of deposit surrounding a mortar emplacement in one of the houses of the walled village (West Street 2/3, Unit [2707] – see Kemp, 1987: 8) contained a considerable quantity of primary plant remains. They are all beautifully preserved, and look very like modern material, except for a darkened orange colour. The assemblage is dominated by cereal remains, and of these, the vast majority is emmer wheat (the few other cereal remains are from 6 row barley). It is plain that the later or last use of this mortar was for processing emmer, with a slight, and probably unintentional, admixture of barley.

The emmer remains range from intact spikelets still containing whole grain, to shreds of light chaff and the tufts of hair which occur at the apex of the grain (the “cereal beards”). There are a large number of “heavy” chaff fragments, broken up to varying degrees, but dominated by emmer rachis internodes and emmer glume bases. The predominance of heavy chaff, together with the intact spikelets, and whole but empty spikelets, shows that the mortar had been used to break up whole emmer spikelets, freeing the grain from the chaff. This is not a surprising conclusion in view of Hillman’s (1984) work. However, the Egyptological literature commonly states that mortars were used to pound grain into flour (Strouhal, 1992: 125, and Sist, 1987: 55, are just two recent examples).

The pattern of breakage has the potential to provide information about the pounding technique itself. Most of the chaff is present in the form of rachis internodes and glume bases, showing that the material which scattered out of the mortar was reasonably well broken up. The complete but empty spikelets in the sample all have a similar pattern of breakage (Samuel, 1989: 284): the abaxial chaff has been torn away, leaving a gap where the grains fell out.

In the original report on these plant remains, I suggested that this pattern could have been a result of rodent gnawing. However, since that publication, I have had the opportunity to examine emmer debris caused by mice feeding from whole emmer ears. Emmer chaff left behind by mice is either in entire spikelets but neatly divested of grain, or thoroughly chewed up into bits. The particular pattern of breakage found on the ancient chaff from the mortar emplacement, therefore, is probably caused by the pounding action.

A number of other items were also found in this assemblage. The “cereal beards” which were recovered were probably attached to whole or broken grains at the time of pounding, but the endosperm and thin bran has since vanished, perhaps eaten by insects. Some seeds of common weeds were also found. They are likely remnant contaminants of the crop which were not cleaned out of the spikelets at an earlier stage. The most common of these are a species of rye grass (Lolium). The presence of some safflower seed remains may have been the result of a separate pounding episode.

To summarize, at a late stage of village occupation the mortar was used for pounding up emmer spikelets to free the grain. A few weedy seeds were apparently mixed up with the emmer, as well as a small amount of barley. The mortar may have been used for pounding other commodities apart from emmer spikelets, but this is uncertain.

Samples from other mortar emplacements, as well as quern emplacements, have been examined. Remains collected around other mortars would have helped to put the information from the West Street 2/3 mortar into perspective, while samples from quern emplacements would follow up the sequence of cereal processing.
However, these samples did not include plant material derived from the use of these installations.

**VISIBLE RESIDUES**

Although at the moment we are apparently missing the archaeobotanical remains which come from further processing stages, the conditions of preservation provide a rare opportunity to look at the end product. Out of the huge mass of pottery sherds recovered from Workmen's village excavations, some have residue clinging to their surfaces. A portion of these residues have been sampled and are being examined. They all come from rubbish deposits outside the main walled village, but must have come from villagers' activities.

There are a number of different types of residue. Work done by Margaret Serpico (University College, London) has established that one group of residues are the remains of resins, which can often be distinguished by their particular appearance. The residues which I initially sampled range from "muddy" to charred, sandy, or powdery, but the most interesting are flakes of orangey material. Examination under low magnification shows that these orange, flaky residues often have shreds of cereal chaff or bran embedded in them. Therefore one original ingredient must have been cereal, making them candidates for further examination.

This work is still in progress at the time of writing, but some preliminary results have been obtained. The shreds of cereal tissue have been extracted from some samples and mounted for observation under high magnification light microscopy. Their cellular patterns show that these pieces of tissue all derive from emmer. This is a particularly satisfying result since emmer was the main constituent of the mortar assemblage discussed above. It expands the evidence for the use of emmer from one mortar emplacement to several final products, and strengthens the evidence that emmer (as opposed to barley) was an important cereal food for people at the Workmen's village. Obviously, this is based on few samples so far, but the evidence is consistent. Although emmer remains are a common constituent in rubbish deposits, indicating its extensive use in the community, this type of evidence links emmer directly to human food, rather than animal feed from numerous pens outside the walled village.

The Workmen's village was certainly controlled and supported by the state [see Barry Kemp's contribution, above]. Food supplies were from official sources. The emerging pattern of emmer linked to food processing contexts shows that it was this cereal which must have been a staple supply for the villagers. Furthermore, the evidence of chaff around the mortar emplacement shows that emmer was delivered to the village in the form of whole spikelets, and that it was up to individual households to process the spikelets to obtain clean grain, and to use that grain for food.

Residues containing cereal remains, as well as those with a similar texture but without cereal tissues, have been examined under the scanning electron microscope (SEM). This type of material lends itself well to SEM work. Because it is thoroughly desiccated, no special preparation is required. The amount of residue available for study is often very small — on the order of a few milligrams — but only vanishingly small pieces of residue, about 0.1mm across, are needed for SEM work to be highly informative.

The results from SEM have been very exciting. In the residues which contain cereal tissue, the most common material is, not surprisingly, starch granules. The starch occurs in a number of forms. It may be completely unmodified, or melted by heat to varying degrees (this melting of starch is called gelatinization), or attacked by starch degrading enzymes.

I will not discuss the implications of these findings in detail here. The SEM analysis shows that cereal starch had been exposed to a number of processes. Different samples show different combinations of starch modification, and these mixtures must be further analysed to determine precisely how the residues were formed. There does, however, seem to be a correlation of starchy residue type to vessel type. A further ingredient in some residues is yeast. This strongly suggests that these residues are the remains of beer. It is possible that the yeast was a chance contaminant which thrived in the damp organic residue. However, due to a number of factors, I believe that this was not the case (see Samuel 1993b for further discussion on this point).

