



Approaches to the Analysis of Production Activity at Archaeological Sites

edited by
Anna K. Hodgkinson and Cecilie Lelek Tvetmarken



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Preface

Anna K. Hodgkinson and Cecilie Lelek Tvetmarken

This volume contains the proceedings of a workshop entitled ‘Approaches in the Analysis of Production at Archaeological Sites’, which took place at the Topoi-House in Berlin-Dahlem on 21–22 January 2018. The workshop was the final deliverable of a Marie Skłodowska-Curie Actions Individual (postdoctoral) Fellowship awarded to one of the editors, Anna Hodgkinson, for a project that took place between October 2015 and September 2017.¹ The research project was entitled ‘Glass, Faience and Food in Late Bronze Age Societies: An Analysis of the Socio-Economics of Urban Industries in Egyptian and Mesopotamian settlements’, or GLASS.² The editors are grateful to the European Commission for financing this workshop and thus making this exchange possible. The publication of this volume has been made possible by generous financial assistance from the *Ernst-Reuter-Gesellschaft der Freunde, Förderer und Ehemaligen der Freien Universität Berlin e.V.* and the Open Access Publication Fund of the Freie Universität Berlin.

The workshop was planned in order to facilitate the exchange of experiences of, and methodologies applied by researchers involved in the analysis of archaeological remains of production activities and papers were presented by doctoral students, early career researchers as well as established scholars. The papers presented at the workshop covered a wide range of industries and manufacturing processes from several geographical regions, including material from both archaeological sites and museum collections, and from a variety of dates. In total, 16 papers were presented, including a keynote presentation on the evening of the first day, which was delivered by Prof. Cathy L. Costin (Professor of Anthropology at California State University) on the topic of ‘Locating Craft Production: Space and Place’.³ Prof. Costin is renowned for her theoretical and anthropological work on archaeological production activities, and we are very grateful for her

contribution to both the workshop and this volume. Participants presented and discussed a wide range of diverse methods employed in the analysis of several sites and their industries, covering topics such as the identification of household-level manufacture, the organisation of production, the identification and analysis of production remains, the procurement and processing of raw materials, and the people involved in the production activities and their gestures. Presentations were grouped into sessions according to material category, i.e. pottery production, glass and glazes, and stone- and bone tools and quarries, with one session focusing on case studies concerned with the organisation of various types of production involving a range of materials (e.g. household and institutionalised production). The variety of topics, the range of ancient industries, and approaches and methods presented at the workshop sparked lively debate amongst the participants. The editors are grateful to all participants for contributing to this diverse workshop and its discussions, and to the chairpersons for moderating the individual sessions, as well as to those that contributed a chapter for this volume.

While the scope of some of the contributions differ from what was presented at the workshop (for various reasons), the general focus of the individual papers remains the same. Some of the individual chapters present new, unpublished data or a first English-language presentation of the same. Other papers provide comprehensive reviews of the application of particular methods or overviews of the evidence available pertaining to a particular industry as well as reinterpretations of existing data on specific topics.

The editors would like to thank Dr David Davison, Patrick Harris, Dr Vendi Jukic Buca and Danko Josić from Archaeopress for their assistance and guidance throughout the publication process of this volume. We are also thankful to the anonymous peer reviewers for their detailed comments towards the individual papers. Our sincerest thanks are also due to Jan Picton and Alan Hodgkinson for their help copy-editing and proofreading parts of this publication.

Further thanks are extended to Prof. Michael Meyer, director of the Excellence Cluster Topoi, who not only granted his permission to carry out this workshop



¹ The fellowship was awarded through the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement no.: 653188.

² See <http://www.topoi.org/project/a-6-cofund-1/> (viewed on 5 January 2020).

³ Please refer to <http://www.topoi.org/event/43029/> for the full workshop programme and https://www.annahodgkinson.co.uk/20180120_AnalysisOfProduction_Abstracts.pdf (viewed on 5 January 2020) for the abstract booklet.

on the premises of Topoi in Berlin-Dahlem, but also welcomed the above-mentioned project, GLASS, into the research group 'A-6: Economic Space at Topoi'. The editors are grateful to the staff at Topoi and Freie Universität Berlin, who helped make the workshop possible. Angela Böhme, the secretary of the Institute of Egyptology, played a key role in organising the catering and various administrative aspects in connection with

both the workshop and this publication. Furthermore, Birgit Nennstiel shall be thanked for the design of the posters, the programme and abstract booklet, and the website. Elisabeth Kanarachou has been helpful in logistical matters concerning the workshop location. Last, but not least, the editors would like to thank all volunteers and the caterers without whom the event would not have been able to take place.

1. Introduction

Anna K. Hodgkinson and Cecilie Lelek Tvetmarken

Many of the things that humans use and consume in their everyday life have at some point been altered to suit a particular purpose, whether functional or aesthetic. Thus, production is ubiquitous and occurs in all segments of society and within a broad variety of social settings. Consequently, production is not restricted to any particular spatial or societal confines, nor does it occur only on a particular scale. It includes everything from domestic activities, such as those considered ‘mundane’ (e.g. food preparation), to mass-production on an industrial scale. Many of these activities leave traces in the archaeological record, forming the focal point of much archaeological research. Manufacturing activities were the central aspect explored in this workshop, which was planned in order to enable researchers involved in archaeological, archaeometric and other related disciplines to exchange their experiences of analysing production activity at archaeological sites. Regardless of time, culture or type of manufacturing activity, the structural and related artefactual and, if available, textual remains associated with production can provide us with a large amount of information concerning various aspects of the workflow, or *chaîne opératoire* of production and the spatial settings of such activities. Additionally, such remains provide us with an insight into socio-economic aspects, such as the organisation of manufacturing activities and the control of resources and finished goods.

Traditional research on ancient production activities, as conducted in the early 20th century, was largely concerned with a culture historical approach. Although research output from this period varies depending on discipline, culture and geographical context, it frequently adopted a typological approach, through which archaeological objects were mainly classified according to optical features.¹ These features were used by archaeologists and anthropologists to assign dates and functions to objects, and this typological classification formed the basis of evidence through which cultures were identified within the archaeological record.²

This general approach opened the way for the so-called processual archaeologists in the 1950s and 1960s, who sought to expand the scope of archaeological enquiries beyond the mostly stylistic and functional focus of past research.³ Their main criticism of previous approaches centred on what they perceived to be the arbitrary classifications of objects based on artificial groups of diagnostic criteria.⁴ Instead, they endeavoured to understand ‘how’ and ‘why’ an object had been made and used. A systems-based way of thinking and interpretation developed during this era, led by scholars such as Lewis R. Binford, who developed the so-called ‘Middle-Range Theory’,⁵ which aimed to create a link between ‘static’ archaeological objects and past dynamics.⁶ Binford himself combined his theory with ethnographic observations in order to understand patterns of human behaviour.⁷ In addition to introducing a wider array of concepts and broadening the focus of archaeological enquiries, this era also saw the use of new technologies, such as spatial and chemical analysis, to understand the composition of archaeological objects and to gather information on the organisation and control of manufacture and labour.

The 1970s and 1980s saw an increased dissatisfaction with a number of approaches and theoretical concerns advocated by processual archaeologists, such as their apparent lack of objectivity and the creation of extremely large datasets.⁸ A notable proponent of this criticism, which became known as post-processual archaeology, is Ian Hodder. He and others argued that there should be greater focus on the concept of ‘human agency’, i.e. the capacity of individuals to act and make decisions on their own behalf.⁹ Post-processual archaeology incorporated a great variety of approaches

for the sequence dating of predynastic and early dynastic Egyptian pottery.

³ Although it should be noted that this dissatisfaction with culture-historical approaches had started before the explicit formulation of the approaches advocated within the so-called processual archaeology (see, e.g., Tallgrenn 1937; as well as Trigger 1989 and references therein).

⁴ See, e.g., Binford (1964: 433); Caldwell (1959); Dunnell (1986: 152).

⁵ ‘Middle Range Theory’ was originally developed by Robert K. Merton for the field of sociology (see Cole 2004).

⁶ E.g. Binford (1962; 1981); see also Costin in this volume.

⁷ See Johnson (2010: 51).

⁸ See Johnson (2010: 56).

⁹ Bernbeck (1997: 311–314); Hodder (1985; 1995: 74); Johnson (2010: 108–109).

¹ Johnson (2010: 18–19).

² See Caldwell (1959: 303–304); Rouse (1960) and references therein. See also Adams and Adams (1991: 99–142) and Petrie (1901: 1–12) for typological case studies, William Matthew Flinders Petrie being one of the first scholars to use this method, having developed a typology

(such as gender studies and phenomenology), which were also applied to the analysis of production and the organisation thereof. It was during these years, more specifically in the late 1970s, that the concept of the *chaîne opératoire* was developed by André Leroi-Gourhan for the study of lithics. This concept comprises numerous steps, ranging from the procurement and manipulation of raw materials to the use, reuse and discard of the finished product, and has been defined by Frédéric Sellet as follows: 'Consequently, the *chaîne opératoire* aims to describe and understand all cultural transformations that a specific raw material had to go through. It is a chronological segmentation of the actions and mental processes required in the manufacture of an artifact and in its maintenance into the technical system of a prehistoric group. The initial stage of the chain is raw material procurement, and the final stage is the discard of the artifact.'¹⁰

This *chaîne opératoire* approach has subsequently been adapted by a number of scholars, including Marcia-Anne Dobres,¹¹ Heather-Louise Miller¹² and Cathy Costin, whose work has focused on the analysis and identification of craft production, the procedures and individuals involved in the processes (human agency), and the organisation thereof. Miller, for example, defines the organisation of production as 'the organizational arrangement within which production takes place. This may refer to one artisan working on an object from start to finish, or it may refer to a system of specialist workers, managers, and materials procurers'.¹³ In a similar vein, Dobres and Costin have argued for the necessity of considering the actors involved in production activities, bearing in mind that these were subject to social, cultural and natural circumstances, while also making their own decisions.¹⁴ Dobres has, furthermore, argued in favour of the concurrent use of scientific archaeometric approaches, since these may provide information on 'technical gestures and related strategic choices of artifact manufacture, use and repair'.¹⁵ Similarly, using both archaeological and ethnographic data from the Andean region, Costin has created a theoretical framework for the classification of production systems according to the level of specialisation observable in the archaeological, textual and ethnographic record. By taking into account such factors as skills and gender-

specific roles in the manufacture of a certain type of product, Costin created a classification of workshops at settlements and other sites, not all of which are visible in the archaeological record.¹⁶ This classification has been and is being consulted and applied by a wide range of scholars working in the field of ancient industries.¹⁷

Production activities often leave a number of physical traces, including, but not limited to, manufacturing tools; raw materials, e.g. clay, stone or minerals; production waste, e.g. chipped stone debitage and metal slag; installations, e.g. ovens and furnaces, olive presses and grinding stones; as well as the finished products. In addition, certain types of production have a greater impact on both the natural and the built environment in which they take place; these include activities such as quarrying and the construction of agricultural terraces and large building complexes. Dennis Mario Beck, for example, in his presentation at the workshop, discussed the organisation of marble procurement and marble object production taking place at *Simitthus*/Chimtou (Tunisia) during the Iron Age. These activities resulted in both the alteration of the natural landscape ('quarryscape') and the construction of an associated built environment through the establishment of housing for the slaves in the so-called *Arbeits- und Steinbruchlager*.¹⁸

A number of papers also considered the spatial configuration of the built environment together with other types of evidence, such as installations and tools associated with production and other material remains, including waste products and raw materials. Macarena Bustamante-Álvarez and Albert Ribera i Lacomba, for instance, discussed the evidence of the manufacture of both perfume and wool from the House of Ariadne in the Guild District¹⁹ in Pompeii (Italy). By analysing both artefactual and structural remains, Bustamante-Álvarez and Ribera i Lacomba were able to demonstrate that these two industries were linked; lanolin, a bi-product from the wool processing, was an essential raw material in the manufacture of perfumes.²⁰

In their presentation, Chiori Kitagawa and Silvia Prell also focused on multiple strands of evidence from a workshop complex at Qantir-Piramesse (Egypt) in their reconstruction of the *chaîne opératoire* of the bone tool production. The latter appeared to be mainly concerned with the manufacture of bone points, which are assumed to be arrowheads used in weaponry. Part of

¹⁰ Sellet (1993: 106).

¹¹ Dobres (2010: 107) states that 'when infused with phenomenological concerns and an explicit focus on gender and social agency, *chaîne opératoire* can also serve as a conceptual framework for understanding the meaningful links and chains between people and products, between artifact and artifacts, and between gestures and gadgets' (emphasis in the original).

¹² Miller (2007: 29–30).

¹³ Miller (2007: 5).

¹⁴ See, for instance, Costin (1996) on the importance of gender studies in the analysis of craft specialisation; see also Dobres (2010).

¹⁵ Dobres (2010: 103).

¹⁶ Costin (1991; 1996; 2005).

¹⁷ See, for instance, Meyer *et al.* (2016: 193) and contributions by Baysal, Doherty, Govantes-Edwards *et al.* and Hodgkinson in this volume.

¹⁸ For further information on this project, see Bebermeier *et al.* (2016: 12–14); von Rummel *et al.* (2016: 103–104).

¹⁹ Della Corte (1965: 181–182).

²⁰ See Bustamante-Álvarez and Ribera i Lacomba in this volume.

their study focused on the analysis of a range of stone tools recovered from the workshop complex, which highlights their multi-functionality and use in the manufacture of a number of different items of armour and weaponry.²¹

Modern methods of investigation, including micro- or macroscopic use-wear analysis and chemical analysis of artefactual and structural remains, have provided researchers with a deeper understanding of past manufacturing processes. Unfortunately, the archaeological contexts of these materials are not always secure; occasionally researchers have to work with material remains that have been removed from their original context. Additionally, archaeological materials have sometimes been excavated a long time ago, often with less than ideal contextual documentation. In these cases, modern methods of investigation have increasingly enabled researchers to acquire previously inaccessible information about the manufacturing processes.

In her presentation, Stephanie Boonstra, for example, outlined the problems related to the identification of actual scarab workshops, one major point being the fact that scarabs are small and portable, having often travelled far distances. In addition, the identification of physical remains associated with their production, i.e. materials, tools and installations, is very difficult, since these were not always exclusively used for scarab manufacture. Based on typological and technological characteristics, Boonstra has succeeded in identifying a number of 'typological' scarab workshops, the physical locations of which have not been established. Boonstra, furthermore, outlined how the survival of physical scarab workshops can help locate 'typological' workshops.²²

Other studies presented at the workshop showed how data from old excavations might yield new information when combined with the results from more recent excavations employing a range of modern excavation, sampling and analytical techniques. Johanna Sigl presented a number of such new methods implemented as part of the 'Realities of Life' project at the settlement site of Elephantine, which the German Archaeological Institute (DAI) has been excavating since 1969. This new project focuses on the excavation of houses dating to the Middle Kingdom; in particular, it aims to identify evidence of food production, living spaces and trade activities. In her paper, Sigl showed that the introduction of a more detailed and rigorous sampling and collection strategy has enabled the team to recover and document a range of microarchaeological material previously not extensively recognised at the site. This,

and other data, has also permitted the team to identify spaces used for domestic bread production and mud brick manufacture, as well the production of jewellery from semi-precious stones.²³

Sebastian Olschok presented his work in the economic complex of the monastery of Deir Anba Hadra (Egypt), outlining the problems associated with data from excavations carried out in the 1920s. He demonstrated how the redocumentation of architectural remains using modern methods (e.g. structure-from-motion) in combination with results from recent excavation allowed a more in-depth analysis of the structuring and use of space and how it changed through time, focusing on structures and installations associated with production activities, including food, oil and ceramics.²⁴

Similarly, Anna Hodgkinson, in her presentation, pointed out the issues associated with the use of old excavation data when carrying out spatial analyses (using GIS) of production activities at archaeological sites, as well as the fact that certain types of evidence may not have been detected during old excavations. Carrying out excavations at Amarna (Egypt) utilising a range of modern techniques, enabled Hodgkinson to obtain a more detailed and complete dataset than documented by the previous excavations.²⁵ Hodgkinson also showed that the on-site use of portable equipment for chemical analysis, such as portable X-ray fluorescence (pXRF), permitted her to gain information on the composition of glass objects that would otherwise be difficult due to the Egyptian Antiquities Law.²⁶

In their presentation, Dirk Paul Mielke and Sonja Behrendt used a multi-method archaeometric approach in order to identify otherwise archaeologically unidentifiable centres of Phoenician pottery production on the Iberian Peninsula and in the Western Mediterranean during the first half of the 1st millennium BC. By applying a combination of pXRF and static, laboratory-based neutron activation analysis (NAA), as well as more traditional techniques (e.g. analysis of vessel shapes and wares), they were able to analyse a great number of pottery sherds from a variety of locations. Acknowledging that there are some issues related to the use of less precise portable technology, Mielke and Behrendt were, nevertheless, able to show how the statistical analysis and interpretation of this data has led to a new understanding of production centres and exchange networks in this region.²⁷

Another multi-method archaeometric approach was presented by Ki Suk Park and co-authors, Ralf Milke and

²¹ See Prell and Kitagawa in this volume.

²² See Boonstra in this volume.

²³ See Sigl and Kopp in this volume.

²⁴ See Olschok (n.d.) for further information.

²⁵ See Hodgkinson in this volume.

²⁶ Hodgkinson *et al.* (2019).

²⁷ See Behrendt and Mielke (2011); Behrendt *et al.* (2012).

Sabine Reinhold, who used methods such as thin-section petrography, chemical analysis and Fourier-transform infrared spectroscopy (FT-IR) in reflectance mode to analyse the mineralogical and chemical composition of Late Bronze Age ceramic vessels from the North Caucasus (Russia) in order to gain information on the makeup of the ceramic material. This, in turn, has not only provided insight into the geological conditions of the raw material sources, but has also given clues on the *chaîne opératoire* used in the ceramics workshops, including firing temperatures and firing conditions.²⁸

Similarly, Carmen Ting and Jane Humphris used a combination of macroscopic and microscopic archaeometrical methods (thin-section petrography and scanning electron microscopy with energy dispersive X-Ray spectroscopy: SEM-EDS) in their investigation of ceramic assemblages dating to the Napatan, Meroitic and post-Meroitic periods from the sites of Meroe and Hamadab (Sudan). By analysing the microstructure of both domestic and technical ceramics recovered from slag heaps at these sites, Ting and Humphris were able to obtain insights into various aspects of ceramics production, such as the standardisation of clay preparation and products, leading to a broader picture of the organisation of pottery production and how it changed over time.²⁹

A new application for pXRF technology was presented by Chloë N. Duckworth, who, together with her co-authors, Eleonora Montanari and Derek Pitman, has developed a technique for conducting *in situ* chemical soil mapping during excavation. By analysing a number of areas possibly used for the production of glass at the Medieval sites of the Alhambra and Medinet Zahra (Spain), they were able to detect concentrations of industry-specific chemicals, thus gaining an insight into the use of space and areas selected for production. Furthermore, they highlighted the advantages of this portable method in gathering large amounts of data over a short period of time while in the field, thus enabling the efficient selection of areas for excavation.³⁰

Another avenue of research into ancient technologies is experimental archaeology. The main focus of this is the recreation and reconstruction of past methods and conditions of manufacturing activities based on various types of evidence, including archaeological and textual remains, as well as ethnographic data. Importantly, experimental archaeology does not prove that the tested processes were carried out in a particular way or using particular resources. Nevertheless, it can still help us gain a deeper understanding of the requirements and logistics necessary for the manufacture of goods,

especially in those cases where precise archaeological evidence or diagnostic finds are missing. In addition, it can provide information on the invisible aspects of production, such as the use of open spaces, and people involved in the manufacturing activities, as well as the evolution of secondary evidence, including the effect of production activity on the human skeleton.³¹

Frank Wiesenbergh, for example, presented the results of a range of archaeological experiments undertaken at the Archaeological Park Roman Villa Borg (Germany), the Provinciaal Archaeologisch Museum Velzeke (Belgium) and in Quarley (England) in order to better understand the functionality and construction of Roman glass furnaces. These experiments highlighted several issues associated with previous interpretations of the surviving archaeological remains of these types of firing structures, in addition to demonstrating that not all industrial firing activities leave a recognisable trace in the archaeological record. Wiesenbergh concluded that experimentation can provide valuable information on logistical and technical aspects of Roman glass workshops.³²

Similarly, Sarah Doherty outlined the information she was able to gain through her experimental archaeological work, which also included ethnographic observations, on Egyptian ceramic production, with a particular focus on the organisation of pottery workshops. In her presentation, Doherty embedded her experimental approach in a broader research framework that included an examination of the archaeological, textual and pictographic evidence of pottery production in Ancient Egypt.³³

Understanding the organisation and processes involved in production activities provides us with a basis from which we can start to reconstruct many socio-economic aspects of past societies and how they developed through time. This includes the organisation of, and hierarchy involved in various types of production, be it pottery manufacture, stone working, food production, metallurgy or the manufacture of vitreous materials. It also enables us to identify levels of specialisation and skills, the degree of control of production and raw materials involved. The study of the circulation of goods makes it possible for us to reconstruct distribution or exchange networks and to identify which products were in demand. All of this makes possible the identification

²⁸ See Park *et al.* (2019).

²⁹ See Ting and Humphris in this volume.

³⁰ See Duckworth (2017).

³¹ Ruff (2008: 184). See Dabbs *et al.* (2015: 36–40) for a bioarchaeological assessment of skeletal remains excavated at the South Tombs Cemetery at Tell el-Amarna (Egypt). Many of these skeletons show signs of malnutrition as well as stress- and trauma-related deformation derived from hard labour. See, e.g., Molleson (2007) for a study of non-traumatic task-related morphologies in the skeletal population caused by routine work undertaken since childhood at the Neolithic site of Abu Hureyra (Syria).

³² See Wiesenbergh in this volume.

³³ See Doherty in this volume.

of various scales of production, including mass-production, elite or royal control of technologies and raw materials, and less regulated domestic networks of production.

For example, in their presentation, David J. Govantes-Edwards, together with co-authors Chloë N. Duckworth, Amaya Gómez de la Torre and Lauro Olmo, demonstrated that the location of certain industries can provide valuable information on the socio-economic status of this industry. Focusing on a number of Visigothic sites in Spain, they argued that the location of glass production in close proximity to palatial complexes from the 6th century AD onward was a symbolic way for the ruler to demonstrate his power over raw materials and glass technology as it was considered bothersome since it involved the use of noisy and pungent furnaces.³⁴

Every industrial and manufacturing activity produces a different set of archaeological evidence, some of which may not survive in the archaeological record (e.g. organic materials). In addition, certain steps or decisions taken in, or the organisation of past manufacturing processes will not be identifiable to archaeologists, especially those conveyed through oral tradition. This applies in particular, although it is not limited to, cultures without a written language. Even if this kind of information does not leave a physical trace in the archaeological record and may not have contributed to the end product, being purely ritual in character, it may have played as important a role in the manufacturing process as, for example, the adding of raw materials or the wielding of certain tools. For example, the production of glass in the Neo-Assyrian Period, more specifically the reign of Assurbanipal (668–627 BC), as documented on a series of cuneiform tablets, involved the recital of incantations at certain stages in the production process.³⁵ Although this information would not provide data on the physical aspects of this process or the finished objects, it can still supply us with valuable insights into the social context, organisation and traditions surrounding various industrial activities.

Similarly, it is not always possible to identify the physical location in which manufacturing activities took place, as pointed out by both Cathy Costin and Adnan Baysal during the workshop. Costin, for example, conducted an ethnographic study of textile production in the modern Andean region, documenting how women still carry out spinning and weaving tasks while walking and conducting everyday activities. Since spinning takes place wherever the weaver goes, it would be difficult

to pinpoint the actual production spaces and places where we look for them in the archaeological record. Applying the concepts of ‘flowscape’ (the movement of matter and materials through the landscape) and ‘taskscape’ (based on interactivity, agency and choice)³⁶ in a discussion of the organisation of textile manufacture in the Inka Empire, Costin, in her keynote lecture, highlighted the importance of distinguishing between ‘space’ (abstract) and ‘place’ (distinctive and meaningful).

Reflecting on theoretical approaches concerned with production and *chaîne opératoire*, Baysal questioned archaeologists’ understanding of the concept of production places and spaces. Baysal pointed out that the concept of *chaîne opératoire* should not necessarily be understood as linear. Using the example of portable ground stone tools used for grinding, he highlighted the fact that products can themselves become places of production and that these places are often not static and may move according to a variety of factors, including personal choice, environmental conditions and so on.³⁷

Costin has, for this volume, produced a theoretical discussion of the term ‘workshop’ based on a lively discourse among the participants during the final roundtable discussion at the event. The resulting paper comprises a literature review of various archaeological and ethnographic studies on the topic of ancient modes of production. In her contribution, Costin questions common assumptions and presumptions regarding a variety of aspects and issues of ancient productivity, including the organisation of labour, craft specialisation and standardisation, the actors involved in production (e.g. gender, identity and family relationships) and the use of tools and space in a workshop. Costin argues that craft specialisation and organisation of labour in the ancient world was much more varied than conveyed by individual authors, and that many of these aspects of production cannot, or can only partially, be observed in the archaeological record. Based on her critique, she suggests some best-practice approaches for future discussions of craft production, such as a move away from a rigid and narrow definition of the term ‘workshop’. Instead, Costin suggests that scholars should use the term together with descriptive modifiers (e.g. ‘domestic’, ‘palatial’, etc.), which would provide a better framework for the analysis of ancient production activities within their broader contexts.³⁸

One important issue that the papers included in this volume have demonstrated is that we need to approach production from a variety of angles, using a variety of

³⁴ See Govantes-Edwards *et al.* in this volume.

³⁵ Thompson (1925) has analysed and described the chemical processes described in the Assyrian cuneiform glass texts. See Oppenheim (1970) and Shortland (2008) for more detailed analyses of this text category.

³⁶ Ingold (1993).

³⁷ See Baysal in this volume.

³⁸ See Costin in this volume.

approaches and analytical methods in order to gain a better understanding of these. We also need to be clear in how we use specific terminology, specifically where no precise definitions exist, or where definitions may be subject to cultural and historical bias.

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2. Working from Home – Middle Kingdom Daily Life on Elephantine Island, Egypt

Johanna Sigl and Peter Kopp

Abstract

Daily life is understood as being marked by the actions of people to ensure their bodily and general well-being, occurring mainly within their homes and the directly surrounding areas. On Elephantine Island such activities are grouped, within the scope of the project 'Realities of Life', into three major foci that may be studied through material culture: a) food and drink, b) production of inedible items and c) living environment. Excavations in Middle Kingdom houses reveal a variety of production activities intended to either provision the townspeople (most likely) or for trade. The use of both standard archaeological and archaeometric methods provide new insight into jewellery and bread production, demands for cleanliness and (supra-)regional connections of the inhabitants of the island city.

Keywords: Elephantine; food production; bread; jewellery; amethyst; Middle Kingdom; household

Kurzfassung

Im Projekt 'Lebenswirklichkeiten' werden unter Aktivitäten des täglichen Lebens solche verstanden, die dem körperlichen und generellen Wohl der Akteure dienen. Diese finden auf Elephantine hauptsächlich im Wohnumfeld und der direkten Umgebung statt. Sie können unter drei Punkten subsummiert werden, die anhand von Ausgrabungsfunden nachvollziehbar sind: a) Ernährung, b) Produktion von nicht essbaren Gütern und c) Lebensumfeld. Neue Ausgrabungen in Häusern des Mittleren Reichs geben Einblick in diverse produktive Aktivitäten zur Versorgung und für kommerzielle Zwecke der Einwohner Elephantines. Standardmethoden wie auch archäometrische Analysen geben Aufschluss über z.B. Schmuck- und Brotproduktion, Sauberkeitsansprüche sowie vorhandene (über-)regionale Verbindungen der Bewohner der Inselstadt.

Keywords: Elephantine; Nahrungsmittelproduktion; Brot; Schmuck; Amethyst; Mittleres Reich; privater Haushalt

Introduction

Research on archaeological finds¹ always deals, to some extent, with either the results or the residues of productive activities. During settlement excavations, objects and features come to light that can be connected to daily production in household, religious, administrative and military surroundings. Within the Middle Kingdom living quarters of the town of Elephantine, the German Archaeological Institute Cairo (DAIK) has, since 2013, been following a new approach²

¹ The word 'finds' here summarises everything from architecture to small finds, raw materials and waste.

² Since 1969, the German Archaeological Institute Cairo has worked on Elephantine Island, Aswan, in cooperation with the Swiss Institute of Egyptian Architectural and Archaeological Research in Cairo, the local authorities and other partners. The principal aim of the archaeological work since 1969 is to study the development of an ancient Egyptian settlement from the Early Dynastic Period to the first millennium AD (c. 3500 BC–AD 1000). One focus lies on the cultic and administrative buildings, the other on the settlements itself, including the small necropolis on the western part of the island (Kaiser *et al.* 1970: 87–90; see as well summary of work until the end of the 1990s: Kaiser *et al.* 1999: 63–70, 230–236). Aspects of daily life have been revealed during the excavation through the discovery of many kinds of artefacts, some of which are displayed in the so-called Annex Museum on the island, and in the composition of the stratigraphic layers. Still, however, only selective information exists on the everyday life of the inhabitants of Elephantine; an in-depth study of the finds in their entirety through the application of more

to the study of daily life³ in ancient times (project 'Realities of Life'). Everyday life is herein understood as being marked by the actions of people to ensure their bodily and general well-being. These activities occur mainly within homes and their immediate surrounding. They become apparent in the archaeological record and are studied in the material culture, focusing on three major categories: a) the production and storage of food and drink, b) the acquisition and manufacture of inedible goods or tools and c) the building, development and use of the living and working environment.⁴ Important factors in those activities are connections of people and places through trade and exchange on a local, regional and supra-regional basis.

In this contribution, several small insights from preliminary results of the excavation project shall be

than standard archaeological methods has so far only sporadically been undertaken. The project 'Realities of Life', which was initiated in autumn 2013, aims to close this gap, at least for the time of the Middle Kingdom, by using a revised archaeological methodology (Sigl 2016; J. Sigl in Seidlmayer, Arnold, Drauschke *et al.* 2016).

³ The study of daily life is positioned in archaeological research under the subfield of 'Household Archaeology'. See Müller (2015: xiii–xlii) for a summary of recent research and background as well as the papers of a workshop on that topic from 2013.

⁴ See for more detail Sigl (2016); J. Sigl in Seidlmayer, Arnold, Drauschke *et al.* (2016); J. Sigl in Sigl *et al.* (2017).

given, highlighting various aspects of productivity in the ancient town of Elephantine during the Middle Kingdom and connecting the inhabitants of the town to their wider surrounding. Even though work is still ongoing and many of the archaeometric analyses are pending, it will become obvious that the basic concept of the project – to focus on the smallest details as well as the overall picture – is adding interesting information to the current knowledge of living in ancient Egypt.

Methodology

The ‘Realities of Life’ project is structured into three main phases of activity: excavation work, analytical processes and interpretation (Figure 1). As of fall 2018, the work concentrates on the first two of these steps. A revised methodological framework, which was set up at the start of the project, builds the foundation not only for the fieldwork and primary find processing, but also of the subsequent archaeological and archaeometric research. Changes to the excavation method and sampling process aim to

- a) prevent contamination of finds and samples, especially those that are meant for (bio-) chemical studies (Figure 2);
- b) collect and process
 - amounts of material appropriate for statistical analyses
 - samples for archaeometric studies such as residue analysis on pottery vessels and stone tools, the component analysis of pigments, binders and metal objects, use-wear analysis of stone tools, bone and shell objects, and reused pottery, etc.; and
- c) ensure adequate work and health and safety conditions for workmen and scientists alike (Figures 2–3).

For the project, a part of the Middle Kingdom town of Elephantine was chosen, which is situated at the north-western edge of the preserved settlement mound, directly next to the small pyramid that once dominated the Old Kingdom necropolis in this area. We excavated two 10 by 10 m trenches, finding several houses ranging in date from approximately the 11th to the 13th dynasty. Due to the focus on fixed-sized trenches and considerations of site management, as Elephantine is an archaeological site open to the general public,⁵ none of these houses has been excavated entirely. This method, however, ensures the presence of profiles around the edges of the trenches that provide a rich sampling ground for, e.g., micromorphological investigation (Figure 3) and help to connect the buildings to each other by stratigraphic chronology. The abundance of finds excavated in all areas due to the systematic

retrieval system, provides a solid basis for a variety of material studies.

While sieving had been occasionally done during the early work of the DAIK, the systematic and in-depth recovery of the smallest finds is new to the project. Since spring 2015, soil samples of every sufficiently large feature (the general sample size is approx. 10 litres, but if a feature yields less than this amount, it is bagged entirely) are taken for floatation (mesh sizes: 1 mm, 500 µm, 250 µm), in order to retrieve botanical and faunal finds as well as small-scale finds. One litre of each sample is extracted before the insertion in water for dry separation. In many instances, dry sieving using a stack of 2 mm, 1mm, 500 µm and 250 µm mesh yields the best results in terms of recovery of botanical material for analysis. However, archaeobotanical and archaeozoological investigations have shown that flotation is necessary to recover the full spectrum of species, because soil and salt particles clinging to the dry-sieved material hinder identification considerably. This can lead to either overrepresentation or underrepresentation of some species if only one of the two methods is used.⁶ Macroscopic faunal finds are cleaned manually with distilled water and cotton pads for easier identification.

While the above-mentioned samples form the major part of the sampling process on site, additional smaller amounts of soil are bagged for entomological analysis (3 litres) and as comparison samples for phytolith studies and micromorphology (in total about 10 grams). Insect remains are retrieved by dry sieving (2 mm, 1 mm, 300 µm). The bulk samples for micromorphology are studied under a polarizing microscope and form an addition to block samples (5 x 5 x 10 cm), which are taken from the profiles around the excavation trench following floor levels and other interesting features.

After the excavation process, archaeometric methods are implemented to the extent that Egyptian archaeological regulations and available technology permit. For this purpose, a wide range of collaborations between international scientists and local laboratories has been established.⁷ This aspect of the project has

⁵ See as well Sigl (2019: 166).

⁶ Information on the results of the botanical studies provided by the project's botanist C.J. Malleon, American University of Beirut, 2018.

⁷ ‘Realities of Life’ project, scientific team: J. Sigl (project director, archaeozoology; DAIK/KAAK); P. Kopp (field director, pottery chronology, small finds; DAIK); B. Bastos (residue analysis; Bradford University); P. Collet (draftsman); A. El-Shafey (phytoliths); D. Fritzsche (micromorphology, Goethe University, Frankfurt); B. Gehad (pigments and binders; Ministry of Antiquities Egypt); C. Jeuthe (silex typology; DAIK); H. Khozaym (geology, micromorphology; Aswan University); M. Looney (typology of jar stoppers; Zürich University); C.J. Malleon (botany; American University of Beirut); G. Mutri (silex/stone tool use wear and residue; Rome University); M. Ownby (pottery petrography; University of Arizona); E. Panagiotakopulu (insects; Edinburgh University); M. Odler (metallurgy; Charles University, Prague); J. Roberson (Pharaonic sealings, papyri and ostraca;

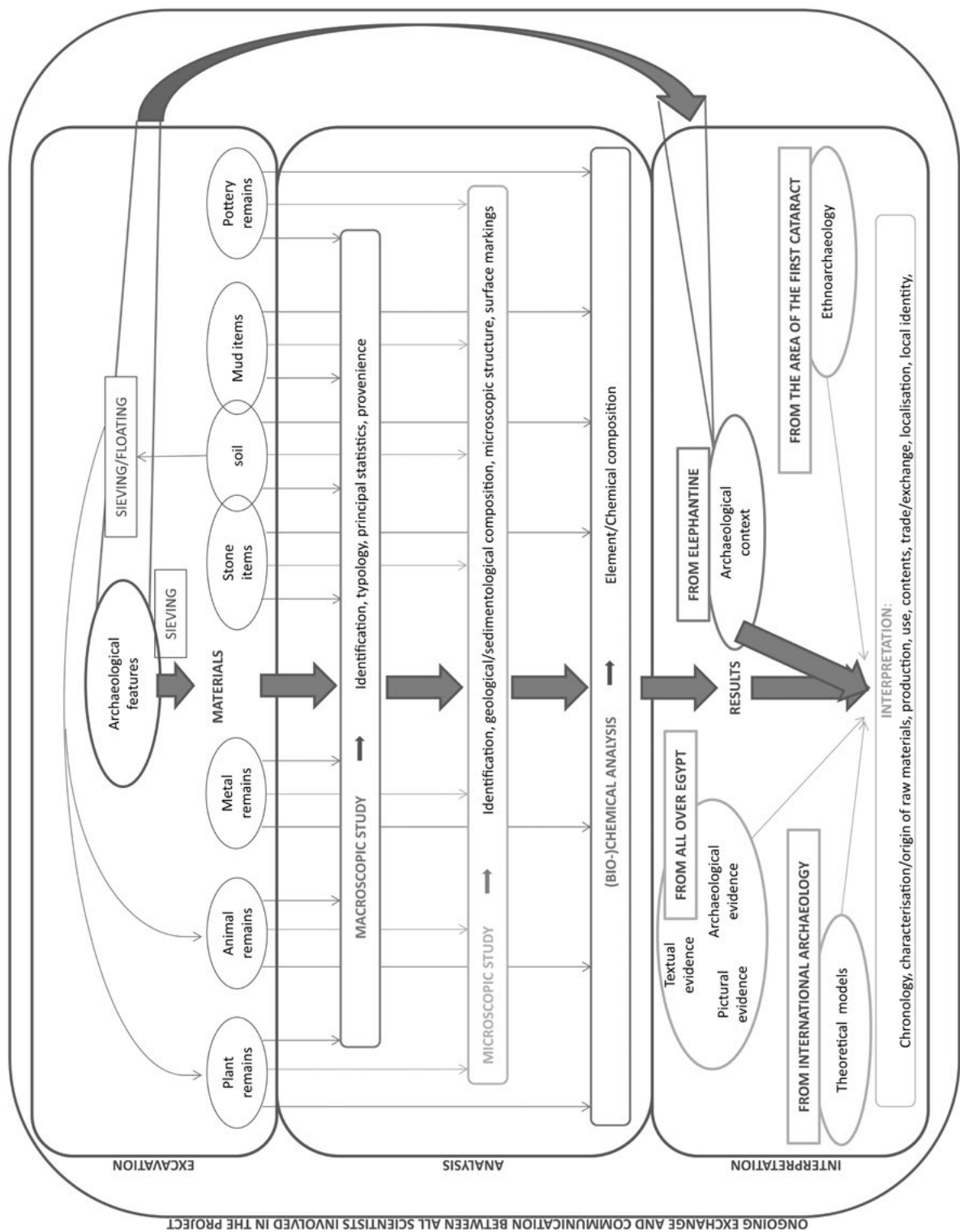


Figure 1: Schematic protocol of work of the 'Realities of Life' project (Graphics: Johanna Sigl © DAI Cairo).



Figure 2: Retrieving a well-preserved pottery vessel from the trench: the workmen are wearing nitrile gloves to avoid contamination and face masks, which protect them while sieving the excavated soil (Photo: Peter Kopp © DAI Cairo).

been one of the most difficult to set up and run, though it has become evident that more or less the full range of necessary methods and machinery are indeed available in Egypt. Additionally, portable devices can be used on site and in the local work and storage rooms with the permission and under the supervision of the Ministry of Antiquities of Egypt.

Evidence for production between settlement layers

Excavated deposits that can be connected to the building, altering and destroying of houses provide easily visible aspects of productive activities. Not only do ground plans of houses change considerably during their habitation (see, for example, House 169 below in Figure 6A–C),⁸ but layers between definable domestic structures give often overlooked glimpses into long-past moments of daily life. They suggest phases of time during which the plot in question was wasteland that

could not be resettled immediately due to legal or other issues.⁹

In the area currently under investigation in Elephantine, several stratigraphic levels represent such wasteland situations, where instead of houses the area features shallow pits consisting of densely packed silty material showing where mud plaster and ingredients for producing mud bricks were mixed.¹⁰ The preserved compounds of the mud show that the production of plaster and bricks utilised similar recipes as found in modern times. For example, culm nodes and cereal chaff were mixed in as a temper for the plaster.¹¹

Footprints found in several of these features belonged to children (Figure 4),¹² whose age, according to modern international shoe size standards,¹³ can be

University of Memphis); M.-K. Schröder (Nubian pottery typology, chronology; DAIK); V. Steele (residue analysis; Bradford University); L.A. Warden (pottery typology and functional analyses; Roanoke College). Laboratories: TU Berlin el-Gouna, IFAO Cairo, Research and Conservation Center of the Ministry of Antiquities.

⁸ See below in the section 'Evidence for production within Middle Kingdom houses – working from home'.

⁹ von Pilgrim (1996: 224).

¹⁰ Similar mud pits were found in other locations on the island as well (von Pilgrim 1996: 220).

¹¹ Information on the results of the botanical studies provided by the project's botanist C. J. Malleon, American University of Beirut, 2018.

¹² E.g. feature 44501R/n, that dates to the late 11th or early 12th dynasty and is situated between the remains of consecutive houses 170–172 and 167–168; feature 46501B/b that dates to the late 13th dynasty at the earliest and is situated between house 169 and later structures built during the Second Intermediate Period.

¹³ See e.g. Kinderzeit.org (2019). In his book on the results of the



Figure 3: Sampling for micromorphological analysis by D. Fritsch from Goethe University Frankfurt: while working on various levels, it is obligatory to wear helmets and to assure that no person disturbs the section from above (Photo: Peter Kopp © DAI Cairo).

estimated at around five years. It is interesting to note that to date no footprints of adults have been found. This leads us to ask why children were walking through these construction areas. The sporadic occurrence of prints does not necessarily indicate the involvement of children in the work, which must have been concluded shortly before the passage of the children.¹⁴ Footprints only preserve under special conditions, the most important of which is that they are not disturbed by water or wind activity or further trampling.¹⁵ Could the children have come through the site while playing or on an errand, e.g. while herding goats or sheep? Unfortunately, neither animal hoof-prints nor other clues have been found in the same context, and this question cannot be answered at the moment.

Apart from construction activities, the deposition of waste in unused plots of land again may allow minute glimpses into long-past productive activities in the town. Judging from the results of 50 years of excavation work in Elephantine, rubbish accumulation in this town happened either because the area was indeed used as a trash dump (primary deposition) or because rubble was moved for levelling or filling purposes from another part of the settlement to the area where it is discovered (secondary deposition).¹⁶ A possible way to distinguish between these two forms of deposition is to look at the preservation of finds such as animal remains.¹⁷ While a later, undisturbed disposal of parts of fish, for example, results in them being found still in anatomical order, a

secondary relocation of waste heaps with contents in an advanced rotten state would have led to a scattering of the bones.

During the excavations in the north-western town of Elephantine, a layer of well-preserved small pottery vessels and several heads and tails as well as parts of the far front or back spine of Nile fish (especially *Lates niloticus* and *Bagrus sp.*) was discovered (Figure 5). This stratum (dating to the early 12th dynasty) overlaid one of the construction levels in which an example of the children's footprints had been found. The presence of only selected parts of the fish, namely those portions that yield the least meat, indicates the processing of the animals at this site. The meaty middle of the fish would have presumably been removed to where it could be prepared as food. Remains of at least eleven large fish individuals of the species Nile perch (*Lates niloticus*; MNI¹⁸ = 9) and *Bagrus*-catfish (*Bagrus sp.*; MNI = 2) were found. Due to this low number of fish from the butchering site, it is unlikely that the area was used over a long time for this kind of action. The sizes of the fish, which exceeded 120 cm in most individuals and could have reached as large a size as an estimated 180 cm, give evidence for the skill of the fisherman; be it by net, harpoon or fishing rod, to remove from the water an animal that would have equalled or even exceeded the fishermen in bodyweight must have been a big challenge. Furthermore, the Nile perch (*Lates niloticus*) was known already in ancient Egypt as giving whoever caught him a severe fight – thus named *ḥ3*.¹⁹ The study of the connection of the fishes with the pottery vessels found in the same stratum and partially containing the fish remains (Figure 5), which were far too big for them, is still in progress.

Evidence for production within Middle Kingdom houses – working from home

In addition to these examples of productive activities, which happened at the site between occupation phases, the fabrication of goods within houses while they were inhabited is a common feature on Elephantine.²⁰ With the revised excavation and sampling strategies of the 'Realities of Life' project, new light is shed on how the work was situated and distributed inside a single building and between chronological phases or separate residential units. Furthermore, we have new insights into the uses of certain items.

Since spring 2016, the excavation efforts of the DAIK have concentrated on the second of two trenches in the north-western town of Elephantine near the small step

Egyptian Footwear Project, A.J. Veldmeijer shows that the footwear preserved to us is seldom a sufficient factor for determining age and gender of ancient Egyptians (Veldmeijer 2019: 216–217). In personal communication (A.J. Veldmeijer by e-mail, October 14th 2019), Veldmeijer states that published results on skeletal material from Egypt do not aid in reconstructing shoe size because toe bones are seldom preserved and often disregarded in the publication; thus foot length cannot be reconstructed. For this reason, a modern shoe size-age correlation has been applied to the footprints from Elephantine. However, it has to be noted that this can only lead to a rough age estimation and future research may provide considerably different results.

¹⁴ In contrast to what was assumed for an accumulation of prints at the ancient town of Piramesse/Qantir (El-Aref 2017). For the recovered prints from Elephantine, advice will be sought from a specialist in criminal forensics to investigate issues such as if the children were carrying weight, which would open the possibility that they had been involved in work at the site after all.

¹⁵ This would also explain why no prints of older inhabitants were found at the site: the mud, which would have contained the negatives of the presumably mature workers' feet, would have been repeatedly destroyed by the mud stamping activity itself and by taking the mixed loam for use elsewhere, down to more or less the original surface, into which the pit was dug.

¹⁶ We are using the term 'deposition' here in contrast to the discussions of 'refuse' by, e.g., I. Shaw (2013: esp. 318–319) or I. Hodder (2012: 73), as the contents of secondary depositions are a mixture of several forms of primary, secondary and tertiary refuse defined by these authors. Furthermore, observations in the villages on *Gezirat Aswan* (ancient Elephantine Island) and in the town of Aswan show that the practice of reusing ruins of buildings or undeveloped real estate for trash deposition is quite common even today. A more thorough study of the nature of depositions in the excavated areas of the 'Realities of Life' project is currently in progress.

¹⁷ See Lyman (2001: 162, 223–225, 436).

¹⁸ MNI = Minimum Number of Individuals.

¹⁹ Gamer-Wallert (1970: 39).

²⁰ See e.g. von Pilgrim (1996: 217); own observations by the authors during excavation work since 2013.

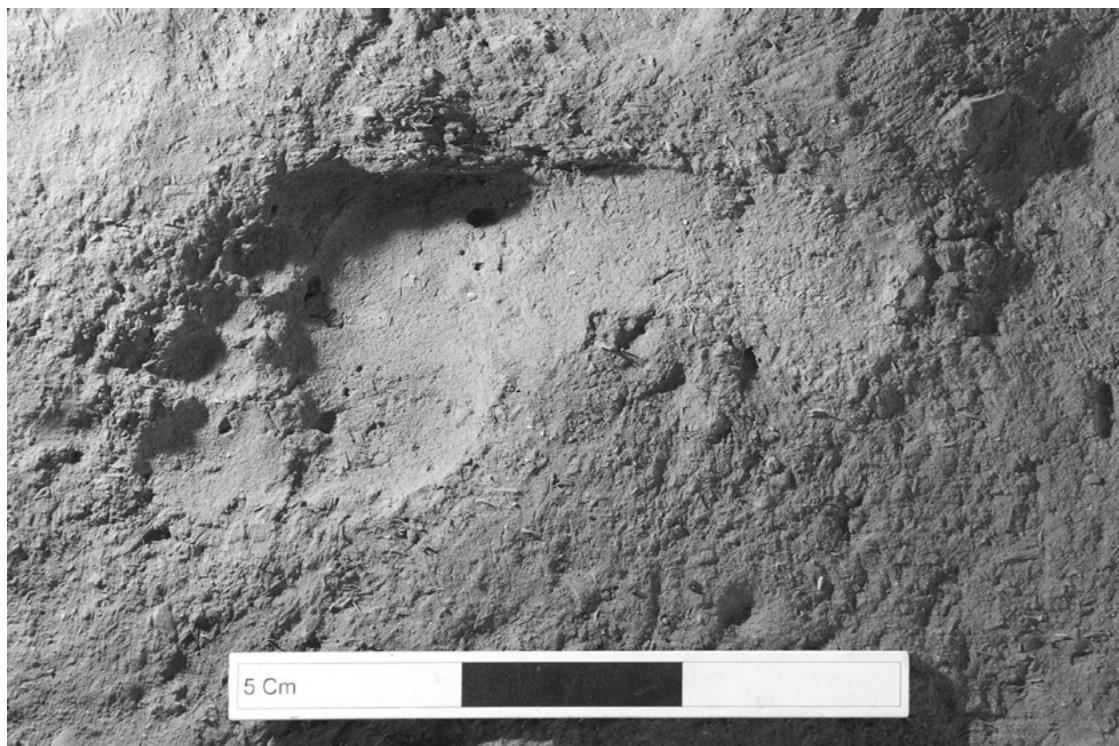


Figure 4: Footprint of a five-year-old child in a mud pit of the 11th dynasty, which was situated between building layers in the north-western town of Elephantine (Photo: Peter Kopp © DAI Cairo).



Figure 5: Spinal bones of Nile perch indicate a fish butchering site in between building layers in the north-western town of Elephantine (Photo: Peter Kopp © DAI Cairo).

pyramid (Figure 6), which dominated the Old Kingdom necropolis on the island. First investigations of this area were carried out by a German mission of the Berlin Museums at the beginning of the 20th century, then by the German Archaeological Institute in the 1990s. During the latter excavations, all layers of the New Kingdom and most of those of the Second Intermediate Period had been removed.²¹ French archaeological work at the onset of the 20th century²² was responsible for a trench of approximately one meter width at the eastern border of the currently excavated square. This ditch ran along the dividing wall between Houses 169 and 166b dating to the 12th/13th dynasties, but luckily it did not penetrate deep into the otherwise well-preserved stratigraphy.²³ These two houses belong to a group of three that once rose next to each other along the north-western hillside of the settlement mound covering the former burial ground and were surrounded by the typical narrow alleys of the island town (Figure 6).

House 169, at approximately 150 m² in size, is so far the biggest residential building of late Middle Kingdom Elephantine.²⁴ Through pottery studies and stratigraphic analysis, several architectural and use phases of the house could be traced, covering the whole of the 13th dynasty.²⁵ Older strata will be investigated beginning in the 2018/2019 field seasons of the project.

During the oldest phase of the late 12th/early 13th dynasty so far recovered, House 169 features the same general layout of the entrance area as in all subsequent phases (Figure 6A–C). The door and a narrow access corridor (R02) lay near the south-eastern corner of the building, coming in from one of the major alleyways of the town. From there one reached the centre of the house. Here, a few of the features from this oldest phase were preserved (Figure 6A), including the half circle of a granary (installation 606) next to the eastern outer wall of the house filled with sheep/goat faeces.²⁶ Because of their unsorted loose layering, it can be assumed that the feature was not used as stable but as a storage place for dung. Manure of small ovicaprids has been found in several fireplaces throughout the excavation and the storage of faeces can therefore be identified as fuel for

firing activities. Another round granary (installation 607) in the south-eastern part of the building also dates to the 13th dynasty and may have fulfilled its more usual storage purpose. This use interpretation follows macroscopic observations of the layering of the visible plant remains/phytoliths, which will have to be confirmed by the analysis of the samples for micromorphology that were taken from this feature.²⁷ The house at that time had no permanent staircase and might have had only a single floor.

Around the mid-13th dynasty, House 169 was refurbished several times. Because the ground level in the centre of the house had risen,²⁸ the entrance corridor (R02) was equipped with some stone steps leading up to a first court (R04) of the house (Figure 6B). Small finds, which shall be addressed in more detail below, indicate that R04 was one of the main working areas of the house. The round granary (installation 607) on the south-eastern side of the court was replaced by a room (R05), which was enclosed by a half-brick-wide wall. To its west a rectangular storage device (installation 602) with a length of about 1 m had been added. It was filled with ashes but showed in itself only slight traces of scorching. Next to it several fireplaces were found, one of which stands out because of its many closely set, roundish holes (Figure 6B: lower left corner; Figure 7). They had varying diameters of a few centimetres each, were on average around 10 cm deep and set in no particular pattern. During the later phases of the house (Figure 6C), this unusual fireplace was covered by use layers²⁹ and, as a replacement for installation 602, a row of small storage bins was built along the walls of R05.

Court R04 was originally enclosed to the north-west by a barely preserved wall (Figure 6B). Along it a circular granary (installation 604) and two rectangular rooms (installation 603 and R07) filled with ashes were arranged. The smaller room (installation 603) was built first, and later on the chamber in the north-east (R07) was added. Both of them had been used to light fires and not only to store ashes, as the vitrified bricks of the walls indicate. Then, approximately in the middle of the 13th dynasty, the wall between the central court and the northern part of the house was torn down and completely rebuilt in a more robust fashion (Figure 6C). Additionally, the entrance to the oven room (R07) was

²¹ Honroth *et al.* (1910: 162–209); von Pilgrim (1996: figs 108–110).

²² von Pilgrim (2012: 280).

²³ In contrast to the currently excavated trench, the first square had been severely disturbed through more or less all of the Middle Kingdom layers in the course of the same French archaeological work (see P. Kopp in Arnold *et al.* 2014: 2; P. Kopp in Sigl 2019: 167–176).

²⁴ The coverage excludes the outer walls that are partly shared with other buildings.

²⁵ As mentioned above, the excavated area does not cover the whole unit but only approximately one third of it. From the walls visible on the currently unexcavated surface around the trench, it becomes clear that House 169 must have been one of the biggest dwellings of the late Middle Kingdom/early Second Intermediate Period on Elephantine (P. Kopp in Sigl *et al.* 2017).

²⁶ Considering the results of the zooarchaeological investigation of the excavated material by the author, it can be assumed that most faeces came from goats, not from sheep.

²⁷ Information provided by D. Fritzsche, Goethe University Frankfurt, responsible for the micromorphological analysis on the project, spring 2018.

²⁸ This stands in contrast to previous results, which showed that the entrance room rose more rapidly due to the influx of sand from outside the house (von Pilgrim 1996: 207).

²⁹ A use layer by our definition is a stratigraphic feature, which might show human activity zones such as fireplaces, and which is compressed by human foot traffic. It does not have the same properties as a floor, which is made by the intentional spreading of mud, but rather came into being through the use of an area by humans.

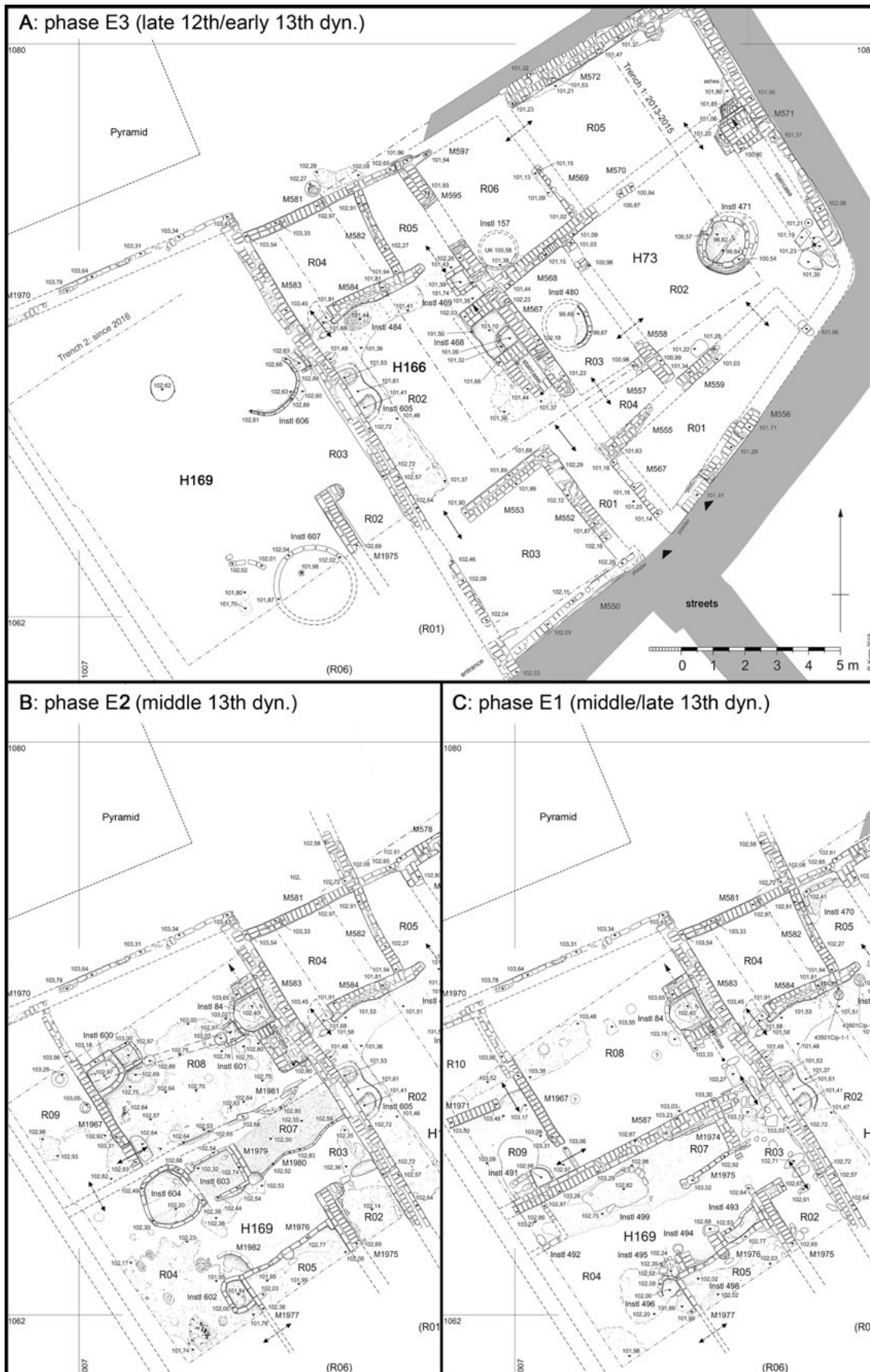


Figure 6: Excavation area of the ‘Realities of Life’ project: distinguished building phases of the 13th dynasty in House 169 (Drawings and digitalisation: Peter Kopp © DAI Cairo).

relocated from the north-east to the south-west, now including the location of the formerly smaller partition (installation 604). The use of this room in the same fashion, however, is proven by further accumulations of ashes and burn marks on the walls. The western corner of court R04 was at least temporarily the site of a square storage bin measuring 1 x 1 m. It was brick-lined and contained the fuel for the fireplaces. Goat faeces and small pieces of wood were found inside.³⁰

In the north-western half of the excavation trench was a second court (R08), which seems to have only existed from around the mid-13th dynasty onwards (Figure 6B); it could be reached by crossing a room (R09) located in the western corner of the trench in the two earlier of the three building phases. This access room to the court was divided at the end of the 13th dynasty into two separate entities (R09 and R10) and was accessible from R08 after the rebuilding of the dividing wall between the two courts (Figure 6C). At this time R09 was equipped with a quern emplacement.³¹

In the northern court (R08) of the house, a sequence of more than 15 living floors was preserved (phases E2–E1: middle to late 13th dynasty). In contrast to the other court (R04), they were clean and without fireplaces and divided by only thin layers of use debris. At the south-western wall was an installation (installation 600), which may have been used for storage purposes. On the opposite side of the court was a mud brick staircase (Figure 6B–C), presumably leading to a first floor that has not survived. A storage feature (installation 84) underneath it was once covered by the arch supporting the steps. Similar emplacements have been identified in several other houses, but their specific use is still unknown.³² Unfortunately, the one in House 169 had already been emptied during earlier investigations of the site, thus holding no clues as to its usage.

Two column bases found in R08 indicate that the north-western half of the room had possessed a second storey during the mid-13th dynasty. This additional floor likely extended on top of the room(s) (R09, R10) in the western corner of the trench.

The entrance to the northern court (R08) was altered at around the same time as the oven room's layout in R04 was revised and the north-western room (R09) was separated (Figure 6C). In the younger phase E1, a doorway in the extension of the axis of the corridor led straight from the entrance (R02) into R08, coming directly upon the foot of the staircase. R09 was from that time on accessible through the door, which had

formerly provided access to R08 from this room. Under the wooden threshold of this door a seal impression including part of the throne name of Amenemhat III was found.³³

As mentioned before, various kinds of production happened in this architectural setting, and we will see shortly that the building's refurbishing phases might even have been influenced by several of the activities taking place in it.

When the entrance to the oven room (R07) had been changed from the eastern to the western side after the mid-13th dynasty (Figure 6C), this part of the house was perhaps used for baking bread. During its long use room R07 slowly filled up with thin layers of white/grey ashes containing hardly any finds except for a remarkably small number of tiny pottery sherds (Figure 8, phase 1). The vitrified bricks of its walls are testimony to the fire activity inside. A brick threshold built in the entrance kept the ashes within the room for some time, but after a while, the threshold was covered, and the ash layers expanded into the court in a straight line along its northern wall. Here, some circular pits up to 60 cm in diameter also contained fireplaces (Figure 8, phase 2a). A refurbishment of the northern wall of the oven room with bricks and stone slabs shows that the room was still in use at this point (Figure 8, phase 2b). Finally, the ashes extended to the western side of the house (Figure 8, phase 3). Their spreading into the court was not due to a displacement of ashes from the oven room but to a shifting of the fireplaces into the court. Several pits showed clear signs of heat, and the surrounding soil was vitrified. Some of the pits were brick-lined like in the oven room, others were bare.³⁴ A well-preserved brick-lined example had an oval shape of approximately 1.6 by 1 m (Figure 8, phase 3c): the unfired mud bricks formed temporary constructions, which were removed after a certain time of use.

The ceramic assemblages found in these fireplaces might indicate their function. Generally, about 10% of the pottery gathered from any feature of similar date in the current excavation work comprises bread mould sherds.³⁵ The ashy deposits in the northern part of court R04 in House 169, however, regularly incorporated more than 40% sherds of this vessel type. Therefore, it is fairly probable that these fireplaces were used for the baking of bread.³⁶ The same can be assumed for

³⁰ About such usage of animal faeces, see Riemer (2011: 158–161).

³¹ For quern emplacements on Elephantine, see von Pilgrim (1996: 213).

³² House 166; see Figure 1, R02, and von Pilgrim (1996: 214).

³³ Sealing impression with the object-no. 47501Z/h-24; identification by J.A. Roberson, March 2018.

³⁴ Square pits with brick lining were previously thought to have been used for baking bread (von Pilgrim 1996: 210).

³⁵ The moulds have the typical narrow cylindrical shape of the Middle Kingdom (Warden 2019: 6–9).

³⁶ For baking Middle Kingdom bread in fire instead of using the Old Kingdom method of heated bread moulds, which are not set into the fire after they are filled with dough, see Warden (2019: 14) and recent archaeological experiments by Adeline Bats (2017).



Figure 7: Unusual fireplace with holes in irregular arrangement in House 169, building phase of the middle 13th dynasty (Photo: Peter Kopp © DAI Cairo).

the ash-filled oven room (R07), although in here this type of pottery was, surprisingly, not found in large numbers. Other rooms of a similar type previously excavated at Elephantine, however, have yielded comparable distributions of sherds: in House 86b a deposit of complete bread moulds was preserved.³⁷ The high number of such oven rooms in houses of the (late) Middle Kingdom on Elephantine shows that the baking of bread generally took place in domestic buildings.³⁸ The quantity of food output from household production has yet to be determined, and depends not only on the number of moulds but also on how the baking process was executed.³⁹

³⁷ von Pilgrim (1996: 210).

³⁸ von Pilgrim (1996: 210).

³⁹ Between the Old Kingdom and the Middle Kingdom, a decentralisation of many things, including bread production, can be observed. On Elephantine an 11th-dynasty state-controlled food production centre, in which large amounts of bread were baked, has been found in the eastern part of the town (D. Raue in Dreyer *et al.* 2002: 170). At the same time, bread baking seems not to have been common in private households. As mentioned in the main text, in the Middle Kingdom, however, the supply of bread was provided by individual households. Following the same line of argument, L.A. Warden (2019: 14–15) suggests that the change of the mould type and size between the Old Kingdom and the Middle Kingdom may be related to this decentralisation of bread baking, from a mainly state-controlled production to work from home. The smaller moulds would have fitted better in smaller domestic hearths and would have been easier to distribute because the loaves did not need to be sliced

Earlier studies on bread making suggested that Middle Kingdom bread moulds had to be broken to extract the finished product. As evidence for this assumption, the vast number of broken sherds in comparison to the few complete examples of this pottery type was brought forward. Additionally, the intact moulds appeared unused.⁴⁰ Archaeological experiments and the results from Elephantine excavations, however, shed a different light on this aspect of bread production. Leslie A. Warden was able to identify macroscopically more than one layer of interior lining in several of the bread mould remains recovered from House 169 and other currently excavated features (Figure 9).⁴¹ This observation was confirmed by petrographic work executed by Mary Ownby at the laboratories of the *Institut français d'archéologie orientale le Caire*. The composition of the bread moulds⁴² themselves indicates that they had been

beforehand.

⁴⁰ Samuel (1989: 256).

⁴¹ Up to seven layers of lining were discovered macroscopically and microscopically: Warden (2019: fig. 3) and pers. comm. with M. Ownby, University of Arizona, on the results of a petrographic study of bread moulds from Elephantine in March 2018.

⁴² Excerpt from the petrographic report of M. Ownby from March 2018: 'A medium coarse Nile clay with common plant remains ranging from fine to coarse in size was employed. This is similar to the Vienna System Nile C (Nordström and Bourriau 1993). Notable were some large sandstone fragments, some siltstone and shale fragments, granite, frequent volcanic rock fragments, some metamorphic rock

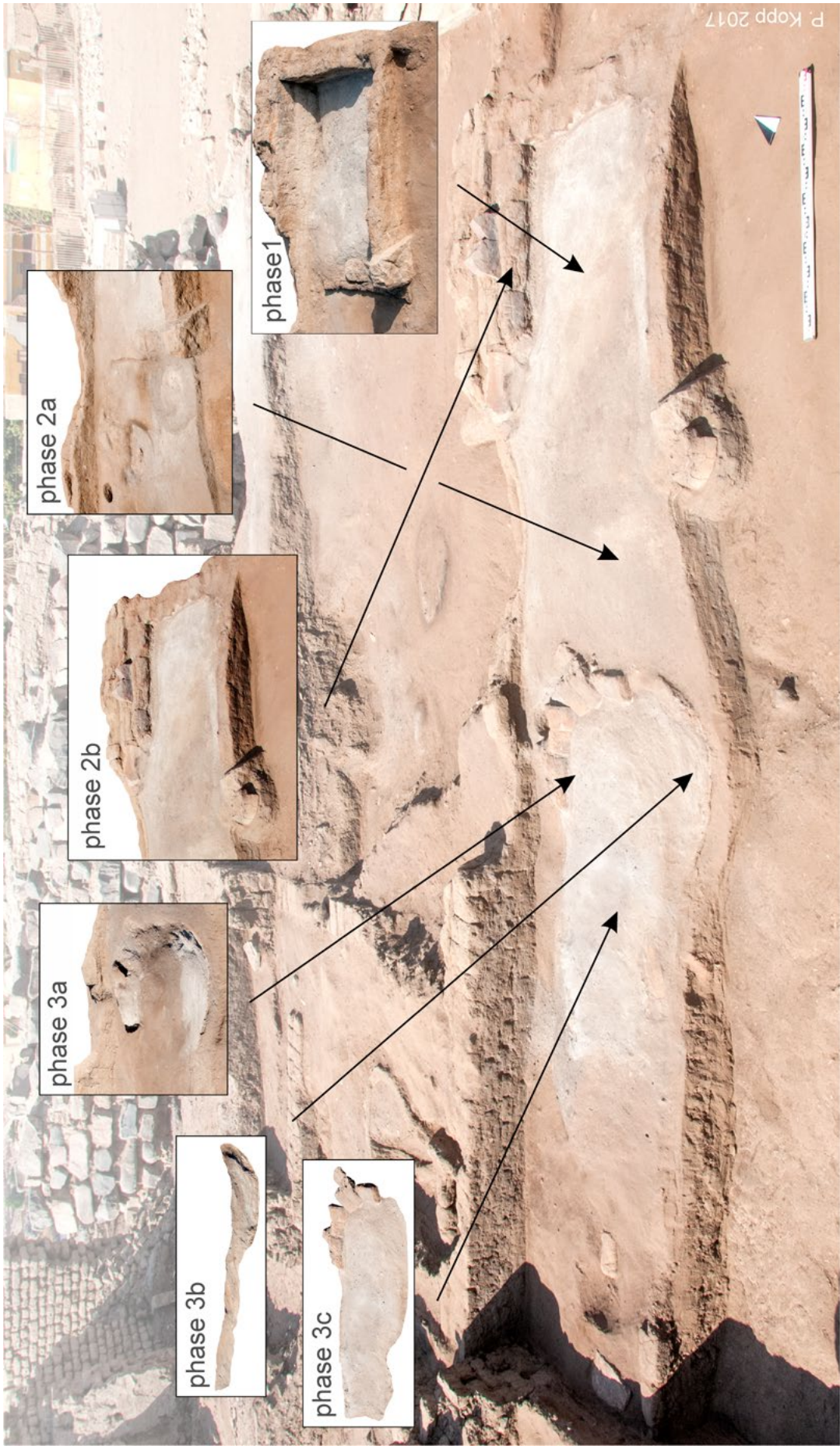


Figure 8: Phases of ash deposits in oven room R07 of House 169 in the middle to late 13th dynasty (Photo: Peter Kopp © DAI Cairo).

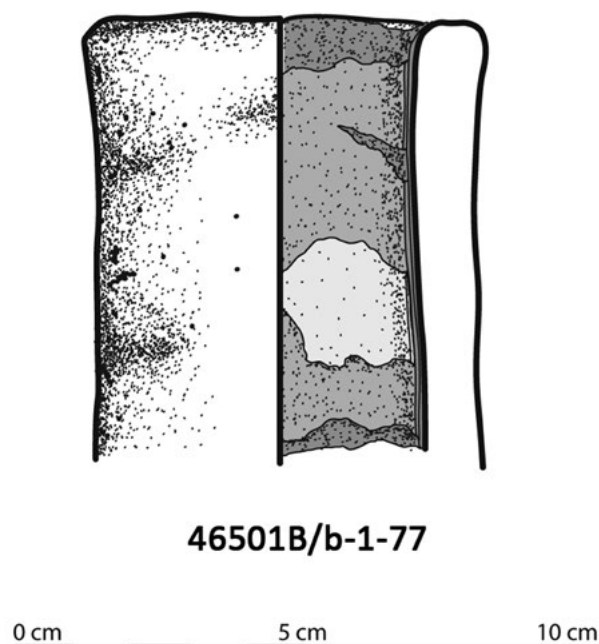


Figure 9: In bread mould 46501B/b-1-77, three layers of interior lining (different grey stages) could be observed macroscopically (Drawing and digitalisation: Pieter Collet © DAI Cairo).

produced in the Aswan area;⁴³ their interior linings are composed of thin layers of fine, silty Nile clay. Some of the base fragments of the moulds had thicker linings than the walls of the moulds, as if the material had run down or dripped into the base when it was applied fresh. The only logical explanation for the presence of these linings is that the moulds had been refurbished and thus must have been used several times for baking.⁴⁴ The linings might have assisted the removal of the finished product. This interpretation is confirmed by the experiments of Adeline Bats, who reproduced bread moulds following examples excavated from the Middle Kingdom harbour settlement of Ayn Sukhna at the Red Sea. She also successfully used those bread forms for baking, and thus found out that the interior linings had to be added fresh before each use of the

fragments, and very rare grog. The firing temperatures ranged from 800° C to 850° C, somewhat high for Nile clay vessels. The characteristics of the inclusions suggest production in the Aswan area due to the volcanic, granite, and sandstone rock fragments (The Egyptian Geological Survey and Mining Authority 1981).⁴⁵

⁴³ The final composition of the clay plus temper is different from that used in Old Kingdom moulds, probably to allow easier absorption of heat and repeated re-baking (Warden 2019: 9). The fabrication of ceramics on Elephantine has already been proven in earlier excavations of the German Institute, in which pottery ovens and unfired bread moulds were uncovered in an early 12th-dynasty context in the north-eastern town of Elephantine (P. Kopp in Seidlmayer, Arnold, Bicker *et al.* 2016: 204).

⁴⁴ Warden (2019: 9). Confirmed by M. Ownby, University of Arizona, March 2018.

mould.⁴⁵ The layers of lining would narrow the already small diameter of the Middle Kingdom moulds, but the vessel would not be discarded until it broke. According to Leslie A. Warden, this could be the reason why bread moulds only form a small percentage of the pottery assemblage from the excavation.⁴⁶

Returning to House 169 on Elephantine Island, it is interesting to note in addition that the various processes of bread production were separated in different locations within the domestic setting. While the 'dirty' work involving fire and producing ashes was done in oven room R07, which is part of the central, probably uncovered court (R04) of the house, 'clean' work such as grinding flour and maybe even mixing the dough was carried out in the other half of the building, especially in room R09. This room was, furthermore, separated from the stairs to the upper floor, which might have been considered a dirty, hazardous place as it was open to the elements. Similarly, in previously excavated Middle Kingdom houses in Elephantine, stairs and grinding emplacements were located in different spots. However, in contrast to current observations, the quern seems to have been set up close to the fireplace on various occasions, which would speak against the wish for cleanliness for certain steps of the bread making process.⁴⁷ So far no mixing bowls for the dough have been identified, but research on starch remains and residues that are planned for the upcoming work seasons of the 'Realities of Life' project might help to identify these household items.

