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Abstract

The article examines recent findings related to pottery production at Uronarti, a Middle Kingdom fortress located near the Semna cataract in Nubia. Among the evidence presented are an updraught kiln, wasters, and unfired pottery sherds. The analysis of the kiln's design and its functionality, alongside a study of the local production context, indicates that the manufacture of Nile silt pottery at Uronarti was a specialised and administered activity, closely linked to state-controlled food production and payment of rations. It is suggested that the scale of production was significant enough to not only satisfy the requirements of the local garrison at Uronarti but those of the garrisons of nearby fortresses also. Consequently, the article highlights the role of the Uronarti workshop in the regional supply of pottery during the late 12th Dynasty and the crucial role of potters in the Nubian colonial project.

Introduction

The survival of the fortress of Uronarti is a unique opportunity to study the production and supply of Egyptian pottery in the Middle Kingdom Nubian forts *in situ*.[1] In 1930, the Harvard University and Boston Museum of Fine Arts expedition (HU/MFA) excavated three structures at the site which the excavator recorded as

1. The author gratefully acknowledges the contribution of members of the 2018 Uronarti Regional Archaeological Project (URAP) team, in particular architect Abigail Stoner and Laurel Bestock, who both discussed the design and construction of the kiln with me on site. Paul Nicholson kindly discussed the kiln with me in 2019 and read a draught of this paper, offering valuable feedback. For the primary publication of the site, see Dunham 1967. New excavations since 2012 by the URAP are directed by the author (Swansea University) and L. Bestock (Brown University). See Knoblauch, Bestock 2013; Bestock, Knoblauch 2014; Bestock, Knoblauch 2015; Knoblauch, Bestock 2017; Knoblauch 2019; Bestock, Knoblauch 2020.

"three furnaces of burnt brick (for pottery making?) with many potsherds around".[2] Unfortunately, there was no proper documentation of the features, and neither their function nor date could be confirmed. In 2019, the Uronarti Regional Archaeological Project (URAP) started a trial excavation of one of the structures still visible on the surface, but the excavation remains incomplete due to recent events in the Sudan. This article is a preliminary report and analysis of the archaeology of the structure as of the completion of the 2019 season. The excavation revealed a very well-preserved pottery kiln that provides new information about the design, construction, and functionality of both this structure and Egyptian firing structures generally. These findings also contribute to our understanding of the social and economic context of local pottery production at Uronarti and allow the development of new models for the production and supply of pottery in the Second Cataract during the Middle Kingdom.

The archaeology of the kiln: URAP Unit FH

The "furnaces" were situated in the outer fort, a large, enclosed area directly adjacent to the fortress' south wall and main gateway (Fig. 1). The terrain of the outer fort drops steeply from the gateway to its eastern perimeter wall (HU/MFA "South Wing East Wall"). The three furnaces were built in a line along the bottom of the slope parallel to this wall in an open space between the corner of the "Southeast Wing" of the fortress and a building comprising HU/MFA "Rooms 192–196" (Fig. 2). An excavation unit (FH) of 3.5 × 3.5 m was opened on the northernmost of the firing structures, the top of which was still exposed in 2019 prior to excavation (Fig. 3). It was later extended a short distance to the south. HU/MFA had cleared the interior of the structure, but the archaeological layers around and beneath the kiln were left intact.

2. Wheeler 1929–1930, Friday 7 March 1930, p. 31; Dunham 1967, p. 11, pl. VI.B. A well-preserved kiln is visible in the background.

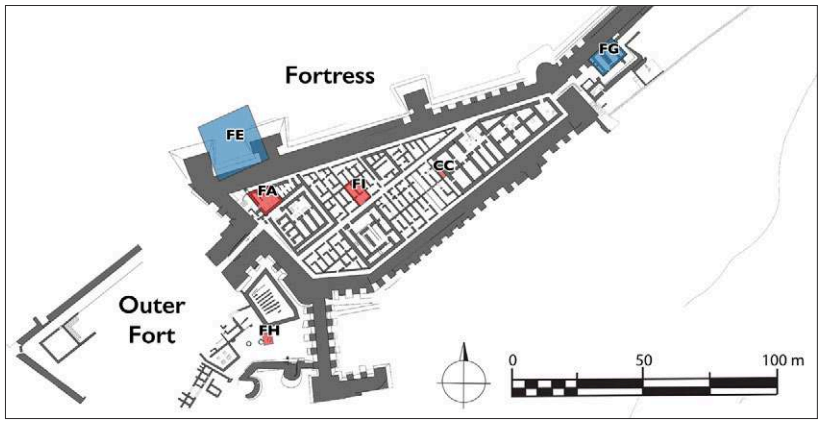

Fig. 1. *Uronarti, excavation areas in 2019. Aegaron with additions by URAP.*

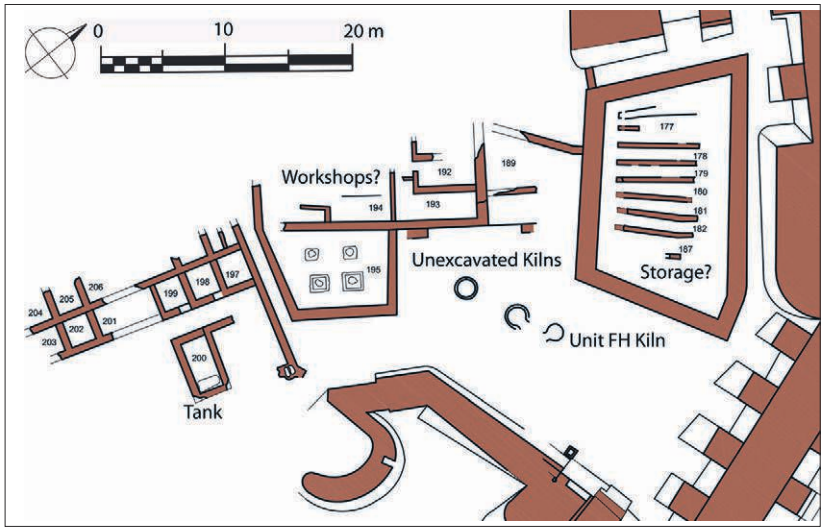

Fig. 2. *The context of pottery production at Uronarti. Aegaron with additions by C. Knoblauch.*

Fig. 3. *Unit FH prior to the excavation, looking north. The HU/MFA "South Wing Inner Enclosure" is visible in the background. Image: L. Bestock.*

The firing structure is a circular wall with an opening to the south-west. It was constructed in a pit sunk into the slope (Figs. 4–5) and built from sundried mud bricks with dimensions of 33 × 16 × 8 cm.[3] The walls were a single brick's thickness and consisted of courses of stretchers with thick layers of mud mortar. The interior face of the wall was coated in a layer of mud mortar up to 0.5 cm thick (Fig. 6a–b). The base of the wall has an estimated minimum external diameter of 196 cm (assuming a wall width of one stretcher all the way to the base) and an internal diameter of 160 cm. It is preserved to a maximum height of 143 cm (or thirteen courses) at its back and 70 cm (five or six courses) either side of the entrance. The wall tapers out evenly from the lowest course, and the radius at the top of the wall is around 5 cm wider than at floor level. The space between the wall and the sides of the pit had been filled with excavated spoil, pottery debris, unfired pottery, and charcoal, although we only excavated the very top of the pit.

The internal face of the wall exhibits significant burn damage due to exposure to heat. The bottom 1 m of the wall is coloured black to dark purple, indicating higher temperatures and direct exposure to the heat source. In contrast, the upper sections of the wall are light red resulting from lower temperatures and indirect exposure to the heat source. There are also patches of unbaked or low-baked brickwork, which represent the remnants of destroyed internal features (Figs. 4, 6c, 7).

Around the wall, at four roughly equidistant points between Courses 2 and 8, we observe stumps of features that project into the interior (Fig. 6c, 7 d–f). Each stump is a single brick length wide and is bonded with the main wall. The lowest two courses consist of two headers that project 3.5 cm (Course 2) and then 9 cm (Course 3) from the wall. Although Courses 4–8 are no longer preserved, the existing bonds in the brickwork suggest they consisted of alternating layers of stretchers and headers. Atop the uppermost course lies a 5 cm thick layer of mud plaster, representing a horizontal surface. The four features appear to represent pairs of corbels or corbel-supported arches converging at the centre of the chamber, which would have created a robust cruciform structure with a flat top (or floor) that divided the structure into upper and lower chambers. The top of this floor was situated 115 cm above the base of the structure. The entire feature was evidently covered with mud plaster, likely to enhance its rigidity.

3. The brick size is here slightly smaller than that of the contemporary kiln at Abydos South; see V. Smith 2010, p. 134.

