Pottery Production

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Paul T. Nicholson

Keramikproduktion
Production de céramique

Pottery represents one of the earliest complex technologies—that of changing a plastic material, clay, into an aplastic material, ceramic, more colloquially known as pottery. In order to produce pottery it is necessary to obtain clay, either from a water course or sometimes by mining, and to process it by adding "opening materials" ("temper") to improve its working properties, or by removing materials such as calcite. Egyptologists recognize two broad types of clay, that containing silt from the Nile River and the calcareous marl clays obtained from the desert. The clay, or mixture of clay and other materials, is then shaped either by hand-forming, using the potter's wheel, or by molding. The finished form is then dried. This is the last point at which the potter could rework the material by simply adding water to it. Once dry, the material is fired either in the open or in a kiln. Firing leads to the fusion of the clay platelets, which renders the material aplastic. It is the sherds of this aplastic material that are most commonly encountered in the archaeological record.

تمثل صناعة الفخار إحدى أول الصناعات المعقدة للمصري القديم حيث قام بتحويل مادة مرنة وهي الطين إلى مادة صلبة وهي الخزف أو الفخار. وهناك عدة خطوات لصناعة الفخار فأولاً يتم الحصول على الطين سواء من مجرى للمياه أو ينقب عنه، ثم يضاف إليه التبن لتحسين خامته أو يتم إزالة المواد الغير مرغوبة مثل الكالسيت. يعرف نوعان من الطين المستخدم بالفخار بالآثار المصرية: طمي النيل وطينة جيرية من الصحراء. يشكل الطين يدوياً أو باستخدام عجلة الفخرانى أو قوالب سواء كان طين فقط أو مزيج من الطين والتبن. بعد ذلك يترك المنتج ليجف وهذه آخر مرحلة يمكن للصانع أن يعيد تشكيل منتجه بإضافة بعض الماء ليصبح مرن مرة أخرى. بعد الجفاف يحرق المنتج النهائي سواء فى مكان مفتوح أو داخل فرن حيث تقوم الحرارة بصهر رقائق الطين ليصبح صلباً. وشقف هذا الفخار هو ما يعثر عليه بكثرة بالمواقع الأثرية.

Pottery is usually the most common artifact on any post-Mesolithic site. In Egypt its abundance can fairly be described as overwhelming, and it generally requires substantial resources in order to be properly recorded by excavators. Pottery was the near-universal container of the ancient world and served those purposes for which we might now use plastics, metal, glass and, of course, modern ceramics. Its abundance in the archaeological record is not due merely to its wide use, but to its near indestructibility, and this is in turn a facet of its technology.

Raw Materials

The raw material for producing pottery is clay (Rice 1987). Egyptologists have distinguished

Figure 1. Collecting Nile silt clay from the bank of an irrigation canal near Deir Mawas, Middle Egypt.

two main types of clay for indigenous Egyptian ceramics: Nile silt and marl (Bourriau 1981; Nordström and Bourriau 1993: 149 - 187). As the name suggests, Nile silt clay comes from the Nile River. Strictly speaking it is a misnomer, since to a geologist "silt" and "clay" refer to two different particle-size fractions. For the Egyptologist it is simply a convenient way of distinguishing this riverine, alluvial clay—which is rich in iron and so fires to a red color in an oxidizing atmosphere—from the marl clays. Marl clays usually contain at least 10% calcium carbonate (lime), and in field tests can be distinguished using a 10% solution of hydrochloric acid, to which they react by effervescing. Marl clays normally fire to a cream or buff surface. This surface starts to form during the drying of the vessel, when the calcium carbonate begins to effloresce on the vessel's surface, in the same manner as the glaze in effloresced faience.

Whereas Nile clays can be obtained virtually anywhere along the course of the Nile (fig. 1) and are therefore widely available, the occurrence of marl clays is much more limited, being confined to a few main localities, notably around the Qena area of Upper Egypt (see Arnold 1981). In these localities the marl is quarried or mined as though it were a rock (fig. 2) and generally arrives at the workshop as solid blocks that must be broken up, soaked, and trampled in

Figure 2. Miners excavating marl clay at Deir el-Gharbi, near Ballas, Upper Egypt.

Figure 3. Trampling marl clay at Deir el-Gharbi, near Ballas, Upper Egypt. Smaller-scale production may only require human (rather than animal) trampling.