Apart from baking, another output of the inhabitants of Elephantine's Middle Kingdom houses was, as mentioned before, jewellery. Many small fragments of semi-precious stones were found in House 169, as well as in the neighbouring Houses 166 and 73, and in the buildings that preceded them. Unlike the neighbouring, slightly older houses, where carnelian fragments and flakes were in the majority, House 169 contained a predominance of amethyst pieces. In the Middle Kingdom, amethyst was mined not far from Elephantine Island in Wadi el-Hudi, located about 35 km south-east of Aswan, and in the adjoining Wadi Dahmit.⁴⁸ The inhabitants of the houses seem to have procured raw material from both of these sites,⁴⁹ which they then worked within their homes. The production of jewellery and stone stamp seals in the north-western town is documented by the manufacturing waste (Figure 10), but also by semi-finished pendants and

⁴⁵ See Bats (2017) and pers. comm. with A. Bats, Université Paris-Sorbonne, 2019.

⁴⁶ Warden (2019: 12–13).

⁴⁷ von Pilgrim (1996: 213).

⁴⁸ Liszka (2015: 37–40); pers. comm. with the geologist of the project, H. Khozaym, Aswan University, 2017.

⁴⁹ Geological studies under the supervision of H. Khozaym are in progress to determine which of these places could be the origin of the amethyst found on Elephantine.



Figure 10: Amethyst splinters, a bead and a partly preserved scarab of the same material, as well as ostrich egg fragments, work residues and beads indicate jewellery production in House 169 on Elephantine (Photos: Peter Kopp © DAI Cairo).

stamp seals. In particular beads of semi-precious stones were therefore not necessarily manufactured in special workshops but in domestic settings.

The question arises how these small pieces of art were produced. Was heat involved in the manufacturing processes? An issue that is still under investigation is the relationship of the above-mentioned unusual fireplace with holes in room R04 of House 169. The location of this fireplace is close to the main deposit of amethyst fragments in corresponding 13th-dynasty strata (Figure 7), and they might therefore be functionally related. Fire would, however, not be used to shape or break up raw amethyst blocks, because it would damage the colourants in the stone.⁵⁰ As an alternative suggestion, the reshaping of tools for working the stone could be proposed to explain the shape and location of the fireplace.⁵¹ However, as this assumption could not

be explored further to date, the relationship of the fireplace to the amethyst fragments remains uncertain, as does the process of shaping amethyst objects.⁵²

In addition to stone, organic materials such as ostrich eggshell, bone and mother of pearl, were fashioned into jewellery. While finished and semi-finished ostrich eggshell beads have been found scattered among many excavated features, all the stages of preparation of a bead – from the shell fragment to the final object – have been recovered from a single use phase in court

History, Brussels, May 2018. This idea for the function of the pitted fireplace in R04 will have to be explored further, e.g. via archaeometric methods, to determine the heat and composition of the feature. Other suggestions for its use would be received with appreciation by the authors.

⁵² In fact, a connection between the fireplace and the accumulation of amethyst fragments for now has to remain an assumption based on their close proximity and their presence in the same archaeological feature. The area might just have been a convenient dump for amethyst, while working this raw material took place somewhere else in the room. At the same time, any number of so-far unknown tasks could have been performed at this extraordinary fireplace.

⁵⁰ Pers. comm. with Georges Verly, Royal Museums of Arts and History, Brussels, May 2018.

⁵¹ Pers. comm. with Georges Verly, Royal Museums of Arts and

R08 and the adjacent room R09 in House 169 (Figure 10). Again, an assumption of separating work with different materials could be made: working with amethyst and using fire could be seen as 'dirty' work and therefore located in court R04, whereas the fashioning of the soft eggshell might not have produced as much of a disturbance to the household climate and thus could be located in the 'cleaner' court R08.

It remains a task for further study and discussion to determine for which purpose jewellery was made in this household setting: would the finished objects have been sold or produced on order, or were the items meant for purely personal use? Who would be the recipient, if they were indeed produced as items of trade and exchange?

Summary

As can be seen in the above examples, various kinds of productive activities were part of the daily life of the inhabitants of Elephantine in the Middle Kingdom. It is probably safe to assume that similar activities occurred in most settlements and households all over Egypt and through all time periods. After all, it was always necessary to build and refurbish the living environment as well as to feed the members of one's home. Mud pits for mixing plaster and making bricks were therefore a common feature when construction work takes place in the vicinity. To use wastelands for this kind of production is logical, as it would provide the space and not disturb the regular flow of traffic. These pits can be time capsules, capturing moments long past, like the moving of children through an area.

The production of food is surely one of the most time-consuming activities of life. Insights into culinary preferences in ancient times can come from discarded food items, such as the remains of processed fish found in the above-mentioned wasteland feature during the new excavations on Elephantine Island. Apart from animal remains, the 'Realities of Life' project has been able to bring to light new evidence on bread baking and the use of bread moulds through the macroscopic, microscopic and statistical study of ceramics. The prior assumption that bread moulds were waste, discarded immediately after each firing, can now be revised: Middle Kingdom bread moulds were used repeatedly. It remains open for discussion how often, however. A minimum of seven firings may be assumed based on the number of interior linings, but a far higher number is quite probable. In the context of bread baking, it was interesting to observe that cleanliness might have played a role in the various stages of the production. The architectural setting of House 169 might even have been adjusted to these needs through time by separating the southern court with its oven room more

thoroughly from the 'clean' work location in the north of the house.

The issue of clean versus dirty space could, in the end, also have played a role for the fabrication of one of the most common inedible products of households in Elephantine: beads and small-scale jewellery items. Thus, a certain spatial separation for the working of different materials could be observed. The question of who the recipients of the produced items were, is still open. Similarly, it will have to be determined how much governmental control played a role in this kind of production as well as the above-mentioned bakeries.

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3. Production Moments and Areas in a Big House in Pompeii: The House of Ariadne from the 2nd Century BC to AD 79.

Macarena Bustamante-Álvarez and Albert Ribera i Lacomba

Abstract

This article analyses the archaeological remains from the processing of perfumery and wool in the House of Ariadne in Pompeii. There were two main periods of productivity in this house: the middle of the second century BC and the period between the reign of Tiberius and the earthquake in AD 62. From the first period, there is a basin in the southern part of the site, which resembles contemporary ones in the neighborhood of perfumers, and in which many ceramic *unguentaria* were found. The second productive period developed along the northern and southern *tabernae*. In the north, in the great *perystilum*, a basin and channels were constructed to treat wool. In the southwestern *taberna*, a facility for perfume production was discovered.

Keywords: Pompeii; perfumes; wool; crafts; economy; topography

Kurzfassung

Dieser Artikel behandelt die archäologischen Hinterlassenschaften der Parfümherstellung und Wollverarbeitung in der Villa der Ariadne in Pompeii. Es gab zwei Hauptperioden der Produktivität: Mitte des 2. Jhd. v. Chr., sowie den Zeitraum zwischen der Herrschaft des Tiberius und dem Erdbeben von 62 n. Chr. Aus der ersten Periode stammt ein Becken im Süden des Geländes, welches zeitgenössischen Becken im Viertel der Parfümhändler ähnelt, und in dem viele keramische *unguentaria* gefunden wurden. Die zweite produktive Periode entwickelte sich entlang der nördlichen und südlichen Außenbereiche. Im Norden in der großen Säulenhalle wurden ein Becken und Kanäle eingebaut, die dazu dienten, Wolle zu behandeln. In der südwestlichen *taberna* wurde eine Anlage für die Parfümherstellung entdeckt.

Keywords: Pompeii; Parfum; Wolle; Handwerk; Wirtschaft; Topographie

In addition to giving a brief description of the origin of perfumes, as well as their application and significance, we will examine all the archaeological evidence that we have to assess perfume production and other activities in the heart of the House of Ariadne and its surroundings.

The House of Ariadne. Brief notes

The House of Ariadne is one of the most extensive buildings in Pompeii (Figure 1), measuring more than 2000 m² and approximately 70 meters in length from north to south. The house is in a privileged location, flanked to the north by Via della Fortuna, one of the main arteries of Pompeii, around which are located some of the most luxurious houses in the city, such as the House of the Faun. In its southern part, the long dwelling opens onto the Via degli Augustali. This street delimits the *macellum* (the public market) from the north and, so, it was mainly associated with trade and economic activities.

The history and function of this house, from its origins in the second century BC, are closely linked to the contrast between its two access points: the northern,

associated with an area of privileged and elitist character, crossed by the aforementioned Via della Fortuna; and the southern, linked to the economic function of the Via degli Augustali. The location of this house, in the nerve center of the city, was very notable for its length. On one side, the southern point faced the market (*macellum*), while the northern was very close to the other large houses and the forum. This situation made it not only the ideal space for family and social life, but also, depending on the state of the economy at any particular moment, a site of commercial enterprise.

Since 2004, an international, multidisciplinary and interdisciplinary team, coordinated by the Archeology Section of the City Council (SIAM) of Valencia and the Valencian Institute of Conservation and Restoration of the Generalitat Valenciana, has been carrying out an archaeological research and restoration project in the House of Ariadne and its surroundings to the west of the house, as well as in neighboring spaces in Via degli Augustali: *Tabernae* VII, 4, 26, 27, 28 and 29 (Figure 2).¹

The archaeological excavations, besides helping us to understand the evolution and the physiognomy of this

¹ Bustamante, Escrivá *et al.* (2010); Ribera *et al.* (2007).

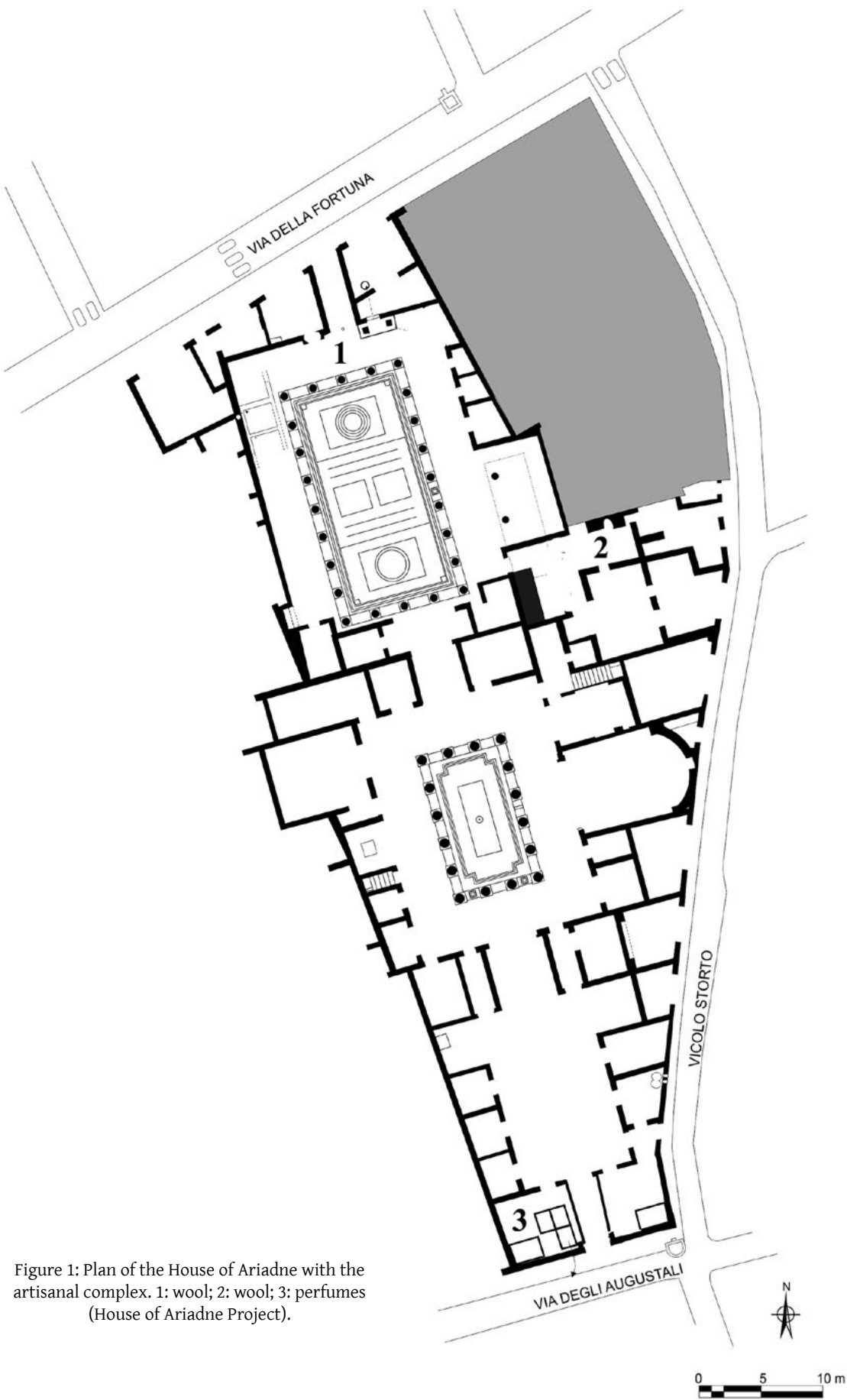


Figure 1: Plan of the House of Ariadne with the artisanal complex. 1: wool; 2: wool; 3: perfumes (House of Ariadne Project).

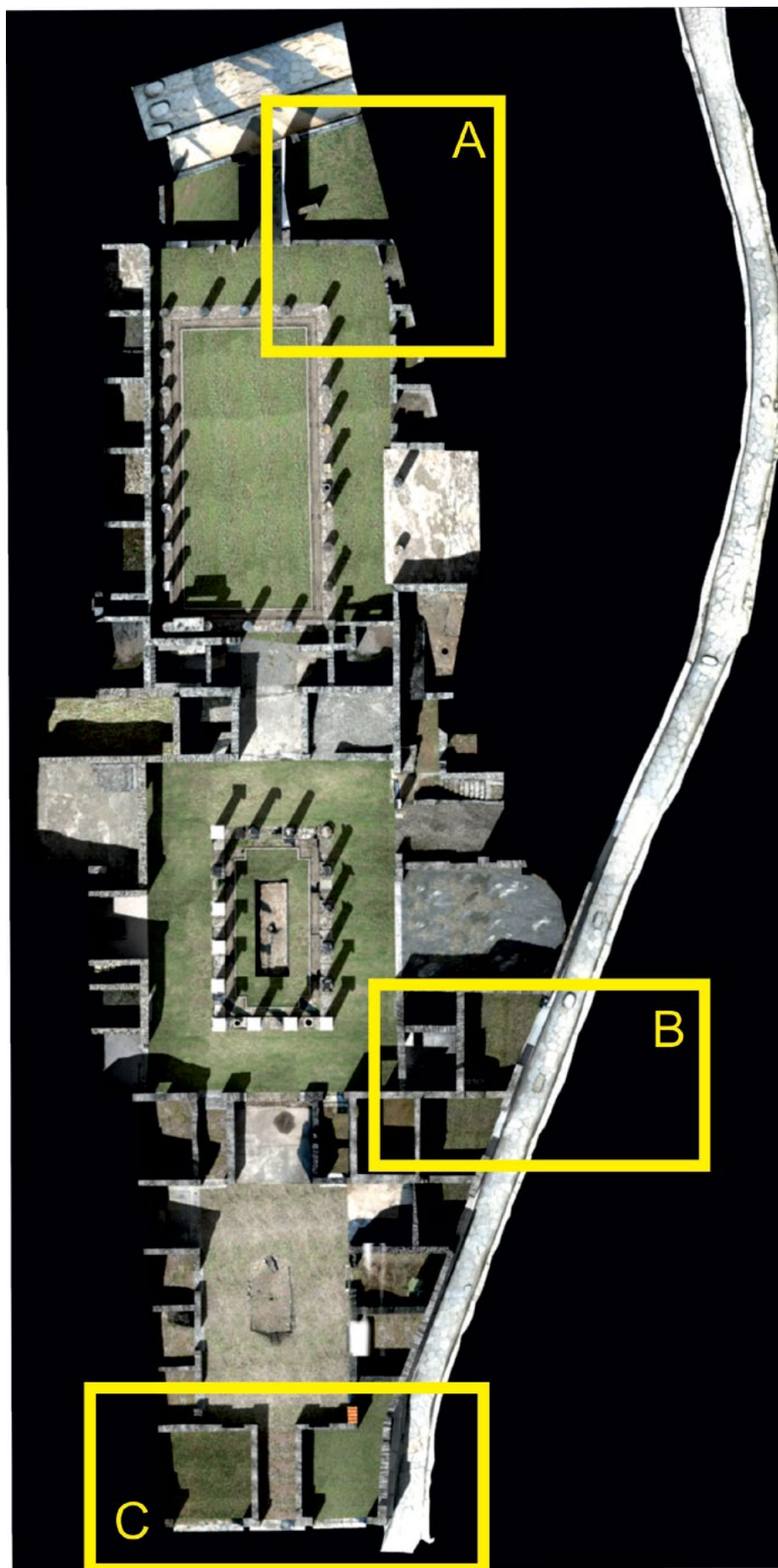


Figure 2: General 3D survey model of the House of Ariadne. C: perfume area (House of Ariadne Project).

domus, have contributed interesting data about the urban development of the city² and have enabled us to study the economic activities that developed within it. We will focus on the analysis of the southern area of the house. In this wing, the domus had two *tabernae* next to Via degli Augustali, connected to the atrium of the house and closed to the outside. Only in the final period, prior to the volcanic eruption in AD 79, these were opened to the street but with access to the interior walled off, which is how they appear today. This street, located north of the nearby *macellum*, was chiefly used for commercial purposes.

The latest findings, both from *Taberna* 30 in the House of Ariadne (2007–2008), and from *Tabernae* 26, 27 and 28 in Via degli Augustali (2011, 2012 and 2013 respectively)³ enable us to analyze the artisanal process of making perfumes, from their manufacture to their sale and individual use. These findings also give us the opportunity to understand the entire perfume production process, represented in different Pompeian frescoes (as in the House of the Vetti or VII, 7, 5).

The impact of the perfume trade on the Italian Peninsula

From the 2nd century BC, the austere and simple character of the early Roman culture was modified by influences from the Near East.⁴ This process began much earlier in the southern part of the Italian Peninsula through contacts with the Etruscans of Campania and the Greeks of Magna Grecia. This situation led to the early introduction of new hygienic-cosmetic habits among the Southern Italic peoples, particularly in the case of the Samnites, the inhabitants of Pompeii from the 5th century BC.

The general adoption of Eastern and Hellenistic practices among the Romans came only with the arrival of Greek culture in the Roman world, beginning in the 2nd century BC.⁵ Interest in the use (and in many cases abuse) of perfumes and perfumed oils expanded rapidly. At the beginning of the reign of Augustus, perfumes became a symbol of ostentation, wealth and power. The use of perfumes degenerated to exaggeration in literature, as some authors reveal, and it is best found expressed in the following quote: '*haec est materia luxus e cunctis maxime supervacui*' (luxury is the ultimate expression of the superfluous).⁶

In the Early Principate, the use of perfumes was extended to all spheres of Roman daily life, both in

Italy as well as in the provinces. Drink, food, temples and streets were all perfumed. The use of perfume in votive offerings and funerals has also been attested.⁷ Along with this constant sumptuous use, it also played a vital role in first aid. Perfumes could acquire a more oily and thick consistency and could be used in *infundibula/lucernae* for light. At the same time, hygiene played a very important role. The massages offered in the *tepidaria* of the *thermae* is an example of the use of this product. Pliny the Younger shows his devotion to hygiene and perfumes in his letter to Eufulanus Marcellinus.⁸

Perfumeries were very common in the Roman cities of the Empire, since contemporary society in this period was accustomed to 'aroma fashion' and used this product as an olfactory complement. Also, demagogically, *unguentaria* had a very important role in Roman populist politics, especially in public acts, and they were produced in Pompeii and elsewhere, including in private households, and even the emperor ordered perfumes for himself.⁹ All these practices are attested in epigraphic sources. Some of the inscriptions to which we can refer allude to *sparsiones* (sprinkled perfumes) used on the occasion of the inauguration of a bath,¹⁰ in the gladiatorial games held in honor of Claudius,¹¹ or even when embellishing the consecration of an altar to Vespasian.¹² This product also played an important role in funerals, since in funeral practices it was considered to be the vital element that enabled the deceased to recover the decorum that his body had lost.¹³ Finally, we should not forget its use as a weapon of seduction in Roman times, both by men and women, who anointed themselves with these products from head to foot.¹⁴

Perfumes in Campania and Pompeii

The region of Campania, where Pompeii is located, was fully integrated into a superregional market that, in the beginning, was practically monopolized by Eastern products. However, Campanian products were soon included in this sumptuous market; the evidence from Campania, such as Capua, shows this clearly. Perhaps the key to this success was the magnificence described by Pliny, who claimed that roses in this area were 'more perfumed than the rest'.¹⁵

In written sources, special mention is given to the main city of pre-Roman Campania, Capua. A famous

² Bustamante, Escrivá *et al.* (2010).

³ *Tabernae* 26, 27 and 28 were excavated in collaboration with the Centre Jean Bérard in Naples.

⁴ Faure (1987: 26 ff).

⁵ Vallet (1962).

⁶ Pliny, *Nat. Hist.* XIII, IV, 20 (Fontán and Moure 1995: 116).

⁷ Huguet and Ribera (2013).

⁸ *Ep* 9, 36 (González 2005: 276–277).

⁹ *CIL* 4, 1177; 1181; 1180

¹⁰ *CIL* 4, 1177.

¹¹ *CIL* 4, 1181.

¹² *CIL* 4, 1180.

¹³ Huguet and Ribera (2013).

¹⁴ Pliny, *Nat. Hist.* XIII, 20–22 (Fontán and Moure 1995: 114–120).

¹⁵ Pliny, *Nat. Hist.* XVIII, 111 (Fontán and Moure 1995: 436).



Figure 3: Photo of the perfume press located in the peristyle (House of Ariadne Project).

neighborhood in the urban center, *Seplasia*, was renowned for being dedicated to the development of perfumes considered to be superior.¹⁶

An inscription found in the Via degli Augustali in Pompeii refers to the *collegium* (professional association) of the *unguentarii* (perfumers). They would have had their headquarters in this area, next to the *macellum* and very close to the forum.¹⁷

Given this background, it was not difficult at the time of their initial excavation to interpret the findings of *Tabernae* 24 and 25 in Via degli Augustali as a perfume factory as reconstructed by Maiuri.¹⁸ Subsequent work by the Centre Jean Bérard in Naples confirmed and expanded the documentation of the site, while at the same time proposing some hypotheses for the functioning of the press.¹⁹

It is assumed that once the odorous raw material was obtained, another phase in the chain of production would take place. This would be the pressing and extraction of the *corpus*/olive oil base for the perfumes. The need to use 'fresh' oils required the installation of the pressing system in the perfumeries themselves. Again, archeological evidence has confirmed what classic authors have indicated, that the presses should be close at hand.²⁰ The arrangement of the presses dedicated to this task has been well-studied in the past.²¹ One of the most exemplary presses for the production of refined oils is known to have been in the House of Ariadne. It is a block of very fine-grained stone with a quadrangular shape, which was found in the northern peristyle of the house (Figure 3). Already in the 19th century, when the house was first excavated,²² the existence and location of this press and its association with perfumed oils and essences were documented. This invalidates the possibility of the oil being brought here from other parts of the city.

¹⁶ Brun (2000).

¹⁷ Della Corte (1965: 181–182).

¹⁸ Maiuri (1929).

¹⁹ Borgard *et al.* (2005).

²⁰ Pliny, *Nat. Hist.* XII, 130 (Fontán and Moure 1995: 100–101).

²¹ Mattingly (1990).

²² Giordano and Casale (2007: 33).



Figure 4: View of a pool located in the northern peristyle (House of Ariadne Project).

Analysis of the perfumer's complex of the *domus* of Ariadne

The archaeological excavations have allowed us to define two main phases of production in the house: first, the middle of the second century BC and second, the period between the reign of Tiberius and the earthquake in AD 62. Dating from the first phase and located to the south, next to the street, there is a pool used in the production of perfumes that is similar to other contemporary ones found in the same street. In *Taberna* 28, a large quantity of ceramic ointment jars (*unguentaria*) has been found. The use of the southern part of the House of Ariadne for perfume production came to an end when a large house with an atrium, peristyle and *hortus* was built on top of *Taberna* 28 at the end of the 2nd century BC. In the middle of the first century BC, the southern Tuscan atrium was removed and another large peristyle, or a Corinthian atrium, was added to the north, next to the street, which modified the access points and the physiognomy and function of the northern and southern spaces.²³

The other main production phase took place between the reign of Tiberius and AD 62, evidence of which were

found both at the northern and southern ends of the building. To the north, around and below the large peristyle, pools and canals were installed, a group of features recently identified as a space for cleaning and treating wool.²⁴ In the southwestern part of *Taberna* 30 (the same area as the pool of the Hellenistic/Samnite period), the base of an oil press and the collection containers for the liquid and the pool have been found, from north to south respectively.

The first manufacturing area was located in the wide northern peristyle with an exit to Via della Fortuna. Around the same peristyle, built in an earlier phase and sheltered under the portico, several pools and a press were placed, which would have been related to the treatment of wool (Figure 4). Secondly, the center of this large open-air space may have been used for the cultivation of aromatic flowers, essential for the production of perfumes.

As part of the process of artisanal perfume production recounted in the classical texts, the maceration of flowers and the extraction of their essences are described.²⁵ In the House of Ariadne, the proximity of

²³ Ribera *et al.* (2007).

²⁴ Bustamante-Álvarez and Ribera (2016).

²⁵ Giordano and Casale (2007).



Figure 5: Large pool located in *Taberna* 32 (House of Ariadne Project).

the garden and the pools would have sped up this first step. Domestic spaces dedicated to flower cultivation have been found elsewhere in Pompeii, such as in the *domus* of the Perfumer and in the Garden of Hercules.²⁶

Along with this evidence from the northern zone of the house, *Tabernae* 30 and 32 in the southern part, both with an exit to Via degli Augustali, unequivocally represent structures designed for the industries of interest in this paper.

Taberna 32 was located in the corner of the insula, at the confluence of Via degli Augustali and Vicolo Storto. This small *taberna*, measuring 4.50 m x 5 m, did not contain traces of manufacturing activities. During the excavations in the nineteenth century, it was assumed that, in the last years of Pompeii, it had been a *thermopolium/taberna*. The structure was superimposed on a production space of the Tiberian period, which coincided with an architectural renovation of the *taberna*, including the blocking of a door between the house and the shop. At this time, a small room was annexed to this space in the rear area, thus facilitating a new opening. So, the *taberna* would have had an exit by Via degli Augustali as well as by Vicolo Storto.

Similarly, in this same productive phase a pool was installed in the southeastern corner, embedded in the base of the corner of the *taberna* (Figure 5). This pool was rectangular, measuring 1.40 m x 1.80 m, and had a preserved height of about 1.60 m. Its construction took advantage of the eastern and southern portions of the foundations of the perimeter walls of the house, which were built from local stone. The structure was completed with two new walls to the west and north. These new walls were made of small volcanic stones as well as some fragments of reused construction material.

The floor of the pool was made of very water-resistant *opus signinum*. The base was completely flat, with only about two centimeters of elevation in the central area. There was no half-round molding at the contact point of the floor with the walls. In addition, no element has been identified that would have aided decantation. The time at which the pool was constructed is unknown because its foundation trenches have not been excavated. Nevertheless, based on the material found within it, it can be placed chronologically prior to the middle of the first century AD, between the reigns of Tiberius and Claudius. In this *taberna*, no vestige of a press has been located. For this reason, we favored the hypothesis that in this area, only oils with essences were agglutinated in the pools, which was the step

²⁶ De Simone (1988: 184–186); Jashemski (1979: 279–288).

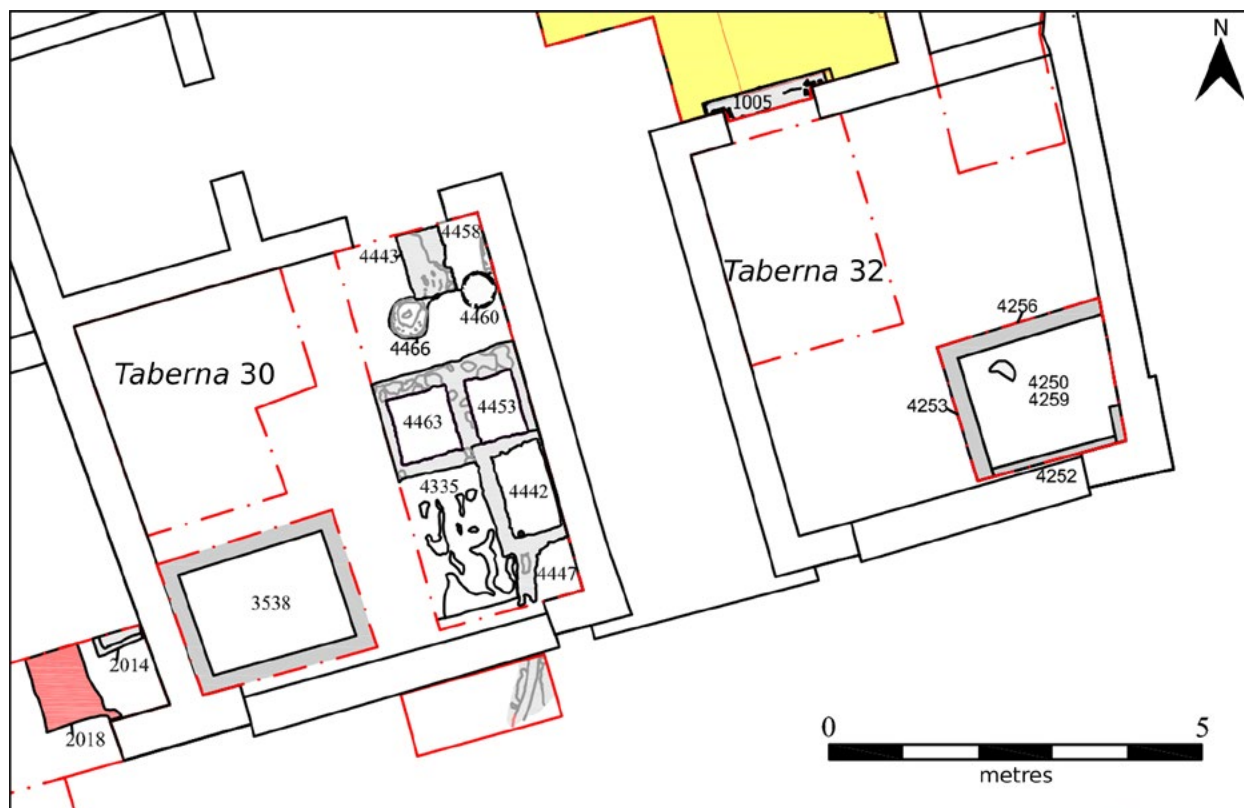


Figure 6: Perfume complex in *Tabernae* 30 and 32 (House of Ariadne Project).

prior to their packaging. This would perhaps also have been carried out in this space.

In short, during the first half of the first century AD *Taberna* 32 became a production area. The best example of this development is the pool in the southeastern corner. This feature was eliminated in the middle of the first century AD, before the earthquake in AD 62. Initially, and pending analytical and interdisciplinary studies, it was related to the perfumer's tradition in Via degli Augustali, which was corroborated in 2001 during the excavations in *Tabernae* nos 24–25, carried out by a French mission.²⁷

As was the case with the other *tabernae*, no traces of artisanal activity were initially found in *Taberna* 30; located on the other side of the *fauces* of the *domus*, it was a *thermopolium* before the volcanic eruption. The excavations located a small, circular well of stones, bricks and fragments of reused hydraulic mortar in the northwestern quadrant. This well was connected to the upper floor by a column of *tubuli*/pipes, which posed the question of whether it collected waste or clean water. An analysis carried out by Hobson and published in his 'Latrines and Downpipes in Pompeii'²⁸ confirms

that it was used for clean water and, therefore, in manufacturing that took place the eastern half of the *taberna*, which appeared to be an establishment for the processing of perfumes (Figures 6 and 7).

There was a rectangular pool measuring 1.22 m x 70 cm, with a preserved depth of about 16 cm, in the back of the *taberna*, which in this period was closed to the street and open to the atrium. The pool was made of irregular masonry consisting of volcanic stones and bricks mixed with mortar. It drained directly onto the street by a channel with a steep inclination that reached 20 cm in its final part, which indicates that this would have been the exit route of a very viscous product, perhaps *corpus* (oil).

In the central area of the *taberna*, with a slightly more recent date, two pools that were small in size and quadrangular in shape were found, which did not have an interior coating and with a floor made of beaten earth. The fact that this arrangement has been less carefully finished, clearly indicates that it was not used for the preservation of delicate products and would instead have been used for the collection of other solid or semi-solid products that have left no trace, perhaps flowers.

²⁷ Borgard *et al.* (2005).

²⁸ Hobson (2009).



Figure 7: Different views of the perfume shop in *Taberna* 30 (House of Ariadne Project).

Further to the north was a rectangular stone resting on the corner of the *taberna*, which was interpreted as the base of a press. It measured 1.20 m x 1 m by 20 cm and included a broken part that had been repaired with various types of gravel. This stone was of a similar shape to the one that was located in a secondary position in the peristyle of the House of Ariadne, which has already been interpreted by Mattingly²⁹ and Giordano and Casale³⁰ as a perfume press. Just at the foot of the stone was the base of a dolium vessel that had been broken intentionally and the impression of another large vessel, or a possible cauldron of copper, necessary for this production. This hollow feature was filled by a later stratigraphic layer. The chronological data were provided by materials such as Italian sigillata, a Deneauve type 9 lamp and Italian kitchen containers of type LT7c/2416. A seashell with two holes was found inside the dolium. This shell was possibly hung up and used as a ladle to scoop up liquids.

To understand how this press would have worked, it is necessary to analyze a series of circular pits containing chocks and mortar that was located in front of the press. These features would have allowed the insertion of adjustable counterweights into the rear wall. The press would have reached an elevation of no more than 2 m, as has already been established based on iconographic parallels.³¹ Specifically, we have evidence of a wooden press, which is well-attested in the pictorial representations of perfumers found in various houses in the Vesuvian area: the paintings of the House of the Vetti (Figure 8), the House of the Deer, the *domus* VII, 7, 5 and the panel of the Fitzwilliam Museum in Cambridge.

Recently, the possibility has arisen that the reconstruction of a press located in Via degli Augustali, in a nearby *taberna*, also have these characteristics,³² which would disprove the initial proposal by Maiuri.³³ This type of press is characterized by its small size, the

²⁹ Mattingly (1990).

³⁰ Giordano and Casale (2007).

³¹ Brun (1998: 437).

³² Mattingly (1990: 86–87).

³³ Maiuri (1929).



Figure 8: Painting from the House of the Vetti (House of Ariadne Project).

largest ones being relegated to more open and, possibly, agricultural spaces.³⁴

The fact that there are two basins without any coating that appear only in the back area, could give us clues about the collection process of a product that was ready to be processed in this press.

This production complex was completed by the construction of a final pool, excavated alongside other pools during the removal of the subsoil, in the southwestern area of the shop that was covered with *opus signinum*. This pool was larger than the previous ones, with dimensions similar to those of *Taberna* 32.

Together with this concentration of perfumeries in the southern area of the house, there were two more production spaces in the eastern and northern areas, which we will outline below.

In the eastern zone, outside the House of Ariadne, there is a series of pools and depressions that, for a long time, has been associated with the washing and processing of wool, that is, an *officina lanificaria*.³⁵ Connected to these pools and depressions was the artisanal complex located off the northern peristyle, which included a large pool with two central pillars that would have supported a large press (Figure 9). This structure is associated with a well and a system of hydraulic channels, pools and pavements located in the other contiguous spaces to which it would connect.

The processing of wool was complementary to the production of perfumes. In fact, these two industries were very closely related, as described by classical sources and current ethnographic parallels. According to Pliny,³⁶ the grease resulting from washing wool, the so-called *oesypum* (modern lanolin), was used to give the skin a smoother complexion, free of spots and moles. Additionally, Ovid³⁷ refers to this product when he gives advice to women on how to seduce men, informing them that their lovers do not see the products to which their skin is subjected. In this same passage there is a very interesting fact about the famous *oesypum*: that it came from the *officina lanificaria* located in the eastern part of the house.

In our supermarkets today, there are ‘miracle ointments’ that rely on this component for the same purpose. Therefore, the manufacture of this product only a few meters from a facility linked to cosmetics and female care can give us the key to understanding this location and, above all, its subsidiary nature.

The end of production

The pool of *Taberna* 32 was found filled with loose, sandy, blackish brown soil together with ashes, remains of animals, shells, large pieces of construction materials and a large amount of archaeological material useful for dating, such as glassware and pottery. In addition, there were metal objects and many coins, the spatial distribution of which indicates the occurrence of a traumatic episode, such as an earthquake. The pottery

³⁴ Brun (1986: 84–90).

³⁵ Bustamante-Álvarez and Ribera (2016).

³⁶ Pliny, *Nat. Hist.* XXX, 28 (Fontán and Moure 1995: 113).

³⁷ Ovid, *Ars. Am.* III, 210–215 (Cristobal 1989: 436).



Figure 9: Press in the *officinal lanifricaria* (House of Ariadne Project).

(Figure 10) can be dated to c. 40–50 AD.³⁸ The Italian sigillata is of Padanian, Pisan, Neapolitan and Arretine origins. Among the forms that stand out are *Conspectus* 12, 20, 26, 27 and 37. The stamps on the sigillata, in addition to confirming the origin of the pottery, also confirm the date. Among this pottery, we found evidence of the potters Ateius, Cresti and Euhodi. In addition to the sigillata, there were other elements of the ceramic ‘kit’ of Claudius’ time, such as thin-walled pottery of local origin, coarse ware from the Vesuvian area as well as a few amphorae and several lamps (the large size of Dr. 23, with a double nozzle and a handle in the shape of a vulva). One of the most outstanding elements was the large number of glass objects and glass tools found in the pool. Of special interest was a glass and plate service made of opaque blue glass of Eastern origin. There were also containers, a wide variety of bowls, bottles and stirring sticks—a typical repertoire in the production and sale of cosmetics.

Together with all these artifacts, a large number of faunal remains were discovered, the majority of which were different elements of pigs, specifically skulls and scapulae, presumably the most ‘gelatinous’ parts of these animals. The predominance of certain fauna coincides with the findings by our colleagues at the

Centre Jean Bérard studying the nearby perfumery of *Taberna* 24 on the same street.³⁹ This predominance of pigs, especially gelatinous parts such as the head and trotters, have correlation in the classical sources with the use of *stymmata* as a binder for oil and essences.⁴⁰ In particular, recent studies in Pompeii explain the need for gelatinous elements in order to achieve the agglutination of floral essences and refined oil, an activity that would have been carried out in these pools.

The twenty-four coins found, the most recent of which was from the beginning of the reign of Claudius, offer a clear date for the end of this installation. They confirmed the date provided by the pottery.

This pool was not filled at the time of the famous earthquake during the reign of Nero, but in an earlier, sudden event during the reign of Claudius.⁴¹ This earlier episode did not affect the city as traumatically or destructively as the Neronian one. It occurred in an area that has always been very dynamic, seismically speaking, with traumatic episodes in prehistoric⁴² as well as protohistoric times.⁴³ Other authors have already

³⁹ Borgard *et al.* (2005).

⁴⁰ Pliny, *Nat. Hist.* XIII, 2 (Manzanero Cano *et al.* 2010: 109–110).

⁴¹ Bustamante, Escrivá *et al.* (2010); Bustamante, Huguet *et al.* (2010).

⁴² Albore Livadie *et al.* (1986).

⁴³ Marzocchella (1986).

³⁸ Bustamante *et al.* (2011).

Taberna 32

A extensive deposit dating to the time of the 'Claudio Earthquake'?



Figure 10: Pottery and coins from the pool in *Taberna* 32 (House of Ariadne Project).

proposed the possibility of other earthquakes before AD 62 based on finds in the House of the Ara Maxima⁴⁴ and in the Insula of the Chaste Lovers.⁴⁵ In addition, the earthquake in AD 62 is known thanks to Tacitus,⁴⁶ who refers to it briefly because of its coincidence with a visit by Emperor Nero to Naples.

In *Taberna* 30, the small southern pool was filled in, as attested by the discovery of abundant remains of painted wall plaster. The motifs represented in these frescoes, especially emblems, do not seem to be the most appropriate for the decoration of a productive *taberna*. It should not be ruled out that these paintings may come from the noble area of the House of Ariadne or other nearby houses. Nevertheless, they would postdate some of the earthquakes that preceded the volcanic eruption, probably the best known being that occurring in AD 62.

Despite the deteriorated state of the paintings, it was possible to differentiate four decorative patterns from the Second, Third and Fourth Pompeian painting styles:

- First, a panel of mythological representations, which has been interpreted as a personification of the Sarno River next to Vesuvius.⁴⁷
- Second, a group of large zoomorphic figures, especially equines.
- Third, another mythological scene with smaller figures, including the god Mercury.
- Finally, a group belonging to the Second Style, which featured flowers outlined on a white background.

The pool's drainage channel was also filled in by the earthquake in AD 62. In it, next to the threshold of the house, a small, complete bowl was found along with the bone of a big feline, probably a lion. This singular deposit has been interpreted as a propitiatory rite for

⁴⁴ Kockel (1986: 498); Stemmer (1992: 40, n.145).

⁴⁵ Varone (1995: 34).

⁴⁶ Tacitus, *An.* XV, 22 (Moralejo 1980: 113).

⁴⁷ Fernández *et al.* (2013).

the new construction phase of the city, at which time the threshold of the *taberna* was installed.

The great pool of *Taberna* 30 appears to have been filled in by a large number of ceramic pieces, especially of African, Sicilian and Hispanic amphorae, as well as Gaulish Sigillata. In this case, the date of the materials pointed to the Neronian earthquake or a moment shortly before the volcanic eruption in AD 79.

The end of the manufacturing activities in the *officina lanificaria* coincided with the earthquake in AD 62, after which the production structures were abandoned. Soon afterwards, the owners appear to have decided to convert the great old house into a luxurious residence. However, the volcanic eruption ended this project.

Conclusions

The archaeological work carried out between 2007 and 2009 confirmed that Via degli Augustali was a street dedicated mainly to the production and sale of perfumes and perfumed oils from the 2nd century BC. It functioned in Roman times solely as a guild district, as has been pointed out by others.⁴⁸ This idea of a spatial organization of guilds is not new, considering the well-known examples of Rome, Capua and Paestum.⁴⁹

The perfumery that we have presented here is the second known installation of this type in Pompeii. The first was located only a few meters from this complex, at VII, 4, 24–25.⁵⁰ In the case of the House of Ariadne, a very precisely organized plan of use was drawn up. On one side of the house, the production of perfumed oils was carried out. On other side, wool was treated, which in turn supplied the perfumer's complex with one of the most essential materials for the production of cosmetics, namely lanolin.

The location of the *tabernae* in front of the *macellum* and their proximity to the thermal baths of the forum, the Central bath and the Stabian bath, would have made this space the ideal place to set up a business of this type.

As far as we can ascertain, the architectural grandeur of the House of Ariadne was perhaps a reflection of the high purchasing power of its owner. With the evidence we have analyzed, we suggest that the owner of the house was a rich *unguentarius*/perfumer of the area. There is much evidence that indicates the great economic rewards that this type of product brought to its merchants. However, in the House of Ariadne, unlike in other Pompeian homes, there are no wall paintings

that allude to this manufacture or suggest the main source of income of this building.⁵¹

The House of Ariadne project has found evidence that reinforces and confirms the existence of an extensive guild district dedicated to the manufacture of perfumed oils and essences. This contribution, which focuses on the Pompeian perfume industries, has highlighted the gaps in our knowledge of the complex world of the local economy of Pompeii.⁵²

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⁴⁸ Della Corte (1965: 181–182).

⁴⁹ Brun (1998).

⁵⁰ Borgard et al. (2005).

⁵¹ Rostovtseff (1957: 92).

⁵² Monteix (2017: 236).

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4. The Bone Workshop of the Armoury from the Chariotry of Ramesses II in Qantir-Piramesse – a Case Study

Silvia Prell and Chiori Kitagawa

Abstract

During the excavations of site Q I at Qantir-Piramesse a significant amount of stone tools were found within structures, which turned out to be part of a much larger workshop complex. According to other finds, this workshop can be associated with the chariotry stationed in the capital of Ramesses II in the eastern Delta of Egypt. Although the tools themselves did not help much with the identification of the branches of production, when considered together with associated finds, it was possible to observe different branches of production and the *chaîne opératoire* of a bone workshop, which comprises everything from the processing from raw materials to the final products. Only one type of stone tool found in the workshop complex, which hosted different branches of production, can be tied to a specific function: tools for smoothing and polishing bone points. This paper presents a summary of the main findings of our study focusing on this bone workshop.

Keywords: Egypt; bone workshop; chariotry; armoury; stone tools; bone points

Kurzfassung

Während der Ausgrabungen im Areal Q I in Qantir-Piramesse trat eine größere Anzahl von Steinwerkzeugen zutage. Die zugehörigen architektonischen Strukturen stellten sich als Teil eines größeren Werkstattkomplexes heraus. Anhand von weiteren Funden können diese Werkstätten mit der Streitwagengarnison in Verbindung gebracht werden, die in der Hauptstadt von Ramses II im Ostdelta Ägyptens stationiert war. Die Steinwerkzeuge waren bei der Identifizierung der Produktionszweige nur bedingt hilfreich. Aber gemeinsam mit anderen Funden waren verschiedene Produktionsbereiche und die *chaîne opératoire* einer Knochenwerkstatt zu identifizieren, die verschiedene Endprodukte fertigte. Nur eine Gruppe von Steinwerkzeugen, die in dem mehrere Produktionszweige umfassenden Komplex gefunden wurden, konnte einer bestimmten Funktion zugeordnet werden – Werkzeuge zum Schleifen und Polieren von Knochenspitzen. Dieser Artikel ist als Zusammenfassung der wichtigsten Ergebnisse unserer Studien in Hinblick auf die Knochenwerkstatt zu verstehen.

Keywords: Ägypten; Knochenwerkstatt; Streitwagengarnison; Waffenschmiede; Steinwerkzeuge; Knochenspitzen

Introduction

The excavations carried out by the Hildesheim mission at site Q I, located in the eastern Delta of Egypt (see Figure 1), from 1980 to 1987, allowed a unique insight into the daily life, especially working life, within the residence of Ramesses the Great. Site Q I is situated south of the modern village of Qantir (Figure 2), not far from site Q IV, where the stables of the chariotry were unearthed in the 1990s.¹ The whole complex lies within a huge palatial district, as was assumed to be the case already during a topographical survey conducted by Josef Dorner in the 1990s² and confirmed by magnetic surveys carried out by Helmut Becker and Jörg Fassbinder in the following years.³

The site in question, Q I, can be subdivided into two main phases of occupation. A foundry of industrial dimensions belonging to an earlier phase of occupation

(Stratum B/3) has been unearthed in the north;⁴ affiliated workshops were attached to the south. This complex is most likely connected to the construction of the new capital under Seti I and Ramesses II.

After the abandonment of the foundry, a court of considerable size was established on its former ground. This court can be identified as belonging to the chariotry of the residence due to the presence of chariot pieces made of stone and bronze,⁵ as well as horse hoof prints found in the corresponding occupation layers.⁶ The workshops formerly connected to the foundry remained in place, though with a partially altered layout⁷ and now supplying the garrison. The stratum in question was labelled B/2 and can be subdivided into at least two phases, B/2b and B/2a.⁸

¹ Pusch (1999).

² Dorner (1996).

³ Pusch *et al.* (1999: 147).

⁴ Pusch (1990: 75–100).

⁵ Herold (1999; 2006).

⁶ Pusch (1996: 134).

⁷ Prell (2011: 170).

⁸ Pusch (1990: 100–102).



Figure 1: The site of Qantir-Piramesse in the north-eastern Nile Delta (after Bietak 2018: 225, fig. 2; graphics: N. Math).

An analysis of the existing material provides an insight into the organisation and assembly of a highly specialised workshop that is associated with the armed forces under government control. This special context makes an intensive examination of the finds, especially the remaining tools, as well as raw materials, semi-finished and final products, particularly important.

Stone tools related to the bone workshop

The majority of the tools from site Q I are different instruments made of stone, which have already been thoroughly published elsewhere.⁹ Four main groups stand out: crushing, abrading, smoothing/polishing and grinding tools (Figures 3–6).¹⁰ Additional tools are known that do not fit into these four main groups. For example, pressure stones for a wooden drill prove that such drills had been used on-site, even if organic material has not been preserved in the wet soil of the Delta.¹¹

The above-mentioned main groups frequently exhibit evidence of use as multi-purpose tools. Hammerstones can display surfaces with marks of abrasion and an abrasion stone can show percussion marks from short-term or *ad hoc* use as a hammer. This multifunctional character of these tools complicates the process of identifying the specific branch of production for which certain tools were used. Additionally, the distribution of stone tools did not help much with the identification of the branches of production, as visible on the overall plot in Figure 7, which was not subdivided into the different occupation layers that the tools were found in.¹²

However, together with associated finds, it was possible to identify a bone workshop, as well as the production of body armour made from leather and metal scales in the earlier phase, which was replaced by the production of shields and their metal fittings in the later phase (Figures 8–9).

⁹ Prell (2011). For some metal tools, see Prell (2011: 102–120).

¹⁰ Prell (2011: 27–80).

¹¹ Prell (2011: 81–82).

¹² Also, the subdivided plots provide little additional information (Prell 2011: 179–226).

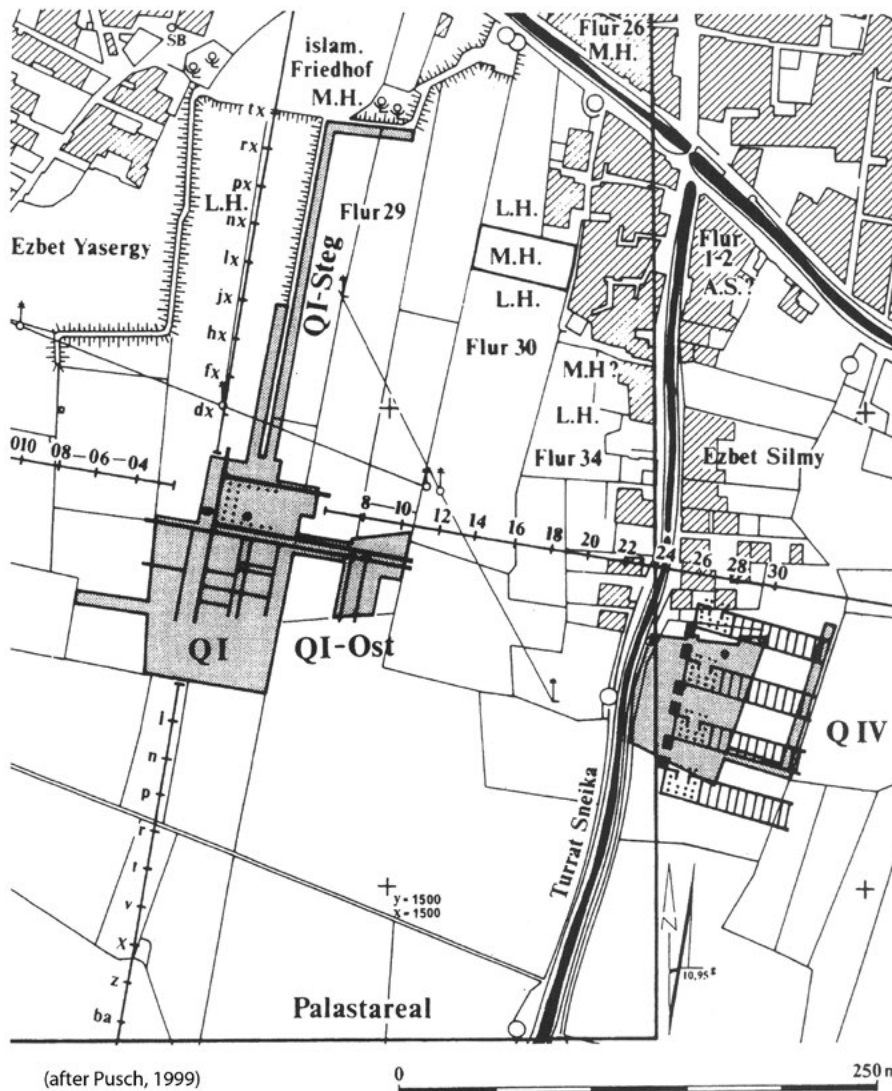


Figure 2: The location of site Q I south of the modern village of Qantir (after Pusch 1999: 18).

The edifice in question is equipped with pillars and contained soil layers rich in humus along with a large amount of waste, as well as roughly shaped products made of bone. This building can thus be identified as a bone workshop where principally bone points were fabricated. In addition, many artefacts made from flint, especially sickle blades, were found in the pillared building. The presence of flint tools used to shape the wooden shafts of the sickles indicate that woodworking took place as well.¹³

Specialised polishing stones predominantly derive from here and they are the only kind of stone tool found at site Q I that can be tied to a specific function.¹⁴ Of those specialised items, two different kinds can be distinguished: 1. polishing tools made of steatite with

drill holes and/or semi-circular grooves and 2. abrasive slabs made from phyllite, some of which had grooves from longtime usage (Figure 10). It is noteworthy that phyllite is a material which is not documented elsewhere in Egypt for any kind of object.¹⁵

Worked animal remains

In total, 465 worked animal remains, which include horn, antler, tooth, bone and molluscs, were found at Qantir in the campaigns that took place between 1980 and 2003.¹⁶ The state of bone preservation was poor in general, partly due to the fluctuating groundwater levels in the Delta. The percentage of worked animal remains among the whole assemblage of faunal remains is not high (3.3%), yet the highest concentration of worked animal remains was observed at Q I (8.2%), followed by Q IV (1.4%) and Q VII (1.2%) (Table 1).

¹³ Tillmann (2007: 77–78).

¹⁴ Prell (2011: 65–71). This connection was already made by Edgar Pusch during excavation due to the large amounts of finished and semi-finished artefacts and the total waste found in a certain part of the complex, indicating a bone workshop (see Pusch 1990: 105).

¹⁵ Prell (2011: 63, fn. 270–271).

¹⁶ Kitagawa (forthcoming).



Figure 3: Examples of pounders and hammerstones (Photos: A. Krause).



Figure 4: Examples of abrasive stones and whetstones (Photos: A. Krause).

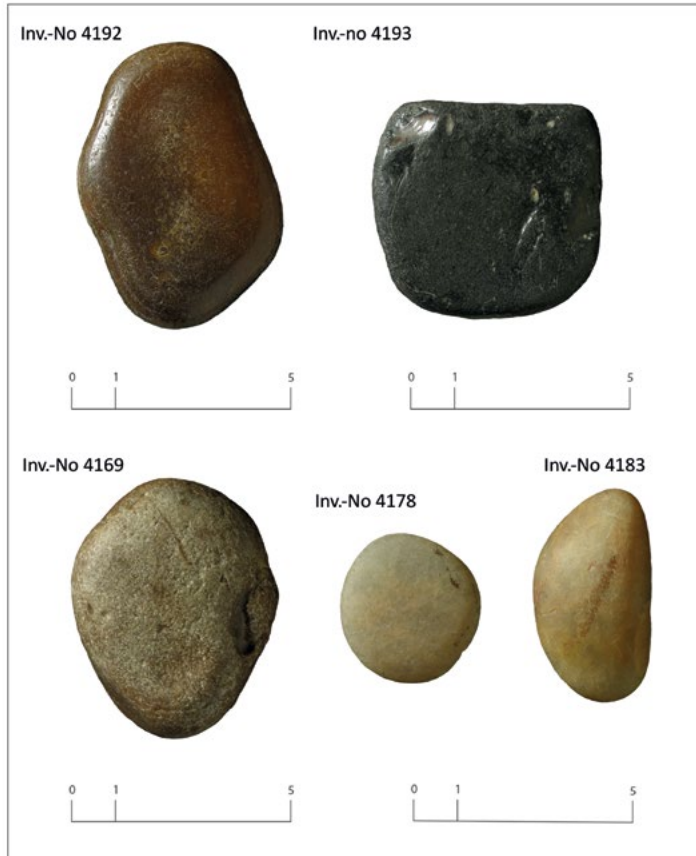


Figure 5: Examples of polishing tools (Photos: A. Krause).



Figure 6: Examples of grinding stones (Photos: A. Krause).

Table 1: Numbers and relative proportions of worked animal remains extracted from the total number of animal remains found at the excavation areas in Qantir (modified after Kitagawa forthcoming: Table 3).

Excavation areas	Q I	Q IV	Q V	Q VII	Total
Worked animal remains (N)	357	93	2	13	465
Total number of animal remains (N)	4367	6466	2108	1092	14033
Relative frequencies of worked animal remains	8.2%	1.4%	<0.1%	1.2%	3.3%

The worked animal remains from Q I are overwhelmingly dominated by mammal remains, comprising 96.6% (N=345), and the small number of the remaining assemblage, 3.4%, was from molluscs.¹⁷ The species most frequently encountered in the mammal assemblage is cattle, which accounts for about 19% of the worked mammal remains from Q I. Equids (donkey, horse and/or mule) represent c. 14%, the second most important group. Though the number of unidentified large mammal bones surpasses 50%,

¹⁷ Twelve molluscs, both from marine and freshwater ecosystems, were recorded among the worked animal remains assemblage from Q I. The majority of them showed traces of being worked, indicating that they were probably beads.

the majority of the specimens were most likely cattle or equids. Utilisation of other mammal taxa, such as sheep/goat, wild/domestic pig and other wild mammal bones, for manufacturing bone objects only took place sporadically, with a few pieces per species being recognised. What is interesting in the assemblage is that faunal materials from several wild mammal taxa, such as lion (N=2), giraffe (N=1), fallow deer (N=2), oryx (N=2) and hartebeest (N=1), some of which were non-indigenous taxa to the area of Qantir and would have been brought to the site from elsewhere, were utilised for tool production, despite their small numbers.¹⁸

¹⁸ Boessneck and von den Driesch (1982); von den Driesch (2006: 309–312); Kitagawa (2008a: 215–216; 2008b: 544; forthcoming).



Figure 7: Distribution of stone tools at site Q I (after Prell 2011: 179).



Figure 8: Established branches of production in the excavated area in stratum B/2b (after Prell 2011: 233).



Figure 9: Established branches of production in the excavated area in stratum B/2a (after Prell 2011: 237).

Skeletal elements extensively used as raw material at Qantir were straight and thick long bones, such as the metacarpus, metatarsus and tibia, particularly those from large mammals (cattle and equids). In addition to long bones, worked bones made of cattle ribs were also found. It could be assumed that they were used since they also display similar characteristic features that long bones do, namely being long and thick, even if they are far less thick and compact than those of the extremities.

At Q I the most common types of worked animal remains are points and debitage.¹⁹ Double bone points, which were worked into a stick-shape with pointed ends, represent only six pieces, although their number seems to have been greatly underestimated since most of the points are broken, and they were, therefore, considered and included in the category of 'point' as well as 'half-finished artefacts'. Thirty-three half-finished worked bones belong to the points that are categorised as 'half-finished artefacts'.²⁰

The function of these points could be diverse, such as pin, awl, drill, scribal stylus, cosmetic tool, needle (in cases where they had a groove, notch or hole on the missing tips) and so on. One can imagine, however, that the main use of the points that were produced at Q I could have been as arrowheads, given the fact that artefacts that were produced at workshops in this area were mostly related to the armoury of the pharaoh.

In addition, a relatively broad spectrum of other objects is also in evidence at Q I, though always in small numbers. Of particular interest is a chariot yoke-knob recovered at Q I. In another excavation area, Q IV, two more chariot yoke-knobs made of bone were found.

A large amount of debitage was present among the assemblage, obviously because bone processing took place on the spot. In particular, offcuts of epiphysis of long bones from cattle and equids were frequently found. They resulted from the removal of the long bone shafts (Figure 10). Bone point processing would have followed the stages of: (1) sawing long bones to separate the epiphysis from the diaphysis; (2) cutting the shaft bone lengthwise in order to form blanks; (3) scraping or whittling away irregularities; and (4) polishing or smoothing the bone surface to form the bone points. Scratched and polished traces on the bone surface have commonly been observed.

Discussion and concluding remarks

At Qantir, the entire *chaîne opératoire* of bone processing can be observed, from raw materials to end products,

which include unprocessed bones, debitage, half-finished artefacts and end products.²¹ Thick shaft bones of large domestic mammals were principally selected for bone modification and processed accordingly with stone tools.²² The lower left image in Figure 10 represents an example of the different stages of bone point modification. It shows a cattle metacarpus on the right (raw material), sawn shaft bones next to that (worked raw materials), and three partly broken bone-points-in-process (rough-out) and the double bone points on the left (end product).

Not only did the bone workshop have its own *chaîne opératoire*; it seems that most of the branches of production within the armoury worked together in an assembly line, particularly the metal processing areas, producing armour scales, metal sheets for shield fittings, as well as arrowheads and other items needed in the immediate surroundings. Even the metal tools essential to the manufacturing activities were most probably produced on site. It is unclear, though, whether they were produced as needed or if a specialised production branch existed for tool manufacture only, as no moulds for metal tools have survived.²³ Nevertheless, metal tools were often found in the workshops together with bronze arrowheads and other small metal objects discarded in hoards, so that they may be considered as items kept for recycling,²⁴ even if one could assume that the palace workshops had access to more or less abundant supplies. Thinking of the *chaîne opératoire* within metal production,²⁵ one has to keep in mind a (centralised?) place for melting down ingots into smaller, more manageable units than what was distributed further within the workshop complex.²⁶ One can assume that specialised workshops of the same craft were attached to various branches in different parts of this artisans' quarter, providing specific items for each specialised section (weaponry, chariots, horse tack, etc.).²⁷

Based on the few chariot parts that were found in the workshops themselves,²⁸ the production and repair of complete chariots cannot be assumed to have taken place in the excavated part of the workshops. The

²¹ Kitagawa (forthcoming).

²² Kitagawa (forthcoming).

²³ Only one mould for jewellery and nails is known from the Q I metal production workshop, see Prell (2011: 93). For moulds used to fabricate shield fittings, see Pusch (2004: 242–246).

²⁴ Prell (2011: 102–103, 122).

²⁵ See Drici (2016).

²⁶ For some possible tongue ingots found on site at Q I, see Prell (2011: 122, 213). A possible location for such a 'place of preparation' may be found in the western part of site Q I (see Figures 8–9); unfortunately, this part of the area was very disturbed (see Prell 2011: 239).

²⁷ Finds of glass remains and faience production within the larger area even suggest that the artisanal quarter within the palatial district was actually much more extensive and not only restricted to items needed by the military (see Pusch and Rehren 2007: 129–131).

²⁸ Herold (2006: 41).

¹⁹ Kitagawa (forthcoming).

²⁰ Kitagawa (forthcoming).



Figure 10: Raw materials (lower left) and specialised polishing tools made of steatite for bone points (arrowheads) (Photos: A. Krause).

chariot parts made from bronze and stone found here,²⁹ however, suggest that complete chariots were produced nearby in an area that included workshops for wood, leather, metal and stone. It is important to note, once again, that the workshops unearthed in the southern part of site Q I only represent a small portion of a much broader multi-functional complex of workshops housing different branches that were organised as an artisans' quarter within the palatial district. Consequently, one can neither assume that the excavated area represents all craft activities associated with chariotry, nor those of the artisanal palace industry as a whole.³⁰

What is interesting, however, is the organisation of those workshops into an assembly line working

together as a *chaîne opératoire*. In case of the bone workshop the *chaîne opératoire* can be established by artefacts found in different stages of production as well as debitage, raw materials and tools used to process the bones. This concept has been discussed in archaeology for a long time³¹ and was introduced by André Leroi-Gourhan³² as an analytical tool to explore the chain of operations required to manufacture a certain artefact, from the raw material to the completed product, also covering its lifespan (use, repair and abandonment). Articles dealing with the subject are, however, often restricted to stone, flint and osseous materials and their procurement,³³ and the concept only recently came to attention in Egyptology,³⁴ especially with

²⁹ Herold (1999; 2006).

³⁰ For other workshops attached to palaces or the royal court in Egypt, although differing from the 'manufacture'-like artisanal quarter at Qantir-Piramesse, see Hodgkinson (2018). A small workshop attached to palace F in 'Ezbet Helmi, area H/I, remains unpublished (see Bietak *et al.* 2016: 86).

³¹ See especially Costin (1991) for further literature on the subject.

³² Leroi-Gourhan (1964; 1965; 1971).

³³ E.g., Vitezović (2013; 202) for further literature.

³⁴ E.g., *chaîne opératoire* of processing animal remains at Qantir was presented at the 5th meeting of the Worked Bone Research Group (International Council for Archaeozoology) in Velico Turnovo, Bulgaria in 2005 (this paper is included in Kitagawa forthcoming; from other sites, see Bloxam 2015; Drici 2016; Nicholson 2017).

regard to the wider concept of organisational structure and spatial distribution within production areas and not solely restricted to the analysis of the individual steps necessary for the manufacture of a certain item.

Above all, the workshops had to be provided with all the necessary raw materials, hence one could presume that, in addition to other branches of production, a large storeroom facility must have existed in an unexcavated part of this extensive workshop complex, in order to guarantee the continuous supply and storage of finished products. In the case of the workshops at site Q I, being attached to the palace and therefore working as a retainer workshop under governmental control on a regular basis,³⁵ this supply operation would likely have been run and controlled by the state. One can imagine that, alongside specialised workmen and many assistants, a large number of scribes and their assistants were also employed within the complex for administrative reasons, in order to assure continuous supplies and distribution of raw materials, as well as to keep track of their whereabouts. All of the people were most likely working on their tasks full-time, within a complex infrastructure with a well-managed system of redistribution. In addition, the administrators had to handle logistics, such as inspections, supervision of the output quality and quantity in each production unit, as well as the storage and distribution of the finished products. Even the accessibility of bronze and stone tools may have been restricted. The need for governmental control is well illustrated by the later addition (Stratum B2/a) of a scribe's office in the north-eastern excavated part of the workshops (Figure 9), where the production of shield fittings took place.³⁶

All in all, the preservation of the workshops at Q I is, unfortunately, not good enough to conclusively assign specific stages of production to a well-defined physical space within the preserved architecture. The attested finds also do not help here, as tasks related to several production stages were most likely carried out simultaneously (compare Figures 8 and 9 for the assumed branches of production according to tools, installations, soil condition, raw materials and finished products). Also hindering a clear definition of a *chaîne opératoire* is the fact that, in addition to the lack of noteworthy amounts of 'precious' raw materials of any kind and larger metal implements, it seems most likely that after the abandonment and re-location of the workshops, the majority of tools and raw materials, as well as finished products were moved out in an organised way; it appears that better preserved stone tools were also removed.³⁷ Despite this, the material

remains discovered at the site of Q I make it clear that work was carried out in an undoubtedly sophisticated and highly organised *chaîne opératoire*, which was, as discussed elsewhere,³⁸ under the supervision of a political institution controlling the production and distribution of the high-value goods manufactured here, in the case of the Q I weaponry and other objects related to the military of ancient Egypt.

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³⁵ For the different kinds of organisation of specialised production, see Costin (1991: 8–9).

³⁶ Herold (2006: 41); Pusch (1990: 100).

³⁷ Prell (2011: 254).

³⁸ Prell (2011: 245).

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5. Smoke Signals: The Social Dimension of Glass Production in Visigothic Iberia

David J. Govantes-Edwards, Chloë N. Duckworth, Amaya Gómez and Lauro Olmo

Abstract

This paper explores the potential symbolic role played by several industrial areas in the Visigothic city of Reccopolis (6th–8th centuries AD, Spain), and other early medieval parallels, in the belief that, contrary to traditional approaches, some technological and industrial activities should be analysed not only in economic terms, but embedded in the wider social context, responding to, and shaping its idiosyncrasies. This notion, which has been put forth by social scientists in recent decades, has not fully permeated archaeology. We shall use industrial-related evidence from the Visigothic period to stress that technology was not only valued for the material culture that it produced, but for itself, perhaps as a reminder of the ruler's power over nature and resources.

Keywords: Late Antique Spain; glass production; Visigothic Kingdom; Suebi Kingdom; Reccopolis

Kurzfassung

Die Studie befasst sich mit potentiellen symbolischen Funktionen industrieller Bereiche der westgotischen Stadt Reccopolis (Spanien, 6.–8. Jh. n. Chr.) sowie zeitgleicher Parallelen, beruhend auf der Annahme, dass technologische/industrielle Aktivitäten nicht nur im herkömmlichen Sinn, also bezüglich wirtschaftlicher Fragen, sondern als in ihrem weiteren gesellschaftlichen Kontext eingebettet betrachtet werden sollten, auf den sie reagieren und dessen Eigenheiten sie beeinflussen. In den letzten Jahrzehnten in den Sozialwissenschaften aufgekommen, hat dieser Ansatz die Archäologie bisher kaum durchdrungen. Wir benutzen industrielle Befunde um aufzuzeigen, wie Technologie nicht nur für ihre Produkte geschätzt wurde, sondern um ihrer selbst willen, z.B. als Hinweis auf die Macht der Herrschenden über Natur und Ressourcen.

Keywords: Spätantikes Spanien; Glasproduktion; Westgotisches Reich; Suebisches Königreich; Reccopolis

Introduction

This chapter examines the production of glass on the Iberian Peninsula between the 4th and 7th centuries AD.¹ We shall focus on direct and indirect evidence for glass working and on its archaeological and historical setting, with the aim of detecting possible patterns in terms of furnace distribution and typology.

The Iberian Peninsula will be considered in its wider Mediterranean and European context, and the role played by the Iberian Peninsula in continental trends will be explored. The main focus will be on the position of glass technology in Iberian society during Late Antiquity and the beginning of the Early Middle Ages. Our arguments will focus on two key premises.

First, that the relationship between technology and society is not a given. We shall not linger too much in the theoretical basis of this premise, but suffice it to say that we do not consider technology only in economic terms, in isolation from other sociocultural factors, but as embedded in the wider social context.² As such,

we want to investigate the social role played by glass production in Iberian society between the 4th and 7th centuries, in the belief that this can, in turn, improve our overall understanding of the period.

Second, we believe that the Iberian Peninsula must not be regarded as a single historical and geographical unit. It is a large place, in which internal communications have to overcome substantial geographical barriers, a place with a tendency to disaggregate politically in the absence of a strong central authority, adding political and social borders to the physical ones. We shall adopt Wickham's notion of sub-region,³ because it is more illustrative of Iberia's historical evolution during this period, in all its complexity.⁴

Questions about vessel chemical composition, typology, circulation and consumption on which most research efforts have been focused to date,⁵ will not feature

¹ Where not specifically stated in the text, all dates are AD.

² Dobres (2000).

³ Wickham (2005: 40).

⁴ This also affects typological studies, which too often consider the peninsula as a single unit, disregarding the possibility of regional differences (Fuentes 2004: 286).

⁵ Notable examples are Sánchez de Prado (2004; 2009) for the southeast; Xusto (2001) for the northwest; Fuentes (2004) for the Central Plateau; and Alarcão and Étienne (1974–1979) for *Conimbriga*.

prominently in our analysis for a number of reasons: the somewhat indiscriminate use of a limited number of published typologies; the lack of precision of ceramic typologies as chronological markers for the Visigothic period; and the frequent absence of references to the archaeological context of the finds, are but three of the most prominent problems. When it comes to museum collections, the very provenance of the objects described is frequently uncertain. Concerning chemical composition, Iberia remains hugely underexplored, and we believe that the gaps in our evidence are still too large for us to be able to even begin offering half a coherent picture, a situation we seek to rectify with our ongoing research. In addition, the typological work is geographically very uneven. The southeast and the northwest are particularly well known, but for other historically key areas (for instance, the Guadalquivir Valley) we are almost completely in the dark.⁶

Glass production and the end of the Classical city in Iberia

One common symptom of the end of the classical urban paradigm is the reoccupation of public space for private use, either residential or industrial, including glass production.⁷ This is a common trend, which can be detected at a pan-Mediterranean level.⁸ Examples include Thessaloniki and Leptimius (Greece), and Florence (Italy), all in abandoned baths buildings.⁹ In parallel, with the advent of Christianity, some workshops, again including glass production, have been found in association with ecclesiastical buildings, for instance in Torcello and Florence (Italy), Thebes (Greece), Cornus (Sardinia) and Caričin Grad (Serbia), probably in relation to the construction of said buildings.¹⁰

The former phenomenon is securely attested in Iberia, and there is also some evidence for the latter. In *Cartago Nova* (modern Cartagena), where the transformation of the Classical urban model began earlier, three glass furnaces have been excavated in the area of the Imperial forum. One of them, dated to the 4th century,

is located in a corner of an abandoned Isis sanctuary,¹¹ while the other two (3rd–5th centuries and late 4th–early 5th centuries respectively) reused unidentified forum facilities;¹² in Ronda (ancient *Acinipo*), a glass furnace was active in the former baths during the second half of the 4th and most of the 5th century;¹³ in Ammaia (Portugal), a glass workshop dated to the late 4th and early 5th centuries was installed inside a tower in the city wall;¹⁴ finally, in Valencia a glass furnace was found in a former commercial building (an *horreum* or a *macellum*).¹⁵ In Seville, substantial evidence for glass working has been identified in Plaza de la Encarnación, in contexts dated to the mid-5th to mid-6th centuries, in close proximity to a coetaneous church. Although the excavators have not suggested any connection between the two, the material is still being analysed, so the possibility should not be ruled out.¹⁶

Other urban glass workshops existed that were not reusing former public spaces. In Ávila, two different Late Roman workshops have been identified. One, in the former Convent of Padres Paules, included a small furnace,¹⁷ and the second one was excavated in Parque de San Vicente and featured a furnace and multiple production remains. It began operating sometime in the 5th century and may have remained active up to the initial decades of the 6th century.¹⁸ Excavations in the ancient suburbs (that is, outside the city wall) of the capital of the province of *Gallaecia*, *Bracara Augusta* (modern Braga), have resulted in the discovery of a substantial Late Roman glass workshop situated on the same site where an Early Imperial glassworks had stood, in the location of the former Post Office building (CCTT). In its latest phase, the workshop was furnished with one furnace, and has been dated by radiocarbon dating between the late 5th century and the early 6th century (AD 490/520).¹⁹

Most site-specific typologies are based on these, and these, in turn, are heavily reliant on published typologies such as Isings (1957), which does not take the Iberian Peninsula into consideration, and Morin-Jean (1913), which focuses on Roman France.