SEM examination of cereal-related residues is providing the evidence for beer production in a village. Bread remains can be studied in a similar way. Unfortunately, no bread from Amarna is known, but loaves from tomb offerings exist in a number of museum collections. Correlations between bread and beer from different sources must be made with caution, but it ought to be possible to use this direct evidence to determine the relationship in production of bread and beer.

**LOCATING CEREAL PROCESSING WITHIN AMARNA**

The discussion of baking and brewing at Amarna has so far focussed on evidence from the Workmen's village. However, the layout of Amarna and its excavation history (as described briefly above), presents a unique opportunity to look at another aspect of cereal processing, on a wider scale.

Anything uncovered during excavations which did not interest earlier archaeologists was left behind on the surface. One group of artefacts which did not attract any attention were quern stones. This has made it possible for me to conduct a survey of querns and quern stone fragments, along with limestone mortars across the excavated portion of the site. I recorded all such finds on site plans, and collected them for further study. Although contextual
information is completely lacking for these querns and mortars, their large size, weight, and lack of intrinsic value make it likely that they were not moved far from their original find spots. This assumption is further borne out by the large numbers which have been found.

Querns and quern fragments are much more abundant than mortars. This is partly due to preservation, for the exposed limestone has been prone to severe weathering, and many recovered limestone mortar fragments are very flaked and fragile. The bulk of the analytical work therefore concentrates on querns. The analysis of querns and their location is not yet complete at the time of writing. One problem to be solved is to determine whether querns were used primarily for cereal grinding, or for some other purpose, such as ore crushing or pigment grinding. However, some preliminary comments can be made.

Firstly, querns were found throughout all quarters of the site. The most unexpected finding of the survey was the location of a large concentration of querns within the official quarter of the city. This is the area containing the temples, a palace, an audience hall, numerous clerks' offices, and other large buildings whose function remains uncertain. The quern concentration was found near the known Great Aten Temple bakeries, and therefore strongly supports the conclusion that they came from official "grinderies" supplying flour for the temple bakeries, and perhaps for the nearby palace as well.

The numbers and distribution of the types of quern which I believe were used for cereal grinding seem to suggest that each household had at least one quern. Pending more detailed analysis, this is just an impression, but is apparently the case for large estates (which may well have had considerably more than one quern), medium-sized houses, and small, poorer houses. The excavated houses of the Workmen's village show that quern emplacements can be found within small dwellings (see Kemp, 1986: 3–5; Kemp, 1987: 4–5, for example). As we have seen, the state-supplied villagers were responsible for processing their own husked grain. The distribution of querns shows that households within the Main City had their own facilities for flour grinding also. Yet the official "grindery" meant that the state had a mechanism for producing flour on an industrial scale.

These findings hint at the Amarna economic system dealing with cereal and flour, both for domestic supply and for state production. Precisely how this fits into the economy in general is still an open question. The economics of quern stone supply itself is entirely open to study at present. The Amarna querns are made from quartzitic sandstone or granite; neither are local resources. It is possible to trace stone sources, particularly the distinctive granites, to work out the supply of essential tools to an ancient capital. A comparison of stone type between domestic and official areas may show a difference in preference or access. This in turn might relate to differential access to quality of tools for cereal processing. The study of quern stones as commodities themselves offers the chance to link different aspects of economic life in ancient Egypt, and to approach the complexity of the system as it must have existed in an extensive, stratified society.

BEYOND AMARNA

This paper has touched on some of the ways in which a better understanding of ancient Egyptian cereal use is being reached. Most evidence is from Amarna, but various strands of evidence are being obtained from elsewhere, to complement and expand on evidence from Amarna, to fill in gaps missing from the Amarna record, and to test the ideas which arise from its analysis.

The Workmen's village at Deir el-Medina is very similar to the Amarna village. The artisans who built and decorated the tombs in the Valley of the Kings and Valley of the Queens, and their families, lived there. It is close in date to Amarna, and it too was supplied with foodstuffs by the state (Kemp, 1989: 193; and contribution by Barry Kemp, above). Unlike Amarna's village, there is a mass of documentary evidence about Deir el-Medina. The site was excavated in the 1930s by Bernard Bruyère (1924–1953) for the Institut Français d'Archéologie Orientale, and many artefacts went to the Louvre. As well as many bread loaves, numerous pots from the Deir el-Medina cemeteries contain cereal residues. By kind permission of the Musée du Louvre, these have been sampled, and are undergoing light and scanning electron microscopy analysis as has been applied to the Amarna remains. Study of museum material such as this will broaden the base of our knowledge for ancient Egyptian cereal food processing at this period.

Within this study, the technology of cereal processing is being established in detail for Amarna, as a case study for the New Kingdom period. As has been demonstrated, the scope of the project is not limited to Amarna alone. It can be tested, elaborated, and refined by further work of a similar kind, more excavation, and by linkage to sources such as documents. In addition, it will be possible to look forward at developments after the Amarna period, and backward, to techniques which were used before, and which led up to New Kingdom baking and brewing technology. Ancient Egypt was not a static culture which stuck to the same way of doing things for 3,000 years. Methods of baking and brewing were just one reflection of a deeply conservative, yet constantly changing and evolving society.

Acknowledgements

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References

14.3 Butchery at the Workmen’s Village (WV), Tell-el-Amarna, Egypt
by Rosemary Luff

INTRODUCTION

The animal bones from the Workmen’s Village (WV) are extremely well-preserved, some still showing skin, hair, tendons and gristle; the arid climate of Egypt combined with the sandy environment speeds the desiccation process of organic remains and this, together with rapid burial, has ensured excellent preservation. Few bones evince evidence of dog gnawing.

Howard Hecker undertook an extensive and impressive preliminary analysis of the faunal remains which had been excavated during the seasons of 1982 and 1983 (Hecker 1984). Most of the bones had been excavated from outside the WV, that is, rubbish deposits from the primary fill of the main quarry and three quarry pits to the south, and the animal pens to the east; but smaller samples had been recorded from the Chapels, the Zir area, site XI and inside the village, that is house no. 6, Long Wall St.

