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POTTERY PRODUCTION IN EGYPT:
THE *CHAÎNE OPÉRATOIRE*
AS A HEURISTIC TOOL

Abstract: The main steps in the production of pottery are well known and are often similar across much of the world. However, the loci of production where such steps took place, namely the workshops/workspaces, have traditionally attracted less attention from Egyptologists than have the major religious and funerary monuments. In the past three decades or so, however, there has been an increased emphasis on settlement archaeology and ‘daily life’ and this shift has increased the importance of understanding production loci.

This paper attempts to use the concept of the chaîne opératoire in association with spatial information in the way which Monteix (2016) has done in his study of Pompeian bakeries in an attempt to better understand the layout of workshops and to identify potential gaps in the archaeological record.

Keywords: Egypt; Pottery; chaîne opératoire; technology; archaeological theory

Introduction

Whilst the main steps in the production of pottery are well known and are broadly similar the world over (see for example Hodges 1964/1981, 19-41; Rice 1987) the loci of production where such steps took place, namely the workshops, have until recently attracted less attention from Egyptologists than have the major religious and funerary monuments. Whilst such a situation is entirely understandable – pottery workshops were unlikely

to attract the attention of early scholars and were unlikely to illuminate the developing chronology of the country – the increasing emphasis of the last thirty or so years on settlement archaeology and ‘daily life’ has increased their importance.

In order to be able to understand the layout of workshops more fully and to identify potential gaps in the archaeological record, and therefore in our knowledge, it may be worthwhile to consider using a *chaîne opératoire* approach and relate it directly to the workshops themselves.

The *Chaîne Opératoire*

The concept of the *chaîne opératoire* (‘operational sequence’) comes from the work of André Leroi-Gourhan (1911-1986) (1943, 1945, 1964, 1965, 1993) himself a student of Marcel Mauss (1872-1950) and is founded in the latter’s concept of techniques as “‘traditional efficient acts’ a way of being and doing” (Schlanger 2005, 27, for a recent review see Monteix forthcoming).

The adoption of the Mauss’s ideas by Anglophone archaeologists probably owed much to the fact that a concept of stages of production had been both implicitly and explicitly used by them for some years. Gordon Childe (1892-1957) in his *Man Makes Himself* (1956) had taken the view that in explaining settlement and activity one needed to look for the necessities of life – water source, productive land etc., taking a staged approach and this idea of steps and stages finds its way implicitly into Singer *et al.*’s *A History of Technology* (1954).

Though used in archaeology, *chaîne opératoire* has not been widely used by Egyptologists, although Shaw (2012, 64) has recently introduced the concept to a general Egyptological audience and Bloxam (2015) has used it in the examination of Egyptian quarrying.

One of the shortcomings of the *chaîne opératoire* concept as it has frequently been used is that it has often done little more than list the steps in a production sequence. Whilst this is a valuable observation to make those steps are often well known, as for example in pottery production, and the concept is capable of greater utility as Monteix (2016) has demonstrated.

The *chaîne opératoire* as a tool for understanding production space

The *chaîne opératoire* when more fully applied looks beyond simple steps in production and at how the techniques involved in the *chaîne*

functioned and were structured (Schlanger 2005, 27). Such structuring of tasks may be reflected archaeologically by their physical location on the ground. This has been elegantly demonstrated by Monteix (2016) in his case study of Pompeian bakeries.¹ A similar approach has been taken by Keller and Keller (1996) in looking at blacksmithing and, although they do not use the term *chaîne* the ideas of process and space are closely linked. The difficulty in applying the concept in ceramic studies, not least in Egypt, has in part been the lack of excavated pottery workshops to which it might be applied as well as a relative lack of ethnoarchaeological studies of pottery production in Egypt. The writer has been fortunate enough to be involved in the excavation of several pottery production sites in Egypt as well as having conducted ethnoarchaeological work and this paper attempts to draw on some of these results.

Monteix has clearly demonstrated that by identifying the individual steps in a production chain these can be mapped onto the excavated surface and a pattern of movement/circulation around the working space be suggested from them. The pattern so derived may draw attention to gaps in the *chaîne* which call for explanation or identify apparent bottlenecks or unexpected changes of direction within the operational flow. In the view of the writer this approach has much to offer to the study of crafts and industries in Egypt and the current paper is an attempt to demonstrate its applicability there. In order to do this it is first necessary to identify the steps, or links, in the *chaîne opératoire* for pottery production.

Pottery Production in Egypt

The basic steps in the production of pottery in Egypt are the same as those across the world and so will only be briefly summarised here. At their most basic they involve the procurement of a plastic material, in the form of clay, and its transformation into an aplastic material through the use of heat. These can be seen as what Lemmonier (1992, 21-24) has described as ‘strategic tasks’, conveniently summarised by Schlanger (2005, 27) as ‘fixed operations which cannot be tampered with or cancelled without undermining the whole project’. These are in contrast to ‘technical variants’ which have an effect on the task but which are a matter of technical

¹ The writer was privileged to hear Monteix’s paper at the recent conference *Craft Production Systems in a Cross-Cultural Perspective* held in Bonn and is grateful to him for a copy of his paper on the bakeries of Pompeii as well as a draft of his forthcoming paper.

and cultural choice. In the case of pottery production these might include the decision on whether or not to add aplastic material ('temper' or 'filler') to the clay in order to modify its working properties (for discussion see Rye 1976; Rice 1987, 406-413).

The links in the pottery *chaîne* may be summarised as follows:

1. *Raw material procurement.* Clay may be obtained from a variety of different sources (Nordström and Bourriau 1993, 160-161). In Egypt the commonest of these is from the banks of the Nile. This iron-rich, and consequently red-firing² clay, accounts for perhaps some 90% of all ancient Egyptian ceramics and is generally referred to by Egyptologists as 'Nile Silt Ware' (Arnold and Bourriau 1993, 160-161). This is in contrast to the much more localised and white-firing³ 'marl clay' (Arnold 1981) which has tended to be used for a more limited range of wares (Nicholson and Patterson 1985; Nicholson and Patterson 1989).

'Temper' or 'filler' material may also need to be transported to the workshop. However, in the case of many Egyptian workshops where sand is used in this role it can be obtained very close to the site. Dung temper may also be used and is, again, readily obtained from the numbers of animals used in agriculture and transport in both ancient and modern times.

2. *Raw material transport.* Where clay is not located at the site of the workshop it must be brought there by some means. This frequently employs human, animal or water transport or some combination of these. Since the material is heavy as well as bulky the quantities transported can sometimes be a reflection of the scale of the workshop since those producing very large quantities of ware and doing so for all or most of the year are likely to require large quantities of clay in order to sustain their production. The situation for those making pottery only for their own domestic use is very different. The transport of tempering materials can be achieved in the same way.

3. *Paste preparation.* This may be a simple matter of the addition of water followed by the kneading of the clay in order to homogenise it and

² Iron rich clays will fire red in an oxidising kiln atmosphere, black where oxygen is lacking, so-called reduction firing.

³ The white surface is from the efflorescence of a calcareous surface 'bloom' as the clay dries. In broken section the clay is frequently pink in colour.

to drive out trapped air. However, in the Egyptian situation there may be two contrasting operations, facets of Lemmonier's (1992) 'technical choice'. These are (a) the removal of aplastic materials or (b) the addition of aplastic materials. The two may sometimes be combined. In (a) it may be necessary to remove small stones, shells, pieces of calcite or gypsum from a clay along with any vegetal material which has become incorporated, perhaps as a result of its having been excavated from a vegetated river bank. In (b) sand, crushed stone, dung or chaff might be added to the clay in order to make it more porous and therefore more suitable as a porous container (Nicholson 1995a; 2002) or to help it to withstand thermal shock (Cardew 1952; Woods 1986).