⁶ Castro and Gómez de la Torre (2008: 126); da Cruz (2009: 164–166; 2011); Gamo (1995: 301–302); Olmo and Castro (2012: 70–71). The case of Seville and the Lower Guadalquivir Valley, of enormous economic importance throughout antiquity, is characteristic. The period between c. 550 and the 9th century is, in the absence of Mediterranean imports, difficult to detect archaeologically (Maestre *et al.* 2010).

⁷ Price (2005: 172–174); Sánchez de Prado (2014: 1394–1396).

⁸ For some arguments in the debate concerning whether this is a sign of urban crisis or of urban vitality, see Harris (2004: 87, 120); Kennedy (1985); Wickham (2005).

⁹ Antonaras (2014: 95); Leonne (2003: 270); Martorelli (1999: 578–580). Two crucible fragments with thick glass adherences were also found in the baths ‘of Constantine’ in Arles (France) (Foy 2008).

¹⁰ Leonne (2003: 277–278); Martorelli (1999: 575).

¹¹ Noguera *et al.* (2017).

¹² Egea (2005); Egea *et al.* (2006: 36); Fernández Matallana (2009: 147).

¹³ Castaño Aguilar *et al.* (2009: 70–71).

¹⁴ da Cruz and Sánchez de Prado (2012: 182).

¹⁵ Sánchez de Prado (2014; 2015). This was found along with multiple production remains, including raw glass, moils, unfinished shapes, and two bronze moulds which could be related to the production of prismatic bottles. The chronology does not seem to be entirely clear, but the operation of the furnace appears to be dated between the late 3rd and early 5th centuries, which fits the date of the most recent types of prismatic bottle.

¹⁶ Amores and González (2003: 202).

¹⁷ Marcos Herrán and Estremera Portela (2010–2012); Marcos Herrán *et al.* (2011–2012). The furnace was found in association with multiple production remains. It was dated between the 2nd and the second half of the 4th century, so potentially outside our chronological framework.

¹⁸ Martínez *et al.* (2004). However, this chronology seems to be based on the typology of glass objects alone.

¹⁹ da Cruz (2009: 217–223; 2011: 86); Martins *et al.* (2010). The radiocarbon dates were obtained from charcoal samples collected from the level corresponding to the destruction of the furnace, Sigma 2 range, Cal AD 260 a 290, Cal AD 320 a 440 e Cal AD 490 e 520; the latter range was considered the most plausible on both analytical and archaeological grounds.

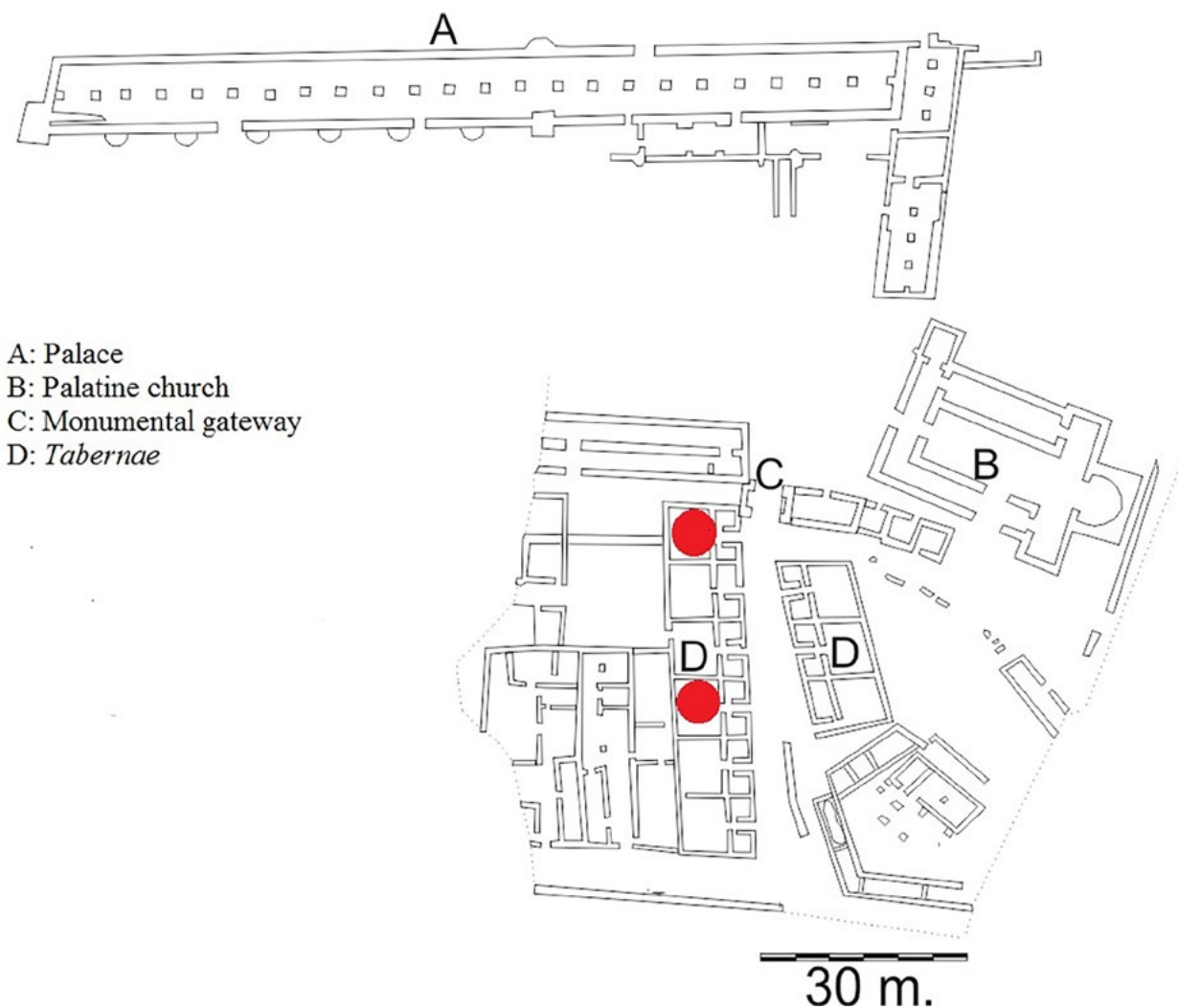


Figure 1: Plan of the excavated areas in the city of Reccopolis. The red dots indicate the position of the glass furnaces (Illustration: authors).

Not all glass workshops were located in urban contexts, however. Another furnace, with associated production remains, was found in *Castellum Madae*, which can be described as what French historiography calls an *agglomération urbaine secondaire* in the province of *Gallaecia*; this furnace was active at some point between the late 3rd and mid-5th centuries;²⁰ in Tui (Pontevedra, also in *Gallaecia*), the remains of a furnace-like feature were found in a semi-rural environment. Rather than a built structure, the feature is more like a pit dug into the ground, with a thick layer of ash lying at the bottom. Unfortunately, the pottery found in this context was non-diagnostic, and the site has been tentatively dated to between the 4th and the 6th centuries based on other nearby finds.²¹

²⁰ Moreira (2010).

²¹ Vilaseco (2003); Mário da Cruz (2009: 244–249) refines this chronology based on typology to the second half of the 5th or even the early 6th century. As part of an ongoing Rakow Grant-funded project, we intend to sample and analyse some of the glass found at the site, in the hope of being able to confirm or rule out these chronologies.

Finally, special mention must be made of the glass furnaces constructed in the city of Reccopolis, erected *ex novo* by king Liuvigild in the 570s in honour of his heir Reccared, after he effectively managed to annex the Suebi kingdom in the northwest, control the northern tribes of the northern coast, and thus get most of the Iberian Peninsula under royal control, in what is considered the ‘golden age’ of the Visigothic monarchy (see below). These furnaces were part of the original plan of the city, being located in a ceremonial thoroughfare leading to the monumental gate that gave access to the royal palace (see Figure 1).²² According to the stratigraphic record, one of these furnaces was active until the mid-7th century, when the commercial/industrial area in which it was located was transformed into houses, while the other remained in operation

The furnace was found in association with glass production remains, including drops, threads, moils and ‘scoria’.

²² Castro and Gómez de la Torre (2008: 117); Olmo (2008: 52).

until the end of the 7th century.²³ In addition to these furnaces (which were very large, in comparison with other furnaces found in Iberia in the period under consideration), production evidence includes raw glass, threads, drops, moils, 'scoria' and crucible fragments, as well as substantial caches of glass cullet, seemingly in preparation for remelting. In total, the excavation of just a few hectares of the ancient city have yielded over 30 kg of glass.²⁴

Moving on to less direct evidence for glass production, we enter somewhat less firm ground, not least because sometimes finds are incorrectly reported. Any form of vitreous slag is commonly reported as glass 'scoria', and the term 'frit' is regularly used to refer to raw glass, to mention only two recurrent errors.²⁵ The mention of frit is rather often followed by the unsubstantiated identification of primary production, of which more later. As such, we shall only include in the list those sites for which the evidence appears to be more reliable, in order not to replicate these misidentifications.²⁶ Merida (ancient *Emerita Augusta*) in Lusitania,²⁷ in Levante, the Late Roman villa of El Albir (Alicante),²⁸ various excavations in the urban area of Benalúa, near Alicante,²⁹ and Tarraco,³⁰ in the northwest, we have firm evidence of glass production in the form of Late Roman crucibles with adhered glass, raw glass, etc. at several sites in *Bracara Augusta*,³¹ as well as *Asturica Augusta* (modern Astorga), *Lucis Augusti* (modern Lugo),³² and

Caldas de Rei (ancient *Aquis Celenis*).³³ To finish with the northwest, a number of sites found in Av. Rosalía de Castro, dated to the mid to late 6th century, were found to contain not only fragments of raw glass, 'scoria' and cullet, but some evidence of serial production: the characteristics of the glass were very homogenous and the shapes few and standardised.³⁴ In the northeast, in Zaragoza, three sites have yielded indirect evidence for glass production.³⁵

Finally, the excavation of the new palatial area built by Liuvigild in Vega Baja,³⁶ near Toledo, as part of the same construction programme that led to the foundation of Reccopolis, has yielded substantial evidence for glass working, in contexts dated, as those in Reccopolis, between the late 6th and mid-7th century, suggesting that glass workshops were also in operation in the vicinity of this royal palace.³⁷

Glass production in Visigothic and Suebi Iberia

In order to be interpreted correctly, this relatively rich picture must be set against its complex historical and political background. Throughout the late 4th and 5th centuries, the effective control exercised by the Roman state in the western provinces became increasingly tenuous, and Rome often had to confront open challenges to its authority, with varying degree of success. Suebi, Vandals and Alans entered the Peninsula in great numbers in AD 409, and many areas were soon under their control, while the Visigoths were initially brought in to counteract this threat a few years later. The coast of Levante was probably the region in which the presence of the Roman State remained strong for the longest, at least until the death of Majorian (AD 461). The coastal area that extends roughly from Alicante to Algeciras was conquered by the Byzantine Empire in the 550s and turned into the Roman province of *Spania*. In the Central Plateau, the Visigoths did a better job of filling the power vacuum created by the collapse of the Western Roman Empire,

²³ Castro and Gómez de la Torre (2008: 123–126); Gómez de la Torre (2017: 63, 82–85).

²⁴ Castro and Gómez de la Torre (2008: 117–118).

²⁵ Fuertes and Hidalgo (2001), for example, reported the discovery of glass 'scoria' in the suburban area of Cercadilla, outside Córdoba, in a context dated to the 7th century. Govantes-Edwards et al. (2014) followed this report, but after analysing the material at a later date, we concluded this 'scoria' to be metal slag. See also da Cruz (2009: 170, 178).

²⁶ The markers that can be used to identify the presence of a glass working area in the absence of a furnace have been summarised by Foy (2000; 2008).

²⁷ Caldera de Castro (1994–1995: 128–131); Lang and Price (1975); Price (2004: 20–21). The evidence includes diverse glassblower utensils (such as blowing irons), raw glass and moils that were found in an industrial area located in the city's outskirts. These utensils were dated to the late 4th century, based on the associated numismatic material, but Price pushes that date up to the early 5th century based on the appearance of the glass remains.

²⁸ Sánchez de Prado (2004: 101; 2009: 178). The site yielded numerous remains of glass blowing – raw glass, 'scoria', threads, finished shapes – found in the disused private baths of the villa, in a context dated to the late 3rd to the first half of the 5th centuries. It has been argued that in Late Antiquity villas were sources of material for recycling, including glass, which often took place on-site (Munro 2010).

²⁹ Reynolds (1987: 147–150; 1993: 14–17); Ronda and Sala (2000: 450). The site has yielded abundant evidence for glass production, including 'scoria', moils and cullet, in association with pottery wares dated to the 6th and the early part of the 7th century.

³⁰ Benet and Subías (1989). The site comprises a late 5th century dump, which was found to contain different remains of glass production, including raw glass and moils.

³¹ da Cruz (2009: 253–258). These are different sites, dated to the early 4th century, from the one in which the glass workshop was attested.

³² da Cruz (2009: 238–243).

³³ da Cruz (2009: 252). Here the excavations have recorded glass 'scoria', raw glass and a blowing iron in a context dated between the mid-5th and the mid-6th centuries.

³⁴ da Cruz (2009: 244–249); Fernández (2014).

³⁵ Ortiz (2001: 67–68). Casa Palacio de los Pardo, with a glass crucible, dates to the 4th–early 5th centuries, c/Universidad, with construction material (likely to have belonged to a dismantled furnace) partially covered with a thick spill of glass, also dated to the 5th century, and c/ Predicadores, outside of the city walls, with other production remains found in a refuse pit, again dated to the 5th century.

³⁶ Perhaps the palace mentioned in the *Vitas Patrum Emeritensium* XII, 310.

³⁷ de Juan Ares et al. (2009: 132); Olmo (2009: 84). The production remains included crucibles, raw glass and 'scoria'. The ongoing excavations in Valencia la Vella have yielded large chunks of raw glass as well as other production remains, such as drops, threads, etc. We have examined these remains and it seems likely that they represent glass blowing activities. They are dated to the late 6th century, but their interpretation is still uncertain, as the excavation of the site has barely begun, and its characterisation is still pending.



Figure 2: Map of the Iberian Peninsula at the beginning of the reign of Liuvigild (Illustration: authors).

although their authority over large areas outside this central region was nominal at best. Until the unifying efforts of Liuvigild, the economic powerhouse that was the Guadalquivir Valley and southern Lusitania was virtually independent, being ruled by the old provincial elites. In the northwest, it did not take long for the Suebi to reach a *modus vivendi* with the provincial elites, leading to the foundation of their kingdom, more or less equivalent to the former province of *Gallaecia* (see Figure 2).³⁸

So, how did all this affect the production, circulation and consumption of glass? The traditional perspective is that, after the fall of the Roman Empire, glass production in Iberia took a downward turn, both in terms of quality and quantity, in response to the generalised crisis that was to characterise the period. It is commonly held that glass was still easy to find in the 5th century, becoming noticeably scarcer during the 6th century,³⁹ although some authors draw the line even earlier, during the 5th century.⁴⁰

However, while it is true that the number of known production sites in the Visigoth-dominated areas is lower than in the Late Roman period, this is not the case in all of Iberia. Indeed, the northwest under the Suebi was to witness substantial glass-making activity. Furthermore, these assessments are made in isolation from the overall archaeological picture, which has important implications as to the *visibility* of social practices such as glass-making. Ceramic typologies, our main chronological marker, are much better known for the Late Roman period than they are for the Visigothic age, for which enormous gaps still exist (see above). As a result of this circumstance, glass from the, say, 4th and 5th centuries is much more likely to make it into the statistics than glass from the 6th and 7th centuries, much of which will necessarily remain undated. It is also worth pointing out that, given the reliance on imports for dating, some regions are more gravely affected than others, as the quantity of foreign goods will be greater in areas close to commercial routes. It is no coincidence that the best-known glass in the Iberian Peninsula is that found in the Mediterranean coast and the northwest, where imports are abundant.

Even the idea that the decrease in the amount of 'circulating glass' and, in consequence, of glass-making

³⁸ García (1998).

³⁹ Fuentes (2004: 286); Gamo (1995: 301–302).

⁴⁰ Fuentes (2004); Gamo (1995); Sánchez de Prado (1999).

itself was the result of a situation of nearly permanent economic crisis may be contested. The widespread presence of Mediterranean imports, including amphorae, fine wares and other items, especially (but not only) in coastal areas, along major communication routes and at urban sites, throughout the 5th and 6th centuries at least, does not speak of economic stagnation.⁴¹ The decrease in such imports in the 7th century, on the other hand, may have more to do with the source of these products than with consumer demand.⁴² Archaeological evidence does not support the idea of widespread devastation with the arrival of the barbarians (the multiple references to this in the texts being little more than literary *topoi*), but rather the continuation of the pre-existing economic agricultural structure; multiple agricultural villas remained in existence until the end of the Visigothic period, and local elites, for instance in Baetica, showed clear signs of economic vitality.⁴³

The number of furnaces and other glassmaking-related evidence, or the volume of dated glass in consumption contexts (as well as the narrower typological range), may suggest that glass production decreased after the dissolution of the Western Roman Empire, and most likely it did, but it is also true that much post-Roman glass-making activity may have been overlooked as a result of the nuances of archaeological visibility.⁴⁴ The typology and location of furnaces is, however, potentially much more interesting than the mere quantitative data. Throughout the 4th, 5th and the first three quarters of the 6th century, most glass workshops attested can be divided into a series of discrete categories. Some of them are clearly part of the reconfiguration of the post-classical city and its industrial activities – Cartagena, Seville, Ronda, *Ammia* and Valencia – while others are located in important commercial hubs – Benalua, Faro, Braga, Vigo. For others, we do not have enough information to be certain, but some educated guesses may be made. The Padres Paules workshop, in Ávila, seems to have supplied glass items at the regional level, judging by the discovery of several vessels identical to those found at the workshop in the villa El Vergel, in San Pedro del Arroyo, 26 km away from Ávila.⁴⁵ On the

other hand, the furnaces in Tui and the remains in the disused baths in the villa of El Albir fit well with the idea of production by small-scale itinerant craftsmen, who resorted to makeshift or reused facilities to supply local demand.⁴⁶

In this context, the location of the furnaces of Reccopolis and of the potential glass working area in Vega Baja stands out. These are urban locations, but very different from Seville, Ávila or Braga, which were ancient cities, now in a process of transformation. Reccopolis was constructed completely *ex novo*, and the palatial area of Vega Baja consciously avoided, not to say deliberately confronted, the pre-existing Roman city.⁴⁷ What is more, in the case of Reccopolis, the glass workshops were located in a more than prominent position, right in the high end of the ceremonial road that led to the monumental gate into the king's palace. This becomes even more significant if we consider that the city did not have to adapt to a pre-existing layout, and that it was one of the central pieces in a programme of propaganda carefully crafted by Liuvigild and his son and heir Reccared (see below). The written sources attest to the momentous nature of the foundation of the city in no uncertain terms, for instance in the words of John of Biclaro.⁴⁸ It does seem strange that they should leave any part of the city layout to chance, least of all in the 'aristocratic' area,⁴⁹ especially considering the role that Isidore of Seville attributes the city as a key cog in the new centralised and unified Visigothic state (Figure 3).⁵⁰

Glass as propaganda?

One of the things that catches the eye when looking at the typological, chronological and geographical distribution of glass working evidence in Iberia in the 4th–7th centuries is not only that the industrial areas in Reccopolis (and probably in Vega Baja) (Figure 4) are so different to the others, but also that after their foundation they are the *only* ones to be found, with the exception of the possible workshop(s) in Benalua, which was at the time part of the Byzantine province of *Spania*.⁵¹ What is more, the flourishing glass industry of the Suebi northwest appears to come to an abrupt end in the second half of the 6th century, coinciding

⁴¹ Bonifay and Bernal (2008: 101–102); García Vargas (2011: 99); Vizcaino (2007: 293–294). See also García (1972) for a systematic analysis of the written evidence of the presence of eastern merchants in Iberia during this period.

⁴² It is beyond the scope of this paper to evaluate in detail the archaeological arguments for and against the 'Pirenne Thesis' or its variants, especially that which associates the Vandal conquest of Carthage with a cessation of African trade with other Mediterranean regions. Suffice it to say that the Vandal conquest of North Africa does not seem to have had a decisive effect on exports to Spain. African wares continued to be delivered along the northern Mediterranean shores, as they were after the Byzantines gained control of the region again (García 1998: 273–276; García Vargas 2011: 104; Hodges and Whitehouse 1983: 3–5; Reynolds 1993: 10–12).

⁴³ García (1998: 225, 346); Wickham (2005: 95).

⁴⁴ Fuentes (2004); Gamo (1995); Sánchez de Prado (1999).

⁴⁵ Marcos Herrán et al. (2011–2012: 326–328).

⁴⁶ Fuentes (2001: 147–148); Gamo (2010: 485); Price (2005: 178, 185).

⁴⁷ Collins (1980: 213).

⁴⁸ *Chronica* [entry for 578]: 'ANNO II TIBERII IMPERATORIS QUI EST LIVVIGILDI IX REGIS AN. X Liuvigildus rex extinctis undique tyrannis, et pervasoribus Hispaniae superatis sortitus requiem propriam cum plebe resedit civitatem in Celtiberia ex nomine filii condidit, quae Recopolis nuncupatur: quam miro opere et in moenibus et suburbanis adornans privilegia populo novae Urbis instituit'.

⁴⁹ Gómez de la Torre (2017: 63, 80–82).

⁵⁰ *Historia Gothorum*, 51, 5: 'Aerarium quoque ac fiscum primus iste auxit, primusque inter suos regali ueste opertus solio resedit, nam ante eum et habitus et consessus communis ut genti, ita et regibus erat. Condidit autem ciuitatem in Celtiberia, quam ex nomine filii Recopolim nominavit'.

⁵¹ Reynolds (1993: 20).

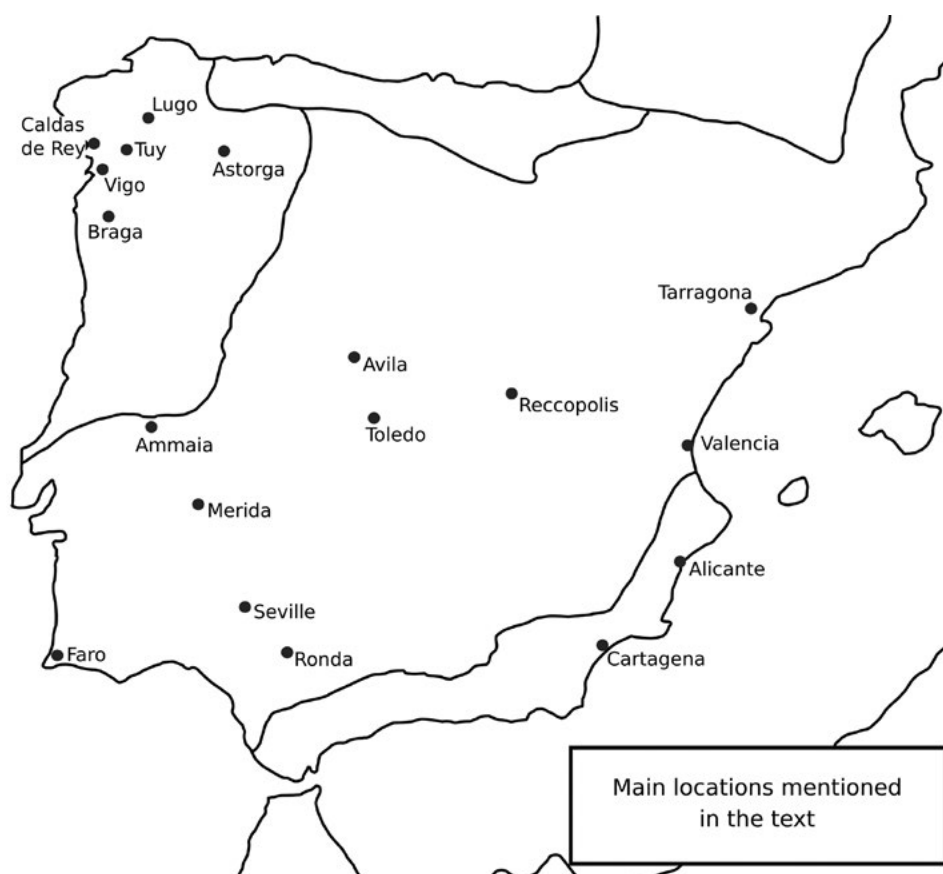


Figure 3: Main locations mentioned in the text (Illustration: authors).



Figure 4: One of the glass furnaces excavated at Reccopolis (Photo: Parque Arqueológico de Reccopolis).

more or less tightly with the Visigothic annexation of the kingdom. *Spania* was the only region that resisted Liuvigild's unifying endeavours.⁵² Is it possible that Liuvigild established a monopoly over glass production?⁵³

There is a fair amount of evidence which suggests that glass production was centrally organised, at least in Reccopolis. For one, the workshops are located in a row of well-planned *tabernae*, homogenous in shape and construction, outlining the main ceremonial thoroughfare, as part of the city's original plan.⁵⁴ An akin row of *tabernae*, similar in both morphology and conception, as well as in chronology, has been recorded

⁵² García (1998: 131).

⁵³ There are hardly any specific written references to glass dating to the Visigothic period, beyond Isidore of Seville's *Etymologies*, and these do little more than reproduce Book 36 in Pliny's *Historia Naturalis*. On the other hand, it is remarkable that the only evidence of glass working in the Byzantine province should be the possible workshop of Benalua which, based on the associated ceramic material, could have been in operation until the beginning of the 7th century, which is precisely when the province of *Spania* was finally retaken by the Visigoths. Admittedly, in the absence of something more solid, this is but circumstantial evidence (García 1998: 154).

⁵⁴ Castro and Gómez de la Torre (2008: 117); Gómez de la Torre (2017: 80–82).



Figure 5: One of the glass caches found in Reccopolis, probably ready for recycling in one of the workshops (Photo: Parque Arqueológico de Recopolis).

in Sardis (Turkey),⁵⁵ and the glass workshop in Beit She'an (Israel) may also respond to a similar pattern.⁵⁶ It is interesting to note that these *tabernae* also included a jewellery workshop, complete with metal 'scoria', bivalve moulds for earrings, scales, a furnace, etc.,⁵⁷ and that a mid-7th century legal compilation attests to the existence in or near the king's palace of a class of servile goldsmiths operating under a royal official known as *praepositus argentariorum*.⁵⁸ Let us remember that toreutics⁵⁹ were a favourite craft among the Visigoths, and that glass often played a central role in the decoration of the most lavish objects, including royal crowns such as those belonging to the so-called Treasure of Guarrazar.⁶⁰ Remarkably, similar jewellery-making tools (scales, moulds, weights, etc.) have also been found in association with the evidence for glass working in Vega Baja.⁶¹ Finally, excavations around the glass furnaces have yielded a substantial number

of large caches of glass cullet (accounting for c. 20% of all the glass found at the site), and it is possible that cullet was being collected regionally and brought to Reccopolis for recycling (Figure 5).⁶²

Concerning raw materials, other than recycled glass, the Visigoths had to rely on trade. An increasing amount of compositional evidence is suggesting that during Late Antiquity and the Early Middle Ages, primary glass production was restricted to a few regions in the Eastern Mediterranean, and that glassblowers elsewhere had to rely on imports of raw glass produced in these primary workshops, as well as on recycling.⁶³ Although little compositional evidence of Iberian glass from the 4th–7th centuries is yet available, what there is appears to confirm this paradigm, for instance in the northwest,⁶⁴ Vascos (Toledo)⁶⁵ and Seville.⁶⁶

Some arguments have been put forward to defend the primary production of glass. Some of them can be rejected out of hand, being based on a limited

⁵⁵ Harris (2004: 91).

⁵⁶ Price (2005: 182).

⁵⁷ Castro and Gómez de la Torre (2008: 118–119).

⁵⁸ *Liber iudiciorum*, *Lex Vis.* II, 4, 4 (García 1998: 272). We know little about the organisation of glassmakers in Late Antiquity and the Early Middle Ages. See Price (2005: 178).

⁵⁹ The term 'toreutics' refers to artistic metalwork, such as gold and silver engraving.

⁶⁰ Perea (2001).

⁶¹ Olmo (2009: 88). A similar association between glass production and toreutics has been attested in *Bracara Augusta* (da Cruz 2011: 92–93).

⁶² Castro and Gómez de la Torre (2008: 119).

⁶³ Degryse *et al.* (2014: 225–226); Freestone (2006: 202).

⁶⁴ da Cruz (2009).

⁶⁵ de Juan Ares and Schibille (2017).

⁶⁶ Gómez-Tubio *et al.* (2006). We must not forget that, in addition to raw glass, some finished products can also be clearly identified, on typological grounds, as foreign productions (Xusto 2001).

understanding of the processes and chemistry involved in glass production and manufacture.⁶⁷ Others are largely based on the *availability* of glass-worthy raw materials (including sands and *salicornias*) near production areas,⁶⁸ but the available analytical data strongly suggests that the potential of these materials was not realised during this period. As such, it is safe to work under the (solidly substantiated) assumption that all the glass circulating in *Hispania* had been originally produced in the Eastern Mediterranean and brought to be worked into shape either in the form of raw glass lumps or cullet.

Is it plausible for glass to have had some symbolic value because of its Eastern-Byzantine connections? The main characteristic of Liuvigild's ideological programme was his desire to dress the Visigothic monarchy with ideal accoutrements that pointed directly to the Byzantine model, which from the 6th century can be considered to have stood as the uncontested cultural reference in the Mediterranean world.⁶⁹ Following this policy of *aemulatio imperii*, Liuvigild was the first to dress in the style of Byzantine emperors,⁷⁰ and to issue coinage accordingly.⁷¹ He also founded cities – not only Reccopolis, but also Victoriaco and Eio-El Tolmo de Minateda – an attribution that was theoretically reserved for the Byzantine emperors (Liuvigild also borrowed their habit of naming the cities after members of the royal family);⁷² furthermore, Reccopolis and the palatial area of Vega Baja were designed to replicate the topography of power of Constantinople.⁷³ Recently, Javier Martínez has argued the case that Eastern engineers might have been involved in the construction of the aqueduct serving Reccopolis, the only *ex novo* such construction to be found in Iberia during this period.⁷⁴ Trade and diplomatic contacts between Iberia and Byzantium appear to have been regular and intense in the late 6th and early 7th centuries.⁷⁵ This should not come as a surprise. Former arguments which stressed the neat separation between two distinct population groups – the Visigoths and the Hispano-Romans – have now largely been discredited; indeed, it is often stated that no Germanic people embraced Roman culture as eagerly as the Visigoths.⁷⁶

This is, largely, indirect evidence which would hold little sway for our question, were it not for the position of the Reccopolis furnaces. Liuvigild and Reccared's ideological programme seems too coherent for these workshops to have taken such a prominent location in one of the programme's set pieces merely by chance. Even if the absence of other glass workshops in the Visigothic kingdom in the late 6th and early 7th centuries could be attributed to archaeological chance or problems related to the dating of finds, the central place of the Reccopolis workshops can not, and we are, therefore, forced to review the relationship between power and glass technology in the Visigothic kingdom. The location of most other workshops in Late Antique and Early Medieval Iberia seems to be clearly associated with economic convenience (availability of adequate infrastructures, proximity of communication routes, etc.), but it is clear that some other factor is at play here.

Technology cannot be regarded solely as an economic factor, but as embedded in the wider social and ideological framework.⁷⁷ The relationship between technology and society is, however, not hierarchical. It is not a matter of using ideology when the standard economic explanations do not work, and in this regard we fully subscribe to Bruno Latour's principle of symmetry (understood as Bruno Latour understands it, that is epistemologically, not ontologically, as some social scientists have assumed it to be).⁷⁸ Workshops should therefore be viewed as part of an integrated mesh which cannot be heuristically separated into different analytical domains.⁷⁹ This is not the place to delve into this too much *in extenso*, as the bibliography that challenges traditional narratives on the social role of technology is indeed voluminous,⁸⁰ but we think that it is now widely recognised that technology is not only applied science, but a social response to social as much as to economic challenges, and that the principle of economic efficiency, strongly embedded into our contemporary worldview (and our own conception of archaeology),⁸¹ largely as a result of the transformations brought about by the Industrial Revolution, does not have universal pre-eminence over social efficiency. Yet, while this solid corpus of theoretical thought has by now reached critical mass, and more nuanced and complexity-friendly approaches are presented all the time, these ideas are not flowing as freely into archaeological practice as they are into theory, and more often than not, archaeologists working in the field

⁶⁷ Ortiz (2001: 133); Paz and Ortiz (2004: 136).

⁶⁸ Castro (2008: 119); Olmo (2008: 52).

⁶⁹ Olmo and Castro (2012: 60); Ward-Perkins (2000: 329–330).

⁷⁰ García (1998: 119–120).

⁷¹ Olmo (2009: 74–75).

⁷² García (1998: 119–120); Olmo (2008: 44–45; 2009: 74–75).

⁷³ García (1998: 321); Gómez de la Torre (2017: 72–73); Mundell (2000: 202–203). This is not exclusive to the Visigoths. The desire to replicate the topography of Constantinople has also been detected among other Germanic states, for instance the construction of the church to the Holy Apostles by Clovis in Paris in AD 511, the construction of a circus in Milan by the Lombard Agiluf in AD 602, and also the possible palatial area of Falperra, in *Bracara Augusta* (Olmo 2008: 44–45; Ward-Perkins 2000: 329–330).

⁷⁴ Martínez (2018–2019, 43).

⁷⁵ Thompsom (1969: 20–21).

⁷⁶ Jiménez (1995: 194–195); Wickham (2005: 664–665).

⁷⁷ North (2005) and Ostrom (1990), following Polanyi (1977), have convincingly argued that this qualification applies to both pre-industrial and industrial economic systems. See also Govantes-Edwards (2007).

⁷⁸ Latour (2005).

⁷⁹ Costin (1991); Dobres (2000); Martín-Torres (2008: 23).

⁸⁰ But see, for instance, Dobres and Hoffman (1999); Ingold (2000); Martín-Torres and Rehren (2008).

⁸¹ Lucas (2005: 50–51).

fall, almost by default, into what Bryan Pfaffenberger labelled the 'standard view on technology'.⁸²

We argue that the position of the Reccopolis furnaces, and those in Vega Baja, should their existence be confirmed, could be a direct and, on this occasion, explicit expression of ideological principles *through* the open and public practice of an economic activity. Glass was a material with direct oriental associations; raw glass was only available through trade, and glass was liberally used in toreutics, the most symbolically-charged Visigothic craft. It is plausible, therefore, that the Visigothic crown was eager to display not only glass items, but the *process* by which they were produced. Rather than an obnoxious presence, industrial activity in the vicinity of the palace could be sending signals of royal grandeur.⁸³

Glass in the context of 6th–7th century AD trade

How was the supply of glass organised? As previously noted, during this period there was a lively trade between the Iberian Peninsula and the Mediterranean. A significant presence of Mediterranean imports was known of old in Levante (Valencia, Tarraco, Cartagena), and up the fluvial routes of the Guadalquivir and Guadiana rivers, Seville and Merida,⁸⁴ but recent excavations have also attested their presence far into the interior of the Peninsula. Mediterranean imports are found in centres connected with the Visigothic political superstructure, such as Reccopolis, Vega Baja, Los Hitos (Toledo),⁸⁵ El Tolmo de Minateda (Albacete),⁸⁶ etc., but also crucially in other types of sites, such as the rural settlement of Góznquez, near Madrid.⁸⁷ It seems likely that glass, in the form of raw glass or cullet, was arriving in the Iberian Peninsula as part of these same cargos.

The presence of these Mediterranean imports is unsurprising, considering how closely tied with the idea of the East the prestige of the Visigothic crown was. Also, given the presence of the Byzantine province of *Spania* in Levante, it is to be expected that a good deal of the Mediterranean trade was channelled through the Byzantine harbours, including Cartagena, Malaga and *Iulia Traducta* (modern Algeciras), and there is considerable evidence that it was, beginning with the numerous warehousing facilities that have been excavated in these cities' harbours. Although it has been argued that in terms of volume of trade,

the establishment of a Byzantine province in Iberia had little impact,⁸⁸ the nature of the products being imported changed substantially. This suggests that the renovated system of the *annona* became the key commercial player. After the Byzantines conquered the eastern strip of land that constituted *Spania*, the ratio of Eastern/African imports shifted sharply. African imports came to overwhelmingly dominate the Byzantine assemblages, while eastern types became much rarer, giving the impression that the supply of *Spania* was fundamentally carried out from the old *Proconsularis*, also a Byzantine possession since AD 533.⁸⁹ The picture at Reccopolis is very similar: most of the imports recovered to date are of African origin,⁹⁰ and ongoing excavations at sites such as Los Hitos are yielding similar results.⁹¹

On the Atlantic coast, the panorama is different, and more complex. At sites like Braga and *Olissipo* (modern Lisbon), throughout the first half of the 6th century, African fine wares predominate, but oriental amphorae clearly outnumber their African counterparts.⁹² The arrival of oriental products seems to cease around AD 550, with the northern city of Vigo being the only exception. There, from c. 560 AD onwards, African fine wares are replaced by Phocean wares, while amphorae continue arriving predominantly from the east. These imports have been shown to continue until AD 620/630.⁹³

Turning back to glass, we unfortunately do not have the benefit of typology to tell us where it was coming from and whether these trade patterns also apply to it. It should be so, provided that we accept that glass was traded alongside bulkier commodities (Christopher Wickham would say 'piggyback'⁹⁴), but the evidence available to date is insufficient to prove it. In this case, compositional data could go a long way towards clarifying the issue, but as previously noted there is not nearly enough of it for this period to be certain. The analyses recently carried out in Vascos indicate that the most numerous group belong to the HIMT/Foy 1/Foy 2 types, a type of glass characterised by a high content of iron, manganese and titanium, the origin of which seems to be Egypt.⁹⁵ On the other hand, Mário da Cruz⁹⁶ reports that this group is also predominant in the northwest from the 5th century onwards, but his data are not separated clearly by period, and it is impossible to determine which of his samples correspond to the 6th century. A batch of approximately 100 samples from

⁸² Pfaffenberger (1992).

⁸³ Even if the Visigothic kings imposed some sort of control over the circulation and production of glass, it seems safe to assume that the itinerant craftsmen who probably dealt with a significant proportion of local demand continued in operation more or less without change.

⁸⁴ García (1998: 273–276); Vizcaino (2007: 293–294).

⁸⁵ Morín (pers. comm. 2019).

⁸⁶ Bonifay and Bernal (2008: 102–103); Olmo (2008: 52, 55).

⁸⁷ Gómez de la Torre (2017: 203–204).

⁸⁸ Vizcaino (2007: 289–291).

⁸⁹ García Vargas (2011: 103); Vizcaino (2007: 297–300).

⁹⁰ Bonifay and Bernal (2008: 102–103).

⁹¹ Morín (pers. comm.).

⁹² Morais (2005: 4–5).

⁹³ Fernández (2014: 129).

⁹⁴ Wickham (2005: 711–713).

⁹⁵ Freestone *et al.* (2003); Freestone *et al.* (2018); Foy *et al.* (2003).

⁹⁶ da Cruz (2009).

Cartagena, Malaga and Algeciras is being analysed by the authors of this paper, and we may preliminarily report that HIMT/Foy 1/Foy 2 types also appear to account for a significant proportion of 6th-century samples.⁹⁷

In a recent work, Jorge de Juan Ares and co-workers have published analytical results for a series of sites located in the proximity of Reccopolis, which seem to break this pattern, as most of the materials dated from the final 6th and through the 7th centuries present characteristic features of Levantine, and not Egyptian glasses.⁹⁸ These results match those corresponding to Reccopolis itself, published preliminarily by Nadine Schibille and co-workers (including the authors of this paper).⁹⁹ While the compositional work by de Juan Ares *et al.* is impeccable, we think that this does not respond to broader changes in patterns of glass supply to the Iberian Peninsula. It is to be noted that this reversal of the usual Egyptian/Levantine proportions is exclusive to Reccopolis and sites in its vicinity, and only appears to kick off with the foundation of the city, and it does appear that this is yet another expression of what we are tempted to call the 'Reccopolis anomaly'. It would seem that the glass being distributed to these rural sites was coming directly from Reccopolis and thus they also reflect the unique pattern of supply that revolved around the city. If our interpretation about the glass-making areas in Reccopolis is correct, and glass was indeed being used for the representation of the Visigothic crown, we may even risk interpreting these as the result of some gift-giving dynamic which does, in fact, occupy a good deal more space in the *Liber Iudicorum* than commercial transactions *sensu stricto*.

That glass was being brought in by the Byzantines seems to be clear, not only because their role in Iberian/Mediterranean trade was considerable at the time, and all raw glass came from the East Mediterranean. There is also more direct evidence for this. The excavation of a Byzantine warehouse in the harbour of Malaga resulted in the discovery of several large lumps of raw glass. The glass was found in a destruction level, dating to the early 7th century; destruction, which has been associated with the conquest of the city by the Visigoths around AD 618,¹⁰⁰ proving that the Byzantines in *Spania* were importing glass all the way until the Visigothic takeover.¹⁰¹

Conclusions

Our knowledge about the production, circulation and consumption of glass in Iberia between the 4th and

the 7th centuries is slowly increasing, but there is still much work to do. The problem with typologies is severe, as previously noted, but this can only improve as our understanding of ceramic series becomes more extensive; a more critical approach to typological parallels should also be adopted. One of the most perverse results of the related issues of archaeological visibility and automatism in the search of typological comparisons is the well-established idea that the Visigothic period was one of sharp decline for the glass industry.¹⁰² Yet, the 5th and 6th centuries witnessed a flourishing glass sector in the northwest, and the Visigothic kings, from Liuvigild onward, appear to have held the material in great esteem, if not to have given it a role to play within their propaganda efforts. General assertions in the sense that after the fall of the Western Roman Empire glass in Iberia was a low-quality product for the popular classes or, conversely, that it was an 'exotic material',¹⁰³ are impressionistic statements based, at best, on a partial picture that ignores the nuances of the archaeological record. This is also favoured by the old narrative of the Dark Ages that followed the fall of Rome. As we have seen, Visigothic Iberia was not necessarily the ruralised backwater that this narrative suggests, but a place where cities could flourish and urban elites could afford to sustain a lively industry.¹⁰⁴ It is not useful to try to characterise glass from such a complex period in one stroke. In Visigothic Iberia, glass was commonly used by peasants in small rural settlements and even by cave-dwellers,¹⁰⁵ while being inlaid in royal crowns, next to emeralds brought from as far afield as Sri Lanka.¹⁰⁶

We have explored the topography, typology and chronology of glass production in Iberia during this period, as manifested by glass workshops. We have defined a series of types, each of which responded to different needs in the context of the late antique and early medieval city. We have also suggested that glass, and crucially, the *process* that led to its production, may have been symbolically loaded, used by king Liuvigild in his *aemulatio imperii*. We are aware that few of the ideas here presented are fully polished. But we hope that we have presented sufficiently compelling arguments to convince those interested in Iberian glass that these ideas are worth pursuing.

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⁹⁷ The results are currently in preparation for publication.

⁹⁸ de Juan Ares *et al.* (2019).

⁹⁹ Schibille *et al.* (2017).

¹⁰⁰ García (1998: 148–150).

¹⁰¹ Arancibia (1998); Navarro (1998).

¹⁰² Sánchez de Prado (2004; 2009).

¹⁰³ Gamo (1995) (authors' translation).

¹⁰⁴ Olmo (2008); Wickham (2005).

¹⁰⁵ Gómez de la Torre (2017).

¹⁰⁶ Cozar and Sapalski (2001).

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6. Finding Scarab Amulet Workshops in Ancient Egypt and Beyond: ‘Typological’ vs. ‘Material’ Workshops

Stephanie L. Boonstra

Abstract

Amulets carved as scarab beetles were the most popular form of amulet in ancient Egypt with a wide-reaching impact beyond Egypt’s borders. Scarab experts have looked for ‘typological’ workshops by studying the physical characteristics of each amulet together with the archaeological provenance in order to identify the location of manufacture of a scarab type. Archaeologists studying the material and scientific evidence of manufacture at a site (‘material’ workshops) can determine that artefacts of a particular substance were produced there. This paper outlines case studies to discuss the evidence of both ‘typological’ and ‘material’ scarab workshops and will demonstrate that in some instances there is evidence of a combined ‘typological’ and ‘material’ workshop.

Keywords: scarabs; production; typologies; Egypt; New Kingdom Egypt; Middle Bronze Age Levant

Kurzfassung

Geschnitzte Skarabäuskäferamulette fanden weitreichenden Gebrauch über die Grenzen Ägyptens hinaus. Skarabäusexperten haben, auf Basis der Merkmale jedes einzelnen Amuletts und seiner archäologischen Herkunft, nach ‘typologischen’ Werkstätten gesucht, um den Herstellungsort eines Skarabäus-Typs zu bestimmen. Archäologen, die die Überreste und naturwissenschaftlichen Belege für die Herstellung an einem Standort (‘materielle’ Werkstätten) untersuchen, können die Produktion von Artefakten aus einem bestimmten Material feststellen. Dieser Artikel verwendet Fallstudien zur Erörterung der Nachweise von ‘typologischen’ und ‘materiellen’ Skarabäus-Werkstätten, um zu zeigen, dass in einigen Fällen Belege für eine kombinierte ‘typologische’ und ‘materielle’ Werkstatt vorliegen.

Keywords: Skarabäen; Produktion; Typologien; Ägypten; ägyptisches Neues Reich; Mittelbronzezeitliche Levante

Introduction

Amulets carved in the shape of the *scarabaeus sacer* (commonly called the dung beetle) were the most frequently made and used of the ancient Egyptian amulets. These scarab amulets were usually further decorated with a hieroglyphic, geometric, or floral design on the base. Due to their small and highly portable nature, these amulets are some of the most travelled of Egyptian artefacts and have been found on sites throughout Egypt.¹ Scarab amulets, and the associated cowroid, scaraboid, and other types of ‘seal’ amulets,² were popular for most of the duration of

pharaonic Egypt and their popularity spread beyond its borders, particularly to the Levant.³ Many studies have been conducted on these amulets, often focussing on typologies and chronologies, and occasionally suggesting production regions.⁴ Fewer studies have examined the materials and production methods of these amulets in order to attempt to determine production sites.⁵ This paper uses evidence from Egypt and the southern Levant to discuss typological patterns and examples of proposed ‘typological’ workshops for scarab amulets, as well as examine the archaeological evidence, or ‘material’ workshops, for these artefacts.

Many of the earliest studies that have attempted to date scarabs have focussed on their inscriptions, principally those with royal names. These studies have often held that the presence of a royal name on a scarab or seal amulet denoted that the owner of the amulet worked for the royal family and that the amulet was an

¹ Andrews (1994: 50); Ben-Tor (1993: 8.)

² The term ‘seal amulets’ is occasionally used as an umbrella term to discuss amulets that were created with a flat, inscribed base that could have been used as a seal (Keel 1995; 1997; 2010a; 2010b; 2013). While the present author often uses this term to collectively discuss scarab amulets, scaraboids, and cowroids, she also notes the inherent issues in using it as scholars such as C. Blankenberg-Van Delden (1969), Othmar Keel (1995: 266–268), Andrée Feghali Gorton (1996: 1), Daphna Ben-Tor (1993: 10; 2007: 3; 2015: 139–140), and Rachael Sparks (2007: 91) have noted that these objects were far more frequently used as protective amulets, rather than as administrative seals, particularly after the end of the Middle Kingdom. However, although the term ‘seal amulet’ may not be completely accurate based upon the intended usage, it represents a clearly defined set of artefacts that were carved to resemble a beetle, cowrie shell, fish, etc., and have a

flat base inscribed with a design.

³ For example, Keel (1995; 1997; 2010a; 2010b; 2013); Ben-Tor (2007); Boschloos (2012a); Burke *et al.* (2017: 110, 113); Fischer and Keel (1995); Fischer and Sadeq (2000: 143–151).

⁴ Ben-Tor (1997; 2007); Keel (1995); Mlinar (2004); Tufnell (1984); Ward (1978); Ward and Dever (1994).

⁵ Keel (1995: 30–37).

administrative seal, or at the very least the inscription was a reference to the reigning king.⁶

In more recent studies, scarabs that have been found in securely datable contexts, such as sealed tombs with diagnostic pottery and foundation deposits, have challenged these past beliefs.⁷ The excavation and study of these amulets have found that in some instances, royal name scarabs were produced centuries or more after the featured royal had died.⁸ For example, many scarabs bearing the name of the mid-18th dynasty ruler Thutmose III (c. 1479–1425 BC) were made throughout the New Kingdom and even until the 25th dynasty, roughly 1000 years after the king's death.⁹ Thus the appearance of a royal name on a seal amulet is not a concrete indicator of when it was produced.

During the second half of the twentieth century, scholars developed another approach to dating scarab amulets. One of the great benefits of a scarab amulet is that despite its small size, as most are only a couple of centimetres or less long, they often bear distinct, albeit minute details that can be typified. The discovery of scarabs in the datable contexts mentioned above has allowed scarab experts Olga Tufnell and William Ward to create a comprehensive typology of scarabs, especially of the early second millennium BC.¹⁰ By using the head, back, and leg types, alongside the base designs, they created a complex typology that aimed to reconstruct regional and chronological styles. This typology has been adopted in numerous scarab studies since then.¹¹ Following this typology (Figure 1) as a model, the scarab in Figure 2 has a head type A3 (lunate with the eyes marked out with single lines), back type II (a double line dividing the elytra, or wing cases), and leg type d7 (chip carved with fore and mid legs notched). The base design falls into the 11A classification as a royal name (in this instance the nomen of Queen Hatshepsut).

This article provides a brief synopsis of some of the results from the author's study of seal amulets and their production in the early 18th dynasty in Egypt. This study analysed the surface features, dimensions, design motifs, and materials of scarab and seal amulets from securely dated contexts in order to identify where typological and material patterns occur first and most frequently to ultimately propose distinct workshops.¹² The study discussed three main typological workshops, two of which are discussed below.¹³

Workshop studies

Before discussing the evidence for scarab amulet workshops, an understanding of the term 'workshop', for both scarabs and other ancient Egyptian artefacts, is essential. The term 'workshop', when applied to the study of the manufacture of objects in ancient Egypt, is quite a broad term. Silvana Di Paolo narrowly defined a workshop as a 'place of the specialised production with many artisans and a range of skills'.¹⁴ However, the term 'workshop' can beneficially be used more loosely to cover many other organisations of craft production. It can be used to describe the archaeological evidence of manufacture at a site (a 'material workshop'), or a typological grouping of artefacts that are believed to have been made by the same craftsman or people without requiring archaeological evidence of a workshop space (a 'typological workshop').

'Typological' scarab workshops

The study of scarab typologies has the benefit of selectively using scarabs from secure, datable contexts. This is primarily due to the fact that scarabs were produced en masse and that they were common grave goods, and thus are frequently found in intact tombs.¹⁵

The benefit of only using objects from secure contexts when attempting to recreate a typological workshop is that the distribution of the objects can provide clues as to where the object type may have originated and thus where it may have first been produced, which could be a specific, regional style. It also must be acknowledged that even though a typological workshop has been found and associated with a particular site, it may not have a singular specific place of production and could have been produced at multiple sites, perhaps mimicking each other. Furthermore, if found in an intact tomb, the associated finds, such as ceramics, can provide evidence for the date of the assemblage.¹⁶

A number of typological scarab workshops have been proposed by scholars studying scarabs based upon the typologies created by Tufnell and Ward.¹⁷ Typological scarab workshops are found by using typologies to identify patterns in surface characteristics, thus allowing a hypothesis on the likely production area based upon the distribution of the amulets belonging

⁶ Hall (1913); Petrie (1917); Ryholt (1997).

⁷ Ben-Tor (1998; 2007; 2015); Mlinar (2004); Tufnell (1984); Ward (1978); Ward and Dever (1994).

⁸ Ben-Tor (1997: 164); Jaeger (1982: 254–255); Ward (1971: 134–136; 1994: 190).

⁹ Jaeger (1982); Ward (1994: 189–190).

¹⁰ Tufnell (1984); Ward (1978); Ward and Dever (1994).

¹¹ Ben-Tor (2007); Keel (1995); Mlinar (2004); Richards (2001).

¹² Boonstra (2019: 23–29).

¹³ The third typological workshop (the 'el-Khokha Faience Workshop')








































































is a newly proposed workshop by the author and is not discussed in this paper (Boonstra 2019: 198–200).

¹⁴ Di Paolo (2013: 125).

¹⁵ Andrews (1994: 50).

¹⁶ Tufnell (1984) bases her typology on the dating provided by the associated pottery found alongside the scarabs from sites such as Ruweise, Byblos, Megiddo, Jericho, Tell el-'Ajjul, and more. Ben-Tor (1998) and Vrownny Hankey and Tufnell (1973) all examine the scarabs and pottery at the Tomb of Maket at Lahun; Christa Mlinar (2004) uses the analysis of the ceramics at Tell el-Dab'a to inform her study of the scarabs.

¹⁷ Boschloos (2012b); Keel (1989a; 1989b); Mlinar (2004).

	A	B	C	D
1	 	  	  	   
2	  	 	 	 
3		 		 
4	  	  		
5	  			 
6	  	 	 	 
7	 	 	 	 
8	 	 		    
9				  










I	II	III	O	H	S	xxx	dec.	vIv
								

Figure 1a: The scarab head and back types identified by Tufnell (1984: 32–37).

d1		d9		e1		e9	
d2		d10		e2		e10	
d3	free	d11		e3		e11	
d4		d12		e4			
d5		d13		e5			
d6		d14		e6			
d7		d15		e7			
d8				e8			

Figure 1b: Some of the scarab leg types identified by Tufnell (1984: 32–37).



Figure 2: Scarab amulet MMA 27.3.179 from the foundation deposits of Queen Hatshepsut’s mortuary temple at Deir el-Bahri, Thebes (The Metropolitan Museum of Art, CC0 1.0).

to the workshop. Three examples from Egypt in the second millennium BC will be discussed below.

Tell el-Dab’a

One well-studied typological scarab workshop was located at the eastern Nile Delta site of Avaris (modern Tell el-Dab’a). Avaris was the capital of the Hyksos rulers of the Second Intermediate Period (c. 1650–1550 BC) and was a site of great expansion during this period

of political fragmentation in Egypt. These rulers and much of the population of the eastern Nile Delta during the first half of the second millennium BC originally came from the Levant¹⁸ and their material culture shows a unique mix of both Egyptian and Levantine ceramic wares.¹⁹

Tell el-Dab’a has been extensively surveyed and excavated by the Austrian Archaeological Institute in Cairo since 1966. Their excavations have revealed a great number of scarab amulets found in secure contexts at the site, which allowed Christa Mlinar to reconstruct the history of scarab production and use at Tell el-Dab’a from the late Middle Kingdom (c. 1800–1700 BC) until the end of the Second Intermediate Period (c. 1550 BC), when the city was attacked by the rival Theban Dynasty from the south of Egypt.²⁰

¹⁸ Anat Cohen-Weinberger and Yuval Goren (2004) believe that the Hyksos population originated in the northern Levant based on the ceramic evidence, whereas Ben-Tor (2007: 187–191; 2009) argued, based on scarab distributions, that they arrived from the southern Levant. Other scholars have also voiced opinions on this debate, including Manfred Bietak (1984; 1986; 2010) and Vanessa Boschloo (2008).

¹⁹ Ben-Tor (2009: 1); Bietak (1996); Cohen-Weinberger and Goren (2004); Forstner-Müller (2010).

²⁰ Mlinar (2004).

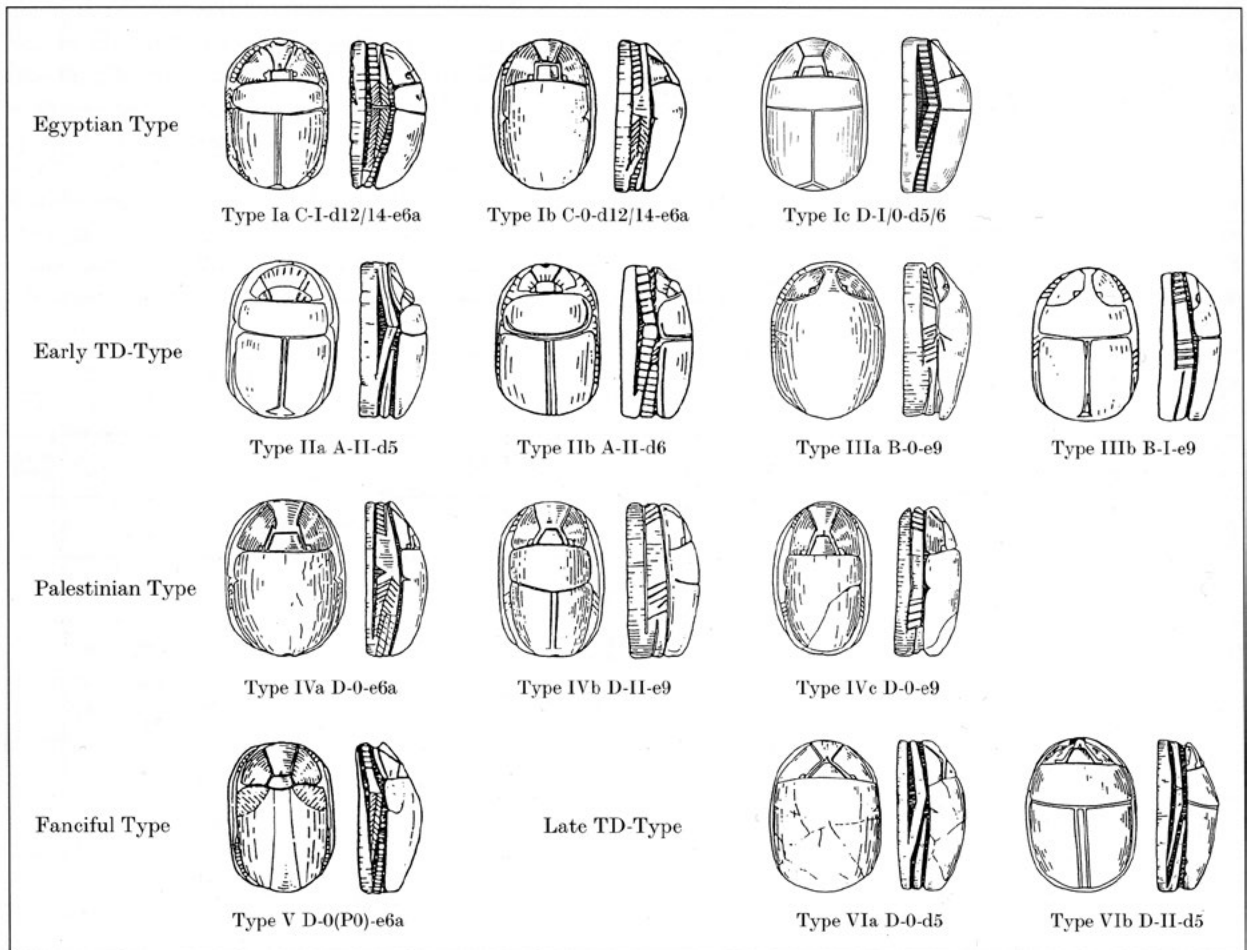


Figure 3: The scarab types of Tell el-Dab'a identified by Mlinar (Mlinar 2004: fig. 16; courtesy of the Austrian Academy of Sciences Press).

By analysing the patterns in surface characteristics and material type of the scarabs found at Tell el-Dab'a, Mlinar determined that the earliest scarabs found in secure contexts were typical Egyptian-made Middle Kingdom scarabs (Figure 3).²¹ These Middle Kingdom Egyptian scarabs frequently had square or trapezoidal-shaped heads, backs with one or more lines delineating the elytra, chip-carved legs, and a high profile. Common Middle Kingdom base designs include scrolls and spirals, private names and titles, and amuletic hieroglyphic signs, such as an *ḥ* or *nfr*.²²

The second phase of scarabs at Tell el-Dab'a dates to the end of the Middle Kingdom and early Second Intermediate Period, and these were manufactured on site, partially mimicking the earlier Middle Kingdom southern Egyptian-made scarabs but with lower profiles, more simplistic legs, and less sensical hieroglyphic renderings.²³ Scarabs and seal amulets

made in the eastern Nile Delta during the early second millennium BC are often given the title of 'Hyksos scarabs', alluding to the particular Second Intermediate Period style of scarabs. However, the Egyptian Second Intermediate Period produced scarabs have sometimes been erroneously grouped in with the Levantine-made seal amulets of the same period,²⁴ which constitute the next phase of scarabs identified at Tell el-Dab'a.

During the early to middle Second Intermediate Period, Tell el-Dab'a began importing scarabs from the southern Levant. Prior to this period, there is little to no indication of scarab amulet manufacture outside of Egypt; however, there is evidence of a boom in Levantine scarab production during the Second Intermediate Period, particularly at Tell el-Ajjul (see below).²⁵ These Levantine scarabs had their own distinct style, with a noticeable 'open' back, in which there were no lines

²¹ Mlinar (2004: 107).

²² Ben-Tor (2007: 12); Mlinar (2004: 107–113); Tufnell (1984: 116–117).

²³ Mlinar (2004: 113–122).

²⁴ O'Connor (1974: 32–33) and Ward and Dever (1994: 119–120) all believed that the scarabs found in the Levant were Egyptian made and that there was no Levantine manufacture of scarabs during the Second Intermediate Period.

²⁵ Ben-Tor (2007: 115–182); Boonstra (2014); Mlinar (2004: 122–128).



Figure 4: The enigmatic *anra* (or *ʿnr*) formula as seen on a scarab from Tell el-ʿAjjul, EXII.159/3 (© UCL, Institute of Archaeology).

dividing the wing casings. A common base design for these Levantine scarabs was the enigmatic *ʿnr* (commonly known as *anra*) formula that was comprised principally of three Egyptian hieroglyphic signs often misrendered and placed in a nonsensical order (Figure 4).²⁶

These scarabs also served to partially inspire the final phase of Tell el-Dabʿa scarab production at the end of the Second Intermediate Period. This included Tell el-Dabʿa created *ʿnr* scarabs, scarabs with the open backs that were popularised by their Levantine counterparts, and deeply cut figures.²⁷ The production of seal amulets at Tell el-Dabʿa ceased after this phase due to the conquering of the Hyksos capital by the Egyptian dynasty ruling from Thebes and the subsequent abandonment of the city.²⁸ This ended the prosperity of Tell el-Dabʿa, as well as the politically fragmented Second Intermediate Period, and ushered in the start of the 18th dynasty.

Hatshepsut Workshop

The first early 18th dynasty typological seal amulet workshop proposed by the author has been named the

Hatshepsut Workshop,²⁹ after the powerful early 18th dynasty Egyptian queen who acted as the ruler of Egypt for roughly fifteen years. This seal amulet workshop (or series of workshops) dates to the queen's reign (c. 1473–1458 BC) and is characterised by some distinct recurring features. First, the scarabs and seal amulets were made of fired steatite with a blue-green glaze and show little to no sign of wear. The scarabs of the Hatshepsut Workshop had a lunate head with its eyes marked with a single or double line (A3 or A5 type on Tufnell's chart;³⁰ see Figure 1), a double or triple line dividing the wing cases, as well as notched, chip-carved legs (Tufnell type d6) (Figure 5).

The bases of the majority (55%) of these scarabs were inscribed with the names and titles of Queen Hatshepsut (Figure 5, no. 1). Many other seal amulets were inscribed with the names and titles of her co-regent Thutmose III³¹ (8%) (Figure 5, no. 2) or her daughter, the princess Neferure (5%) (Figure 5, no. 3). A large number of the remaining scarabs (10%) were inscribed with the name of the god Amun-Re (Figure 5, no. 4), who was of great importance during the early 18th dynasty and especially to Hatshepsut.³²

Most of the features of the scarabs of the Hatshepsut Workshop were archaising. They frequently copied the style of the early Middle Kingdom scarabs, effectively disregarding the style of those that were made in the politically fragmented, foreign-ruled Second Intermediate Period. This archaising trend in the seal amulets echoes other design inclinations during Hatshepsut's reign, notably the placement and architecture of her mortuary temple (next to and resembling the 11th dynasty king Mentuhotep II's temple),³³ which served as a link between her reign and that of the founder of the Middle Kingdom.

One noticeable feature in the Hatshepsut Workshop scarabs that was not archaising, is the presence of humeral callosities on many of the backs (30%). Humeral callosities are the v-shaped marks on the 'shoulder' area of the wing casings that can also be seen in nature on the insects themselves (see Figure 5, no. 4). This feature is seldom seen on scarab amulets before the early 18th dynasty.³⁴

²⁹ Boonstra (2019: 195–198).

³⁰ Tufnell (1984: 32).

³¹ Although Thutmose III was officially Queen Hatshepsut's co-regent and charge for the duration of her reign (as he was initially too young to ascend the throne), she assumed the titles that were traditionally taken on by the male ruler of Egypt, including *nsw.t bitj* (King (f.) of Upper and Lower Egypt) and *nb.t t3.wy* (Lord (f.) of the Two Lands) (Keller 2005: 96–97; Quirke 1990: 14–16).

³² Allen (2005: 83); Ben-Tor (2015: 10–141, 143).

³³ Arnold (2005: 135–136); Roth (2005).

³⁴ Ben-Tor (2007: 183; 2015: 142); Tufnell (1984: 36); Ward (1994: 189).

²⁶ Ben-Tor (2007: 115–182); Mlinar (2004: 125); Richards (2001).

²⁷ Mlinar (2004: 129–133).

²⁸ Bietak (1996: 67).



Figure 5: Examples of scarab amulets from the Hatshepsut Workshop in Thebes, all found within the foundation deposits at Deir el-Bahri. 1) MMA 27.3.243; 2) MMA 27.3.304; 3) MMA 27.3.322; 4) MMA 27.3.345 (The Metropolitan Museum of Art, CC0 1.0).

Most of the scarabs from the author's proposed Hatshepsut Workshop were found in the foundation deposits of Queen Hatshepsut's mortuary temple at Deir el-Bahri in Thebes. In fact, a staggering 306 scarab and seal amulets were found within four pits around the perimeter of the temple, and the vast majority of the scarabs bear the aforementioned features.³⁵

Due to the presence of hundreds of scarabs with these recurring features in Thebes and the lack of wear on the foundation deposit scarabs (suggesting that they were made specifically for the deposits and were not used prior), it is posited that the Hatshepsut Workshop was also based in the 18th dynasty religious capital and was likely situated near to the temple of the queen.

Cornelian/Red Jasper Workshop

A second typological workshop (or series of workshops), also dating to the early to mid-18th dynasty, has been identified in the present study and is called the Cornelian or Red Jasper Workshop by the author.³⁶ This workshop's most distinct feature is that the scarabs were made of a red stone. Most frequently the red stone used was cornelian; however, those found in Egyptian contexts appeared to have been made from cornelian and red jasper indiscriminately.³⁷ This indiscriminate

use of stone alludes to the colour, rather than the material, being of top significance and is also likely due to the accessibility of both red jasper and cornelian in the Eastern Desert of Egypt, whereas neither are naturally occurring in the Levant.³⁸

The second most distinctive feature of this workshop is the base design. On the base of these cornelian or red jasper seal amulets, a linear design, often a simple X or star, was incised (Figure 6). The heads of these scarabs were lunate-shaped and the wing casings were separated with a double line.³⁹ Vanessa Boschloos noted that a wide variety of leg types were seen on the examples outside of Egypt; however, she was unable to compare them to the Egyptian examples whose profiles were often unpublished. The author's in-person examination of seven of the Egyptian examples has shown that all visible profiles were sub-types of the 'e' leg; either the simplistic e11 or the more detailed e5. These could point to two phases of production or one workshop mimicking, with slight alterations, the other. Two of the Egyptian examples have ring mounts (see Figure 6) that completely obscure the profiles and thus the leg type is unknown.

These scarabs have a much wider distribution than those of the nearly contemporaneous Hatshepsut Workshop

³⁵ Ben-Tor (2015: 139).

³⁶ Boonstra (2019: 157–160, 201–202); see also Boschloos (2012b).

³⁷ Boschloos (2012b: 8).

³⁸ Aston *et al.* (2000: 27, 29); Boschloos (2012b: 5).

³⁹ Boschloos (2012b: 7).



Figure 6: Scarabs from the Cornelian/Red Jasper Workshop. 1) Burial of Amenhotep the child (MMA 36.3.158, CC0 1.0); 2–3) the Tomb of Maket (AN1890.789(iii) Image reproduced with kind permission of the Ashmolean Museum, University of Oxford; Tufnell 1984: 114 (scale unknown)); 4) Tomb 27, Gurob (GLAHM:D1921.31 © Hunterian Museum); 5–7) Tomb 1723, Sedment (E.34a-c.1921© Fitzwilliam Museum); 8) Tomb 1728, Sedment (E14145 © Penn Museum).

and have been found throughout Egypt, including examples in the Tomb of Maket at Lahun,⁴⁰ tomb 27 at Gurob,⁴¹ tombs 1723 and 1728 at Sedment,⁴² and from a burial near the Tomb of Hatnefer and Ramose,⁴³ as well as in the southern Levant and even in Athens⁴⁴ and on Crete.⁴⁵ The highest number of examples, as well as the earliest, has been found clustered in Middle Egypt around the Faiyum Oasis region, which is likely the area in which they were originally produced.⁴⁶ It is also likely that after the original Faiyum workshop, other workshops mimicked and produced their own red stone scarabs, perhaps even outside of Egypt.

Archaeological evidence of scarab and seal amulet production

The following section examines the material evidence of industry at archaeological sites. In order to locate the specific areas at a site where the production of scarabs and seal amulets occurred, evidence of that manufacture must be found. Unfortunately, evidence of production has often been overlooked or inadvertently destroyed, as many of the sites that are well-known to contain areas of production were excavated in the early years of scientific archaeology and many other

sites have been encroached on by settlements and agriculture.⁴⁷ Thus, it is still plausible that scarab and seal amulet workshops existed on sites that now have no archaeological evidence of manufacture.

Scarab and seal amulets were made of a wide variety of materials, including semi-precious stones, organic materials, and even precious metals, but the most common material for scarab manufacture was glazed steatite, followed by Egyptian faience. In the author's study of early 18th dynasty scarabs and seal amulets, 80% of the sample were made of steatite and 15% were made of faience or frit (13% faience, 2% frit).⁴⁸

For glazed steatite scarabs, the primary required material was steatite, which is commonly known as soapstone or talc. Steatite was the preferred medium as it was exceptionally soft (Mohs hardness of 1) and thus allowed for great detail to be carved into it. However, once the steatite object was fired (either in a kiln or even on an open hearth), the chemical composition of the stone changed, and it became a Mohs hardness of 6 or 7, the same hardness as quartz or emerald.⁴⁹

The vast majority of steatite scarabs had a glaze applied⁵⁰ before they were fired, and the glaze used was

⁴⁰ Tufnell (1984: 112, fig. 23 no. 23); Ashmolean AN1890.789.iii.

⁴¹ Brunton and Engelbach (1927: pl. XXII no. 5); Hunterian GLAHM D.1921.31.

⁴² Petrie and Brunton (1924: 25–26, pl. LVIII, nos 19–21, 36); Penn E4145; Fitzwilliam E.34a-c.1921.

⁴³ Lansing and Hayes (1937: 36); MET 36.3.158.

⁴⁴ Blackman (1999: fig. 5).

⁴⁵ Phillips (2008: 145).

⁴⁶ Boschloos (2012b: 10).

⁴⁷ Sites such as Memphis, Tell el-Amarna, and Malqata all have evidence of production but were first excavated in 1908 (Petrie 1909), 1894 (Petrie 1894), and 1888 (Daressy 1903), respectively.

⁴⁸ The study sample comprised 876 scarabs, scaraboids, and cowroids from securely dated early 18th dynasty Egyptian contexts (Boonstra 2019).

⁴⁹ Tite and Bimson (1989: 88); Tite, Shortland and Bouquillon (2008: 24).

⁵⁰ Some scholars have posited that steatite amulets made in the

comprised of the same ingredients required to make faience artefacts: silica (from sand or crushed quartz), alkali (from natron or halophytic plant ash), lime, and a colourant (usually copper). In the production of Egyptian faience scarabs, these same glazing materials would be combined to create a paste that could be shaped by hand or by clay mould into an amulet and then left to set.⁵¹

The presence of the above-listed raw materials in the archaeological record can provide supporting evidence for the production of glazed steatite and faience scarabs and seal amulets at a site. Unfortunately, industrial waste is not always immediately noticeable on archaeological sites, and many production sites in Egypt were initially explored in the early twentieth century, when archaeologists were often preoccupied with finding museum grade objects.⁵² Fortunately, clusters of quartz pebbles, which could be used as the required silica, have been discovered near known areas of production, such as at the workshops of Tell el-Amarna.⁵³

The required temperature to fire glazed steatite and faience was roughly 800–1000° C;⁵⁴ a temperature similar to that which was needed for ceramic production, and thus the kilns used for glazed steatite and faience could be shared with other industries and may be hard to associate definitively with seal amulet production.⁵⁵

Faience ‘wasters’, or manufacturing errors, usually denote an area of faience production. These wasters are often caused by an error in the mixture or an accident in the kiln that causes multiple faience objects, such as bowls, to become fused or overfired, causing the glaze to pool and crack.⁵⁶ In all probability, examples of faience scarab or seal amulet wasters exist; however, none are known by the author.⁵⁷ A fairly definitive sign

of faience scarab production would be the presence of a clay scarab mould, which could be an indicator of mass production. Clay moulds for a variety of amulet types have been found en masse at sites such as Naukratis, Malkata, and Tell el-Amarna.⁵⁸

For steatite scarabs, the best indicator of production is unfinished and unfired scarabs, such as these examples from Memphis (Figure 7). These pieces of soapstone had been roughed out and then abandoned during manufacture. This would have usually occurred as a result of the drilling process. Drilling the longitudinal hole to allow for a string or ring bezel was one of the most difficult aspects of bead and amulet production, and when the object had the greatest chance of fracturing.⁵⁹ The majority of the unfinished steatite scarabs from the Memphis workshop (see below) appear to have broken either during or shortly after drilling as can be seen from the piercings on the fractured scarabs. As unfinished steatite scarabs are not found in tombs or similar votive contexts (such as foundation or temple deposits), it can be presumed that they denote production and were not treated as a finished consumer good.⁶⁰

Semi-precious stone scarab production is more difficult to identify in the archaeological record than that of steatite and faience. The raw materials and tools required for these amulets would have been the same as those used for creating a wide variety of semi-precious stone objects. Therefore, debitage could bolster an argument for the production of seal amulets of semi-precious stone if there was other evidence of their production at a site.⁶¹ It would be reasonable for the evidence to be lacking for broken and discarded semi-precious stone scarabs as there would be greater incentive for the craftsperson to rework a broken scarab into another, smaller bead due to the value of semi-precious stone.⁶²

Known ‘material’ scarab workshops

In instances when archaeological evidence of scarab production has been discovered at a site, this has been titled a ‘material’ scarab workshop. Two sites dating to the second millennium BC in Egypt with archaeological evidence of said manufacture will be outlined below.

