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Ancient Egyptian Cereal Processing: Beyond the Artistic Record

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The main source of data for the study of daily life in ancient Egypt has customarily been a rich collection of artistic depictions from tombs. Throughout Dynastic Egyptian history, and beyond into Graeco-Roman times, tomb decoration was an integral part of funerary custom for the wealthier members of society. During Old to Middle Kingdom times (*c.* 2575–1640 BC), scenes from daily life were common, but thereafter most tomb art focused on religious themes. There are a few examples from the New Kingdom (*c.* 1550–1070 BC) which show some aspects of daily life.

The artistic record is a useful source of data, providing a window onto an ancient world as the people of the time saw it. However, this evidence presents a number of problems which have rarely been critically addressed. Firstly, is it valid to extrapolate what may be the practice of one segment of the population, to technology used by the whole of society? These scenes are only found in the tombs of those able to afford embellishment. Are the processes depicted here those used daily by the majority of the population, the villagers and urban artisans who could not afford artistic decorations for their burial places? Is it possible that the food preparation scenes, for example, show what occured on ritual occasions, or represent an idealized view, available only to the élite? The representations do provide some insight for at least a part of an ancient population. This alone is unusual and valuable; but it is important to establish just how widely applicable they are.

Another problem is more critical, and is directly linked to human perception. How well can we today understand the scenes we see on the walls of tombs, or depicted in models? How much are we interpreting what we see according to our own contemporary experience of what we consider to be similar activities, thereby perhaps imposing onto ancient scenes something that is not there? How can we know what was the artist's own intention and perception, without experiencing the actual, living actions which are being portrayed? Viewed in this way, the artistic depictions can be seen as a barrier, because modern viewers inevitably impose their own experience onto what they observe.

The study of food preparation in ancient Egypt

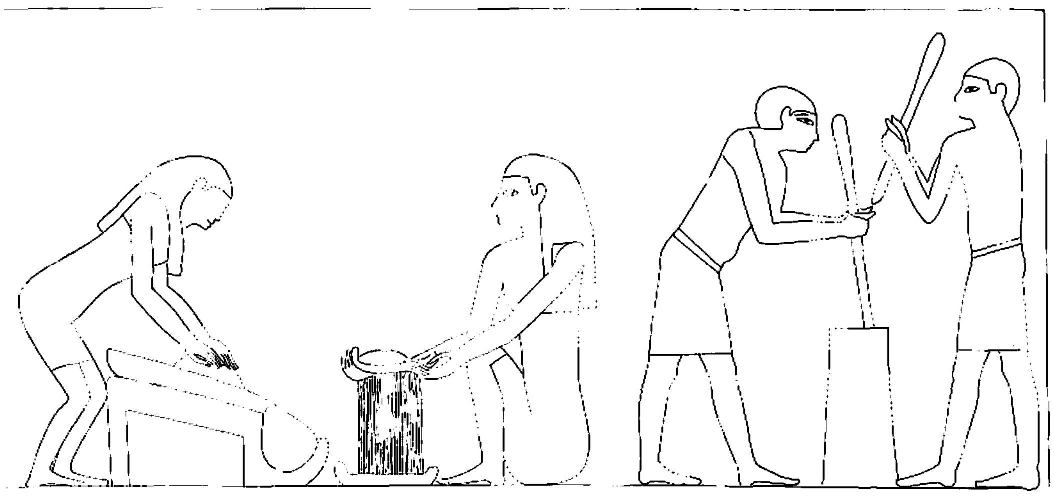

Figure 1. *Cereal preparation as portrayed in the 12th Dynasty (Middle Kingdom) tomb of Antefoker at Thebes (# 60). (From Kemp 1989, 123.) The two figures on the right are pounding with pestles in a mortar, the figure on the left is milling on a saddle quern set into an emplacement, the central figure is sieving. There are a number of questions which the representation does not answer: What is being pounded in the mortar? Where in the sequence does the siever belong? Is she working with material produced by the pounders, the miller, or some other stage not portrayed? What is the texture of the milled product?*

is one of the many subjects which has been approached almost exclusively through contemporary artistic representation (see e.g. Fig. 1). There has been little attempt to go further, for there seems to be an implicit assumption that the tomb scenes and models show all one needs to know. For example, very little reference has been made to archaeological data. Indeed, many publications on Egyptian settlement archaeology refer back to artistic data to validate interpretations made of it. Flour production from stored cereals is examined below as one example of the difficulties of the traditional approach. An alternative is proposed which develops a model for past daily activity.