Figure 4. Trampling marl clay at Deir el-Gharbi, near Ballas, Upper Egypt. A second preparation stage at Deir el-Gharbi; elsewhere possibly the only stage.

order to produce a workable clay (figs. 3 and 4; Nicholson and Patterson 1985; 1989). Veins of calcite frequently occur in marl deposits, and any pieces of calcite that are included in the clay mixture are carefully removed by those treading the clay, since to

leave them in may lead to flaws in the vessel. This refining of the clay by picking out aplastic material may also be applied to Nile silt, which may contain undesirable pieces of shell, small stones, and other debris.

Clay Preparation

The amount of preparation given to the clays is, to some extent, dependent upon their final use. Coarse utilitarian wares may require relatively little cleaning.

As well as the cleaning of clays, it is frequently necessary to make additions to their mixture in order to enhance their working properties. These additions are usually referred to as "temper" or "filler" by archaeologists, although potters use the term "grog." "Opening materials" might be a more suitable term. For example, some clays, or mixtures thereof, may be too sticky to handle well and so have another material such as sand added to them. This has the effect of reducing their plasticity somewhat, as well as "opening" the clay fabric so that air can penetrate it and help it to dry more evenly. Such open clay bodies may also fire more readily with simple technology, in that the more coarse fabric allows the escape of steam as the moisture is driven out of the clay during the firing process. A coarse body requires only simple kiln control; a finer one may require careful handling during the firing process if the vessel is not to become bloated and deformed as a result of the buildup of steam in the fabric. In addition to sand, it is possible to use crushed rock fragments, pieces of fired pottery, and plant fibers or hair. Dung can also be added, which brings with it plant material. Chopped straw or chaff may be used where an open-textured fabric is required, since it burns out during firing to leave voids. These voids help to prevent the propagation of large cracks, as well as allow the fabric to heat quickly, or to "sweat"—the evaporation thus enabling the vessel to keep any water stored within cool and fresh.

Porous fabrics, be they silt or marl, are suitable for the storage of water. The amphora-like "Ballas jar," still made from marl clay in the Qena/Ballas region of Upper Egypt, has been made in much the same form since Roman times (Nicholson and Patterson 1985). The porous clay allows the transport and short-term storage of water: the vessel "sweats" gently in the sun, the resulting evaporation helping to keep the water cool. The same principle is true of a whole range of present-day Nile silt-ware vessels, including the coarse straw-tempered *gidr* used in Middle Egypt, and the ubiquitous *zir* vessels for the longer-term storage of water, which are frequently found outside houses for the convenience of guests and travelers. Similar vessels seem to have served the same purpose in ancient times; *zir* emplacements are a common feature of the archaeological record.

Some authors have argued for the levigation of ancient Egyptian clays and have cited tomb scenes as supporting this view. The levigation process involves the mixing of clay with large volumes of water (in a large container, such as a tank), followed by a period of settlement whereby the coarsest fraction of the clay settles to the bottom first, allowing the finer fraction to then be skimmed off so that a fine and uniform clay is produced. The tomb scene most frequently regarded as showing this process is in the tomb of Kenamun at Thebes, where a man is shown—apparently—wading in a tank (Holthoer 1977: 19). This would, in fact, stir up the clay again, defeating the object of levigation. The scene should rather be considered as showing the treading of clay, which helps to homogenize the mixture and drive out air.

Vessel Forming

Once prepared, the clay must be formed into a vessel. Although there are many methods by which this can be achieved, they are divided into two main groups: hand forming and wheel forming. Arnold and Bourriau (1993: 15) have established a three-fold scheme for the development of pottery forming in Egypt, using "non-radial," "free-radial," and "centered-radial" techniques, according to how radial symmetry (that is, the walls being at an equal distance from the vertical axis of

Figure 5. Making a water storage vessel (*gird*) using a paddle and anvil and a hollow for shaping. Deir Mawas, Middle Egypt.

the vessel) is incorporated. Non-radial methods treat the vessel as though it were a piece of sculpture and essentially model it without reference to a particular vertical axis. In the free-radial method the pot might be constructed by coiling or rotating intermittently as the clay is drawn up to form the walls. Centered-radial techniques involve a rotating support with a fixed central axis—the potter's wheel. The rotation of this device at speed allows the use of centrifugal force to help in the drawing up and shaping of the vessel.