In the angle between the corbels at Courses 6–8 were three additional features (Fig. 7a–c). Each feature was a single stretcher in width, three courses high, and was integrated with the main wall using a leaning brick in the lowest course. These bricks were supported by small pieces of unworked limestone. We hypothesise that these features are remnants of springers from low arched elements with flat tops that projected inward. Their intended purpose was to support the cruciform structure and increase the floor's surface area. It is possible that a fourth arch existed in the wall above the entrance. Overall, eight arms of flooring radiated outward from the centre of the feature. Firing patterns on the wall indicate that gaps were intentionally left between these arms.

The base of the wall rested on a thin layer of cultural material used to create a level building surface (Figs. 5 [sections], 8). On top of this was the floor of the lower chamber, a thick layer (10 cm) seemingly composed of lime plaster or solidified ash hardened through firing.[4] A 60 cm wide opening to the south was at ground level. The hole was flanked on the north side by a low brick wall coated with heavy mortar with horizontal finger smoothing still plainly visible (Fig. 9). Above this was a flat stone that appears to have been incorporated during a secondary configuration of the entrance. The excavation on the other side of the entrance was incomplete. A 1.5 m long staircase was cut from the hillside in three shallow steps leading down to the opening from the south-west.

On either side of the doorway were horizontal layers of ash and charcoal 50 cm deep. Above these were dumps of halfa grass, a piece of well-preserved bark from an acacia tree, mud seals from "beer jars", and fish bones that look like the remains of a meal. The excavations around the circumference of the structure were incomplete but uncovered the remains of many partially burnt pottery sherds as well as unfired pottery sherds, tools, and charcoal.

4. This has to be scientifically tested. See S. Smith 2014.

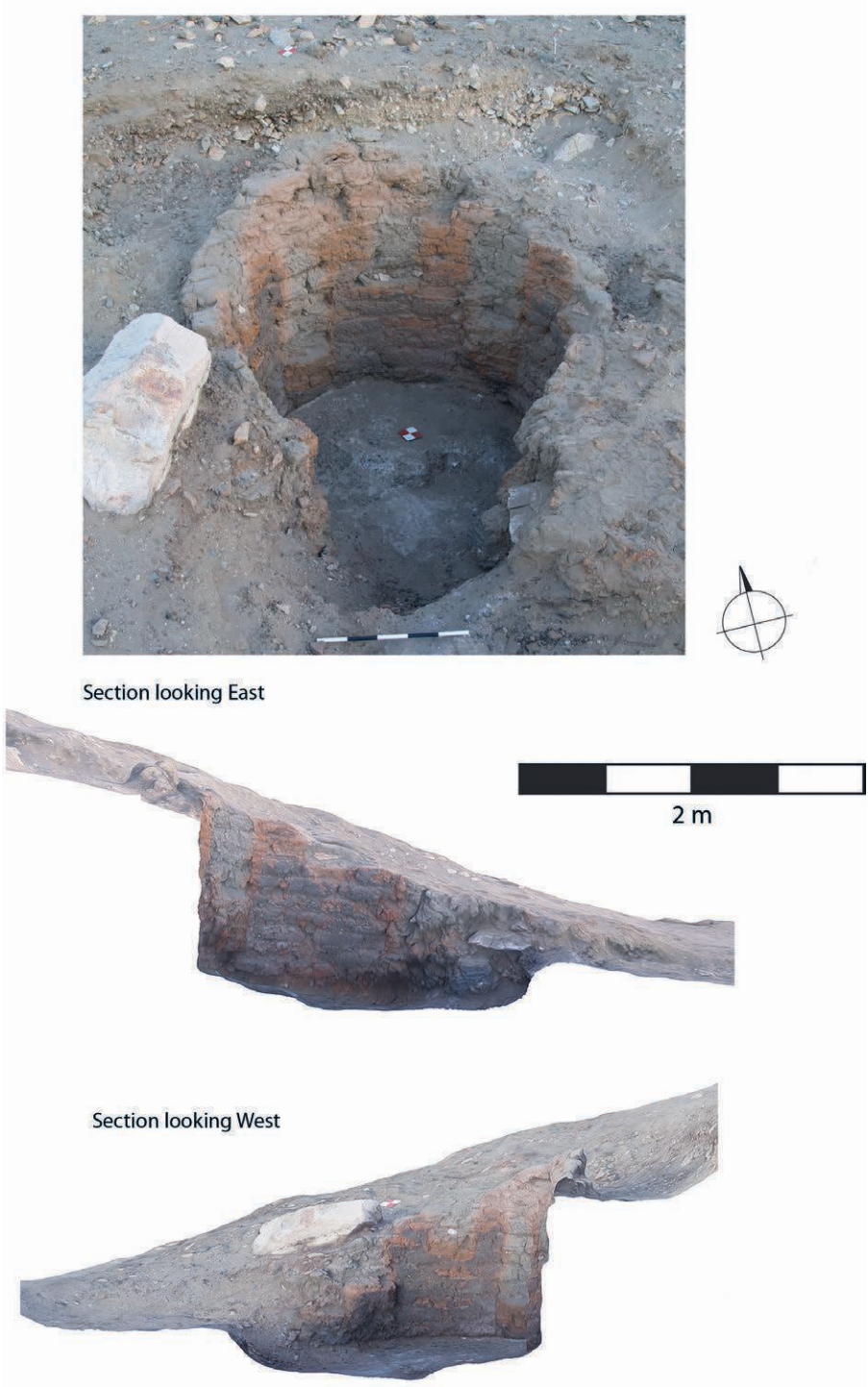

Fig. 4. *Unit FH during the excavation. Photogrammetric sections: E. Levine; image: C. Knoblauch.*

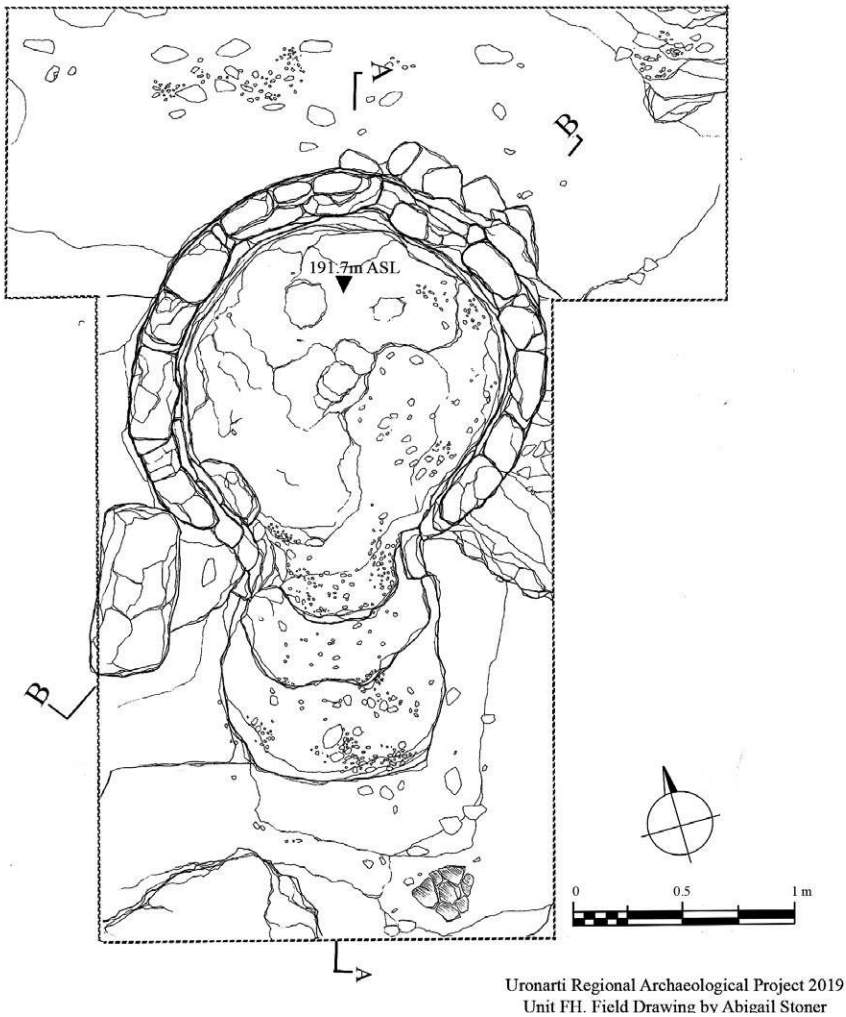

Fig. 5a. *Plan of the kiln in Unit FH after the end of the excavation in 2019. Field drawings: A. Stoner; additions: C. Knoblauch.*