There are many discussions of cereal processing in the Egyptological literature. Two examples are presented here. They are both based on artistic evidence. The first is Vandier's (1964, 272–3) description[1]:

> Grain was first removed from the granary. It was then cleaned of various impurities using a circular coarse sieve [riddle]. After this, the grain had to be reduced to flour. This began by crushing the grain with a long pestle. The grain broken in the mortar was then passed into a winnowing tray. The interior, which could be used for flour, was thus cleaned of the husk, which served as animal food. It goes without saying that the product thus produced had nothing in common with what we call flour. A final operation was then necessary. The crushed grain, cleaned of husk, was spread on a stone trough and a servant crushed it with the help of a large stone. This work, surely punishing, was often assigned to the women, who knelt, bent over double, and rocked alternately back and forth, above the trough, leaning very hard on the grinder. The product thus obtained was not homogeneous: it was a mixture of coarse and finer flour. This mixture was sieved and the coarse meal ground on the mill more than once if necessary, to obtain, finally, a relatively pure product.

More recently, Strouhal (1992, 125) has described the preparation of flour:

> Reliefs and models demonstrate the initial crushing of the grain, usually by men, with stone pestles on flat limestone mortars. The coarse product was then ground again, this time by kneeling women, with a spherical or ovoid roller over a low stone saddle quern with a central depression. In later periods this quern was tilted in a wooden frame with the women leaning over it. For finer grinding tall cylindrical or conical mortars were used, round which both men and women are shown standing with long pestles in their hands . . . (Flour) was sometimes passed through papyrus or net sieves . . . The flour was never fully milled or sieved, so that uncrushed germs and even whole grains remained in the bread, averaging about five per cubic centimetre.

Here we have two accounts, based on the same pool of artistic evidence, describing actions using mortar and pestle, and quern. The functions suggested for the mortar and pestle are not the same, the overall sequence of actions does not correspond, and the suggested texture of the end product is completely different. Other descriptions of cereal processing vary to a greater or lesser degree from these two examples.

Figure 2. *Ears of emmer wheat, grown to full size but still unripe and green.*

The artistic record, superficially easy to understand, is not so clear after all. When other interpretations of cereal processing are examined, there is a lack of consensus on nearly every detail. The information which seems to be conveyed by the depictions in fact depends on the individual who looks at it. These very discrepancies suggest that the traditional primacy of artistic evidence is misguided.

It seems best to put aside the artistic record for the time being. An independent body of data is needed to build a model of ancient Egyptian daily life. It should take into account all available evidence, bringing data together into a coherent framework, which in turn should confer upon it strong explanatory power. The concept of a new approach as development of a model acknowledges the likelihood of error. As with any scientific analysis, new facts will confirm, refine, or substantially change the model. The artistic record can be compared and reassessed, or used for different research questions, as is suggested at the conclusion of this article.

One obvious source of data for the study of daily life is settlement archaeology. Excavations at two villages dating to the New Kingdom have uncovered various different tools connected with cereal processing. The villages are that of Deir el-Medina at Luxor in Upper Egypt and the Workmen's Village, which lies to the east of the city of Amarna in Middle Egypt. The exceptionally dry climate of these desert sites has preserved several objects made of organic material which may be connected with cereal processing, such as palm leaf sieves and wooden pestles. More abundant are the stone tools, the limestone mortars and the granite or quartzitic sandstone saddle querns, with which cereals were processed. Emplacements for quern stones are also common, especially at the Amarna village.

By themselves, however, these tools do not indicate more than can be deduced from a general knowledge of their purpose: mortars were used for pounding, and querns for grinding. Little advance has been made in determining their specific role in the ancient Egyptian processing sequence. This is because a key element is missing: the nature of the commodity which was processed.