In practice, techniques might be combined so that, for example, a vessel made by coiling is given a rim made on the wheel. However, historically there was an increasing tendency for vessels to be wheel made. There are numerous ways in which vessels may be shaped within each technique. Among the non-radial methods, Arnold and Bourriau (1993: 16) define pinching and hollowing, paddle and anvil, shaping on a core or over a hump, and shaping in a mold. All of these methods were in use by the mid-18th Dynasty, but some were employed only for relatively specialized vessels. For example, bread molds were frequently made by pressing the clay over a core, known as a "patrix," which gives the interior of the vessel its shape and smooth surface. The technology is simple and requires little skill. It is not unlikely that unskilled potters may have produced these bread molds in close proximity to bakeries, since that would have been more efficient than transporting large numbers of fired vessels. The paddle and anvil technique (fig. 5), in which a bat, or paddle, is used to beat the clay against an anvil (often no more than a round stone) in order to thin the clay and draw it up, enjoyed wide use from Predynastic times and was often used in association with coiling, which is a free-radial method.

The free-radial methods include slab-building, coiling—sometimes in association with a simple wheel—and turning on a turn-table. This latter might be used with various non-radial methods. All were known by the Archaic Period/early Old Kingdom.

Arnold and Bourriau (1993: 17) differentiate between types of wheel and whether they are rotated by hand or "kicked" by movement of the foot (fig. 6). All wheels, however, are capable of producing pottery using centrifugal force, as has been demonstrated in experiments by Powell (1995) (fig. 7). The first known wheels appear in the Old Kingdom (Dynasty 5 or 6), with the kick-wheel perhaps appearing in the Late Period.

Figure 6. A typical kick-wheel. Deir Mawas, Middle Egypt.

It has been supposed that the introduction of the potter's wheel necessitated the use of a finer paste than that required by the hand-making techniques. However, this is not necessarily true. Many Egyptian potters of the present day use very coarse clays, with sharp inclusions, but work the clay very wet (Nicholson 1995: 286), with the wheel revolving relatively slowly, so that any sharp inclusions are easily pressed into the clay body

Figure 7. Professional potter Catherine Powell throwing a pot on a reconstructed 18th Dynasty potter's wheel.

by the pressure of the hands without causing undue abrasion.

Firing

There is a relationship between the fabric of a vessel, its firing technology, and its intended function. Generally speaking, fine clays require more careful firing, in a more controlled regime, than coarse ones. Fine clays are also generally more suitable for the application of painted decoration, or for service as prestigious table-wares. The same fine nature that makes them unsuitable for firings where the temperature rises quickly also makes them unsuitable as cooking vessels, as rapid heating leads to differential thermal expansion with resultant cracking of the vessel. Thus, for example, marl clays were often used in the New Kingdom for high quality table-wares and for producing amphorae for the storage of wine. The surfaces of these marl vessels are often carefully slipped and burnished—that is, compressed with a smooth stone or piece of hard leather so that they are shiny and less porous. The finely burnished surfaces of some marl clays, and indeed of some Nile silt clays as well, can be mistaken for glazing by those unfamiliar with Egyptian pottery, which is not glazed before the Roman Period. Coarse fabrics, frequently silts, can be fired in a relatively uncontrolled way, with a rapid rise in temperature. The porous nature of the final product renders it well suited for use as a cooking vessel (Woods 1986), since the numerous small cracks that developed during firing (as a result of the burning out of organic material sometimes added as temper) prevent the propagation of larger cracks (see Cardew 1952).

Firing is the means by which the transformation from the plastic clay to the aplastic ceramic is achieved, and there are a variety of ways by which the process can be carried out. The simplest method is sometimes called "bonfire firing." As the name suggests, the fuel is piled over and around the unfired vessels. Once the fuel is lit there may be almost no control over the firing, but experience allows suitably fired pots to be produced. However, there are numerous ethnographic examples of potters using this technique with great care, positioning vessels in particular parts of the fuel heap, and building elongated heaps such that the wind drives the heat back toward the rearmost pots, which require the longest firing but perhaps the slowest initial heating. In this way fine vessels might be produced. Little is known of the means by which the extremely fine black-topped red ware of the Naqada Period was produced, but it was surely the product of open firing. The makers of this ware were able to fire it sufficiently to produce a hard fabric, but not at so high a temperature that the burnished surface was degraded. They also managed to produce a vessel whose lower part was oxidized red, while the upper part was black as a result of reducing (oxygen deficient) conditions at the end of the firing. This may have been