Hecker states that the pig is the most commonly represented animal followed by the goat and then the cow. It would appear that pigs were slaughtered locally and very likely raised in or near the WV; this idea is supported by the fact that all the skeletal elements are present, both sexes are present, and there is a wide range of age groups with a preferred age of slaughter at 2 to 8 months and 14 to 24 months. Goats were also kept at the WV since all parts of the animal were recovered. Few cattle were reared at the site, since most beasts had been slaughtered at less than four years old, and skull bones were low in number, the limb bones dominating the sample.

During the 1990 season, I decided to make a detailed examination of the butchery marks on the WV’s animal bones, mainly of the domestic stock, cattle, sheep-goat, and pig, because there appeared a consistent and regular pattern of butchery to the skeletal elements of the pigs and goats, which contrasted with a much more random pattern of butchery with respect to the cattle. This was unlike anything that I had observed with respect to the vast quantities of cattle, pig, and sheep/goat bones from the Roman town of Colchester, and other related urban and rural sites in Britain.

Butchery marks can describe a wide range of activities within a community, for example, methods of slaughter, carcass dressing, food processing techniques for initial consumption and/or storage, horning, skinning, tanning, tawing, glue making, grease production, and bone working. But, in addition, they are signatures of human behaviour and can reveal something of the nature of the ancient Egyptian’s aptitude and competence for undertaking specific tasks. It is this specificity which is the key to being able to understand how skillfully the work was being undertaken; bad butchery cannot be rectified, the evidence is all too plain to see.

It is commonly assumed that a skilled butcher will not leave knife-cuts on the bones; indeed a fine membrane, the periosteum, surrounds the bone and knife-cuts are not as likely to be seen as cleaver marks. However, a tired hard-pressed butcher might well leave more marks than
someone who is not, as indeed would the implements if they were not well honed. In this investigation of the Amarna butchery, the competence of the butcher will be judged with regard to his/her awareness of animal anatomy, and the overall success of the procedure will be assessed by comparing the input of human energy with the output of animal products.

These observations will be compared with a model for the butchery of Romano-British cattle, proposed by Mark Maltby, who compared data from urban and rural sites in Hampshire. Although there are wide discrepancies, both geographically and temporally between ancient Egypt and Roman Britain, the anatomies of the domesticates and types of butchery implement have not changed over the millennia.

I shall also look for differences in butchering activities with respect to supply at a local level as distinct from supply via an external administrative source.

Primary butchery describes the slaughter, skinning and evisceration of the animal, while secondary butchery refers to the division of the carcass into the major cuts, for example, legs and loin, and tertiary butchery reflects more the household use of rendering meat into usable fractions.

**PIG BUTCHERY**

The pig was the most important animal in the WV and provided most of the meat supply. To rear pigs in the arid wilderness of the WV would have been an arduous undertaking, and it is reasonable to suppose that great effort would have been expended by the butcher/butchers, in retrieving as much in the way of animal products as possible. Thus the efficiency of the butchery is directly proportional to the competence (that is the awareness of the animal's anatomy) of the butcher/butchers, but, in addition, one of the most critical considerations to take into account is the time available for the butchery.

Thus

\[
\text{efficiency} \propto \text{competence/time}
\]

that is, efficient butchery depends on an expertise in the pig anatomy and being able to wield a knife quickly and accurately. One might argue that time might not be so important in a rural setting, however it is easier to butcher a freshly killed beast than one which has become stiff, so time considerations are, to a certain extent dictated by this constraint. Furthermore, in order to obtain an unainted carcass, the body needs to drain freely of blood and hence preliminary slaughter should be carried out as quickly as possible.

Huge amounts of pig bones were recovered from Roman Colchester in Essex, England, and the scant evidence of butchery marks, together with burnt bone suggested that the animals had been roasted whole (Luff in press). However, the Amarna pig bones contained little burnt material but much evidence of dismemberment, with some filleting butchery marks. It therefore seemed likely that the meat had been prepared for consumption through processes other than roasting, possibly stewing, or even drying or salting whereby no cooking would have been necessary.

**A description of the marks**

**HEAD – skull**

Knife-cuts on the frontal, parietal and zygomatic bones demonstrate skinning.

One skull shows (1219) two chop marks into the frontal bone which possibly suggest pole-axing.

The head was commonly removed by inserting a knife across the occipital condyles.

A pig cranium (4044) from inside the WV had been heavily chopped in order to remove the brain and another example was excavated from outside the WV (1352).

The mandible was dislocated from the cranium as shown by knife-cuts under the condyle along the caudal edge, and was then chopped in two through the mandibular symphysis. Knife-cuts along the medial side of the ascending ramus and further forward, below the premolars, indicate removal of the tongue, while knife-cuts extending laterally along the ascending ramus show the extraction of cheek meat.

**NECK – atlas, axis, remaining cervical vertebrae**

The head was removed less commonly by either oblique chop marks through the caudal edge of the atlas, or knife-cuts across the cranio-dorsal, cranio-ventral or caudo-ventral articulation. One example had been chopped through the mid-dorsal surface, while another displayed knife-cuts in the same area, which perhaps had caused the death of the animal.

Knife-cuts on the ventral surface, just behind the odontoid process of the axis also resulted in head removal.

**TRUNK – thoracic and lumbar vertebrae**

One thoracic vertebra displayed a sagittal chop mark (very unusual), while another was chopped transversely through the centrum, both examples illustrating dismemberment. Two vertebrae show knife-cuts on the dorsal surface of the lateral process and others have diagonal knife-cuts at the sides of the spinous processes, which demonstrate removal of the tenderloin, a very succulent part of the pig.

Butchery of the lumbar vertebrae was similar to the thoracics, knife-cuts on the dorsal surface of the lateral processes and along the spinal sides indicate removal of the tenderloin. Knife-cuts underneath the lateral processes and also underneath the centrum show that the ribs were removed; several ribs showed a profusion of knife-cuts which would appear more related to the tertiary butchery of meal debris.
Fig. 14.9A & B: A, Pig scapula, left, medial view showing knife-cuts; B, Pig scapula, left, lateral view showing knife-cuts.