It has long been known that the cereals of ancient Egypt were barley and emmer wheat. This has been established through archaeobotanical finds, of both offerings in tombs, and debris of settlement sites. A number of different barley species were grown. These were mainly two-row (*Hordeum distichum* L. emend. Lam.), and six-row (*H. vulgare* L. emend. Lam.), both of which are hulled, that is, the chaff is fused to the grain. Isolated finds of naked barley (exact species not mentioned) have been made in contexts earlier than the New Kingdom (Täckholm *et al.* 1941, 288–92). The only wheat species grown on a large scale was emmer (*Triticum dicoccum* Schübl.). It is a glume wheat which means that, when threshed, the ear is broken up into spikelets (see Charles 1984). In contrast, the grain of naked wheats, such as bread wheat (*T. aestivum* L. — one of the staple cereals of the modern Western diet) falls clean of the chaff upon threshing. Glume wheat spikelets are composed of grain still closely invested by the tough chaff, and these can only be broken up by further vigourous processing. Hulled barleys also need the same type of treatment to remove the fused chaff from the grain.

There is good evidence to show that ancient Egyptian cereals were stored in granaries not as cleaned grain, but as emmer spikelets or hulled barley grain, and that they were subsequently processed as needed. Containers of cereal placed in tombs hold emmer spikelets or hulled barley, not clean grain. Model granaries, also from tombs, have been filled with barley retaining its hull, and emmer in spikelet form. Evidence that emmer spikelets, not grain, were processed after storage comes directly from a cereal processing context. Plant remains were recovered around a mortar excavated recently from the Amarna Workmen's Village. Analysis has shown (Samuel 1989, 279–86) that the assemblage is made up almost entirely of emmer chaff, broken up into all possible

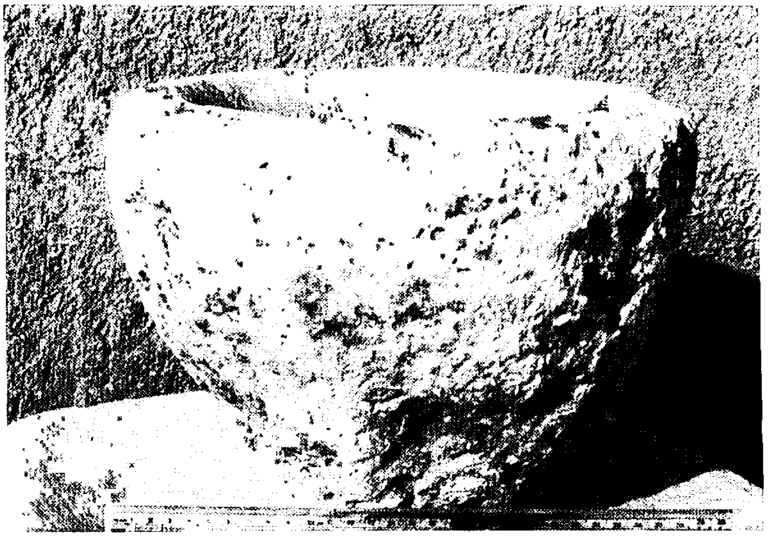

Figure 3. *An ancient Egyptian limestone mortar recovered from house 9 in Gate Street of the Workmen's Village, Amarna (Kemp 1987, 32), and used in the experimental reconstruction of cereal processing.*

fragment sizes. This find brings us much closer to the specific function of mortars in the cereal processing sequence, for it demonstrates that this particular mortar was used for the processing of emmer in spikelet form, not as cleaned grain.

The tough chaff of emmer, and chaff adherence to the grain for hulled barleys, are biological facts which have frequently been overlooked in the literature on ancient Egyptian cereal processing. Therefore, the need to apply processing methods beyond what is necessary for naked wheats has rarely been appreciated. This may also help to explain conflicting modern interpretations of the artistic record. Most present-day experience is not relevant to ancient Egyptian cereal processing. Until recently, no appropriate analogue was available.