4. *Shaping*. There are numerous ways in which the shaping of the prepared paste can be achieved (Hodges 1964/1981) though these can be divided into two broad classes, namely (a) hand making and (b) wheel-making. In (a) the clay is shaped without the aid of a mechanical device. This may be achieved by pinching the clay, forming it into rings or coils, cutting it into slabs or drawing it up with tools, most notably a 'paddle and anvil'. In (b) a wheel is employed to develop rotary motion (cf. Childe 1954). Such a wheel may be powered by kicking a flywheel or by spinning by hand or with a stick. Hand-making is employed by some Egyptian potters working in the modern era (Blackman 1927) while wheel throwing was the method adopted throughout most of the Pharaonic era (Doherty 2015) as well as being practiced today. Incised or applied decoration might be added to the pot at the end of this shaping stage of the process as a technical variation.

5. *Drying*. In this stage the completed (or sometimes partially completed) pot is set to dry. This may take place indoors or outdoors according to the stage of completeness of the vessel (Nicholson and Patterson 1985) and may be a process of one, two or more stages. The drying process is essential so that as much moisture as possible escapes from the clay fabric before it is subject to the intense heat of firing, which would otherwise generate a considerable body of steam whose failure to escape properly would cause damage to the desired product. A further stage of technical variation is possible at this point since vessels might be covered in a layer of slip, be burnished or be painted.

6. *Firing of the shaped product*. Firing, it may be argued, is the critical point in ceramic production since it renders a change of state, changing

the plastic clay to an aplastic ceramic. Any error made before this point can, at worst, be overcome by simply adding water to the part finished product and kneading it again to be re-cycled as clay. Once firing has taken place and the chemically combined water in the clay has been driven off it cannot be re-shaped by the potter (although it can be further broken up and ground down for use as a temper/filler generally referred to as ‘grog’ by archaeologists – Hodges 1964/1981, 20). The change of state from plastic to aplastic is achieved through the use of heat either in a simple open firing (sometimes erroneously referred to as ‘bonfire firing’) or in a kiln. The updraught kiln, in which the fire is located beneath the charge of vessels and separated from them by a perforated floor or chequer is almost universally used by traditional potters in contemporary Egypt as well as accounting for the firing of most pharaonic pottery.

7. *Post-firing processing.* This step is essentially a technical variation. Fired vessels may be checked by the potter for defects and where these are found an attempt can be made to remedy them. Such remedies might include the insertion of new clay, or even dough, into cracks or holes in a pot followed by the covering of the surface in a fugitive slip. Such post-firing treatments are extremely difficult to detect archaeologically, leaving little or no trace on the vessels and generally requiring no specific processing area within the production space.

The approach taken by Monteix (2016) is to attempt to map the stages of production onto the physical spaces in which they took place. However, there are potential problems in doing this in the ancient Egyptian context, not least because it is likely that the stages of at least some crafts took place outside the workshop building itself, in the courtyard or other open areas (Shaw 2004, 17) or even in the street itself. The evidence provided by ethnographic studies and by artistic representations can be helpful here but is not, of course, definitive.

Case Study 1: Contemporary Deir el-Gharbi, Upper Egypt

In order to test the use of the *chaîne opératoire*, as applied by Monteix, on an Egyptian situation, the contemporary potting settlement at Deir el-Gharbi in Upper Egypt has been chosen. This site forms part of the Ballas industry and has produced two handled, amphora-like vessels for the transport and short term storage of water since at least the Roman era in Egypt whilst use of the clay source has a much longer ancestry

(Arnold 1981). The industry was examined in two studies during the 1980s (Nicholson and Patterson 1985; Nicholson and Patterson 1989).

The steps in the *chaîne opératoire* can be identified as set out below and are summarised in plates 1 and 2.

1. *Clay procurement.* Clay is obtained from adit mines in the hills of the Western Desert at some distance from the village of Deir el-Gharbi itself. It is a marl clay and when extracted is in the form of rock-like lumps.

2. *Clay transport.* Once extracted the clay is transported from the mines to the village by donkey or camel. In the mid-1980s some potters had arranged to have larger quantities moved by tractor and trailer.

3. *Clay preparation.* Once the clay reaches the workshops it is unloaded into piles beside one of the trampling pits. It is then broken into smaller pieces using hammers and the pieces thrown into the shallow pit(s). It is then soaked in water and left to stand whilst it absorbs the water and the individual clay layers begin to delaminate. More water is added and the clay is then trampled using a water buffalo led around by one of the potter's assistants. The assistant works barefoot and during the trampling process picks out any aplastic material which he detects as a result of treading on it. The commonest such material is lumps of calcite which run as veins through the clay. If left in the mixed clay it would cause spalling of the finished vessel. No material is deliberately added to the clay at this stage but dung from the water buffalo may, inevitably, be incorporated into the mixture. It is not, however, present in significant quantities and is unlikely to be mistaken for deliberate dung temper by ceramicists.

This, however, is but the first stage of clay preparation at Deir el-Gharbi. The clay is next removed from the pit and carried into the workshop where it is dumped onto the trampling floor, located in front of the potter's wheel. This dump of clay is arranged as a low circular mound about 30cm high. The mound of clay is then trampled in a very organised and systematic manner by two assistants who tread it against the cobbled surface of the floor. As they do this they drive out air from the clay and also have the opportunity to locate any aplastic material missed during the first stage of trampling.

Once the assistant potters are satisfied that the clay is sufficiently well processed it is removed from the trampling floor and piled into a mound in a corner of the workshop.

4. *Clay shaping (stage i)*. This is carried out by the master potter who is seated at his wheel and who works alongside an assistant. The assistant first uses his extended hand and forearm to cut through the pile of clay and removes a large slab of it from the pile. This he takes to a sloping area of the workbench beside the potter's wheel and proceeds to wedge it, a process designed to drive out any remaining trapped air. As he does this he gradually rolls and revolves the mass of clay until it is transformed into a tall cone resembling an artillery shell in shape.

The potter takes the cone and centres it on the wheel head. He proceeds to open the cone into a cylinder and gradually forms the rim, neck and shoulders of his intended amphora-like vessel. He does not, however, make use of the very bottom part of the cone which is left as a solid lump. Whilst this shaping process is going on the assistant has prepared the next cone, as he finishes it so the potter finishes the shaping and hands the part-finished vessel to the assistant to take it away to the drying room attached to the workshop. This is an aspect of this industry to which attention can be drawn through study of the *chaîne opératoire* (below).

5. *Clay drying (stage i)*. The partly finished Ballas jars are stood on their unfinished bottoms in the drying room. The production of these is usually completed in the late morning and by mid-afternoon further assistants, at Ballas usually the children of the potter and his assistants, come into the drying room and add handles to the jars. The handles are pulled from lumps of clay which are brought from the clay pile in the main workroom. The process of handle making and attachment is very rapid. The jars, with their upper part now complete, are left to dry overnight.

6. *Clay shaping (stage ii)*. Next morning the partially dried jar's tops are taken from the drying room and inverted on the wheel which has a bucket-like arrangement on the wheel head. This has two slits in it into which the handles fit so that the whole acts as a kind of chuck for the throwing process. The potter re-wets the lump of clay which remains as the base of the original cone and begins to shape it into a cylinder which he gradually draws outwards before bringing it inwards to form the base. As he starts to bring it in again he slows the wheel and impresses a pre-cut length of cord around the widest point of the vessel which helps to support it as he brings in the clay to close the base. The vessel is now complete, though at two different stages of drying – the upper part approaching or at, the green-hard⁴

⁴ Also known as the leather-hard stage.

stage, the lower part soft. The potter's assistant hands the potter the next partially finished vessel and takes the completed one outside to dry.