Levant may have been fired without the addition of a glaze, calling them ‘burnt steatite’ rather than glazed steatite. Unfortunately, this is difficult to substantiate as glaze degradation on steatite amulets is much higher in the Levant due to the less favourable preservation environment. As of present, there is no evidence for intentional ‘burnt steatite’ scarabs made in Egypt (Keel 1995: 33; Tite, Shortland and Bouquillon 2008: 29–30).

⁵¹ Nicholson and Peltenburg (2000: 187–189).

⁵² Nicholson (2007: 21); Nicholson and Peltenburg (2000: 183–186); Sparks (2013).

⁵³ Nicholson (2007: 133); Petrie (1894: 25).

⁵⁴ Nicholson (2013: 144); Tite, Shortland and Bouquillon (2008: 27); Tite, Shortland and Vandiver (2008: 47).

⁵⁵ Tite, Shortland and Bouquillon (2008: 27); Wodzińska (2009: 1).

⁵⁶ See BM 1980, 1017.1 in Friedman (1998: no. 180) for a waster from the faience ‘factory’ at Memphis. In this example, three dishes had fused together because the excessive heat of the kiln melted the ceramic supports. ECM586 (Eton College), which may also be a waster from Memphis, displays the pooling and cracking of the glaze (Boonstra 2018; Nicholson 2013: 8).

⁵⁷ Other potential amulet wasters have been found in the archaeological record. For example, an object excavated at Naukratis (Ashmolean AN1886.452) appears to be a waster in which a faience amulet of the god Bes was fused to a faience amulet of a male head (Masson 2013–2015: 73).

⁵⁸ For Naukratis, see Masson (2013–2015: 5) and Petrie (1886: 36); for Malkata, see Newberry (1920: 156), Nicholson (2007: 20–21), and Tytus (1903: 25); and for Tell el-Amarna, see Hodgkinson (2018: 105–118), Nicholson (2007: 133), and Petrie (1894: 28–29).

⁵⁹ Stocks (1989).

⁶⁰ Boonstra (2014: 25); Keel (1995: 33–34).

⁶¹ For example, if a typological workshop had been identified at that site, then the presence of debitage of the appropriate stone could support an argument for the location of the workshop on site.

⁶² See Černý (1954), Haring (2009), and Sherratt and Sherratt (1991) for discussions on values in ancient Egypt.



Figure 7: Unfinished and broken steatite scarabs from Memphis, L.A162.1909
(Photograph: author's own, reproduced courtesy of New Walk Museum, Leicester City Council).

Tell el-Amarna

The first site with evidence for material scarab workshops is at the Middle Egyptian city of Tell el-Amarna. This site was only inhabited for a short period of time, during what Egyptologists identify as the Amarna Period (c. 1347–1336 BC). There have been numerous studies conducted on the various industrial activities that occurred around the city;⁶³ however, little evidence of scarab production has been demonstrated at the site.

During the 1921 field season, Eric Peet, working on behalf of the Egypt Exploration Society, excavated three scarab moulds in the area of N49, which is located in the Main City South.⁶⁴ The mould found in building N49.19 was not published, nor was its material noted; however, it was illustrated on the object card (TA.OC.21.414 of the Egypt Exploration Society), but with little detail. In building N49.20, a mould was described on the object

card (TA.OC.21.467) as 'Mould. Limestone – double. ? Two scarabs'. Unfortunately, this mould was not illustrated on the object card or in the publication.⁶⁵ A clay mould found in building N49.33 had been recorded in slightly more detail on its object card (TA.OC.21.484) as the hieroglyphic base design is illustrated. However, as this 'Mould clay. Scarab. (fragment)' (as designated on the object card) is of only the base design for the scarab, it could have been used in the production of any type of oval seal amulet (as the back of the amulet would have been created by a separate mould). Thus, without further evidence that this hieroglyphic base design was meant for a scarab, and not another type of seal amulet, this mould does not definitively indicate the production of a faience scarab.⁶⁶

⁶³ Boyce (1995); Hodgkinson (2015); Nicholson (2007); Rose (2012); Shaw (2012: 127–150); Stevens and Eccleston (2007: 149–152), to name a few.

⁶⁴ Peet and Woolley (1923: 23–25).

⁶⁵ To add to the confusion, the publication for building N49.20 states 'Objects: Three clay moulds, 21/456, 457 and 467: limestone spindle-whorl, ...' (Peet and Woolley 1923: 24). Thus, perhaps the 'limestone' scarab mould may in fact have been ceramic and the object material types were conflated during the registration process.

⁶⁶ This mould was subsequently distributed to Wellesley College (Massachusetts) (Peet and Woolley 1923: 174). Unfortunately, the current location of this object is unknown, which is likely due to the fact that at least 120 of the artefacts donated by the EEf/EES to Wellesley were subsequently auctioned off in the following decades (Stevenson 2019: 190).

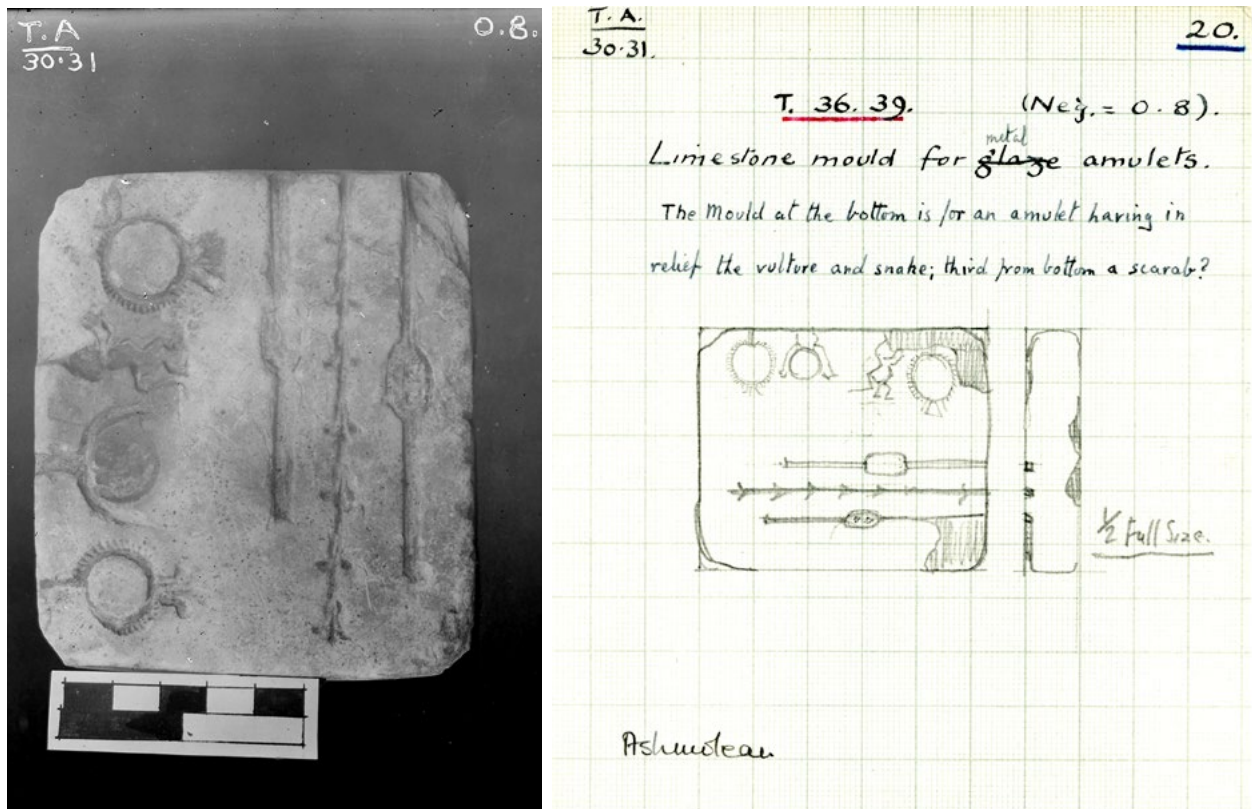


Figure 8: Photograph (TA.NEG.30-31.O.008) and object card (TA.OC.30-31.020) of the limestone amulet mould excavated in area T36.39 of Tell el-Amarna in 1931 (Courtesy of the Egypt Exploration Society).

During the 1930 excavation led by Henri Frankfort and John Pendlebury, another limestone scarab mould was found. This mould was discovered in the central western quarter of the North Suburb in building T36.39, which the excavators labelled as a 'big compound, or Khan'.⁶⁷ Fortunately, this mould was photographed and illustrated,⁶⁸ in which its difference to the more common Nile clay moulds used for faience scarab production is visible (Figure 8). This 11 by 9 cm limestone object was evidently used as a mould for a variety of objects, including beads and amulets. The excavators believed that this limestone mould would be used to produce metal amulets, rather than faience (as demonstrated by the change in designation on the object card; see Figure 8). As most known moulds for faience scarabs and seal amulets were made of Nile clay,⁶⁹ the use of limestone for both this mould and the one discovered in 1921 in N49.20 may suggest the production of metal scarabs at Tell el-Amarna.

More recently, the excavations by Barry Kemp and Anna Stevens of the Amarna Project have uncovered a further

three broken clay scarab moulds from the Main City South, in an area designated as Grid 12.⁷⁰ These moulds are described as having sharp features; however, only 30% or less of each of the moulds has survived.⁷¹ Also found in the vicinity of these scarab moulds was further evidence of vitreous material production activities, including numerous fired clay moulds, faience amulets, crucibles, wasters, and glass rods and ingots.⁷²

Further evidence of faience scarab manufacture at Amarna was discovered in 2014 at the workshop site of M50.14-16 in the Main City South. M50.14-16 was initially excavated in 1922 by Woolley, who described the domestic building complex as a workshop site.⁷³ Anna Hodgkinson re-examined the houses, outbuilding, and courtyard, and has identified a domestic vitreous materials workshop in the courtyard with an abundance of evidence for faience and glass production. Hodgkinson described the courtyard floor to the south of building M50.16 as 'covered' with vitrified kiln debris, and also found glass rods, two glass ingots, faience moulds, and many faience wasters, all significant indicators of a

⁶⁷ Frankfort *et al.* (1933: 45).

⁶⁸ Frankfort *et al.* (1933: pl. XL, no. 2); TA.NEG.30-31.O.008; TA.OC.30-31.020.

⁶⁹ Nicholson (2013: 136).

⁷⁰ Kemp and Stevens (2010a).

⁷¹ Kemp and Stevens (2010b: 481-484).

⁷² Kemp and Stevens (2010a: 528-606; 2010b).

⁷³ Hodgkinson (2015: 279); Peet and Woolley (1923: 19).

vitreous materials (glass and faience) workshop.⁷⁴ Of particular interest, the team also discovered a small faience scarab in the complex that fit perfectly within a clay scarab mould that was excavated in the courtyard.⁷⁵ Therefore, there is definitive evidence, albeit limited in comparison to sites such as Memphis and Naukratis, of scarab production at the late 18th dynasty site of Tell el-Amarna.⁷⁶

Memphis

Memphis was a city of production and was a centre for industrial activity in all periods of its ancient history. To exemplify this, the chief deity of the city was Ptah, the god of arts and crafts.⁷⁷ One example is the Roman Period Egyptian faience workshop that has been extensively studied in recent years by Paul Nicholson, in which he discovered evidence of kilns, a great many faience wasters, plaster moulds,⁷⁸ and faience figurines, amulets, beads, and vessels.⁷⁹ No evidence of scarab manufacture was noted at this workshop, although, considering scarab production was less common in the Roman Period than in preceding periods, this is not exceptional.

In 1909, Egyptologist William Matthew Flinders Petrie discovered a workshop area at the site that contained the remains of 'glazed beads and waste beads, and great numbers of little pellets of burnt clay about a quarter of an inch across',⁸⁰ the latter of which he believed were used to separate objects in the kiln. Of significance to this study was the discovery of 'many' unfinished steatite scarabs that were roughly blocked out (see Figure 7 above), as well as unfinished calcite beads.⁸¹ These objects were recorded as having been found in the outer court of the Temple of Merneptah of the 19th dynasty, but it still remains unclear if the workshop and the temple were contemporaneous. Petrie noted that the workshop remains were located 'below the houses, belonging to a time when rubbish was thrown into the

court, but before it was appropriated to civil use',⁸² which could then narrowly predate the workshop to the temple or the temple court.⁸³ Unfortunately, Petrie gives little further information about the scarab manufacture at Memphis and devotes only a paragraph to this Memphite material workshop.

Keel has noted a series of 19th dynasty scarabs discovered in the Levant that depict Ptah as superior to Re-Horakhty (the falcon-headed god of Heliopolis). He hypothesised that these 'propaganda' scarabs may have been produced in Memphis, perhaps even as products of the workshop that Petrie discovered the remains of.⁸⁴

Consolidating 'typological' and 'material' workshops

Typological scarab workshops and archaeological or material workshops have been identified by current and past scholars, as demonstrated above. However, combining these two types of scarab and seal amulet workshops is more difficult. Can a 'typological' scarab workshop be anchored to an exact 'material' workshop (such as the workshop of M50.14–16 at Tell el-Amarna)? Can we positively identify a scarab workshop in the archaeological record that was producing specific types of scarabs? To find concrete examples, there is a need to look outside the confines of Egypt in the second millennium BC. The Nile Delta port site of Naukratis and the southern Levantine city of Tell el-'Ajjul are two examples that provide evidence of where the marrying of these two types of seal amulet workshop may be possible.

Naukratis

The site of Naukratis in the western Nile Delta was an important city that flourished during the Saite Period in the mid-first millennium BC when the port site became an international trading centre and allowed Greek traders to settle there, a few hundred years before the Ptolemaic Period of Egypt (332–30 BC). The site was first excavated by Petrie in the 1880s under the auspices of the Egypt Exploration Fund. During the 1885 season, he uncovered what he termed the 'Scarab Factory' near the sanctuary of Aphrodite. The main archaeological evidence for this workshop was a waste pile in which Petrie found hundreds of clay moulds (Figure 9) for mass-producing faience and frit scarabs,⁸⁵ as well as the presence of raw materials and amulets at the site.⁸⁶ The designation of the 'Scarab Factory' is largely appropriate as the archaeological evidence points to the mass production of amulets, particularly

⁷⁴ Hodgkinson (2015: 281–282).

⁷⁵ Hodgkinson (2015: 282, fig. 6); see Hodgkinson in this volume, fig. 3. Hodgkinson (pers. comm. 23 December 2019) notes that another scarab amulet and a heavily eroded scarab mould were excavated during the 2017 season at M50.14–.16.

⁷⁶ To the author's knowledge, there is no other evidence of scarab production at Tell el-Amarna. Out of the 86 amulets moulds at the Petrie Museum of Egyptian Archaeology from the site, none are for scarab amulets. Similarly, of the over 70 faience amulet moulds studied by Nicholson from production site O45.1, none were for scarab amulets (Nicholson 2007). Furthermore, Vanthuyne's (2012) study of the faience moulds from Amarna does not mention the presence of scarab moulds, nor are any mentioned by Boyce (1995) in house P46.33.

⁷⁷ Baines (2002: 134); Jeffreys (2001).

⁷⁸ Nicholson (2013: 136) noted that unlike the moulds of the pharaonic period, which were made of Nile clay, these later Roman moulds were made of plaster.

⁷⁹ Nicholson (2013).

⁸⁰ Petrie (1909: 11).

⁸¹ Keel (1995: 34); Petrie (1909: 11, plate XXVIII, fig. 13, 14).

⁸² Petrie (1909: 11).

⁸³ Petrie (1909: 11).

⁸⁴ Keel (1989c: 294–298).

⁸⁵ Petrie (1886: pl. XXXVIII).

⁸⁶ Masson (2013–2015: 5); Petrie (1886: pl. XXXVII).

scarabs made of faience and frit, primarily between 600 and 570 BC.

This archaeological evidence of scarab and amulet production has been supported by the study of Andrée Feghali Gorton on the typologies of the Naukratis scarabs. Feghali Gorton has identified at least seven distinct types of scarabs and scaraboids that were mass-produced at this Egyptian workshop (Figure 10). Many of these scarabs bore distinctly Egyptian motifs, including Type XXXVI, which was sometimes inscribed with *Menkheperre*, the throne name of the 18th dynasty king Thutmose III.⁸⁷ She has based her research on both the excavated scarabs from Naukratis and their distribution. These scarabs were widely exported to Greece and throughout the Punic world as consumer goods, but were also used locally as daily wear amulets, funerary goods, and votive offerings to both the Greek and Egyptian deities of Naukratis.⁸⁸ However, Günther Hölbl's conclusions on scarabs found in Greece determined that those found at sites, particularly at Perachora, had not been made at Naukratis based upon material and typological analysis, and thus the Naukratis scarabs did not have as wide a distribution as Feghali Gorton suggested. Regardless, there is no doubt that Naukratis mass-produced blue frit scarabs on site during the Late Period.⁸⁹

Tell el-'Ajjul

As mentioned previously, scarab amulets were so popular in Egypt in the second millennium BC that they were widely exported and even mimicked and manufactured outside of Egypt, particularly in the Levant. Evidence of scarab production has been discovered at a number of Levantine sites including Beth Shean⁹⁰ and Tell Beit Mirsim;⁹¹ one such workshop will be discussed below, based upon the author's previous research.⁹²

Tell el-'Ajjul, located in the modern Gaza strip of Palestine, was an important trading city during the Second Intermediate Period (Middle Bronze II; MBII), during the same period as the prosperity of Tell el-Dab'a in the Nile Delta. These two cities appear to have been closely linked through trade.⁹³ Over 1200 scarab and seal amulets were found at Tell el-'Ajjul during Petrie's 1930s excavations. This is in comparison to Gezer, the largest southern Levantine site of the same period, where less than 700 scarab amulets were discovered.



Figure 9: One of the many Nile clay moulds for mass-producing scarabs from the 'Scarab Factory' of Naukratis. BM1965, 0930.897 (© The Trustees of the British Museum).

The high number of scarab and seal amulets at Tell el-'Ajjul is particularly exceptional as only a small area of the site has been fully excavated. All but less than 20% of these scarabs date to the MBII period.⁹⁴

Two distinct types of scarabs made of steatite were found in large numbers at the site (Figure 11).⁹⁵ These scarabs bore trapezoidal heads (Tufnell type D), open backs (Tufnell type O), and schematic profile legs (Tufnell type e10 and e11); furthermore, two recurring base designs are noticeable. These base designs bore deeply cut motifs, of which a few examples have been found at Tell el-Dab'a (TD Type VI), likely as a result of trade.⁹⁶ The distribution of these types of scarabs is largely concentrated at Tell el-'Ajjul with a small number of scarabs fitting the typology found at other southern Levantine sites, in the Nile Delta, and in Nubia, noticeably largely avoiding the Nile Valley.⁹⁷

⁸⁷ Feghali Gorton (1996: 129).

⁸⁸ Feghali Gorton (1996: 91–131); Masson (2013–2015).

⁸⁹ Hölbl (1979: 202–211).

⁹⁰ Ben-Tor and Keel (2012).

⁹¹ Keel (1995: 34).

⁹² Boonstra (2014). The Tell el-'Ajjul workshop was included in this paper as the author had direct access to the scarabs from this site during her MA research. The author hopes to publish the results from this study in the future.

⁹³ Fischer and Sadeq (2000); Kempinski (1974); Mlinar (2004: 133).

⁹⁴ Boonstra (2014); Keel (1997; 2013); Tufnell (1984: 92).

⁹⁵ In a study of the UCL Tell el-'Ajjul scarabs, 25% bore these characteristics (Boonstra 2014: 33).

⁹⁶ Boonstra (2014: 33–39); Mlinar (2004: 133).

⁹⁷ Mlinar in Fischer and Sadeq (2002). Only one example is known to have been found in the Nile Valley, at Mostagedda (Fischer and Sadeq 2002: 151). Tell el-'Ajjul and the southern Levant were known allies of the Second Intermediate Period Hyksos Dynasty ruling from the Nile Delta. A theory behind why these scarabs may have appeared in Nubia and not the Nile Valley could be due to the trade and political relations between the Nubian Kingdom of Kush and the Hyksos, who may have been plotting together against the rival Theban Dynasty, if historical sources such as the Kamose Texts have any validity. While the Kamose Texts are full of hyperbole (Bourriau 2000: 211; Enmarch 2012), it does provide an enticing explanation as to why the Tell el-'Ajjul scarabs avoid the Theban territory.



Figure 10: 1) EA34956, Feghali Gorton Type XXXV, subtype 1-7; 2) EA66519, Feghali Gorton Type XXXII, subtype A2-27a; 3) EA66452, Feghali Gorton Type XXX A, subtype A19-31 (© The Trustees of the British Museum).

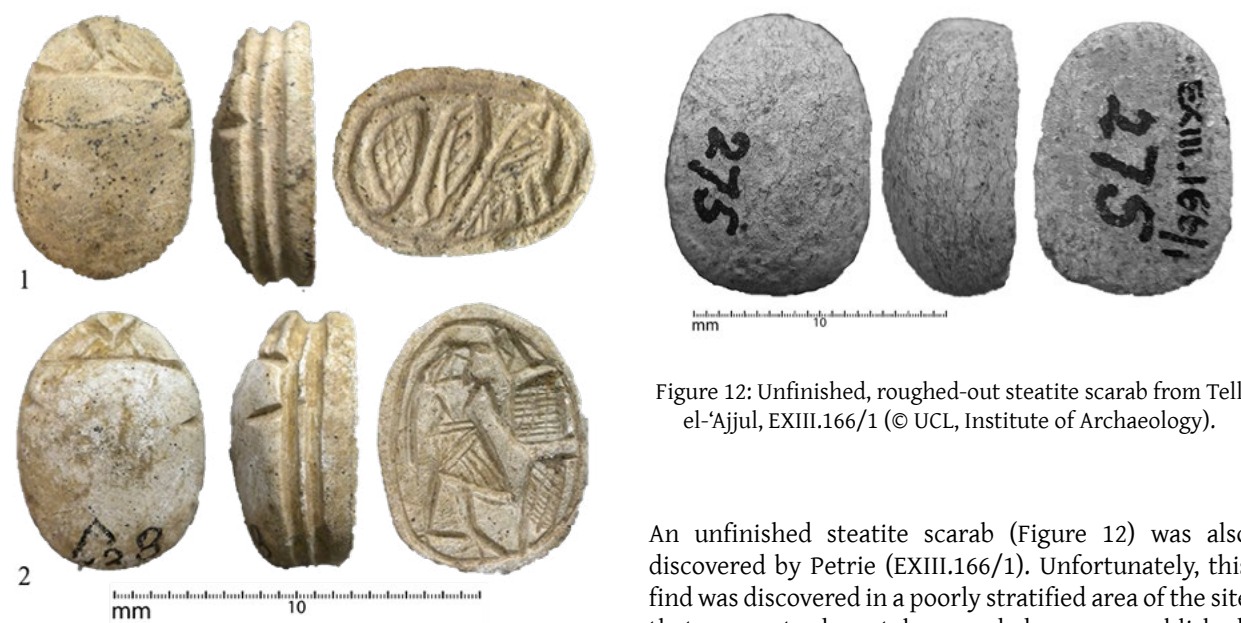


Figure 11: Scarabs from the Tell el-‘Ajjul Workshop. 1) EXI.14/2, Type 1a; 2) EXI.9/1, Type 1b (© UCL, Institute of Archaeology).



Figure 12: Unfinished, roughed-out steatite scarab from Tell el-‘Ajjul, EXIII.166/1 (© UCL, Institute of Archaeology).

An unfinished steatite scarab (Figure 12) was also discovered by Petrie (EXIII.166/1). Unfortunately, this find was discovered in a poorly stratified area of the site that was not adequately recorded or even published, and thus the precise location of the proposed material scarab workshop at Tell el-‘Ajjul remains unknown.⁹⁸

⁹⁸ Boonstra (2014); Sparks (2005).

Ideally, future excavations will uncover more unfinished steatite scarabs to bolster the evidence of scarab production at Tell el-'Ajjul.

The great number of scarabs discovered at Tell el-'Ajjul, the distinct style of a number of these amulets (and the fact they appear earlier and in greater numbers at the site than elsewhere), and the presence of an unfinished steatite scarab (which in and of itself is likely an indicator of some level of production) strongly suggest the presence of both a typological and material workshop producing scarabs at this southern Levantine site that will hopefully be further illuminated if excavations continue in the future.

Conclusion

The past study of scarab workshops has largely focussed on the typological styles and chronology of scarabs. Some studies, such as Keel's introductory volume on scarabs in the Levant, tackle how they were made and the archaeological evidence for their production at sites in Egypt and the Levant.⁹⁹ However, little effort has been made to isolate a 'typological' scarab workshop within the archaeological record. This could largely be due to the challenge in locating the physical, or 'material' workshop for a typological style to any degree of accuracy. Some archaeological sites have produced such a wealth of data, both in terms of material and typology, e.g., Naukratis, that the process of locating the typological workshop in the archaeological record is less challenging.

To continue attempting to marry these two types of scarab workshops, sustained study on the typological styles and regional distribution of scarabs must be conducted alongside a detailed examination of the archaeological record of sites that may possibly have produced these amulets. Thus, a clearer image begins to emerge of scarab amulet production on archaeological sites and their wide-reaching, or localised, distribution.

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⁹⁹ Keel (1995).

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7. Using Spatial Analysis for Understanding the Manufacture and Manipulation of Late Bronze Age Egyptian and Ancient Near Eastern Glass

Anna K. Hodgkinson

Abstract

This paper discusses the glass- and faience-industries of Egypt and the Ancient Near East (ANE) during the Late Bronze Age, focussing on the domestic manufacture of vitreous materials alongside the production of food in an urban setting. With a focus on Tell el-Amarna, a comparative spatial analysis of urban settlement sites in Egypt and the ANE has been carried out using GIS technology in order to detect patterns of control over these industries. It has been possible to gain information on the control of raw materials by studying the proximity of buildings used in food and faience production and glass-working to institutional ones such as palaces, temples or elite houses. This paper compares the evidence from Amarna and Malqata (Egypt) with that from Assur and Nuzi, as well as with Tell Brak and Ugarit (ANE).

Keywords: Late Bronze Age; glass; faience; pyrotechnology; GIS; Egypt; Ancient Near East

Kurzfassung

In diesem Beitrag werden die städtischen Glas- und Fayenceindustrien der Spätbronzezeit neben der Lebensmittelproduktion in Ägypten und Vorderasien (VA) untersucht, um Auskunft über die häusliche Herstellung von glasartigen Materialien zu gewinnen. Der Fokus dieser Untersuchung liegt auf Tell el-Amarna, während mithilfe von GIS-Technologie Vergleiche mit anderen Städten in Ägypten und Vorderasien gezogen werden, um Muster der Kontrolle über diese Industrien zu erkennen. Hierbei sind Informationen über die Rohstoffkontrolle, die Nähe der Gebäude, welche Lebensmittel, Fayence- und Glas produzierten zu institutionellen Einrichtungen, wie Palästen, Tempeln, oder elitären Häusern, gewonnen worden. In diesem Beitrag werden Amarna und Malqata (Ägypten) mit Assur und Nuzi, Tell Brak und Ugarit (VA) verglichen.

Keywords: Späte Bronzezeit; Glas; Fayence; Hochtemperaturtechnologie; GIS; Ägypten; Vorderasien

Introduction

This paper discusses the glass- and faience-industries of Egypt and the Ancient Near East (ANE) during the Late Bronze Age (LBA, roughly equivalent to the Egyptian New Kingdom, c. 1550–1070 BC), focussing on the examination of the domestic manufacture of vitreous materials in an urban setting alongside the production of food.¹ With a special focus on Tell el-Amarna, in Middle Egypt, the main aim is to carry out a comparative spatial analysis using geographical information systems (GIS) technology between urban settlement sites in Egypt and the ANE. This was done in order to detect patterns of control over these industries,

which were understood to have produced high-status or luxury items.

While many of the individual sites examined in this contribution have already been discussed with regard to their internal socio-economic organisation and distribution patterns (especially at Amarna), the present study aims to provide an inter-site comparison. By taking into consideration both old and more recent work done on these sites, this discussion delivers both a broader and a more in-depth overview of the urban vitreous materials industries and their connection to food production.

The detection of spatial clusters of industrial activities and workshops, and their relationships and interactions with each other and the surrounding streets and local networks form the focal point of this study. It has been possible to identify patterns of raw materials management, how produce was shared and consumed, how goods travelled and which groups of the population had access to these goods. In order to

¹ This is the final deliverable of research carried out as part of a Marie Skłodowska-Curie post-doctoral fellowship, which was conducted in 2015–2017 at the Freie Universität, Berlin, in cooperation with the Prussian Cultural Foundation, more specifically the National Museums in Berlin, and the Amarna Project. The overall project bore the title 'GLASS: Glass, Faience and Food in Late Bronze Age Societies: An Analysis of the Socio-Economics of Urban Industries in Egyptian and Mesopotamian Settlements' (grant agreement no.: 653188).

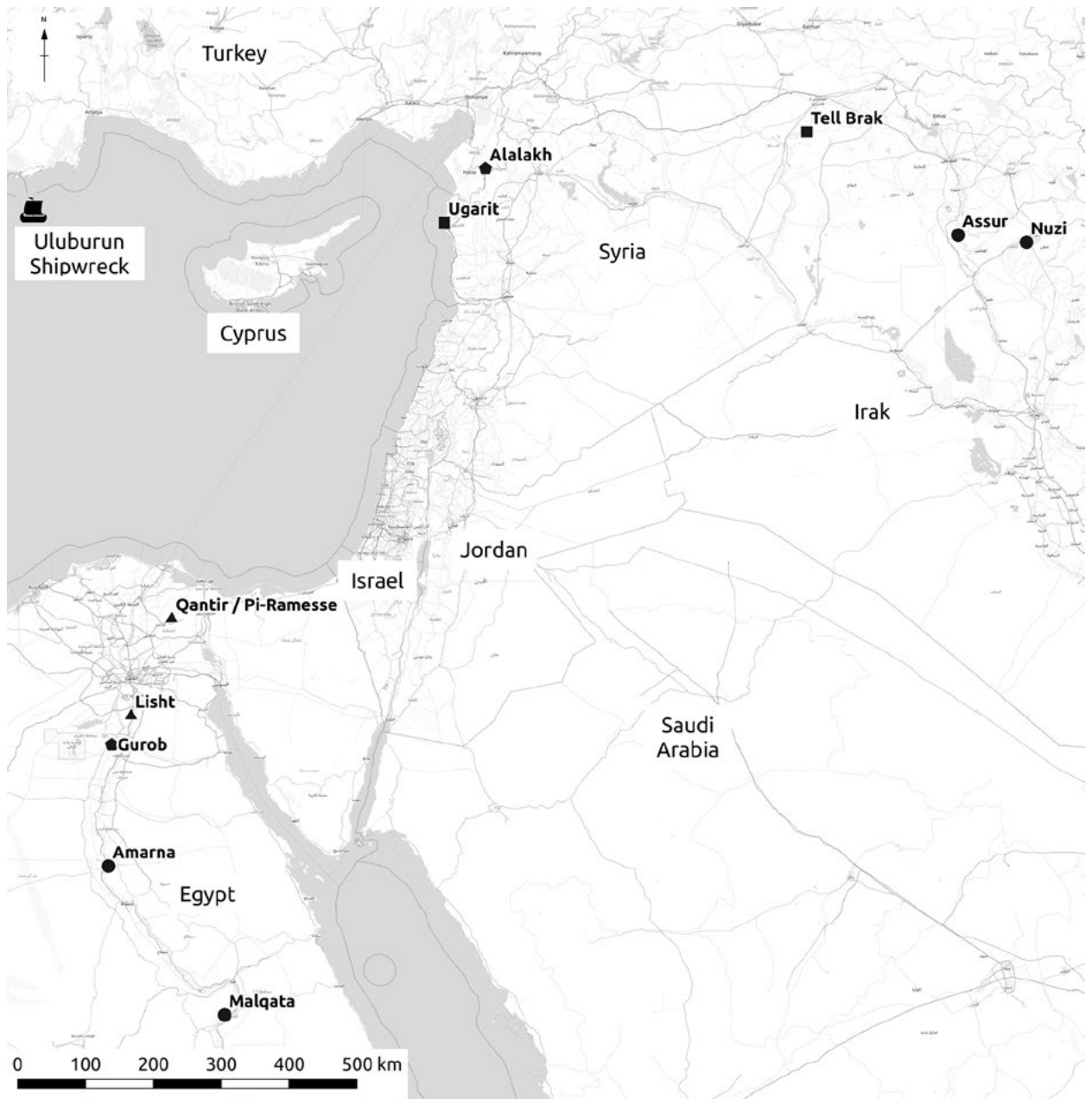


Figure 1: Sites discussed in this paper (Basemap: OpenStreetMap, illustration: Anna K. Hodgkinson).

understand control, the proximity of buildings used in food and faience production and glass-working to institutional buildings, such as palaces, temples and elite houses, has been examined.

The present paper compares the evidence from the Egyptian sites of Amarna and Malqata, and the ANE sites of Assur and Nuzi. The sites of Tell Brak and Ugarit will be used for comparative purposes, although they will not be discussed in greater detail since they have already been dealt with elsewhere (Figure 1).² The following

sections will provide background and a theoretical framework to this study, placing the analysis into context. This is followed by a methodological discussion that will also highlight the issues encountered with the data collected for the individual projects. Finally, using the results obtained, certain theories describing the discrepancies and similarities between domestic and institutional vitreous materials industries at LBA Egyptian and ANE sites will be presented.³

² Hodgkinson (forthcoming).

³ The results of chemical analyses carried out on material from the sites discussed in this paper are mentioned, though not treated in depth. The various methods used for chemical analysis, whether non-invasive or destructive, provide a vast potential for the further



Figure 2: Domestic ceramic oven with external clay lining situated in a courtyard belonging to building M50.16 at Amarna (Photo: Anna K. Hodgkinson).

Background

The working of raw glass into finished objects and the production of faience goods were frequently, but not exclusively, found in connection with each other in the urban settlements of the Egyptian New Kingdom (c. 1550–1070 BC), which has been demonstrated in a number of studies, both modern and antiquary.⁴ Since small household ovens have been found to be capable of achieving temperatures of up to 800–1000° C, sufficient for the processing of glass and the firing of faience,⁵ and diagnostic objects such as glass rods and faience moulds have been found in domestic buildings, it may be postulated that these materials were processed in those locations by a non-elite population (Figures 2 and 3). The primary purpose of these ovens, however, was the production of foodstuffs, such as bread, and the frequent discovery of pottery for food production and querns for the grinding of grain, sometimes in association with these ovens, emphasises this.

The glass-industry has generally been considered high-status throughout the LBA, with the production of raw glass from primary materials being a royal

monopoly. This is because colourants were precious and high temperatures were required to melt the raw materials, necessitating large amounts of fuel and a specialised workforce. The industry is said to have originated in the ANE, more specifically in the Levant and Mesopotamia.⁶ Evidence exists of the working of raw glass into finished objects, the industry being initially elite-controlled and either household-based or institutionalised once the industry had been well-established.⁷ While small objects such as amulets and beads could be produced with a relatively low level of technological skill in domestic buildings, the manufacture of core-formed, polychrome glass vessels required a greater set of skills. A similar scenario can be reconstructed for the manufacture of faience goods, in which the manufacture of small items of jewellery or inlays is easily managed by means of moulds and a limited set of skills, while the production of core-formed vessels or polychrome tiles required a more specialised workforce.⁸ No great level of skill is required for the production of bread. However, as is the case with the manufacture of small glass and faience objects, this also appears to have been both institutionalised and household-based, with a degree of elite-control.⁹ At

understanding of vitreous materials, including information on dating, provenance and technology. Where applicable, the results of such analyses have been mentioned in the text.

⁴ See, for example, Friedman (1998: 17); Hodgkinson (2017: 19, 263–273); Nicholson (2009: 9); Shortland *et al.* (2001: 147–160).

⁵ Eccleston (2008: 33–35); see also Krzyżanowska and Frankiewicz (2015: 125).

⁶ Oppenheim (1973: 262).

⁷ Henderson (2013: 131); Nicholson (2007: 7); Oppenheim (1970: 2–104); Shortland *et al.* (2001).

⁸ Mass (2002: 67–82). See also Hodgkinson (2010: 71–79); Nicholson (2008: 1–13).

⁹ Moreno García (2012).

Amarna, for instance, large, industrial bakeries, which have also yielded evidence of the production of glass and faience objects, have been located throughout the Central City, while many more grain storage and baking facilities have been discovered in the larger houses throughout the urban areas of the settlement, the same applying to other ancient Egyptian urban settlements.¹⁰

Theoretical approaches to workshop detection at urban sites

A theoretical framework for the identification of industrial activities and craft specialisation across archaeological sites has been produced by Cathy L. Costin, which has been used as a basis for the present analysis of the archaeological evidence.¹¹ Costin's 'Issues in defining, documenting, and explaining the organization of production' links the status of an object not only with its material value, but also with the level of skill and specialisation required for its production.¹² Using a *chaîne opératoire* approach, Costin differentiates between crafts involving a more complex technology and those that do not, linking some complex technologies to specialised crafts and production for the elite.¹³ She furthermore states that specialisation is connected to demand and economic relationships, defining it as 'a differentiated, regularized, permanent, and perhaps institutionalized production system in which producers depend on extra-household exchange relationships at least in part for their livelihood and consumers depend on them for the acquisition of goods they do not produce themselves'.¹⁴

The *chaîne opératoire* approach has also been employed by Heather-Louise Miller and other scholars working in the field of industrial archaeology.¹⁵ Marcia-Anne Dobres, for example, has argued for the recognition of the practice of craftsmanship by highly-skilled human individuals as a crucial aspect in the understanding of the organisation of ancient craft production and technology, adhering to a framework of archaeological post-processual theory.¹⁶ Dobres furthermore employs a *chaîne opératoire* approach, including scientific analysis, to describe the 'technical gestures and related strategic choices of artifact manufacture, use and repair',¹⁷ linking the act of manufacture to the person producing the object.

In fact, most remains of the *chaîne opératoire* related to glass-working and faience manufacture are easily

distinguishable in the archaeological record, in the form of glass rods (Figure 3), cylindrical vessels (moulds for glass ingots), faience moulds and unfinished products. The evidence of bread production, by contrast, occurs largely in the form of (mostly fragmentary) pottery vessels, such as bread moulds, querns for the preparation of flour, granaries for storage and ovens.

Costin has presented a typology of craft organisation, including but not limited to autonomous, specialised individuals; a more localised level of specialisation; nucleated workshops; a *dispersed corvée*, working for the elite or government on a part-time basis; and full-time individual artisans producing for the elite. Four parameters characterise the organisation of production: the degree of elite sponsorship (and demand), concentration (where the workshop is located and whether it is included in a group of buildings or stands alone), the scale (whether a workshop is kin-based or can be defined as a purpose-built factory), and the intensity (full-time or part-time). According to Costin, more independent workshops are generally more utilitarian, in contrast to the more specialised and higher-status, 'attached' and dependent workshops, which produced in order to meet the demands of the elite.

Barry Kemp has defined a tripartite organisation of craftsmanship at Amarna, which has generally been accepted, ranging from large, institutional workshops to craft production in elite houses and to domestic workshops.¹⁸ Applying these theoretical approaches, the following spatial analyses will demonstrate that boundaries between workshop types and classes, at least in Egypt, were less strict and more fluid than previously assumed. ANE production sites, by contrast, appear to have been under a higher level of control.

Spatial analytical approaches to urban sites

The last two decades have brought forth a series of publications on the usability of survey techniques¹⁹ and spatial analyses in archaeological science, including numerous approaches, ranging from the analysis of small spaces to wide landscapes, land usage and visibility.²⁰ GIS has become recognised as a modern and efficient tool capable of analysing object distribution patterns and thus efficiently extract knowledge of the function of various areas of archaeological sites and their infrastructure and organisation.

¹⁰ Hodgkinson (2017: 20, 110).

¹¹ Costin (1991: 3–18).

¹² Costin (1991: 5; 2005: 1074).

¹³ Costin (2005: 1074).

¹⁴ Quote from Costin (1991: 5); see also Costin (2005: 1056–1059).

¹⁵ See Miller (2007: 5, 29–30).

¹⁶ See, for instance, Johnson (2010: 108). See also Dobres (2010: 103).

¹⁷ Dobres (2010: 103).

¹⁸ Kemp (1989: 56–58; 2006: 330–331); Stevens (2006: 259–270). See also Stevens and Eccleston (2007: 155).

¹⁹ See Banning (2002: 12–22) for a discussion of various approaches to archaeological survey and models. A standard reference volume on the subject is Conolly and Lake (2006).

²⁰ Studies include, for example, those carried out by Hodder and Orton (1976) and Verhagen and Gazenbeek (2006: 411–423).

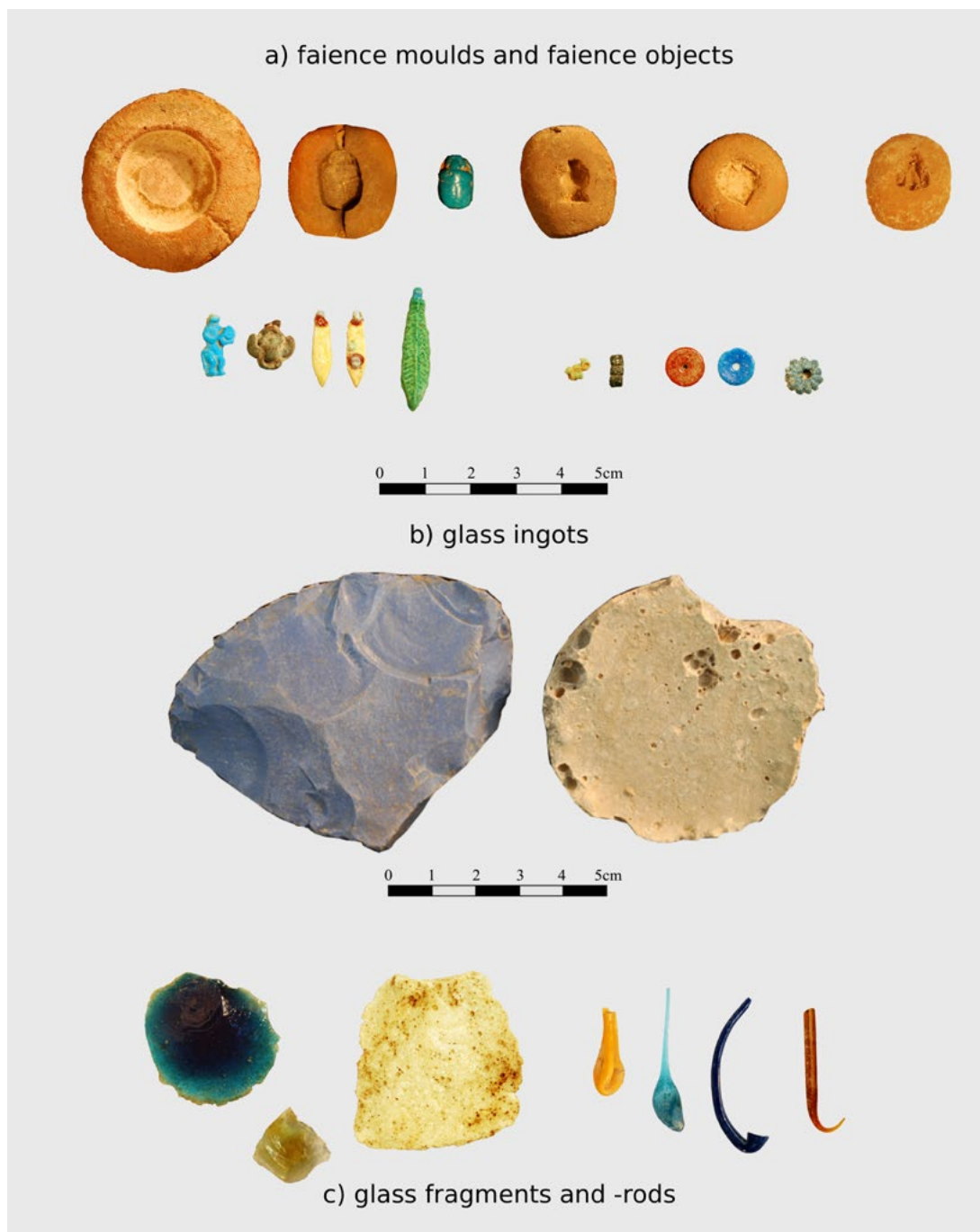


Figure 3: a) Faience moulds and faience objects, b) two glass ingots and c) glass fragments and glass rods. All from Amarna site M50.14–16, excavated in 2014 (Photos: Anna K. Hodgkinson).

For example, one of the scholars arguing in favour of the careful study of the distribution of evidence of productivity is Costin. While stating that spatial analysis will highlight not only areas of concentrated industrial activities across landscapes, she maintains that it will also detect patterns of demand and consumption, as well as specialisation.²¹

²¹ Costin (1991: 19–20; 2005: 1056–1059).

Focussing on the geographical region of Zimbabwe, particularly the metabolic organisation of local societies in light of climate change and urban development, Paul Sinclair has developed a spatial approach for the study of ancient urban sites as part of a multi-scalar methodology including archaeological survey, excavation and paleoenvironmental data.²²

²² Sinclair (2010a: 15; 2010b: 592); Sinclair and Petré (1999). See also Pedersén *et al.* (2010: 133, 140).

A complex urban archaeological model based on survey data, for instance, is that produced for the site of Qalhât in Oman.²³ Another good example of this is the composite map constructed for Amarna by Kemp and Salvatore Garfi, which has been used by the author as a basis for the spatial analysis.²⁴ Many more examples exist, including a spatial analysis by the author of luxury-goods manufacture at Amarna, Gurob and Malqata.²⁵ It is essential, however, to be aware of any problems associated with the data, and to apply a consistent and very specific methodology. Such problems may, for instance, be derived from errors in the archaeological record caused by early excavations and the subsequent misinterpretation of distribution patterns.

Objectives and methodological approaches in the present study

Based on the theoretical framework outlined above and the available archaeological data, the following objectives, some of which will be discussed in this paper, have been defined for the overall research project:

1. To identify, document and analyse in detail domestic and administrative archaeological contexts that encompass a combination of glass-working, faience manufacture and food production in both LBA Egypt and the ANE;
2. to examine the organisation of workshops and areas of industrial activities throughout the urban sites and their infrastructures, within both LBA Egypt and the ANE;
3. to compare industrial activities within ancient Egyptian settlements and those taking place in contemporary ANE settlement and palace sites; and
4. to examine export and trade facilities and networks in order to demonstrate how the products of these industries were consumed, transported and traded. This latter aspect is not elaborated upon in the present publication but will be discussed in a future publication.²⁶

The overall aim was to create a theoretical model for each site, describing the infrastructure and organisation of these industries, and whether and how they stood in relationship to each other. This has been achieved using existing archaeological plans of these sites, information on productivity gleaned from the literature and by visualising this data by means of GIS in order to facilitate cross-site comparisons. The cross-cultural comparison of urban production and its organisation throughout

LBA Egypt and the ANE has facilitated the detection of patterns of product consumption, evidence of industrial activity and related socio-economic structures.

The focal site in this research project is Amarna in Middle Egypt, in addition to Malqata (Upper Egypt) and Gurob (Faiyum) (Figure 1).²⁷ Spatial analyses have already been carried out for these three Egyptian sites, but only the results for Amarna and Malqata will be summarised here.²⁸ Contemporary ANE sites that have been analysed in this context are Assur, Tell Brak, Nuzi and Ugarit. While the results of the analyses of Tell Brak and Ugarit have already been published and will only be summarised here,²⁹ this paper presents the results of the Assur and Nuzi analyses in greater detail. In addition, this paper places the evidence from LBA Egypt and ANE sites into the broader context of neighbouring countries in the ANE. The data will also be compared with the published evidence from the site of Tell Atchana (Alalakh) in Turkey.³⁰

Data acquisition and methods overall

A detailed spatial database of all glass-working related objects, a large number of finished glass objects, as well as faience moulds indicative of the manufacture of small faience items, was produced. This data was obtained from published sources, including the lists of objects excavated at the sites named below. Only objects with secure archaeological context information (e.g. the number of the house-unit in which an object was found in the case of Amarna) were added to the spatial database. Where possible, stratigraphic information was taken into account, although only single-period sites and individual stratigraphic sequences, or time periods, were examined for this paper.

All objects that do not have a recorded archaeological context, which is – unfortunately – frequently the case with museum material, were not included in the spatial analysis presented here, but were used for reference and comparison only.³¹ Additional information was retrieved during visits to the archive of the Egypt Exploration Society in London, which houses the excavation records and finds from early British work

²³ Regagnon and Barge (2012: 314–325).

²⁴ Kemp and Garfi (1993).

²⁵ Hodgkinson (2017: 53–184).

²⁶ Hodgkinson (forthcoming).

²⁷ See Hodgkinson (forthcoming).

²⁸ The data for Gurob has not been included in this publication since it is discussed in Hodgkinson (forthcoming).

²⁹ Hodgkinson (forthcoming).

³⁰ See the section 'Overall results and conclusions' in this paper. A detailed study of this site has already been published by Dardeniz (2016; 2017; 2018).

³¹ For example, c. 1500 glass objects from the collection of the Egyptian Museum and Papyrus Collection of the National Museums in Berlin were catalogued, and material from other European collections, including RCMH Brussels, the Petrie Museum of Egyptian Archaeology and the British Museum in London, the World Museum and the Garstang Museum in Liverpool, and the Ashmolean Museum in Oxford, were also added to the database for the overall project, although without a spatial reference.

at Amarna. Further information on the nature of industrial activities at Malqata was acquired through a detailed study of the relevant materials and the archive held in the Metropolitan Museum, New York.

In addition, information on all bread ovens, kilns and other firing structures was extracted from publications, archive material and maps of the sites and added to the database. Finally, a visual inspection of the surface at Amarna was carried out,³² and any further evidence of firing structures was added to this database.³³ Bibliographical sources for industrial activities in the ANE settlements focussing on glass- and faience-industries were collated. Unpublished information on the ANE site of Assur was acquired through the archive and finds journals housed in the Vorderasiatisches Museum of the National Museums in Berlin. The author had the opportunity to study the objects in the Berlin collection, but not those in Istanbul Archaeological Museums.³⁴

Furthermore, certain textual sources were used to glean information on the hierarchy and the organisation of production, as well as the consumption of and trade in finished goods. These include inscriptions on clay tablets, such as the Amarna Letters,³⁵ and relief inscriptions with tributes or lists of offerings in New Kingdom temples and tombs. The LBA Uluburun Shipwreck, which contained c. 175 raw glass ingots among other things, is of high value for the understanding of the glass (and other materials) trade during this period.³⁶

Focussing on Amarna, the precise plotting of all relevant material enabled the development of raster-based heat maps, which in turn enabled the identification of areas of concentrated industrial activities and overlaps in object categories, i.e. the occurrence of objects related to glass- and faience-industries, together with those indicating the production of foodstuffs. This method was successfully implemented for the site of Amarna, but the production of GIS maps for other sites, particularly those of the ANE, proved not to be as straight-forward. Therefore, a detailed analysis of all evidence available through published and unpublished sources has to suffice for a cross-site comparison.

³² Nicholson (1989: 64–81; 2007).

³³ The analysis is based on data and results produced for a previous publication, which examined the socio-economics of the production of high-status goods throughout LBA Egyptian urban sites (Hodgkinson 2017).

³⁴ See Şeniz (1998). Some of the objects from Assur held in the Istanbul Archaeological Museums are included in Schmidt (2019: 17–20, 183–185).

³⁵ See, for example, Moran (1992); Mynářová (2007).

³⁶ Nicholson *et al.* (1997); Yalçın *et al.* (2005). See also Pulak (2005; 2008: 293).

Egyptian sites

Amarna

Introduction

The site of Tell el-Amarna, or *Akhetaten*, lies in Middle Egypt, c. 60 km south of modern Minya (Figure 1). The city was established in the fifth regnal year of pharaoh Akhenaten (c. 1353–1336 BC) as a new capital and residential city and for the cult of the sun god Aten. Stretching c. 7 km from north to south along the eastern bank of the Nile, in addition to some outliers, the city was occupied by the royal family and members of the elite and non-elite populations. Since it was gradually abandoned after the reign of Akhenaten, when the royal court was reinstated in Memphis and the ruins were left mostly untouched, the remains of the ancient settlement provide a unique insight into the daily life and industrial activities of 18th dynasty Egypt.

Data and methods

The archaeological evidence of a vitreous materials industry at Amarna was first examined by William Matthew Flinders Petrie, who also attempted the first reconstruction of the technology.³⁷ Petrie collected and distributed a large quantity of items considered by him to be technological samples – thousands of pieces of glass-working debris and faience moulds (Figure 3) – which were distributed to museum collections worldwide.³⁸ Unfortunately, he did not note the finds locations of these materials, so that their context is now lost. He only marked the location of an area of ‘moulds’ on his original map, stating that this is where he retrieved thousands of faience moulds, and he described some glass furnaces in his publication, but without mentioning their locations. He stated that the majority of glass vessel fragments came from the so-called palace waste heaps (Figure 4), although the providence of the bulk of glass rods and ingot fragments kept in the Petrie Museum of Egyptian Archaeology in London, for instance, has been lost.

Excavations carried out on behalf of the Deutsche Orient-Gesellschaft by Ludwig Borchardt and colleagues (1911–1914)³⁹ and on behalf of the Egypt Exploration Society by T. Eric Peet, C. Leonard Woolley, Henri Frankfort, Francis G. Newton, Francis L. Griffiths and John D. S. Pendlebury (1921–1936)⁴⁰ did record finds locations, at least by house-unit, and object cards with drawings and descriptions were written. As such,

³⁷ Petrie (1894: 25).

³⁸ A spatial analysis, not using GIS, was carried out by Andrew Shortland (2000), although his analysis did not take into account the chronology and internal sequence of the occupation at Amarna.

³⁹ Borchardt and Ricke (1980).

⁴⁰ Frankfort and Pendlebury (1933); Newton (1924); Peet and Woolley (1923); Pendlebury (1951).

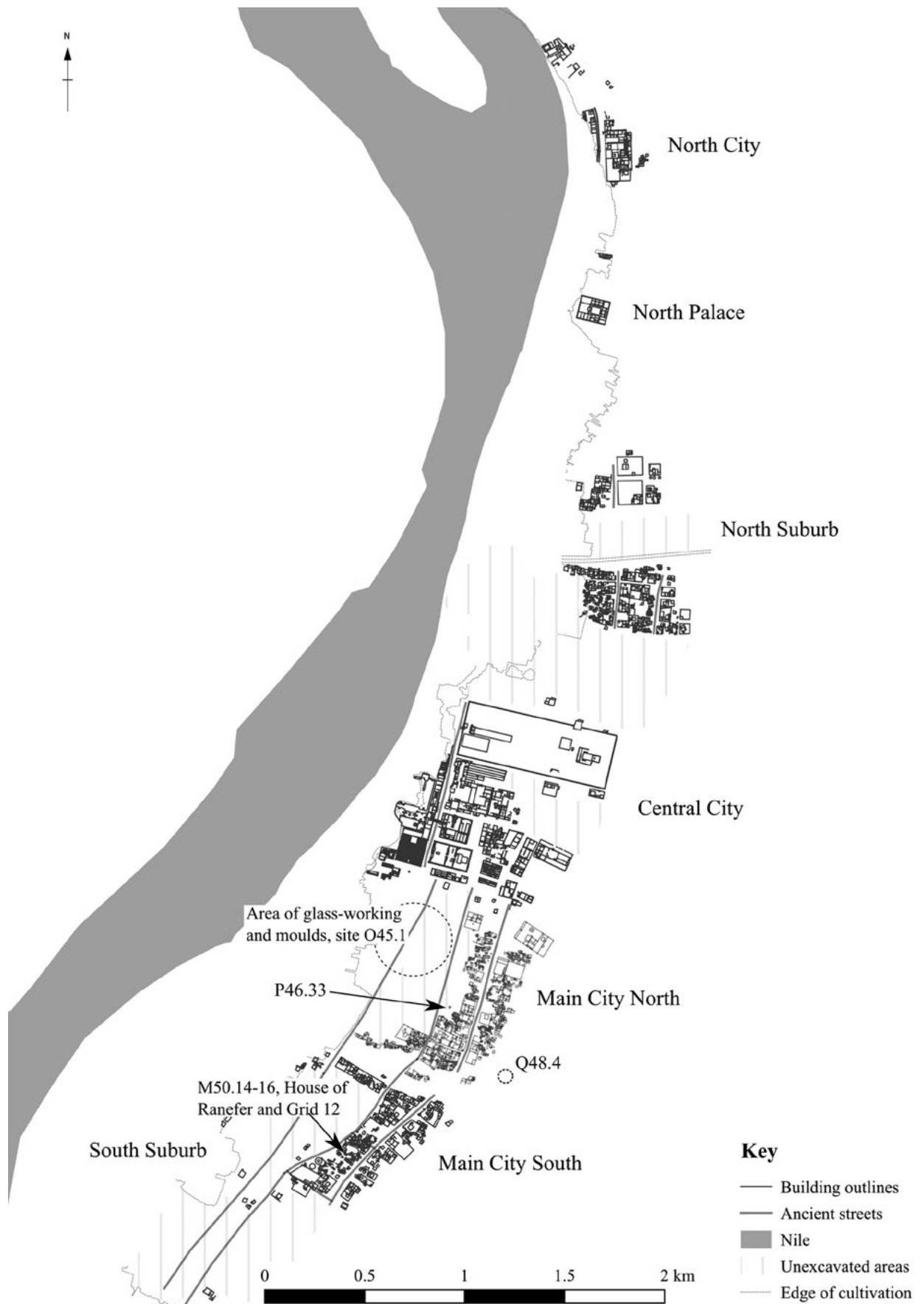


Figure 4: Map of Amarna showing the locations discussed in this paper (Illustration: Anna K. Hodgkinson).

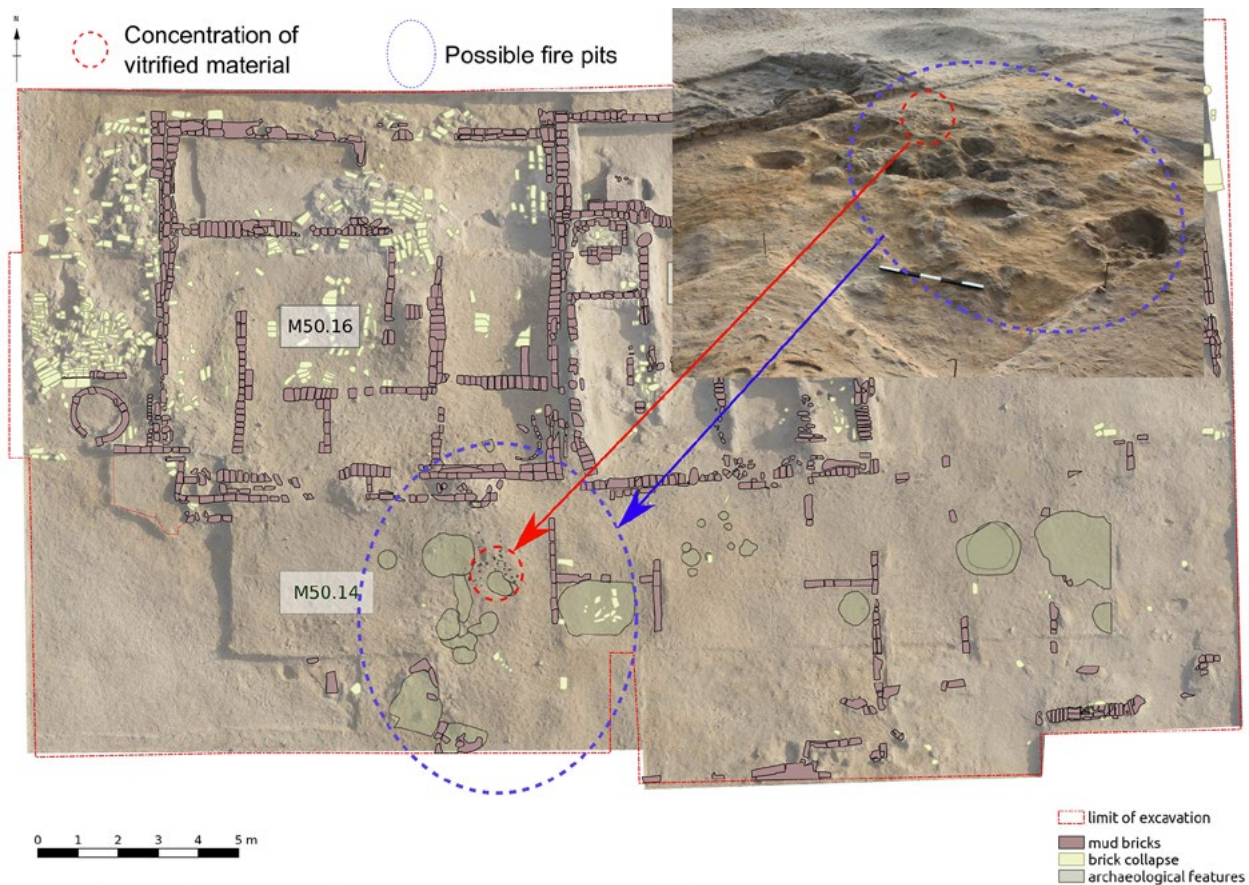


Figure 5: Amarna M50.14–16: location of possible fire pits and concentration of vitrified debris (Illustration and photo: Anna K. Hodgkinson).

we have gained some information on the original distribution and context of the objects. However, there are some problems regarding these excavations: first of all, the workforce employed was very large, and expansive areas of the city were excavated immediately and quickly. The main interest of the excavators lay in the study of the architecture and the city plan, as well as the retrieval of ‘nice’ objects and artefacts, meaning that manufacturing debris was often not documented very carefully. Object quantities were frequently given as ‘many’, ‘several’ or ‘hundreds’. In contrast to modern excavations, spoil was never sieved, leading to the loss of large quantities of objects. However, this also resulted in large quantities of, for instance, glass rods being given to European and American collections, including the British Museum, the Royal Museums of Art and History in Brussels, and the Egyptian Museum and Papyrus Collection in Berlin. Although some of the context information of finds was lost during the Second World War, the number of objects in existence in the collection (around 1500 raw or half-finished glass objects) surpasses the number recorded in the original excavation diaries, indicating that material was not always recorded, but collected as technological samples.

Alongside this superficial method of excavation, courtyards of houses often remained unexcavated, with only the main walls and architectural features recorded, and the fills of both courtyards and internal spaces were often not excavated to floor level. Thus, some ovens were excavated, but more ephemeral features, such as fire pits, frequently escaped the attention of the excavators (Figure 5).

Subsequent modern excavations at workshop sites at Amarna were much more thorough, and they often yielded evidence of vitreous materials manufacture in the form of ovens, oven debris, glass-working related objects (rods, bars, ingot chips, etc.) and faience moulds. Since excavations were carried out using a combination of grid squares and single-context recording, spoil was sieved and all objects were recorded by archaeologists and specialists, it has been possible to preserve much more information than previously. Such recently-excavated workshop sites include P46.33 and Q48.4, excavated in the 1980s, and O45.1, excavated by Paul Nicholson and Caroline Jackson in the 1990s,⁴¹ in

⁴¹ Nicholson (2007).

addition to site M50.14–16 excavated by the author in 2014 and 2017 (Figure 4).⁴² M50.14–16 lies in the vicinity of another workshop site: the small houses of Grid 12, the House of the chariotry officer Ranefer and house N50.23, excavated in the early 2000s.⁴³

All these workshop sites are located in the Main City at Amarna, stretching south from the Central City, the area containing institutional buildings, including palaces and temples. Apart from the North City and North Suburb, which lie further north and have thus been exposed and more vulnerable to looting, the Main City was the most-densely and longest populated area of the settlement, containing numerous large houses belonging to members of the elite population. These were interspersed with small groups of houses that appeared to have been grouped around the larger houses and filled the gaps between them, demonstrating an organic urban growth pattern, rather than a planned cityscape. Together with the tri-partite workshop system described above, Kemp recognised this and named this settlement pattern that of an ‘urban village’, in which a ‘small-world network’ is formed by nodes, made up by the influential inhabitants of the city. In addition, the houses act as building blocks of the urban structure. According to this model, the royal court functions as the central node, enabling the individual to communicate with the elite and the royal court.⁴⁴ This model matches the locations of these vitreous materials workshops, which are loosely interspersed throughout the Main City, and some of which are located within the houses of the elites and others in smaller domestic buildings.

For the spatial analysis, all data with an archaeological context (i.e. a house-unit number) from old and modern excavations related to glass-working (in total, 2283 glass rods, bars and strips, ingot fragments and ingot moulds, i.e. cylindrical vessels) were catalogued alongside almost 1000 faience moulds. The objects were entered into a database, categorised according to function, and located by house number. An SQL⁴⁵ query then produced the total quantity of objects related to each category for each house-unit. Numbers of finds quantified in bulk by archaeologists working during the early 20th century were estimated, based on the observations and rough estimations of numbers supplied by the early excavators.⁴⁶ The same was done for ovens and firing structures, which were taken from the literature and

archival material, although these were placed in the correct locations, obtained from site plans. Only objects and firing structures with a building reference as a find spot were integrated into the analysis.

This information was then attached to a SpatiaLite⁴⁷ database containing polygons of all buildings and areas at Amarna in Quantum GIS (QGIS). Based on the object data, centroids (points on the centres of these polygons) containing the same metadata were produced, which enabled the production of heat maps based on this information. The heat map function was also employed in order to determine which houses containing glass-working or faience manufacturing objects had access to ovens, and which houses yielding evidence of either industry had the shortest or furthest distances to the nearest oven. This was done in order to determine the presence of workshops and the control networks in place within the settlement, which affected the vitreous materials industry.

Results

From the map in Figure 6 it is obvious that the workshops excavated in modern times have produced the largest amounts of data regarding the vitreous materials industry. Although some hotspots were already visible in the analysis of the old data, some of the new workshop data actually covers the hotspots reflected in the early excavation data.⁴⁸ The first result is the identification of a cluster of industrially-active buildings in the Main City South, formed by the Grid 12/House of Ranefer/N50.23 excavations together with the new data from M50.14–16. It has been noted that all these buildings contained evidence of glass-working and faience manufacture together with metal-working and, possibly, stone-working.⁴⁹ This points towards the existence of an industrial network based on the exchange of raw materials and expertise: glass, faience and metal require approximately the same working temperatures of between 800–1000° C, while copper, the base ingredient of bronze, was commonly used as a colourant in glass and faience. The houses of Grid 12, like M50.14–16, contained small, chipped glass items, such as bars and strips, which were cold-worked into inlays and amulets.⁵⁰ This is a parallel to the manufacture of jewellery from stone. The house of Ranefer being an elite building, M50.14–16 being a medium-sized complex and the houses of Grid 12 being a cluster of small buildings, this industrial cluster

⁴² Hodgkinson (2015: 279–284).

⁴³ Kemp and Stevens (2010a; 2010b).

⁴⁴ Kemp (2012: 399–400).

⁴⁵ SQL stands for ‘Structured Query Language’. This data query language is used to extract information from structured databases.

⁴⁶ The mention of ‘several beads’ in an early excavation report, for instance, has been entered into the database with a quantity indicator of ‘five’, which has been discovered to be a larger-than-average number of objects from the early excavations (see Hodgkinson 2017: 28).

⁴⁷ SpatiaLite is an open source database format that provides structured databases in SQLite format with geospatial capabilities.

⁴⁸ This has been discussed in an earlier study, see Hodgkinson (2017: 82–86, specifically figs 2.16–2.18).

⁴⁹ The manufacture of agate jewellery has so far only been observed at M50.14–16 (Hodgkinson 2015: 282) and a site recently excavated at Alalakh (see below and Dardeniz 2016: 268).

⁵⁰ Stevens and Eccleston (2007: 151).

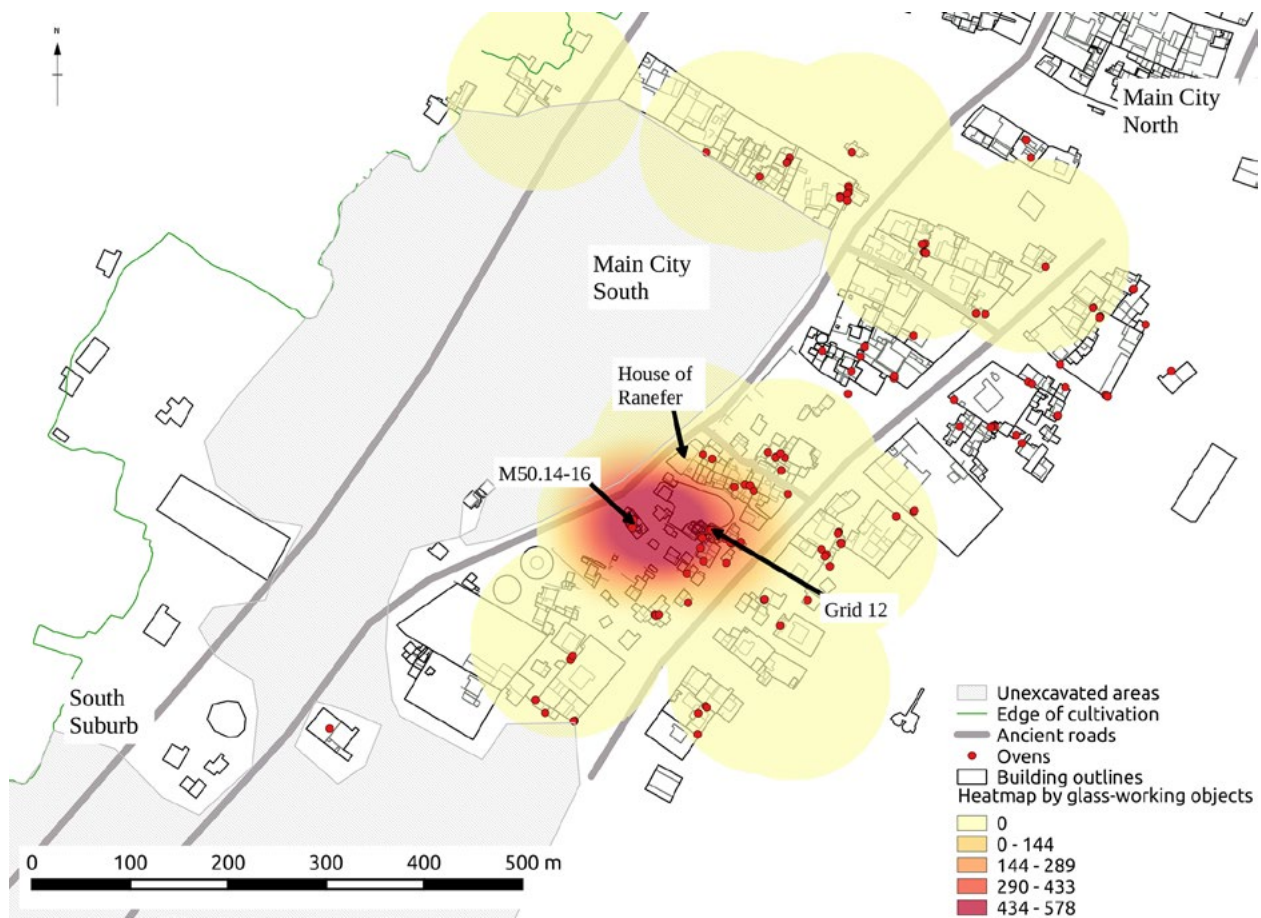


Figure 6: Map of the Main City South at Amarna showing a heat map based on the number of glass-working related objects excavated in each building (illustration: Anna K. Hodgkinson).

provides a good example of the ‘urban village’ concept outlined above.

Secondly, the maps describing the distance between houses containing glass-working or faience making evidence (Figure 7) demonstrate how we are dependent on the archaeological record, and how this can be very misleading. First of all, the issues with the recording system used by archaeologists at the beginning of the 20th century may have influenced the numbers of finds located in each house, which, of course, are also subject to secondary deposition. In addition, the large area of houses with no apparent access to ovens or with ovens located a distance away may in fact not have been as sparsely equipped with firing structures as assumed. While this area of houses has not been published, the archival records housed in the archive of the Egypt Exploration Society appear to be thorough and do mention ovens and fireplaces. They state that this area of housing is very badly preserved, and a walk-over survey conducted by the author in the autumn of 2017 confirmed this. It is entirely possible that this

area has been heavily disturbed in the past, resulting in any ephemeral firing structures possibly used for the manufacture of glass or faience objects not being discernible to the early excavators. In addition, most of these buildings did contain a hearth, i.e. a central fireplace, often disregarded, but with the potential, if fired appropriately, to reach high temperatures. Finally, it is important to point out that the quantities of glass rods, for instance, catalogued for this area, are not large, usually no more than five per house-unit, meaning that this may be the result of a secondary deposition. Simultaneously, it is, of course, possible that the houses in this area, being small and flimsy structures, were populated by a group of people working in the vitreous materials industry, who may have taken some of the raw glass, the faience moulds or other tools home with them, but who would have carried out their work in a different location, such as one of the larger workshops. Whatever the result of such a spatial analysis, it is important to bear in mind the date of the excavations carried out, the quality of the record and the nature of the site.