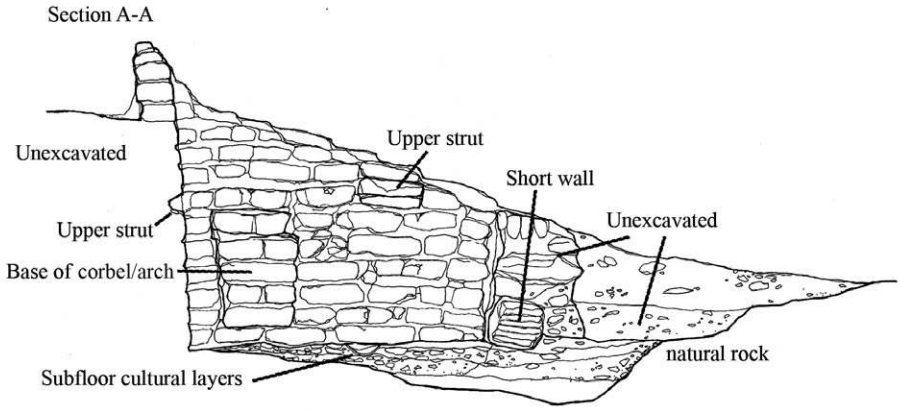

Fig. 5b. *Section of the kiln in Unit FH after the end of the excavation in 2019. Field drawings: A. Stoner; additions: C. Knoblauch.*

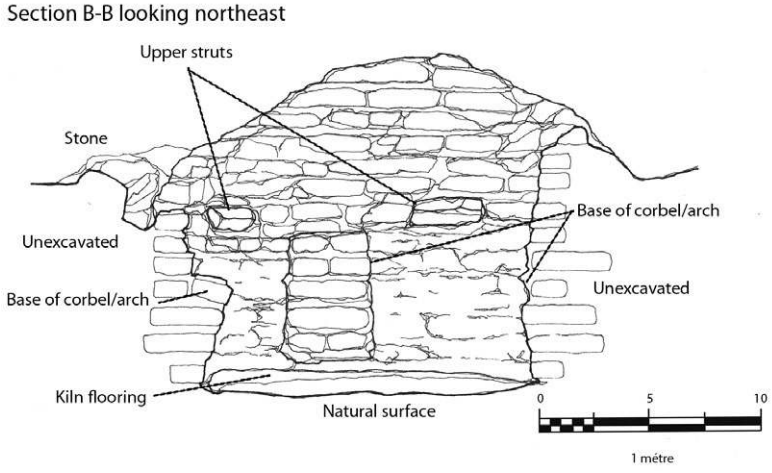

Fig. 5c. *Section of the kiln in Unit FH after the end of the excavation in 2019. Field drawings: A. Stoner; additions: C. Knoblauch.*

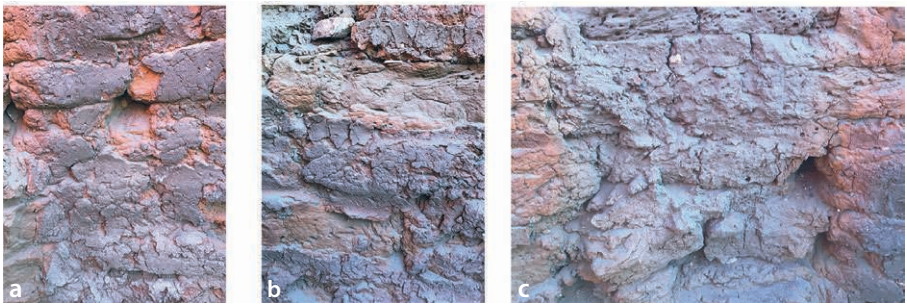

Fig. 6a–c. *Semi-vitrified mud bricks with overlying, burnt mud plaster from the combustion chamber. In (c), the plaster has fallen away in parts to reveal the lower fired brickwork behind. c. Unbaked brickwork and mortar belonging to the stump of a now destroyed internal feature that supported and formed the kiln floor ("Strut 3"). Photo: URAP; image: C. Knoblauch.*

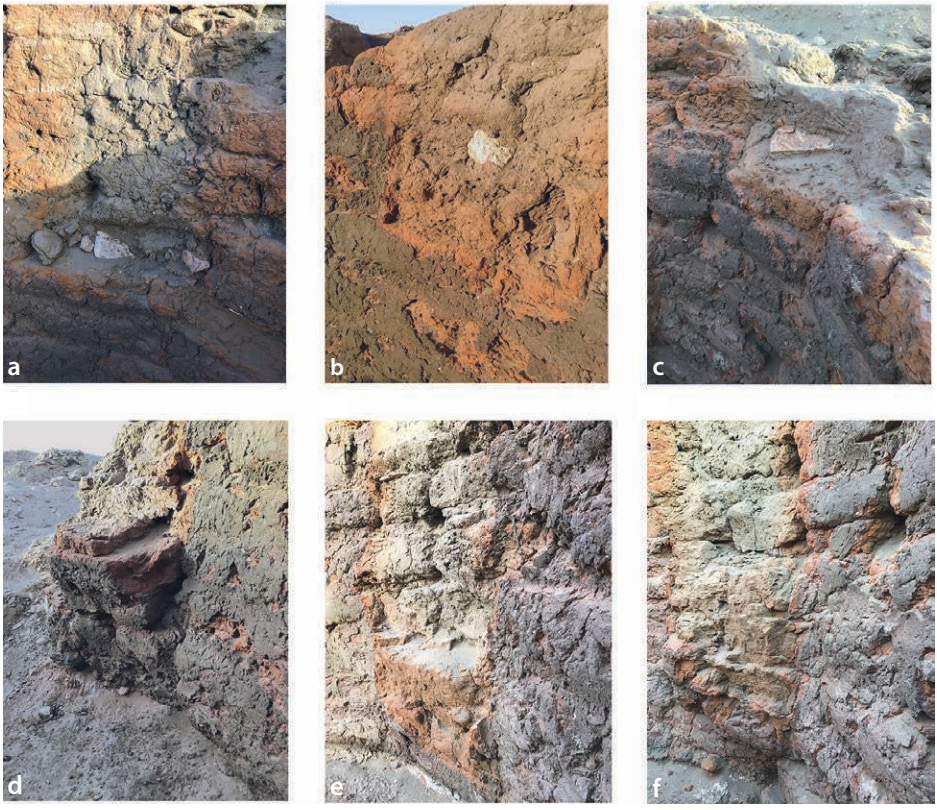

Fig. 7. *Details of internal features.* **a–c.** *Detail of upper ring of supports showing unbaked shadow of features and limestone fragments in the lowest course, presumably to support a springer for a low arch.* **d–f.** *Detail of lower ring of supports: (d) shows a well-preserved example of corbelling with a thick layer of mortar on the uppermost bricks; (e–f) were both no longer preserved, but their outline and basic structure is still visible. Photo: URAP; image: C. Knoblauch.*

Fig. 8. *Details of the lowest course of brickwork and underlying levelling layers containing cultural materials. Photo: URAP; image: C. Knoblauch.*

Fig. 9. *Details of construction at the opening of the kiln. Photo: URAP; image: C. Knoblauch.*

Analysis

The structure in Unit FH exhibits many characteristics typical of pottery kilns found in archaeological excavations.[5] Additionally, aspects of its design closely resemble depictions of kilns in tomb artwork.[6] Together with direct evidence of pottery production (see *infra*) and the lack of indications of other high-temperature industries, this strengthens the identification of the structure as a pottery kiln. Following Paul Nicholson, there were two main types of pottery kilns during the Middle Kingdom: box kilns, where the load is enclosed by a wall and the fire is either in the walled space or outside and drawn through an opening in the wall; and the updraught kiln, consisting of a combustion chamber, where the fuel was burnt, with a firing chamber above it where the pottery load was fired by the upward movement of hot gasses through a perforated floor that separated the two chambers.[7] Most known Middle Kingdom kilns belong to the updraught type, similar to the Uronarti kiln, but the latter is particularly well preserved. This preservation provides an opportunity to explore various aspects of its design, construction, and functionality in detail.

It is uncommon for an Egyptian updraught kiln to be preserved well enough to accurately assess its shape, which can then be compared to kiln representations found in ancient artwork. The overall shape of the Uronarti kiln is an inverted, truncated cone that widens towards the top evenly from the lowest course of brickwork (Fig. 10). Kilns that widen in this way are sometimes shown in Old and Middle Kingdom tombs[8] and are described as "V-shaped".[9] Most of these structures in the tomb scenes, in fact, have lightly concave walls that flare more towards the top. The flaring shape of the firing chamber allowed an increase in the volume of the charge and facilitated the staggering of vessels in order to avoid the development of chimneys that could damage the load.[10] V-shaped kilns can be distinguished from the cylindrical updraught kilns that taper towards the top and are commonly shown

5. List in Marchand 2014. The kilns at Serra East, Askut, and Abydos can be added to the Middle Kingdom examples: V. Smith 2006; V. Smith 2010; S. Smith 2014; Reshetnikova, Williams 2016; Wegner 2021, pp. 319–321. The nature of the oven excavated by V. Smith at Abydos has recently been questioned; see Wegner 2021, n. 53.
6. Convenient summary in Holthoer 1977.
7. Nicholson 2010, pp. 2–3.
8. See for example Davies 1900, pl. XVIII, no. 399; Steindorff 1913, pl. 84; Arnold 1976, pp. 6–9; Holthoer 1977, fig. 50, nos. 7–13; Arnold 1986; Nicholson 1993, p. 108. The "South Kiln" at Serra East appears to be of a similar design (Reshetnikova, Williams 2016, p. 496) as was one of the Old Kingdom kilns from Dakhla (Hope 1993, p. 122).
9. Reshetnikova, Williams 2016, p. 496.
10. Reshetnikova, Williams 2016, p. 496.

in Middle Kingdom tomb paintings in Middle Egypt.[11] The organisational aspects of the different kiln types, for example whether they relate to the scale of production or different work processes and communities of practice, require further technical study.