7. *Clay drying (stage ii).* Outside the workshop, usually close to the kiln, the now completed vessels are stood on their rims (the driest and so strongest part of the vessel) in order that the drying process can be completed. As drying progresses so an effloresced surface begins to form on the vessels. After a time the assistants go around and remove all the strings from the bases as they start to dry away from the vessel. These are taken back to the workshop where they are re-used. Once the vessel bases are judged to be sufficiently dry to withstand the weight of the vessel the pots are turned right side up so that air can circulate inside them and dry them thoroughly. Efflorescence continues and it is common to see a less well effloresced patch on the base of a vessel where it has been in contact with the sand of the drying area.

8. *Firing of the shaped product.* Once sufficient vessels have been produced and dried (usually in the order of 625 at Deir el-Gharbi) they are loaded, upside down, into the kiln for firing. Loading is a very careful process and the vessels are arranged in 5 layers⁵ before the top layer is covered with broken sherds. These sherds may provide some insulation if the weather changes and becomes windy during firing but their main purpose is to form a layer on which soot can build up without affecting the charge of vessels.

Firing itself is also carefully carried out using much the same quantity of fuel irrespective of weather conditions (see Nicholson and Patterson 1989 for fuller discussion).

9. *Post-firing processing.* At Deir el-Gharbi there is generally no post-firing processing. The vessels have a now permanently fused white surface⁶ and so need no fugitive or other slip treatment. Very occasionally a broken sherd used to separate vessels during the firing may have adhered to the vessels, usually in the lowermost layer where temperatures are highest, and needs to be removed but otherwise there is no special treatment. Vessels are unloaded and then stacked ready for distribution and sale. It is at this

⁵ This applies to the standard sized vessels. If a batch of smaller ones is prepared there might be a greater number of vessels and more layers.

⁶ Though vitrification has taken place this surface is not itself glassy (i.e. vitreous) except in the case of over-firing when it is usually discoloured to a greenish hue. It is this surface to which sherds sometimes adhere in firing.

point that it becomes apparent whether any aplastic material has been missed since the calcite, dehydrated during firing, re-hydrates and expands and in doing so spalls the surface of the pot. These spalls are very easily spotted as with the white surface broken away the pink of the clay is visible along with the offending white speck of calcite.

The *chaîne opératoire* concept has sometimes been used to look the sale, use and discard of products. However, the focus of this paper is the use of the concept in the examination of workshops and so these steps are not considered here.

Case Study 1: Discussion (Pls. 1-2)

Mapping of the operational sequence described above onto the plan of a workshop at Deir el-Gharbi immediately draws attention to features of the layout which may not be immediately apparent from simply looking at the basic plan alongside a narrative of the work which takes place in the building.

Thinking of the plan from the standpoint of someone used to the Fordian mass-production layouts of the 20th and 21st Centuries (Ford 1926, but see also Batchelor 1994, 6 n. 4). there are ‘problems’ with it. The doorway into the workshop from the outdoor preparation area is narrow, as is that between the workshop and drying room. It is not possible for two adults to pass one another in such a doorway. This is helpful in drawing attention to an aspect of working practice – two adults do not need to pass one another in this opening, only one assistant uses the doorways at a time. Their narrowness does, however, limit what can be carried through them and this is potentially more problematic. Again the doorway indicates the maximum size of any product, but is still smaller than might seem ideal for a mass-production operation. The reason is probably to be found in the desire to keep the workshop cool and dark. If additional light or warmth is required the potter has his assistant remove part of the roof above his wheel. In an archaeological situation, where the roof has been lost, such a detail would be lost and it is likely that one might assume that the workshop was lacking in light.

This lack of physical evidence draws attention to an important point made by Monteix (2016, 170) ‘only production phases that can be traced through material remains can be reconstructed’. In the present context the stages are known from direct ethnographic observation, but if they were not then the workshop would be more difficult to understand. For example,

the clay preparation pits outside the workshop are obvious but inside, with the clay pile gone, only a cobbled floor would be left. Someone with a knowledge of pottery workshops might note that it was probably for clay preparation but such hard surfaces are not universal nor exclusive to pottery workshops. The features of the workbench would probably be apparent even if the wheel itself had gone, but the function of the drying room would be much less obvious. In a roofless condition it might be thought to be a courtyard and – despite the narrowness of the door – buffalo have been observed grazing in abandoned workshops and drying rooms which serve as just such enclosures. The outdoor drying area is not marked in any special way and though its existence might be expected its location could not be detected with certainty, not least since its position is not rigidly fixed.

What is also lacking within the workshop is a knowledge of time. Because the essential stages of pottery production are known from numerous studies it is obvious that some operations must be carried out before others can happen. However, what is less easy, or may be impossible, to ascertain is whether some operations went on simultaneously and how long it took to produce particular vessels. In the case of Deir el-Gharbi if the wheel was reconstructed it would be apparent that the potter could not easily get up from his seat to get more clay each time he needed it. As a result it is safe to assume that he worked with at least one assistant. However, if it was realised that this was part of a whole village of specialised potters who are essentially mass-producing a particular type of vessel, which might become apparent from large area excavations, then the archaeologist might begin to think in terms of greater numbers of workshop staff. In practice each workshop has a minimum of three people and more usually four. In this way clay can be prepared in the outdoor pits or on the trampling floor at the same time the potter is being supplied with cones or bases on which to work. Study of the finished Ballas jars might indicate that they were made in two stages but it would not be certain that the tops were left to dry overnight before the bases were made the next day and the whole set to dry outside.

The *chaîne opératoire* approach then, draws attention to features of the workshop, but in an archaeological context where particular production steps may be invisible, has its uncertainties. Fortunately, most products require a number of set manufacturing stages and these can be observed ethnographically and inferred archaeologically, albeit with caution. Monteix (2016) points out that not all of the bakeries in his study had all of the features which might be expected, thus tempering (Monteix 2016, 156)⁷ might be

⁷ Tempering here refers to a bread making process and is unrelated to ceramic tempering.

done at a location away from the workshop and one should be aware that in some instances clay preparation or even firing might be done away from the workshop.

Case Study 2: Pictorial Evidence

Before turning to the evidence of an excavated ancient Egyptian pottery workshop it is worth considering what can be learned from the examination of representational evidence of craft scenes.

Those studying ancient Egyptian pottery technology are fortunate in having at their disposal a number of so-called ‘daily life’ scenes which depict various aspects of crafts and industries of their time. For the purposes of this study I will draw on two of these from the site of Beni Hasan in Middle Egypt. The tombs are of Bakt III (BH15) of the 11th Dynasty (2055-1985 BC – Pl. 3: 1) and of Amenemhat (BH2) which dates to the early 12th Dynasty (1985-1795 BC – Pl. 3: 2) (Newberry 1893; Newberry and Fraser 1894).

Both of these scenes are well known but have usually been considered simply a part of a series of stock views of ‘daily life’ and perhaps more noteworthy for their artistic depiction of craft scenes than for their reality, though Holthoer (1977) recognised that the scenes were useful guides to the stages in ceramic production. However, Nicholson and Doherty (2016) have recently argued that the scenes have a greater utility and that they might be considered as detailed ethnographies, at least for pottery production.

Both scenes show broadly the same operations taking place; clay preparation, clay shaping, firing and kiln unloading. Neither scene shows the operations taking place in what might be regarded as a step-by-step fashion, beginning with clay preparation and finishing with the taking of vessels for market. Rather, the scenes show a range of actions taking place in what at first seems to be a confused order. However, it can be argued that what the artist is attempting to show here is one of the things which is lacking in the archaeological examination of an excavated workshop, namely the timing of actions. These scenes attempt to inform the viewer that several activities are taking place at once. It is not clear if all actually took place simultaneously since there is no information as to the size of the workshop or whether the same individual might be represented several times, but there are clues.