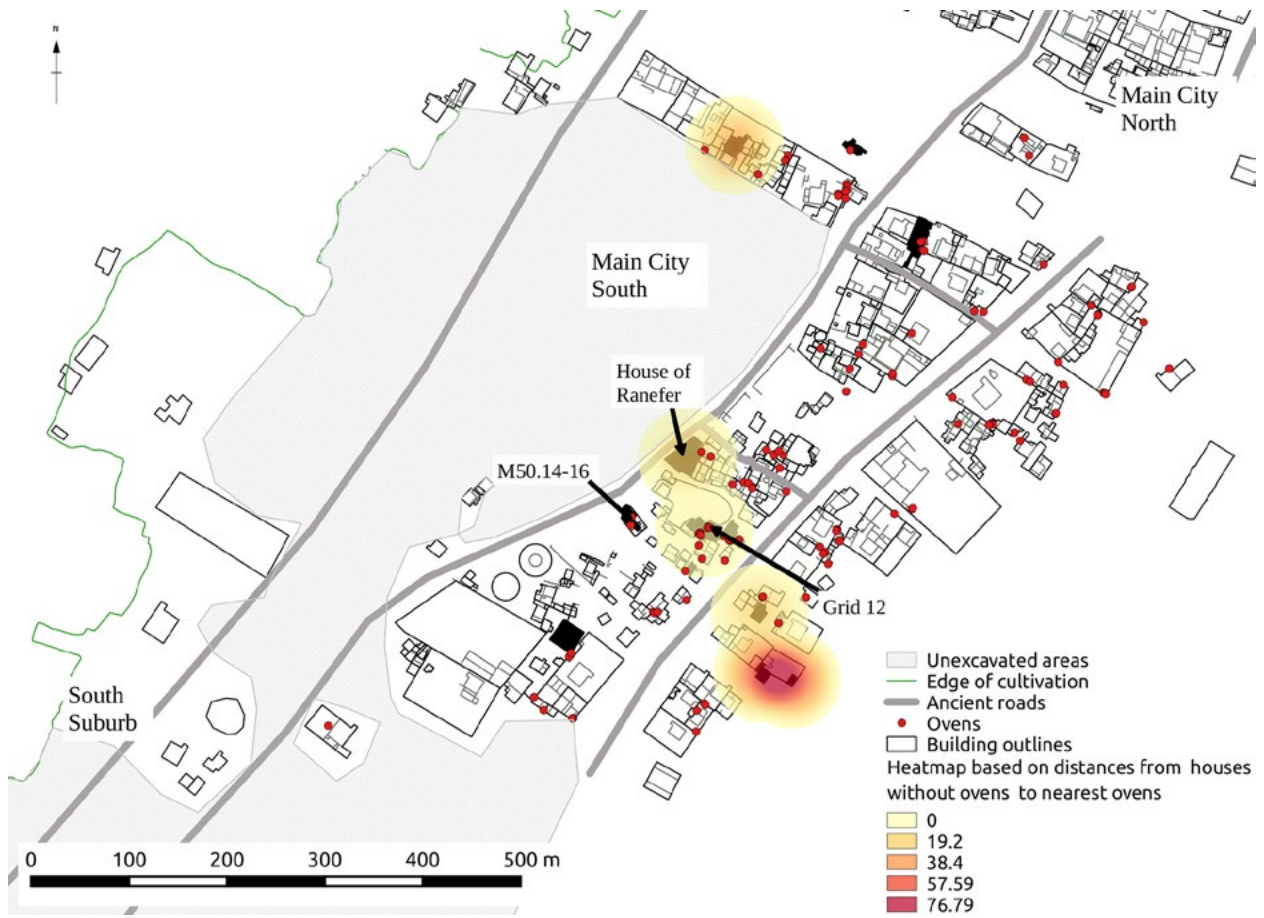


Figure 7: Map of the Main City South at Amarna showing a heat map based on the number of glass-working related objects excavated in each building (Illustration: Anna K. Hodgkinson).

Malqata

The palace site of Malqata, located in the area of modern Luxor (Figure 1), was established by the father and predecessor of Akhenaten, Amenhotep III (c. 1386–1349 BC), for the celebrations of his regal jubilees. Consequently, the site encompasses a range of palace buildings, a large temple dedicated to Amun and some semi-permanent areas of settlement.⁵¹ A summary will be given in this context since the site can be used for comparison with Amarna.

Malqata is considered to contain the first urban workshop for glass in Egypt, producing glass vessels and other objects. In addition, the site manufactured large quantities of faience objects, notably rings, given out as royal favours during the jubilee festivities. The site was first excavated by Robb de Peyster Tytus, and then on behalf of the Metropolitan Museum of Art, New York, between 1910 and 1920, under the direction of Herbert

E. Winlock and others.⁵² Some further archaeological work, i.e. the excavation of a number of trenches, took place in the 1970s on behalf of the University Museum of Pennsylvania.⁵³ As is the case with many archaeological sites, the early excavations produced large numbers of objects related to glass-working, possibly even raw glass production, as well as faience moulds, although without a secure provenience. The 1970s excavations, by contrast, recorded the findspots of excavated material, producing a discrepancy in the data and a problem with regard to carrying out a spatial analysis.

However, through the use of bibliographical and archival resources, it has been possible to determine those areas of the site that have yielded evidence of the manufacture of vitreous materials, this being the Palace and South Village Refuse Heaps, the magazines belonging to the South Palace, the Pavilion/North Village/North Palace area and the South Village. The latter is an area of settlement, albeit one that was only

⁵¹ Although much has already been published on this site, a spatial and artefactual analysis has been published by the author (Hodgkinson 2017: 206–227; forthcoming).

⁵² de Peyster Tytus (1903). See also Evelyn-White (1915); Lansing (1918; 1920); Lythgoe (1918); Winlock (1912; 1914).

⁵³ Kemp and O'Connor (1974).

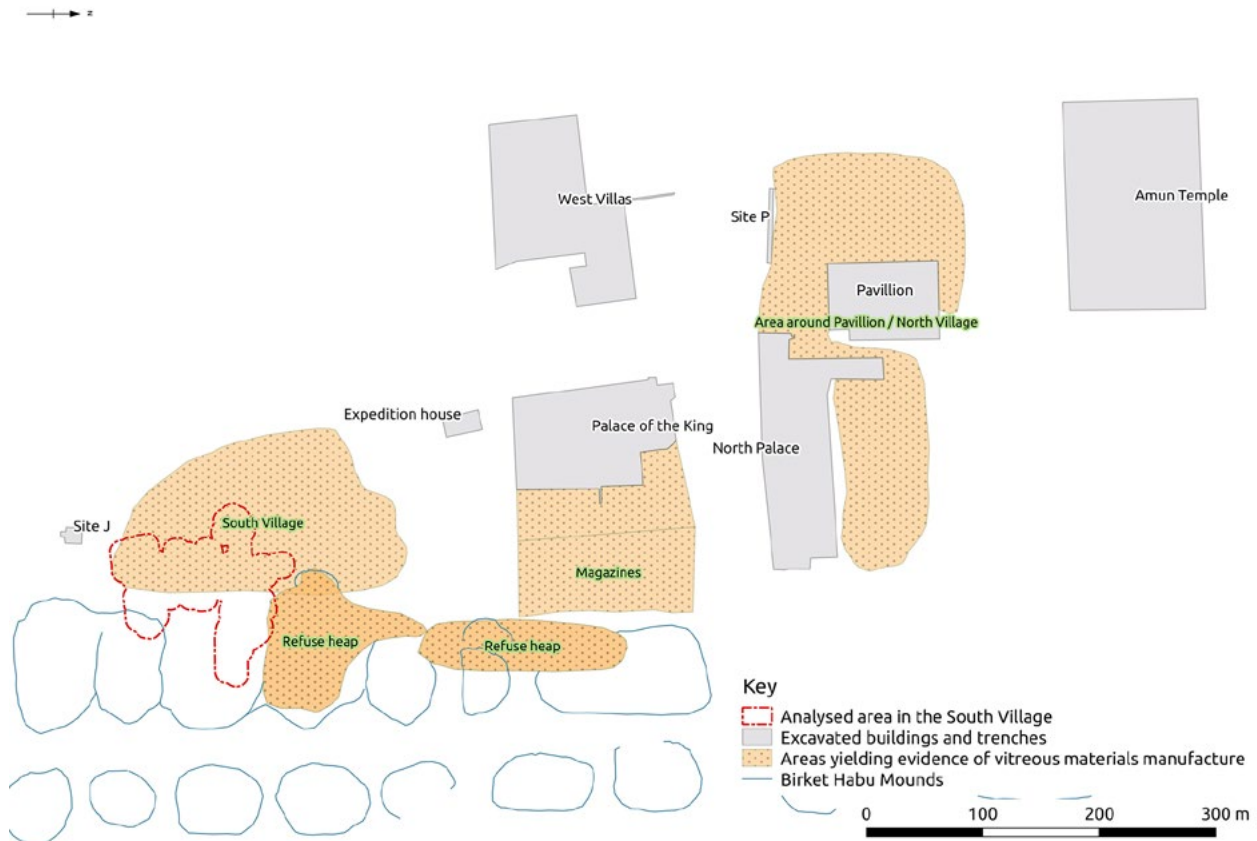


Figure 8: Map of Malqata showing the areas in which glass-working related objects were found (Digitised by Anna K. Hodgkinson, after Kemp and O'Connor 1974: 111. Reproduced with kind permission of David O'Connor).

settled temporarily before and during the festivals. This distribution pattern suggests that glass was produced and/or worked in the area of the South Village and the area near the so-called Pavilion, and that some of the raw material and tools were stored in the palace magazines, the waste being discarded on the waste heaps (Figure 8).

Together with the small size of the settled area of the site and the proximity of all buildings to the palace structures, it may be suspected that the manufacture of vitreous materials at Malqata was under royal control. This is probably due to the fact that glass was still considered a novel and specialised material during this early period of its production in Egyptian history. By contrast, the vitreous materials industry at Amarna was fully developed, having probably been moved directly to Amarna from Malqata and then administered by members of the elite in domestic and larger workshops throughout the city rather than being under the exclusive control of the palace.

Ancient Near Eastern sites

Nuzi

Introduction

The site of Nuzi, known as Yorghana Tepe, lies to the south-west of modern Kirkuk in Iraq (Figure 1). The ancient settlement was established during the time of the Akkadian Empire (c. 2334–2154 BC) and abandoned just after the Middle Assyrian Empire (1392–934 BC). The tell occupies an area of c. 200 m in breadth, in addition to some outliers to the north-east, and its central buildings include temples and palaces, surrounded by areas of housing. The stratigraphy of the site encompasses several phases, but Stratum II, dated to around 1350 to 1330 BC, is almost contemporary to the Amarna Period.⁵⁴ Despite containing a palace, temples and elite houses, the city had a predominantly provincial character.

⁵⁴ Henderson (2013: 140); Shortland (2012: 64–65); cf., Moorey (1994: 196). Stratum II had previously been dated to the 15th century BC (see Starr 1937–1939), but this has recently been revised.

The site was more or less fully excavated in the 1920s and early 1930s by Richard Starr and team, and the vitreous materials from the site are now kept in the Semitic Museum of Harvard University. The vitreous materials from the site have been subject to an analysis by Susanna Kirk, and chemical analysis have been and are being continued by Andrew Shortland and colleagues.⁵⁵

Data and methods

Thousands of objects from vitreous materials, including beads, glass vessel fragments and some small pieces of raw glass, have been found in Stratum II at Nuzi, with some additional objects from faience and frit. Similar to the early excavators working at Amarna, who located the objects within the house-unit rather than at a precise findspot, Starr's excavations recorded the objects according to the room in a house or part of the city in which they were found.⁵⁶ This makes the reconstruction of the vitreous materials industry at Nuzi somewhat difficult. In addition, chemical analysis applied to some of the beads from the site kept in the Semitic Museum, has revealed that at least some of these c. 9500 objects do not date to the LBA,⁵⁷ but are in fact modern objects from mixed and disturbed contexts.⁵⁸ Another issue is the weathering of objects, as mentioned above, this being the same case at certain other ANE sites, such as Assur and Alalakh. Due to soil conditions the objects have degraded to a great extent, making an optical distinction between faience and frit very difficult.

A preliminary spatial analysis has already been carried out by Kirk, who recognised that most beads and vessel fragments from glass came from the area of the Ishtar temple and the palace.⁵⁹ Kirk also notes that a small number of vessel fragments came from the house of Shilwi-Teshub, an elite individual, in the north-eastern area of the site, detached from the main site only by the limit of the old excavations; this house also contained some frit objects. Although a grid system was in place at Nuzi, the spatial analysis was carried out using room numbers as identifiers for finds locations. Because of this, centroids were developed, and heat maps produced in order to highlight areas with relevant finds. However, as is the case with other sites discussed in this paper, the level of disturbance in the archaeological record at Nuzi and the resulting insecurity regarding the provenance of the objects, makes caution necessary when interpreting the data.

⁵⁵ Kirk (2009); see also Shortland *et al.* (2018).

⁵⁶ Henderson (2013: 140).

⁵⁷ Kirk (2009: 68) points out a discrepancy between the entries in Starr's notebook, mentioning c. 16,000 beads, and the finds journal, which lists a total of 9434 beads.

⁵⁸ Shortland *et al.* (2018).

⁵⁹ Kirk (2009: 71–75).

Results

The results of the spatial analysis as shown on the distribution map (Figure 9), emphasise those already described by Kirk: glass objects can be found across the site as a whole, while concentrations are visible in institutional buildings, including the eastern part of the palace and the temple area. In addition, some of the more substantial houses in the north-western area of the site, as well as the house of Shilwi-Teshub, contained glass objects.

The locations of the ovens and other firing structures excavated at Nuzi have been added to the map. It is evident that the rooms containing glass objects were usually not the same ones as those containing ovens. However, only three objects related to glass-working were found and noted by Starr and Kirk.⁶⁰ These lumps of raw glass were all found in the western palace area, but without any real concentration visible and no real discernible proximity to any firing structures.

Assur

Introduction

The ancient settlement of Assur had been established on the western bank of the river Tigris by the time of the Early Dynastic period (c. 2900–2350 BC), and its status evolved to that of the capital of the Middle Assyrian Empire by the 14th century BC (Figure 1). The city, which was walled, measured c. 1.2 km², including a range of palaces and temples erected across the centuries in various building phases. Not much is known of the settlement during the time of the Middle Assyrian Empire, since it was not extensively excavated, and most of the domestic buildings excavated in the northern (institutional) part of the city date to later periods.

Data and methods

Assur was excavated between 1903 and 1914 on behalf of the Deutsche Orient-Gesellschaft under the direction of Walter Andrae.⁶¹ A 20 x 20 m excavation grid was used in order to locate finds and buildings, and the same grid was used by the author for the spatial analysis. Although Andrae and his team excavated the site according to a stratigraphic sequence, assigning dates and phases to the mud brick architecture they excavated, the finds recording was not as thorough: objects were entered into a finds journal, giving a brief description of the object, sometimes outlining the finds context and the grid square number, but little other information. Sometimes the layer from which the

⁶⁰ Kirk (2009: 71).

⁶¹ Pedde (2008: 743).



Figure 9: Map of Nuzi showing the rooms containing glass objects and objects related to glass-working (Digitised by Anna K. Hodgkinson, after Starr 1937: plan 13).

object came was referred to, although not in every case, and this information did not always reflect the dating of the site.

The objects were divided between the Istanbul Archaeological Museums and the Vorderasiatisches

Museum, Berlin, although the portion of objects for Berlin was seized en route by the Portuguese army due to the outbreak of the First World War, and went on display in Porto until they were sent to Berlin in 1926. Therefore, much information on the objects, including excavation numbers, was lost during this time and the

subsequent damage to the Berlin museums during the Second World War, leading to further confusion regarding the dating of the objects and their finds locations. A new project aiming to recontextualise the objects from Assur in the Berlin collection, led by Johannes Renger, in order to complete and to publish the database, was established in 1997.⁶² This project is ongoing and it has resulted in tens of thousands of items being identified, restored and published.⁶³

Several hundred objects from glass, frit and other vitreous materials are contained in the Berlin Assur collection, and this assemblage has never been studied thoroughly.⁶⁴ The Berlin collection contains numerous beads and some vessel fragments, in addition to a large number of raw glass and half-finished products. Some fragments of glass ingots, together with one very large piece of a red, opaque glass ingot, make up part of the assemblage. Red glass, together with white, black, turquoise and yellow, occurs in a number of mosaic glass tiles and fragments of the same piece, which were found in the main palace area, leading to the possible conclusion that these tiles were manufactured from raw material at Assur. The presence of this ingot may possibly also point towards the raw glass having been made at the site. Due to the fact that the assemblage has not been studied in detail, and no chemical analysis has been carried out on the raw and finished glass objects, it is not possible to say whether these objects belong to the same period.

One further major problem with the identification of vitreous materials at Assur is that many objects that were probably made of glass have been published as 'frit' due to their iridescent weathered and corroded outer layer, which gives glass a white and crumbly appearance. For the above reasons, it has only been possible to place those objects with a finds location in the find journal on the map of Assur. Bead concentrations, such as those deposited in the foundation pits of temples, have also been incorporated into the database where possible. The spatial analysis was carried out using the grid with its equally sized cells as an analytical aid, therefore not requiring any heat maps for visualisation.

Results

The map (Figure 10) shows the distribution of all finished, half-finished and raw glass objects that can be located on the plan. Not all glass objects can be separated into pure glass-working and finished products. This is particularly the case with the pieces of mosaic glass mentioned above: while some of these look

like fragments of finished objects, others show signs of production errors, meaning that this material is in fact half-finished products.⁶⁵ This concentration of material was found in the south-western part of the settlement in a test trench in square eB9I. Although a Middle Assyrian date has been assigned to these objects, it is not certain what kind of context they were found in. It is possible that these objects were recovered from an urban workshop, but this is not certain, especially since no associated firing structures were found here.

The map (Figure 10) shows a concentration of glass in the area of the northern-central Anu-Adad Temple. This red grid square is due to an intentional deposition of glass beads in a foundation pit.⁶⁶ Further concentrations can be found in the areas of the Ishtar and Assur Temples, to the north-west and north-east of the site.⁶⁷

As mentioned above, the issue with the vitreous materials from Assur lies in the lack of documentation and the incompletely excavated plan of the city, resulting in a potentially slightly skewed distribution pattern across the site. Although a concentration of glass objects can be identified in the areas of the temples, and also in the region of the palace, it is not certain whether this pattern would persist if the rest of the site were to be excavated as well. In conclusion, it is only possible to assume a palatial or temple-controlled vitreous materials industry at Assur, unless the occurrence of the polychrome fragments in the southern part of the site point towards a domestic workshop.

Other Ancient Near Eastern sites

In order to provide some context to the sites of Assur and Nuzi, the results from separate studies (published elsewhere) on Tell Brak⁶⁸ and Ugarit⁶⁹ in Mesopotamia will be outlined here:

Tell Brak is situated in northern Syria (Figure 1). Although it was first settled in the fourth millennium BC, the so-called 'Mitanni Palace' to the north of the site, dated to around 1500 BC, is the only structure dating to the LBA containing material of a vitreous nature. The palace complex, which encompasses one main palace and a possible smaller temple, was first excavated as 'Area HH' by Max Mallowan in the late 1930s.⁷⁰ It was subsequently re-excavated by Joan and David Oates from the 1970s until 2011, during which a

⁶² Renger (2003).

⁶³ Pedde (2008: 744–745).

⁶⁴ Only a summary on the objects from the settlement has been published so far by Henderson (2013: 141–142). The vitreous objects from the burials were published by Haller (1954).

⁶⁵ This is find number ASS 7514a in the Vorderasiatisches Museum, Berlin.

⁶⁶ Andrae (1909: pl. 2).

⁶⁷ See Andrae (1935: 24–25, 33, 42, 55–57; 1938: 121–123) for beads found in the Ishtar Temple.

⁶⁸ Oates *et al.* (1997).

⁶⁹ See, for instance, Yon (2006).

⁷⁰ Mallowan (1947: 50).



Figure 10: Map of Assur showing the grid squares containing glass objects and objects related to glass-working (Digitised by Anna K. Hodgkinson, after Andrae 1938: Appendix. Courtesy of the Deutsche Orient-Gesellschaft).

set of domestic structures south of the palace was also excavated.⁷¹ The later excavations have resulted in the re-contextualisation and publication of large amounts of material from the old excavations. Since all objects related to glass-working were found within a set of rooms interpreted as a workshop due to the presence of several oven and kiln structures, a strong royal monopoly on the vitreous materials industries found at Tell Brak can be assumed. The finds corpus includes glass ingots with a chemical fingerprint similar to the ANE glass of the period.⁷²

The port city of Ugarit, also known as Ras Shamra, is situated in the north-west of Syria (Figure 1). The city

was established around 6000 BC, with a continuous occupation until the LBA, after which it was destroyed. The mound encompassed a large palace structure and a number of ceremonial buildings, in addition to large areas of settlement and cemeteries, and a harbour at Minet el-Beida, c. 1.3 km north-west of Ugarit.

The site was first excavated by Claude F.-A. Schaeffer between 1928 and 1948. Later work was carried out by a team under the direction of Henri de Contenson, and then by Marguerite Yon and Yves Calvet from 1972.⁷³ Almost 20,000 objects from vitreous materials were excavated at the main site, while 2% of these came from Minet el-Beida.⁷⁴ Because of this small number of

⁷¹ Oates *et al.* (1997).

⁷² Shortland *et al.* (2007: 786–789).

⁷³ Yon (2006: 8).

⁷⁴ Henderson (2013: 138).

finds, the analysis does not include the port, although it is important to emphasise that the site had close economic ties with Egypt in the LBA, acting as a trade centre, while also being a vassal state to the Hittites during the LBA. Indeed, chemical analysis has identified some of the material as having an Egyptian or Aegean (Mycenaean) chemical fingerprint.⁷⁵ During the reigns of the later Thutmose III and Amenhotep III, Ugarit even stood under Egyptian rule.⁷⁶

The most significant stratigraphic level in the palace and domestic areas of Ugarit is Level I, which has yielded c. 18,000 objects from faience and c. 1000 glass objects (mainly beads), including raw glass, and some objects from Egyptian blue. The beads were most commonly found in caches in domestic houses, together with objects from other materials.⁷⁷ In addition to beads, the corpus of glass objects includes polychrome vessel fragments, pendants, amulets, gaming pieces and a weight in the shape of a bovine head from the palace precinct.⁷⁸

The material has been partly recorded and published by Valérie Matoïan, who has stated that neither the number, nor the exact findspots of all the objects have been possible to establish due to both the poor state of preservation of the material and the poor quality of the documentation of the early fieldwork.⁷⁹ However, the glass-working related objects from Ugarit were usually found in the palace district rather than in the domestic areas, although no firing structures were found in the palace.⁸⁰ Schaeffer mentions a jewellery workshop for the processing of glass and stone excavated in the south-western part of the site, although no further records exist for this, and not many firing structures have been excavated at Ugarit in general.⁸¹

Overall results and conclusions

In summary, the ANE sites of Assur, Nuzi, Ugarit and Tell Brak all yielded evidence of vitreous materials manufacture in the area of institutional buildings, such as palace districts or temples, suggesting a strict central control of this industry, closer to the evidence from Malqata than that from Amarna. However, the problems highlighted throughout the text include those of old excavation records not being very reliable and information also being lost during the wars. In addition, the old excavations carried out in the ANE have frequently focussed on the investigation of large standing structures, such as temples and palaces,

leading to the discovery of vitreous materials production places mostly in these locations. Recently excavated areas in the non-palatial south-eastern area of Alalakh (Tell Atchana) in southern Turkey (Figure 1), contain possible evidence of domestic production of vitreous materials, including raw glass.⁸² According to Gonca Dardeniz, this multi-craft workshop, which included a specialised kiln for glass, has some similarities to the layout and functionality of workshop site O45.1 at Amarna.⁸³ In addition, similar to other domestic workshop sites excavated at Amarna, including, but not limited to, M50.14–16⁸⁴ and Grid 12,⁸⁵ the workshop at Alalakh was multifunctional in nature, processing not only glass, but also faience, metal and stone.⁸⁶

The reasons for the discrepancy in royal control over workshop types may lie in the different state systems represented: the ANE cities and settlements were often either self-governed or dependent vassals of more powerful empires and kingdoms of the period, necessitating a higher level of control over raw materials and specialised industries, which explains their proximity to palaces and temples.⁸⁷ The production of high-status materials such as glass in palatial centres is also relevant in the context of the international exchange of gifts across the Mediterranean and beyond, especially since the participation in such a network would have necessitated the royal court and the local administration having direct access to these goods.⁸⁸ Additionally, Carla Sinopoli has argued that 'We should expect therefore the simultaneous existence of multiple levels of economic organization and control, varying with products, location, cultural meanings, and environmental conditions'.⁸⁹ This implies a more flexible, product-based approach to control,⁹⁰ which may have been the case at these sites.

In the case of Malqata, the glass-industries had not been established in Egypt for a long time and only appeared to have functioned before or during festivities. However, some domestic industrial activities, located not too far from the palaces, can also be observed. The urban industrial network, as defined by Kemp and also observed by the author in the case of the vitreous industries at Amarna, can be a lead to a similar organisational structure as found at the ANE sites. With both Amarna and Malqata being royal settlements, containing palaces, the level of elite

⁷⁵ Henderson (2013: 138); Matoïan (2003).

⁷⁶ Yon (2006: 18–21).

⁷⁷ Matoïan (2000: 30; 2003b: 336).

⁷⁸ Matoïan (2000: 32).

⁷⁹ Matoïan (2000: 26–28); cf. Henderson (2013: 138).

⁸⁰ Matoïan (2000: 27, 40).

⁸¹ Matoïan (2000: 27).

⁸² Dardeniz (2017).

⁸³ Dardeniz (2017).

⁸⁴ See Hodgkinson (2015; 2019).

⁸⁵ Kemp and Stevens (2010a; 2010b).

⁸⁶ See Dardeniz (2016: 268). See also Dardeniz (2017; 2018: 97–99) for detailed descriptions of the workshop excavated at Alalakh; Henderson (2013: 139, 142–143); Hodgkinson (2020); Nicholson (2007).

⁸⁷ See Yoffee (2005: 47–48).

⁸⁸ See Sherratt and Sherratt (1991: 371).

⁸⁹ Sinopoli (1994: 165).

⁹⁰ Sinopoli (1994: 164–166).

control in place may have connected the industrial activities in domestic units to the palace, thus placing them under indirect royal control. Consequently, these craftspeople would be ‘attached’ to the royal household and the elite as defined by Costin (see above). The royal household and the elite would also be receiving the primary output from these workshops, describing the main demand for the produced goods.⁹¹ However, based on spatial analysis alone, no further assumptions can be made regarding the scale and intensity of these workshops, i.e. when and by whom they were being operated. This would depend on other data, such as texts, which do not exist for LBA vitreous materials manufacture in Egypt.

Industrial activities, such as the manufacture of vitreous materials, took place not only in attached (and, sometimes, highly specialised) workshops, but also across entire cities, as can be observed at household-level at Amarna. The link between the manufacture of foodstuffs and high-temperature industries can be established, based on a number of aspects, including the use of fuel and firing structures. Wood, which was scarce in ancient Egypt, can be understood as a valuable commodity, owing to its inaccessibility.⁹² The most commonly encountered species is the Nile acacia (*Acacia nilotica*), with charred remains of this wood being found in both industrial contexts as well as those believed to be of a primarily domestic nature (although containing some evidence of industrial activities), such as the Grid 12 houses at Amarna.⁹³ These observations indicate that the same wood was used for various types of firing activities, and that fuel, which had been used for pyrotechnical processes, could be reused for cooking activities. As outlined above, industrial activities, such as faience production and bread making could sometimes take place in the same structures.⁹⁴ Therefore, a domestic site containing a firing structure, and yielding even a small amount of objects related to vitreous materials manufacture, may be understood as a domestic workshop site, possibly carrying out craft activities and answering to the surrounding houses of the elite.

Nevertheless, there is a danger in making such general assumptions: In this context it is important to highlight that, although it has been possible to carry out a series of spatial analyses, the results depend greatly on both the quality of the input data and the analytical strategy. From the material presented above, the issues with data

obtained through excavations that took place around or just after the turn of the 20th century are obvious: incomplete or missing information on finds locations, secondary deposition patterns, stratigraphy as well as object quantities, together with loss of data as a result of the wars, have made the production of a complete and meaningful catalogue and spatial GIS model difficult. Furthermore, it is important to emphasise that factors such as personal bias and object selection, as well as the methods used for spatial analysis (such as rasterisation factors) can also cause varied results. A connected issue is that of missing firing structures and other evidence of industrial activities other than the raw materials in the settlements. As demonstrated in the case of Amarna, these features may not have been recognised in the archaeological record, and therefore not entered into the excavation diaries. Therefore, caution and awareness are necessary when carrying out a spatial analysis based on archaeological data.

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⁹¹ Costin (1991: 11). See also the section on ‘Theoretical approaches to workshop detection at urban sites’ above, where this has been described.

⁹² Cf. Gerisch (2010: 406–408).

⁹³ See Gerisch (2007: 169–175; 2010: 402) regarding the use of acacia wood in the kilns of workshop O45.1 and at the small domestic houses of Grid 12 at Amarna.

⁹⁴ See Eccleston (2008: 33–35).

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8. Some Results of Experimental ‘Roman’ Glass Furnace Projects and Their Relevance for Archaeology

Frank Wiesenber

Abstract

Since neither archaeological excavations nor written sources provide detailed information on the exact design and functionality of Roman glass furnaces, experimental archaeology involving reconstructed glass furnaces appears to be the only means of gaining information about the probable complete design and functionality of these furnaces. Apart from testing and evaluating general functionality, the experiments provide data concerning the layout of Roman glass workshops for glass making and glass working (processing), fuel consumption, efficiency and working waste, of which the first two will be dealt with in this paper. The projects also provide the infrastructure for the evaluation of theories concerning Roman glass manufacturing techniques. In this way, experimental archaeology makes an invaluable contribution to the analysis of archaeological glass production sites.

Keywords: Roman glass; furnace; workshop; glass making; glass working; reconstruction; experimental archaeology

Kurzfassung

Da weder archäologische Ausgrabungen, noch Schriftquellen verwertbare Auskünfte über den genauen Aufbau und die Funktionsweise von römischen Glasöfen bieten, scheint die Experimentelle Archäologie die einzige mögliche Methode zu sein, Informationen über den gesamten Ofenaufbau und seine Funktion zu erlangen. Über einen reinen Funktionstest hinaus liefern diese Experimente Informationen über den Aufbau römischer Glashütten zur Glasherstellung und Glasverarbeitung, Brennstoffbedarf und Effektivität der Öfen sowie Produktionsabfälle. Die Projekte bieten ferner die Infrastruktur zur Überprüfung von Theorien zur Glasverarbeitung, insbesondere der Herstellung von Glasgefäßen. So liefert die Experimentelle Archäologie einen unschätzbaren Beitrag zur Analyse archäologischer Stätten der Glasverarbeitung.

Keywords: Römisches Glas; Glasöfen; Glashütte; Glasverarbeitung; Glasherstellung; Rekonstruktion; Experimentelle Archäologie

Introduction

Archaeological excavations from more than seven decades can provide information about the basic layout of Roman furnaces for the making of glass vessels, but, even today, not a single glass furnace has been preserved including the upper structures to the total extent. Contemporary written sources do not mention the subject at all, and only the depiction of a furnace and glassblower, on three identical Roman oil lamps (Figure 1) dating to the second half of the first century AD,¹ provides any information about the upper structures of Roman glass furnaces. Experimental archaeology involving reconstructed glass furnaces therefore appears to be the only means for gaining information about the likely complete design of Roman glass furnaces. Furthermore, such experiments can deliver information concerning their working temperatures, fuel consumption and efficiency as well as their suitability for glass making and glass working, and also provide an insight into the working conditions of a Roman hot glass workshop.

By evaluating the excavations of Roman hot glass workshops, different types of furnaces and ovens for glass processing can be identified. Firstly, we have large, rectangular daub structures, so-called tank furnaces, suitable for melting huge amounts of freshly mixed batch to workable glass, which leads to the interpretation of these workshops as being primary glass workshops where the raw material was melted. Nevertheless, these furnaces would also be ideal for manufacturing larger glass vessels or for the manufacture of window panes,² since large amounts of glass are required for these processes. The other type of easily distinguishable glass furnaces features a round or keyhole-shaped ground plan and uses one or a number of ceramic pots serving as melting crucibles for the glass, which are therefore known as pot furnaces. They are connected with glass processing, for example blowing glass vessels, and enable the identification of secondary glass workshops. The third type of daub structures for glass processing may be hard to

¹ Abramic (1959); Baldoni (1987); Lazar (2006).

² The amount of glass needed for manufacturing a single vessel or window pane is directly depending on the size of the product and therefore exact quantities of glass are not included here.



Figure 1: David Hill's reconstruction of a first century AD oil lamp depicting a Roman glass workshop (Photo: Manuela Arz).

identify but is essential in the manufacturing process: Hot glass needs to be cooled down slowly in order to avoid cracking due to the inner stresses of the glass, the process being referred to as the tempering or the annealing process of glass objects. Cooling ovens, often called *lehr* or *annealer*, which operate at a significantly lower temperature than the glass melting and glass working furnaces, are used for this purpose.

In order to compensate for the outlined lack of information about the Roman glass workshops, three related project series at different European locations were (and still are) carried out, beginning with Mark Taylor and David Hill running the 'Roman Furnace Project' close to their modern glass studio in Quarley (Hampshire, England) in 2005 and 2006. These first two projects, employing three different furnaces for glass working typical for the North-Western provinces of the Roman Empire and two annealing ovens for tempering the glass vessels, were well documented and published.³ For further documentation on taphonomy, the latest daub furnace structures have been left exposed to

weather conditions since 2007 (Figure 2). Since 2008, the Provinciaal Archaeologisch Museum Velzeke (East Flanders, Belgium) has hosted an annual glass furnace project called 'Velzeke Furnace Project', inviting several glassmakers from different countries to work at the one glass furnace⁴ and two annealing ovens.

In 2013, the Archaeological Park Roman Villa Borg (Saarland, Germany) began their annual 'Borg Furnace Project' to provide an infrastructure for Hellenistic and Roman glass research. Until October 2018, four different furnaces for glass working, four annealing ovens, and, recently, nine different small furnaces for bead making were built in two separate workshops. Ten projects lasting about one week each for researching and teaching a wide range of glass making techniques were held until November 2019.⁵ Furthermore, the smallest glass furnace at Borg and several bead furnaces were used for numerous days of demonstration.

'Hardware-results': glass workshops and glass furnaces

Although basing the reconstruction of the upper structures of the glass furnaces just on the excavated layout combined with the depiction of the glass workshop on the oil lamps can involve significant difficulties, several interrelationships remain essential in the design of a functional glass furnace. Even Roman glass furnaces must follow basic thermodynamic and other physical principles. Therefore, reconstructions by 'form follows function', based on the Roman furnace outlines, are very likely to deliver realistic results.

Following the most basic furnace layout for glass working, nine different small shaft furnaces for bead making were formed from a daub mixture made from local loam and straw or freshly cut grass at the Archaeological Park Roman Villa Borg (Figure 3) until summer 2019. Since these furnaces are dedicated to heating glass rods which are wound up on a steel wire (mandrel), they do not need to include a melting crucible. Therefore, they may be very compact, measuring just 50 cm by 30 cm at the base with a height of around 50 cm. Starting with the first idea of a simple cut-open, tapering cylinder – which worked not too well⁶ – the designs were altered and improved from furnace to furnace.⁷ At the current stage of research in 2019, a tapered conical shaft with an added collar in front serving as a stoking channel, calming down the

³ Paynter (2008); Taylor and Hill (2008).

⁴ Twelve Velzeke Furnace Projects 2008–2019; two projects in 2009, but none in 2012 (van den Dries 2009; see Wiesenberg 2008–2011).

⁵ Seven annual 'Borg Furnace Projects' (BFP2013–BFP2019), two projects connected with glass conferences in 2015 and 2016, and the test-run of the latest tank furnace in 2018 (Birkenhagen and Wiesenberg 2016; Wiesenberg 2014; 2016a).

⁶ Wiesenberg (2016b: 115–117).

⁷ Wiesenberg (2016b; 2018a).



Figure 2: Weathering of the two glass furnaces used at Quarley in 2006, as recorded in 2015. The annealing oven is already deteriorated (Photo: Frank Wiesenbergl).



Figure 3: Students working at the small bead furnace PO-Borg-5 'Bert' (Photo: Manuela Arzl).

air, causing a long and steady flame at the top working hole, works best for a constant heat supply of more than 900° C. A shelf above the collar may collect and anneal the beads.⁸ Rolling the beads from glass rods onto a

⁸ As tested with PO-Borg-6 and PO-Borg-8.

mandrel directly inside the flame which extrudes from the top hole of the bead furnace works well.

Comparing the results from excavations of Roman glass workshops in the North-Western provinces of the Roman Empire, the glass furnaces with round or



Figure 4: Workshop setup around the glass furnace GO-Borg-1 'Erna': two working areas with marvers, toolrests and stools; annealing oven KO-Borg-1 and stoking area in the back; wood storage in the back room (Photo: Jochen Wiesenberg).

keyhole shaped outlines seem to dominate. Ceramic pots left in situ and containing traces of glass, such as at the excavation Trier Hopfengarten,⁹ indicate that these were pot furnaces, which held one or several pots of molten glass. Until now, several pot furnaces were reconstructed in Quarley, Velzeke and Borg alike,¹⁰ differing slightly in details and dimensions. All of them work well for making glass vessels from glass gathered out of the pot(s) at temperatures ranging from 1000 to 1100° C, if a marver¹¹ and toolrests (Figure 4) are added in front of the working hole(s). Smaller pot furnaces, such as the one built in Quarley in 2006 and the even smaller furnaces GO-Borg-2¹² (Figure 5) and GO-Borg-4 at Borg, may contain a single pot centrally held by some daub supports protruding from the furnace walls, whereas larger pot furnaces, such as the big one at Quarley, the one at Velzeke or GO-Borg-1 at Borg,¹³ offer

room for up to five large pots, each containing about 4.5 litres of glass,¹⁴ with one or two placed in front of each gathering/working hole (see Table 1). It has been found that in each case, the pots have to be placed above the fire and directly into a long, hot flame, and that the successful furnace construction relies on a good natural draft inside the furnace. Ideas, such as the pot being placed on some stones or directly on the furnace floor¹⁵ were thereby disproved.

Large rectangular furnaces have also been recorded in the North-Western provinces of the Roman Empire. One of them, furnace 1482 at Hambach 500,¹⁶ provided the layout for the very first reconstruction of a 'horizontal' tank furnace, GO-Borg-3, measuring 1.8 m by 3 m, which was successfully tested in October 2018 and used for one week during the 'Borg Furnace Project

⁹ Pfahl (2000: 53–54); Wiesenberg (2014: 18–20).

¹⁰ van den Dries (2009); Taylor and Hill (2008); Wiesenberg (2014).

¹¹ A marver is a flat slab used to roll and shape molten glass.

¹² In order to clearly identify the various furnaces at the Archaeological Park Roman Villa Borg, the names indicate their function: GO = Glasofen (glass melting/working furnace), KO = Kühllofen (annealing/cooling oven), PO = Perlenlofen (bead furnace); see Table 1 for a complete list.

¹³ Wiesenberg (2014: 33–37, 45–55).

¹⁴ Since the daily glass vessel production seems to be limited by the capacity of the annealing oven, one 4.5 litre pot proved to provide more than sufficient glass supply for one glassmaker at the glass furnace projects, but the pot might require refilling at the end of the day. Making more than one pot accessible from each working hole helps to assure a well-cleared and good-quality glass quality with just a small amount of bubbles, since the glassmaker may switch from one pot to the other after each day of working.

¹⁵ Fischer (2009: 83, Abb. 88); Pfahl (2000: 54, Abb. 12).

¹⁶ Heege (1997: Table 5).



Figure 5: Public demonstration using the small glass furnace GO-Borg-2 'Sofia' (Photo: Manuela Arz).

Table 1: Borg furnaces, annealing ovens and bead furnaces.

Furnace name	Function	Location	Building	Time of usage	Outer dimension (l x w x h)	Firepit shape	Capacity	Working temp.	Comments
Furnaces for glass melting + glass working (GO = Glasofen)									
GO-Borg-1	glass melting + glass working	workshop 1	2013	1 week per year since 2013	165 cm x 120 cm x 95 cm	keyhole-shaped	3x 4.5 l pots + 3 0.2 l pots	1000–1100° C	reconstruction followed Trier Hopfengarten excavation
GO-Borg-2	glass melting+ glass working	workshop 1	2016	>50 single working days	80 cm x 60 cm x 80 cm	keyhole-shaped	1x 0.3–0.8 l shallow pot	1000–1150° C	annealing chamber attached; reconstruction inspired by Roman oil lamp; can be transported from workshop 1 to workshop 2
GO-Borg-3	glass melting+ glass working + batch melting?	workshop 2	2018	1 week per year since 2018	300 cm x 175 cm x 135 cm	D-shaped	1 m ² tank (or 4x 14.5 l pots)	1000–1050° C	reconstruction inspired by Hambach 500 excavation
GO-Borg-4	glass melting+ glass working	workshop 2	2018	c. 10 single working days since 2018	120 cm x 75 cm x 105 cm	keyhole-shaped	1x 0.5–0.8 l shallow pot	1000–1100° C	annealing chamber on top; reconstruction inspired by Roman oil lamp
Annealing ovens (KO = Kühlöfen)									
KO-Borg-1	annealing oven for GO-Borg-1, 2*	workshop 1	2013	1 week per year since 2013	105 cm x 65 cm x 85 cm	rectangular		400–500° C	reconstruction followed Trier Hopfengarten excavation

Furnace name	Function	Location	Building	Time of usage	Outer dimension (l x w x h)	Firepit shape	Capacity	Working temp.	Comments
KO-Borg-2	annealing oven for GO-Borg-1	workshop 1	2014	1 week per year since 2014	140 cm x 90 cm x 105 cm	rectangular		400–500° C	same construction, but larger than KO-Borg-1
KO-Borg-3	annealing oven for GO-Borg-2*, 3, 4	workshop 2	2014	1 week per year since 2018	120 cm x 75 cm x 105 cm	rectangular		400–500° C	same construction, but larger access to annealing chamber than KO-Borg-2
KO-Borg-4	annealing oven for GO-Borg-2*, 3, 4	workshop 2	2014	1 week per year since 2018	105 cm x 55 cm x 95 cm	rectangular		400–500° C	same construction, but larger access to annealing chamber than KO-Borg-1
Bead furnaces (PO = Perlenofen)									
PO-Borg-1	bead furnace	workshop 1	2014	2014–2015, c. 15 working days	35–55 cm x 35 cm x 50–55 cm	keyhole-shaped	for use with glass rods	900–950° C	layout was changed/improved during working days; demolished to build PO-Borg-2
PO-Borg-2	bead furnace	workshop 1	2015	2015–2016, c. 20 working days	70 cm x 45 cm x 50 cm	keyhole-shaped	for use with glass rods	900–1000° C	demolished to build PO-Borg-3
PO-Borg-3	bead furnace	workshop 1	2016	2016–2018, c. 30 working days	80 cm x 45 cm x 50 cm	P-shaped	for use with glass rods	900–1030° C	very effective; demolished to build PO-Borg-8
PO-Borg-4	bead furnace	outside	2016	2016, c. 5 working days	80 cm x 45 cm x 50 cm	P-shaped	for use with glass rods	900–1030° C	copy of PO-Borg-3; long-term study object of weathering
PO-Borg-5	bead furnace	workshop 2	2017	c. 20 working days since 2017	55 cm x 35 cm x 50 cm	keyhole-shaped	for use with glass rods	900–1030° C	small, but effective structure
PO-Borg-6	bead furnace	workshop 2	2018	2 working days 2018	45 cm x 30 cm x 55 cm	keyhole-shaped	for use with glass rods	900–950° C	transportable bead furnace; with collar for annealing of beads
PO-Borg-7	bead furnace	workshop 2	2018	c. 10 working days since 2018	40 cm x 30 cm x 50 cm	keyhole-shaped	for use with glass rods	900–1000° C	transportable bead furnace; small, but effective
PO-Borg-8	bead furnace	workshop 1	2018	2018–2019, c. 20 working days	60 cm x 45 cm x 45 cm	keyhole-shaped	for use with glass rods	900–950° C	lowest structure; with collar for annealing of beads; demolished to build PO-Borg-9
PO-Borg-9	bead furnace	workshop 1	2019	c. 10 working days since 2019	60 cm x 40 cm x 55 cm	keyhole-shaped	for use with glass rods	900–1000° C	very effective; tallest structure

* GO-Borg-1 may be placed either in workshop 1 or workshop 2.



Figure 6: Working directly at the large tank furnace GO-Borg-3 'Myrte' (Photo: Manuela Arz).

2019'. The initial interpretation by Andreas Heege of this structure serving as a combination of a pot furnace with a short stoking channel and an adjacent annealing oven with only a daub wall dividing both parts¹⁷ had to be rejected by the analysis of the documented soil colours of the Hambach 500 excavation. The red colour of furnace 1482 indicated a highly-fired area in the flat area also adjacent to the D-shaped entrenched fire chamber. Therefore, this furnace was reconstructed as a tank furnace with the tank and the wall dividing it from the D-shaped fire chamber formed from daub, settled onto several layers of sandstone and fragments of Roman roof tiles laminated with daub. To cut down on the expenses, the first test firing in October 2018 was undertaken employing only two 4.5 litre pots, followed by a total of three pots containing 14.5 litres each during the project in June 2019, rather than filling the whole tank with at least 300 litres of glass. Nevertheless, it proved the general functionality of the horizontal-oriented furnace, exceeding 1000° C on all the measuring spots, even at the very far wall inside the furnace opposite to the stoking hole. As expected, working in front of the gathering hole of GO-Borg-3 (Figure 6) was extremely uncomfortable due to the excessive heat emission, which occurred even by direct radiation despite the adjacent gathering hole being kept closed. Therefore, this furnace might instead be used in combination with one or a set of smaller furnaces,

such as GO-Borg-2¹⁸ and GO-Borg-4, whereas the large furnace can be used as a supply of molten glass and the smaller furnaces as so-called 'glory-holes' for daytime production (Figure 7), maybe even containing a small melting crucible for decorating the glass. Operating the smaller furnace only during daytime and letting it cool down during the night offers the option to add an annealing chamber to its design, since the rhythm of this furnace matches the rhythm of running the annealing ovens to cool down the glass vessels. The results of even this first test-run already provide ideas for re-evaluating the interpretation of some Roman glass workshops.

The most difficult part in interpreting a Roman glass workshop is connected with the need to cool down the glass objects in a controlled manner, because this involves oven structures operated at significantly lower temperatures than the glass melting and working furnaces. Whereas the temperature of the molten glass inside the pots may range between 1000 and 1100° C for glass blowing, a temperature between 400 and 500° C inside the vessel chamber of the annealing ovens (or chambers) proved sufficient for tempering the glass without distorting the vessels by overheating. Furthermore, the maximum temperature inside the fire chamber should not exceed 700° C since the glass vessels may eventually be exposed to direct flames. The

¹⁷ Heege (1997: 38).

¹⁸ If GO-Borg-2 is transferred to the larger workshop containing the tank furnace GO-Borg-3.



Figure 7: Gathering some glass from tank furnace GO-Borg-3 (right) while working at the small glass furnace GO-Borg-4 (left) (Photo: Manuela Arz).

completely collapsed annealing oven at Quarley (Figure 2) and the rapidly deteriorating bead furnaces PO-Borg-1 and PO-Borg-4 (Figure 8) at Borg¹⁹ demonstrate that within a few years nothing more than a red area will remain visible of these fired daub structures. Since these structures were not dug into the ground, this area will deliver no data about the former furnace design. Nevertheless, some excavated Roman glass workshops feature structures that very likely were annealing ovens, such as the Trier Hopfengarten workshop.²⁰ Several different reconstructions of solitary annealing ovens proved to be successful in annealing the glass vessels at Quarley, Velzeke and Borg (Figure 9). However, as indicated before, structures for annealing the glass may also be added to furnaces for glass melting and/or working. In this case, the construction has to take into account the need for gradually cooling down the glass objects to an ambient temperature, ideally following a daily rhythm. This idea was tested at Borg with the small furnaces GO-Borg-2 and GO-Borg-4, each featuring a small passive annealing chamber in a different location beside or on top of the working chamber. At Quarley, the small tank furnace that was used in 2005 heated an adjacent annealing chamber with the exhaust gases.²¹

Since the two very compact furnaces GO-Borg-2 and GO-Borg-4 are built above ground, they also demonstrate that some Roman hot glass workshops may have existed, which may not have left an imprint in the soil except a red-fired, keyhole-shaped spot. For smaller pot furnaces that hold only a small, shallow pot of glass, there is simply no need to bury parts of the furnace in the ground if the extrapolated working height of 50 to 60 cm for the glassmaker sitting on a stool in front of the furnace's working hole, as depicted on the oil lamp, can be achieved. Small finds, such as glass trails, working waste and glass covered daub fragments, may be the only indicators for such small workshops.

'Software-results': glass workshops and working conditions

Apart from the information regarding the 'hardware' of Roman hot glass workshops, the furnaces and ovens themselves, the glass furnace projects provide a great amount of data concerning the 'software' connected with running these workshops. In order to blow glass in a hot glass workshop, proper weather protection for the whole workshop is crucial. Direct sunlight, rain and wind have to be kept out. The first firing of the Velzeke furnace during a winter storm in November 2008 demonstrated clearly that there is no need for channelling the wind in front of the stoke hole in

¹⁹ Wiesenberg (2016b: 122, fig. 12; 2018a: 96, fig. 11).

²⁰ Wiesenberg (2014: 16–17, figs 9 and 10).

²¹ Taylor and Hill (2008: 251, fig. 1).



Figure 8: Since 2016, PO-Borg-4 serves as a study object for weathering processes (Photo: Frank Wiesenbergl).

order to improve the draft of the furnace.²² Wind can cause uncontrolled blasts of flames and hot air towards the glassmakers. Therefore, a proper shelter needs to protect the stoke hole and the glassmaker's workplace from the wind. This could be either a stone-walled or timber-framed room, or a wooden shelter, in each case offering decent light conditions for working, good ventilation and a good deduction of the smoke.

The wooden shelters for the workshops at Velzeke and Borg demonstrate that there is no noteworthy fire hazard caused by the glass furnaces and ovens. Building the glass workshops close to or in the pottery districts of Roman cities, as seen for example in Trier,²³ might have been motivated by the presumably daily supply of firewood.

The layout of the workshops needs to offer sufficient space to stoke the furnace, handle and store logs of wood – at least the supply for a day, which might range from a wheelbarrow-load to half a ton of wood

for a single furnace, depending on its size – and to place the glassmaker's stool, tools and toolrests, and also to handle the hot glass.²⁴ There has to be enough room to rotate the blowing iron with the glass parison in order to elongate the bubble by centrifugal force. Therefore, the roof needs to offer a sufficient height to enable these actions. If the furnace or workshop offers more than one working hole, this applies to all of the working holes and glassmakers. The glassmaker(s) and stoker(s) need to have enough room to move without conflicting with one another. Finally, the annealing oven or chamber needs to be easily accessible for the glassmaker(s).

Results: glass making and glass processing

Since most interpretations of Roman hot glass workshops have been based on the extrapolation of experiences of modern glass workshops using modern glass compositions, some of the frequently quoted assumptions may be questioned. The postulated three-stage fresh batch melting process²⁵ for melting raw glass from the main ingredients (sand, soda and lime), following Roman glass compositions identified by chemical analysis, is a good example. A fritting process, i.e. crushing the around 800° C merely-sintered, half-molten glass in water, is thought to be essential.²⁶ Furthermore, a temperature between 1200 and 1300° C is postulated for clearing the glass to get it to a good, virtually bubble-free working quality,²⁷ before it may cool down to be kept at a workable temperature of 1000° C.²⁸

The 'Borg Furnace Project 2015' demonstrated that glass of a Roman composition can be melted directly from the raw ingredients in a ceramic crucible placed inside a reconstructed Roman pot furnace operated at a temperature ranging between 1000 and 1100° C, even without regular stirring, within one week.²⁹ All of the glassmakers involved in the experiment reported that this glass was easily workable after the melt had cleared. It also displayed an amount and distribution of bubbles similar to the Roman natural-coloured, blue-green glass,³⁰ which indicates that the Roman glass is likely to have been similarly cleared. Neither a fritting process nor a temperature significantly above 1100° C was needed for melting the fresh batch. The project also proved that the rather small GO-Borg-1 pot furnace

²⁴ Wiesenbergl (2014: 35, esp. fig. 23). Wood consumption and temperature data are recorded for each experiment.

²⁵ Seibel (1998: 26).

²⁶ Seibel (1998: 26–29).

²⁷ Seibel (1998: 26).

²⁸ Seibel (1998: 27).

²⁹ For further detail on technical aspects of the experiment, see Wiesenbergl (2016c).

³⁰ The blue-greenish appearance of the natural-coloured glass is caused by iron oxides, which derive from the sand being used for the glass; see Freestone and Stapleton (2015: 64).

²² van den Dries (2009: 6).

²³ Goethert (2011: 70–76, esp. fig. 2).



Figure 9: Large and small annealing ovens KO-Borg-2 and KO-Borg-1 (Photo: Frank Wiesenberger).

was suitable for raw glass melting.³¹ Therefore, melting glass from raw ingredients may not be restricted to large rectangular tank furnaces. Employing a series of pots for melting the glass inside a pot furnace and working one after the other, day by day, would offer a continuous workflow from raw ingredients to marketable glass vessels.

Some of the results concerning efficiency³² as well as working and production waste³³ have already been published and will not be elaborated upon here.

³¹ The fresh glass produced from the raw ingredients during the 'Borg Furnace Project 2015' was used directly for manufacturing a variety of mould-blown and free-blown vessels as well as one window pane and two ribbed bowls. Since the capacity of the rather small furnace GO-Borg-1 (and similar pot furnaces) is limited to (in the case of GO-Borg-1) three glass pots containing 4.5 litres of glass each and the melting and clearing of a fresh glass takes about one week, the furnace projects still rely on the supply of prepared glass batch of a Roman composition provided by Mark Taylor and David Hill. Judging by the temperatures measured during the test-run in October 2018, the tank furnace GO-Borg-3 would be suitable for melting up to 300 litres of a fresh glass batch. Because of the size of the furnace and the amount of glass, a project for melting fresh glass lasting at least one month would be desirable.

³² Taylor and Hill (2008); Wiesenberger (2014: 60–71).

³³ Paynter (2008); Paynter and Dungworth (2008).

Results: glass manufacturing techniques

More than twenty glass furnace projects at the three aforementioned locations and numerous one-day research projects at Borg have served as opportunities to research several Bronze Age, Iron Age, Hellenistic and Roman glass manufacturing techniques. The bead furnaces, for instance, were not only used for bead-making practise and demonstration, but also to verify the idea of blowing glass from glass chunks as suggested by E. Marianne Stern,³⁴ and blowing small glass phials from glass tubes (Figure 10), which may be an early pre-form of glass blowing, executed in a workshop in Jerusalem in the middle of the first century BC.³⁵

The projects benefited from the research undertaken by Mark Taylor and David Hill, who dedicated the last three decades to researching different glass manufacturing techniques. The Borg projects repeatedly offered the opportunity to demonstrate that the early Roman flat window panes (so-called

³⁴ Stern (2012).

³⁵ Israeli (1991); cf. Wiesenberger (2016b: 116–117, figs 6–8; 2018a: 91, 93, figs 3 and 6).

'cast' window glass) featuring one matte and one glossy side was not 'cast' at all, but rather stretched and pulled, alternating with frequent reheating inside the furnace (Figure 11).³⁶ Another early domed window glass type could also be successfully and repeatedly reconstructed at Borg by slumping a flat hot glass disk over a hemispherical mould.³⁷ This type of window seems to be technologically related to Hellenistic and Early Roman slumped mosaic bowls (Figure 12) and ribbed bowls, monochrome as well as polychrome, and also probably made by combining fusing and slumping techniques following the ideas developed by Mark Taylor and David Hill.³⁸ Numerous bowls of various sizes and decorations were manufactured in Velzeke and Borg, monochrome and colourful mosaic alike.

Mould blowing produced a wide range of vessel shapes, starting in the first century AD. This technique, using the ceramic moulds reconstructed by David Hill, serves as an important part of the furnace projects, especially for teaching. By constantly improving details of the mould making procedure, David Hill was able to re-create the most complex mould of Roman times, for a jug made by the first century glassmaker Ennion (Figure 13).³⁹ Two projects at Borg were devoted to Pre-Roman gold-band glass, employing different core-forming techniques reconstructed by Mark Taylor and David Hill, to contribute to the PhD research of Giulia Cesarin.⁴⁰ Three projects at Borg conducted by Mark Taylor and several other glassmakers⁴¹ also covered the observations by E. Marianne Stern and Sylvia Fünfschilling on Roman blown mosaic glass.⁴²

Conclusion and outlook

Although the Roman glass furnace projects began back in 2005 and more than twenty longer-term research and teaching projects as well as numerous one-day research and demonstration projects have already taken place, it seems much too early to draw a final conclusion regarding the functionality of Roman glass furnaces and Roman glass manufacturing techniques. However, a short screenshot and outlook will be allowed. Many manufacturing techniques have so far been reconstructed, but many others, such as cameo-glass and cage cup-blanks, still remain a desideratum. Also, researching the glass chemistry has barely



Figure 10: Small phial made in the bead furnace PO-Borg-2 'Lydia' (Photo: Frank Wiesenberg).



Figure 11: Making flat Roman window glass at GO-Borg-1 'Erna' (Photo: Manuela Arz).

been touched upon by the furnace projects. Since the atmosphere inside the wood-fired glass furnaces differs significantly from laboratory or glass studio equipment, the furnace projects would provide great potential for future chemical research, not only on glass compositions and the interaction of their ingredients within the melt, but also of the chemical processes inside the furnace and annealing oven atmosphere.

The constant development of the projects, especially at Borg, offers great potential to test different glass furnaces, workshop layouts, and even integrated glass production lines, as they relate to outlines excavated at Roman sites. Since the wood consumption and temperature data are recorded for each furnace and oven during the Borg research weeks, these projects can provide data for the evaluation of fuel efficiency, urban logistics, economy and environmental working conditions of the pre-industrial crafts centres in Roman suburbs.

³⁶ Wiesenberg (2016d; 2017a).

³⁷ Wiesenberg (2016e; 2017a).

³⁸ Wiesenberg (2017b; 2018b).

³⁹ Hill (2016).

⁴⁰ Cesarin (2017).

⁴¹ François Arnaud, Jason Klein, Torsten Röttsch and Frank Wiesenberg.

⁴² Stern (2017). For the first two projects, 'new' mosaic glass chips (florets) were used, which created a compact layering of different colours in the cross-section of the glass. In June 2019, an additional project employed fragments of broken mosaic bowls created by Mark Taylor and David Hill, with the aim of re-creating widely-stretched single mosaic patterns without much layering.



Figure 12: Mark Taylor making a mosaic bowl at GO-Borg-1 'Erna' (Photo: Manuela Arz).



Figure 13: Reconstructing an Ennion jug (Photo: Manuela Arz).



Figure 14: Mark Taylor teaching students at GO-Borg-1 'Erna' (Photo: Manuela Arz).

Besides the general and specific information gained concerning glass workshops and glass making techniques, these projects also deliver a range of details particular to Roman hot glass workshops, such as working waste, which can be directly compared with Roman small finds and should help archaeologists in identifying glass workshops.⁴³

By publishing results from the projects at the Archaeological Park Roman Villa Borg and communicating them regularly in the form of lectures and papers, this section of experimental archaeology provides an invaluable contribution to the analysis of archaeological glass production sites. Spreading the knowledge gained about Roman glass, glass furnaces and glass manufacturing by these projects is also aided by involving students from various universities and institutions and researchers in the Borg projects (Figure 14).⁴⁴ Apart from the annual 'Borg Furnace Projects', two research projects on operating a 'horizontal' tank furnace and two special research and demonstration projects of one week each were conducted by the Archaeological Park Roman Villa Borg. In 2015, this museum hosted the 'Glastag' Conference and in 2016 it staged the international conference 'Roman glass

furnaces – contexts, finds and reconstructions in synthesis' in order to encourage a dialogue between glassmakers, archaeologists and glass specialists. The proceedings of the latter conference and a publication of several results of the furnace projects and research days are in preparation. Furthermore, evaluation and publication of the economic aspects of the different glass furnaces, comparison of the different furnace designs and detailed information on the typical working waste connected with the production of different types of glass vessels is in planning.

To date, the tank furnace at Borg was used as a large pot furnace rather than a tank furnace. A long-term project employing the tank furnace for melting fresh glass batches still remains a desideratum and is depending on funding. It is possible that the forthcoming 'Borg Furnace Project 2020', which is scheduled for June 2020, may offer the opportunity to conduct an experiment on raw glass melting.

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⁴³ For the best example of this, see Paynter and Dungworth (2018).

⁴⁴ Universität zu Köln, Universität des Saarlandes, Universität Trier, Philipps Universität Marburg and Römisch-Germanisches Zentralmuseum Mainz.

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Author biography

Frank Wiesenberg, MA, is an independent researcher focusing on Roman manufacturing techniques with a special interest in glass making, glass working and glass furnaces. The thesis for his BA in Archaeology of the Roman Provinces at the University of Cologne covered the reconstruction of a Roman glass workshop. Since 2013, he coordinates the glass furnace project at the Archaeological Park Roman Villa Borg.

9. Investigating Dynastic Egyptian Pottery-Making: Archaeological and Ethnographical Considerations

Sarah K. Doherty

Abstract

This paper will consider the scale of pottery workshop production in ancient Egypt and Sudan through a comparison of ethnographic pottery studies, representations of ancient workshops, archaeological remains and the author's own experiments with replicating ancient pottery. Despite many investigations throughout Egypt, with 10,000s of pottery sherds analysed at each site, surprisingly few pottery workshops have been uncovered. Most settlements would have required the services of at least one pottery workshop to provide the local populace with the containers needed to store, produce, cook, and brew beer and so on. Is the reason for this dearth of pottery production sites due to archaeological bias?

Keywords: workshops; ceramics; pottery production; workshop organisation; experimental archaeology

Kurzfassung

In diesem Beitrag wird das Ausmaß der Keramikwerkstattproduktion im alten Ägypten und im Sudan anhand eines Vergleichs ethnografischer Keramikstudien, Darstellungen alter Werkstätten, archäologischer Überreste und eigener Experimente der Autorin zur Herstellung antiker Keramik untersucht. Trotz vieler Untersuchungen, bei denen in ganz Ägypten zehntausende Keramikscherben analysiert wurden, wurden überraschend wenige Keramikwerkstätten entdeckt. Die meisten Siedlungen hätten mindestens eine Töpferwerkstatt benötigt, um die örtliche Bevölkerung mit den Behältern zu versorgen, die sie zum Lagern von Erzeugnissen, zum Kochen von Speisen, zum Bierbrauen usw. benötigten. Ist der Grund für diesen Mangel an Keramikproduktionsstätten die Voreingenommenheit der Archäologen?

Keywords: Werkstätten; Keramik; Keramikproduktion; Werkstattorganisation; Experimentelle Archäologie

Introduction

To date, surprisingly few ancient potteries are known or have been excavated in Egypt and Sudan. The most in-depth work on the excavated potteries, and indeed on ancient Egyptian pottery in general, is Arnold and Bourriau's seminal work *An Introduction to Ancient Egyptian Pottery*.¹ Despite many investigations throughout Egypt, with 10,000s of pottery sherds analysed at each site, surprisingly few pottery workshops have been uncovered. Most settlements would have required the services of at least one pottery workshop to provide the local populace with the containers that they needed to store produce, cook their food, brew their beer and so on. Is the reason for this lack of pottery production sites due to the archaeological bias of exploring only the elite areas of settlements and the historical focus on tombs and temples? Perhaps pottery workshops were located in areas that were built upon by later generations and so lost to archaeology, perhaps they are difficult to identify from other archaeological workshops, or perhaps archaeologists simply are not looking in the right places.

In order to understand pottery production in Egypt and Sudan, the evidence for pottery production sites must be thoroughly analysed. This article will consider the following questions:

1. Where can sites of pottery production be found?
2. How does the layout of the production site affect the manufacture of pottery?
3. What other evidence can be gleaned from secondary sources?
4. What can we learn from modern pottery workshops?
5. Can much be learnt from experimental reconstructions of ancient techniques?

Pottery production sites

Having analysed the academic literature, the author knows of only 32 possible dynastic period pottery workshops (as opposed to ovens or metalworking furnaces, of which there are many examples), or more specifically where a pottery kiln has been found, i.e. where it can be beyond reasonable doubt that pottery vessels were fired within them (see Table 2).² Many

¹ Arnold (1993); see also Holthoer (1977).

² See Nicholson (1993; 2010) for a thorough discussion of kiln firing

Table 1: Type and known number of pottery workshops.

Type of Workshop Locations	Amount	Percentage %
(1) Within an estate or temple workshop area	14	43.75
(2) On the outskirts of a settlement, often close to a water source, tends to be large, with 3+ kilns	8	25
(3) Close to a cemetery and specialised in the production of funerary vessels	3	9.36
(4) Pottery workshop within town, tends to be small-scale production with 1–2 kilns.	5	15.63
Unknown	2	6.25
TOTAL	32	

more examples date to Ptolemaic and Roman times.³ A pottery workshop, where the tools of the potter, the clay working pits and pottery working areas have been located are much rarer. The most recent to have been excavated dates to the 4th dynasty at Kom Ombo Temple, some 45 km north of Aswan.⁴ It was discovered in July 2018 during a water table reduction project by an Egyptian mission. Thus far, not many details are known apart from three photographs, which appear to show the remains of a pottery handbuilding workshop with hollow circles suitable for paddle and anvil construction of round-bottomed, bulbous and bag-shaped vessels (such as modern cooking jars, hemispherical bowls, or water coolers).⁵ The excavators also suggest that they have uncovered an early example of a ‘turntable’ or potter’s wheelhead and the socket of a potter’s wheel, both made of limestone. Further analysis is needed, but from the published photographs it is likely that this arrangement may, in fact, be an emplacement for creating coil-built pointed based vessels, such as spindle shaped jars or ovoid jars rather than a potter’s wheel.⁶ The emplacement tapers to quite a narrow point, which is unlike the curved parabola shape of the bearings of a potter’s wheel.

The location of excavated potteries relative to the areas of settlement could benefit from more in-depth analysis, but in general potteries seem to be located in one of the following areas: (1) within an estate or temple workshop area; (2) on the outskirts of a settlement, often close to a water source, with usually more than three kilns; (3) close to a cemetery and specialising in the production of funerary vessels, e.g. red polished wares; or (4) within a town, where it tends to be a small-scale production with 1–2 kilns. Using these quite basic

categories, and the 32 pottery dynastic workshops that are known to the author (see Tables 1 and 2) it is possible to suggest the following:

Workshops occur most frequently either within a temple or in the private estate of a landowner or the state (Type 1), e.g. in Amarna⁷ and Medinet el Gurob.⁸ Kilns and workshop areas could be located away from settlement sites in Egypt⁹ (Type 2), such as at the Dakhla Oasis,¹⁰ or where potteries are close to cemeteries (Type 3), such as at Hierakonpolis.¹¹ The off-site location of such kilns and workshops would, therefore, hinder the likelihood of them being discovered by archaeologists. Rarely they occur within settlements (Type 4), e.g. Mirgissa¹² with 1–2 kilns, or even smaller box-ovens with multiple uses (including bread baking). But as Shaw¹³ noted, industrial workshops may not have been buildings at all and many craft activities would have taken place in open areas or courtyards, and so would be less archaeologically visible. Nevertheless, for pottery production it would be expected to find areas where some sort of roof or covering (and therefore a structure) was supplied for clay storage and to keep it damp, as has possibly been located at Amarna¹⁴ and Gurob.¹⁵ In lieu of caves, which have been documented as suitable sites for ancient pottery workshops in the Levant,¹⁶ or cellars or sheds as used by modern potters, a roof would have been necessary for pottery production.

Old and Middle Kingdom models and tomb scenes¹⁷ indicate that there may have been particular areas where workshops were located, often close to other

technology. The most basic requirement being the change from clay, a plastic material, into an aplastic ceramic at temperatures between 700–1000° C.

³ Doherty (2015a: 127–131).

⁴ Arab News Online (2018).

⁵ Wodzińska (2010: 49–51, 330–334).

⁶ See Doherty (2015a) and Powell (1995) for published examples of potter’s wheel bearings.

⁷ Nicholson (1995a; 2010).

⁸ Hodgkinson (2012); Hodgkinson and Boatright (2010); Shaw (2011: 463).

⁹ McNicoll *et al.* (1982: 57).

¹⁰ Hope (1979).

¹¹ Baba (2006: 18); Hoffman (1982).

¹² Vercoutter (1970: fig. 3).

¹³ Shaw (2004: 16).

¹⁴ Nicholson (1992).

¹⁵ Hodgkinson (2012: 11–14).

¹⁶ Magrill and Middleton (1997: 68–73).

¹⁷ See section on ‘Secondary evidence’ below.

craftworkers' workshops in industrial quarters, e.g. carpenters or blacksmiths as seen at the Amarna¹⁰ and Lachish excavations,¹⁶ or near to temples and palaces as at Hierakonpolis and Tell Yarmuth.¹⁸ Whether all potter's workshops were near to palaces or as part of the estate of wealthy landowners is uncertain, but some archaeological remains indicate that some craft activities, notably potting, cobbling, painting, and bread making, could all have been performed at some level in the home. The sheer quantity of basalt chippings found at the Amarna houses P49.3–6 and other Amarna houses with pigments, amethyst and glass bead working areas would provide evidence of a series of workshops next to or within the houses.¹⁹

The layout of known pottery workshops

It may perhaps be assumed that the design of ancient potteries had general similarities to modern ones, even if they were not exactly the same. The 'typical' potter's workshop in ancient times (much the same as the modern ones) would have required access to water, fuel and clay sources, and would have needed a working space to fashion pottery vessels, probably with structures to provide shade from the hot sun for the workers, and to allow for more controlled drying time of the pots.

Potters would have required clay preparation areas (sometimes called paddling pits) and clay storage areas, pottery drying yards and finished vessel storage areas. Close by, though likely a little separated from the main pottery site, would be the pottery kilns with fuel storage areas. Most pottery workshops would have created all the vessels that the local markets required. However, it is also likely that some pottery types could have been made in domestic households. Holthoer,²⁰ for example, has argued that flower pots, beer bottles and bodega vessels were domestically made and fired. The size of pottery workshops must have varied considerably, depending on local market needs and the space available. Unfortunately, it is not always certain what the extent of the workshop area may have been as, in some excavation reports, archaeologists merely listed the existence of a 'kiln' to indicate the presence of a pottery workshop, and it seems that the full extent of the workshop was either ignored in the final report or was not uncovered.²¹ Much of the drying and wedging of the clay likely took place in an outside or courtyard location, which are difficult to detect archaeologically. Kilns, on the other hand, are easier as they were heated to high temperatures (>700°C) and were formed of mudbricks. In general, most

dynastic pottery kilns falls within the diameter range of 1.2–2.5 m.²² The best preserved kilns have perforated floors to allow air to flow through and circulate around the kiln.²³ Where supposed 'kilns' are described in reports, they often measure just 50–60 cm in diameter. Therefore, they may be misidentified. For example, two 'pot kilns' found in estate U33.9 at Amarna, which was excavated by Frankfort and Pendlebury,²⁴ measured 50 cm each and were therefore likely to have been for cooking rather than pottery firing. In general, it can be stated that correctly identifying pottery workshops in the archaeological record has been and continues to be difficult. Residual finds such as unfired sherds, ash filled pits, vitrified and siliceous mudbricks, and trampled clay floors are key indicators of pottery workshop areas, whereas, as we have seen, the presence of small 'pot' kilns can be misidentified as pottery kilns when they may in fact have been cooking ovens.²⁵

Using the types of workshops listed previously in Table 1, the essential outline of each known workshop type will now be described.

Type 1: Within an estate or temple workshop area: Gurob, el Fayoum (New Kingdom)

In 2009–2012, the excavation team at Gurob, el Fayoum, focused on an area known as 'the fort'²⁶ which was located c. 40 m north-east of the palace. Termed Area IA1, two pottery kilns were uncovered, together with a potential pottery workshop area.²⁷ Kiln 1 measured 2.8 m in diameter, Kiln 2 was 2.4 m. Only about half of Kiln 1 was excavated within the area of the workshop. It was filled with large numbers of discarded ceramic sherds,²⁸ mudbrick and vitrified material. The workshop area possibly contained a paddling pit measuring 1.5 x 0.95 m. Three pits, two of which had pebbled floors, were located to the north of Kiln 1, the functions of which are uncertain. To the east, close to Kiln 2, the workshop area sloped downward; where a shallow pit of clay containing some potsherds (>0.05 m) was uncovered, perhaps a clay paddling pit or mixing area. Other clay dumps and shallow pits were also revealed. From the later analysis of satellite images, this pottery workshop area appeared to be part of a wider set of buildings, perhaps an estate related to the production of pottery for the palace.

²² E.g. Nicholson (1989a; 1995a: 228).

²³ Examples include kilns at Mirgissa (Vercoutter 1970: figs 24 and 57), Dakhla (Soukiassian *et al.* 1990: 153–154) and Dashur (Stadelmann 1983: 228–230).

²⁴ Frankfort and Pendlebury (1933: 74, pl. 25:4).

²⁵ Rose (1989).

²⁶ Brunton and Engelbach (1927: 3). The author was part of the Gurob Harem Palace Project, led by Ian Shaw.

²⁷ Hodgkinson (2012); Hodgkinson and Boatright (2010); Shaw (2011: 463).

²⁸ Area IA1 generated 557.19 kg of body sherds alone (Gasperini *et al.* 2012).

¹⁸ Baba (2006); Roux (2009: 199); Roux and de Miroschedji (2009).

¹⁹ Shaw (2004: 18–19).

²⁰ Holthoer (1977: 27).

²¹ E.g. Borchardt (1932: 73–79).