Ethnographic studies of traditional glume wheat and hulled barley processing, in countries where both cereals are still used for human food, have proved to be essential to understand ancient Egyptian cereal processing. An ethnographic approach is valid because, as Hillman (1984a, 8) has pointed out, there are very few non-mechanized ways of processing a given crop species. One clear example he provides is the dehusking of hulled barley: nearly all traditional communities throughout Europe and Asia which have been studied use some form of pestle and mortar. The sequence of processing and the type of actions required are controlled by the biological structure of the crop in question. For each specific step, there are a number of possible tools which might be applied, but the overall effect of each slightly varying method for a given crop is the same. Because of the limited range of options, it is possible to extrapolate from ethnographic observations, to predict ancient equivalents.

Working in Turkey, Hillman (1984b) has established in great detail the sequence of traditional emmer processing, from preparation of fields for sowing, to production of various types of emmer foods. This sequence is closely allied to that for dealing with hulled barley but, for convenience, emmer will be referred to throughout. The ethnographic observations gathered by Hillman are briefly summarized here, beginning with the spikelets, since the ancient Egyptian post-storage sequence starts at this stage. The spikelets are pounded in a pestle and mortar, breaking up the tough chaff and freeing the grain. The mixture of shredded chaff and whole grain produced by this operation is winnowed, to remove the light chaff, and sieved, to separate out the heavy chaff. Winnowing and sieving are repeated several times. The chaff by-product can be used for a number of purposes including animal feed, fuel, and pottery temper. The clean grain thus obtained may be picked through by hand

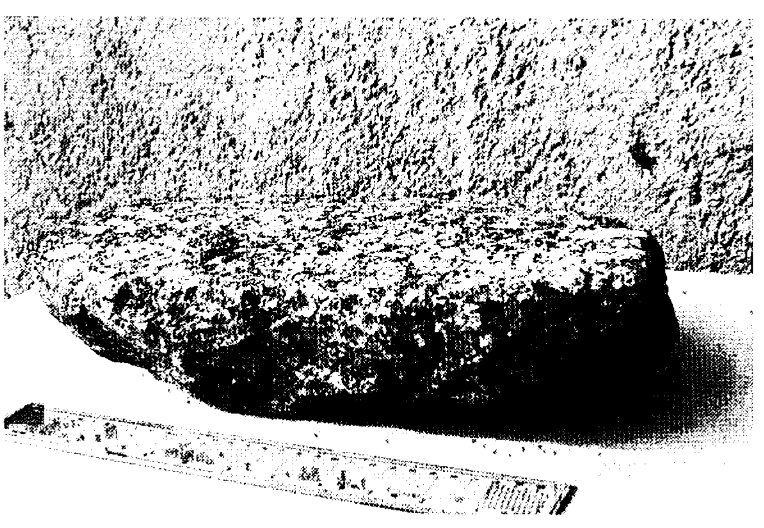

Figure 4. *An ancient Egyptian saddle quern made from a fairly coarse black, pink, and white granite. This was a surface find from the Main City of Amarna and was used for experiments in cereal processing.*

Figure 5. *The pounding stage of experimental cereal processing. The limestone mortar is that shown in Figure 2, and is emplaced as archaeological data shows it had been when originally used. The wooden pestle is a replica, based on an ancient pestle excavated from house 6, Main Street, of the Workmen's Village at Amarna, by Peet & Woolley (1923, 77).*

to remove the last remaining chaff, weed seed, or stone contaminants.

Turning to grinding, ethnographic study of milling with the saddle quern is now possible in the Old World only in sub-Saharan Africa. Recently, Schön & Holter (1990) published an account of milling on saddle querns by the nomadic Mahria of eastern Sudan. These people grind millet on querns which in use are supported so that the upper end, behind which the miller kneels, is raised off the ground about 19 cm, while the lower end is raised about 8 cm. This creates a marked slope on which to grind. Four and a half litres of whole millet are milled in about an hour and a quarter. The length of time may not be applicable to emmer grinding, since millet is a much smaller grain and therefore may be more quickly rendered into meal.

Ethnography and archaeology can be linked through experimentation to create models of ancient processes. As with any other method of examining the past, preconception can be a hazard of experimental work. To minimize this pitfall, and to ensure that reconstructions are well-grounded, experiments need to reflect as closely as possible the conditions of the past. In particular, the raw materials which are used must be authentic. This principle should be applied to all experimental exploration. It is the nature of the raw materials, be they cereal spikelets or metal ores, which will to a large extent dictate the processes which are needed to achieve a given result. Properly designed, experimental archaeology tests hypotheses generated through study of the ethnographic and archaeological record, and can offer direct insights into the subject of study. It can fill the gaps in knowledge about processes and actions, the vital non-material links which are lost when knowledge and experience, in the form of culture, die out.