To take the Bakt III scene as an example (Pl. 3: 1), it begins with a potter at his wheel, behind him stand two assistants who are treading clay

in the same systematic way as observed at Deir el-Gharbi (above). It might be thought that their positioning is one of artistic balance but, as has been seen at Deir el-Gharbi, it is not, rather the systematic treading around a pile of clay is represented. Behind these figures clay is being shaped by hand into a cone or mound and carried over to a potter at his wheel. The wheel head is empty, ready to receive the cone and behind the seated potter is a finished vessel, coloured red to show that it has been fired. This probably holds water for wetting the clay or possibly ash for dusting the wheel head. In his hand is a grey lump, perhaps clay or another substance being used to lubricate the wheel pivot (Nicholson and Doherty 2016).

In front of this potter are four more, each shaping vessels on the wheel from a mound of clay like that being carried by the assistant. It is possible that one of these is meant as the same person as the one who is waiting with an empty wheel head, however, each of the four is making vessels ‘on the hump’ of clay and there seems little reason to repeat the scene several times, it seems more likely that what is being depicted is a workshop where up to seven potters work at the wheel served by a number of assistants and all of these activities are going on roughly simultaneously. Above the seated potters (with the exception of the one at the start of the scene) are shown finished, but unfired, vessels. This may be an attempt not only to show which forms are being made but also to show where they are in the production cycle, thus the potter on the far left, at the start of the scene, is just beginning work and has produced nothing, the next one has made a vessel but awaits more clay whilst the next four are already producing vessels and have each completed two (or perhaps more if the two are simply an indication of production).

Moving to the next register of the scene, on the left we see an assistant standing to the right of a quantity of unfired pots. The scene is helpfully captioned as ‘drying’ so making it clear that this is the drying area for the products which have presumably been collected from the smaller groupings made near the wheel by another assistant. Behind this figure we see a squatting individual who holds a large grey object, possibly clay for mending the kiln or perhaps a vessel which he is burnishing or to which he is applying a slip – the scene is damaged and cannot be interpreted with any certainty.

In front of the damaged figure is a man firing the kiln, its red glow clearly visible at the entrance. The next scene shows the kiln being unloaded by two men, it is clear that this is unloading rather than loading of a second

kiln because the vessels have now become red showing that they are fired.⁸ The scene ends with the carrying away of the fired, red, vessels in baskets – presumably ready for sale.

Although given in a slightly different order, the elements of the Amenemhat scene (Pl. 3: 2) are essentially the same as those in Bakt III. The impression is of a busy workshop with numerous stages of production taking place. What we are not told in the hieroglyphic captions and what we cannot know with any certainty is whether firing took place daily whilst throwing of vessels continued or whether it happened on another day. It might be argued that the change of register in the Bakt III scene, starting the second register with drying, may be an attempt to show a subsequent day or later time but it may simply be a matter of convenience within the space and in the Amenemhat scene kiln unloading is happening in the midst of forming. The Amenemhat scene is later in date than that in Bakt III and is less detailed, it may be drawing on a selection of the commonest scenes whilst giving an indication of activities happening more or less contemporaneously.

Enough has, it is hoped, been said to indicate that these scenes, and others like them, are more than decorative, at least in the case of pottery (see however Stevens and Eccleston 2007, 146). They can be used to indicate the steps in the production sequence, steps which are known to be technologically necessary. They also add information which might not be known simply by applying the *chaîne opératoire* to an excavated workshop. For example, the throwing of vessels on a hump of clay might not be evident. Here then we have the suggestion that workshops could be busy places with multiple workers and that production stages might be happening simultaneously. What the scenes lack is any sense of the physical space of the workshops and for that we must turn to archaeological examples.

Case Study 3: An Excavated Workshop at Tell el-Amarna

Tell el-Amarna, the ancient city of *Akhetaten* was founded by the so-called ‘heretic pharaoh’ Akhenaten (1352-1336 BC) around the 5th year of his reign (Kemp 2012, 34). It was occupied for only a couple of decades before abandonment and the lack of later building on the site has meant that large areas of the site are well preserved.

⁸ Fraser and Newberry (1894) do not show the colours of the vessels but rather give all in outline. It is necessary to look at a colour image for these.

Amongst the well preserved areas are several pottery workshops including at site Q48.4⁹ (Kirby and Tooley 1989; Nicholson 1989), one discovered by Borchardt at P47.20 but mistaken for a bread making installation (Borchardt 1933; Borchardt and Ricke 1980, plan 2; Nicholson 1995b) and as part of the more complicated industrial area at site O45.1 (Nicholson 2007). The workshop at Q48.4 provides a useful example in the context of the present discussion.

The workshop (Pl. 4) is in a walled enclosure and comprises a small chamber (area 12) with a doorway on its north side. This chamber contained a pottery jar (*zir*) set into the floor and nearby a brick lined pit in which was found the remains of a potter's wheel of the type seen in use in the Beni Hasan scenes. If this room is the original location of the wheel then it would be reasonable to assume that the *zir* might have served as a water container. Its size and depth seem unnecessarily large, but it may well have been used as a reservoir from which a smaller vessel was regularly filled during the working day.

By leaving the room by the doorway on the north side a worker could turn west and immediately south to walk into area 1 which is a long building with a clay preparation pit. A wall was later added on its east side but previously it would have been open in that direction and would give easy access onto the central area of the walled enclosure where two kilns (one of them in the course of construction and so never used) are located.

One should, however, think of the workshop using the *chaîne opératoire*. In taking this approach it is evident that, just as at Deir el-Gharbi, the clay for use in the workshop must have been brought in, in this case from the river Nile to the west, which would mean crossing the ancient city to reach this desert edge location. The obvious place for clay to be dumped when brought to the workshop would be in area 1, near the clay pits and extending perhaps beyond the line of the later wall, toward the centre of the courtyard. Since the quantities of clay required and the number of deliveries made each week/month/year are unknown one can only speculate on the kind of storage area required.

Preparation. Once at the workshop the clay would be put into the clay pits and wetted. At this workshop there is no trace of a hard surface for clay trampling such as that observed at Deir el-Gharbi. Such a surface is known at the O45.1 workshop (Nicholson 2007, 150), however, showing that they were sometimes used in ancient times.

⁹ The numbers refer to the grid layout used at Amarna. For details see Kemp and Garfi (1993).

Shaping. From the preparation area the clay would be carried indoors into area 12. It is unlikely that any further treading of the material would take place here, but it may have been the locality in which the clay was thrown on the wheel. The function of the lined pit is uncertain. It may have been a bin for storing clay, but this seems unlikely. Perhaps it served for an assistant to stand in to help spin the potter's wheel, although it is known that they can be managed by a single individual – as is shown in the Beni Hasan scenes discussed above. It should also be borne in mind that the wheel, though found in area 12, may not originally have come from this part of the site. It may be that it was used indoors only at particularly hot or cold periods of the year and was otherwise located somewhere in the courtyard. Shaw (2004, 17) has suggested that in ancient Egypt much work was probably undertaken outdoors and even in the street rather than in the discrete workshops which we in the modern west tend to envisage. Such a courtyard location is attested by the positioning of the wheel (albeit a kick-wheel) at the workshop at Deir Mawas in middle Egypt (Nicholson 1995a, 280).