Type 2: Outskirts of a settlement: Ain Asil (Dakhla Oasis)²⁹ (Old Kingdom)

The settlement of Ain Asil ('Spring of the Source') is located 3 km east of Balat and 8 km north-west of Tineida, at the junction where the ancient Darb el Tawil joins other routes through the oasis. An administrative centre for Dakhla during the reigns of Pepi I and Pepi II, most of the town appears to have been destroyed by fire at the end of the Old Kingdom and abandoned for a time. At the site, some 25 circular/horseshoe shaped kilns divided between two sprawling multi-roomed workshops were discovered during excavations south-west of the main town. The kilns belong to four phases of use, with most fireboxes opening to the south, perhaps to take advantage of the prevailing winds.³⁰

Type 3: Close to a cemetery and specialising in the production of funerary/cultic vessels: Abu Sir (Old Kingdom)

The following example could almost be considered Types 1 or 3, as it was located within a temple, but was producing vessels for the mortuary cult of King Unas or Pepi II. A pottery workshop was uncovered during excavations at Abu Sir, located in the mortuary pyramid temple of Queen Khentkaus II, wife of King Neferirkare (c. 2450–2300 BC), but likely to be associated with the later cult of King Unas or Pepi II (c. 2450–2181 BC). The workshop was located to the north-east of the pyramid temple with a kiln at the south-eastern end, next to the *ka* pyramid. The kiln was conical shaped, originally 2 m high and under 1 m wide, with a firebox facing north. For a kiln the dimensions are small and since it does not appear to have traces of a perforated floor, it is unlikely to be an updraught kiln, but it does have traces of vitrified mudbrick. Around the kiln was found 5th dynasty pottery sherds and animal bones. A fragment of mud sealing dating to the reign of Unas was found in a nearby storeroom surrounded by kiln debris and malformed beer jars, suggesting a *post quem* date for the kiln area's initial construction, though the fill of the kiln itself contained only ash, sand and limestone chips. The kiln was propped up against the mortuary *ka* cult pyramid walls and is associated with a new entrance being made in the magazines opposite room SE-1. A clay potter's wheelhead was recovered loose on a nearby wall.³¹

The wheelhead was found at the opposite end of the temple area, resting on a short wall, MEW, one of two (a and b) set against the enclosure wall MBW. Wall (a) was preserved to 85 cm high and (b) to 56 cm. Above wall (a) was a slot 20 cm deep that had been cut into the wall

MBW. The excavators suggested that this slot was used to insert a workbench which rested upon walls (a) and (b). Next to wall MEW was a shallow rectangular area measuring 3 x 1.5 m, suggesting a fence line of palm ribs, or possibly a roof enclosing the workshop area. The wheelhead was made of baked clay, measuring 45 cm in diameter, which had been broken and repaired in antiquity by drilling four holes near the broken edge and inserting string or wire.³²

Type 4: Pottery within a town, tends to be small-scale production with 1–2 kilns: Amarna (New Kingdom)

A box-oven was discovered at Chapel 556 of the workmen's village at Amarna.³³ These structures can be considered as the step between open/pit firing and the more complicated updraught kiln, which contains a firebox located underneath the pottery stack and a perforated floor. By contrast, box-ovens are simpler with a screen or containing wall within which pots are stacked. The fire may be within the wall or outside it and drawn in through an opening at the bottom of the wall. It has been suggested that box-ovens may also have had the dual function of having been used as a bread oven and a pottery kiln for making bread moulds.³⁴ In effect, making the vessel to then later bake the bread in, removing the need to pay for a potter to produce the vessel.

Chapel 556 was one of many examples in the workmen's village at Amarna and was located in the north-eastern corner of the village. It contained an unroofed annex running alongside it. Within this annexe was a box-oven located against one wall and other features including a circular oven (29 cm in diameter) and four garden plots containing alluvial soil. The box-oven had been created by walling off the north-eastern corner of the annexe to create a rectangular space measuring 77 x 64 cm. In front of the oven were several pits filled with ash. A full set of 64 bread moulds were uncovered, 30 long and 34 cylindrical and hemispherical vessels with a foot knob and squared rim. It could be that the box-oven is better suited to the baking of bread in bread moulds than the *tannur* style circular oven which would be ideal for flatbreads similar to modern *balady*. This box-oven had been in regular use, as there were lots of ashy deposits around it.

The interpretation of the excavator was that the box-oven had a dual function. The box-oven contained a variety of fired vessels *in situ*. In later experiments testing the firing capability of box-ovens, it was demonstrated that they could be successfully used to fire ceramics, at least low fired ceramics such as bread

²⁹ Soukiassian *et al.* (1990: 5–9).

³⁰ Soukiassian *et al.* (1990: 12, fig. 5).

³¹ Verner (1992; 1995: 33–34).

³² Verner (1992; 1995: 26).

³³ Kemp (1987: 73–76); Nicholson (2010: 3).

³⁴ Holthoer (1977: 16).

Table 2: Selected pottery workshops/kiln sites (Pre-Dynastic–18th dynasty).

Site	Period	Potter's Wheel	Kiln (type)	Other Details	Type
Mahasna ¹	Pre-Dyn. ²	X	Screen/Pot kiln	Large vessel supported by firedogs, surrounded at one time by wall.	3
Hierakonpolis ³	Pre-Dyn. (c. 3650 BC)	X	Screen/Pot kiln	Locality 29. Shallow pit-updraught kiln. Large vessel supported by firedogs, surrounded by a low wall. Top not covered.	unknown
Hierakonpolis ⁴	Pre-Dyn. (c. 3200–3100 BC)	X	Screen/Pot kiln	Locality IIC, Kiln B1. Shallow pit-updraught kiln. <i>Tamarix</i> and <i>Acacia</i> logs used as fuel.	3
Buhen (Northern Town) ⁵	OK 4th dyn.	X	3 tall cylindrical circular kilns/copper furnaces	Separate firing chamber by a grid of bricks resting on square support of brickwork. Kilns located to south-east. Piles of malachite nearby. Possibly copper furnaces.	2
Kom Ombo Temple ⁶	OK 4th dyn.	Possible limestone wheelhead attached to socket(?)	None	The remains of a pottery handbuilding workshop with hollow circles suitable for paddle and anvil construction. Example of a 'turntable' or potter's wheelhead and the socket of a potter's wheel both made of limestone.	1
Abusir (pyramid complex of Khentkaus) ⁷	OK 4th–5th dyn.	Burnt clay wheelhead originally laid on a slab of wood	Circular kiln/conical shape	Wheel in secondary position. Part of the mortuary temple during the reign of Unas. Workshop surrounded by fence of reed mats. Storeroom. Circular pit. Kiln to the south, opposite end of workshop, built on floor of corridor.	3
Dakhla Oasis ⁸	OK	X	6 circular kilns, but possibly 10	Type 1 similar to copper furnaces at Buhen. Type 2 circular or horseshoe-shaped with a draught tunnel running from stoke hole. Vessels may have been supported on kiln dogs, more sophisticated version of Hierakonpolis-style. Site 33/390-I9-3 and 33/390-K9-I. Located to the south-east of a small settlement.	2
Elephantine ⁹	OK mid-4th–5th dyn.	X	2 circular kilns	Row of vertical bricks as lowermost course and both open to the north to take advantage of the prevailing winds.	2
Ain Asil (Dakhla Oasis) ¹⁰	OK/FIP-G/R	Possibly 2 pivots, but likely to be for door	25 circular/horseshoe-shaped kilns divided between 2 workshops	Various kilns and associated workshop remains to south-west of main town, kilns belong to 4 phases of use, most open to the south.	2
Abu Ghalib ¹¹	MK	X	Circular	Isolated in square, open space, south-west of habitation.	2

¹ Garstang (1902).² Abbreviations: dyn.=dynasty, N=north, S=south, E=east, W=west, Pre-Dyn.= Pre-Dynastic, OK=Old Kingdom, MK=Middle Kingdom, NK=New Kingdom.³ Hoffman (1982: 12).⁴ Harlan (1982).⁵ Adams (1977: 172–173); Emery (1963: 117); Nicholson (1995a).⁶ Arab News Online (2018).⁷ Verner (1995: 55–59).⁸ Hope (1993).⁹ Kaiser *et al.* (1982).¹⁰ Soukiassian *et al.* (1990: 5–9).¹¹ Larsen (1941: 11).

Site	Period	Potter's Wheel	Kiln (type)	Other Details	Type
Dashur ¹²	MK	X	4 roughly circular kilns	Best preserved kilns, dimensions 2 m E-W by 1.6 m N-S. To the northern side is a trench 3 m long and 1.2 m wide, possibly a draught tunnel to use wind to increase the through-draft. Details of flooring such as T-shaped piece of vaulting found with cross-arm running E-W.	3
Mirgissa (Sudan) ¹³	MK	X	Square oven, possibly for preparation of bread moulds	Opening to hearth is rectangular. Open basin paved with mud in front of kiln.	4
Mirgissa (Sudan) ¹⁴	MK	X	Circular	Brick-walled pit and fire hole to south-east, 2.5 m (diam.) x 1 m (depth).	4
Nag Baba (Sudan) ¹⁵	MK	Possible pivot/wheel with black lubrication	Screen	Workshop, drying bins, pebbles. Kiln measured 2 m x 2 m x 1 m high.	1
El-Lahun ¹⁶	MK	X	Circular pot kiln	-	unknown
Qurnet Mura'i (Amenhotep III's workers village), Thebes ¹⁷	18th dyn.	X	2 large circular kilns	Diameter of c. 2 m, and the stoke hole has a screen towards the south.	4
Amarna ¹⁸	18th dyn.	X	Square kiln with 2 passages at the ground, vent holes	Roof of vent holes had 2 diagonally placed bricks. Contained large quantities of charcoal and had a white cobbled pebble floor of quartz.	4
Amarna ¹⁹ (1986 excavation)	18th dyn.	X	Box-oven with load of clay bread moulds	2 types of bread moulds, conical and chalice. 30 cones stacked in 3 rows of 10. Firing structure rather than just a kiln, as also used to bake bread.	4
Amarna ²⁰	18th dyn.	X	2 pot kilns	Situated in corner of estate, possibly associated with a kitchen (U33.9).	1
Amarna North Suburb ²¹	18th dyn.	Socket and pivot of granodiorite	X	Associated with the largest house in the Northern Suburb of Amarna T36.11. Ashmolean Museum no. T1929.417.	1
Amarna ²²	18th dyn.	X	3 pot kilns	Row along southern wall of magazines south of the temple.	1
Amarna P47.20 ²³	18th dyn.	X	Circular (no. 4102), earlier kiln in room 10 (no. 4122) and in private house complex (no. 3896)	No. 4102: Separate hearth and firing chamber, associated with a private house, room 10, near south-eastern corner. 1.2 m N-S x 1 m E-W. Depth of fire pit floor 1m. Lowermost course of vertical bricks. No. 4122: Only 14 vertical bricks survive. No. 3896: Circular, within private house, 24 bricks in barrel form, no support for kiln floor, so kiln must have been floored at higher level and stoke hole at the ground.	1

¹² Stadelmann (1983: 288).¹³ Holthoer (1977: 16).¹⁴ Vercoutter (1970: fig. 3).¹⁵ Säve-Söderburg (1963: 58).¹⁶ Mace (1922: fig. 15).¹⁷ Porter and Moss (1972: 457); Varille and Robichon (1935).¹⁸ Petrie (1894: 26).¹⁹ Frankfort and Pendlebury (1933); Kemp (1987: 73–79).²⁰ Frankfort and Pendlebury (1933: 74).²¹ Hope (1981); Powell (1995: 316).²² Pendlebury (1951: 31).²³ Borchardt (1932); Nicholson (1995a); Nicholson and Patterson (1989).

Site	Period	Potter's Wheel	Kiln (type)	Other Details	Type
Amarna ²⁴	18th dyn.	X	4 pot kilns	Row against wall, joined by mud brick with vent hole leading up to each hearth. Associated with a private estate (O49.9).	1
Amarna, square Q48.4 ²⁵	18th dyn.	Upper stone of basalt wheel	Large updraught kiln, smaller unfinished kiln	Rectangular enclosure with various industrial buildings.	1
Amarna ²⁶	18th dyn.	X	Pot kiln	Associated with kiln of private house.	1
Amarna, square G4, no. 2984 ²⁷	18th dyn.	X	Oval kiln	2.3 m N-S x 1.5 m E-W x 1 m deep, of which 0.75 m below the ground. Part of the stoke hole preserved to the south. Kiln floor half the height of the stoke hole. Area around kiln is a workshop.	1
El Malqata ²⁸	18th dyn.	X	Small circular pot kiln	Associated with kitchen of private house south of enclosure. Lack of scale.	1
Medinet Habu ²⁹	NK (pre-Ramesses III layer)	X	6 pot kilns	To north of western fortified gate. 3 free standing, 3 joined together. Probably baking and cooking.	2
Mirgissa ³⁰	18th dyn.	X	Area MI 6: definite kiln, but potentially 11 others	Sizes of kilns vary; some have lowermost course of vertical bricks, and engaged columns running up the walls beneath the floor, to support it.	2
El Sebuia (Nubia) ³¹	NK	X	Oven or granaries	Sphinx alley of temple, to the south. Square opening at the ground and tapered upper opening.	1
Gurob, el Fayoum ³²	18th–19th dyn.	X	2 pottery kilns	Located in IA1 c. 40 m north-east of palace, pottery kilns uncovered, together with potential pottery workshop area. Kiln 1 measures 2.8 m in diameter, kiln 2 2.4 m. Workshop area possibly contains a paddling pit 1.5 x 0.95 m.	1
Huruba, near el-Arish, Sinai ³³	18th dyn.	X	2 kilns	Associated with potter's workshop at location A-345. One kiln thought to be complete, ³⁴ measured 1.5 m in height, circumference 1.8 m. Fire chamber 1 m high and dug into the ground, 0.7 m stoke hole faced south to avoid prevailing winds. Perforated floor preserved, 0.2–0.25 m thick, holes of 0.1 m diameter and spanned the kiln as a vault. Outside steps leading up to kiln. Second kiln preserved to height of 1 m, fuel chamber had tiled floor, perforated floor was supported on projecting bricks.	2

²⁴ Borchartd (1932: 73–79).

²⁵ Nicholson (1992: 61–70); Rose (1989: 85–87, figs 4.2–4.4).

²⁶ Peet and Woolley (1923: 49).

²⁷ Nicholson (1995a).

²⁸ de G Davies (1918: 10).

²⁹ Hölscher (1939: 73).

³⁰ Vercoutter (1970).

³¹ Gauthier (1912: 34).

³² Hodgkinson (2012); Hodgkinson and Boatright (2010).

³³ Oren (1987: 100).

³⁴ Petrie (1894).



Figure 1: Potter's workshop from tomb of Ty, storeroom, register 7 Saqqara, Egypt c. 2450–2300 BC (Drawing: S. Doherty after Épron and Daumas 1939).

moulds (discovered nearby), which require firing temperatures of 500–600° C.³⁵ Making dynastic bread moulds is quite a simple task: the clay is rolled out and wrapped around a wooden mould, left to dry and then fired at a low temperature.³⁶

Secondary evidence

Tomb scenes and texts can provide a wealth of information towards the understanding of the pottery workshop and give hints as to how it might have been organised. Old Kingdom tomb scenes and Middle Kingdom wooden models provide quite extensive detail as to the practicalities of the pottery and can go some way to reflecting the reality of a working pottery.³⁷ The potters' workshop scenes are often located adjacent to baking and brewing scenes, suggesting to Dorman³⁸ that they ought to be viewed not merely as a pottery manufacturing scene in isolation, but as an important part of the food preparation and storage process; significant for the nourishment of daily life, but also for the maintenance of the *ka* of the deceased in the afterlife.³⁹ These potters' workshop scenes provide a valuable insight into the everyday life of the Egyptian potter, the organisation of the workshop, and suggest that potters were often under the jurisdiction of the great estates of the Egyptian nobility, or state-initiated workshops (e.g. Heit el Ghurob, Giza⁴⁰), working in large groups rather than working alone. It is also likely that each village had its own potter who could create the pots that the average Egyptian could not, e.g. large water jars and tableware, as is the case today in traditional potteries in Egypt.⁴¹

During the 5–6th dynasties credible scenes of potters working in pottery workshops have been found, notably in the tombs of Ty at Saqqara⁴² and Ptahshepses at Abu Sir,⁴³ in the 11th–12th dynasty nomarchs' tombs of Bakt III (BH 15, dynasty 11), Amenemhat (BH2, early dynasty 12) and Khnumhotep (BH3, mid-dynasty 12) at Beni Hasan.⁴⁴ The 5th-dynasty nobleman Ty had a mastaba built at Saqqara during the reign of Niuserre.⁴⁵ Ty was Director of the Hairdressers of the Great House (i.e. the palace) and overseer of the estates and temples of Kings Sahure and Neferirkare (c. 2440 BC). As such, he would have been involved in the day to day administration of the temples and estates and presumably organised the supply of pottery and its production, although probably indirectly.⁴⁶

Above a scene of a bakery (Figure 1) in the storeroom of Ty's tomb a pottery workshop is depicted with six potters busily manufacturing pots in two different ways, one using the potter's wheel to make *hnw* vessels on the wheel (the bowls rather than the spouted vessel above the potter, see Figure 1), the others form a production line hand rotating pots and *ḏwiw* vessels (beer jars) in a stationary block. The hieroglyphic captions above the two potters making *ḏwiw* vessels reads 'bb 'flattening, forming, smoothing, completing' and *ḏd* 'building, forming'.⁴⁷ Both share a *ḏwiw* jar as their determinative, implying that this is what is being made.⁴⁸ Above is the potter at his wheel *dh hnw* 'creating *hn* vessels'. Therefore, in Ty's workshop, we have representations of two pottery manufacturing traditions, namely

(2002); Vincentelli (2003).

⁴² Épron and Daumas (1939).

⁴³ Vachala (2004a; 2004b); Vachala and Faltings (1995: 281–286).

⁴⁴ Newberry (1893; 1894). See Table 2 for a more complete list.

⁴⁵ Tomb no. 60 according to Jacques de Morgan, or D22 by Mariette. It is located c. 150 m from the entrance to the Serapeum (Porter *et al.* 2003).

⁴⁶ Épron and Daumas (1939: pl. 71); Steindorff (1913).

⁴⁷ Holthofer (1977: 7).

⁴⁸ Hannig (2003: 265, 1343).

³⁵ Nicholson (1989b: 246–251).

³⁶ Nicholson (1989b: 243–250).

³⁷ Nicholson and Doherty (2016).

³⁸ Dorman (2002: 58).

³⁹ Drenkhahn (1976: 87).

⁴⁰ Wodzińska (2009: 236).

⁴¹ van der Kooij and Wendrich (2002); van der Leeuw (2002); Nicholson

throwing on the wheel and handbuilding beer vessels using coils of clay and then rotating them in a stationary block to support the pot while the potter smoothed down the joins and created the rim. Many beer jars of the Old Kingdom have tapering or pointed bases,⁴⁹ and are quite large, testifying to the use of such a block as depicted in the tomb of Ty, rather than utilising a 'turntable' or potter's wheel.

The kiln is placed to the far left of the scene, with bands around it to protect it from cracking when the mudbrick expanded during firing. A single potter supervises the kiln. He holds his right hand to his face as protection from the heat, in a similar manner to that common in bread making scenes (included on the lower register of the pottery scene in Ty's tomb). Above him is the caption *fš.t t3*, 'heating the oven/kiln'. Ty's pottery workshop seems to provide evidence of specialised potters who were involved in the making of selected pottery shapes and that the potter's wheel was a significant part of that specialisation process.⁵⁰ In modern pottery production, potters specialise in particular shapes and often produce only a set number of vessel shapes, usually due to restrictions from market demand, despite being capable of producing more shapes.⁵¹ Nile silt clay potters seem to produce a more varied corpus compared to marl clay potters.⁵²

Three tombs at Beni Hasan dating to the Middle Kingdom (c. 2055–1700 BC), those of Bakt III (BH 15, dynasty 11), Amenemhat (BH2, early dynasty 12) and Khnumhotep (BH3, mid-dynasty 12), each include detailed representations of potters and their workshops during this period. These tombs have already been thoroughly described elsewhere.⁵³ However, the tomb scenes of Bakt III are exceptionally rich and show considerable detail, with seven potters, all at differing stages of throwing pots, and a vivid kiln unloading scene.⁵⁴ Such scenes give the sense of a bustling workshop with clay preparation and mixing, throwing, handbuilding and kiln unloading all taking place. What does not seem to be depicted in these tomb scenes is the process of gathering or mining clay, adding inclusions to the clay (chaff, limestone, pebbles, etc. as known to any ceramicist working on archaeological ceramics), wedging clay (where impurities or air pockets are removed) before throwing and kiln loading.

Wooden models from tombs also provide useful evidence for workshop production in Egypt. There is a variety

of wooden models dating to the First Intermediate Period and Middle Kingdom known to contain scenes of potters working at their wheels, (two examples from the tomb of Karenen,⁵⁵ one in the tomb of Gemniemhat⁵⁶ (Figure 2), the tomb of Inpuemhet and Usermut⁵⁷ (and from the tomb of Pharaoh Montuhotep II (2061–2010 BC)).⁵⁸ These have been variously described already by a number of authors.⁵⁹

These models take quite a common form. The potters all sit on the ground or on a block with their knees drawn up to their body. With their right hand, they shape or throw the vessel and with their left they spin the wheel, with a water pot nearby to moisten the clay. Often, they are sitting near to a kiln with an assistant close by making up fresh cones of clay to be later applied to the wheel so that the potter can continuously throw pots in the manner of an assembly line. It is interesting to note that in many cases the pottery workshop is beside a carpenter's workshop and with at least one stone vase driller, perhaps signifying that these crafts were linked in ancient times. Shaw⁶⁰ has suggested that industrial workshops may not always have been buildings at all and that many craft activities would have taken place in open courtyards; these models may provide evidence for this proposition in relation to potters. It would make sense for at least some of the potters' activities to occur outdoors, and as the models indicate, perhaps wheel-throwing and kiln firing were such actions. Many of the model workshops are partially roofed, presumably suggesting that roofs were needed to keep off the heat of the day, but with the majority of the industrial processes taking place in the open air.

Workshop organisation in modern potteries in Egypt

As noted in a previous article,⁶¹ pottery workshop scenes such as the ones analysed in Ty's tomb should be viewed as accurate representations of the craft. If such scenes were only to serve as vague representations of pottery manufacturing, then the artist need not have depicted such details as trampling the clay, shaping the clay into cones, throwing different shapes on the wheel, loading the kiln using pots painted grey and then painted red once fired.

The key stages of clay acquisition are rarely shown in these potting scenes. Nile silt clay came from the banks of the Nile or an irrigation canal likely quite far away

⁴⁹ E.g. Rzeuska (2006: 211, pl. XCI:14).

⁵⁰ Costin (1991); Longacre (1999).

⁵¹ Wodzińska (2009: 237).

⁵² Nicholson and Patterson (1989). See also, for example, Holthoer (1977); Rose (2007); Wodzińska (2009; 2010) (not an exhaustive list) for the different types of marl clay and Nile silt vessels.

⁵³ Doherty (2015a: 23–47).

⁵⁴ Holthoer (1977: 12, fig. 14).

⁵⁵ Quibell (1908: 10–11, 75–76, pl. 17 1,3 and 19,4).

⁵⁶ Firth and Gunn (1926: 53, pl. 29 C).

⁵⁷ Quibell and Hayter (1927: 40–41, pl. 24).

⁵⁸ Arnold (1981: 33, pl. 37).

⁵⁹ Arnold (1993: 69); Breasted (1948: 49–51); Holthoer (1977: 10–11, 15–16).

⁶⁰ Shaw (2004: 16).

⁶¹ Nicholson and Doherty (2016: 437).



Figure 2: Wooden model from the tomb of Gemniemhat at Saqqara, AEIN 1633 (©Ny Carlsberg Glyptotek). Right: bird's eye view showing carpenters at work behind the potters in the partially covered buildings, while the potters work outside. One works the wheel; the other prepares fresh cones of clay to pass to the other potter when needed. The tools are for the carpenters. Inset: Face view of potter working a pot on his wheel, left hand spins the wheel, right works at shaping the pot. Note the completed pot or possibly a water jar to his right (Photos: Ivor Pridden).

from the workshop. If it was collected in the manner noted at the modern pottery workshop of Deir Mawas, it may have been no more than a weekly event and not something that the artist witnessed.⁶² This lack of recognition of the importance of clay gathering can also be noted in the account of ethnographer Winifred Blackman.⁶³ The collection of fuel is also rarely depicted, with the possible exception of a scene of woodcutters at the tomb of Khnumhotep II at Beni Hasan.⁶⁴

Nicholson and Patterson⁶⁵ have observed that at the modern pottery of Deir el Gharbi, in the Ballas pottery industry of Upper Egypt, the making of vessels continues at the same time as firing takes place. In this industry, there are numerous workshops and not all fire on the same day. Even within a single workshop where some assistants are needed to work at the kiln, wheel manufacture of pots continues. A similar circumstance was noted by the author at el Nazla pottery in the Fayoum (see below). At the modern pottery at Deir Mawas in Middle Egypt, the master potter, who normally operates the wheel, ceases throwing during firing. The other family members still prepare clay and hand form vessels.

Such attention to detail depicted by the artists in tomb scenes can only indicate that they had witnessed the processes involved in pottery manufacture with sufficient frequency to enable them to accurately paint it. Through comparison with ethnographic work, experimental reconstruction and analysis of pottery such as that undertaken by the author, such tomb scenes can be said to be an ethnographic depiction of pottery workshops.

Clay recipes may be another indication of different workshops. In general, two types of clay were used during dynastic times; Nile silt and desert marls. Nile silts, i.e. clays deposited by the river between the Upper Pleistocene and the present, are rich in silica and iron and appear grey to black in their raw state. Marl clays, originating from shale and limestone found along the river, are calcareous and rich in mineral salts.⁶⁶ Ceramicists often note the difference in vessel types between marl and alluvial clays.⁶⁷ The Vienna system has further subdivided the different clay fabrics and it can be noted that certain fabrics were often used for particular vessel shapes. For example, fabric Marl D is often used for New Kingdom amphorae.⁶⁸

It could be that particular workshops specialised in either Nile silt or marl clay pots. As noted by Wodzińska

⁶² Nicholson (1995b: 279–308).

⁶³ Blackman (1927: 135).

⁶⁴ Newberry (1893: 68, pl. XXIX).

⁶⁵ Nicholson (1989a: 71–86); Nicholson and Patterson (1989: 222–239).

⁶⁶ Bourriau *et al.* (2000); Hassan (1976).

⁶⁷ For example, Nicholson (2002: 144); Wodzińska (2010).

⁶⁸ Rose (2007: type ME 3.4).

at Heit el Ghurab,⁶⁹ when comparing carinated bowls to other marl products, the Marl C carinated bowls did not appear to be made locally. The clay was quite different than the local Marl A2 fabrics, indicating that the workshops making such pots were probably located in different regions. Marl C is commonly associated with the Fayoum oasis. By contrast, at el Nazla where the potters tend to use a mixed clay recipe of chaff, sieved kiln ash (mostly burnt straw, sawn wood and wood ash), and clay, it would be difficult to determine individual workshops within the pottery as all take from the same clay pit. One potter told the author that if 'it smells right and bubbles' then it is ready to be used. As an amateur potter, the author would agree with this statement, as clay that has been left too long in storage can smell like rotten food.

Pottery making has sometimes been viewed as a major innovation altering the course of cultural development; its invention is cited as a criterion for the transition from savages to barbarians by early scholars.⁷⁰ Moreover, it is the potter's wheel, in particular, that is hypothesised to have stimulated new and further technological and social transitions.⁷¹ In ethnographic studies, the beginning of the use of the potter's wheel coincides with a switch in pottery making between genders when the males adopt the potter's wheel while the women continue to manufacture by hand.⁷² When women do use a wheel, they tend to use it for coiling rather than throwing, e.g. the Danish potters of Karhuse, Island Fuenen,⁷³ and in Hungary during the 1880s.⁷⁴ In the 20th century pottery workshops and industries taking up throwing involved crossing both a class and a gender code. Throwing was an artisan activity for men, and it appeared to be difficult to train women potters to take up the wheel and abandon handbuilding, mostly due to the expense of setting up a studio.⁷⁵ By contrast today, it is far easier to teach throwing to men and women who have no previous pottery skills.⁷⁶ It is difficult to trace whether this might have been the problem for the Egyptians taking on the potter's wheel or workshop production. Tomb scenes and wooden models do not depict women working in pottery workshops. Is this a deliberate exclusion or a reflection of the reality of potter's workshop activities? Nicholson and Doherty⁷⁷ describe the potter's workshop scenes as ethnographic depictions of potting, so we must assume therefore that the Egyptian artists were drawing what they were seeing in the potter's workshops. Perhaps these tomb scenes suggest that there was a male dominance in

specialist occupations. The only examples of female potters are Nubian women making handbuilt jars using the paddle and anvil method, not attested in Egypt in dynastic times.⁷⁸ In general, in modern ethnographic studies, women are the primary handbuilding pottery producers, making pottery by hand using the paddle and anvil technique (but see Figure 3).

When elite individuals have control of the objects produced, they also gain control of the craftspeople and the technologies they use and therefore control the status of both themselves and the craftspeople.⁷⁹ Technologies allow such elite agents to construct social identities and power relations as well as producing utilitarian objects.⁸⁰ The types of labour that an individual performs and the types of services or goods they offer to a group help to define the individual's place in society. Prestige and status are often derived from the work one performs, particularly in complex societies.⁸¹ Gender often establishes the range of economic activities permissible since crafting in complex societies is materially and ideologically linked to the power hierarchy and to social participation.⁸²

The modern potters of Ballas have organised the production of their amphorae into clearly defined activities. The Ballas potters make their wares using marl clay from one part of Egypt, Ballas (Deir el Gharbi) in the Delta.⁸³ Compared to the Nile silt potters' chaotic and disorganised workshops, the Ballas industries appear highly organised with mostly all of these potters making amphorae in large workshops.⁸⁴ There are often several workshops in one area, all being supplied with the same clay by specialist clay miners. It is possible to trace which potter made what type of pot, as each potter's apprentices form the handles of the amphorae in a particular way. In addition, they allocate particular intermediaries to sell their wares to a specific market, each market favouring slight differences in the size, shape, texture, or temper of the pot. This is the result more of taste and fashion than particular obvious differences.⁸⁵ Similar inferences could also be made for ancient potteries, where presumably the ancient market was just as fickle with its own preferences.

Case study: the pottery at el Nazla

The author visited the pottery of el Nazla in 2012, which has been already documented by others⁸⁶ but the author thought it worthwhile to briefly outline her

⁶⁹ Wodzińska (2009: 236).

⁷⁰ Morgan (1877).

⁷¹ Gandon *et al.* (2011; 2018).

⁷² Rice (1991: 437); Vincentelli (2003: 13–14).

⁷³ Vincentelli (2003: 22–23).

⁷⁴ Szabadfalvi (1986).

⁷⁵ Vincentelli (2003: 13–14).

⁷⁶ Joan Doherty (pers. comm. 2011).

⁷⁷ Nicholson and Doherty (2016).

⁷⁸ Arnold (1993: 21, fig. 15A).

⁷⁹ Herbert (1993).

⁸⁰ Dobres (1999: 129).

⁸¹ Costin (1996: 113).

⁸² Helms (1993), Nicholson (2017).

⁸³ Nicholson and Patterson (1989).

⁸⁴ Bourriau (2002: 78–95).

⁸⁵ Nicholson (2002: 138–146); Nicholson and Patterson (1989).

⁸⁶ van der Kooij and Wendrich (2002).



Figure 3: A relatively rare example of a man making pottery using the hammer and anvil technique, an activity normally undertaken by women. El Nazla, Fayoum, Egypt (Photo: S. Doherty).

impressions in term of the workshop organisation. The pottery at el Nazla is situated to the west of Fayoum city, approximately 25 km away on the Medinet el Fayoum Abshoi road in a valley where a canal, the Masraf el Wadi, a branch of the Bahr Yusuf, twists through. The workshops are located along the narrow floodplain strip. The levels of cultivation seem to have been lowered over a long period of time, whilst the village has been built on the higher areas. The pottery is just beside the canal and occupies a space of some 200 m x 55 m. It is reached by climbing down steep steps from the village road to the level of cultivation. The area has been worked by the current family of potters for generations. At one time there used to be over 60 people supported by the pottery, but now it is only 15–20. The potters mostly make water storage pots (*zirs*), water coolers (*girdr*) and bowls (*madra*), although the large pots so frequently on display in tourist hotels are also made here.

Each family lives on site, with their own self-contained workshop, comprising:

1. Clay basins used for kneading and mixing the clay.
2. Workshop rooms constructed from pottery wasters, mud and occasional mudbrick, and

a flat roof mainly of reeds, some with two entrances. Inside these are damp storage areas where prepared clay, sacks of straw, the potter's wheel and the hollow depressions for shaping pots are located.

3. Circular tower shaped kilns of mainly two sizes (3.5 m and 5 m) built of mudbrick. el Nazla has about 15 of these in various states of repair.
4. Open space for drying pots.

The distribution of these functional spaces is not even. Clusters of two or more kilns and several workshops are grouped together. It seems that the spatial organisation is associated with kinship amongst the male family members; with the sons learning the trade from their fathers and brothers from an early age. After ten years of apprenticeship, a young potter is considered good enough to make a wide variety of products. This is interesting, as psychologists⁸⁷ have noted that to be an expert in almost any field, regardless of talent, whether that be sports, crafts or chess, a minimum of ten years continuous practice is needed.

There are two different sorts of manufacturing techniques that can be found at el Nazla – the paddle

⁸⁷ Ericsson and Lehmann (1996).

and anvil handbuilding technique and the mechanical kick-wheel technique. Neither requires any electricity but relies entirely on the strength and dexterity of the potter to know when and in what manner they need to apply a particular technique. The overall quality of the vessels is not high at el Nazla.⁸⁸ When the el Nazla corpus⁸⁹ is applied to Gandon *et al.*'s⁹⁰ prescribed model forms, the reproducibility of the vessels was likely to be strong as the potters were creating the same 4–5 vessels on a regular basis, with little variation. Roux,⁹¹ proposed that vessels with more acute angles are more difficult to produce, as part of her theory of techno-morphological taxonomy. When applied to the el Nazla corpus, which consists mainly of squat or globular jars or large basins with obtuse angles, her taxonomic theory suggests that the designs are easy to make. The potters making them are not being very innovative in their designs as there is little variation in the types produced.⁹²

Unfortunately, the author was not able to be present when a kiln firing took place, but she hopes to return. Despite not being able to watch a firing, there was lots of evidence around for the firing activities. About 15 kilns in various states of repair are scattered around the pottery, each with a perforated floor and a double brick thick firebox mostly positioned to the east. The potters informed the author that in summer they fire once a week, usually on a Thursday. For fuel the potters use whatever they can find such as straw, sawdust, local trees and offcuts from the local carpenters. This is interesting as many of the Middle Kingdom wooden models which depict potters often show them alongside carpenters (see above). The kiln is stacked with *zirs* upside down first so that the heat can circulate within the pot and then rise to the next one and so on. The smaller pots are then placed on top and wasters or broken pots are placed on top to act as a heat-proof roof. Once fired, the pots are sold at the side of the road and in local markets in the Fayoum.

Alongside handbuilding, the potters of el Nazla were using a kick-wheel to make the larger water jars (*zirs*) which are ubiquitous in every Egyptian town. As has been noted by the author,⁹³ kick-wheels are difficult to detect archaeologically, as the ancient potters may have simply adapted the so-called 'slow wheel' stone bearings to the taller (and more comfortable) seating position of the kick-wheel. In the next section, some experimental pottery wheels will be briefly discussed.

Experimental reconstructions of ancient techniques

A matter of regular discussion amongst field ceramicists is precisely what constitutes a wheel-turned, a wheel-thrown and a handbuilt vessel. In this section, the author will tentatively suggest some answers through reconstructions of ancient techniques.

From the late 3rd–4th dynasty, the first wheel-thrown pottery occurs only in the most illustrious of state-run projects, that of pyramid mortuary temples and mastaba chapels in the form of miniature vessels.⁹⁴ This suggests that potters specialising in the use of the potter's wheel were for at least one dynasty kept within the confines of the pharaoh's control in state-controlled temple workshops and later this specialism was disseminated⁹⁵ to private individuals running their own estates. In addition, the use of the elite hard stone, such as basalt and granite to construct the machinery of the potter's wheel, with the moving parts of a pivot rotating in a stone socket and used to create pottery miniature vessels may also be significant. To produce such items would have required the buy-in or sponsorship from an entrepreneurially minded wealthy person, or perhaps even the pharaoh himself to sanction the use of stones normally reserved for temple or tomb architecture and statues.

The remains of potter's wheel bearings were uncovered in some of the excavated pottery workshops described in Table 2. The majority of the potter's wheel bearings are comprised of an upper pivot and a lower socket stone usually of basalt, granodiorite or limestone. They range from 15 to 24 cm in diameter and vary in height from 5.5 to 6 cm and have been previously published by Powell and Hope.⁹⁶

The potter's wheel was in use in the Levant and Mesopotamia from c. 4000 BC where the wheel was used to finish coil built vessels.⁹⁷ The crucial development of producing truly wheel-thrown pottery – where the vessel is entirely produced on the wheel from a ball of clay to completed vessel, rather than finished or 'turned' – appears to be an Egyptian innovation from 2500 BC.⁹⁸ A wheel-thrown pot is made entirely on a potter's wheel and is shaped by the potter's hand lifting the clay, aided by centrifugal force.⁹⁹ The techniques involved in using a potter's wheel are entirely different to that of handbuilding and require a stable forearm,

⁸⁸ See video: Doherty (2015b).

⁸⁹ See published drawings in Wodzińska (2010: 330–337).

⁹⁰ Gandon *et al.* (2011: 1081).

⁹¹ Roux (2009).

⁹² Wodzińska (2010: 330–337).

⁹³ Doherty (2015a).

⁹⁴ See Doherty (2015a: chapter 6).

⁹⁵ Possibly during the 5th dynasty, when the Meidum bowl begins to be fashioned on the potter's wheel and when depictions of the wheel first begin to appear in private individuals' tombs, e.g. Ty (Épron and Daumas 1939).

⁹⁶ Powell (1995: 309–311); Hope (1981: 127–133).

⁹⁷ Roux and de Miroschedji (2009).

⁹⁸ See Doherty (2015) for a full explanation and Roux and Corbetta (1989) and Roux and de Miroschedji (2009) for Levantine comparisons.

⁹⁹ Rye (1981: 74).

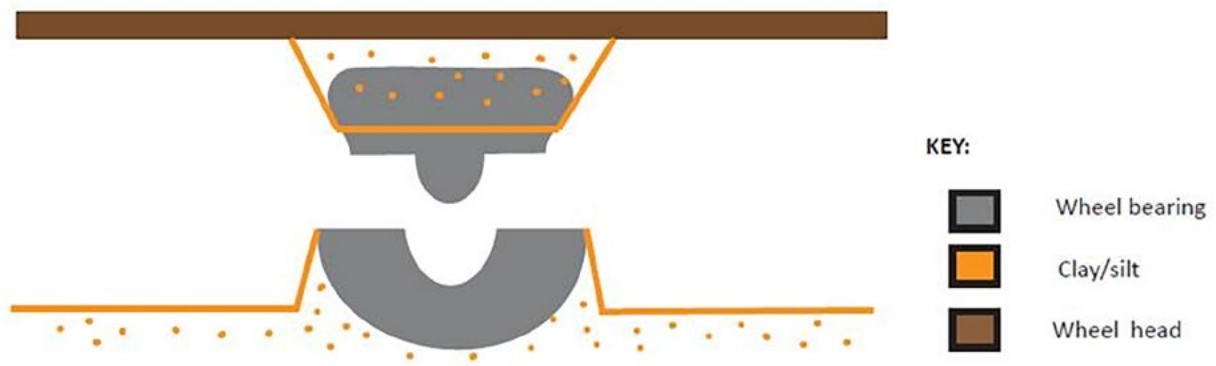


Figure 4: The reconstructed potter's wheel (Drawing: S. Doherty).

the ability to be ambidextrous and the skill of knowing how much pressure to exert when manipulating the vessel on the wheel, depending on the plasticity of the clay, the speed of the wheel and the shaping method. Too much or too little, and the vessel collapses.

The author's experiments in re-creating Egyptian miniature vessels sought to prove that these were amongst the first pottery vessels in the world to be completely wheel-thrown, using centrifugal force on the type of potter's wheel termed the 'slow wheel'. Centrifugal force is achieved by the swift rotation of the potter's wheel, determined as Rotations per Minute (or r.p.m.). The process of throwing on an ancient wheel is essentially the same as throwing on an electric one, although the moving force of the wheel is provided by the potter's left arm. The potter's wheel socket and pivot when fitted together and spun, formed a thrust bearing to effectively absorb the force parallel to the axis of revolution. Placing a baked/fired clay or wooden wheelhead on top of the basalt bearings added extra weight and increased the momentum of the spinning of the wheel. Pouring lubricant such as linseed oil¹⁰⁰ in the socket prevented the tenon from locking inside the socket and maintained an even spin (Figure 4).

Once centred, creating a pot on the replica wheel bearings took about 9 minutes and achieved a speed of 45 r.p.m., but it is likely that Egyptian potters would have been far faster (Figure 5). Similar hand-rotated wheels are still in use in Afghanistan and Pakistan¹⁰¹ where potters are able to create pots in under 5 minutes. In contrast, coil pots can take much longer (15–30 minutes or more), depending on the finishing and drying times in between coil attachments.

The speed that a potter's wheel needs to achieve before it can be considered a 'fast' versus a 'slow' wheel can now be disputed. The author can find no such distinction, as the replica potter's wheel was successfully able to create thrown pottery at speeds lower than the suggested 50–150 r.p.m.,¹⁰² thus inducing centrifugal force, even at the speed of 20 r.p.m., not considered by Jacobs and Edwards¹⁰³ to be throwing. It is suggested that such terms as *fast* and *slow* wheel needs to be readdressed if they should exist as a distinction at all. Near Eastern style V-rim bowls were also recreated, which were coil built and wheel finished.⁹⁹ The technique involved building up coils of clay, and then shaping, thinning the resulting vessel by slowly rotating the replica potter's wheel. This reproduced the method outlined by Courty and Roux¹⁰⁴ and demonstrated a phase of pottery manufacture that falls between coiling and throwing. This was perhaps the first use of the potter's wheel in the Near East before it was discovered that it could be utilised for true wheel-throwing inducing centrifugal force.

Conclusion

In order for pottery workshops to be economically effective, it is crucial that all of the stages of pottery production are managed correctly, and this is quite different from the casual or ad hoc village potter. Large-scale workshop production would require several potters to stay permanently (or semi-permanently) in the workshop to build, maintain, and use the kiln and wheels. This in turn required new levels of expertise: kiln firers (someone to watch the kiln overnight and to manage the temperature), apprentices to assist, as well as specialised potters to make the vessels, together with others to supply a dependable transport of clay,

¹⁰⁰ Powell (1995: 316, 322, 331–334).

¹⁰¹ Roux and Corbetta (1989).

¹⁰² Rye (1981: 74).

¹⁰³ Edwards and Jacobs (1987: 49–56).

¹⁰⁴ Courty and Roux (1995); Roux and Courty (1997: 25–43; 1998: 747–763).



Figure 5: The author has finished centring the lump of clay on the reconstructed ancient wheel and is commencing opening out the vessel with the fingertips. (Right) The author is shaping the body and rim of the vessel prior to its being removed from the potter's wheel (Photos: S. Doherty).

fuel and also to bring the pots to market (and for the market to be desirous of the product).

The earliest evidence for workshop pottery production in the 4th dynasty coincides with the appearance of the updraught kiln and potter's wheel and seems to be aligned to the demands of the funerary market and elite cults. It is only later (from perhaps 5th dynasty onwards) that the potter's wheel and updraught kilns supplied domestic markets. This new format for pottery production created a need for more permanent, specialised workshops. These were state sponsored to produce pottery for the elite cultic rituals.

Through the examination of pottery workshops, representations of ancient workshops in tomb scenes and models, archaeological remains and the author's own experiments with replicating ancient pottery, this paper has sought to unpick some of the stages of workshop production in Egypt and to aid future archaeologists in understanding the nature of workshop production and what to look for when uncovering potential future pottery workshops.

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Author biography

Dr Doherty holds a PhD in Archaeological Science, 2013, on ‘*The origins and use of the potter’s wheel in Ancient Egypt*’ from the School of History, Archaeology and Religion, Cardiff University. Dr Doherty previously worked at the Ashmolean Museum of Art and Archaeology, Oxford, in the Public Engagement Department and currently is an Archaeology Tutor at Oxford University and a Heritage Officer in the UK Commercial Archaeology sector. The focus of her research is on the pottery production of ancient Egypt and Sudan, experimental archaeology and ceramic analysis. Doherty has acted as archaeo-ceramicist and field archaeologist for a number of different sites in Egypt, Sudan and Europe. This included the Gurob Harem Palace Project, Amarna, Gebel el Silsila, the Valley of the Kings, and Amara West.

10. Pottery Production in Ancient Sudan: A Case Study of the Pottery from the Slag Heaps of Meroe and Hamadab

Carmen Ting and Jane Humphris

Abstract

This study contributes to the current efforts to characterise how various crafts were organised during the Kingdom of Kush and the period immediately following its decline by means of an investigation of pottery production. We focus on the ceramic assemblages recovered from various securely dated slag heaps at the Royal City of Meroe and the nearby Meroitic site of Hamadab to assess the potential of the methodological approach to contribute to the growing understanding of Kushite ceramic production. We assess the level of standardisation in the morphological, compositional, and technological attributes of the ceramic assemblages based on the data derived from macroscopic and microscopic analyses. Despite the relatively small sample size, our results indicate that the degree of specialisation appears to have evolved through time, and that such change in the specialisation of pottery production could have corresponded to the course of wider socio-political developments.

Keywords: pottery production; craft organisation; standardisation; thin-section petrography; SEM-EDS; Sudan; Kushite society

Kurzfassung

Diese Studie soll anhand einer Untersuchung zur Keramikherstellung einen Beitrag zu den fortwährenden Bemühungen um ein Verständnis der Organisation der verschiedenen Handwerke im Königreich von Kusch und in der Zeit unmittelbar nach dessen Niedergang leisten. Auf der Grundlage makroskopischer und mikroskopischer Untersuchungsergebnisse beurteilen wir den Standardisierungsgrad morphologischer, kompositioneller und technologischer Merkmale kleinerer Inventare stratifizierten keramischen Fundmaterials aus verschiedenen sicher datierten Schlackenhügeln im Stadtgebiet von Meroe und dem nahe gelegenen meroitischen Fundort von Hamadab und versuchen, um den potentiellen Beitrag dieses methodischen Ansatzes für einen Erkenntniszuwachs zur kuschitischen Keramikproduktion einzuschätzen. Unsere Ergebnisse zeigen, dass der Spezialisierungsgrad im Laufe der Zeit zu variieren scheint, und dass diese Veränderungen in der Spezialisierung der Keramikproduktion dem Verlauf allgemeiner gesellschaftspolitischer Entwicklungen entsprechen könnten.

Keywords: Keramikherstellung; Handwerksorganisation; Standardisierung; Dünnschliffpetrografie; SEM-EDS; Sudan; Kuschitische Gesellschaft

Introduction

This study aims to contribute further insights into the way pottery production was organised in ancient Sudan by investigating the pottery assemblages that were recovered from the slag heaps at the archaeological sites of the Royal City of Meroe and Hamadab.¹ Although the ceramics were recovered from slag heaps and underlying archaeology rather than pottery production activity areas, they are ideally suited to

our study for two main reasons. First, the radiocarbon dates of the slag heaps allow the ceramic assemblages to be positioned into broad phases, from the Napatan to Meroitic and post-Meroitic periods, enabling us to chart the transformations in craft organisation through time. Second, a variety of forms and types of vessels were recovered from these slag heaps, which makes it possible to explore whether or not craft organisation was uniform across different vessel forms and types, and within a chronological framework.

The extant knowledge on Kushite pottery production is largely built on two lines of evidence. The first type of evidence concerns the remains of pottery production activities such as kilns, wasters, and potters' tools.² The

¹ It should be noted that this study began as a three-year, high-resolution investigation into ceramic production (technical and domestic). The research was cut short after only one year due to the premature termination of the senior author's involvement in the project resulting from temporary suspension of project funding. Nonetheless, we decided to publish the results so far, rather than lose the initial insights our work had begun to reveal, and we hope that our results and conclusions can contribute to future ceramic investigations.

² Adams (1962); Ahmed (1992); Baud (2008); Edwards (1995; 1999); Garstang and Sayce (1912); Török (1997); Welsby (2010); Wolf *et al.*

second type of evidence makes use of technological analyses, focusing mostly on the composition of ceramic assemblages.³ These characterisations tend to be framed by the assumption that pottery production was highly specialised, without questioning whether or not the traits seen in the ceramic assemblages reflect the said level of specialisation. Attempts to merge these two lines of evidence were initiated by Romain David, who adopted the *chaîne opératoire* approach to delineate the diachronic development of Meroitic pottery technology and organisation.⁴ In this case, special attention was paid to the morphological traits related to vessel building and surface finishing methods, while the potential of other traits has yet to be fully explored.

Against this background, we propose to offer insights into the craft organisation of Kushite pottery production by using the concept of standardisation.⁵ Standardisation here refers to the relative variability that exists within an assemblage; generally speaking, the greater the degree of standardisation, the more specialised the production. That being said, we are aware that the association between standardisation and specialised production is not always straightforward, as demonstrated by ethnographic research on present-day potting communities.⁶ We are equally aware of the inherent limitation of our dataset,⁷ with more variability being expected to be observed in the larger assemblages from one slag heap (MIS6) at Meroe and those excavated at Hamadab, as opposed to the smaller assemblages from other slag heaps (MIS1/2, MIS2, MIS3, and MIS4) at Meroe. In this study, we focus on three parameters: the morphology, composition, and technology of the assemblages. Morphology refers to the appearance of the pottery, including the vessel form, rim shape, rim diameter, lip thickness, wall thickness, decoration, and colour of ceramic paste. As for decoration, we examine the form and mode of decoration rather than its iconographic or stylistic significance. Composition denotes the raw materials used to make the ceramic paste and slip. Technology entails the technical practices in raw materials selection, paste preparation, forming, surface finishing, and firing.

Pottery assemblages and their archaeological contexts

The earliest pottery assemblage analysed here derives from excavations within the slag heaps situated to the east of the railway outside the current site boundary of the Royal City of Meroe (Figure 1). Here, excavations have focused on three slag heaps: MIS2, MIS3, and MIS4. Additionally, an area termed MIS1/2, situated between MIS2 and MIS1, was excavated. From these excavations, only 14 pottery sherds were selected for analysis (since the samples discussed here were analysed, the excavations at these slag heaps have been significantly extended and more pottery sherds are available for future analysis). The single sherd from trench 3 at MIS4 (Vu 693) was found at a depth of c. 1 m within the metallurgical remains. The stratigraphically closest unmodelled calibrated radiocarbon date places this sherd around the late 6th century BC, making this the earliest sherd analysed. Trench 5 at MIS4 was positioned at the southern end of the slag heap, known from stratigraphic analysis to be later than the deposits in trench 3. The sherds (Vu 690, 686, 688, and 689) from this trench are, consequently, more than likely later within the formation period of MIS4 (late Napatan and perhaps early Meroitic period), and are likely contemporary to those from MIS2 (formed from the 5th to the 2nd century BC), MIS3 (formed from the 5th to the 3rd century BC), and MIS1/2 (formed from the 4th to the 1st century BC).

No slag heaps have yet been excavated that provide an understanding of pottery sherds dating from approximately the 1st century BC to the 2nd century AD. Rather, the subsequent ceramic assemblage considered here comprises 48 samples, dating to the late Meroitic to post-Meroitic period, excavated at slag heap MIS6 on the southern mound of the site of Meroe (Figure 1).⁸ For the purpose of this paper, the periodisation of the MIS6 assemblage is defined as being pre-metallurgy (i.e. the context underlying the metallurgical deposits that contains no slag, dating to the late Meroitic times) and metallurgy related (dating to the late Meroitic to post-Meroitic period and thus interpreted as contemporary to the analysed sherds from Hamadab). The formation of the metallurgical deposits at MIS6 took place from the late 2nd to the mid-6th century AD. Vu 724 and 725 were found to predate the construction of the furnace workshop at MIS6. Vu 745 from trench 4 was excavated within spit 3. This spit contains some of the earliest radiocarbon dates from the slag heap and so this sherd most likely dates to an earlier period of the slag heap formation. The pottery sherds found in trench 2 all came from spit 2, which yielded a 2-sigma calibrated, modelled radiocarbon date of the 3rd to 6th century AD. Vu 723 and 729 were excavated from contexts

(2014).

³ Brand (2016); Daszkiewicz and Bobryk (2003); Daszkiewicz and Schneider (2011); Daszkiewicz *et al.* (2005); Mason and Grzymski (2009); Smith (1995; 1996; 1997; 1999).

⁴ David (2018; 2019); David and Evina (2016).

⁵ Arnold and Nieves (1992); Benco (1988); Blackman *et al.* (1993); Costin (1991: 33–36); Eerkens and Bettinger (2001); Hagstrum (1985); Kvamme *et al.* (1996); Longacre (1999); Longacre *et al.* (1988); Martínón-Torres *et al.* (2014); Rice (1981; 1991); Roux (1989; 2003); Stark and Heidke (1998); Wengrow (2001).

⁶ Arnold (2000); Arnold and Nieves (1992); Gosselain (1999; 2011); Longacre (1999); Rice (1991: 277); Stark (1995).

⁷ Costin (2005: 1067).

⁸ Humphris and Carey (2016).

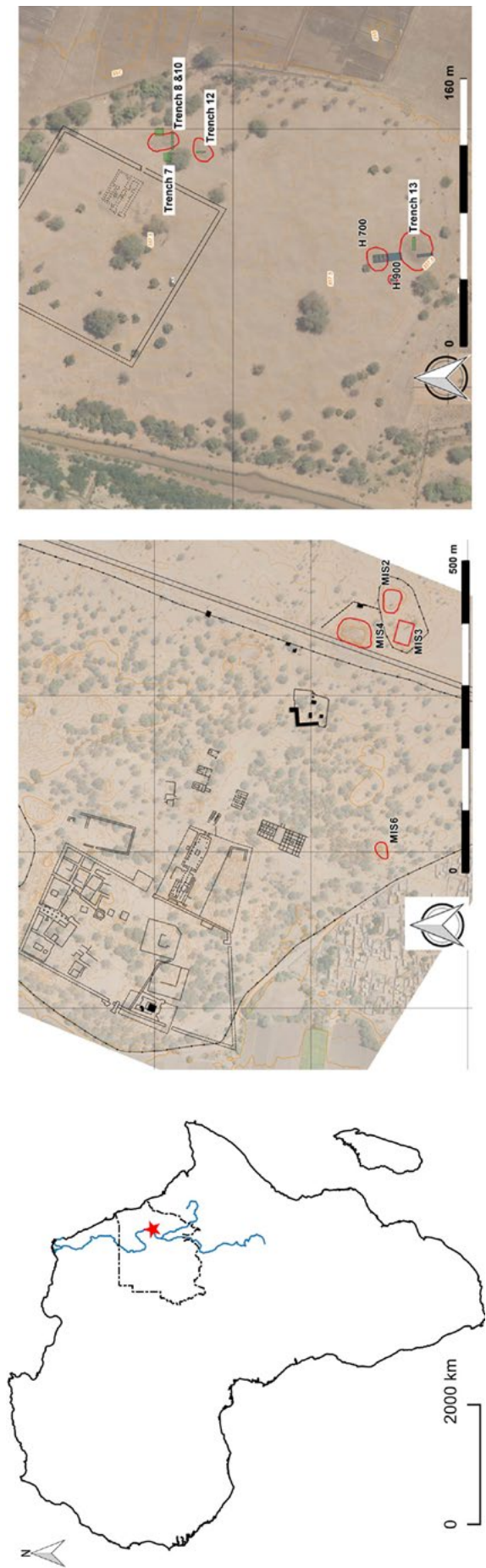


Figure 1: Left: location of Meroe and Hamadab marked by the red star; centre: Meroe, location of slag heaps; right: Hamadab, location of trenches (Map originally produced by Frank Stremke).

associated with the final phase of use of the furnace workshop, probably dating to the 5th century AD.

The Meroitic site of Hamadab, 3 km to the south of Meroe, was excavated during collaborative research with Dr Pawel Wolf (German Archaeological Institute) as part of this investigation due to the presence of slag heaps situated just outside of the enclosed 'Upper Town' (Figure 1).⁹ The metallurgical deposits excavated so far at Hamadab date mostly to the post-Meroitic period,¹⁰ and were found to be shallow layers overlying Meroitic archaeology. Of 34 samples investigated here, the earliest sherds in the sequence, those from the pre-metallurgy contexts, were excavated from three trenches. It remains unclear as to whether or not earlier iron production remains will be found elsewhere at the site in the future. Trench 7 was situated to the west of slag heaps 100–200 (Vu 257, 259, 260, 261, 262, 264, and 265). Trench 12 in slag heap 300 revealed a well-defined separation between the earlier Meroitic archaeology and the later metallurgical deposits (Vu 311). The eastern end of trench 13 in slag heap 800 (Vu 297, 298, 299, 301, and 303) contained mostly Meroitic architecture underlying the metallurgy found in the western end of the trench. The sherds from trench 10 in slag heap 100 (Vu 267, 268, 269, 270, 272, 276, 295, 316, and 317) and trench 13 in slag heap 800 (Vu 300, 305, 308, 309, and 313) date to the transitional period between the pre-metallurgy and metallurgy periods of the site. The sherds from trench 8 (Vu 285, 286, 287, 289, 293, and 294) and trench 13 (Vu 314) were found in the upper contexts, suggesting they date to the end of the period of iron production, perhaps from the 5th to the 6th century AD.

Methods

The pottery samples were analysed using various macroscopic and microscopic methods. The initial identification and designation of vessel forms and types was conducted in Sudan by Saskia Büchner-Matthews, following the classification system developed by the Hamadab German Archaeological Institute team.

Macroscopic examination

The purpose of macroscopic examination is to record the dimension of attributes such as lip thickness, wall thickness, and decoration (e.g. distance between the rim edge and the incised line, width of incised line, etc.). The coefficient of variation (C.V.) was used to measure the degree of standardisation in the dimension of the morphological attributes; and, generally speaking, the lower the C.V., the higher the degree of standardisation

and vice versa.¹¹ Macroscopic examination also records the presence of parallel striation marks on the vessels' surface, the presence of slip and decoration, and the thickness of dark firing cores and associated ceramic paste colours, which are useful for the preliminary assessment of manufacturing technologies.

Thin-section petrography

Thin-section petrography identifies the types of aplastic inclusions such as minerals and rock fragments in the samples. A comparison of the samples' mineralogical composition with published data on local geology permits the determination of the potential sources of raw materials. Variation in the types of inclusions, as well as in their texture (i.e. relative abundance, shape, size, and sorting of inclusions), serves to divide the samples into fabric groups.¹² It is hypothesised that the fabric groups are ceramic paste recipes reflecting the choices of raw materials and technical practices (e.g. the addition of tempering material and clay mixing) that were unique to specific producers or groups of producers. The thin sections were prepared and analysed using the polarising microscope at the UCL Qatar Archaeological Material Sciences Laboratories.

Scanning electron microscopy energy dispersive spectrometry (SEM-EDS)

A subset of samples, those with slip on the exterior surface, was further analysed using an EOL JSM 6610 SEM with an Oxford Instruments X-Max N50 EDS to characterise the composition of the slip and associated ceramic body.¹³ The instrument was operated at 20.0 kV and at a working distance of 10 mm. The beam current spot size was set to 5.6, with an acquisition time of 100 s. Three reference materials – BCR-2, BHVO-1, and BIR-1 – were analysed to monitor the accuracy and precision of the instrument. An average of four analyses were conducted on the slip and ceramic body of each sample. All data were converted to oxides by stoichiometry and normalised to 100 wt % to account for fluctuations in beam intensity and sample porosity.

Results

Morphological and technological variability at the macroscopic level

Napatan and early Meroitic pottery at Meroe

The samples from MIS1/2, 2, 3, and 4 do not have a great variety of vessel forms. Based on their rim

⁹ Wolf *et al.* (2014: 12).

¹⁰ Humphris (2014); Humphris and Scheibner (2017).

¹¹ Blackman *et al.* (1993); Costin and Hagstrum (1995); Eerkens (2000); Eerkens and Bettinger (2001); Kvamme *et al.* (1996); Longacre *et al.* (1988); Roux (2003).

¹² Whitbread (1995).

¹³ Freestone (1982: 114–119); Tite *et al.* (1982).

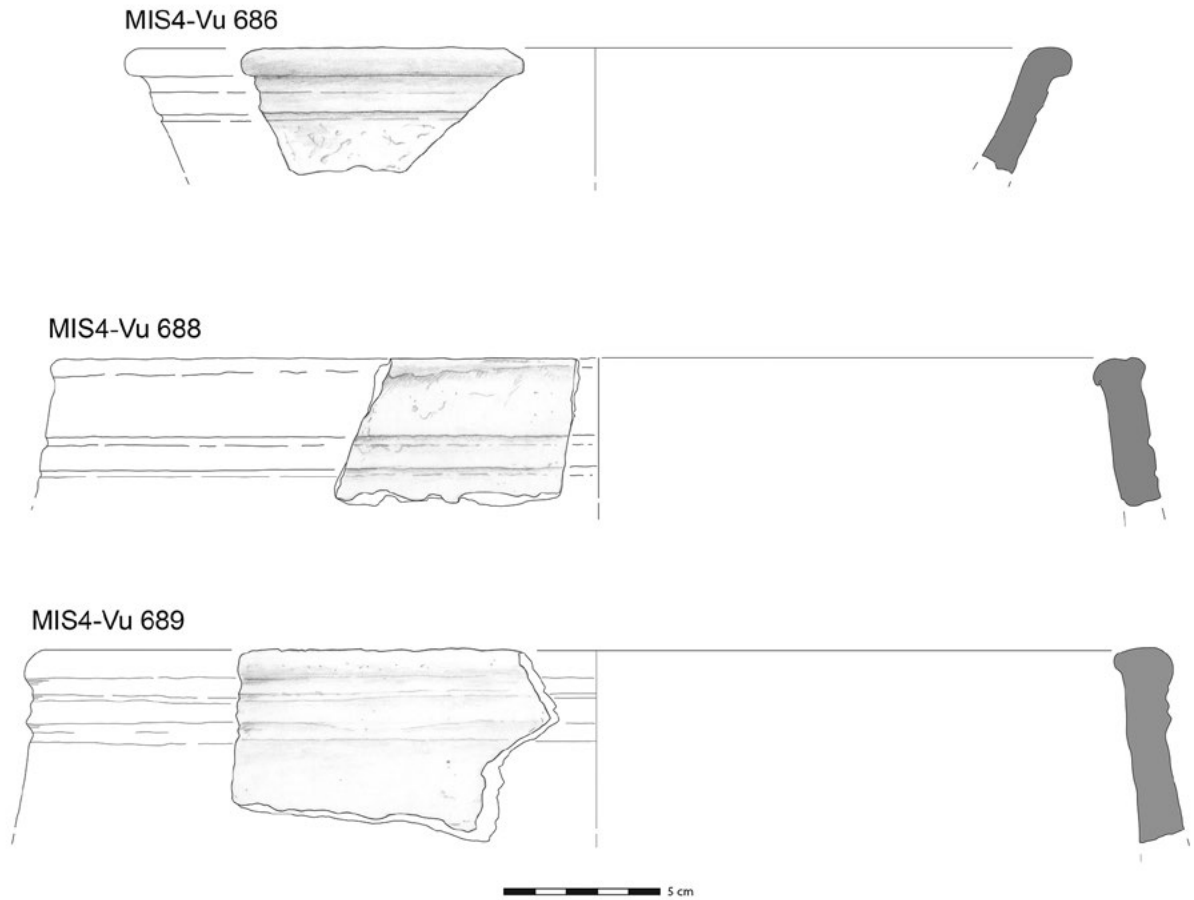


Figure 2: Planar and profile view of the three basin samples from MIS4 (Illustration: Saskia Büchner-Matthews).

Table 1: The minimum value (min.), maximum value (max.), mode, mean, standard deviation (st. dev.), and coefficient of variation (C.V.) of rim diameter, lip thickness, and wall thickness of the basins from MIS4.

Site	Vessel form	Dimension	Min. (cm)	Max. (cm)	Mode (cm)	Mean (cm)	St. dev.	C.V.
MIS4	Basin (n=3)	Rim diameter	29	39	n/a	34	5	14
		Lip thickness	1.29	1.48	1.29	1.35	0.11	8
		Wall thickness	0.85	1.34	n/a	1.05	0.26	25

shape, there are three basins, one bowl and one jar, and the rest are either undetermined or not specified. All basin samples were recovered from MIS4 but have different rim shape and decoration (Figure 2). The rim diameter, lip thickness, and wall thickness are also not uniform, as reflected in the higher C.V. (Table 1). Despite the variation in morphological traits, all MIS4 basin samples appear to share similar technological traits, including a lack of striation marks on the surface, the use of incision as a decorative technique, and the presence of a thick dark firing core sandwiched by thin layers of pale brown and reddish brown ceramic paste. A lack of striation marks indicates that the vessels were likely made by hand-forming methods, although

it is difficult to identify further forming methods (e.g. coiling, moulding, slab building). The dark firing core suggests that the vessels were fired in a reducing atmosphere followed by a brief period of oxidation. These observations of the technological traits also apply to the majority of samples from MIS1/2, MIS2, and MIS3.

Late to post-Meroitic pottery at Meroe

Four main vessel forms, including 27 bowls, eight jars, three basins, and two baking plates, are identified among the assemblage from MIS6. The bowls, being the largest class of vessel form, can be further divided

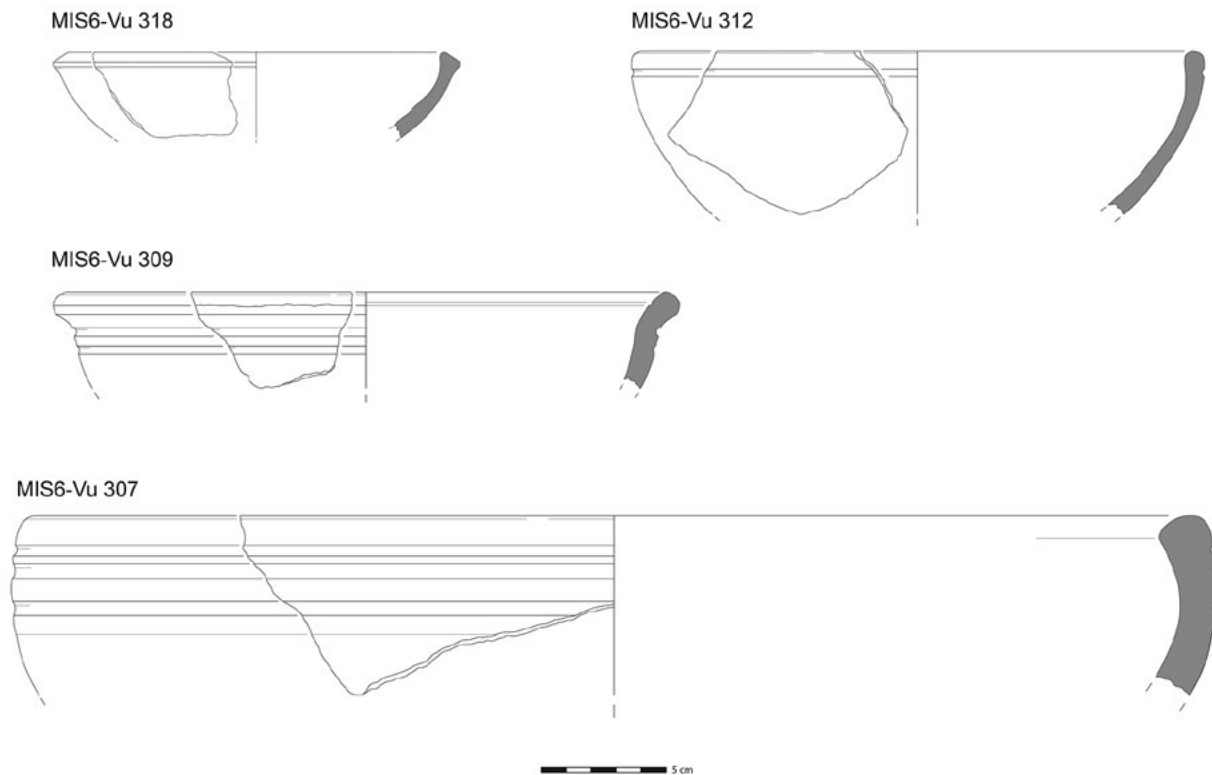


Figure 3: Planar and profile view of selected samples representative of different types of bowls from MIS6: small bowl (Vu 318), medium bowl (Vu 312), deep bowl (Vu 309), and big bowl (Vu 307) (Illustration: Saskia Büchner-Matthews).

into small, medium, large, and deep, based on their size derived from the rim diameter estimation (Figure 3; Table 2). Noteworthy here is that ‘deep’ is used to describe the projected shape of the vessel deduced from the rim orientation and diameter, and such a description has little implication on the potential function of the vessels. The wall thickness more or less corresponds with the rim diameter, whereby the smaller bowls have thinner walls and vice versa, although wall thickness is not standardised within each bowl type as reflected in their higher C.V. (Table 2). The majority of the bowl samples have similar rim shapes, which is characterised by a straight rim with a round or slightly pointy edge. Parallel striation marks can be found on the surface of the majority of the bowl samples, indicating that the vessels were likely formed by wheel-throwing. Where decoration is recorded, it is mostly in the form of incised lines (single or double) running beneath the rim, with some of the bowls being covered in reddish brown slip. The ceramic paste colour ranges from homogeneous reddish yellow or pale brown to the presence of a thick, dark firing core, suggesting that the bowls were fired in a wide range of redox atmospheres.

The jar, being the second largest class of vessel forms, can also be divided into necked jars and jars. The rim diameter, lip thickness, and wall thickness of both jar

types are not standardised, as seen in the C.V. (Table 2). The rim shape is also not uniform, and no two samples within each type share the same rim shape. Although the morphological features are not homogenous, the jars share similar technological traits, including the identification of parallel striation marks, and a lack of decoration on the exterior surface of all but one of the samples. Most samples have a dark firing core of varying thickness sandwiched between a pale brown or greyish brown ceramic paste, indicating that the jars were likely fired in an incomplete oxidising atmosphere.

The three basin samples from MIS6 have a more consistent rim diameter, more outward curving and thicker lip, and more diverse surface decoration as opposed to the MIS4 basins. However, these basins vary in lip thickness, wall thickness, decoration, and the presence and thickness of a dark firing core (Table 2). Similar observations also apply to the two baking plate samples.

Late to post-Meroitic pottery at Hamadab

Three main forms, including 16 bowls, ten jars, and two baking plates, are identified among the Hamadab assemblage. The bowl, being the largest class of vessel forms, can be further divided into bowl, large,

Table 2: The minimum value (min.), maximum value (max.), mode, mean, standard deviation (st. dev.), and coefficient of variation (C.V.) of the rim diameter, lip thickness, and wall thickness of different bowl types, jar types, basin, and baking plate from MIS6.

Site	Vessel form	Vessel type	Dimension	Min. (cm)	Max. (cm)	Mode (cm)	Mean (cm)	St. dev.	C.V.
MIS6	Bowl	Small bowl (n=14)	Rim diameter	12	16	16	15	1.33	9
			Lip thickness	0.41	1.07	n/a	0.72	0.24	34
			Wall thickness	0.52	0.86	n/a	0.64	0.12	18
		Medium bowl (n=9)	Rim diameter	18	30	22	23	3.99	17
			Lip thickness	0.75	1.11	n/a	0.96	0.14	15
			Wall thickness	0.58	1.13	n/a	0.74	0.16	22
		Large bowl (n=1)	Rim diameter	46	n/a	n/a	n/a	n/a	n/a
			Lip thickness	1.92	n/a	n/a	n/a	n/a	n/a
			Wall thickness	1.42	n/a	n/a	n/a	n/a	n/a
		Deep bowl (n=3)	Rim diameter	16	24	n/a	21	4.16	20
			Lip thickness	0.67	1.05	n/a	0.90	0.20	22
			Wall thickness	0.58	0.82	n/a	0.74	0.14	19
	Jar	Necked jar (n=6)	Rim diameter	8	23	10	12	5.67	48
			Lip thickness	0.59	1.22	n/a	0.84	0.26	31
			Wall thickness	0.39	1.05	n/a	0.75	0.25	34
		Jar (n=2)	Rim diameter	22	31	n/a	27	6.36	24
			Lip thickness	1.05	1.57	n/a	1.31	0.37	28
			Wall thickness	0.82	0.95	n/a	0.89	0.09	10
	Basin (n=3)	n/a	Rim diameter	37	40	n/a	39	1.53	4
			Lip thickness	2.02	3.07	n/a	2.56	0.53	21
			Wall thickness	0.97	1.32	n/1	1.15	0.18	15
	Baking plate (n=2)	n/a	Rim diameter	38	40	n/a	39	1.41	4
			Lip thickness	1.38	1.69	n/a	1.53	0.22	14
			Wall thickness	1.59	1.91	n/a	1.75	0.23	13

deep, flat, and closed, based on a combination of the estimation of the rim diameter and the projection of the overall vessel shape (Figure 4). We recognise that different criteria were used to define the bowl types, and this is based on the presence of different types and sizes of bowls in each assemblage. Almost half of the Hamadab samples (n=7) are placed into the bowl type. When cross-referencing with the bowls from MIS6, the rim diameter of the Hamadab bowl types is consistent with the range of the medium bowl of MIS6. Four samples belong to the large bowl type. The wall thickness of the bowls and large bowls correspond with the rim diameter, in which the large bowls generally have thicker walls than the bowls, even though the wall thickness of the bowls of each type is not standardised, as reflected in their higher C.V. (Table 3). The remaining bowl samples are placed into the smaller types of deep

bowl (n=2), flat bowl (n=2), and closed bowl (n=1), with their dimensions listed in Table 3. The bowl samples also display great variation in their rim shape.