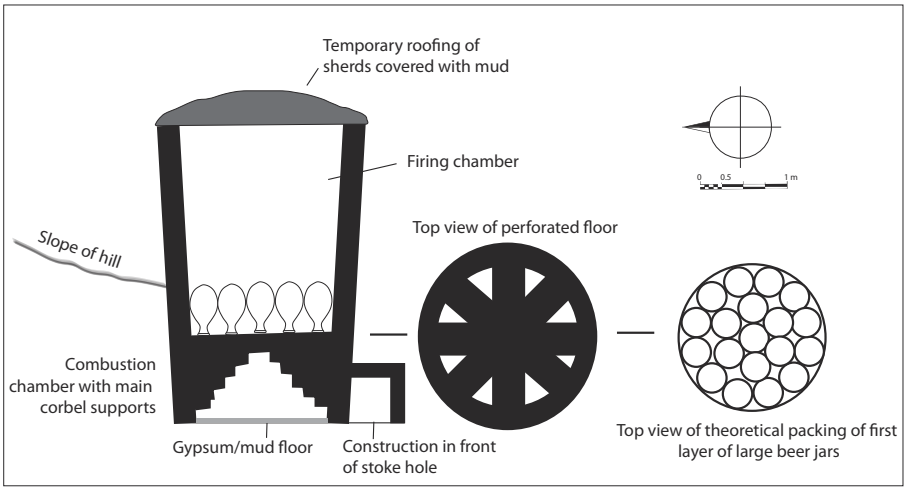

Fig. 10. *Schematic reconstruction of the Uronarti kiln assuming an overall height of 3 m. Image: C. Knoblauch.*

Estimating the original dimensions of Egyptian kilns is difficult as no complete examples have ever been excavated for means of comparison. Even estimating the height of the combustion chamber and its volume is rarely possible due to poor preservation. At Uronarti, the maximum external diameter of the combustion chamber was 1.9 m, which is close to the upper size limit for Egyptian updraught kilns. It is slightly smaller than the largest kilns in the late Old Kingdom–First Intermediate Period workshop at Balat and the Middle Kingdom workshops at Mirgissa and Dahshur, but most combustion chambers were smaller with a diameter of 1–1.5 m.[12] The maximum height of the arched combustion chamber was approximately 0.8 m.

Estimating the overall height of the kiln is conjectural and draws on the assumption that the relationship of the diameter to the height of kilns depicted in tomb scenes accurately reflects the dimensions of actual kilns. According to this formula, the kiln could have been at least 2.5 m in height and perhaps as much as 3 m.[13] The height of the firing chamber alone was probably between 1.35 and 1.85 m. The diameter of the kiln at the top was 2–2.2 m or a little wider depending on the projected height and flare. Middle Kingdom kilns are usually shown as relatively narrow and close

11. Newberry 1893, pl. XI; Holthoer 1977, fig. 14.
12. The figures are from Vercoutter 1970; Stadelmann 1983; Soukiassian et al. 1990.
13. Using the lower ratios suggested in Soukiassian et al. 1990, pp. 62–65.

to the height of a standing figure, but the Uronarti kiln is evidently taller and wider, and is more like the very large New Kingdom kiln shown in the tomb of Kenamun at Thebes.[14] The minimum volume of the firing chamber would have been 3.2 m^3, while a higher firing chamber would increase the volume to around 4.9 m^3.

The division between the combustion chamber and the firing chamber was a heavy, permanent floor (chequer/grate) formed by eight supports projecting inwards from the kiln wall with which they were fully bonded. The construction of the wide and heavy chequer of the firing chamber that rested on projections springing laterally from the kiln wall without the aid of a central support pillar corresponds to "*type 4*" or "*type 5*" in the kiln typology developed for late Old Kingdom to First Intermediate Period kilns at Ain Asil.[15] This seems to have been the regular design for firing chamber floors during the Middle and New Kingdom, though there is usually only limited information about the construction technique available. A review of publications suggests that there was considerable variation in the construction of the main floor supports forming the weight-bearing cruciform structure, and this is the first time that the upper ring of supports have been observed for the Middle Kingdom.[16] The omission of a vertical and centrally placed floor support system common in earlier structures was intended to remove obstructions from the firing chamber and to make raking out the chamber easier.[17]

The combustion chamber was fed and the atmosphere controlled by a stoke hole at ground level that was directed to the south-west away from the very strong north wind at the site. Further protection was offered by a short construction around the opening. The control of wind conditions during firing was evidently a concern, and the kiln had been placed in the most wind-still place on the fortress hill. The primary

14. Davies 1930, pl. LIX.
15. Soukiassian et al. 1990, p. 58, fig. 30.
16. The precise construction of the floor supports of published kilns is often impossible to determine based on the plan alone. The "struts" or "pillars" theoretically could either be the bases of corbels or vertical pillars that supported horizontal brickwork (Soukiassian et al. 1990, p. 59, Type 5). The construction of the Uronarti supports might have been a mixed construction with arches supported on struts, such as in *four* 623 at Balat (Soukiassian et al. 1990, fig. 30, pl. 9.2). They do not seem to be proper arches as in the cruciform arch structure that formed the perforated floor of a kiln at Dahshur (Stadelmann 1983, pp. 228–230, fig. 3, pl. 268). They are different of the small "struts" that probably supported "fire bars" of clay or stone forming the perforated floor in the Amarna kiln in the house of Ramose (Nicholson 1995b, p. 228). That even larger kilns could have had a "floating" floor of this type has been demonstrated by experimental archaeology (Nicholson 1995a). The variation in the flooring situation of Middle Kingdom kilns was considerable: the Abydos *shena* kiln had only three "struts" (V. Smith 2010, pp. 134–137); the Serra East kiln had four non-bonded struts supporting low arches (Reshetnikova, Williams 2016); the construction of the floor support at Mirgissa were different again (Vercoutter 1970, fig. 24). For the floor of New Kingdom Amarna kilns, see Nicholson 1995b; Nicholson 2010, p. 5. For further details about New Kingdom kiln construction, see Barahona Mendieta et al. 2019, Table 1.
17. Nicholson 2010, p. 5.

purpose of the channel leading to the stoke hole would have been to provide access for the potter to the firing chamber for adding fuel and oxygen, and raking out.[18] The kiln was insulated during firing by the mud-brick material as well as the thick mud plaster on the internal walls and the gypsum floor, all fired hard through use.[19] The kiln was also dug into the slope of the hill, which in addition to supporting the weight of the brickwork insulated the lower half and prevented cracking caused by rapid temperature changes and temperature differences between the interior and exterior.[20] A single firing of the kiln would have required very large amounts of fuel.[21] According to macroscopic analysis of organic materials found around the kiln, this was mainly grasses, perhaps halfa grass (*Desmostachya bipinnata*).[22]

At three places around the circumference of the feature, at the height of the Course 4, small gaps (about 5 cm) were left between the bricks (Figs. 7f, 8). If they are intentional features rather than sloppy work or of post-depositional origin (perhaps animals), they may have held organic materials used to support the floor during construction, but it is also possible they are a technical feature related to the function of the lower chamber, for example vents to better control the firing atmosphere. Such features have never been noted archaeologically, although they might be related to unusual features in some kiln representations. For example, a red hole is depicted at the rear of an early Middle Kingdom tomb model,[23] and fire is shown springing through the walls of a firing structure at Deir el-Bersha.[24]

The design of the permanent floor of the firing chamber indicates that the loading and unloading of pottery were carried out through an opening at the top, following the removal of a temporary roof, as seen in depictions from the Beni Hasan tombs.[25] Given the kiln's height, the process likely required the use of the slope into which the kiln was excavated. Potters would have utilised this slope to access the top of the kiln easily. Additionally, standing within the kiln itself would facilitate careful packing and unpacking.

18. Dahshur, Kiln 1; see Stadelmann 1983, p. 228.

19. Egyptian mud bricks have a quartz content of 60–70% (Kemp 2000, p. 81). Quartz has refractory properties that protected the kiln from thermal shock caused by constant temperature fluctuations (Golani, Asscher 2023).