Fig. 14.10A & B: A, Pig humerus, left, medial view showing knife-cuts; B, Pig humerus, left, anterior-lateral view showing knife-cuts.

Fig. 14.11 Pig humerus, left, anterior view showing horizontal knife-cuts around the coronoid fossa and shaft.

FORE-LIMB - scapula, humerus, radius/ulna
(Note the similarity to goat butchery).

Scapula (Figs 14.9A & B, 28 bones)
Figures 14.9A and 14.9B show a distinct patterning, with a zoning of knife-marks at a point on the distal lateral caudal edge, and this is related to cut-marks on the posterior proximal humerus, at the edge of the head and just below (Fig. 14.10A) and signifies dismemberment. Fine longitudinal marks were recorded along the medial and lateral portions of the blade and are indicative of filleting.

Only two bones exhibit chop-marks into the blade, that is, the medial caudal edge, while one example (1474) shows a curious criss-cross series of knife-cuts along the spine, again reflective of meat removal.
Food for an Egyptian City: Tell el-Amarna

Humerus (Figs 14.10A, B & 14.11, 34 bones)
Knife-cuts mainly centre around the posterior edge of the head for dismemberment, but there are some placed more centrally in the articulation and also on the greater tubercle (Fig. 14.10A).

The shaft exhibited a few oblique filleting marks made by knives.

However, the distal portion of the bone demonstrated the most marks, partly because it preserves better than the proximal end, but also because it is much easier to disarticulate the shoulder joint than the elbow joint. The former joint is a ball-and-socket type, and it is relatively easy to insert a knife between the articulating bones while that of the elbow is a hinge joint, movable in one direction only.

The most striking fact about the distal humeri butchery is that there are few marks on the distal articulation itself, that is, the surfaces of the capitulum and trochlea (Fig. 14.10B), and this suggests that the elbow joint was not opened up before butchery commenced. Most of the knife-cuts concentrate on the medial and lateral edges of the coronoid fossa above the actual articulation (Fig. 14.11 and see section below on the elbow joint) and also the medial and lateral epicondyles; this resulted in the severing of the tendons around the joint, thus introducing flexibility into one of the tighter articulations in the skeleton, and also helped to expose the articulation by cutting through the muscle insertions.

Radius/ulna (Figs 14.12 & 14.13, 22 bones)
Most of the butchery marks centre medially and laterally on the medial and lateral tuberosities of the proximal anterior surface of the radius, with only a few bones exhibiting filleting marks, while the ulna demonstrates knife-cuts across the anterior ridge and semilunar notch.

One bone shows a chop mark mid-medial shaft of both
Joint (distal humeri and proximal radii) definitively show that the joint had been flexed when butchered, that is, the distal articulation of the humerus was not visible when in association with the proximal radius; hence, any butchery marks into this joint had to leave their mark at the proximal part of the radius and the most distal part of the humerus which was the coronoid fossa.

The presence of knife-cuts around the proximal margins of the radius has been interpreted as a fairly clear sign that no leverage was exerted during the disarticulation of the elbow joint (Fig. 14.13; Peck 1986). However, we need to be cautious in interpreting this pattern of butchery as demonstrating a low level of aptitude; other factors need to be considered, for example, had these pigs been freshly killed or had they been slaughtered sometime before, thus allowing the joints to stiffen up? If the latter had happened, it would have been extremely difficult to apply leverage in order to open up this joint.

Binford has detailed the butchery procedures using knives employed by Alaskan Eskimos with respect to caribou (Binford 1981). His observations concerning the dismemberment of the caribou elbow joint are pertinent in our investigations, since he was interested in determining the different type of marks that would result if the animals were butchered stiff/frozen as opposed to warm. He observed that the kind of butchery already described for the Amarna bones occurred when the animals were frozen and/or stiff; in addition to these marks, he described knife-cuts on the posterior distal humerus around the olecranon fossa, and this was found on some of the Amarna pig bones. In addition, ulnae showing knife-cuts across the dorsal ridge of the olecranon, as well as the semilunar notch, reflected caribou that had been butchered cold and again this was seen on some of the Amarna material.

Binford was in the happy position of knowing that the caribou had been butchered cold but, equally, the Amarna butchery might well represent ineptness on the part of the butcher/butchers. The only way that we can differentiate between these hypotheses is to make a careful study of all the butchery.

Carpal joint
The distal radii, carpals, and proximal metacarpals are characterised by scant butchery marks, which is perhaps a reflection of the competence of the butcher.

Elbow joint
The collective evidence of the knife-cuts from the elbow joint (distal humeri and proximal radii) definitively shows that the joint had been flexed when butchered, that is, the distal articulation of the humerus was not visible when in association with the proximal radius; hence, any butchery marks into this joint had to leave their mark at the proximal part of the radius and the most distal part of the humerus which was the coronoid fossa.

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Carpal joint
The distal radii, carpals, and proximal metacarpals are characterised by scant butchery marks, which is perhaps a reflection of the competence of the butcher.

Hind-limb – pelvis, femur, tibia
There was a distinct lack of hind limbs in the animal bone assemblages from the WV. However, the hip joint shows clear evidence of dismemberment by the knife-cuts on the ventral borders of the ilium, ischium, and pubic bones (at least 9 bones).

One femur shows oblique marks on the medial anterior face as a result of filleting, while another shows spectacular chop marks through the neck and major trochanter, while another shows a knife-cut on the head. A tibia revealed horizontal/oblique marks on the distal anterior surface possibly indicative of skinning.

Hock joint
Bones from this joint are scarce, but the ones that do occur demonstrate horizontal knife-cuts along the anterior and inferior distal articulation of the astragalus, together with some above the articulation and at the lateral distal edge. Knife-cuts were also observed on the medial proximal articulatory surfaces of a cuboid, and the superior surface of a navicular.