Despite the variation in rim shape and diameter, and wall thickness, other morphological and technological traits are similar among the bowls. Reddish brown is the common slip colour. Incision is the principal mode of decoration where decoration is recorded, even though other modes of decoration, such as stamping, painting and punctuation were also used to create a diversity of designs. The majority of the samples have a dark firing core of varying thickness sandwiched between lighter-coloured ceramic paste, indicating that the bowls were fired in an incomplete oxidising atmosphere or a reducing atmosphere, followed by a brief period of oxidation. Overall, in comparison with the MIS6

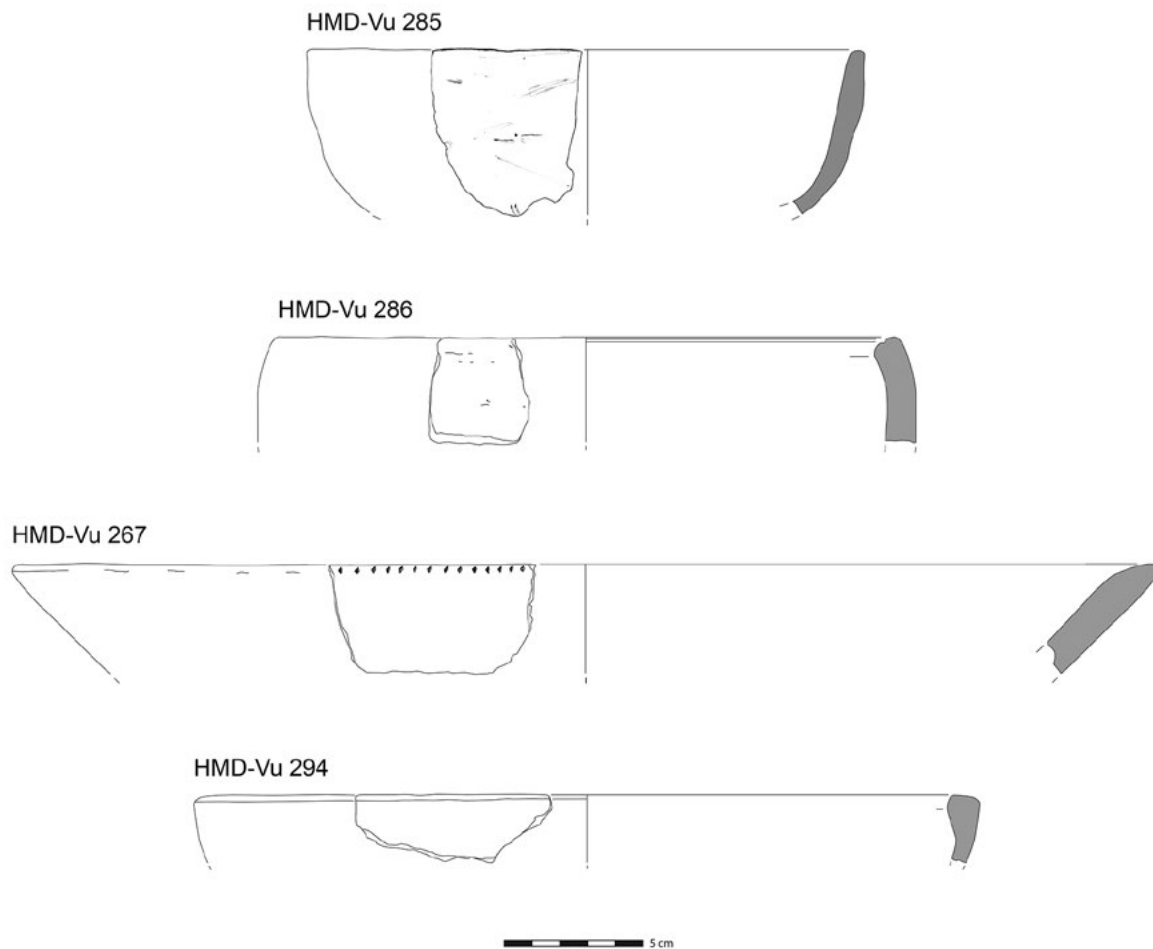


Figure 4: Planar and profile view of selected samples representative of different types of bowls from Hamadab: bowl (Vu 285), deep bowl (Vu 286), flat bowl (Vu 267), and closed bowl (Vu 294) (Illustration: Saskia Büchner-Matthews).

bowl samples (and allowing for the limited nature of the sample collection), an interesting observation within the Hamadab assemblage is the absence of the bowl with a smaller rim diameter (the small bowl), which is the largest type of all bowl samples from MIS6. Another observation is that the flat and closed bowls, not featured within the MIS6 assemblage, are represented at Hamadab. A further observation is that a greater proportion of the vessels from Hamadab were produced using hand-forming methods rather than wheel-forming, which contrasts with the dominance of wheel-throwing to make the MIS6 bowls.

The jar, being the second largest class of vessel forms of this assemblage, can be divided into jar and storage jar. The jar samples ($n=7$) vary greatly in their morphological and technological traits. The rim diameter, lip thickness, and wall thickness are not standardised, as evident in their higher C.V. (Table 3). The rim shape is not uniform, with no two samples sharing the same shape. Decoration, such as incisions and diagonal scraping

marks, is only present on the exterior surface of two samples, whereas striation marks are only found on the surface of two other samples. The storage jar samples share similar morphological and technological traits, including the presence of cord-patterned decoration on the unslipped exterior surface, and a lack of striation marks (Table 3). As diverse as they appear to be, one shared trait of both jar types is the thick dark firing core sandwiched by lighter-coloured paste, suggesting that the jars were fired in a reducing atmosphere followed by a brief period of oxidation.

The two plate samples, together with the samples representative of other vessel forms, display great variation in their morphological and technological traits. None of these samples have decoration on their exterior surface, with the exception of three samples where slip is present. All samples have a dark firing core of varying thickness, implying that the vessels were likely fired in differing degrees of reducing atmosphere.

Table 3: The minimum value (min.), maximum value (max.), mode, mean, standard deviation (st. dev.), and coefficient of variation (C.V.) of the rim diameter, lip thickness, and wall thickness of the bowl types, jar types, and baking plate from Hamadab.

Site	Vessel form	Vessel type	Dimension	Min. (cm)	Max. (cm)	Mode (cm)	Mean (cm)	St. dev.	C.V.
HMD	Bowl	Bowl (n=7)	Rim diameter	18	31	31	21	6.19	24
			Lip thickness	0.54	1.30	0.57	0.88	0.36	41
			Wall thickness	0.50	1.06	0.72	0.75	0.17	22
		Large bowl (n=4)	Rim diameter	35	53	35	41	10.39	25
			Lip thickness	0.94	1.51	n/a	1.20	0.29	24
			Wall thickness	0.85	1.31	n/a	1.08	0.21	19
		Deep Bowl (n=2)	Rim diameter	22	30	n/a	26	5.66	22
			Lip thickness	0.71	0.93	n/a	0.82	0.16	19
			Wall thickness	0.83	0.93	n/a	0.88	0.07	8
		Flat bowl (n=2)	Rim diameter	41	50	n/a	46	6.36	14
			Lip thickness	0.74	1.22	n/a	0.98	0.34	35
			Wall thickness	1.00	1.21	n/a	1.11	0.15	13
		Closed bowl (n=1)	Rim diameter	27	n/a	n/a	n/a	n/a	n/a
			Lip thickness	1.18	n/a	n/a	n/a	n/a	n/a
			Wall thickness	0.72	n/a	n/a	n/a	n/a	n/a
	Jar	Jar (n=5)	Rim diameter	16	28	n/a	22	6.00	27
			Lip thickness	0.69	1.84	n/a	1.13	0.62	55
			Wall thickness	0.70	1.33	n/a	1.07	0.25	23
		Storage jar (n=5)	Rim diameter	18	n/a	n/a	n/a	n/a	n/a
			Lip thickness	0.92	n/a	n/a	n/a	n/a	n/a
			Wall thickness	0.77	1.41	n/a	0.96	0.26	27
	Baking plate (n=2)	n/a	Rim diameter	50	n/a	n/a	n/a	n/a	n/a
			Lip thickness	2.34	n/a	n/a	n/a	n/a	n/a
			Wall thickness	1.75	2.74	n/a	2.25	0.70	31

Compositional and technological variability at the microscopic level

The petrographic analysis has identified the presence of two fabric groups – the Non-mixed Clay Group (NCG) and the Mixed Clay Group (MCG) – among the samples. The samples within each group are further divided into subgroups based on mineralogical and textural variations (Figure 5 and Figure 6; Table 4).

The NCG samples are distinguished by the absence of evidence indicating the practice of clay mixing. With the exception of one sample (i.e. the outlier with very coarse-grained quartz fabric), all samples have a similar mineralogical composition characterised by the presence of quartz, biotite, muscovite, amphibole, hornblende, and plagioclase and microcline feldspar, and Fe-rich nodules. In most samples, remnants

of organic inclusions can be seen in the voids. The mineralogical composition of the samples is consistent with that of the Nile alluvium, which is described to have consisted of quartz, feldspars, amphiboles, clinopyroxenes, mica, fragments of basic volcanic rock, and phytoliths, produced from the weathering of the basaltic Ethiopian Highlands.¹⁴ Such similarity implies that the clay collected from the Nile alluvial deposits was likely the source used to make the NCG fabric. However, slight variation in textural characteristics, particularly in terms of the relative abundance of different types of inclusions and grain size, serves to divide the samples into four subgroups (Subgroups A, B, C, and D). Such variation could be attributed to the use of different deposits of Nile clays, although the verification of this hypothesis will require systematic

¹⁴ Brand (2016: 78–79); Mason and Grzymski (2009: 87–88).

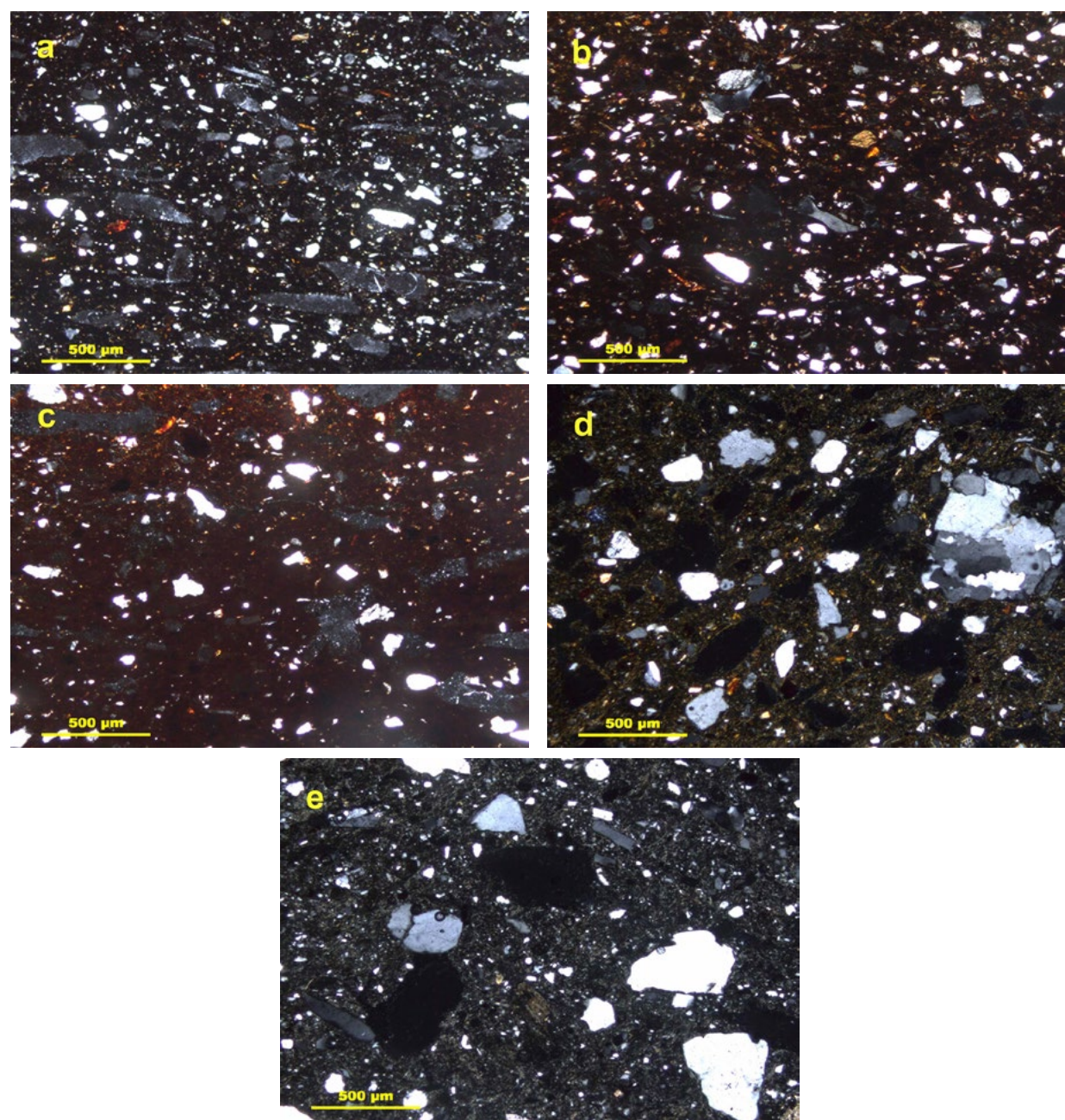


Figure 5: Photomicrographs of the fabrics of the NCG: (a) Subgroup A, (b) Subgroup B, (c) Subgroup C, (d) Subgroup D, and (e) outlier with coarse-grained quartz inclusions. All photomicrographs are taken in crossed polarisation at x50 (Photomicrographs: Carmen Ting).

sampling and analysis of the Nile clays in the region. The fabric of the outlier is dominated by the presence of quartz inclusions with very few mineralogical constituents that are similar to the Nile alluvium, making it difficult to establish its potential provenance.

The MCG samples exhibit evidence indicating the occurrence of clay mixing. Clay mixing here refers to the practice of adding clay pellets and/or mixing two or more different clays. Variation in the type of clay pellets or clays added or mixed divides the samples

into seven subgroups. In the case of Subgroups A, B, C, D, and F, the clay pellets were added as temper to the clays derived from the Nile alluvium, which have a composition similar to some NCG samples. Thus, a local production is postulated for the pottery belonging to these subgroups. However, the potential provenances of the raw materials of the remaining two subgroups in the MCG are yet to be determined. Subgroup E stands out for its absence of the mineralogical composition characteristic of the Nile alluvium, as well as the addition of micritic calcite and Fe-rich clay pellets to

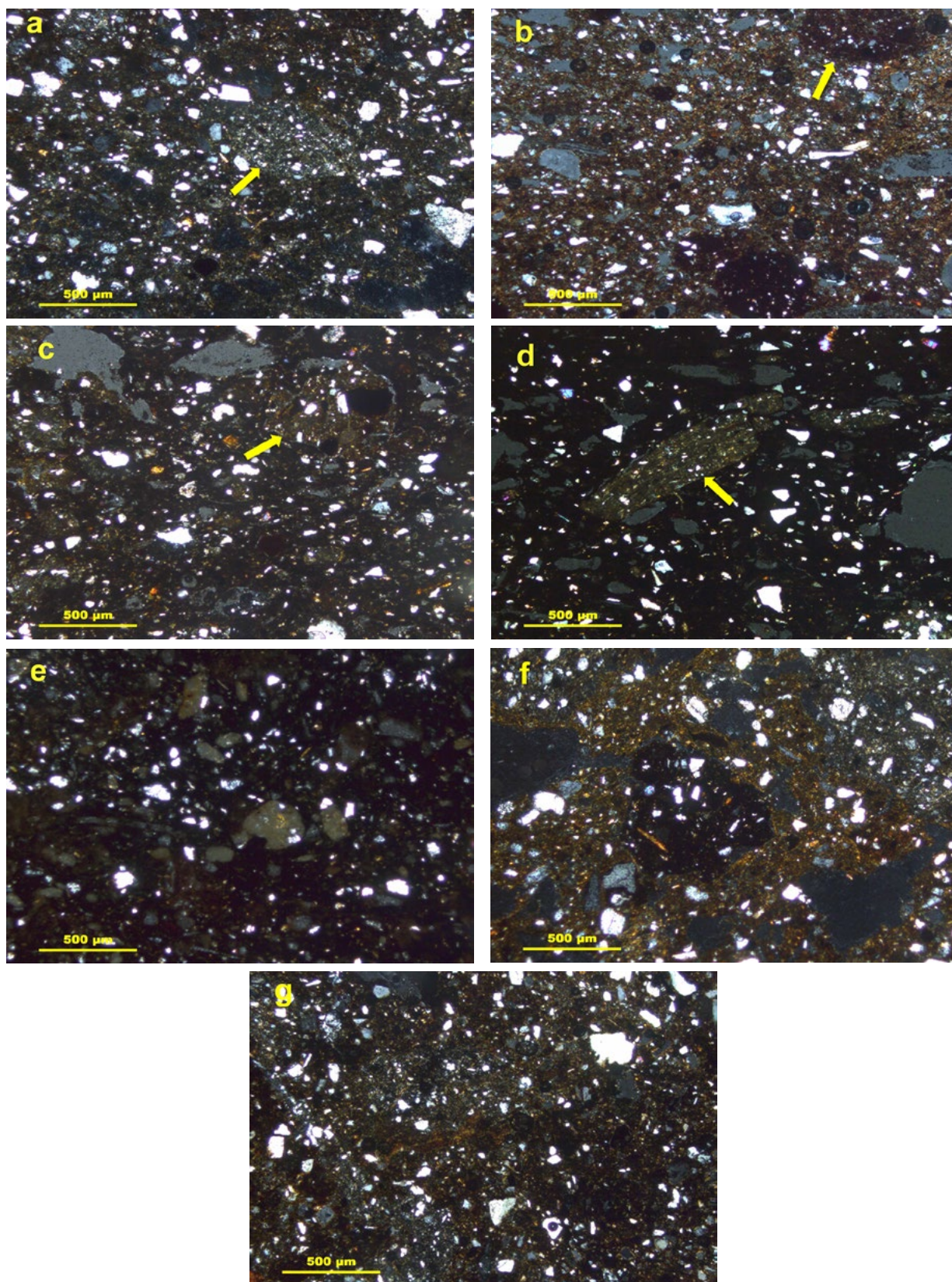


Figure 6: Photomicrographs of the MCG, with features noted here marked with arrows: (a) Subgroup A with clay pellets added to the Nile clay, (b) Subgroup B with Fe-rich pellets added to the Nile clay, (c) Subgroup C with clay pellets added to the Nile clay with biotite-rich matrix, (d) Subgroup D with kaolinite added to the Nile clay, (e) Subgroup E with micritic calcite and Fe-rich pellets added to the clay, (f) Subgroup F with grog and clay pellets added to the clay, and (g) Subgroup G with wet clays mixing. All photomicrographs are taken in cross polarisation at x50 (Photomicrographs: Carmen Ting).

Table 4: The frequency distribution of fabric groups and associated subgroups by contexts.

Fabric Group	Fabric Subgroup	Brief description	MIS1/2	MIS2	MIS3	MIS4	MIS6	HMD
Non-mixed Clay Group (NCG)	Subgroup A	Nile clay	-	1	3	2	17	7
	Subgroup B	Nile clay with biotite-rich matrix	2	-	2	3	5	3
	Subgroup C	Nile clay with very red matrix	-	-	-	-	4	-
	Subgroup D	Nile clay with coarse-grained quartz inclusions	-	-	-	-	2	4
	Outlier	Very coarse-grained quartz	-	-	-	-	-	1
Mixed Clay Group (MCG)	Subgroup A	Clay pellets added to the Nile clay	-	1	-	-	8	8
	Subgroup B	Fe-rich pellets added to the Nile clay	-	-	-	-	5	3
	Subgroup C	Clay pellets added to the Nile clay with biotite-rich matrix	-	-	-	-	3	2
	Subgroup D	Kaolinite added to the Nile clay	-	-	-	-	2	-
	Subgroup E	Micritic calcite and Fe-rich pellets added to clay	-	-	-	-	-	3
	Subgroup F	Grog added to clay	-	-	-	-	1	1
	Subgroup G	Wet clay mixing	-	-	-	-	1	2

the clay. The clays of Subgroup G were mixed when they were wet, as is evident in the lack of clear boundaries of the two clays and a clear difference in the mineralogical composition and matrix colour. One of the clays contain the mineralogical constituents distinctive to the Nile alluvium, whereas the other clay contains mainly quartz inclusions, suggesting that at least part of the raw materials used to make this fabric came from the Nile.

Napatan and early Meroitic pottery at Meroe

The pottery samples recovered from MIS1/2, MIS2, MIS3, and MIS4 exhibit little variation in terms of their composition. The petrographic data show that all but one sample belong to the NCG, specifically Subgroups A and B. This finding suggests that Nile clay served as the principal source of raw materials used to make the vessels, and that clay mixing was not involved in the preparation of the ceramic paste recipes. The relatively small range (0.05 mm–0.50 mm) and a strong mode (0.20 mm) of grain size in the inclusions of both fabric groups (NCG Subgroups A and B) imply that the clays were either naturally well sorted or the ceramic pastes were prepared in a standardised way. The voids and inclusions do not align parallel to the margin of the thin section as one would expect in wheel-thrown samples, supporting the macroscopic observation of the use of hand-forming techniques.

There is no correlation between the Nile clay fabrics and context of recovery, with the samples of NCG Subgroups A and B present in all slag heaps except MIS1/2. No correlation is seen between the fabrics and vessel forms, although the variety of vessel forms found in these early contexts is not as diverse as those found in the late and post-Meroitic contexts. Two of the three basin samples from MIS4 (Vu 686 and 688) belong to the same fabric subgroup, NCG Subgroup A. However, these two samples do not have uniform rim shape, rim diameter, lip thickness, or wall thickness. The observed variation in the basin samples may reflect the presence of types within the basin class, or that these samples were produced by different producers.

Late to post-Meroitic pottery at Meroe

The samples from MIS6 are placed into more diverse fabric groups and associated subgroups. More than half of the samples belong to the NCG, further placed into Subgroups A, B, C, and D, although mostly in the first two subgroups. The remaining samples belong to the MCG, also divided into Subgroups A, B, C, D, F, and G. The identification of more fabric groups among the MIS6 samples has two implications. The first one is that a greater variety of raw materials were used in later times. These raw materials include possibly more deposits of the Nile clays and different tempering materials such as clay pellets, Fe-rich pellets, kaolinite

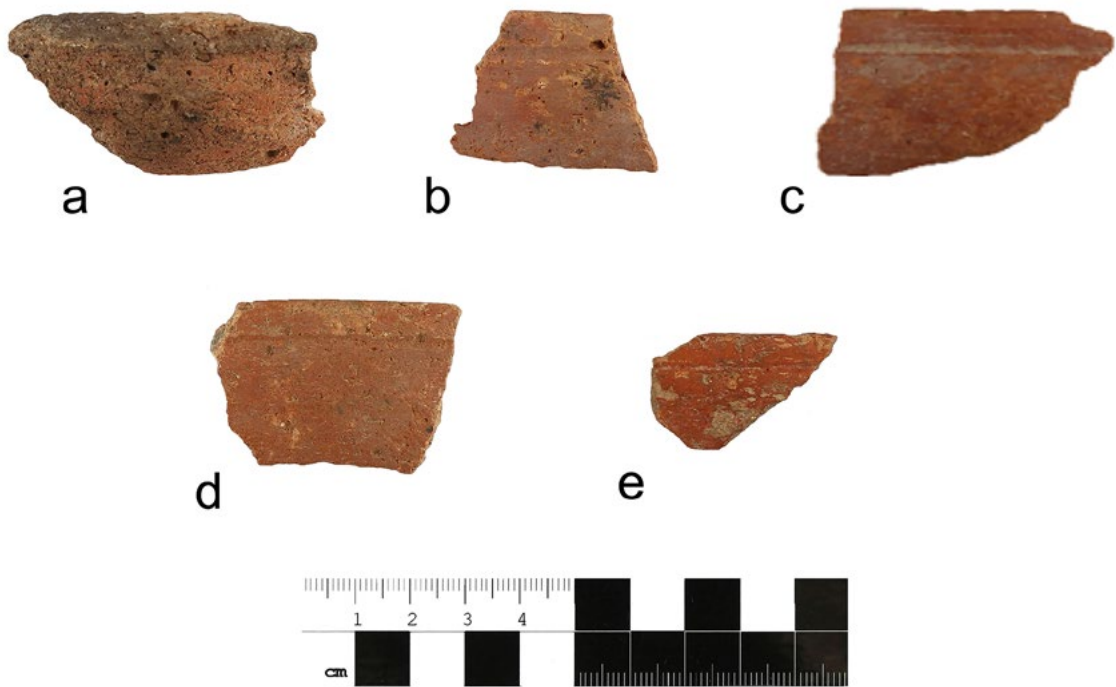


Figure 7: Small bowls from MIS6: (a) Vu 318, (b) Vu 391, (c) Vu 415, (d) Vu 448, and (e) Vu 745 (Photos: Saskia Büchner-Matthews).

Table 5: The rim diameter, lip thickness, wall thickness, distance between the rim edge and top of the incised line, incised line width, and fabric subgroup of five small bowls from MIS6. The mean, standard deviation (st. dev.), and coefficient of variation (C.V.) of four samples belonging to NCG Subgroup A are also presented.

Sample no.	Rim diameter (cm)	Lip thickness (cm)	Wall thickness (cm)	Rim edge and top of the incised line distance (cm)	Incised line width (cm)	Fabric subgroup
Vu 318	15	0.56	0.61	0.68	0.18	NCG Subgroup A
Vu 391	13	0.51	0.60	0.59	0.21	
Vu 415	14	0.45	0.52	0.67	0.17	
Vu 448	16	0.55	0.53	0.63	0.20	
Mean	15	0.52	0.57	0.64	0.19	
St. dev.	1.29	0.05	0.05	0.04	0.02	
C.V.	9	10	8	6	10	
Vu 745	14	0.52	0.68	0.54	0.09	MCG Subgroup B

fragments, and grog. The second implication is related to the assignment of more samples to the MCG, suggesting that clay mixing, which was rarely seen in the samples from the earlier contexts, was a common practice at Meroe during the later and continuing into the post-Meroitic period.

By cross-referencing the fabrics and vessel forms, it is apparent that each fabric subgroup was used to make more than one vessel form; and that more than one fabric was used to make each vessel form. More specific

correlation exists between fabric subgroups and vessel forms. This is reflected in the use of NCG Subgroup A to make only three vessel forms in spite of it being the largest fabric subgroup among all the MIS6 samples, comprising 57% (n=8) of the small bowl samples, 56% (n=5) of the medium bowl samples, and 57% (n=4) of the necked jar samples. For the necked jar samples, only one fabric, i.e. MCG Subgroup A, was used to make the vessels. However, the correlation between fabrics and vessel forms alone is not sufficient to indicate whether or not specialised production was involved in pottery

Table 6: The normalised data of the elemental composition (wt %) of the slip and associated ceramic body of three small bowls and two medium bowls from MIS6, and one bowl from Hamadab (HMD).

Site	Vessel form	Sample no.	Area of analysis	Na2O	MgO	Al2O3	SiO2	K2O	CaO	TiO2	FeO
MIS6	Small bowl	Vu 318	Slip	2.6	1.5	30.7	48.0	2.4	3.0	1.0	10.8
			Body	1.4	2.6	26.4	54.3	2.6	2.3	1.2	9.3
		Vu 391	Slip	2.3	1.1	30.9	47.1	2.5	3.5	1.2	11.5
			Body	1.4	2.4	29.1	51.9	2.1	2.5	1.2	9.3
		Vu 745	Slip	1.3	0.8	32.2	49.6	1.8	1.8	1.2	11.3
			Body	1.5	1.7	24.4	58.2	2.5	3.9	1.4	6.4
	Medium bowl	Vu 313	Slip	2.0	0.9	31.9	48.0	2.1	2.1	1.3	11.7
			Body	1.9	1.6	28.2	54.0	2.0	2.5	1.2	8.7
		Vu 417	Slip	1.4	1.3	29.8	47.6	4.3	2.9	1.1	11.7
			Body	0.9	2.1	25.1	56.3	2.4	3.0	2.0	8.1
HMD	Bowl	Vu 262	Slip	2.6	0.5	30.2	44.7	6.5	1.4	1.2	12.9
			Body	0.7	1.3	29.9	57.7	2.5	1.9	1.0	5.0



Figure 8: Medium bowls from MIS6: (a) Vu 312, (b) Vu 313, (c) Vu 417, and bowl from Hamadab (d) Vu 262 (Photos: Saskia Büchner-Matthews).

Table 7: The rim diameter, lip thickness, wall thickness, distance between the rim edge and top of the incised line, incised line width, and fabric subgroup of three medium small bowls from MIS6 and one bowl from Hamadab. The mean, standard deviation (st. dev.), and coefficient of variation (C.V.) of two medium bowls belonging to NCG Subgroup A are also presented.

Site	Sample no.	Rim diameter (cm)	Lip thickness (cm)	Wall thickness (cm)	Rim edge and top of the incised line distance (cm)	Incised line width (cm)	Fabric subgroup
MIS6	Vu 312	22	0.83	0.70	0.65	0.27	NCG Subgroup A
	Vu 313	20	0.78	0.70	0.68	0.24	
	Mean	21	0.81	0.70	0.67	0.26	
	St. dev.	1.41	0.04	0	0.02	0.02	
	C.V.	7	4	0	3	8	
	Vu 417	20	0.75	0.61	0.80	0.39	MCG Subgroup D
HMD	Vu 262	28	1.02	0.72	0.77	0.29	NCG Subgroup B

production, given the diversity of technological and morphological traits that are clustered under the same fabric and vessel form. That being said, a strong correlation among the fabrics, vessel forms, and technological and morphological traits is detected in two cases as described below.

Five small bowl samples (MIS6-Vu 318, 391, 415, 448, and 745) share similar morphological traits, i.e. a straight rim with a round edge, an exterior surface covered with reddish brown slip, and a single incised line beneath the rim on the exterior surface (Figure 7). Four out of five bowl samples belong to NCG Subgroup A and are homogeneous in terms of the range of the grain size (0.05 mm–0.50 to 0.60 mm) and mode grain size (0.15 mm). These four samples are also homogeneous in terms of the lip thickness, wall thickness, distance between the edge of the rim and the top of the incised line, and width of the incised line, as reflected in the C.V. of the respective dimensions (Table 5). The chemical composition of the slip and associated ceramic body of two selected samples reveals that the composition has slight but systematic variation, in which the slip has higher FeO and lower SiO₂ and CaO concentrations than the ceramic body, as revealed by the SEM-EDS analysis (Table 6). This suggests that a similar source of clay was used to make both slip and ceramic body, but quartz grains may have been removed to attain the fineness of the clay required for the slip, and iron oxide might have been added to enhance the redness of the slip. The remaining sample not only stands out due to its different fabric, i.e. MCG Subgroup B, and thus different paste preparation method, but also its lip thickness, wall thickness, distance between the edge of the rim and the top of the incised line, and width of the incised line (Table 5). The SEM-EDS analysis of this sample suggests that the slip and ceramic body of this sample were made of clay of a similar source and that this was not the same source as that procured for the other samples (Table 6).

Another example is three medium bowls (MIS6-Vu 312, 313, and 417) that have a straight rim with a round edge, an exterior surface covered with reddish brown slip, and a single incised line beneath the rim (Figure 8). Two samples belong to NCG Subgroup A, with their inclusions being homogeneous in terms of grain size range (0.05 mm–0.70 to 0.75 mm) and mode grain size (0.20 mm). These two samples also have uniform morphological features, expressed in the lower C.V. of the lip thickness, wall thickness, distance between the edge of the rim and the top of the incised line, and width of the incised line (Table 7). The remaining sample contrasts with the other two owing to its different fabric, one that is characteristic of MCG Subgroup D, as well as displaying different dimensions and morphological traits (Table 7). By comparing the result of the SEM-EDS analysis of one sample from NCG Subgroup A (Vu 313) and one from MCG Subgroup D (Vu 417), clay from similar sources might have been used to make the slip and associated ceramic body in both cases, but the difference in the composition between the analysed samples is not significant enough to prove that different clays were used (Table 6).

Late to post-Meroitic pottery at Hamadab

The samples from Hamadab are placed into as many fabric groups and associated subgroups as the MIS6 samples. Two observations based on these small sample groups could distinguish the fabrics of Hamadab from those of MIS6. The first is that a greater proportion of the samples are defined as MCG than NCG. The MCG samples account for more than half of the assemblage, further divided into Subgroups A, B, C, E, F, and G. The remaining samples belong to the NCG, placed into Subgroups A, B, D, and the outlying fabric with coarse-grained quartz inclusions. In particular, MCG Subgroup A is the largest fabric subgroup, comprising 23% (n=8) of the samples from Hamadab, and this contrasts with the dominance of NCG Subgroup A

among the samples from Meroe. We argue that such a difference in the preference of ceramic paste recipes indicates that the producers at Hamadab during this later period were using more diverse sources of raw materials, and in some cases raw materials that were not used by their counterparts at Meroe. This is evident in the identification of MCG Subgroups E and G, which is exclusive to the samples from Hamadab. Also, clay mixing seems to be more widely practiced at Hamadab. The second observation is that the inclusions of the Nile clays used to make the vessels from Hamadab are generally coarser-grained, regardless of the fabric groups they are assigned to. An obvious example is NCG Subgroup A, in which the grain size stretches a broader range measuring between 0.05 mm and 1.20 mm, and displays a coarser mode measuring 0.30 mm, than its counterparts from Meroe. Whereas it is possible that the coarser grain size of the Nile clays was reflective of the natural variation of raw materials (the sites are located c. 3 km away from each other along the eastern bank of the Nile),¹⁵ it is also possible that the producers at Hamadab were not as effective in removing the coarse particles of the Nile clays.

A comparison of the fabrics and the vessel forms of the samples from Hamadab shows that each fabric was used to make more than one vessel form, and that more than one fabric was used to make each vessel form, as was also seen in the MIS6 samples. More specific correlation exists between MCG Subgroup A and the bowls, with MCG Subgroup A being the fabric most commonly used to make the bowls. However, such a correlation is complicated when the technological and morphological traits of the bowls are also considered because their rim shape, lip thickness, wall thickness, and mode and type of decoration (HMD-Vu 264, 287, and 297) are not homogeneous.

Of particular interest is one bowl sample (Vu 262), which shares similar morphological traits with some medium bowl samples from MIS6 (Vu 312, 313, and 417) (Figure 8). This bowl sample has a round-edged rim that curves slightly inward, reddish brown slip on the exterior surface, and a single incised line beneath the rim. The wall thickness, distance between the edge of the rim and the top of the incised line, and width of the incised line of Vu 262 falls within the range of the dimensions of the MIS6 medium bowls, whereas its rim diameter and lip thickness are slightly outside the range (Table 7). Petrographic analysis of Vu 262 shows that the bowl was made using the ceramic paste recipe characteristic of NCG Subgroup B, which was not used to make any MIS6 medium bowl samples. The SEM-EDS analysis reveals the difference in the composition of the slip and ceramic body between HMD-Vu 262 and the MIS6 samples (Vu 313 and 417), suggesting that the

clay for the Hamadab bowl may have been acquired from a source different from that used to make the medium bowls from Meroe. Based on these findings, we argue that HMD-Vu 262 may have been a variant of the medium bowl local to Hamadab; highlighting the co-existence of multiple producers or workshops at Meroe and Hamadab producing the bowls that were intended for local circulation and consumption.

Despite the correlation between MCG Subgroup A and the bowls, no other clear correlation is noted between other fabrics and vessel forms among the Hamadab samples. An interesting observation is made regarding the fabrics of the baking plates (Vu 270, 308, and 309). While different fabrics – NCG Subgroup D, MCG Subgroup F, and the very coarse-grained outlier of NCG – were used to make the three baking plate samples, they are all coarse-grained fabrics, with the mode grain size of the inclusions ranging from 0.50 mm to 0.75 mm. The choice of using coarse-grained fabrics to make baking plates may relate to the vessel's function, as coarse-grained inclusions have the effect of increasing thermal shock resistance during cooking and food preparation.

Discussion

By comparing the relative standardisation of the morphological, technological, and compositional attributes, we are able to explore the level of specialisation in pottery production, and using this characteristic, suggest how the organisation of such craft might have changed through time. The samples dating to the Napatan and early Meroitic periods are characterised by a lower level of standardisation in the morphological attributes and a higher level of standardisation in the compositional and technological attributes. Whereas the small sample size should be taken into account, the compositional and technological standardisation can be interpreted as reflective of the producers sharing a similar set of technical practices in pottery making. These technical practices include the use of clays from the Nile alluvium, which were not mixed with other clays or tempered in preparing the ceramic pastes; the use of hand-forming methods and incision to form and decorate the vessels; and the firing of vessels in incomplete oxidising or reducing atmospheres. We suggest that the use of a similar set of technical practices to produce different vessel forms could point to the existence of some sort of specialisation oriented toward the producers, as well as to some levels of continuity in technical practices throughout the Napatan and early Meroitic periods.

The level of standardisation of the morphological, compositional, and technological attributes varies within the samples from MIS6, dating to the late and post-Meroitic periods. A higher level of standardisation

¹⁵ Wolf (2015: 124–128).

and a strong correlation among the three attributes are observed in some samples. This is demonstrated by some small bowls with a single incised line (Vu 318, 391, 415, and 448) and the medium bowls with a single incised line (Vu 312, 313, and 417). The results of the macroscopic, petrographic, and SEM-EDS analyses suggest that the vessels were likely products of specialised producers or groups of producers, each using a specific set of technical practices in raw materials selection, paste preparation, and surface finish (both slip and decoration) that were highly standardised in execution. These technical practices appear to have varied from producer to producer, or from group to group, as highlighted by the manner in which the outlying small bowl sample with a single incised line (Vu 745) and the medium bowl sample with a single incised line (Vu 417) deviate from their counterparts in terms of the ceramic body and slip composition, and the dimension of morphological features. The co-existence of more than one set of technical practices among the small bowls with a single incised line and medium bowls with a single incised line could imply that multiple producers took part in the production of these vessels during the later period at Meroe. Although they used technical practices that were specific to themselves or their groups, it seems that these producers aimed at making vessels that exhibited similar appearances. In this sense, we suggest that the specialisation was not only centred on the producers, as was the case during the Napatan and early Meroitic periods, but also on the products.

The producers during the later period at Meroe were not tied to producing only one vessel form and type, as shown in the identification of different vessel forms and types within each fabric. However, a high level of standardisation and strong correlation among the three attributes is not recorded in other samples of small and medium bowl types, as well as other vessel forms and types from MIS6. This is highlighted, for example, by the vessels of NCG Subgroup A. The necked jars display a lower level of standardisation in morphological features, which contrast with the highly standardised small bowls and medium bowls as described above, despite the use of the same ceramic paste recipe. The observed variation in the level of standardisation may relate to the vessel's function, as the bowls were 'tableware' made for serving purposes, whereas the necked jars were produced for cooking and liquid or food storage.¹⁶ We interpret this finding as additional evidence demonstrating the skills and technological know-how of the producers.

The samples from Hamadab are generally marked by a lower level of standardisation and a weak correlation among the morphological, compositional,

and technological attributes within and across the vessel forms and types. Although our present findings show that pottery production at Hamadab displayed lower level of specialisation during the later Meroitic and post-Meroitic period, such production was characterised by the following features. First, the producers seem to have had greater liberty in the execution of technical practices. They did not follow the producers of the vessels from the earlier periods at Meroe in using a standardised set of technical practices to produce different vessel forms and types. They also did not follow the producers of the vessels from MIS6, operating at a similar time but 'down the road', in using a specific set of technical practices to produce a specific vessel form and type, and/or adopting the use of the potter's wheel. Second, not all producers at Hamadab achieved uniformity in the morphological features of the end products, even though they might have shared the idea of what certain vessel forms and types should look like. Whether this is due to a difference in technical skill or that such uniformity was not considered significant to achieve is unknown. This is highlighted, for example, by the storage jars with cord/matt-patterned decoration and the medium bowl with a single incised line (Vu 262). As for the latter example, in particular, the production of the medium bowl from Hamadab was cruder, with the incised line being faint and crooked rather than broad and straight as was its MIS6 counterparts (MIS6-Vu 312, 323, and 417). Nonetheless, we suggest that the producers at Hamadab exhibited a technological know-how, as expressed in the link between the use of coarser-grained fabrics and the function of the baking plates.

We suggest that the observed difference in the degree of specialisation in pottery production could be linked to the socio-political developments within the broader society. The dominance of an apparently more standardised approach to pottery production during the Napatan and early Meroitic periods coincided with the time when the City of Meroe was perhaps gaining in political power, indicated by the production of large quantities of iron to supply the kingdom and by the appearance of royal burials in the area from the early third century BC. The pottery production might have shifted to the coexistence of multiple, standardised approaches during the later Meroitic and post-Meroitic periods when the decline of the Royal City of Meroe, and indeed the Kingdom of Kush, was underway. Despite its apparent demise, Meroe seems to have maintained producers that possessed certain standards of technical knowledge and skills to execute specialised production, and this access was possibly not available to other contemporaneous settlements such as Hamadab. This is suggested in the parallel development of pottery production at Hamadab during the late to post-Meroitic period, in which the producers seem to have improvised with raw materials and techniques rather

¹⁶ Dittrich (2010: 89–90).

than adhering to a rigid program of technical practices as were their counterparts at Meroe. This finding echoes the results of our previous study on the production of technical ceramics used for iron production recovered from the same slag heaps – which highlights the difference in the manufacturing technology and craft organisation between Meroe and Hamadab – although the interaction between the production of pottery and technical ceramics is yet to be established and will be the focus of future research.¹⁷

Our results are complementary to the extant characterisations – especially two main features – of Kushite pottery production. The first feature is the potters' preference for selecting the clays from the Nile alluvium and the use of various ceramic paste recipes.¹⁸ In this regard, our results also correspond with the previous study of the pottery from Meroe,¹⁹ which showed that clay mixing was a common practice in preparing the ceramic pastes for Meroitic pottery. The second feature is the recognition of the existence of a certain degree of specialisation in pottery production, which has been emphasised by the majority of previous research on Kushite pottery production. However, it is difficult to compare whether or not the level of specialisation as seen in the pottery in our study is as 'high' as was identified in previous studies, given the differences in the criteria used to assess specialised production, in which we applied the concept of standardisation to the study of ceramics recovered from non-production locations as opposed to the assumption of the presence of specialised production based on the recovery of kiln and/or finewares by the previous studies.²⁰ Notwithstanding the hypothesis of specialised production, our results are able to further indicate that the degree of specialisation evolved through time, and that different levels and types of specialisation co-occurred within the same time period. Yet, in spite of its possible association with the socio-political developments of Kushite society, there is no evidence indicating that the pottery production was administered by the elites, which has been suggested for the production of some fineware ceramics.²¹

Conclusion

Whereas it is true that our overall sample size is small, our research, nonetheless, marks a starting point towards a deeper understanding of the craft organisation in Kushite society by investigating

pottery production and technology, which is somewhat underrepresented within the existing analytical framework. By using a combination of macroscopic and microscopic analyses, the resultant data have not only indicated the presence of a certain degree of specialisation in the pottery production, but also highlighted how such specialisation may have changed through time. We further emphasise the possible link between pottery production and the socio-political developments of the Kushite society, and the possibility that this can also be seen within the craftspeople responsible for making the technical ceramics used for iron production. Our insights are possible owing to the focus and methods used in our study, which serve to add an extra dimension to the current research on Kushite pottery. First, we focused on the ceramic assemblages rather than the kiln structures and associated remains as indicator of specialisation. We deliberately selected samples of pottery that are dated to different time periods, permitting us to explore how the production changed through time. We introduced a list of attributes concerning different aspects of pottery production, such as morphology, composition, and technology, rather than using only one attribute such as composition or decoration. These attributes constitute the basis of comparison to evaluate the relative level of standardisation and thus specialised production. The potential of this approach is solidified by our results, suggesting that it can be applied to other studies, especially when direct evidence of production is unavailable. In this way, more data will be generated, and when interpreted in conjunction with the direct evidence of production, will lead to a more comprehensive understanding of ancient pottery production in Sudan.

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¹⁷ Ting and Humphris (2017).

¹⁸ Brand (2016: 79–82); Daszkiewicz and Bobryk (2003); Daszkiewicz *et al.* (2005); Daszkiewicz and Schneider (2011); Mason and Grzymski (2009: 87–89).

¹⁹ Brand (2016: 82–84); Mason and Grzymski (2009: 88–89); Smith (1997; 1999: 45–46).

²⁰ Edwards (1999: 37–38; 2014); Robertson and Hill (2004: 116–117); Török (1997: 530); Wolf *et al.* (2014: 12).

²¹ Edwards (2014); Smith (1999); Török (1997: 530).

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11. Ground Stones: The Product as a Production Place

Adnan Baysal

Abstract

Product and production issues are debated widely in archaeological literature. This paper shows that a product can also be a production place using grinding stones as an example of multi-functional tools. These large lithic tools are portable and employed for food and tool production. They are made by using lithic tool making technologies such as rubbing and knapping. The *chaîne opératoire* approach is useful to understand the technologies related to their production. Based on this, it is possible to track ground stone tools as products of technologies in sequences of tool making, resulting in final products. Ground stones are the result of applied lithic technologies until they start to be used, at which point they become a production place. This paper emphasises how an artefact can transition from being a product to a production place.

Keywords: product; production; ground stones; context; Çatalhöyük

Kurzfassung

Fragen zu den Begriffen ‘Produkt’ und ‘Produktion’ werden in der Archäologie umfassend diskutiert. Diese Arbeit zeigt, dass ein Produkt auch ein Produktionsort sein kann, was am Beispiel von Mahlsteinen dargestellt wird. Diese großen Steinartefakte sind multifunktional und mobil, und wurden bei Nahrungs- sowie Geräteproduktion eingesetzt. Sie wurden unter Verwendung von Techniken wie Reiben und Abschlagen hergestellt. Der Ansatz der *Chaîne Opératoire* ist nützlich, um die Technik ihrer Herstellung zu verstehen. Darüber hinaus kann ein Mahlstein als Produkt von Technologien in Abläufen der Werkzeugherstellung verstanden werden, welche zum Endprodukt führen. Er ist das Ergebnis angewandter lithischer Techniken, bis er zum Einsatz kommt und zu einem Produktionsort wird. Hier wird dieser Übergang vom Produkt zum Produktionsort betont.

Keywords: Produkt; Produktion; Mahlstein; Kontext; Çatalhöyük

Introduction

Archaeology is concerned with material culture, and archaeological artefacts, objects and materials are often mentioned in relation to understanding past communities.¹ These items represent human engagement and interaction with the world. They are consequences of human actions in nature and/or evidence of humans’ creative existence in the world. However, when do we classify such items as artefacts, objects or materials, and how do we separate these from each other? The division between them is sometimes confused or they are often used to mean the same thing in different contexts. There are scholars in archaeology,² anthropology³ and other social sciences⁴ who have dedicated their research to understanding such definitions, such as Schiffer,⁵ who has focused on the problem of defining the above terms and aimed

to clarify the differences between these terms in his work. Schiffer tries to establish material and artefact definitions where human beings make wider encounters with the outer world: ‘An *artifact* is provisionally defined here as any material, in contradistinction to spiritual or mental, phenomenon that exhibits one or more properties produced by a given species (for another expansive definition of artifact, see Deetz 1977: 10–11). This definition allows one to refer not only to human artifacts but also to artifacts of bees or beavers. However, unless otherwise specified, “artifact” in the present work denotes *human artifact*’.⁶ Schiffer uses the artefact definition in two senses, one as above and the other including surroundings, effectively meaning almost everything. Based on the idea of Schiffer’s artefact definition, one of the most engaging topics on which archaeology focuses is production and the places where it happened. This concern either targets the artefacts themselves or any other bi-products or tools associated with them. In addition to this, the object side of the material world is also widely debated from a philosophical point of view, particularly within

¹ Gosden and Marshall (1999); Hodder (2012; 2016, 2018); Hurcombe (2007); Ingold (2012); Knappett and Malafouris (2008); Kopytoff (1986); Kraybill (1977); Miller (1987); Roux (2016); Schiffer (2002); Skibo and Schiffer (2008); Tret’iakov (2006).

² Hodder (2012; 2016).

³ Ingold (2012).

⁴ Harman (2016).

⁵ Schiffer (2002).

⁶ Schiffer (2002: 2).

the frame of 'object oriented ontologies' (OOO),⁷ and its impact can be seen in current archaeological debates⁸ as well as material culture related theoretical approaches.⁹ Harman, within the view of 'OOO', defines the term object as 'any entity that cannot be paraphrased in terms of either its components or its effects'.¹⁰ The object-oriented perception of the material world has resulted in the re-introduction of the idea of the definition of artefact, object and material in archaeological thought.

Studies concerned with archaeological material culture and its associated archaeological contexts are the primary source of information for both production and the places in which production takes place. In this sense the term 'context' refers to the physical setting of an artefact at the time when it was excavated. Anthropological and ethnographic studies also assist by providing comparative examples from living cultures. Experimental archaeology helps us to understand the technological sequences and/or strategies of production to a certain extent, as emphasised by Shillito *et al.*,¹¹ as long as the end result is known and therefore the production process and actions and behaviours related to that process can be identified. Although material culture, replicas and reproductions have advanced our knowledge by developing our understanding of the concept of production stages and their consequences, we still do not have a very strong grasp of production places in early prehistory unless they are intensive production areas or workshops. An arrowhead can be produced anywhere by a capable craftsman as long as a sufficient amount of raw material and tools are available. The same is true for most chipped stone tools. The issue here is that the areas of smaller-scale production or renewal, as in the case of hunters, are not easily found in the archaeological record. Production places are usually identified based on contextual information and the presence of debris and/or residues within archaeological contexts or areas that have been the subject of archaeological research. It is possible for us to question the types of production and their archaeological contexts and whether these production types result in debris and/or any other indications that can be archaeologically identified. We can ask what was produced, and what were the associated standards? Where and how did production take place? Can we draw limits and boundaries around production areas? How do we understand the places that witnessed production? How do archaeologists define, identify and interpret production? Can all types of past activities discernible in the archaeological record in the form of finished and used materials be understood as 'production'? Archaeology is mainly based on surviving

artefacts and these questions can be answered to their full potential again by examining the material world of the past. Although there has been considerable advancement in the analytical methods available as a result of interdisciplinary studies in archaeology, there is still a long way to go in order to fully understand all the dimensions of products and production. Costin¹² is one of the scholars who have based their research mainly on craft specialisation and production related issues. Costin's research provides us with extremely valuable information for understanding and answering questions related to and raised by studies of production and related activities. However, a continuing frustration is that contextual approaches in archaeology are often still unsatisfying in helping us to understand production and its places. For example, the archaeological context of portable tools, such as ground stones, should not just be viewed as the last place where the item was used, discarded or abandoned; it can also be interpreted as a place of production. This can be seen in the example of Çatalhöyük, which I use here (Figure 1).

This paper also questions the reliability of contextual approaches in establishing the concepts of product, production and production place, by looking at the sequences of the chain of production. On the one hand, ground stone tools are portable and can be used in various locations, many of which may not be revealed by archaeological excavations, nor do these locations, which may include the production sites of the tools, have the potential to be identified in the archaeological record (due to, for example, the cleaning of houses in the Neolithic period). Our contextual inferences are based on the characteristics of the physical locations in which tools are recovered in the archaeological record. The ground stone tools are heavy and bulky,¹³ and the weight creates transportation problems. Therefore, sourcing and, where necessary, initial shaping have to take place at or near the source in order to reduce the excess weight. This already constitutes a few steps of the *chaîne opératoire*. Beck and colleagues¹⁴ assessed the costs and benefits of quarry behaviour from the point of view of the cost of transport and the impact on product and technology. Since the acquisition of raw material is the first step in the *chaîne opératoire* and the quarry or the source of raw material is the first physical context of production, archaeological sites will not include this context unless the quarry itself is excavated. The contextual analysis of ground stones at Çatalhöyük,¹⁵ for example, does not include the quarry context despite source identification.¹⁶

⁷ Harman (2017).

⁸ Harman (2019).

⁹ Harman (2016).

¹⁰ Harman (2016: 3).

¹¹ Shillito *et al.* (2014).

¹² Costin (1991; 2000; 2002; 2008).

¹³ Beck *et al.* (2002).

¹⁴ Beck *et al.* (2002: 482).

¹⁵ Baysal and Wright (2005b).

¹⁶ Türkmenoğlu *et al.* (2005).

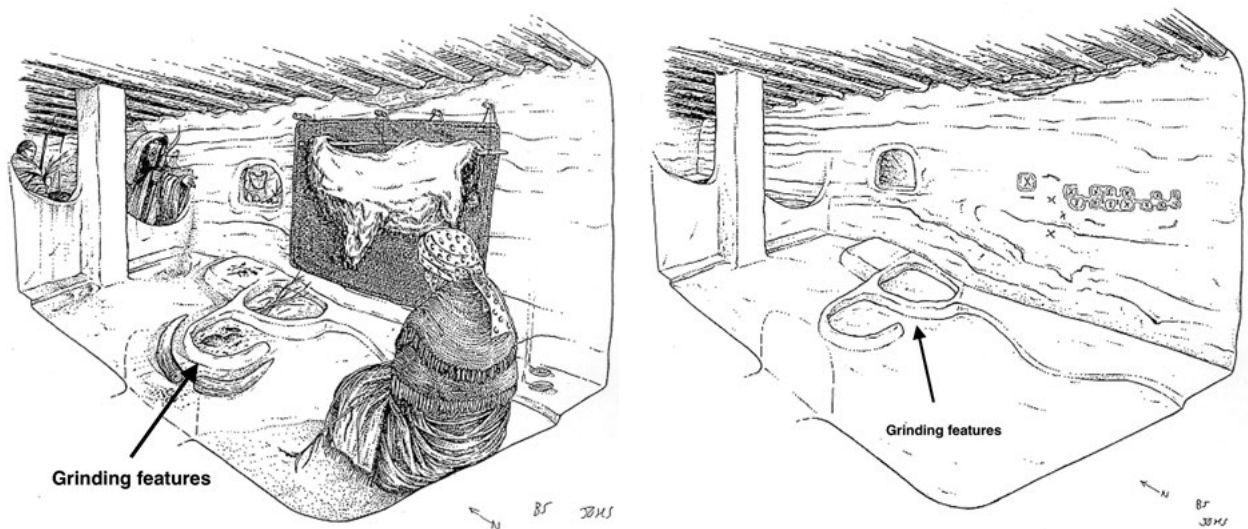


Figure 1: Specifically designed grinding features from Çatalhöyük, Building 5, space 155, features 355 and 356 (Illustration: John Gordon Swogger, with kind permission of Ian Hodder).

I will explore these concepts through ground stone artefacts, particularly based on the upper (handstone) and lower grinding (quern) pair. The reason that ground stone artefacts have been chosen for this purpose is the nature of their multi-purpose functionality and their mobility, both of which are explored in more detail below. Since such grinding pairs are mainly employed in food processing, these tools are an important category in human subsistence and thus were utilised as part of everyday life. Therefore, using these tools as a case study also allows us to reflect on food processing, as well as production areas and contexts to a certain extent. These tools required certain technological skills in both their production and use. As a result, such ground stones (handstones and querns) provide a good example for our purpose of showing the transitions in a single item from being a product to becoming a production place. Although these changes took place at specific times and within specific spaces, the context of the changes is closely related to the actions, which converted these tools from a product to a production place, regardless of their location.

Product

A product is usually defined as the 'manufacture or refinement of an article or substance' or 'a thing or a person [that] is the result of an action or process' in English dictionaries.¹⁷ Both of these definitions refer to change. This change can be slow or rapid, but the end result is visible and conceivable by third parties. Taking into account this point, it is possible to say

that archaeology mainly deals with the world of these changed substances, in other words, objects that have been created or altered by humans. This is referred to as the material world and/or culture in archaeology. Since its early days, archaeology has aimed to understand the objects discovered through excavations, and via these objects to understand cultures, types, ecology, humans and their material and symbolic world in the past. So, what are these substances and where and how were they acquired? And what was done with them? Prehistoric communities had access to a range of raw materials that were available to them in the natural environment, including clay, bone and stone. Humans are creative and discovered ways of giving new shapes and forms to these materials, manufacturing or refining raw materials for their advantage and thereby making an important leap into a cultural world. This creativity populated the inhabited world with objects that can be seen as an extension of human life, and which were practical, aesthetic, functional, symbolic and so on. As a result, this material world in return started to act and react with the human mind and its cultural world. This is true to the degree that, as objects are created by humans, humans are also being created by these objects. Molleson's work on 162 human skeletons from Abu Hureyra (Syria) shows that ground stone assemblages demonstrate this level of interaction, for example, in cases where ground stone tools caused severe damage to the skeletal structure¹⁸ and teeth. Archaeological interpretation has found a challenge in trying to understand this interactive creativity and the various stages of the process. Time is involved in the

¹⁷ Oxford University Press (2019a).

¹⁸ Molleson (1994).

transitions from one stage to another. This perspective has resulted in a categorical way of looking at the material world and in the classification of these objects into groups and subgroups according to their details. Classification is based on their raw material, shape or other qualities.

Production

Production is another simple term that is challenging to conceptualise as well as to understand as a process. Production is defined as the ‘action of making or manufacturing from components or raw materials, or the process of being manufactured’ or ‘the process of or management involved in making...’.¹⁹ In both definitions, we see that reference is made to the process. The first one clearly involves both parties in the ‘action of making’ or ‘becoming’ or ‘being manufactured’. Reid²⁰ defined production as a process where goods are made for use. These definitions underlie both the active and passive state of change. Since the early 1990s, Costin²¹ has vastly contributed to the understanding of economic systems of past communities by focusing on product, production and consumption which has enhanced the research subject in archaeological literature.

In order for change to happen within the process of production of a product, an impact, power and time are required. This change starts with the acquisition of raw material and continues until the intended end result is achieved, which includes use, re-use and discard. Although it has been argued in some cases that the idea of the *chaîne opératoire*²² can also encapsulate technique, performance and social filtering, its limits remain broadly the description of a mechanical chain of sequential activities. The *chaîne opératoire* idea²³ mechanically formulates actions and defines the process and its stages (Figure 2). These stages are the technological processes resulting in identifiable change during the production process. This process can also be conceived as the external or practical side of creativity. The operational chain will be divided into two areas in this paper to support the argument that will be pursued below. These areas are both product and production, according to the definitions given above (Figure 3).

A few decades ago, scholarly works on this subject in archaeology revolved around ceramic production, then moved onto tool and food production, and many other topics have followed since. Costin’s accumulated work on product, production and consumption issues

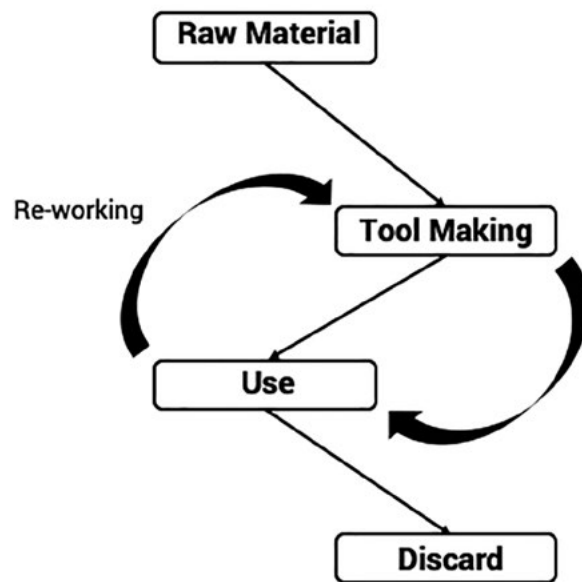


Figure 2: Simplified tool production stages, also known as the operational chain (Illustration: Adnan Baysal).

has underlined the imbalance in scholarly interest which has concentrated on the size/scale of production and its context.²⁴ Costin’s work and its impact on the subject have continued to shed light on other related research topics from the identity of producers to class/hierarchy and gender issues,²⁵ production processes through time and space to the localised organisation of production.²⁶ The concept of production on which most archaeological interpretation is based is action, and through action the production concept has been reduced to ‘making something new’ or ‘bringing something new from raw material’²⁷ that is in some way functional or valuable. In order to understand the related issues, work has been undertaken in order to try and identify the scale of production, including the quantity, number of people involved, population that shared products, distances reached, styles, techniques and so on. Costin²⁸ points out the pitfalls of this ‘scaling the production’ approach by saying that: ‘We must be careful not to confuse the size of the community at which production occurred or the areal extent of the debris with the scale of production’.²⁹

Costin emphasises two issues in identifying the scale of production – *production locus* (context) and *production unit* (organisation). It is possible to add time to Costin’s issues as another parameter. This approach has created

¹⁹ Oxford University Press (2019b).

²⁰ Reid (1934).

²¹ Costin (1991; 2000; 2002).

²² Tostevin (2011).

²³ Edmonds (1990); Garcea (2005); Martín-Torres (2002); Roux (2016); Sellet (1993).

²⁴ Costin (1991).

²⁵ Costin (2001).

²⁶ Costin (1991).

²⁷ May (1994: 72).

²⁸ Costin (1991).

²⁹ Costin (1991: 29).

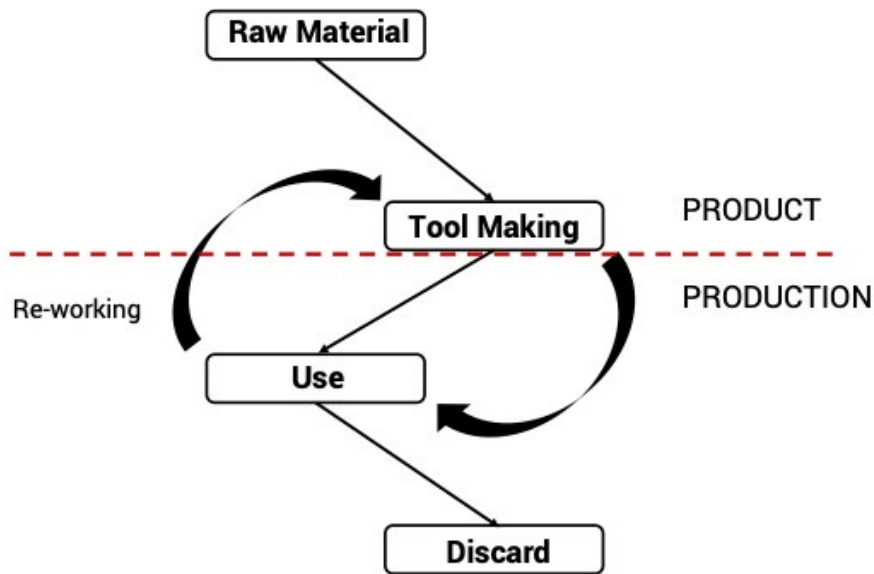


Figure 3: Tool production process and, on the basis of this process, where ground stone tools (handstone and quern) can be identified as product and production place (Illustration: Adnan Baysal).

counterviews too, such as evaluating production as consumption or vice versa.³⁰

Although production sounds like a one-way action, it has wider implications; as Douglas and Isherwood³¹ have pointed out, these implications start with consumption and demand. Douglas and Isherwood highlight this spiralling connection between production, consumption and technology as follows: ‘Consumer demand drives production, and production fired by demand drives technology, and technology has affects on human lives’.³² It is also possible that the product can define the scale of demand and consumption or subsumption. According to Ngai³³ ‘subsumption of production allows the consumption to appear’ as in the case of, for example, smartphones.

As a result, in order to understand any one of these elements, particularly production, analysis is required, and close examination is needed to see the relations and dynamics at play between the various connected elements. In this frame of thought, production is closely related to consumption.

The relationship of product and production is very complicated, especially when other elements start to have a direct impact on the relationship. Time can be used as an example. Production processes can take place in a short time or be structured to happen over a

longer period of time – they may even happen over the course of generations. Sjöstrand³⁴ presents an example from northern Sweden, focusing on accumulative rock art at Namforsen. Sjöstrand’s argument revolves around the long-term process from which perspective production and consumption can be seen as a giant, unending process. Rock art is a slow process as is also the case in Hodder’s view of the Neolithic in which he argues, based on ground stone tools, for a slow Neolithic since these types of tools were used from the Upper Palaeolithic onwards.³⁵ Schiffer³⁶ has also evaluated site formation processes in his works. Site formation can also be classified as a slow process and/or long-term production, following the definition of product and production given here.

Although micromorphology, ethnographic and experimental studies and anthropological data all provide insight into these questions, the question still remains, how does this evidence shape our thinking, especially when it comes to production places? I will show that while material culture accumulation, deposition and re-deposition in the archaeological context inform our understanding of whether a place is a workshop, ordinary living quarter, stable, ritual area or cooking area, this may not be possible in every instance, especially in the case of ground stones. Contextual analysis is usually very simple because the objects are viewed in a specific context and interpretations about the artefacts and the context are made by inference.

³⁰ Miller (1987); Reid (1934) was probably the first person to approach production as consumption.

³¹ Douglas and Isherwood (1979: xxvi).

³² Douglas and Isherwood (1979: xxvi).

³³ Ngai (2003: 469).

³⁴ Sjöstrand (2010).

³⁵ Hodder (2018); see also Baysal (2010); Wright (1994).

³⁶ Schiffer (1987).

But can it be that simple and easy? Activity area studies have been employed as an important interpretive tool for processual archaeology to understand the daily activities³⁷ of people in the past. In order to emphasise my point, I will present a case study based on data from Çatalhöyük comprising areas of food processing activity and their associated ground stone tools. This case study will be used as an example to demonstrate the importance of careful interpretation. In a similar manner, Pfälzner³⁸ has already drawn attention to the reliability of, but also the issues associated with activity areas in his case studies from the Bronze Age sites of Tell el Bderi (Syria) and Tell Mishrife (Syria).

The production sequences of ground stone tools followed the same main stages of the *chaîne opératoire* as many other artefacts: acquisition of raw material, production of the tool, use, repair and re-use and finally discard when they reached the end of their function, use life or became unusable (through breakage or wear, etc.).³⁹ This general scheme of the *chaîne opératoire* is accepted for all manmade items regardless of whether the objects functioned practically or symbolically. While most objects that were produced in prehistory served one purpose, in the case of ground stones it is safe to say that they were multi-purpose, multi-functional tools. Like any other object, ground stones have their own life histories or biographies.

Production is a complicated activity and demands skills, raw material, networks⁴⁰ or meshworks.⁴¹ It consists of many elements in order to complete a simple product. In the case of ceramic production, water and weather conditions, shade and temperature become important, for example. In addition to this, there are various material-based requirements, knowledge, skills and networks. These elements can be found in the same place, person or entirely different contexts, but they are all connected to each other through the process. The interwoven juxtaposition of such processes is considered by van der Leeuw,⁴² in his analysis of ceramic production, and Copercini,⁴³ in his analysis of the fashion world in Berlin; both scholars have shown us relational and co-existing systems of a networked environment. Hodder also points out similar systems in his theory of entanglement.⁴⁴ Production is the connection of networks⁴⁵ which reflects on product, production and consumption.

Ground stone tools

The Neolithic period is associated with the processes of animal and plant domestication. As a result, during this time food processing and consumption became more and more complex. This period also witnessed the transition to settled life, complex architecture, planting and harvesting, all of which required time, energy and strength. This also resulted in a gradual increase in the number of people in the Neolithic.⁴⁶ More people consumed more food. In order to solve the problem of food production and gain time in the food preparation process, grinding stones became very popular in the production of food. Residue analyses have revealed starch, animal fat⁴⁷ and ochre (red paint)⁴⁸ remains on the surface of these tools, which suggests that the purpose of these tools was not only that of grinding grains. Tools within ground stone assemblages such as hammer stones, abraders and polishers were also used in producing other objects. Hammer stones were employed in knapping and abraders used for the preparation of the striking platform; polishers were used in pot making. Although such ground stones were multi-purpose tools⁴⁹ that were present since the Upper Palaeolithic, they became one of the essential tools of the Neolithic household.

Since Kraybill's work on ground stones,⁵⁰ their technology and contribution to archaeological knowledge have been studied, described and discussed systematically by many scholars, especially in the context of Southwest Asia.⁵¹ As a result of this close engagement it became clear that these tools were produced, used, renewed and discarded like many other objects (i.e. ceramics, chipped stones). Ground stone tools were part of daily life.⁵² However, when their daily usage is considered, especially in terms of the context in which they were found or used⁵³, archaeological interpretations tend to associate them with fireplaces or cooking areas.⁵⁴ As a result of contextual approaches, these tools are generally classified as food processing tools and part of in-house activities. Contextualising ground stone tools in such a way, and thereby overlooking their portability, may lead to confusing inferences, especially in locating and understanding food production areas. Ground stone tools are interpreted as the representation of agricultural activities and food processing which has caused considerable data loss in the development of the studies and analysis on these tools in the Near East.

³⁷ Kent (1990); Pfälzner (2015).

³⁸ Pfälzner (2015).

³⁹ Baysal (2010).

⁴⁰ Knappett (2008).

⁴¹ Ingold (2008).

⁴² van der Leeuw (2008: 233–239).

⁴³ Copercini (2015).

⁴⁴ Hodder (2012; 2016).

⁴⁵ Knappett (2013).

⁴⁶ Bellwood and Oxenham (2008); Bocquet-Appel and Bar-Yosef (2008).

⁴⁷ Dubreuil *et al.* (2015).

⁴⁸ Baysal (2005).

⁴⁹ Baysal and Wright (2005a); Stroulia (2010); Wright (1991).

⁵⁰ Kraybill (1977).

⁵¹ Baysal (2010); Davis (1982); Wright (1991; 1994).

⁵² Baysal (2010).

⁵³ Baysal and Wright (2005b).

⁵⁴ Baysal and Wright (2005a); Hodder (2018).

Considering that ground stones are portable tools and that this mobility has been evidenced in multiple cases, for example at Çatalhöyük,⁵⁵ context-based interpretive approaches may be misleading if the interpretations are always limited to associations with limited spaces. Çatalhöyük is a world heritage site in Turkey and the second period of excavations (1993–2018) were directed by Ian Hodder. The excavation project revealed that Neolithic Çatalhöyük consisted of flat roofed, rectangular mud-brick houses. The entrances to these houses were apparently from the roof. The roof played a particularly important role in daily life. Since the roofs were flat and as large in plan as the house (approx. 6 x 6.5 m) a big part of daily life was conducted on these roofs, which were utilised as an activity area. There were small gaps between the houses and the excavations of these gaps revealed almost complete, semi-used or broken tool fragments and the character of related fills supports the idea of rooftop activities. Among the broken tool fragments were also ground stones, including handstones, and broken querns. This enabled us to conclude that ground stone artefacts are portable tools that were not only being employed or used inside the houses but probably also on the roof space.⁵⁶

The employment of ground stone tools in food processing and their utilisation on the rooftops of houses continued until at least the late 1980s in Turkey (Figure 4), and probably until the present day. It is also known that people used these tools in their gardens, near the roadside, in the middle of villages, school yards, under suitable shady areas, basically in any place seen as suitable (Figures 5 and 6). Therefore, contextual approaches to food processing areas, especially based on portable tools such as ground stones, demand careful consideration of where and how to define such areas.

Ground stone tools are made of either locally or distantly sourced raw materials. As is the case with knapped stones, many techniques are employed in their production. Since they are tools that are made from stone, there are three different matters that need to be understood: the question of what the ground stones are (i.e. their purpose/function), the way in which they were made in order to carry out a specific function and their state of production and, finally, how they (particularly querns, hand stones, mortars and pestles) can be seen as a production place (Figure 7).

It is first necessary to briefly define ground stone tools and their production technology. Ground stone technology is very similar to that of chipped stones; both chipped and ground stones encompass most of the same production strategies, although the production of ground stones may involve the use of

different techniques. Ground stones are produced by knapping, rubbing, polishing, incising, pecking, drilling or by combinations of these actions. In order to differentiate them from knapped stones, we must draw the borders of ground stone technology. Ground stone technology involves materials other than the typical flint, obsidian, quartz and radiolarite that produce consistent conchoidal fractures. The raw material categories associated with grinding stone production are primarily volcanic rocks such as andesite, basalt, rhyolite and sand stones, among others. These rock types can generally be easily found and acquired in the vicinity of prehistoric sites, although of course the difficulty of acquiring raw material depends on the proximity of convenient sources according to the geological character of the areas where settlements were located. The variety of available rock types impacts the variation of tool types and their level of use.

The *chaîne opératoire* was defined above, and its stages of tool production are sufficient to understand how a raw material was converted into a tool. Even in this simplified definition the raw material is a meaningless piece of rock without human interference, that can be found in the source areas or elsewhere as a result of events prior to it being sourced. The raw material can only be converted into a functioning tool by the application of outside action. The impact of the action can include variables from the quality of the raw material to the skills of the craftsman, demand, design, dependency and many others. The result of these actions is that a raw material will be converted to a functioning tool. This chain of actions results in the bringing into existence of a product. This product could be anything, but in relation to our case it is a ground stone, and in particular the quern and handstone pair. Both the quern and handstone go through similar production stages and in the end they both become a product that functions either together or individually (Figure 7). These are generally identified as food processing tools in the archaeological literature, but we can also identify these tools as a product of skills, design, experience and many other factors, including elements of creativity. Although they are physically a functional tool, after going through the production sequence, they also become a representation and physical evidence of thought processes and creativity.

To give an example of the evaluation of ground stones as both product and production place (Figure 7), I want to emphasise the following points: In order to make grinding stones consisting of upper and lower parts (such a set-up may not always be necessary, depending on the variety of tasks undertaken), perforation, rubbing, pecking and other such methods are employed in addition to the techniques usually associated with chipped stones. These activities are a result of a sequence of actions and the resulting tool is a product. During the

⁵⁵ Baysal (2010).

⁵⁶ Baysal (2010).



Figure 4a: Flat-roofed houses and their usage during daily activities (Photo: Tuğrul Çakar, David French archive BIAA).



Figure 4b: Flat-roofed houses and their usage during daily activities (Photo: Tuğrul Çakar, David French archive BIAA).



Figure 4c: Flat-roofed houses and their usage during daily activities (Photo: Tuğrul Çakar, David French archive BIAA).



Figure 5a: Food processing with grinding equipment, in the yard (Photo: Tuğrul Çakar, David French archive BIAA).



Figure 5b: Food processing with grinding equipment, in the yard (Photo: Tuğrul Çakar, David French archive BIAA).



Figure 5c: Food processing with grinding equipment, in the yard (Photo: Tuğrul Çakar, David French archive BIAA).



Figure 6: Food grinding on the roof (Photo: Tuğrul Çakar, David French archive BIAA).

process from the procurement of the raw material until reaching the final product form, the various stages of production can be completed in a range of different localities. After the completion of these processes, the product is brought to the place in which it will be used. At this location the use process starts to take place. The journey of the stone is via multiple different contexts – source, production, transportation – to a context as a finished product, and so on.