This approach has been applied to the experimental processing of emmer from spikelets to flour. Ancient limestone mortars (Fig. 3) retrieved from recent excavations at the Amarna Workmen's Village (Kemp 1987, 6, 10, 32) are robust enough to be used for experimental work, as are many of the stone saddle querns which have been retrieved across the site of Amarna (Fig. 4). Recent archaeological work at the same site has uncovered two quern emplacements (Kemp 1986, 3; 1987, 5). Although damaged, enough has survived on which to base the construction of a replica made from the same materials, mud brick and mud plaster. A wooden pestle was replicated, based on an earlier find, but other perishable tools, the sieves and winnowing baskets, had to be improvised. The emmer spikelets were handled with all these tools according to Hillman's Turkish ethnographic sequence (Hillman 1984a,b).

Replicating the cereal processing sequence has firmly established that emmer is best processed if the grain is not crushed when pounded in a mortar and pestle. Instead, by slightly dampening the emmer spikelets, the pounding process (Fig. 5) strips away the chaff, freeing the enclosed grain, which remains largely intact. It produces a mixture of light shredded chaff, large heavy pieces of chaff, whole free grain, some large broken pieces of grain, and some unaffected whole spikelets. The proportion of whole spikelets (Fig. 6) in any given batch is probably dependent on the operator's strength and skill. The less

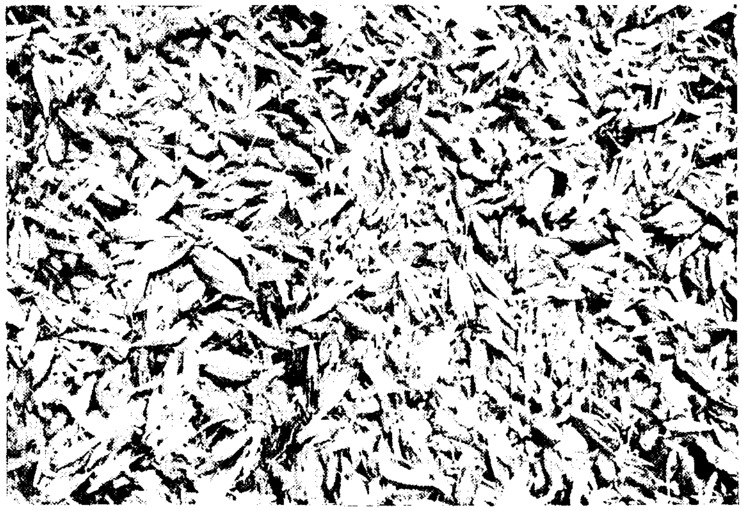

Figure 6. *Emmer spikelets pounded in an ancient Egyptian mortar with replica wooden pestle, as illustrated in Figure 5. Note the whole freed grain, the range of chaff sizes, and the presence of unbroken whole spikelets.*

damaged the grain is by pounding, the easier it is to clean in subsequent steps.

The mixture of loose chaff and free grain must then be separated. Ethnographic evidence shows that this can be done by a combination of winnowing and sieving. Close replicas of ancient Egyptian winnowing baskets and sieves could not be obtained for experimentation, but using reasonable substitutes it has been possible to establish that a winnowing basket is ideal for removing light chaff, and sieving rapidly separates out grain from large fragments of heavy chaff. These steps must be repeated several times to achieve clean grain, making this separation labour intensive. Even with tools specifically designed for the task, this was probably a time-consuming stage.

When the grain has been thoroughly cleaned of chaff, it is ready to be milled. Grinding with the quern on the ground has not been tested and may be arduous, but grinding at an emplacement of ancient Egyptian type is very easy and relatively comfortable. The idea that the saddle quern is a crude implement, on which grain meal must be recycled at least once if not several times to produce fine flour, has been refuted through experiment. The texture of flour can be controlled by the miller without difficulty. I have produced both coarse meal and very fine flour on the same quernstone with the same ancient handstone. The only difference in production was the amount of grinding to which each was exposed. Fine flour can be produced in one operation, taking only slightly longer to mill.