Feet – metapodials and toes
One fourth metatarsal had a knife-cut at the proximal anterior edge which describes dismemberment.

Summary of pig butchery
The culinary versatility of the pig is renowned: not only is it edible from head to trotter and tail, but curing, sausage-making, and smoking make pork not one meat, but many.

The butchery of the shoulder and elbow joints has produced a very specific patterning of knife-cuts. If this was the result of a very low level of competence I would expect a much more random orientation of butchery marks, particularly around the glenoid cavity of the scapula and humerus head, the shoulder joint being a much more accessible joint. It seems likely that a few, or maybe just one person, were involved in this secondary butchery activity. Thus the elbow joint is a very important piece of evidence which intimates, that at this stage of butchery, the carcasses were quite stiff. Possibly the cut-marks had resulted through slicing meat for consumption, after the joint had been preserved through drying, smoking and/or salting.

The pig husbandry undertaken at the WV was more than a simple cottage craft industry; Hecker has pointed out that the back limbs of both pig and goat are greatly underrepresented in the bone samples as compared with the front limbs, and has suggested that these components were being exported to the Main City.

The extremely low perinatal mortality is impressive and intriguing and reflects skillful animal management. Accounts of the present-day rearing of piglets show that this is no light undertaking; approximately 20% of piglets die before weaning, mostly in the first two to three days of life (Sutherland 1967).

Goat butchery
The Amarna goats were being bred mainly for their meat but most of the animals had not reached full body weight,
being 6 to 12 months old (Luff in progress). In a subsistence economy it makes more economic sense to slaughter beasts for meat when they have reached maximum body weight in order to offset the cost in raising them.

As with the pigs, one is struck by the lack of perinatal casualties, the perinatal period being the most dangerous in the life of an artiodactyl. Present-day domestic goats have a kidding percentage (offspring per 100 females) of 150-180; however, perinatal mortality is said to reach 20% in the more primitive breeds (Noddle 1990, 33).

Goats can provide milk, meat, and hair. The Roman agriculturist, Columella, states that the production of meat can be accomplished without a serious drop in the abundant yield of milk, a one year-old nanny should immediately be deprived of her kids, while the kid of a two year old should be left with her kids until ready to be sold (Columella, De Re Rustica VII.6.8 after White 1970, 314). In the Georgics, Virgil refers to the practice of weaning all kids at birth, the aim being to increase the milk supply (Georgics III. 398-99 after White 1970, 315).

Modern statistics giving comparative milk-yields for sheep, goats, and dairy cows, show the yield from goats to be almost three times as high in proportion to their body-weight as from cows, and about four times as high from sheep (White 1970, 315). We do not know whether milk was drunk in large quantities in ancient Egypt, or whether the Egyptians suffered the lactose intolerance seen in Middle Eastern and African populations today. However, the husbanding of goats and pigs together would have been extremely beneficial. In the manufacture of cheese, the by-product whey is invaluable for animal feeding since it has a high vitamin content and is rich in calcium (important for sty-fed pigs). Ryder has pointed out that whey illustrates the inter-relationship of farming operations, since cheese-makers have traditionally kept pigs to consume this by-product (Ryder 1983, 239). Specialised feeding of piglets could have involved goat foster-mothering, since piglets (and lambs) reared on cows' milk at birth hardly survive but do very well on goats' milk (Mackenzie 1970, 275). Furthermore, sows' milk is deficient in iron and may lead to anaemia in piglets. Clearly the older goats recovered from the WV could have provided milk for this purpose.

A description of the marks

HEAD — skull
The head was removed by chop marks into the occipital condyles of the skull.

Two horn-cores revealed knife-cuts laterally, consistent with the removal of horn. However, preservation of organic material is so excellent at the WV that most of the horn-cores had the horn still adhering to the bone. Horn-cores and horns concentrated within site XI, which was a multi-roomed non-residential building located approximately 50 metres to the south of the village. This makes sense, since horning is a particularly smelly activity and would best be practised away from the confines of the village.

NECK — atlas, axis remaining cervical vertebrae
The head was also removed by inserting a knife into the joint between the atlas and occipital condyles of the skull, and by axe and knife-cuts across the cranio-dorsal and cranio-ventral edges of the atlas.

Some of the goats had suffered their throats being slit as evidenced by horizontal, mid-ventral knife-cuts on the atlas. Knife-cuts, ventro-caudally indicate that the neck was severed between the atlas and axis.

On the axis, knife-cuts were recorded on the ventral surface cranially behind the odontoid process. Also one axis had the odontoid process chopped off obliquely, again for head removal, while another example was chopped further back through the main body.

A cervical vertebra from Woolley's dump had been chopped through the main body, while another demonstrated knife-cuts just behind the anterior facets.

TRUNK — thoracic and lumbar vertebrae
On the thoracics, knife-cuts at the lateral edge of the base of the spine show removal of the tenderloin, while those towards the tip of the spine perhaps indicate clumsy skinning. Knifecuts below the centrum were for the dismemberment of the ribs as described by Binford (Binford 1981)

A lumbar vertebra had been chopped through (N16 7).

FORE-LIMB — scapula, humerus, radius/ulna
Scapula (Figs 14.14A & B, 12 bones)
Mainly horizontal knife-cuts (one slight chop-mark) can be observed in a very specific position, that is, the distal caudal edge, and are connected with dismemberment.
Some marks along the spine reveal the removal of flesh, as do filleting marks along the length of the scapula, but most of the marks are those of dismemberment.

Humerus (Figs 14.15A, B & 14.16, 30 bones)
There are some marks of disarticulation along the posterior edge of the head and through the greater tubercle. However, a lack of many marks in this area is probably related to the comparative ease with which this joint can be disarticulated.

The shafts shows horizontal filleting marks along the upper margin of the olecranon fossa and some in the same position anteriorly.

However, as with the pig, most of the butchery marks concentrate in the distal part of the bone. Horizontal and oblique knife-cuts pass across the anterior and inferior articulation, and also medially and laterally around the edge of the coronoid fossa, together with horizontal and oblique knife-cuts across the medial and lateral epicondyles.