Drying. The excavations at Q48.4 did not reveal a clearly defined drying area. However, it is most likely that the vessels would have been placed to dry in the main courtyard to the east of the clay pits. This is another instance where one must face the limitations of the archaeological evidence. There seems to be no connection between areas 12 (the likely spot for the wheel for at least some of the year) and area 13 to its east. Whilst it is possible that the walls around area 12 were only a few courses high and supported a shade this cannot be proven and there is no evidence that one could step from area 12 direct into area 13. This means that access to the courtyard would have had to be via area 1, not the most obvious choice from the perspective of workshop efficiency. It is possible that immediately east of the later wall which marks the eastern limit of area 1 there was a veranda running from the south-east wall of area 13 to the north east wall of area 3 which would have provided some shade for vessels when first put outdoors (and also a possible location for the wheel when the weather was suitable) with the more fully dried vessels being moved further east, toward the kilns, later in the drying process.

Unlike the situation at Deir el-Gharbi the kilns are not of great size and as a result it may be suggested that production was similarly smaller in scale and the need of extensive drying areas accordingly less. That a second kiln was under construction might mean either that the first was ending its useful life or that production was expanding. Whatever the situation it seems likely that the courtyard area would offer ample space for the drying of vessels.

Firing. From the proposed drying area in the courtyard, near to the kilns, it would be an easy task to load the vessels for firing. The spread of ash on the south of the kilns shows that they were cleaned out largely via the stokehole and the ash thrown there. The route by which the finished vessels left the workshop is unclear.

In passing one should note that another workshop may be present in the southern range of rooms but its status is uncertain and so has not been considered here.

Case Study 3: Discussion

Using the *chaîne opératoire* concept it is possible to propose a different interpretation of the evidence from Q48.4. The suggestion made in plate 4 makes use of the findspot data but also means that the person bringing clay to the potter in area 12 must walk around to the entrance and then carry out the finished product by the same route. Whilst this is entirely possible it is not very efficient. If the wheel, which was not complete when found and which may not be in its original location, was originally located to the south of the clay preparation pit as in plate 5 then the route taken by an assistant is much simpler. Given that the wall between area 1 and the courtyard is a later addition as the excavators suggest the route is still more simple.

One should also consider the matter of scale of production. If Q48.4 was a small-scale operation doing little more than producing pottery for the use of one of the large villas at Amarna then the apparently inefficient aspects of its layout are of little significance since the facility might be used only on an occasional basis. If, however, the facility were intended to supply more widely then thought needs to be given as to why the rather awkward arrangement of parts of the workshop were tolerated. The site is located close to a well from which water seems to have been drawn and sent to Workmen's Village to the east of the site (Renfrew 1987, 98). Given the workshops proximity to the water source and supply route to the village it is tempting to speculate that it may have been the source of supply for the pottery sent to the workmen who are thought to have been in the employ of the state. If this was the case, then it must be assumed that production was both regular and substantial and the rather clumsy layout of the workshop seems incongruous.

The reason that a more efficient scheme is not apparent may be to do with the relatively short-lived nature of the site. Its exact duration is unknown

but Kemp (pers. comm.) agrees that it was not in operation over a long period. Evidence for this comes from one of the kilns which was still being completed, and had never been fired, at the time the site was abandoned. This may be because the workshop was built only late in the life of the city and was abandoned with it, or because – like other parts of the settlement – it was subject to a change in the grand plan and was no longer needed. In either instance a short duration might explain why a more efficient layout had not been employed, though one must also bear in mind that the operating conditions of such sites were very different to those of the modern factory.

The ‘mapping’ of *chaîne opératoire* steps onto the plans of workshops provides a focus for revision and reinterpretation of activities. This does not mean, of course, that workshops are always efficiently or logically laid out. Their plan and the working methods practiced within them may have evolved over time and the workers have become so accustomed to them that no attempt is made to rationalise the system. Ancient Egyptian workshops did not operate under the same economic conditions as do modern factories and it should not, therefore, be expected that their layouts will always be rational and efficient. However, the heuristic potential of the *chaîne opératoire* in examining them opens new possibilities for interpretation.

Conclusions

In conclusion it can be said that whilst the steps of production which characterise the usual use of the *chaîne opératoire* are not new in archaeology, both in Egypt and elsewhere, the application of a spatial dimension to the discussion renders the concept much more useful than it might otherwise be. Consideration of the locations in which particular tasks took place and the means of ingress and egress to these areas has proven to be a valuable heuristic concept.

Attention is drawn to the limitations of the archaeological data – how can particular rooms, such as drying rooms, be interpreted in the absence of any physical evidence of the process? What distinguishes them from a store room? Where processes take place in the open how safe are we in inferring them because of the presence of other structures – as for example the likely drying areas at Amarna Q48.4? Where buildings in Egypt survive to only a few courses high, and where it is known from ethnographic data that potters often work under temporary shade or in the open, is it reasonable to postulate that these buildings had only partial walls? Similarly, are we perhaps too greatly influenced by the findspot of some items, such as

the potter's wheel at Q48.4? In this instance it was not found complete, only the top stone was present; that it occurred in a room with a *zir* sunk into the floor and which might therefore have served as a water container in potting could be entirely coincidental. In looking at the plan of the site one might wonder if the wheel might not be better located in area 1, somewhere near feature [3720] and an alternative is presented in plate 5. Whilst it cannot be proven that this is the actual layout of the workshop it does offer a realistic, and perhaps more plausible alternative.

The visual evidence of scenes such as those at Beni Hasan must be used cautiously but a knowledge of the necessary steps in production helps in understanding them and using them in turn to give some indication of workshop scale and perhaps time-depth to the relatively bare archaeological data.

It is hoped that enough has been shown to demonstrate the utility of Monteix's (2016) method of relating the *chaîne opératoire* to spatial distributions and its power as an aid to archaeological interpretation.