A detailed model for ancient Egyptian flour production has thus been evolved. The key factor in its development is the biological structure of the cereals which were used, and the fact that this structure dictates the traditional processing sequence. Ethnographic studies on the traditional handling of these cereals have informed the interpretation of archaeological finds, and experimentation has tested the use of these tools. The model defines the specific function of tools related to cereal processing, and lays out the sequence of steps required to dehusk emmer spikelets and hulled barley.

It also provides a number of insights which open up new possibilities for further research. The relative difficulty, and the time needed to undertake each step relative to the others, can be established in broad terms at least. The logistics of the whole process begin to emerge. These findings in turn can be related back to the archaeological record, so that the layout and position of cereal processing equipment can be studied with regard to use of space and patterns of activity. Through archaeological excavation, the patterns of processing can be compared for different levels of society, and at different periods.

The coherent model established by this multidisciplinary approach, compared to the various conflicting descriptions of the artistic record, can be contrasted through one example. Most reconstructions of flour production based on artistic depictions propose that flour milled on the saddle quern was then sieved. Experimental reconstruction of the process indicates this was rarely if ever done.

Why have conventional descriptions of ancient Egyptian flour production assumed that flour was sieved? Modern practice may have influenced this perception. In modern and recent traditional milling, sieving is an integral part of flour production. In the most modern mechanized break and reduction roll mills, sieving removes the larger chunks of grain, sending them back for further milling (Barnes 1989, 395–6). Sieving also removes the bran, to produce white flour (David 1977, 30–1). This sieving and recycling process has always been a feature of mechanized milling. Flour is also often sieved at a much later stage, during food preparation. If it is sieved before being mixed with a liquid, the flour is more easily incorporated without going lumpy, and gives a lighter texture to the dough or batter.

Experimental work has established that there is no reason to sieve flour milled on an emplaced saddle quern. The particle size can be controlled by adjusting the grinding technique. Furthermore, the arrangement of the emplacement, with the quern raised from the ground, means that the fall into a container below renders the flour light and fluffy, more so than could be achieved by sieving. The conclusion that flour was rarely if ever sieved is confirmed by examining the end product in which it was the main ingredient. No ancient flour is available for examination, but loaves of bread have been preserved through desiccation in tombs. These loaves vary considerably in texture. As Strouhal (1992, 125) has pointed out (see above) whole grains are often found in ancient bread. Many loaves are made from coarse fragments which include whole grains, such as those from the Deir el-Medina tombs now at the Louvre (E16410, for example). Other loaves are fine textured, of relatively even particle size, such as a loaf which also appears to have had fruit added, now at the British Museum (#5346). Loaves very often contain some fragments of husk, from shreds of light chaff to thick and robust pieces. If flour had been sieved, even through a relatively coarse mesh, these larger inclusions would have been removed. It is the establishment of details like the place of sieving in the cereal processing sequence, which creates a more accurate basis on which to look at such questions as the use of space in ancient settlements.

Given that a model for cereal processing and flour production can be developed without reference to the artistic record, do tomb depictions have a role in the study of ancient Egyptian life? I suggest that they are a rich source of information, not as a sketchy and confusing 'manual' of ancient techniques, but as one approach to the study of ancient cognition. Provided with an integrated model which can be used to analyze and predict, it is possible to investigate how the ancient Egyptians chose to portray the same processes. The actions which they considered to be important, and the way in which these actions were represented can be defined. The package of images which conveyed to the contemporary viewer a more complex process can be analyzed. Working with both artistic representations and archaeology, the relationship between the ancient perception of a process, and the execution of that activity throughout all levels of society, can be established. The artistic record thus has considerable potential for insight into the workings of the ancient Egyptian mind.

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Note

1. This draws in large part on studies of the artistic record made by Montet (1925, 230–56), who himself concentrated on evidence from the tomb of Ti (Saqqara, 5th Dynasty, *c.* 2465–2323 BC); by Klebs (1915, 90–4; 1922, 119–21; 1934, 171–7); and by Breasted (1948).

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