All the butchery is mainly of knife-cuts, except for a chop-mark through the greater tubercle and a series of superficial chops across the head.

Radius (Figs 14.17 & 14.18, 17 bones)
As with the scapula, the butchery marks (knife-cuts) are all in a very specific place on the proximal part of the bone, by the medial tuberosity, and indicate dismemberment.

Some horizontal filleting marks occur along the anterior distal half of the shaft together with short diagonal marks.

Distally, horizontal knife-cuts across the styloid process illustrate dismemberment.

Shoulder joint
This shows consistent butchery and is closely comparable with that of the pig.

Elbow joint
The evidence imparts two forms of butchery based on the joint being flexed or unflexed:

1. Knife-cuts across the anterior and inferior distal articulation of the humerus show that the joint was opened up, while knife-cuts across the lateral edge of the distal humerus ultimately impacted the bone on the face of the olecranon, just beside the semilunar notch, making for easy dislocation. These procedures could only have been achieved if the joints were flexible, thus suggesting the body was warm when butchered.
Food for an Egyptian City: Tell el-Amarna

2. Knife-cuts along the dorsal crest of the olecranon and along the margins of the olecranon fossa, together with knife cuts across the medial face of the distal condyle, resulted in obliquely orientated cut-marks. These marks, which can be quite high up on the condyle, together with marks on the dorsal ridge of the olecranon and along the margins of the olecranon fossa, show that this joint was butchered when stiff. (Binford 1981).

While the pig butchery marks suggest that most individuals were butchered stiff, this is not true of the goat, where several examples were butchered warm. Binford suggests that the stiffness may be related to the dismemberment being part of secondary butchering activities or to scheduling problems at mass kills.

HIND-LIMB - (femur, tibia)
As with the pigs, there is a scarcity of hind-limb elements. One pelvis provides evidence of disarticulation by a series of short knife-cuts adjacent to the acetabulum on the ventral side of the ilium. Another one displayed dismemberment knife-cuts on the ventral surface of ischium by the acetabulum. Filleting marks were observed on the lateral surface of an ilium and also dismemberment marks occurred on the ventral surface of the pubis and ischium.

Six femora show dismemberment marks medio-posteriorly below the head, while two show these marks at the anterior portion of the head and on the posterior surface of the major trochanter. The inferior surface of the medial condyle shows dismemberment, while filleting marks occurred obliquely on the posterior and lateral shafts. Chop marks for dismemberment were directed through the greater trochanter and also below the head anteriorly (6272).

One tibia exhibits a filleting mark on the posterior portion of the shaft.

FEET - metapodials and toes
Two metacarpals have short transverse/oblique marks on the anterior proximal edge, which indicate dismemberment, but then there are other horizontal/diagonal marks mid shaft anterior and posterior, which Binford thinks are indicative of skinning.

Summary of goat butchery
The goat butchery is very similar to that of the pig, in that it was mainly carried out by knives. The main difference in technique lies in the fact that there is more evidence for the elbow joint being opened up for butchery in the goat. This could mean that the goat butchers were more skillful, or that more goats were butchered warm than cold. Since the knife-cuts of the shoulder joint (more accessible joint) occur in a very specific place, it is proposed that the latter is true.

In such a small community one would not expect that different people butchered different species of livestock;

Fig. 14.17 Goat radius-ulna, left, anterior-proximal view showing knife-cuts.

Fig. 14.18 Goat radius, left, anterior-proximal view showing knife-cuts on the medial tuberosity.
the same butchers must have butchered both the pigs and the goats. Indeed the knives support this. Assuming this to be the case, it is evident that they knew how to open up a goat’s elbow joint for butchery. It follows from this, that it is more than likely that the pig elbow joint could not be opened up very easily because it was stiff.

CATTLE BUTCHERY

HEAD - skull

Skull
A frontal bone exhibits a deep chop mark, perhaps indicative of pole-axing as does a malar bone.

There are three examples of malar bones with knife-cuts which are perhaps related to skinning. A zygomatic and a paroccipital bone also show knife-cuts perhaps relating to the same activity.

The head appears to have been severed via a chop through the occipital condyle and also the occipital bone itself.

NECK - atlas, axis, remaining cervical vertebrae

The articulation between the skull and atlas is very tight since it is surrounded by the ligamentum nuchae which supports the head. However, the axis/atlas vertebral articulation is much more flexible and mobile than that of the skull/atlas (Binford 1981)

A chop mark through the caudal part of an atlas severed the head as did a knife-cut across the cranial articulation of another example.

An axis demonstrates a chop-mark medio-laterally and also a knife-cut under the odontoid process.

Chop marks were observed through the caudal superior zygopophyses of several cervical vertebrae and also transversely and sagitally through the main bodies for dismemberment.

TRUNK - thoracic and lumbar vertebrae

The vertebrae show chop marks through the main body and also knife-cuts at the base of the spine to remove the tenderloin. Knife-cuts under the lateral processes of the lumbar vertebrae indicate that the ribs were removed.

FORE-LIMB - scapula, humerus, radius/ulna

Scapula (8 bones)
The scapula displays clumsy chop marks through the neck which is the most resistant part of the bone, presumably this was an attempt at dismemberment (Fig. 14.19). Chop marks were also made through the glenoid fossa. However, a few bones demonstrate knife-cuts on the medial distal edge, evidence of dismemberment together with some filleting marks.

Humerus
Disarticulation was achieved both proximally and distally, by chop marks through the proximal head and greater...
Food for an Egyptian City: Tell el-Amarna

Carpal joint

The carpal/metacarpal joint is easy to manoeuvre, and leverage is not difficult so that the cow's front feet can be extricated without the knife contacting the bone (Peck 1986). However, many of the Amarna cattle carpal bones demonstrate knife-cuts, for example, horizontal knife-cuts on the right radial and intermediate carpals with oblique knife-cuts across the anterior face, knife-cuts inserted into the superior face anteriorly/posteriorly of the intermediate carpal, knife-cuts around the accessory carpal cutting through the ligaments at the back, knife cuts through the anterior face of carpal 2+3, carpal 4, and also the medial face of the ulnar carpal. All these cuts demonstrate evidence of inept butchery.