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References

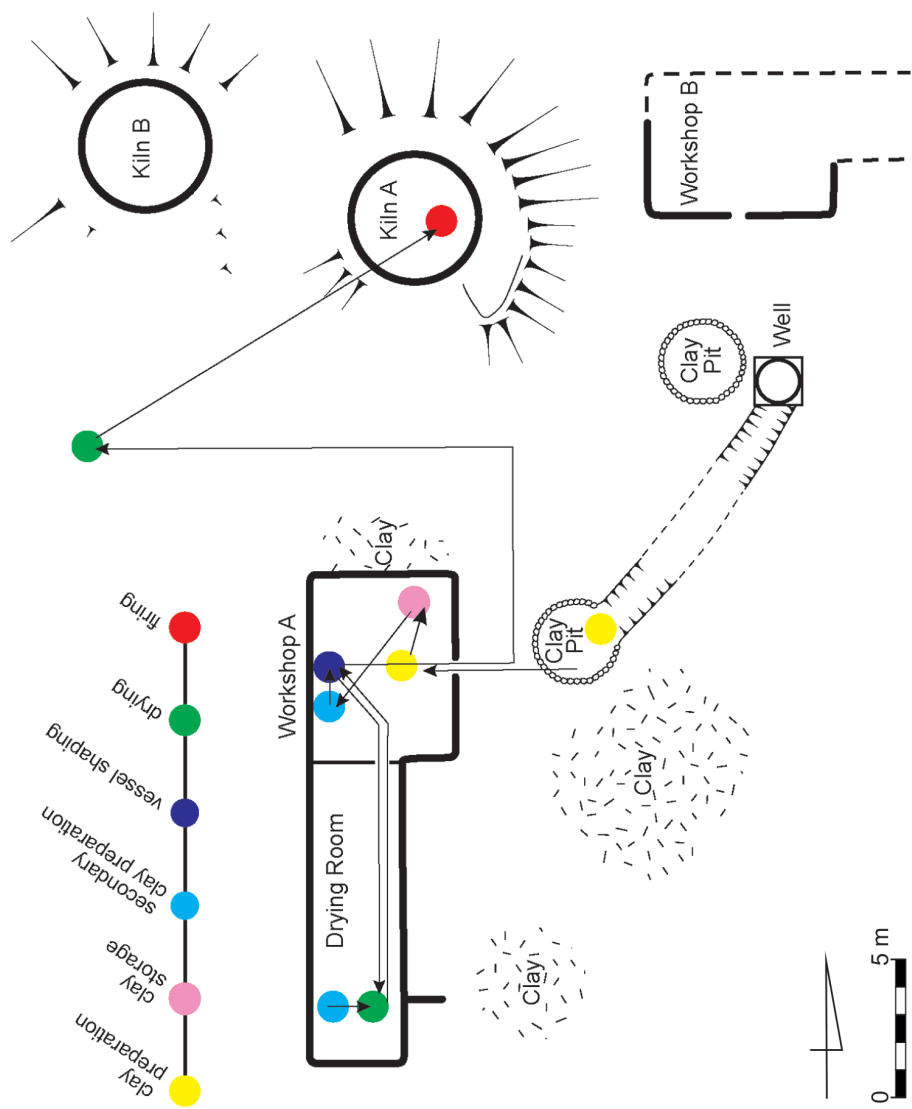
- Arnold D. 1981.** Ägyptische Mergeltone ('Wüstentone') und die Herkunft einer Mergeltonware des Mittleren Reiches aus der Gegend von Memphis. In D. Arnold (ed.), *Studien zur altägyptischen Keramik*, 167–191. Mainz.
- Arnold D. and Bourriau J. D. 1993.** *An Introduction to Ancient Egyptian Pottery*. Mainz.
- Batchelor R. 1994.** *Henry Ford: Mass Production, Modernisation and Design*. Manchester.
- Blackman W. S. 1927.** *The Fellahin of Upper Egypt*. London.
- Bloxam E. 2015.** 'A Place Full of Whispers': Socialising the Quarry Landscape of the Wadi Hammamat. *CAJ* 25 (4), 789–814, [on-line] <https://doi.org/10.1017/S0959774315000426>.
- Borchardt L. 1933.** Ein Brot. *ZÄS* 68, 73–79.
- Borchardt L. and Ricke H. 1980.** *Die Wohnhäuser in Tell el-Amarna*. Berlin.
- Cardew M. 1952.** Nigerian traditional pottery. *Nigeria* 39, 188–201.
- Childe V. G. 1954.** Rotary motion. In C. Singer, E. J., Holmyard. and A. R. Hall (eds.), *A History of Technology*. Vol. 1: *From Early Times to the Fall of Ancient Empires*, 187–215. Oxford.
- Childe V. G. 1956.** *Man Makes Himself*. 3rd ed. London.
- Doherty S. K. 2015.** *The Origins and Use of the Potter's Wheel in Ancient Egypt*. (Archaeopress Egyptology 7). Oxford.

- Ford H. 1926.** Mass production. In *Encyclopedia Britannica* 30, 821–823.
- Hodges H. 1964/1981.** *Artifacts*. London.
- Holthoer R. 1977.** *New Kingdom Pharaonic Sites: The Pottery*. (SJE 5.1). Copenhagen, Stockholm.
- Keller C. M. and Keller J. D. 1996.** *Cognition and Tool Use: The Blacksmith at Work*. Cambridge.
- Kemp B. J. 2012.** *The City of Akhenaten and Nefertiti: Amarna and its People*. London.
- Kemp B. J. and Garfi S. 1993.** *A Survey of the Ancient City of El-Amarna*. London.
- Kirby C. and Tooley A. M. J. 1989.** Report on the 1987 excavation of Q48.4. In B. J. Kemp (ed.), *Amarna Reports V*, 15-63. London.
- Lemonnier P. 1992.** *Elements for an Anthropology of Technology*. Ann Arbor.
- Leroi-Gourhan A. 1943.** *Evolution et techniques*. Vol. 1: *L'Homme et la Matière*. Paris.
- Leroi-Gourhan A. 1945.** *Evolution et techniques*. Vol. 2: *Milieu et techniques*. Paris.
- Leroi-Gourhan A. 1964.** *Le Geste et la parole*. Vol. 1: *Technique et Langage*. Paris.
- Leroi-Gourhan A. 1965.** *Le Geste et la parole*. Vol. 2: *La Mémoire et les Rythmes*. Paris.
- Leroi-Gourhan A. 1993.** *Gesture and Speech*. Trans. A. Bostock Berger. Cambridge, Mass.
- Monteix N. 2016.** Contextualizing the operational sequence: Pompeian bakeries as a case study. In A. Wilson and M. Flohr (eds.), *Urban Craftsmen in the Roman World*, 153–179. Oxford.
- Monteix N. forthcoming.** Using the *chaîne opératoire* to interpret the layout of Roman workshops. In M. Bentz and T. Helms (eds.), *Craft Production Systems in a Cross-Cultural Perspective*. Bonn.
- Newberry P. E. 1893.** *Beni Hasan Part II*. London.
- Newberry P. E. and Fraser W. 1894.** *Beni Hasan Part I*. London.
- Nicholson P. T. 1989.** The pottery kilns in Building Q48.4. In B. J. Kemp (ed.), *Amarna Reports V*, 64–81. London.
- Nicholson P. T. 1995a.** The potters of Deir Mawas. An ethnoarchaeological study. In B. J. Kemp (ed.), *Amarna Reports VI*, 279–308. London.
- Nicholson P. T. 1995b.** Kiln excavations at P47.20 (House of Ramose Complex). In B. J. Kemp (ed.), *Amarna Reports VI*, 226–238. London.