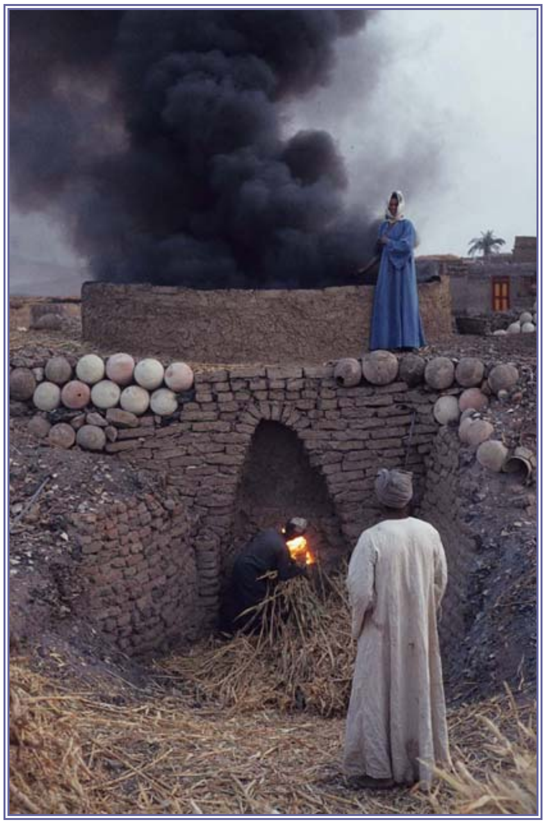

Figure 8. A large updraft kiln at Deir el-Gharbi, near Ballas, Upper Egypt. Fuel is being fed in at this stage, hence the black smoke.

achieved by inverting the hot vessel in sand or vegetable matter at the end of the firing.

A more usual way to control firing, however, is the kiln (fig. 8). Among the advantages of this structure over open firing is that the fuel can be separated from the vessels, thereby preventing their discoloration from contact with the fuel and avoiding localized areas of reduction/oxidation. The structure also protects vessels from the wind. Furthermore, if partially sunk into the ground, it can provide insulation, allowing for firing for longer periods or at higher temperatures without significant increases in fuel, as well as easier manipulation of the kiln atmosphere and more controlled cooling.

Ancient Egyptian kilns were invariably of the updraft type—that is, the fire was located beneath the stack of vessels, which were separated from it by a gridded floor or "chequer." The hot gases (the draft) would pass up through the chequer and so heat the pots stacked above it. Vessels were frequently fired mouth-down so that each filled with hot gases, thereby slowing the passage of the heat through the kiln and increasing its effectiveness. As the stack of vessels heated up, the vessels themselves radiated heat. The heat trapped within the kiln helped to fire the vessels more effectively.

Ancient Egyptian kilns are depicted in a number of tombs, such as that of Bakt III at Beni Hassan (BH15), where they appear to have been open-topped, rather than having a sealed dome. The top would probably have been covered with a layer of broken pottery, as is the case with most contemporary Egyptian kilns. Such covering serves to provide some insulation, but equally importantly serves as a layer on which soot collects. At the end of the firing, after the kiln has cooled, the layer of blackened sherds is removed and the cleanly fired pots are removed from the kiln.

Bibliographic Notes

The literature on ceramics, generally, and on Egyptian pottery, specifically, is vast. Rice (1987) probably offers the best general overview of pottery, while the work of Arnold and Bourriau (1993) offers the most comprehensive introduction to ancient Egyptian pottery. Although it has often been criticized, the work by Holthoer (1977) provides a useful summary of depictions showing pottery production and remains a useful research tool. Bourriau's (1981) *Umm el-Ga'ab* ("Mother of Pots") remains the most accessible catalog showing Egyptian pottery across a wide chronological range. While this book is not intended as a typology, it does give an excellent indication of the great range of ceramics produced in ancient Egypt. Anna Wodzínska's ongoing works (2009a; 2009b; additional volumes forthcoming) are a timely addition to the corpus.

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