HIND-LIMB — pelvis, femur, tibia

Pelvis

The hip joint was commonly chopped through and around the acetabulum, although, as with the shoulder joint, there are examples of dismemberment via knives. Filleting marks along the ventral surface of the ilium was undertaken by knives but also by choppers.

Femur

This bone shows classic chop marks both proximally and distally, but again there is evidence of dismemberment proximally with knives, which fits the evidence from the pelvis. Knife-cuts occur on the anterior part of the head and also medialy just below the head together with filleting marks on the shaft.

Tibia

This was chopped through proximally into quarters in order to dismember the joint, and one tibia was cleaved through completely in order to extract marrow. Knife-cuts on the tibia shaft show evidence of filleting.

Stifle (knee) joint

Peck describes this as one of the most mobile and accessible in the skeleton (Peck 1986). It can be chopped through without any direct impingement of tool upon bone and the proximal articulation of the tibia is heavily protected by cartilage and acts as a shock absorber, protecting the bone surface against the percussive impact of a cleaver blow. However, a low level of competence is demonstrated in that the blows were directed into areas of maximum resistance, that is the distal femoral epiphysis and proximal tibia.

Hock joint

As with the carpal and stifle joint, butchery of this joint allows us to judge the ability of the slaughterperson. It is necessary to understand that the joint needs opening up, by leverage being applied at exactly the right place; if the joint surface is not opened, a distinct osteological signature is left as horizontal knife-cuts distributed around trochanter, and distally through the trochlea and medial epicondyle (Fig. 14.20). However, there was evidence of knife-cut dismemberment proximally/posteriorly through the head, and also distally across the anterior surface of the trochlea and capitulum, and also anteriorly around the coronoid fossa.

Radius

Similarly, the radius shows these two traditions of butchery in dismemberment by vertical chop-marks through the proximal and distal articulations, and tiny knife-cuts centring on the proximal medial tuberosity (Fig. 14.21). There is some evidence of filleting using knives.

A low level of aptitude was shown by the butcher/butchers since one radius shows four chop-marks into the middle of the medial/posterior shaft (see also scapula).

An ulna demonstrates knife-cuts in the semilunar notch and across the lateral and medial surfaces, indicative of dismembering.

Fig. 14.21 Cattle radius, right, anterior-proximal view showing knife-cuts on the medial tuberosity.
the proximal margin of the metatarsal, or more frequently around the posterior or axial surface of the astragalus (Peck 1986). A skillful butcher would open the area between the navicular cuboid and proximal metatarsal and here insert the knife. This joint can indicate whether the butchery has been labour intensive as an unskilled person would leave many marks.

The Amarna bones show a tendency for chop marks to be directed proximally along the posterior surface of the calcaneum, which seems singularly inept, and, in addition, the calcaneum displays knife-cut butchery. An astragalus shows a knife-cut distally/posteriorly. A tarsal 2+3 has knife-cuts on the medial surface as does the anterior and medial surfaces of a navicular cuboid. However, not as many signatures are left across this joint as for the carpal one.

**FEET - metapodials and toes**

The marks on the metapodials are mainly those of knife-cuts, except where an axe has been used in creating heavy chop-marks down the anterior surface of a metacarpal shaft, and two chop marks into a distal anterior metacarpal just above the articulation.

There are knife-cuts of dismemberment at the lateral and medial distal articulations, but there are also marks above the articulation both for the metacarpal and metatarsal, posteriorly and anteriorly. There is no meat on these bones, and the short horizontal marks are the result of cutting through tendon insertions (Binford 1981).

A second phalanx has knife-cuts on the proximal posterior surface and also across the distal posterior articulation for dismemberment. A third phalanx exhibits knife-cuts consistent with the removal of keratin.

**TAIL - caudal vertebrae**

Two caudal vertebrae display transverse knife-cuts that indicate the tail was severed.

**A COMPARISON OF THE MAIN DOMESTICATE BUTCHERY**

Clearly there is a distinct difference in the butchery of the pig and goat in comparison to that of the cow; butchery of the former employed a fine knife-cut tradition while the latter was mainly dismembered with heavier implements, axes or cleavers.

A distinct patterning of butchery marks was observed for the smaller domesticates, particularly with respect to the dismemberment of the shoulder and elbow joints; the marks occurred in specific places on the bone and, while it might be argued that the anatomy of the animal would dictate this, knife-cuts inserted into the much more accessible shoulder joint were carefully placed and could signify the handiwork of just a few or maybe one individual. Axes or cleavers were very occasionally used in butchery, particularly where knives would have been useless, for example, splitting the mandible in half at the mandibular symphysis.

This method of butchery via knives is undoubtedly labour intensive, but allows a more inexperienced butcher to extract meat in a much more controlled fashion, and is perhaps partly why little use was made of the much more efficient choppers. This in turn suggests that the main occupation of the villagers was not the raising of animals, which has always been questionable considering the arid environment, but that of tomb building. One might judge the butchery to be somewhat heavy-handed since the bones are quite strongly marked, but a workman is only as good as his tools, and it could be, that as butchery proceeded, knives were becoming somewhat blunt.

Pigs and goats were raised primarily for meat at the WV, and it is a reasonable assumption that the villagers were compelled to butcher accurately in order to avoid commercial losses through leaving meat attached to the surfaces of filleted bones. This latter comment is related to Hecker’s finding that there is a predominance of forelimbs as opposed to hindlimbs of sheep/goat and pig at the WV; he has suggested that the hindlimb sections were being exported from the village down to the Main City.

My examination of the Main City animal bone during 1989 supports this hypothesis with respect to the goats but not the pig (Luff in progress). Although the Main City bone is a much smaller, less well preserved sample than that from the WV, the butchery of cattle, goat and pig shows remarkable similarity, in that goat and pig are butchered with knives, and cattle demonstrate the two traditions, that of knives and choppers.