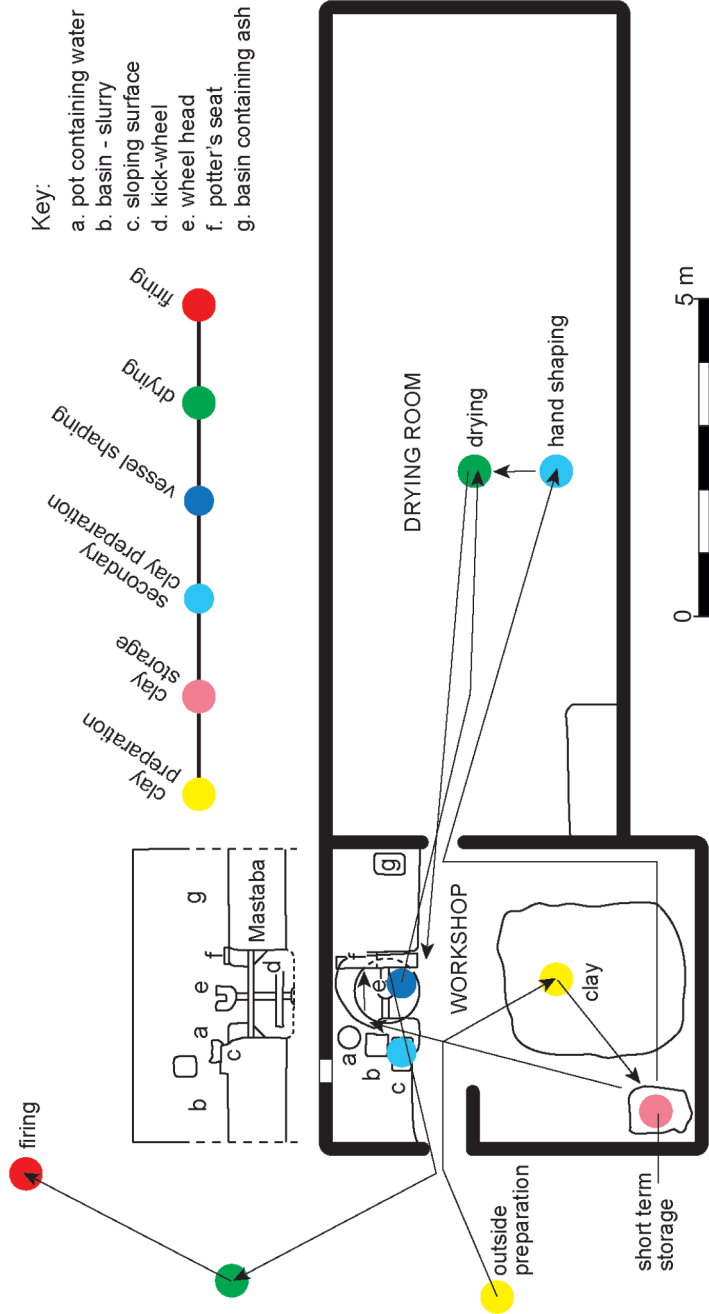
- Nicholson P. T. 2002.** Deir Mawas and Deir el-Gharbi: two contrasting ceramic traditions. In W. Z. Wendrich and G. van der Kooij (eds.), *Moving Matters: Ethnoarchaeology in the Near East. Proceeding of the International Seminar Held in Cairo, 7-10 December 1998*, 139–146. Leiden.
- Nicholson P. T. 2007.** *Brilliant Things for Akhenaten. The Production of Glass, Vitreous Materials and Pottery at Amarna Site O45.1*. London.
- Nicholson P. T. and Patterson H. L. 1985.** Pottery making in Upper Egypt: An ethnoarchaeological study. *WorldArch* 17 (2), 222–239, [on-line] <https://doi.org/10.1080/00438243.1985.9979964>.
- Nicholson P. T. and Patterson H. L. 1989.** Ceramic technology in Upper Egypt: A study of pottery firing. *WorldArch* 21 (1), 71–86, [on-line] <https://doi.org/10.1080/00438243.1989.9980091>.
- Nicholson P. T. and Doherty S. 2016.** Arts and crafts: Artistic representations as ethno-archaeology. A Guide to craft technique. In B. Bader, C. M. Knoblauch and C. Köhler (eds.), *Vienna 2: Ancient Egyptian Ceramics in the 21st Century*, 435–450. (*Orientalia Lovaniensia Analecta*, 245) Leuven.
- Nordström H.-Å. and Bourriau J. D. 1993.** Fascicle 2: Ceramic technology: Clays and fabrics. In D. Arnold and J. D. Bourriau (eds.), *An Introduction to Ancient Egyptian Pottery*, 143–190. Mainz.
- Renfrew A. C. 1987.** Survey of Site X2. In B. J. Kemp (ed.), *Amarna Reports IV*, 87–102. London.
- Rice P. M. 1987.** *Pottery Analysis: A Sourcebook*. Chicago.
- Rye O. S. 1976.** Keeping your temper under control: Materials and the manufacture of Papuan pottery. *Archaeology and Physical Anthropology in Oceania* 11 (2), 106–37, [on-line] <https://doi.org/10.1002/j.1834-4453.1976.tb00245.x>.
- Schlanger N. 2005.** The *chaîne opératoire*. In C. Renfrew and P. Bahn (eds.), *Archaeology: The Key Concepts*. London.
- Shaw I. 2004.** Identity and occupation: how did individuals define themselves and their work in the Egyptian New Kingdom? In J. Bourriau and J. Phillips (eds.), *Invention and Innovation: The Social Context of Technological Change 2: Egypt, the Aegean and the Near East, 1650-1150 BC*, 12–24. Oxford.
- Shaw I. 2012.** *Ancient Egyptian Technology and Innovation*. London.
- Singer C., Holmyard E. J. and Hall A. R. 1954.** *A History of Technology*. Vol. 1: *From Early Times to the Fall of Ancient Empires*. Oxford.

- Stevens A. and Eccleston M. 2007.** Craft production and technology. In T. Wilkinson (ed.), *The Egyptian World*, 146–159. London, New York, [on-line] <http://doi.org/10.4324/9780203820933.ch11>.
- Woods A. J. 1986.** Form, fabric and function: some observations on the cooking pot in antiquity. In W. D. Kingery (ed.), *Ceramics and Civilization*. Vol. 2: *Technology and Style*, 157–172. Columbus, Ohio, [on-line] <https://doi.org/10.1002/gea.3340020209>.

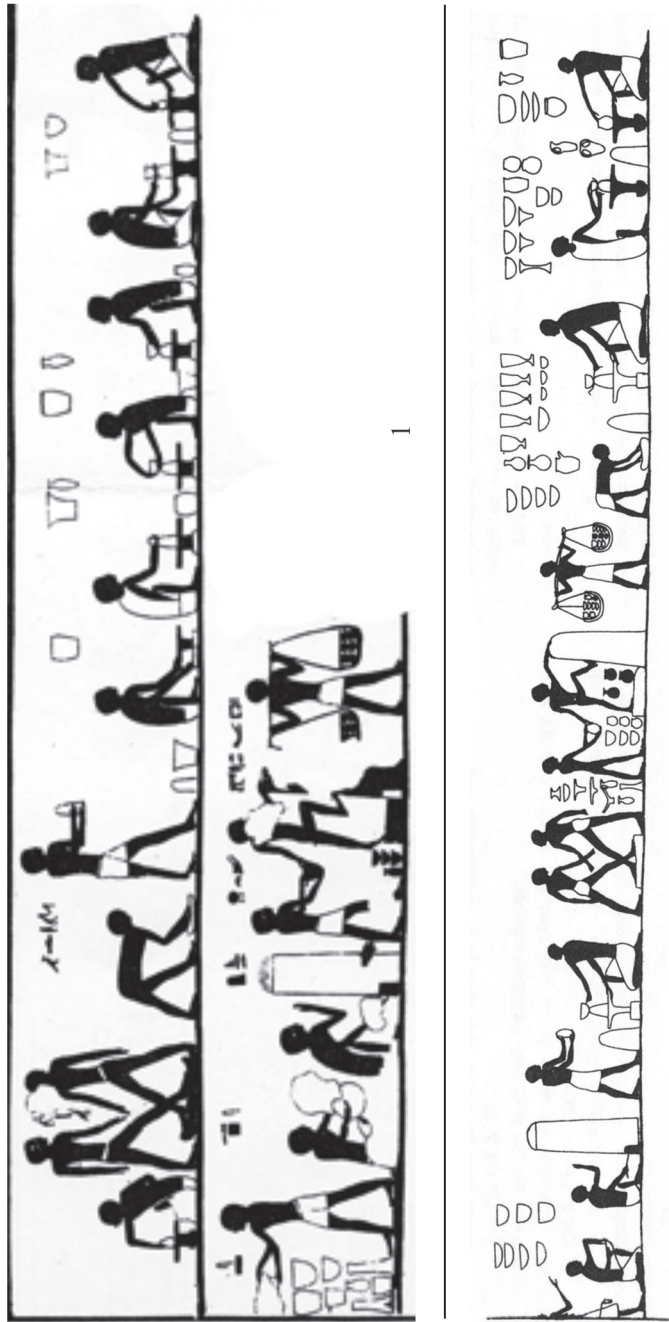
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Pl. 1 – Plan of workshops and features at Deir el-Gharbi, part of the Ballas Industry.
Adapted by Kirsty Harding from drawing by H. L. Patterson and P. T. Nicholson