20. Reshetnikova, Williams 2016, p. 494. See also Arnold 1976, p. 8; Soukiassian et al. 1990, p. 49.

21. An experimental firing of an updraught kiln of similar design and smaller dimensions required 191.55 kg of fuel; see Nicholson 1995a, p. 254.

22. Not scientifically tested yet.

23. Tomb of Karenen, Saqqara; see Holthoer 1977, p. 11.

24. Tomb of Djehutyhotep; see Griffith, Newberry 1895, pl. XXVII, no. 2. This might not be a pottery kiln.

25. See Newberry 1893, p. 7, pl. XI, XXIX; Holthoer 1977, pp. 13, 15; Nicholson, Doherty 2016, p. 445. A loading hole in the side of the firing chamber is sometimes depicted in the Old Kingdom hieroglyph for "kiln" (Holthoer 1977, p. 8, fig. 5a) but does not occur in the Middle Kingdom.

Because of the state of preservation of Egyptian kilns, the nature of the temporary roofing of the firing chamber is a subject of speculation.[26] At Uronarti, these coverings (or "dampers") appear to have been composed of layers of pottery sherds, based on the hundreds of burnt pottery sherds coated in soot dumped around the sides of the kiln (Figs. 11, 12f). These are not "wasters" or "cooking pots" but sherds that have been secondarily burnt and then discarded around the sides of the kiln. The use of pottery sherds for this purpose in ancient Egyptian kilns has been previously proposed based on the modern practice of some potters in Egypt and elsewhere,[27] and the damper of a kiln painted in a Middle Kingdom tomb at Beni Hasan was almost certainly composed of this material.[28] The practice is both economical and functional as it reduces spoilage by trapping carbon and prevents the forming of chimneys while allowing the kiln to reach temperatures of around 1,000 °C, well in excess of the firing ranges for Egyptian Nile silt pottery.[29] The pottery used to cover the firings in the modern-day pottery of Deir Mawas is the breakage from previous firings kept in a pile near the pottery kiln.[30] The practice at Uronarti was obviously more flexible and included recycling workshop and household waste, and resulted in the formation of middens of burnt sherds around the kilns themselves. Such middens of secondarily burnt sherds have presumably often been found in connection with ancient Egyptian pottery kilns but were either not reported or misidentified.[31]

The vessels to be fired would have been placed upside down in the combustion chamber to catch the gases and slow their upward movement (Fig. 10).[32] Three small round balls of fired silt pottery with a diameter of around 2–3 cm found in the debris of the kiln interior close to the floor may have been spacers used to support vessels and reduce points of contact in the packing of the firing chamber (Fig. 11c).[33] Fragments

26. Arnold 1976; Nicholson 1993, p. 109.

27. Nicholson 1995c, p. 295.

28. Tomb of Amenemhat, Beni Hasan Tomb 2; see Montet 1911, p. 2, figs. 1–2 (note the curved red objects lain in layers with the interior side downwards: they are not vessels fired in the kiln, as these are always shown complete to illustrate the success of the firing). The shape of the roof and its texture is well illustrated in the 18th-Dynasty tomb of Kenamun (Davies 1930, pl. LIX). Different sources for the roofing construction are discussed in Arnold 1976, p. 8, n. 21; Nicholson 1993, pp. 108–113; Reshetnikova, Williams 2016, pp. 496–497, n. 38.

29. Nicholson 1995a, p. 242.

30. Nicholson 1995c, p. 297.

31. Rainer Stadelmann found many burnt sherds around the kilns he excavated at Dahshur, which he interpreted (1983, p. 228), without presenting evidence, as the waste from large scale cooking rather than as a technical feature of pottery production.

32. Nicholson, Patterson 1989.

33. They might have had a similar function to the small cones of pottery discovered by William Flinders Petrie at Memphis (1911, p. 35, pl. XVIII, no. 212), that he thought were used to space vertically packed bowls. They were kept in place by a dob of wet clay applied to the vessel base.

of two partially vitrified trays of silt may have been kiln furniture used to protect and support vessels in the packing of the kiln (Fig. 13).[34] The quantity of vessels that could be fired in a single firing varied according to the size and shape of the vessels, and the combination of vessel types. The Uronarti potters produced a range of vessel sizes (see *infra*) including both small bowls (6 × 12 cm) and large jars (32 × 48 cm). Clearly hundreds of the smaller types could be fired at once, and if the height of the firing chamber was 1.5 m, three layers or around sixty large jars could be baked in a single firing (Fig. 10). As the firing of Nile silt pottery in an Egyptian updraught kiln takes only a few hours plus cooling times, two or more firings could have been conducted each seven days,[35] meaning that the minimum weekly output of the kiln would have been one hundred and twenty large jars or thousands of the smaller shapes.

Fig. 11. *Secondarily burnt sherds found around the kiln that are probably the remains of temporary roofings of the kiln during firing. Photo: URAP; image: L. Bestock and C. Knoblauch.*

34. As is visible in a kiln at Medamud; see Barahona Mendieta et al. 2019, fig. 8.
35. Nicholson 1995a, p. 260, for a modern week. The Egyptian week was ten days long.

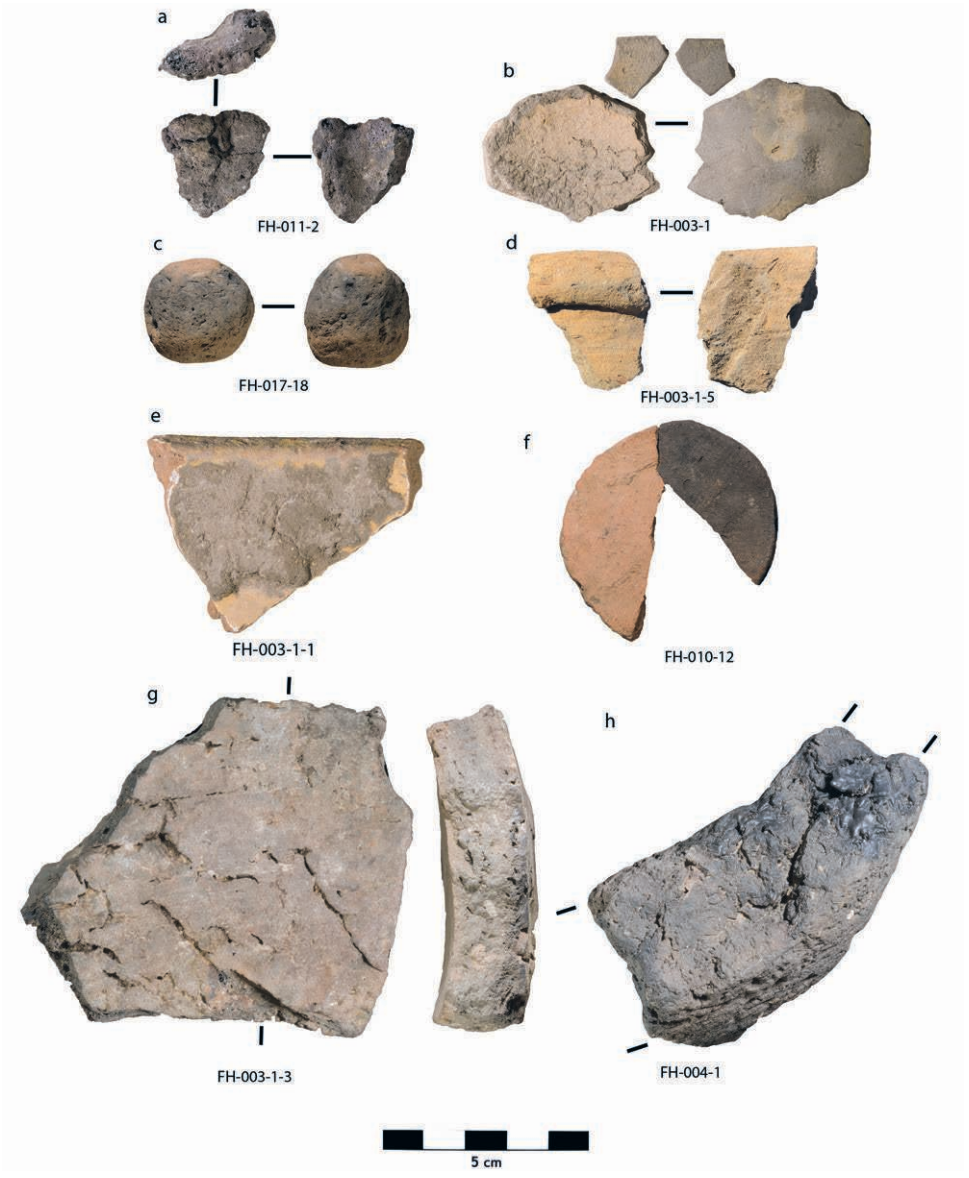

Fig. 12. *Finds from around the sides of the kiln above the construction pit:* **a.** *Overfired bread mould waster;* **b.** *Fragment of an unfired cup with yellow coating on the interior and drips of yellow coating on the exterior;* **c.** *Ball made from a reworked pottery sherd, possibly used as a spacer in kiln packing;* **d.** *Rim sherd of unfired beer jar with yellow coating;* **e.** *Rim sherd of unfired basin with yellow coating. Remains of clay on interior;* **f.** *Pottery tool of marl clay (it was evidently broken, and part of it was used in the roofing of the kiln while the other part was discarded next to the kiln);* **g.** *Semi-vitrified body sherd of a beer jar;* **h.** *Semi-vitrified body sherd of a beer jar. Photos: URAP; image: C. Knoblauch and L. Bestock.*