The cattle butchery at the WV is extremely inefficient compared with that for pig and goat, where every part of the animal was carefully extracted. Overall the cattle butchery shows a low level of aptitude, in many cases chopping was directly through the shaft, the point of greatest resistance as distinct from the joint itself, which is the point of least resistance. The latter approach indicates a much more adept slaughterer in that this would have been a less energy-intensive operation. Furthermore, some bones show repeated chops indicating a low level of awareness of the anatomy of the cattle carcass on the part of the butcher. It is possible that some of the cattle were very stiff when butchered hence rendering butchery difficult, particularly with respect to the femoral/tibia joint.

There are some cattle bones demonstrating more proficient dismemberment and filleting, via knives along the same lines as the pig and goat butchery, and this is curious considering most of the butchery was so clumsy. However, this can be explained by the knife-cut beasts being the villagers’ own animals and those cut up with choppers being beasts imported in from the Main City. Hecker has already suggested that cattle limbs were imported into the WV from the Main City and based this suggestion on the restricted age range of the beasts (most
would have been consumed, but a large proportion of it was kept for later consumption. The evidence from the butchery would lend great support to these notions.

Mark Maltby’s model of Romano-British cattle processing in Hampshire, England is of interest to our investigation of animal supply to and from the WV. Maltby has found that urban butchery tactics were quite different from rural ones, in that a knife-cut tradition existed more in the countryside while that using heavy choppers and cleavers was dominant in the towns (Maltby 1989, 91). He related this to the need for faster methods of processing meat for distribution to a growing urban populace. Obviously the style of butchery could become somewhat haphazard if carried out speedily and in less time; further, if the butcher was some lowly employee and did not own his/her own herds, he/she might feel less constrained to perform a perfect job. The butchery of the WV pigs and goats, although labour intensive, was carefully done but that of the cattle was botched. I suggest that the villagers did not carry out the main butchery of the cattle and that it was more likely the work of Temple employees in the Main City.

One of the most important objectives of modern western European butchery practice is the separation, as precisely as possible, of those parts of the animal carcass that can be sold for high prices from those parts that command low prices (Grant 1987, 55). Although a monetary economy was not in existence in dynastic Egypt, there was an efficient system of exchange in most commodities.

Depictions of roasting beef in Ancient Egyptian art are rare but there are many scenes of cooks roasting fowl (Darby et al 1977, 152). The most commonly depicted cooking method is that of boiling. The evidence from Amarna revealed scent burnt bone which suggests that where cooked, meat may have been boiled rather than roasted over an open fire.

With goats and pigs, practically every piece of the animal appears to have been carefully used. However, the carcass was not exploited to the full since many of the limb bones are preserved intact and fragmentation is low, showing that marrow was not extensively exploited.

The kill-off profiles for both pig and goat indicate that there must have been specific times of the year when these animals were slaughtered and butchered. Some meat would have been consumed, but a large proportion of it would have been stored for later consumption. The literary and pictorial records are not of much help here, but the butchery evidence of primarily the pigs, but also the goats and cattle show that most animals were butchered when stiff.

It is likely that joints of beef and goat meat were preserved by being hung up to dry, surface drying retards bacterial growth thereby slowing the process of putrefaction; if meat was left lying on a surface, the part in contact with the surface would rapidly decompose and perhaps sour (Rixson 1989). Rixson has suggested that the easiest way to dispense the meat, would be to cut the flesh as required, from the hanging carcass; this method would improve the keeping qualities of meat, because if meat is kept intact, in large pieces, the rate of bacterial decomposition is slowed down.

However, pork is much fattier, having a layer of subcutaneous fat which prevents evaporation of water from the muscle surface. Furthermore, the rate of oxidation (spoilage) of intra-muscular fat tends to be higher in non-ruminants than ruminants (pork in comparison to beef and mutton) (Lawrie 1979, 214–215). Smoking inhibits fat oxidation and also microbial activity (Lawrie 1979, 264) and therefore it is possible that pork was preserved by this method.

Pork may also have been preserved by curing, either dry (salting) or wet (brining) curing, although there is no direct evidence that this was practised. The part of the pig’s carcass that is most difficult to cure is the top of the hind limb which carries the most meat. Prolonged curing was frequently required, sometimes up to 80 days (Lawrie 1979, 264). This could be significant in relation to the WV, since these parts are missing from the Amarna assemblages and perhaps curing tanks lie waiting to be excavated!

Great surprise was generated initially concerning the number of Phaeronic sites that yielded pig remains. Perhaps the importance of the pig lay not just in its fecundity and culinary versatility but also in its production of fat/grease. For any technologically evolving society some form of oil/grease would have been important, for example the maintenance of wheeled vehicles, oiling axles etc. A major, widespread and rich source of oil would have been the castor plant which is indigenous to Egypt and seeds of which were found in the potters workshops in the Main City in 1987 (Delwen Samuel pers comm). Notwithstanding, the pig would have been invaluable for people with few cows and oil-bearing vegetables.

CONCLUSION

An analysis of the butchered animal remains from the WV has shown that the villagers butchered their own herds of pigs and goats in a careful but labour-intensive way. Knives were primarily used, although some form of chopper was occasionally resorted to, and, in addition to pork and kid, other products were utilised, including pig and goat skin, the brains, tongue and cheek meat of pig and goat horn. While some meat would have been consumed fresh, there is evidence that joints of pork and kid were preserved, possibly by drying or smoking or salting or a combinations of these techniques. It is probable that meat was traded from the village, most likely...
into the city, as evidenced by the lack of pig and goat hind limbs.

Although the villagers probably kept some cows, most of the beef was imported from the city (in exchange for cured hams?); the dominant form of butchery was accomplished with an axe/cleaver and indicates a very low level of competence, suggestive of a mass butchery operation, most likely carried out by temple butchers in the city. Butchery via knives is thought to have been undertaken by the villagers, since the style mimics that performed on the pig and goat carcasses. The level of competence is not high but this could be a result of lack of practice.

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