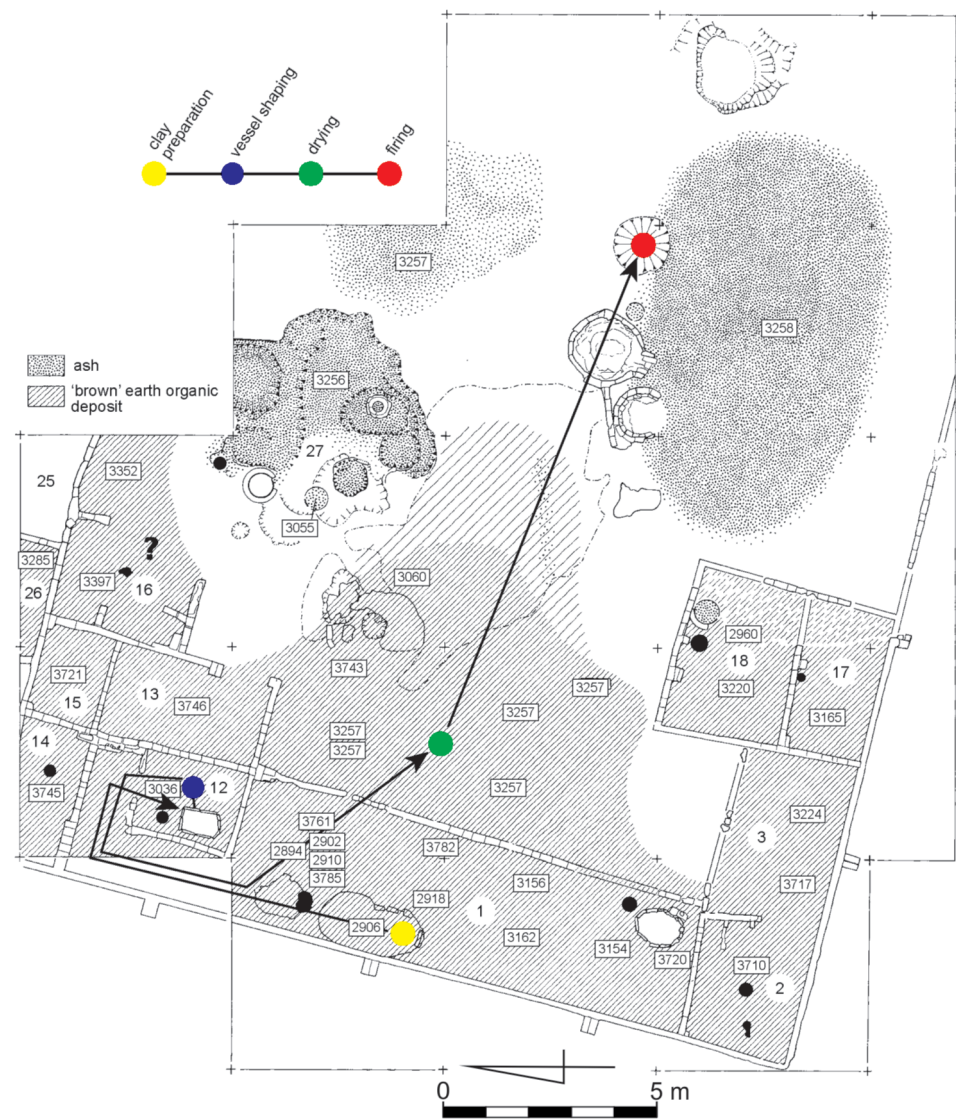


Pl. 2 – Plan of workshop and features at Deir el-Gharbi, part of the Ballas Industry.
Adapted by Kirsty Harding from drawing by H. L. Patterson and P. T. Nicholson

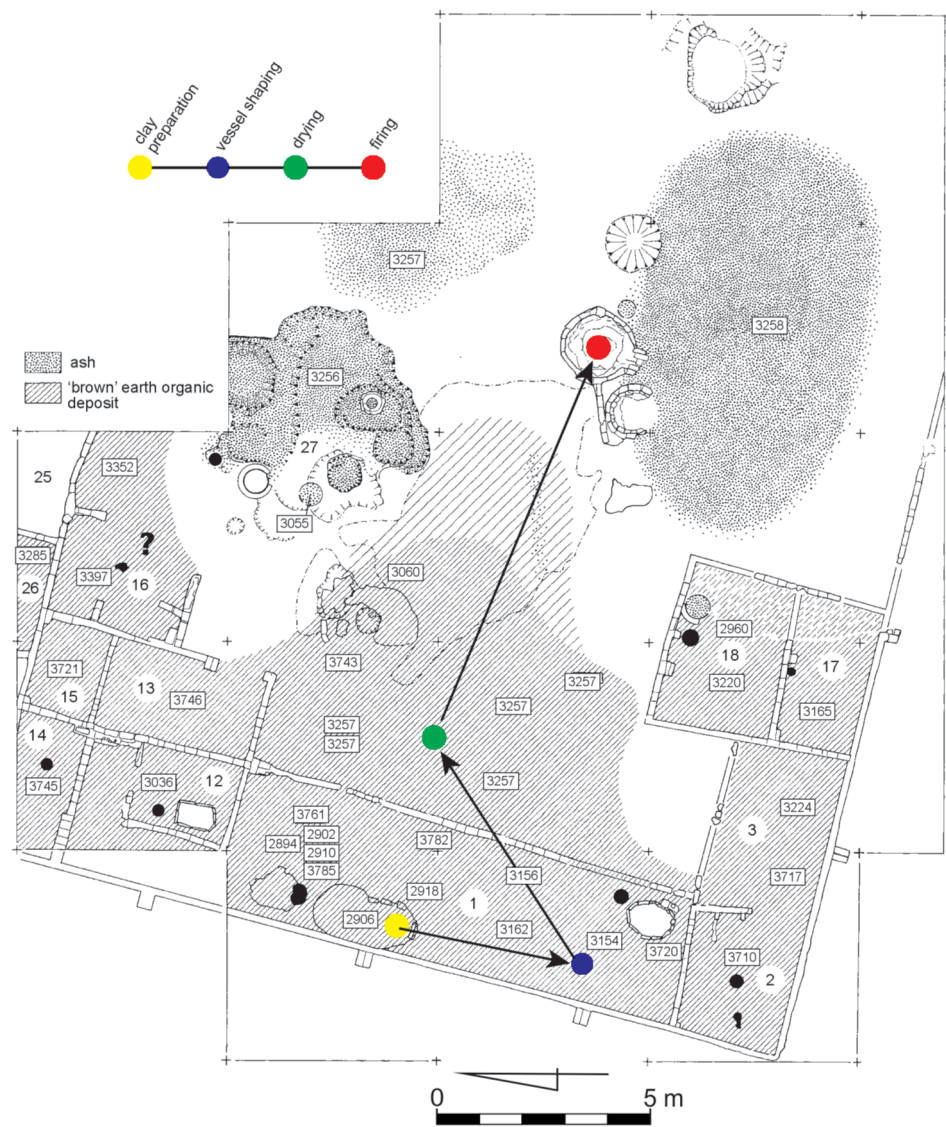


Pl. 3: 1 – Potting scene from the tomb of Bakt III (BH15) of the 11th Dynasty (2055-1985 BC) at Beni Hasan, Middle Egypt. The scene is on the western end of the south wall of the main chamber, other parts of the scene have been omitted here. After Newberry 1893 pl. VII; reproduced Courtesy of the Egypt Exploration Society

Pl. 3: 2 – Potting scene from Amenemhat (BH2) which dates to the early 12th Dynasty (1985-1795 BC) at Beni Hasan, Middle Egypt. After Newberry 1895, pl.11; reproduced Courtesy of the Egypt Exploration Society



Pl. 4 – Plan of the workshop at Amarna site Q48.4 showing its first phase. The potter's wheel was found in area 12. Original plan from Kirby and Tooley 1989, fig. 2.17, additional information by Kirsty Harding



Pl. 5 – Plan of the workshop at Amarna site Q48.4 showing its first phase. The potter’s wheel was found in area 12 but in this interpretation, it is suggested that it might belong in area 1 (original plan from Kirby and Tooley 1989, fig. 2.17 additional information by Kirsty Harding)