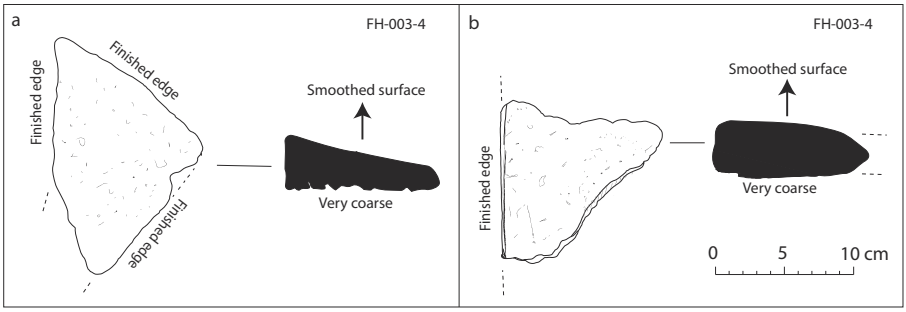

Fig. 13. *Semi-vitrified objects found around the kiln. These are possibly kiln furniture used to assist the packing of the kiln. Drawings and image: C. Knoblauch.*

Locally produced pottery

Our knowledge of the repertoire of local production is based on a small number of wasters (n = 2) and forty-four sherds of unfired pottery vessels found in original archaeological layers around the sides of the kiln, above the filling of the sides of the construction pit (Figs. 12, 14). The sherds are all Nile silt, a clay resource that occurs throughout the cataract area and the commonest clay type at Uronarti, where it constitutes between 80 and 95% of random and non-random samples.[36] The potters produced standard fabrics (Nile silt B1, Nile B2/C1, Nile C1) that are macroscopically similar to those produced in the Egyptian Nile Valley.[37] Three different building methods are so far attested: making over a mould; wheel-coiling; and throwing on a wheel with round bases finished by hand. Some of the vessels were covered with a yellow ochre coating or slip which turned red when fired.[38] One of the vessels had a thin layer of white beneath the yellow that might be an undercoating.[39] The quality of production is high and represents specialist production (see discussion *infra*).

The Uronarti potters produced at least four shapes: conical bread moulds (Figs. 12a, 14; FH-003-3-4; Fig. 15); large "beer jars" with "yellow" coating (Figs. 13d, 14; FH-003-1-5) as well as plain surface (Fig. 16); small hemispherical-shaped drinking cups (Figs. 12b, 14, 17; FH-003-3-3, FH-003-1-4); and deep basins (Figs. 12e, 14; FH-003-1-1). These are amongst the most common forms of Middle Kingdom pottery at Uronarti: bread moulds were used for the baking of sticks of bread that were the basic unit of ration

36. By both weight and sherd count; see Knoblauch, Bestock 2013, pp. 118–119, 126.
37. The definition of fabrics is according to the Vienna System; see Nordström, Bourriau 1993. A petrographic study to help distinguish local production from imported production is planned.
38. This explains the discrepancy between the frequent occurrence of a yellow coating on unfired pottery despite its absence on fired pottery; see Rose 1989, p. 90; S. Smith 2014, pp. 115–116.
39. See the discussion in Rose 1989, p. 90.

for soldiers at the fortress;[40] beer bottles were used for the short-term fermentation and distribution of "beer", which alongside bread formed the basis of the ration system;[41] hemispherical-shaped cups were the classical drinking cup and are probably to be associated with the *ḥnw* vessel, 1,400 of which are listed in a Middle Kingdom supply list at a ratio to other types of roughly 10:1.[42] The vessels were extremely thin-walled and fragile, and, to judge by the huge number of cup sherds on all Middle Kingdom sites, including Uronarti, had exceptionally high breakage rates thus requiring constant replacement.

Importantly, workshop production was not limited to pottery vessels. The excavations of the kiln revealed thirty-three small tubes of unfired, fine Nile silt (Fig. 18). They are about 4 cm long, 1 cm thick in the middle, and were formed on a string or reed. They might be a preparatory stage in the production of blanks for mud seals for papyri or other items.[43] Alternatively they might be beads[44] or hair appliques for figurines whose manufacture also took place in pottery workshops.[45] A convincing explanation, however, is outstanding.

Date of the kiln

Ceramics indicate a limited period of use for the kiln not long after the foundation of the fortress in the reign of Senusret III during the last third of the 12th Dynasty.[46] Pottery from the thin cultural layer beneath the kiln wall, the unfired pottery sherds around the kiln, and the pottery used to roof the kiln during firing are of the same "ceramic phase" (Fig. 14 = Uronarti Phase I). This is the earliest phase at the fortress and starts with its foundation during the earlier part of the reign of Senusret III. Uronarti Phase II material, which for convenience is equated with the end of the 12th Dynasty and the early 13th Dynasty, is not present and is largely absent from the surrounding surface debris, suggesting the operation of this kiln had ceased by the time this new tradition appeared. While this is very inexact, we propose that the kiln might have been operational for a couple of decades at the very longest.

40. Ration tokens in the form of bread sticks have been found in the fortress; see Dunham 1967, pp. 34–35, 37, pls. XXVII–XVIII; Oppenheim et al. (eds.) 2015, p. 168.
41. On rations, see Mueller 1975.
42. Bourriau, Quirke 1998; Collier, Quirke 2006, pp. 70–73.
43. Reisner 1955, p. 27, Type C seal; von Pilgrim 1996, p. 238, fig. 94; Wegner 2007, p. 300, Type 1.
44. Dunham 1967, pl. XCI.D.
45. Soukiassian et al. 1990, pp. 85–128; Marchand 2014, p. 202, n. 4.
46. The date for the foundation of the fortress is given according to the stela; see Janssen 1953; Obsomer 2017.

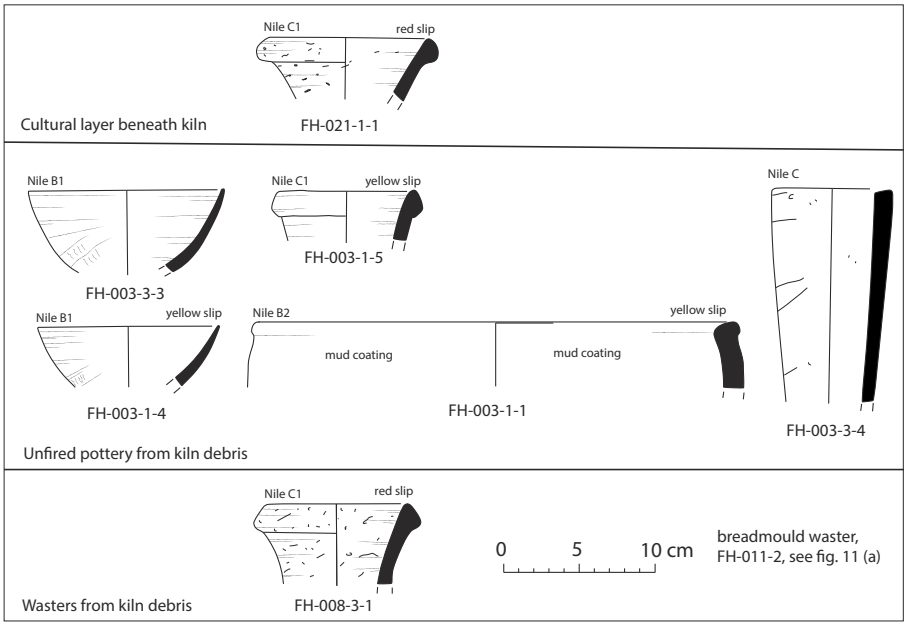

Fig. 14. *Pottery associated with the foundation and use of the kiln. Drawings and image: C. Knoblauch.*

Fig. 15. *Unfired bread mould sherds. Photo: URAP; image: L. Bestock and C. Knoblauch.*

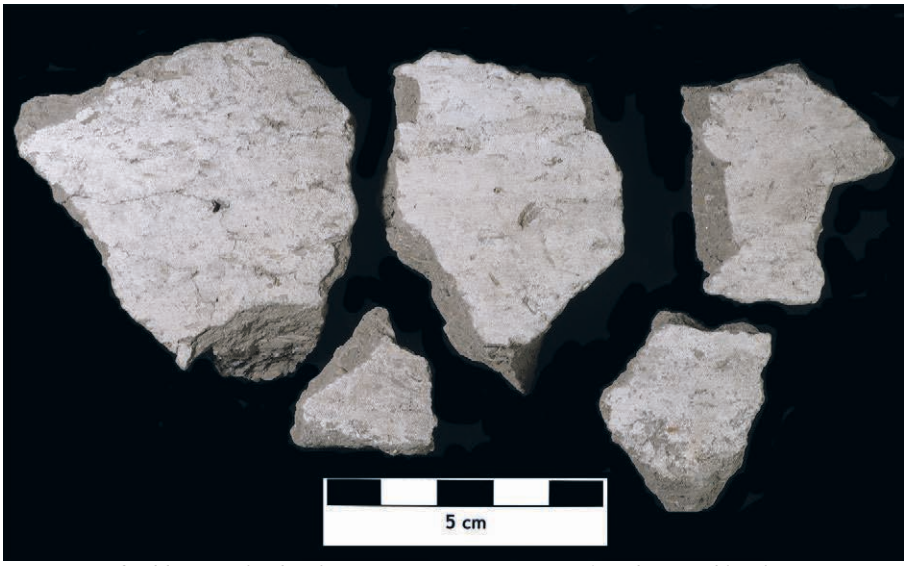

Fig. 16. *Unfired beer jar sherds. Photo: URAP; image: L. Bestock and C. Knoblauch.*

Fig. 17. *Unfired cup sherds. Photo: URAP; image: L. Bestock and C. Knoblauch.*

Fig. 18. *Unfired clay/mud objects. Photo: URAP; image: L. Bestock and C. Knoblauch.*

Discussion

Models for the production and supply of Nile clay pottery to the Middle Kingdom Nubian forts have changed dramatically in the last two decades. Similarities of pottery from the forts to that in the Residence in Lower Egypt were initially interpreted as evidence for mass pottery deliveries to Nubia from that region.[47] More recently, direct and indirect evidence for local pottery production at the forts has been re-evaluated, and it is now accepted that the scale of local production was previously

47. S. Smith 1995; Bourriau 1998, pp. 195–198. See also discussions in Aston 1998; Knoblauch 2007.

underestimated.[48] The evidence for a kiln at Uronarti supports the claim for *in situ* production of Nile silt pottery and adds new evidence for reconstructing the local context of production as well as the network of production and supply covering the area of the Semna cataract during the period of its operation.

The local context of production (Fig. 2)

The kiln excavated by the URAP is one of three "furnaces" in a line along the slope of the outer fortress parallel to the eastern perimeter wall. Based on the limited documentation, the other two structures were approximately the same size or a little larger but have different designs. The middle structure has a stoke hole at ground that is oriented to the south-east, not the south-west. The westernmost kiln is set slightly apart from the first two and does not have a stoke hole at ground level. Assuming the drawing is correct, it may indicate that the combustion chamber was sunk into a pit with a stoke hall set at a higher level, as known from a large Middle Kingdom kiln at Mirgissa or the "North" kiln at Serra East.[49] It is unclear whether all kilns were used contemporaneously or whether they attest to multiple generations of pottery production in the same area.

The wider area of the kilns, where one would expect to find the workshops and accommodation for the potters, was excavated rapidly at the end of the final HU/MFA season (1930), and the record is poor. Directly adjacent to the kiln area in the west, and possibly built in consideration of the placement of the westernmost of the kilns, was a building (HU/MFA "Rooms 189–196") tentatively identified by the excavators as accommodation for personnel not admitted to the interior of the fortress or a workshop.[50] Neither the published architecture nor finds are helpful in settling this matter, but given the placement right next to the kilns, both alternatives are tenable and not mutually exclusive. The building consisted of a walled courtyard with covered verandas on all four sides resting on "crude" column bases ("Room 195") and some smaller rooms. Shallow rectangular tanks lined with large stone slabs in the building directly to the south (built over by "Room 200") are listed as "magazines" but they might be trampling pits,[51] similar to the ones found filled with clay near to the pottery kilns at Serra.[52] A further two "magazines" were built directly below the kilns against the eastern perimeter wall.[53]

48. Knoblauch 2007; Knoblauch 2011; S. Smith 2012; S. Smith 2014; Reshetnikova, Williams 2016.
49. Vercoutter 1970, p. 80, fig. 24; Reshetnikova, Williams 2016, fig. 3.
50. Dunham 1967, p. 11.
51. Arnold 1993, pp. 12–13; Bourriau et al. 2000, pp. 123–124.
52. Reshetnikova, Williams 2016.
53. Wheeler 1929–1930, p. 28.

A large (20 × 12 m) building occupied the slope directly above the kilns and was connected by a wall to the "workshops" (Fig. 2; storage?). Its monumental presence and the occurrence of official seals and "stamp seals" suggest it played a significant role in the economic and administrative running of the settlement, reflecting in some way its deliberate placement "between" the inner and outer fortress next to the main gate (HU/MFA "South Wing Inner Enclosure", "Rooms 176–187").[54] The southern two thirds of the building were filled with nine, 40 cm thick parallel walls set 1 m apart that might be part of a freestanding complex of eight, long, narrow chambers placed in a courtyard.[55] The finds included dense, non-random concentrations of mud/clay "stamp seals" as well as "locally" produced micaceous slipped pottery vessels (mostly lids and stands), which arguably should date just after the period of operation for the Uronarti kiln. Both the architecture and archaeological finds indicate that the building was a centrally administered storehouse for goods that did not require the same level of security as items stored inside the fortress in the treasury and granary. Following its proximity to the kiln site and the concentration of clay-based products, this may have included maintaining inventories of locally produced pottery.[56]

This building is a good candidate for the fortress' *wḏꜣ* (storehouse), one of the four major institutions of the Middle Kingdom fortresses that occupied an almost identical position at the fortress of Askut, also in connection with pottery production.[57] In general terms, the *wḏꜣ* was attached to state-run towns as a central collection point, store, and distribution centre for diverse goods including subsistence items, raw materials, tools, and weights.[58] Considering the proximity to the pottery production area at both Uronarti and Askut, it is likely that the officials of this institution were not only responsible for receiving pottery but acted as intermediaries between the administrators of the fortress and the producers, assembling lists of items that needed replacing, taking receipt of the produced items and ensuring they met requirements, and then organising their distribution.[59]

The scale, purpose, and institutional context of pottery manufacture at Uronarti, alongside what evidence we have for potters during the Middle Kingdom, suggests

54. Dunham 1967, p. 11. For a discussion of the stamp seals, see Wegner 1995.
55. Dunham 1967, p. 11, pl. VI.B, Map III. The series of long parallel walls are superficially reminiscent of the closely packed, short parallel walls overlain with mats of a "drying facility" for agricultural produce and fish at Buto (Hartung et al. 2016, pp. 80–82). See also a similar arrangement in a "fish drying facility" at Giza where the roof is supported by columns embedded in the "benches" (Lehner 2002, pp. 42–46).
56. The concentration of micaceous-slipped vessels here (n = 21) is noteworthy in this regard; see Knoblauch 2011, pp. 174–175.
57. Gratien 1995, pp. 158–159. For Askut, see S. Smith 1990, pp. 213–214; S. Smith 2014, p. 105.
58. See the discussion in Gratien 2019, pp. 112–113. See also Glanville 1932, p. 20; Simpson 1963, p. 81; Simpson 1969, p. 37.
59. A similar situation may be documented in pap. UC32193 from Kahun, where a sealer appears to oversee three potters who provided pottery for the town; see Collier, Quirke 2006, pp. 70–73.

they were probably a small group of specialists in the employ of the state who practiced their craft full-time in exchange for a wage.[60] They may have been male based on the evidence we have for attached potters during the Middle Kingdom.[61] They might be classified as attached specialists partaking in administered production. Their *chaîne opératoire* and output are macroscopically similar to that of other major Middle Kingdom centres in the Egyptian Nile Valley and demonstrate that they belonged to a geographically widespread community of practice that included the Residence and parts of Upper Egypt. As this level of similarity suggests direct transfer of technical knowledge, it is likely that at least the first generation of potters at Uronarti had learnt their craft as apprentices in workshops attached to state institutions in Egypt or Nubia where a standardised pottery tradition was practiced. Like the soldiers that manned the fortress in its first phase, they may have been sent to Uronarti on assignment for a limited period before being replaced by other potters.

Uronarti was found *ex nihilo* in a remote, environmentally challenging, and geopolitically unstable region. Securing the regular supply of pottery, which was central to Egyptian lifeways for food production and the payment of rations to the fortress' garrison, was obviously an essential component of the colonisation strategy. The supply needed to be reliable, at a high volume, and regular enough so as to be able to adapt at short notice to unforeseen demands, something that long, slow supply chains back to Egypt clearly could not do.[62] As was sometimes the case in the Old and Middle Kingdom, supply was guaranteed not by the mass importation of pottery but by attaching potters to foreign missions and colonising projects.[63] Using potters trained in the tradition of the central seats of power and administration not only supported the lifeways of an expatriate community including officials from these places but facilitated the export of the Egyptian system of mass food production, and the administrative and economic system it underpinned, to Nubia. It would also enable, in theory, the reintegration of records of local transactions into regional and supra-regional centralised accounts using standardised types with comparable volumetric capacities.[64] At the very least, it would have increased transparency and consistency in accounting practices.

60. Earle 1987, p. 73.

61. This seems to have been the case for all the potters during the Middle Kingdom (Stefanović 2013) and could be confirmed through finger print analyses.

62. The New Kingdom town of Deir el-Medina received a delivery of pottery every ten days. While the quantity of pots to be delivered was notionally fixed to a combination of quantities of specific types, the composition of the deliveries was heterogenous (Frood 2003, pp. 44–45). Presumably this reflected both projected inventories and short-term adjustments and demands.

63. See for example the kilns discussed in Tallet et al. 2013; O'Connor 2014.

64. Egypt was a pre-industrial society, and standardisation must be considered a relative term. Given the mode of production during the Middle Kingdom, it is unlikely that the produce of a single potter would always have the same volumetric capacity, let alone the output of a whole workshop of potters even for a short time. Capacities only had an approximate comparability. See the discussion for the Old Kingdom in Warden 2014.

Pottery production and supply in the Second Cataract

The settlement at Uronarti was part of a 7 km long fortified border zone around the Semna cataract, consisting of five fortresses with a combined, estimated garrison strength of 350–700 men.[65] All these fortresses were probably founded during the reign of Senusret III as individual components of a coordinated system of border defence with each fortress playing a distinct role.[66] Till now, Uronarti is the only one of these border forts with direct evidence of pottery production. This could simply be an archaeological problem created by the limited excavations in the extramural areas of the other sites, and perhaps all the major fortresses originally had their own potteries (see *infra* for Askut). On the other hand, the maintenance of multiple pottery workshops in a small area with a modest population does not seem sustainable over the long term due to the significant amounts of raw materials required to operate a pottery workshop on a full-time basis.[67] Given the scale of production at Uronarti (see *supra*), the workshop could have produced sufficient pottery vessels and clay items for all the other fortresses in the boundary zone in addition to pottery for the garrison on Uronarti.[68] This would complement the central role for the site that has recently been suggested on the basis of a new analysis of reports written on papyri[69] as well as its strategic placement on a well-defended island 5 km behind the actual border. Sealing practices attest to the fortresses being reliant on local networks of supply, and it is plausible that this system extended to pottery vessels and other clay products.

The nearest Second Cataract fortress to Uronarti with direct evidence for pottery production is the small fortress at Askut, 12 km north of Uronarti, roughly halfway between Semna and the major fortress and trading town at Mirgissa. The evidence consists of the head of a pottery wheel, wasters, unfired sherds, and three structures identified as pottery kilns.[70] While their design and construction are related to the updraught kiln type also present at Uronarti, they are much smaller and represent a different scale of production as measured by labour investment, output, and

65. There are no clear criteria for accurately estimating the population of a single fortress, let alone the entire region. The figures are for illustration only and are based on the intuition of George Reisner (1929, p. 72), with the addition of an estimated twenty-five (low) and fifty (high) man garrison for both Shalfak and Semna South. Arguably, Askut could be added to this list. It is treated in the next paragraph.

66. S. Smith 1994; Vogel 2004; Knoblauch 2019.

67. Paul Nicholson (1995a, p. 260) has calculated that a single updraught kiln similar in design and size to the Uronarti kiln consumed 125,424 kg of fuel and 301,600 kg of unfired clay over a ten-year period.

68. The case of Deir el-Medina is instructive: the pottery supply for an estimated 1,200 people was produced by two groups of potters at any one time; see Frood 2003, pp. 39–41.

69. Kraemer, Liszka 2016, p. 40.

70. S. Smith 2014.

consumption of resources.[71] Despite this, the nature of production at both sites is broadly comparable. The Askut potters were specialists working in an administrative context who followed the same *chaîne opératoire* as the Uronarti potters to produce vessels originating in the same Middle Kingdom tradition.[72] Of course, Askut itself alone would not have required a full-time potter, and it may have only been periodically in operation by potters from another site, perhaps Uronarti or Mirgissa, who were sent to work at the smaller site for short periods of time. This could have been part of a regular system of short-term residencies with the intention of building up local surpluses at the regional centre of Askut,[73] but it may also have been irregular and ad hoc in response to short-term surges in demand around periods of construction work, seasonal goldmining at Saras, or military expeditions. For example, an Old Kingdom letter from Dakhleh Oasis requested for a potter to be sent in advance of an expedition, presumably to build up a supply of pottery.[74]

The chronological dimension of pottery production at Askut, however, presents a new perspective: the predominance of unfired material at Askut typical of Uronarti Phase II pottery (Askut very late 12th–13th Dynasty) suggests that the production of pottery there dates after the period of pottery production so far identified at Uronarti. It might represent a modification to the system originally put in place to supply the region with pottery during the reign of Senusret III. This change occurred against the background of changing economic and administrative strategies in the Nubian forts, and a demographic shift from large rotating garrisons of soldiers to smaller, permanent populations of administrators, soldiers, and their families.[75] It was also around this time that pottery production in the Second Cataract started to develop its own character combining local features and Upper Egyptian influences, with an increasing distance to Memphite production.[76] This makes it very likely that there were also substantial changes to the organisation of pottery production and supply as well as its social and administrative context in the very late 12th Dynasty to early 13th Dynasty. More data is clearly required to contextualise the developments at Askut with contemporary evidence from Uronarti.

71. The diameters are between 1 and 1.2 m; see S. Smith 2014, p. 117.
72. S. Smith 2014, pp. 112–116.
73. A similar situation might have existed at the Serra East fortress, in lower Nubia; see Reshetnikova, Williams 2016.
74. "The servant that I am says: 'Let it be made known to the mail clerk who is at the council that the potter has not yet arrived in Roudjet to prepare the trip of the head of Demiyou. That the *ka* of the mail clerk orders that a potter be sent'" (Pantalacci 1998, pp. 306–310, fig. 1).
75. S. Smith 1995; Knoblauch, Bestock 2017; Knoblauch 2017.
76. Knoblauch 2007; Knoblauch 2011; S. Smith 2012.

Conclusion

The 2019 excavations at Uronarti revealed a well-preserved updraught, pottery kiln. The kiln's functionality indicates a highly specialised and efficient production process, and a local workshop capable of producing large quantities of ceramics in a single firing. The potters using the kiln produced Nile silt pottery forms, including vessels to produce bread and beer, the staples of the Egyptian diet and the basis of the local wage/ration system on Uronarti. These findings contribute to an ongoing shift in our understanding of the economic and social context of Nile silt pottery production in Nubia during the Middle Kingdom, emphasising a localised manufacturing model that challenges earlier notions of significant importation from Egypt. While imports from Egypt were a constant, particularly for marl clays, the evidence from Uronarti suggests that most, if not all, of the Nile silt pottery was capable of being locally produced. The local context of production underscores the attached character of production in an administrative context. The scale of production indicates the strategic importance of Uronarti as a centre for regional production, and it was proposed that the workshop of Uronarti was a key element in the production and supply of pottery to the remainder of the Second Cataract forts in the early years of the colony.

The study of the Uronarti kiln has also provided new archaeological information on the design, construction, and functionality of Middle Kingdom firing structures. This includes a detailed understanding of the brickwork and other materials used to construct the kiln, a reliable estimation of the height of the combustion chamber, the method of construction of the perforated floor with an upper ring of supports, the shape of the firing chamber as an inverted, truncated cone, and the method of insulating the kiln with a layer of sherds. The preservation was such that a plausible estimate of the height and volume of the firing chamber could be proposed, which is rarely possible with archaeologically attested Middle Kingdom firing structures.

However, this work is only beginning and is so far at a macroscopic level, and there is much still to learn. Future fieldwork should include micro-archaeological analysis of the brickwork, plastering, and flooring to establish precise composition of the primary materials and their effect on the pyrotechnical functioning of the kiln as well as firing temperatures. This will be accompanied by the botanical analysis of the fuel and the petrographic analysis of the unfired sherd material stored in Khartoum. Finally, a planned project of experimental computational modelling will help to better understand the pyrotechnical qualities of the kiln, the heat transfer, and the movement of gases. Combined with excavation of the remaining kilns and associated workshops, this provides a unique opportunity to reconstruct much of the *chaîne opératoire* and ultimately a much more complex understanding of the organisation of pottery production at the site.

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