In order to explain the case of ground stone tool production at Çatalhöyük, one has to understand the geology and localities of the available, suitable raw material sources. Çatalhöyük is located in the alluvial Konya Plain, Turkey. Mellaart, who discovered and excavated Çatalhöyük in the early 1960s, first drew our attention to the absence of rocks as a commodity in the near vicinity of the site. Mellaart probably made his statement based on mud-brick houses with no stone foundations and the lack of stone usage in the architecture at the site as well as the alluvial nature of the Konya Plain.⁵⁷ Mellaart reported the presence of various rock types at the site and their possible sources at some distance from the site.⁵⁸ The excavations under

Hodder's lead provided us with a chance to expand on Mellaart's suggestion that the raw materials that were used at Çatalhöyük were primarily volcanic rock types (andesite, basalt, rhyolite), mainly andesitic types, and, in addition to those, sandstone, limestone and schist.⁵⁹ Unlike obsidian (approx. 125 km), the nearest volcanic formation and rock source is called Karadağ (Black Mountain) and is situated 40 km away from the site. The other rock sources, such as the Taurus Mountains, are 60 km distant and schist sources are situated 100 km to the west of the site. These distances had a serious impact on ground stone use and production. The size of the tools that were discovered at the site were usually small or exhausted due to long-term use. The long-term use is a result of maintenance, which is evidenced by rejuvenation flakes and chips that were discovered within the midden areas. These flakes were mainly the removal of exhausted use surfaces. Based on the ground stone debitage on site,⁶⁰ it was clear that these tools were rejuvenated or converted from one form to another during their use life.⁶¹ It is safe to say that ground stone tool production took place away from the site. The lack of ground stone production areas or workshops at the site, as well as a lack of any debris that can be associated

⁵⁷ Mellaart (1962: 46).

⁵⁸ Mellaart (1963: 43).

⁵⁹ Türkmenoğlu *et al.* (2001; 2005).

⁶⁰ Baysal (2010: 189–190).

⁶¹ Baysal (2010).

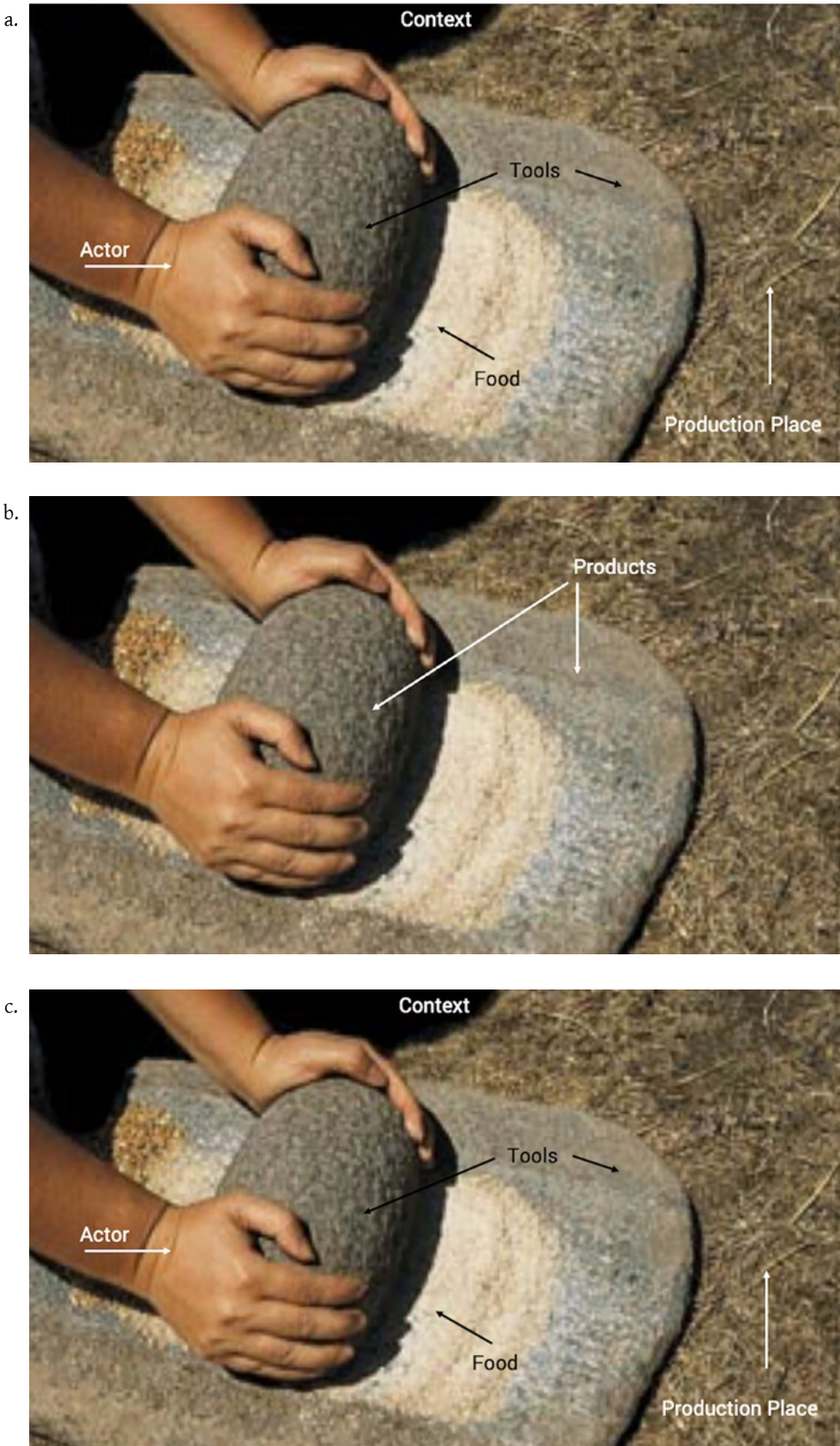


Figure 7: (a) General interpretation of ground stone tools and their contexts in archaeology; (b) in fact, the grinding tools themselves are a product of lithic technology; (c) and grinding tools become a production place when they are used (Mehmet Özdoğan's personal archive).

with primary production, suggests that the ground stone tools arrived at the site as finished products. Rejuvenation is evident from flakes that have worn out use surfaces visible on their striking platforms or left and right lateral edges. Due to the lack of availability of raw material, conversion of broken tools into other types (e.g. handstones) was another activity resulting in debitage that also took place on site. The use of the grinding tool(s) as a pair in the production of food or the grinding of other materials, transitions the pair from an individual product to a production place. Which is to say that with each processing of wheat or other material, the stone turns into a production place. The use surfaces of these stones might not be that large, but they allow the grinding process to be carried out. The recovery of these stones from contexts associated with ovens, hearths, silos or storage areas associated with the cooking and storage of food has been the cause of the general equation of these stones with the production of food. Ground stone tools are also discovered within walls,⁶² midden areas and below oven bases. It is known from archaeological, anthropological and ethnographic data that these stone tools were not always used in the same area or place, although some forms, especially the lower part (quern), suggest that their use was only possible when fixed into the ground. It can be seen from research into periods in both the past and present in archaeology and ethnography that while the purpose of the stones may not change, the places of use include a variety of locations such as rooftops, doorways, gardens and even roadsides (Figures 5 and 6). Given this evidence, the restrictive association of these artefacts to contextual relationships with hearths and ovens needs to be reconsidered. In addition, we also know that these stones were not only used in the preparation of food. Upon re-evaluation of functionality and contexts, this situation makes it clear that we need to be careful about preconceived ideas and inferences, such as that ground stone tools are a representation of agricultural activities.

It is not necessary for the tools that are used in grinding activities to be in the same context from the beginning of the tool production throughout the time of the production process. In fact, following the process of raw material procurement they can be moved to different, distant places through time as the necessary processes are carried out. Each stage of tool production can be carried out at a different location. Equally, at the use stage, usage may or may not take place at a fixed location. The use of these items in different locations is normal considering their generally portable nature, their use life, and the possibility of the changing demands of their users during the long periods of time they remained in use (for example, according to different seasons and weather conditions). In this

case, when we interrogate the production place in conjunction with the tools and contexts in which they were used, then the production associated with the stone, although broadly similar in purpose (e.g. food production), can be seen to have taken place at different times and in different places. In this case, from the point of their own production the tools become a point for the realisation of production and do not stay tied to the same context – on the contrary, they frequently changed in space and time. It is therefore more accurate to see these tools as production places and to evaluate them carefully within the contexts in which they are found.

To give an example, we can look at the stones used by a family in Anatolia in the 1980s for their grinding activities. After they were produced, these grinding tools were portable and during the summer were moved to the roof of the house and possibly various other locations, i.e. open spaces, gardens and the village centre, as also witnessed in other villages in which gardens and common places were locations where grinding activities were carried out.⁶³ In the winter they were moved back into dry areas, such as where the wheat was stored. Correspondingly, ground stone tools were more likely moved and used in the interior parts of the houses where specific features are attributed to grinding activities during the winter at Çatalhöyük. Clay basins with slightly raised plaster rims, which held the ground stones, were used for grinding activities in the houses (Figure 1⁶⁴).⁶⁵ The ethnographic examples (Figures 4–6) indicate that food preparation or processing is a social activity, or at least an activity involving more than one person. This shows a good example of how the flat roofs of houses could be included into the area of the house and also the thin dividing line between the inside and outside areas, as well as the need for the re-interrogation of borders drawn within the way we think about the household area. In this example, the carrying out of the grinding on the roof of a house by members of the household takes on a new meaning in terms of context and social meaning when we take into account that the same procedure is also carried out communally in the village square by those who live in the village. In this case it is not only the physical but also the social context that changes. The reason for this change of location lies in the differing possibilities for socialising and community building in the different contexts. In this case, which physical location should be accepted as the place of production? The question is, should we look at the change in production place or only at the two stones as the place of production? It is clear that the social, temporal and spatial context can change,

⁶³ Personal observation by the author.

⁶⁴ See also Pfälzner (2015).

⁶⁵ Cessford (1998).

⁶² Baysal (2010); Hodder (2006: 3).

and even the individuals carrying out the production can change, but the tools being used remain the same.

Conclusion

Based on the number, quality and type of products made at a production place, it can be defined in various ways, such as a workshop, factory or portable production place.⁶⁶ However, differences are also seen in their use and/or product quality and quantity relating to demand, market, consumption, population and so on. These places can show change through time and space. However, ground stones present a special case. Since they are a portable product that, when used, turns into a production place, it is important that we do not overlook this process of transition. Although as a product they have a different role, as an object, they become entirely different things as soon as they are converted to a functioning tool; a production place and an interactive and communicative object. Ground stone tools convert edibles into flour, meat can be mashed, or any unsuitable potential food material that is not ready to be consumed, as in the case of acorns, can be made edible. Basically, ground stones can process and convert materials into desired edible substances, or raw materials into another tool or useful product, and therefore, ground stones present a very good case to emphasise the shift from being a product to a production place. They become social and linked with other activities. As Hodder stated, they actively play a role within the world of entangled dependencies.⁶⁷

I want to suggest that the evaluation of ground stones as a portable production place forms a good example of how a product can be seen as a production place based on the food and other materials that it was used to produce, and that it can enhance our understanding of places of activity in the prehistoric past. In particular, ground stones on which food production was being carried out in the open air, could be moved to a different location in case of a sudden rain shower or other similarly ephemeral events, in which case the portability of the items was of enormous importance. Without hindering the process of production or changing the way it took place, production of food on the same surfaces would not be changed by the process of relocation of activity. Ground stones show the ability of a single item to be perceived as both product and production place. In this sense, I think it would not be wrong to suggest that ground stones can fill the gap of an element of material culture that can transform itself from product to production place. It is safe to say that the term production place, which in the case of ground stones can also be a product in itself, should not be limited to specific locations or static contexts.

⁶⁶ The case of a travelling craftsperson can be given as an example.

⁶⁷ Hodder (2012).

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12. What is a Workshop?

Cathy Lynne Costin

Abstract

The term 'workshop' is used in the craft production literature by investigators in several academic disciplines and intellectual traditions, with different research interests, training, and types of data. This chapter explores the properties often ascribed to workshops and evaluates the extent to which they have been identified in the archaeological record. I argue that narrow definitions of 'workshops' are problematic, in part because they focus on traits that are archaeologically invisible in many parts of the world, in part because many of the organizational and logistical characteristics they assume are actually rare in antiquity, and in part because they are based on narrow, Euro-centric models that privilege some types of products and modes of organization over others.

Keywords: workshop; craft production; household production; artisan; specialization

Kurzfassung

Der Begriff 'Werkstatt' (engl. 'workshop') wird in der Literatur von Wissenschaftlern vieler unterschiedlicher Fachrichtungen sowie intellektueller Traditionen, mit verschiedenen Interessen, Ausbildungen, und Datentypen gebraucht. Dieser Beitrag untersucht die den Werkstätten häufig zugeordneten Merkmale und bewertet den Grad derer Identifikation im archäologischen Befund. Ich halte enge Definitionen von 'Werkstätten' für problematisch, da diese sich auf Merkmale beziehen, die im archäologischen Befund nicht erkennbar sind, während viele dieser organisatorischen und logistischen Merkmale in der Antike selten sind, und auf engen, eurozentrischen Modellen beruhen, die manche Produktarten und Organisationsformen anderen vorziehen.

Keywords: Werkstatt; handwerkliche Produktion; Haushaltsproduktion; Handwerker; Spezialisierung

'Many problems apparent in past interpretations of workshops arise from a failure to define precisely what is meant by "workshop". Apparently, for most archaeologists the concept is self-evident and in no need of definition'.¹

A word heard quite frequently in this conference was 'workshop'. As is the situation more generally in the craft production literature, it was used in an array of diverse contexts, a wide variety of places, and in cases that relied on different types of data and/or analytic techniques to draw conclusions about the organization of production. It was used in several instances without any tangible evidence of the physical place in which the subject goods were produced. And so this got me thinking, 'What is a workshop?'

For reasons that go far beyond the obvious need to define our terms, I suggest it is important to explore – if not necessarily agree upon – just what constitutes a 'workshop'. We are, of course, interested in the diverse ways that work and labor are organized, and workshops are generally considered to be one 'kind' or type of production. Increasingly, we are paying more careful attention to the social contexts in which

artisans crafted and the lived experience of workers, and workshops are places where the actors perform certain tasks in certain places and relate to one another in diverse ways. But perhaps most importantly, our often unconscious suppositions about workshops can play into broader ideas about the nature of things and societies. First, a narrow use of the term 'workshop' can inadvertently reinforce the lingering stigma that differentially values 'arts' and 'crafts', the former produced in special-purpose places ('workshops'), the latter production more likely embedded in a residential setting. Second, 'workshops' – as a type of production or labor organization – are almost invariably embedded in larger neo-evolutionary schemes about sociopolitical complexity, with workshops superseding domestic production² just as stratified societies are thought to supersede egalitarian ones. Because they are existentially tied to the concept of specialization (discussed below), workshops – in their presence or absence – are tied to our ideas about sociopolitical complexity. In various typological schemes, the use of terms such as 'levels', 'ranks', or 'stages' of production organization – where workshops are one stage or level, for example – further casts a neo-evolutionary

¹ Clark (1990: 198).

² Patterson (2005).

ordering to different ways of doing craft production.³ Workshops – as amorphously as they might be defined – are often taken as indicators of other social institutions or political structures. As Masson and colleagues note, ‘The complexity of the organization of craft production mirrors multiple aspects of the larger political economies of premodern states’.⁴ Further, workshops are considered by many to be key features of urban places, particularly the ‘capitals’ of ancient states.⁵ Overall, as Rosen⁶ has noted, ‘Archaeologically, the presence of specialized workshops has often been taken as *prima facie* evidence for the rise of [complex] economies (e.g., Evans 1978; Tosi 1984; Wattenmaker 1998: 4) and therefore the distinction between workshops, activity areas, and other types of production loci takes on an importance beyond mere semantics’.⁷ However, neo-evolutionary schemes that posit the unilinear codevelopment of social complexity, economic specialization, and workshops are highly problematic. As Baysal and her colleagues⁸ have noted recently, ‘archaeological evidence of the last decades has increasingly shown that craft specialization did not follow a linear pattern of development interdependent with concurrent “progressions” in social structure. Instead it waxed and waned for several millennia before institutionalized, centrally organized, consistent and long-lived production became commonplace.’ For purposes of this discussion, I would amend this statement to say ‘specialization and formalized workshops’.

Thus, ‘workshop’ is a freighted concept worthy of exploration and explication. As used broadly by investigators in several academic disciplines, coming from a variety of intellectual traditions, different research interests, with different kinds of training, using different data sets, working in different parts of the world, the concept of the ‘workshop’ is actually quite complex. As noted, there is no clear, consensus definition. Is a workshop simply a recognizable place where production occurred? Or is it a particular ‘kind’ or type of production organization, with certain scalar properties as well as social and economic relationships? Should this term be used to describe a group of objects with similar (homogeneous) iconographic content, formal properties, stylistic or physical (material) attributes, implying that they were produced by artisans working together in the same place, or should it be limited to cases where we have the actual locus of production? Because it is used differently by scholars working from different perspectives and practices, the concept remains problematic, to the detriment of our

understanding of the mechanics and organization of craft production specifically and ancient economies more generally. If we want to do interdisciplinary work, if we want to do comparative work, if we want to speak directly and productively with one another, I maintain we need to make our assumptions about the characteristics of workshops and the properties of their products more explicit.

To this end, in this chapter, I explore ‘workshop’ as a concept, that is, as an abstract idea; a general notion for a class of things – in this instance, a kind of entity that makes things – that has certain essential features and its utility for both the examination of specific cases and for cross-cultural, comparative research. To do so, I dive into the recent literature on craft production to analyze how investigators across disciplines – archaeologists and art historians, classicists and prehistorians – working in both the Old and New Worlds have defined and identified production locales, addressing the question: what are the features and properties that ‘workshops’ tend to possess, such that investigators have put specific instances of production into the class ‘workshop’? In particular, I review both the assumptions investigators make about ‘workshop’ production and the degree to which they materially and concretely identify those characteristics as opposed to assume them.

Defining and identifying places of production

I begin this essay by considering how investigators have generally defined and identified places of craft production and characterized their organization. Interestingly, few reference books or dictionaries specifically aimed at archaeologists provide a working definition for ‘workshop’. It may seem that the simplest and most straightforward definition of a workshop is the one found in popular dictionaries: a workshop is a place where production occurs.⁹ As Hodgkinson stated recently, ‘In archaeological terms, a workshop is defined by the presence of evidence of work, such as tools, raw materials, and half-finished goods’.¹⁰ But if we settle on this most basic of definitions, we almost immediately encounter two complications. First, I suspect most archaeologists would agree that not

³ See, for example, Santley *et al.* (1989); Sillar and Joffré (2016).

⁴ Masson *et al.* (2016: 229).

⁵ Manzanilla and Chapdelaine (2009: xiii).

⁶ Rosen (2010: 16).

⁷ See also, for another example, Emery (2009: 465).

⁸ Baysal *et al.* (2015: 251–252).

⁹ For example, the Oxford Dictionary Online defines a workshop as ‘A room or building in which goods are manufactured or repaired’ (Oxford University Press 2019). Merriam-Webster probably comes closer to the idea implied by most archaeologists: ‘a small establishment where manufacturing or handicrafts are carried on’ (Merriam-Webster 2019). I find the Wikipedia entry for ‘workshop’ highly problematical for its ethnocentric/Euro-centric focus: ‘Beginning with the Industrial Revolution era, a workshop may be a room, rooms or building which provides both the area and tools (or machinery) that may be required for the manufacture or repair of manufactured goods. Workshops were the only places of production until the advent of industrialization and the development of larger factories’ (Wikipedia 2018).

¹⁰ Hodgkinson (2018: 9).

every place where crafting occurred was a 'workshop'. Rosen, for example, explicitly distinguishes between two spatial types of production loci: activity areas and workshops.¹¹ While acknowledging that there is in fact a continuum between these types, he defines activity areas as foci of domestic subsistence activities and workshops as loci of intense manufacture for 'export'.¹² But where and how do we draw the line? Must workshops be 'discrete, architecturally delineable spaces' as stipulated by Murphy?¹³ Must they be spaces containing fixed installations, as specified by many working in the complex societies of the Mediterranean world, when, in fact, few pre-industrial technologies – particularly those used in the Americas – required fixed facilities?

There is an even more fundamental issue: must we identify a physical place of manufacture in order to identify 'workshop' production and how should we do so? In the abstract, direct evidence for production – material remains including accumulated raw materials, tools and equipment, waste products, and fixed facilities, among other things – often stand as the primary evidence for workshop production. However, it is often difficult to recognize the places where production occurred for reasons ranging from site formation processes to the ways in which those sites are excavated to the nature of the production technology, as some technologies leave little trace in the archaeological record.¹⁴ As will be discussed later in this chapter, in the many cases where we do not have a physical locus of production at all, archaeologists and others often rely on the attributes of the objects themselves to provide clues about the organization of their production.

Even when we recover direct evidence for production, tools, features, and facilities might be hard to interpret, especially without complementary ethnographic analogy or experimental archaeology. Here, I raise a particularly vexing conundrum faced by archaeologists: our reliance on manufacturing debris to identify production locations can lead us to conflate production waste 'dumps' with production areas, referring

incorrectly, for example, to debitage concentrations as 'workshops'.¹⁵ As Clark and others note, ethnoarchaeological studies indicate that dangerous or noxious waste will often be discarded far from areas used for other activities, including many stages in the production process. Further, as Rosen points out, it is not the simple quantity or density of debris that indicates intensified production; rather it is the configuration of that waste,¹⁶ a point also made by Clark.¹⁷ A corollary issue arises in attempts to distinguish between the remains of long-term low intensity activities and short-term high intensity events.¹⁸ And even the concepts of density and concentration are relative. As Cobb writes, 'what does "an abundance of debitage" really mean? ... what constitutes an abundance of debitage on an eastern woodlands site [in North America] would be viewed as merely a moderate density on a Mesoamerican or Near Eastern obsidian workshop'.¹⁹

While some industries create interpretation problems because they generate so much waste, other media or manufacturing techniques leave very little permanent, visible debris, among them textile production, lapidary work, and the final stages of metalworking. This is even the case for some lithic production: 'pecking' largely leaves dust, so we might not be able to directly identify manufacturing loci.²⁰ Thus, the workshops of some crafts might be much harder to see archaeologically than those of others.

And finally, what has often been classified as production 'debris' might not, in fact, be production waste at all. Among myriad possibilities, I note that flakes identified as production detritus in fact make excellent tools;²¹ items identified as clay 'turntables' used in pottery production might have been jar lids.²² In cases such as these, we might be identifying loci of production, but not necessarily for the immediately recognizable tools. In other cases, this purported debris might represent a different suite of behaviors. For example, Hodgkinson notes that glass ingots were widespread in Mesopotamia, not because glass-working was ubiquitous but rather because glass was used as a currency.²³

Returning to our basic definition: I do believe archaeologists would agree that workshops are inextricably tied to production specialization.²⁴

¹¹ Rosen (2010).

¹² Rosen also discusses a third type, the production locus, which is intermediary between activity areas and workshops. For Rosen, these places represent production activities that are supplements or sidelines to basic subsistence activities, but not primary economic activities.

¹³ Murphy (2016: 135).

¹⁴ Many tools are made of perishable materials and are often unrecognized or unacknowledged. In my own work, I use ceramic and stone spindle whorls as proxies for prehispanic Andean cloth production (e.g., Costin 1993), but ethnographic observation demonstrates that women in the Andes today use a wide variety of ad hoc materials for this purpose, including hunks of potato. Similarly, even in classical antiquity, potters' wheels can go unrecognized because the wheels themselves were made of wood and investigators often misidentify the non-perishable fittings (cf. Murphy and Poblome 2012a).

¹⁵ See critiques in Clark (1986); Mallory (1986); Moholy-Nagy (1990; 1997).

¹⁶ Rosen (2010).

¹⁷ Clark (1990).

¹⁸ Rosen (2010); Torrence (1986).

¹⁹ Cobb (2010: 127).

²⁰ Cf. Olausson (1998: 133).

²¹ Clark (1990).

²² Day *et al.* (2010).

²³ Hodgkinson (2018).

²⁴ Unlike the concept of 'workshop', the concept of 'specialized production' has been explored at length (see, for example, Brumfiel and Earle 1987; Costin 1991; 2005; 2007; Clark 1995; 2007; Flad

'Workshop' production is often contrasted with 'household' production, just as 'domestic' (i.e., generalized or unspecialized) production is contrasted with 'specialized' production.²⁵ Thus 'workshops', like specialization, involve the production of items to be used by individuals other than the producers.²⁶ This connection is often made explicit, as illustrated by these definitions from across a spectrum of times and places: workshops are defined as 'places where craft activities produce goods in a larger quantity than for the producer's own consumption';²⁷ 'A "workshop" is not just a place where something is being manufactured. It is an area where a specialized labor force performs a limited set of activities, in order to produce items for exchange; that is, for consumption outside the production unit';²⁸ workshops are 'facilities organized to produce for super-household consumption'²⁹ or 'surplus production contexts'.³⁰

Given this correlation between workshops and specialization, for some investigators, identifying a place as the locus of specialized production is sufficient to call it a 'workshop'.³¹ Clark, for example, defines workshops rather simply as '*loci of specialized craft production*' (emphasis in the original).³² This seems like a reasonable place to begin, the 'least common denominator', if you will. However, for most investigators, workshops possess other features or properties, including characteristics of the spatial organization and social context of production; aspects of work group size and composition, including their internal organization and task responsibilities; the type or degree of collaboration and interaction among individual craft workers and work groups; the nature of worker recruitment and remuneration; and characteristics of the goods produced, including the nature of the output and the finished products. In the enduring scheme proposed by Peacock³³ – which forms the basis for most later typological frameworks – a workshop consisted of a space with clearly delineated activity areas, was staffed by a number of individuals of varying skill who were tasked with different activities, and produced an output that was both 'large' and

relatively standardized.³⁴ Since publication of that work, other typologies have been proposed to account for variations in the organization of production not modeled by Peacock,³⁵ some of which differentiate among different kinds of workshops.³⁶ Because the concept 'workshop' implies other elements of economic, social, and/or political scale and complexity, we need to be cognizant that some definitions of workshops might privilege certain times and places. Thus, I explore the extent to which aspects of work location and organization are *defining* characteristics as opposed to variables worthy of further elucidation and explanation.

As already noted, unlike dictionary definitions of workshops that focus on place, most archaeologists, prehistorians, classicists, and art historians employ 'workshop' as a conceptual category that implicitly or explicitly conveys ideas about various logistical, organizational, and relational aspects of production, including elements of technology, the physical setting and layout of the production space, and characteristics of the workforce. Taking as a given that workshops are places where specialized production occurs, a broad review of the literature indicates that the following additional attributes are often stipulated as properties of workshops and workshop production:³⁷

- Workshops are special-purpose settings or facilities, distinct from residential space.
- The space is formally structured and there are often discrete task or activity areas.
- Artisans work 'full-time' at their task(s).
- Kinship is not the primary mode of labor recruitment and personnel are generally not related to one another.
- Workshops are comprised of many workers; artisans do not work alone.
- The workforce is functionally specialized. Tasks are segmented and there are internal divisions of labor. At least some of the workers are highly skilled, but workers often exhibit a range of skills, as some might be 'masters' while others are helpers or apprentices.
- Production requires capital investment in infrastructure such as equipment and facilities as well as large-scale storage or curation of materials.

and Hruby 2007; Hirth 2009a; Hruby and Flad 2007; Menon 2008; Schortman and Urban 2004; Spielmann 2002; Wailes 1996), and I will not reiterate those discussions here.

²⁵ Cf. Di Paolo (2013: 114).

²⁶ This, of course, differs from the popular usage, which includes the 'home workshop' where hobbyists and avocational artisans and builders 'tinker'. Places where individuals made things for their own use or for the use of members of their household – and likely more informal, ad hoc production for others – would be called 'activity areas' by archaeologists (e.g., Rosen 2010).

²⁷ Andrieu (2013: 23).

²⁸ Forenbaher (1998: 58).

²⁹ Anthony (1996: 50).

³⁰ Masson *et al.* (2016: 238).

³¹ For general discussions on how archaeologists identify specialized craft production, see Costin (1991; 2005).

³² Clark (1990: 198).

³³ Peacock (1982).

³⁴ Peacock (1982) further distinguishes between a workshop and a manufactory, based largely on the range of products made.

³⁵ For example, Bey and Pool (1992); Clark and Parry (1990); Costin (1991; 2005); Santley *et al.* (1989).

³⁶ See also van der Leeuw (1977) for an enduring scheme that predates Peacock.

³⁷ For comprehensive discussions, see also Di Paolo (2013); Rice (2009); Rosen (2010).

- Technological processes are such that artisans must receive training to develop the necessary skills.³⁸
- The work unit focuses on the production of a single item, limited range of items, and/or a single medium.
- The overall scale of production/level of output is 'high'; for many media this will be reflected in large accumulations of waste.
- Products are standardized.
- Workshops are likely to be located in 'urban' areas.

As Smith notes, the loose use of the term 'workshop' for any production location causes confusion.³⁹ However, if we adopt too narrow of a definition of 'workshop' – that is, if we demand manufacturing loci meet most or all of these criteria – this privileges just a few regions and time periods and large swathes of time and space will be deemed to lack workshops, and implicitly, all concomitant social, economic, and political characteristics, institutions, and relations. Indeed, a broad survey of the literature on craft production reveals that there are relatively few places where the full suite of classical criteria (non-residential, internally differentiated task allocation, hierarchical labor organization, large output, 'market' demand) apply, let alone even one or two. This statement applies not only to smaller-scale and mid-range societies, but even to the great states and empires outside of the Mediterranean and Near East.⁴⁰ Thus, uncritically examined definitions risk being ethnocentric in the extreme and perpetuating evolutionary schemes that privilege western and capitalist modes of social, political, and economic development. They also overlook the power and vitality of alternative modes of production organization.

Although most investigators have moved away from an explicitly typological approach in studying craft production,⁴¹ 'workshops' as a particular type of specialization continue to be referenced frequently in the literature. In the remainder of this chapter, I evaluate many of the characteristics that are more commonly treated as inherent features or properties of workshops in the craft production literature. I pay particular attention to those characteristics that (1) are referenced most frequently and (2) can be identified using archaeological data, given the paucity of textual evidence for most of the ancient world.⁴²

³⁸ Rosen (2010: 177) argues that the primary investment is, in fact, skill and knowledge – the ability to construct and use the equipment and features.

³⁹ Smith (2004: 83).

⁴⁰ Di Paolo (2013) argues that if we adopt such a rigid, narrow definition, there is no evidence for 'workshops' in the Near East.

⁴¹ See Costin (2005); Duistermaat (2016).

⁴² Some commonly assumed properties – such as the criterion that artisans work full-time at their craft – are difficult if not impossible to

Is the phrase 'domestic workshop' an oxymoron?

For many investigators – primarily those working in Europe, the Mediterranean, and the Near East – 'workshop' implies a non-domestic setting; that is, craft production takes place outside of the household.⁴³ Indeed, Di Paolo argues that 'there is an oxymoron between workshop and household-based production'.⁴⁴ In this conceptualization, the workshop is a special-purpose locale, lacking residential structures and evidence of 'domestic' activities. In my own early work on the organization of production I distinguished between specialized production that took place within households and workshop production,⁴⁵ following earlier studies on the organization of craft production whose models were largely Old World examples.⁴⁶ Yet, it is particularly the case for the Americas that non-residentially-based crafting is rare, and even large-scale, intensive production can take place in domestic contexts. As Feinman noted recently, 'almost all data for craft activities in pre-Hispanic Mesoamerican contexts, from the advent of sedentary settlements (c. 2000–1500 BC) to the Aztec world, have been found in domestic contexts, not nonresidential workshops'.⁴⁷

Similarly, with the exception of the Inka empire, production of both utilitarian and prestige goods in prehispanic South America took place largely in residential contexts.⁴⁸ Generally, only the most noxious and/or dangerous crafting activities were located outside of residential sectors until the Inka, as part of their imperial strategy, established large-scale non-residentially based production facilities to meet the demand for large quantities of politically and symbolically charged 'imperial' ceramics, textiles, and metal objects. In speaking of Mississippian stone hoe production, Cobb sums things up well: 'there is no reason why a habitation and workshop should not coincide'.⁴⁹

Part of the issue of determining the relative prevalence of residentially-based and non-domestic craft production is the lack of data from household contexts in many parts of the world. Several factors likely contribute to the belief, most prevalent among

conclusively demonstrate archaeologically (see Costin 2005).

⁴³ E.g., Forenbaher (1998).

⁴⁴ Di Paolo (2013: 114, fn. 7).

⁴⁵ Costin (1991; 2001).

⁴⁶ E.g., van der Leeuw (1977); Peacock (1982).

⁴⁷ Feinman (2013: 455). See also Feinman (1999); Hirth (2009a). There are myriad examples of specialist crafting in domestic contexts in Mesoamerica. A highly selective list includes the work done at Aguatecas (Inomata and Triadan 2000), Copan (Widmer 2009), Teotihuacan (Manzanilla and Chapdelaine 2009; Sullivan 2006), Ejutla (Feinman 1999) and the Aztec city of Otumba (Charlton *et al.* 1991; Nichols 2013). See also the recent volume edited by Hirth (2009a) for more examples.

⁴⁸ E.g., Bernier (2010); Chapdelaine (2009).

⁴⁹ Cobb (2010: 127).

investigators working in Europe and the Near East, that specialized crafting occurs primarily in non-domestic contexts. Wattenmaker has argued that 'one reason for the paucity of workshops may be that Near Eastern archaeologists have traditionally neglected houses and site suburbs, where much craft activity would have taken place'.⁵⁰ Second, there is an implicit assumption that some industries – particularly metallurgy – are too complex or too noxious to conduct in a residential setting. Many scholars maintain, for example, that metalworking is sufficiently complex that it must take place in an extra-domestic and well-organized locale or well-articulated series of locales. However, we now have ample evidence that simple metallurgy can be conducted within domestic contexts.⁵¹

This bias about the appropriate setting for certain technologies, along with long-standing preferential attention to textual evidence, probably explains why archaeologists and (pre)historians working in the Near East and Mediterranean spheres have defined workshops as large, non-residential workplaces. However, examples of specialized crafting in residential areas are found throughout the Old World, including in large-scale, complex polities. For example, in the just cited paper, Wattenmaker describes evidence for household-based specialized weaving, pottery production, and possibly metallurgy from several sites in Northwest Mesopotamia.⁵² At Tell Arpachiyah, a 'house' was also clearly identified as a 'workshop' by the excavators.⁵³ Hodgkinson has provided a detailed overview of specialized production of both utilitarian and high-status goods in domestic contexts in and around Amarna during the Late Bronze Age, including in elite houses.⁵⁴ Demonstrating the problematic nature of the assumption regarding the spatial incompatibility of domestic and 'industrial' activities, Todaro has reexamined the materials recovered on the slopes of the palace hill at Phaistos and determined that these structures, originally identified simply as houses, were, in fact, the 'residence-working places of artisans ... pottery workshops' based on the presence of raw materials, kiln wasters, and other debris.⁵⁵ And as a final example: archaeologists have identified more than two dozen 'workshops' in atrium houses in Pompeii, and many others at Herculaneum. Indeed, Flohr notes, 'houses did not lose their domestic function once a workshop was inserted'.⁵⁶

Residentially-based artisans do not just produce in 'commoner' settings. Rather, objects indicative of craft production are often found in elite contexts⁵⁷ and it is often argued that it was the elite themselves who did this work.⁵⁸ For example, there is a growing body of evidence from several Classic Maya sites that high status individuals engaged in crafting in residential compounds,⁵⁹ a conclusion supported by epigraphic studies and through analogy with later codices and (Spanish) Colonial-era documents.⁶⁰ As Inomata and Triadan argue from the evidence recovered at Aguateca, 'It appears that there was not a clear distinction between [elite] residences for domestic life and workshops for craft activities'.⁶¹

This brief review suggests that investigators would do well to pay more attention to the spatial separation between domestic areas and craft production work areas, or the lack thereof. The criterion that 'workshops' be set apart from domestic or residential structures fails to take into account myriad manufacturing constraints and technological, environmental, political, and social factors that influence where production will be located. Several decades ago, I noted: 'Small-scale, independent production is often directly associated with commoner domestic architecture. As the scale of independent production increases, manufacturing may be moved to separate facilities' (emphasis added).⁶² But many other factors come into play. Often overlooked is the issue of scheduling, particularly for part-time specialists. Characteristics of the industry itself are important: whether it is 'efficient' to transport raw materials far from their source; the amount of open work-space needed; the degree and amount of undesirable, noxious, or dangerous byproducts such as sharp lithic flakes, broken slag, or broken pottery or other dangerous waste; the generation of heat, smoke and soot, noise, and/or noxious smells; the possibility/need for multitasking (time-allocation); as well as contextual and economic considerations such as the degree of control (over esoteric knowledge, techniques, distribution and use of final products). What is more, some production is embedded in ritual practice, and therefore will be set apart from regular domestic activities. Examples of this include African metallurgy⁶³ and weaving in the American southwest.⁶⁴

Rather than a strict dichotomy between crafting spaces and residential spaces, the empirical archaeological record suggests a broad spectrum in terms of the

⁵⁰ Wattenmaker (1998: 53). Cf. Pullen (2013).

⁵¹ Gero (2015); Gero and Scattolin (2002); Leibowicz and Jacob (2011); Murillo-Barroso *et al.* (2017).

⁵² Wattenmaker (1998). Our understanding of 'workshops' in Mesopotamia is distorted in large measure because it is based on textual evidence, which focuses almost exclusively on large-scale production for the state.

⁵³ Healey and Campbell (2014: 86).

⁵⁴ Hodgkinson (2018).

⁵⁵ Todaro (2009: 346).

⁵⁶ Flohr (2016: 165).

⁵⁷ González Licón (2009).

⁵⁸ Costin (1993; 2016); Inomata and Triadan (2000).

⁵⁹ Inomata and Triadan (2000); Widmer (2009).

⁶⁰ Reents-Budet (1998).

⁶¹ Inomata and Triadan (2000: 63).

⁶² Costin (1991: 25).

⁶³ Childs (1998).

⁶⁴ Hays-Gilpin (2000); Mills (2000).

physical association between (craft) workplaces and domiciles, ranging from cases where crafting takes place squarely within a residential structure or compound, to situations where crafting loci are immediately adjacent to residential structures or interspersed with residential structures in a neighborhood, to cases where settlements are more clearly divided into residential and 'industrial' sectors. Acknowledging the prevalence of specialized crafting in domestic contexts also suggests we need to rethink some of our assumptions about the structure of and the relationship between the domestic and political economies, and the strict lines we draw between them. Masson and colleagues, for example, point out that increasing recognition of the significance of household craft production to the political economy of Mesoamerican (and New World) states contributes to an appreciation of the importance of households as primary economic units.⁶⁵

The craftspersons: one or many?

A second set of often specified properties of workshops concerns the size and make-up of the workforce. For example, Di Paolo states, a 'workshop is, by definition, the place of specialized production with many artisans and a range of skills'.⁶⁶ Similarly, Herrmann defines a workshop as a building in which many artisans operate, each one specialized in a single phase of production.⁶⁷ And in describing workshops, Menon writes 'there would have been a system of a division of labour, with skilled processes limited to certain individuals and groups...[with] a hierarchization of tasks'.⁶⁸ There are actually two issues here: (1) can a workshop be comprised of one artisan working alone? and (2) assuming that more than one individual is involved in production, what is the allocation of work among them? Empirical archaeological evidence is hard to come by, and in the absence of contemporaneous textual evidence, we must rely on analogies to suggest how premodern workshops were likely to have been staffed and internally organized. Regarding the first issue, historical and ethnographic examples indicate that some artisans clearly producing for exchange work on their own. Mills, for example, cites a study of contemporary Zuni fetish carvers in which 78% worked alone.⁶⁹ However, the bulk of the ethnographic and textual data suggest that artisans, including those working in residential contexts, rarely work alone; that is, they rarely complete all the tasks by themselves. This is particularly the case for residually-sited production, although often parts of the workforce are 'invisible': as Mills and Wright have documented, much

of the literature on crafting ignores the contributions of family members to craft production.⁷⁰

Thus, it is reasonable to assume that most specialized craft production will involve a 'group' effort and an element of task allocation and cooperation. But research suggests that in the absence of hard data, we often overestimate the number of artisans supplying a particular good to a particular group at a particular time. For example, Clark and Hagstrum have demonstrated that comparatively few artisans were needed to supply sizeable populations with large quantities of utilitarian items such as obsidian blades and domestic pottery.⁷¹ And although scholars originally suggested that Attic painted vase workshops were staffed by dozens of workers, more recent scholarship indicates that workshops were relatively small, staffed by perhaps a lead potter, a painter, and a few assistants.⁷² In sharp contrast to this, I have suggested that for some crafts (especially textiles), investigators have grossly underestimated the amount of time and labor invested – and the number of artisans involved – in production.⁷³

The logical conclusion from these observations is that we should not assume the size of the work group (or artisan population) but rather develop methods to more realistically approximate or measure the size of the workforce. In cases where there are fixed facilities and there is a correspondence between an installation and a worker, it might be possible to approximate the number of workers by identifying parallel workspaces. For example, Murphy and Poblome⁷⁴ identified spaces for at least three potter's wheels in a single ceramic workshop at Sagalassos, and Flohr⁷⁵ used the number of fixed tubs in Roman fulling workshops to suggest the size of the workforce and variation in the scale of the industry. Identification of different task areas within a workshop might indicate the number of workers, although it might be hard to determine if different 'stations' were used simultaneously by different workers or sequentially by a single artisan.

Size notwithstanding, the issue remains as to how formalized task differentiation was within work groups. Investigators working primarily in Mediterranean and Near Eastern contexts posit formal organizational structures within workshops. This is possible because the internal configuration of workshops is often documented in the textual and pictorial data available to them. Hasaki, for example, analyzed a variety of painted scenes of pottery workshops, which, along with textual sources, indicate a complex, formally ranked

⁶⁵ Masson *et al.* (2016: 260).

⁶⁶ Di Paolo (2013: 125).

⁶⁷ Herrmann (2000: 274).

⁶⁸ Menon (2008: 142).

⁶⁹ Mills (1995: 160).

⁷⁰ Mills (1995; 2000); Wright (1991). See also Costin (1996; 2018).

⁷¹ Clark (1986); Hagstrum (1989).

⁷² E.g., Osborne (2004); Sapirstein (2013).

⁷³ Costin (2013).

⁷⁴ Murphy and Poblome (2012a).

⁷⁵ Flohr (2017).

structure with a master, skilled associates, assistants, apprentices, and unskilled workers.⁷⁶ Similarly, Cooney describes a workshop structure where individuals had a 'formal role' – an individual had to officially enter the workshop after gaining and demonstrating specialized skills and knowledge.⁷⁷

As is the case for non-residential production, there is little evidence in the Americas that artisans were organized into highly structured work groups. Admittedly, this may reflect the general lack of written texts for most pre-Columbian cultures rather than what actually happened there. In the cases where we do have texts, there are some suggestions of task differentiation, differential skill, and perhaps an organizational hierarchy within work groups. For example, Reents-Budet has suggested that Classic Maya workshops were comprised of a master artisan and several apprentices,⁷⁸ a conclusion supported by Houston's work on Maya artisans' signatures.⁷⁹ Tate argues that among the Maya, women made paper and shaped ceramic vessels, while men were the ones who painted on both.⁸⁰ And early Spanish colonial documents from the Andean region indicate that the tasks in Inka textile production were differentiated/specialized, as there are native Quechua terms for spinners, dyers, loom warpers, weavers, and textile painters.⁸¹ However, the technical attributes of fine Inka cloth suggest that the same person strung the loom, wove, and finished the individual piece and/or that producers were closely associated in the same production locale.⁸²

In the absence of written documents, internal divisions of labor and task specialization might be difficult to identify archaeologically. A relatively high degree of task-based worker specialization might be recognized archaeologically through the presence of distinct task areas, even different function rooms within a multiroomed production facility.⁸³ There is evidence from some elaborate textiles in the Andes that several 'hands' (i.e., weavers) produced different sections of an elaborate mantle,⁸⁴ and a unique Chimu-Inka figurative ceramic vessel shows two weavers working simultaneously on the same loom.⁸⁵ Vidale⁸⁶ cites the case of the bronze Raice warriors, where careful technical analysis of the modelling techniques of the casting core indicates that the two legs were created in slightly different ways, suggesting one person modeled

the left leg and a different person made the right leg, further suggesting that two artisans were likely supervised by a chief craftsperson, whose existence is documented in written sources. Despite these examples, often there is little or no material evidence for internal task specialization and the concomitant division of labor from carefully excavated production locales.⁸⁷ For this reason, rather than considering this as a necessary attribute of a workshop, I suggest investigators focus on best practices for identifying the spatial arrangement of activities within a production locale and acknowledge when data are unavailable or ambiguous at best.

Personnel: artisan identity, recruitment principles and training

The implied association between workshops and non-domestic spaces implicates a host of assumptions about the characteristics of the workforce, including their social identities and how artisans were recruited and trained.⁸⁸ One of the most fundamental is the issue of kin-based as opposed to non-kin-based labor organization. Although much of the literature on crafting in the Mediterranean and Near East defines workshops as places staffed by non-kin-based work groups, textual and ethnographic literature suggests that more often than not kinship was the primary mechanism of artisan recruitment. In many pre-modern polities, artisans' roles were ascribed by heredity, for example, as Sinopoli documents for ancient India.⁸⁹ In ancient Egypt, crafting roles were largely hereditary, although skill played a role in advancing in the workshop hierarchy.⁹⁰

Drawing on ethnographic data, we see that many work groups are composed of related individuals. For example, Sinopoli notes that workshops in India were staffed by members of nuclear or extended families, similar to Mills' observations about contemporary Zuni artisans.⁹¹ But principles of artisan recruitment are difficult, albeit not always impossible, to determine from archaeological data alone. That 'households' were a basic unit of recruitment and work is attested by the observation that residually-based 'workshops' often persisted over many generations; for example, at Huacas de Moche in Peru, where they were reconfigured and remodeled over successive rebuilding episodes.⁹²

⁷⁶ Hasaki (2012).

⁷⁷ Cooney (2013).

⁷⁸ Reents-Budet (1994; 1998).

⁷⁹ Houston (2016).

⁸⁰ Tate (1999).

⁸¹ Costin (2018).

⁸² Baker (2001).

⁸³ E.g., Duistermaat (2015); Murphy (2016).

⁸⁴ Paul and Niles (1985).

⁸⁵ Vanstan (1979).

⁸⁶ Vidale (1998).

⁸⁷ E.g., Hirth (2009b).

⁸⁸ The term 'household' itself is problematic. We know from the ethnographic record that all individuals who reside together ('the household') may or may not be linked through kinship. That is, the members of a household are not necessarily all 'family'. Rather, as Hirth (2009b: 46) defines them, households are 'task-related residential units composed of individuals who reside together for a variety of ends'.

⁸⁹ Sinopoli (2003).

⁹⁰ Cooney (2013).

⁹¹ Mills (1995).

⁹² Bernier (2010).

Overall, evidence suggests that ‘family-based’ training was an essential element of artisan recruitment, even when skill ultimately determined an artisan’s status within a work group.

In contrast to the ‘Old World’ idea that workshop members are unrelated, in the Americas, the default assumption is that workshops were staffed by people related through kin-ties, largely, of course, because the bulk of craft production took place in residential contexts. When craft production is directly associated with residential architecture, particularly commoner houses, the default assumption is that they were staffed by people related through kin-ties. For example, in describing workshops in a residential section of Mayapan, Masson and colleagues conclude, ‘Such pairs of workshops ... were probably occupied or used by extended family members’.⁹³ And while the association between residential contexts of production and kin-based work groups holds more often than not, this is not always the case. For example, Menon discusses the beadworkers of modern Khambat, who often congregate in one person’s residence to produce beads for sale.⁹⁴ An interesting historical example of non-kin related artisans working together in a residential context is the ‘sweatshop’ pattern in the late 19th and early 20th centuries garment industry of New England, where a workshop ‘owner’ assembled a small number of workers in his or her home to sew clothing on order from large-scale aggregators.

As previously discussed, many definitions of workshops include the assumption that they are comprised of workers with varying degrees of skill. In part, this is a reflection of the notion that unskilled individuals enter into workshops to be trained; for many, the basic definition of workshop includes the notion that a workshop is ‘a place of artistic and craft production where craftsmen were also trained in a range of skills, with apprentices and pupils attached to experienced artisans’.⁹⁵ This is not to say that learning was unimportant or somehow amorphously structured in those societies for which we lack evidence, especially ones in which specialized crafting was household-based. Rather, this particular characteristic is entirely compatible with the workings of domestically-based workshops. I suggest that task allocation and divisions of labor in non-kin based production facilities are in fact modeled/based on divisions of labor found in specialist households, where (particularly younger) family members engage as ‘helpers’ in less-skill based tasks as they learn (that is, ‘apprentice’). Thus, the process of scaffolded learning occurs in both formal and informal (household) contexts, although learning in a

domestic context might rely more on demonstration, observation, and imitation, while formal training might rely more on spoken instruction.

As Wendrich points out, modes of technical knowledge and skill transmission are difficult to identify archaeologically.⁹⁶ Archaeologists have used ethnoarchaeological studies to suggest the characteristics of items made by novices.⁹⁷ For some industries – especially reductive ones – a careful analysis of production processes and accumulated debris might provide insight into the relative skill or training of workers. In a detailed study of materials from a somewhat unique blade manufacturing site in Beer Sheva, Davidzon and Gilead concluded that the assemblage was aimed at a standardized production process but was produced by knappers of different skill levels, and therefore represents a workshop comprised of both skilled and unskilled – that is, apprentice – knappers.⁹⁸ Baysal and colleagues reached a similar conclusion for a Chalcolithic stone bracelet workshop in Turkey, arguing that different ordering of steps in production processes distinguished the efforts of novice and experienced artisans.⁹⁹ However, for many media (including textiles, pottery, metal, and glass), inexpertly made items can be reworked or the raw materials can be reused, so errors do not enter the archaeological record. Moreover, the specific characteristics of goods made by neophytes are often material, time and place specific, which limits the usefulness of these studies for establishing general principles, patterns, or analogies for identifying the work of artisans-in-training.

Other aspects of artisan identities are also often assumed rather than demonstrated. For example, a narrowly conceived concept of the workshop – particularly one that emphasizes their non-residential context – carries with it assumptions about the gendered division of labor. It is often presumed that craft goods – pottery in particular – are made primarily by women when production is household-based, but that crafting becomes a male-gendered activity when it is carried out in non-household-based workshops.¹⁰⁰ But empirical evidence – both ethnographic and textual – demonstrates that the situation is significantly more complex.¹⁰¹ Like gender, age is an aspect of artisan identity that is difficult to see archaeologically,¹⁰² although models of artisan training usually assume that crafting skills are learned beginning in childhood, if not adolescence.¹⁰³

⁹³ Masson *et al.* (2016: 255).

⁹⁴ Menon (2008).

⁹⁵ Di Paolo (2013: 111).

⁹⁶ Wendrich (2012a).

⁹⁷ Crown (2001; 2014); Knight (2017); Wendrich (2012b).

⁹⁸ Davidzon and Gilead (2009).

⁹⁹ Baysal *et al.* (2015).

¹⁰⁰ E.g., Peelo (2011); Rice (1991); see also Murdock and Provost (1973).

¹⁰¹ Costin (1996; 2013; 2015).

¹⁰² Costin (1996; 2018).

¹⁰³ See chapters in Minar and Crown (2001); Wendrich (2012b).

Facilities and technology

The foundational studies of the organization of production by Peacock and van der Leeuw defined several types of ‘workshops’, all of which included an investment in infrastructure.¹⁰⁴ And it is quite true that in later prehistory (primarily in the Old World) and classical antiquity, there was often a correlation between technological investment and organizational complexity. Sapirstein, for example, notes the sizeable infrastructure investment needed to establish an Attic black-gloss workshop.¹⁰⁵ More generally, the archaeological practice is often to conclude that if one *does not* find such fixed facilities, there was no workshop production. A correlate of this view is that technological complexity is (always) reflected in the size and permanence of production facilities. But, as with many of the other criteria proposed as defining features of workshops, relying on the nature of the ‘technology’ for determining the complexity of the organization of production is fraught. In particular, as previously discussed, not all craft types require (capital investment in) large-scale equipment, site furniture, or special physical infrastructure, even if they have a lengthy *chaîne opératoire* or require a high degree of technical knowledge or skill. In particular, many New World societies produced incredibly sophisticated and intricate crafts using what might be deemed relatively simple tools and equipment. As previously noted, training and practice – to develop knowledge and skill – are often the most important ‘investments’ made in becoming an accomplished artisan. Such investment in ‘human capital’ is of course virtually invisible in the archaeological record. It is also the case that in some industries artisans can produce large quantities of goods in production locales that are archaeologically ephemeral. As an example: at the same time I was finishing this chapter, I visited a number of contemporary artisan villages and workshops in Oaxaca, Mexico. Among the largest in terms of personnel and output were those devoted to souvenir-quality wood carving. Although some employed a dozen or more workers, differentiated by skill and task, the craft itself did not require fixed facilities or permanent equipment of any sort.

A second reason for caution regarding using the degree of capital investment as a necessary criterion for identifying ‘workshop’ production is that technology is also often linked to sociopolitical structures in the aforementioned neo-evolutionary models of cultural development. As Murillo-Barroso and colleagues note, ‘Technology has traditionally been considered of essential importance in social change, given that key technological innovations have the capacity to

cause profound social transformations. However, we should be wary of possible assumptions implicit in this premise: there is a tendency to relate technology to “progress” and from this surmise that more complex technological systems equate to superior societies’.¹⁰⁶ As suggested by this statement, this neo-evolutionary stance is problematic. Some technologies can remain essentially unchanged for thousands of years and span societies of many different sociopolitical ‘types’.¹⁰⁷ In other cases, the ‘complexity’ of the technology lies in mental processes or gestures that leave almost no material record. For example, pre-Columbian Andean weavers used enormously complex weaving techniques – triple and quadruple weave, scaffold weave – to create cloth considered in many ways to be ‘superior’ to that produced in Europe at the time.¹⁰⁸ Yet they used physical tools and equipment far ‘simpler’ than those employed by Old World masters; it is only through the careful study of the few extant examples of this cloth that we are able to recognize and reconstruct these complex textile technologies. Indeed, the complexity of this industry is underappreciated because of the ‘simplicity’ of the tangible elements of its technology. This example, I think, demonstrates the danger of privileging tangible elements of technology over intangible ones in neo-evolutionary schemes of technological development.

Therefore, it is probably not advisable to require substantial capital infrastructure investments as *necessary* properties of workshops. However, consideration of the nature of the technology and the details of the *chaîne opératoire* can make an important contribution to actual studies of workshops. At the most fundamental level, a full understanding of production processes and their material correlates will enhance our ability to recognize and describe places of production. Second, because virtually all craft production is complex and requires several stages of work from raw material to finished product, studying the remains of production loci in the context of the *chaîne opératoire* might reveal the extent to which production steps were located in a single, fixed place or were spread across multiple places. The degree to which production tasks are carried out in different locations or contexts has implications for broader issues of economic coordination and decision-making, the management and administration of production, and the social relations of production and distribution, among other things. Depending on the particular craft, there might be several different ‘workshops’ involved in the full production sequence from raw material to finished

¹⁰⁴ van der Leeuw (1977); Peacock (1982).

¹⁰⁵ Sapirstein (2013: fn. 20).

¹⁰⁶ Murillo-Barroso *et al.* (2017: 1539).

¹⁰⁷ See, for example, Andersson Strand (2012).

¹⁰⁸ In addition to developing a much broader array of elaborate cloth production methods, in comparison with Renaissance tapestry weavers, Andean weavers used finer yarns to produce tighter weaves on cloth that was finished on both sides. Indeed, the Spanish conquerors marveled at the fineness and delicacy of Inka cloth.

product. For example, analysis of artifacts associated with iron production and metallographic analyses of materials recovered from the *oppidum* of Condé-sur-Suippe in France indicate that raw materials, partially refined materials, and ‘semi-products’ or roughs moved from one ‘workshop’ to another until they reached the place where they were fashioned into finished goods.¹⁰⁹ Similarly, Moore and Vilchez suggest that some shell items manufactured at an imperial Inka workshop in Ecuador were intended for use in inlaid wooden objects manufactured elsewhere.¹¹⁰

Additionally, it is worth considering how the operations and material components of the *chaîne opératoire* will influence the physical and organizational features of the workshop. Fundamentally, the length of a production chain may affect the size and organization of the workshop. More specific elements include not just the presence or absence of fixed equipment and facilities, but also the overall location(s) of production tasks, the internal spatial arrangement of the place(s) where the various steps occur, and the potential size and composition of the workforce. Understanding the *chaîne opératoire* also enlivens interpretation of the workshop. Linking the physical space and the processes undertaken therein invites discussion of the patterns of movement in workspaces, as exemplified by studies of Egyptian¹¹¹ and Roman¹¹² workshops, as well as consideration of the relationships among workers.¹¹³ Finally, because particular industries often necessitate a core of steps that must be performed in a linear sequence, once the basic *chaîne opératoire* is known, it might be possible to identify gaps in the archaeological evidence resulting from incomplete data collection, misinterpretation or misidentification of tools¹¹⁴ or debris,¹¹⁵ ‘missing’ steps,¹¹⁶ and, by further extension, identify ‘missed’ members of the workforce.¹¹⁷

Goods produced: output scale, range of products, and standardization

My literature review also revealed a number of common assumptions about the goods produced in workshops. Most notably, the assumption is often made

that workshops primarily turn out large quantities of a single, standardized type. All three attributes are tied directly or indirectly to ‘efficiency’, the need for which is often given as a prime catalyst for the development of extra-household production.

For some, particularly those working in the Old World, the presence of workshops presumes a large ‘market’, perhaps more broadly conceived of as ‘demand’. Workshops – particularly non-residential workshops – are presumed to have developed to increase production output, the argument being that artisans working in their homes can only produce small quantities of items. However, ample ethnographic and archaeological evidence indicates that even fairly high outputs can be achieved by artisans working in a residential context¹¹⁸ and, as noted above, archaeologists often overestimate the number of artisans needed to supply a given population.

For some, again largely Old World, scholars, workshops are also distinguished by the narrowness of the range of goods they produced, suggesting that workshops were distinguished from other modes of production by their focus on a limited repertoire, if not a single commodity. For most who adopt this criterion, it is connected to efficiency, the idea being that a focus on a single product can lead to greater task specialization and greater routinization, and therefore increased speed and proficiency. Yet study after study demonstrates that artisans in premodern societies engaged in an array of productive activities and that a range of goods were often produced in the same production place. These ‘multi-crafting’ loci run the gamut from relatively small-scale societies though highly complex polities. As an example of the latter, Topic notes that at the Chimú capital of Chan Chan, ‘workshops were specialized spaces but did not necessarily specialize in one product’.¹¹⁹ Among the Aztec, some craft ‘guilds’ were linked by marriage so that multiple crafts were produced in a single residential sector. In the Old World, Hodgkinson identifies a number of what she calls ‘multifunctional workshops’ at Late Bronze Age Egyptian sites.¹²⁰

The production of several different crafts in a single workshop can occur for several reasons. Often, crafts produced in the same workshop were related by material or technology. For example, at Xochicalco, several specialist households produced obsidian prismatic blades and blade tools along with lapidary work in diverse materials.¹²¹ The Amarna O45.1 workshop yielded evidence for four pyrotechnologies: glass-

¹⁰⁹ Bauvais and Fluzin (2013).

¹¹⁰ Moore and Vilchez (2016).

¹¹¹ Nicholson (2017).

¹¹² Monteix (2016; 2018).

¹¹³ Maritan *et al.* (2019).

¹¹⁴ In some industries, many tools are informal, ad hoc, or adaptations of other objects that have been recycled and reused. Indeed, Ingold (2000) reminds us that almost any object can be used as a tool, complicating our reliance on using tools as indicators of workplaces.

¹¹⁵ Which is quite common for some industries, such as bone- and antler-working (see, for example, Gál 2011; Vitezovic 2013).

¹¹⁶ Monteix (2018).

¹¹⁷ Wright (1991) and Mills (1995; 2000), among others, have pointed out that women and children are often underrepresented in discussions of craft production because they perform ‘invisible’ tasks such as resource procurement and transportation and the initial processing of materials.

¹¹⁸ Feinman (1999); Roux (2003).

¹¹⁹ Topic (1990: 156).

¹²⁰ Hodgkinson (2018).

¹²¹ Hirth (2008).

making, metal-working, pottery manufacture, and faience production.¹²² There are numerous examples from the Greek World of potters and metallurgists working in the same workshop, not only because both crafts were pyrotechnologies, but also because potters used metal tools and many metal items were cast in clay molds.¹²³ Some multi-crafting occurred because artisans were making their own tools¹²⁴ or worked various materials for composite objects. In an example of the latter, the workshop of the Amarna sculptor Thutmose yielded evidence for the production of faience and gold foil, presumably to be used as inlays in sculpture, the latter being its primary output.¹²⁵ In other instances, it is not immediately clear why different items were produced in the same place. For example, Masson *et al.* identified several households at Mayapan that produced a range of goods in several media¹²⁶ and Hodgkinson identified several dozen households at Amarna which engaged in two or more specialized crafts.¹²⁷ One possibility is that these households diversified their work as a risk-minimization strategy.

A third presumed feature of workshop production is that its products will be standardized across one or more attributes: style, iconography, production processes, and/or raw material components.¹²⁸ This standardization may be the result of the high degree of face-to-face interaction and collaboration among artisans within the workshop, the use of technologies such as the potters' wheel or molds, or the use of the same stock of raw materials and production processes.

Of course, it is almost always possible to find a counterexample to general principles put forward. So, for example, while technological homogeneity is often considered to be a hallmark of workshop production, there are cases where quite different methods or materials were used in the same physical production locale. For example, Maritan and colleagues analyzed the materials from an Iron Age potter's workshop in north-eastern Italy that burnt down. They identified two petrographically distinct wares and two *chaînes opératoires*, concluding that production of all the types was 'performed as parallel tasks in the same production unit and quite likely by the same craftpersons'.¹²⁹ Interestingly, cases where we detect multiple technological processes co-occurring are often situations where artisans with different social identities or backgrounds were (forcibly) brought together by a domineering actor. For example, Peelo

suggested that male and female potters at the Mission San Antonio De Padua in Alta California used different techniques to form pots, the likely result of the way in which pottery making was introduced and taught along gender lines after the Spanish conquest of this region.¹³⁰ Similarly, a number of scholars working on Inka pottery production have demonstrated that different techniques were used at imperial ceramic workshops, reflecting the traditional practices of potters from different communities conscripted by the state.¹³¹ And Brysbaert and Vetter have suggested that some of the artisans working at the Mycenaean citadel of Tiryns were 'foreigners' based on features of the workshop as well as their use of technologies not typically associated with Mycenaean production.¹³² These examples remind us that technological processes and objects are media through which identities – including the identities of artisans – are constructed and displayed, and reinforces that workshops are often comprised of interacting individuals and that the concept therefore has strong social implications as well as economic and political ones.

'Should' we even talk about workshops when we do not have the physical locus of production?

Perhaps nowhere is the concept of 'workshop' as an abstraction treated as though it had concrete, material existence more unmistakable than in cases where archaeologists rely on 'proxy data'¹³³ or indirect evidence¹³⁴ – attributes of the assemblage or objects themselves – to postulate the organization of production, in particular the number of work groups, often labeled 'workshops'. It is the presumption of relative standardization just discussed that most often underlies the attempts to identify the products of 'workshops' based on the characteristics of the objects themselves. That is, the products of a single work entity (artisan, workshop) are expected to be homogeneous across one or more of the following attributes: raw materials, specific production methods, form, and/or visual appearance ('style' or iconography). Statements linking standardization and the relative number of work groups (workshops) are common in the archaeological literature, and I too have suggested that standardization is a powerful proxy for the organization of production.¹³⁵ This is one of the only – if not the only – areas where one does not find systematic differences among investigators working in different parts of the world or different intellectual traditions! Thus, we see argued for the Classic Maya that 'pottery that shares a distinct paste-chemistry compositional profile should represent

¹²² Hodgkinson (2018).

¹²³ Segbers (2018).

¹²⁴ Topic (1990).

¹²⁵ Hodgkinson (2018).

¹²⁶ Masson *et al.* (2016: table 1).

¹²⁷ Hodgkinson (2018).

¹²⁸ E.g., Meyer *et al.* (2016: 195).

¹²⁹ Maritan *et al.* (2019: 2056).

¹³⁰ Peelo (2011).

¹³¹ E.g., Hayashida (1999).

¹³² Brysbaert and Vetter (2010).

¹³³ Webster (1972).

¹³⁴ Costin (1991).

¹³⁵ Costin (1991; 2005); Costin and Hagstrum (1995).

the output of a group of potters working closely together within one community and, possibly, even within one workshop',¹³⁶ while investigators analyzing *figulina* pottery, a distinctive, technologically complex ware dating to the Middle Neolithic in Dalmatia, note that 'subtle variation in paste compositions provide a window into unintentional standardization resulting from unconscious patterning that acts as a signature of a potter or workshop';¹³⁷ and Pullen concludes, 'The relative uniformity of Late Bronze Age ceramic products in the Argolid, and elsewhere, suggests a few large-scale producers'.¹³⁸

Some investigators express great certainty in this approach. Meyer and colleagues are representative of this confidence in the standardization hypothesis when they state, 'Examining the component raw materials and the nature of the production process (clay, temper, shapes, firing procedures) often allows specific ceramic products to be assigned to specific workshops... [because] specific production workshops, and even individuals distinguished by particular abilities produced pots of more or less distinct types'.¹³⁹ Indeed, the above cited authors are quite confident of the utility of such an approach, stating that an analysis of technological processes as well 'offers relatively clear information about the forms of production without knowledge of the actual place of production'.¹⁴⁰

Just as relative homogeneity is interpreted as evidence for a single production group (that is, workshop), the inverse is also considered true, as exemplified by statements such as 'greater variability in paste compositions between sites implies a lower degree of specialization and a greater number of production locales'.¹⁴¹ Aprile suggests that terracotta objects made from different materials were manufactured in different workshops.¹⁴² An early archaeometric study of pottery from Tell Leilan suggested that pottery was made in non-centralized workshops.¹⁴³ And Vacca specifically attributed variation in the fabric (identified through petrographic analysis) of the Early Bronze Age ceramic assemblages from Ebla and Tell Tuqan to the existence of 'multiple workshops operating within the region'.¹⁴⁴

The standardization hypothesis has been applied to a wide variety of media to argue for workshop production. Ceramics are the most commonly analyzed in this way, but there are a plethora of examples from other media as well. For example, Healey and Campbell argue that

obsidian items of adornment recovered at the site of Domuztepe were so similar to one another that they were likely 'the product of a single workshop'.¹⁴⁵

As might be deduced from the examples just cited, the most common attributes used in archaeological studies of standardization relate to raw materials, analyzed using a variety of techniques. Meyer *et al.*, for example, maintain that 'archaeometrical methods are ideal for distinguishing workshops without actually locating them precisely'.¹⁴⁶ Nevertheless, some ethnoarchaeological studies suggest that morphological and stylistic variables are more reliable characteristics for differentiating between different production sources, including different workshops in the same settlement, because these attributes will capture the idiosyncratic variation among artisans using the same raw material source(s). Examples using dimensional standardization to determine the organization of production include Duistermaat's work on Middle Assyrian ceramic production¹⁴⁷ and Adan-Bayewitz *et al.*'s high-resolution morphological analysis of pottery from Roman Galilee.¹⁴⁸

Finally, visual similarity is often interpreted as evidence for face-to-face interaction among artisans, possibly within the same 'workshop'. Here, analyses might focus on iconography, the manner in which motifs and figures are rendered and represented, or both. This 'connoisseurship' approach is often employed by those working in a more art historical tradition. Although more often associated with classicists, this line of reasoning can also be found among investigators working in the Americas. For example, in her analysis of marble vessels from the Ulua Valley in Honduras, Luke concludes, 'The stylistic data from 166 whole vases and fragments indicate a very standardized iconographic program with standardized vessel forms and sizes, both evidence of a single workshop'.¹⁴⁹ Depending on the types of objects and the complexity of their attributes, some posit varying degrees of interaction, from suggesting the possible hand of a specific artisan though to a group of artisans working closely together (workshop) to a group of loosely affiliated crafters working in the same locality or region.¹⁵⁰

Often, investigators derive greater confidence in their interpretations when they base their interpretations on several attributes. For example, Martínón-Torres *et al.* used a combination of typological, metric, and compositional data to first identify the possibility that several 'workshops' produced each of the component

¹³⁶ Reents-Budet *et al.* (2000: 101).

¹³⁷ Teoh *et al.* (2014: 353).

¹³⁸ Pullen (2013: 440).

¹³⁹ Meyer *et al.* (2016: 191).

¹⁴⁰ Meyer *et al.* (2016: 193).

¹⁴¹ Teoh *et al.* (2014: 353).

¹⁴² Aprile (2013: 433).

¹⁴³ Blackman *et al.* (1993); Stein and Blackman (1993).

¹⁴⁴ Vacca (2018: 18).

¹⁴⁵ Healey and Campbell (2014).

¹⁴⁶ Meyer *et al.* (2016: 193).

¹⁴⁷ Duistermaat (2015).

¹⁴⁸ Adan-Bayewitz *et al.* (2009).

¹⁴⁹ Luke (2002).

¹⁵⁰ E.g., Donnan and McClelland (1999: 187–189).

pieces of the weapons carried by the warriors of Qin Shihuang's Terracotta Army and to then suggest more generally how labor was organized to assemble the corpus.¹⁵¹ Reents-Budet and her colleagues analyzed 140 Maya painted ceramic samples and concluded that 'chemical, typological, and stylistic homogeneity indicate specialized workshop production'.¹⁵² In a follow-up to the study of Ulua marbles mentioned above, Luke, Tykot, and Scott analyzed stable isotope, petrographic, formal, iconographic, and other stylistic attributes and concluded, 'The excellent correlation between the limited stylistic variability and the similar isotope analyses for both the vases themselves and a matching procurement zone points to a single workshop operating with a very limited number of artisans'.¹⁵³ As another example, I cite Hruby, who relied on standardization of clay recipes and formation techniques to argue that the plainwares recovered in rooms 18–22 (half of all the plainwares recovered from the palace) at Nestor's Palace were the products of a single workshop.¹⁵⁴ Indeed, using fingerprint data, she goes so far as to argue that these vessels were the output of a single potter!

The 'standardization hypothesis' has been critiqued extensively in the literature¹⁵⁵ and I will not repeat the arguments in detail here. But it is important to note that while a large number of investigators express great confidence in their ability to use the standardization hypothesis to recognize products deriving from the same workshop, others are more cautious, usually because they can demonstrate that the correlation between product homogeneity and workshop organization is not perfect. For example, Hirth directly identified four contemporaneous obsidian manufacturing loci in different residential units at Xochicalco.¹⁵⁶ Visual inspection and neutron activation analysis (NAA) of materials recovered from the workshops revealed a complex pattern of resource use. Overall, the Xochicalco artisans used four different known obsidian sources, plus a small number of unidentified sources. Obsidian from all sources was found at all the workshops, so there was no definitive correlation between a specific workshop and a specific raw material source. Two of the workshops had nearly identical source profiles; the other two differed in the relative percent of obsidian from different sources. The workshop with the highest output exploited the greatest number of different raw material sources. Overall, different workshops were not distinguishable by resource type(s) used. In a similar vein, Gilstrap and colleagues analyzed the ceramics produced at a single

workshop locus – identified by the presence of wasters and a potter's wheel – and determined that the potters used different fabric recipes to produce different types of vessels. This single workshop produced a wide range of products, including: table-ware, jugs, large storage jars, bathtubs, and cooking vessels.¹⁵⁷ And although Adan-Bayewitz and colleagues were able to distinguish between the products of two known manufacturing locations located only 200 m from each other at the same archaeological site (Kefar Hananya) using both chemical element composition analysis (instrumental neutron activation analysis (INAA) and high-precision X-ray fluorescence analysis) and computerized morphological analysis, it has more often proved to be difficult to distinguish the products of different 'workshops' operating in the same community.¹⁵⁸ As Osborne notes, in using indirect data to establish the organization of production, investigators run the risk of advancing a circular argument: objects are attributed to the same workshop because they are homogeneous in some key way, but analysts explain that objects are similar to one another because they come from the same workshop.¹⁵⁹

Using proxy or indirect data is likely more fraught than we often acknowledge. Given that objects that are highly similar to one another might or might not have come from the same specific workshop, some investigators use the term 'workshop' cautiously in the absence of material evidence for the actual locus of production. For example, in their analysis of pottery production at Gordion, Henrickson and Blackman place the word workshop in quotation marks ('workshops') in interpreting the significance of clusters of vessels grouped together by chemical characterization (INAA).¹⁶⁰ And while most are willing to use indirect evidence, albeit cautiously, to identify the products of a 'workshop', Rice emphatically argues, 'unless the samples are drawn from a single context archaeologically identified with production, *these geochemical groups are not necessarily equivalent, in and of themselves, to any socio-economic units such as workshops*' (emphasis in the original).¹⁶¹ As Brysbaert and Vetter's¹⁶² succinctly put it, a workshop is an 'actual place of practice'.

¹⁵¹ Martín-Torres *et al.* (2014).

¹⁵² Reents-Budet *et al.* (2000: 101).

¹⁵³ Luke *et al.* (2006: 25).

¹⁵⁴ Hruby (2013).

¹⁵⁵ E.g., Arnold (2000); Blackman *et al.* (1993); Rice (1996).

¹⁵⁶ Hirth (2008).

¹⁵⁷ Gilstrap *et al.* (2016).

¹⁵⁸ Adan-Bayewitz *et al.* (2009) note that even though in their study where they were able to differentiate between production locations based on chemical composition, the ceramics from the two production loci are compositionally actually quite similar to each other and that only high-precision analysis could conclusively discriminate between them.

¹⁵⁹ Osborne (2004: 78).

¹⁶⁰ Henrickson and Blackman (1996).

¹⁶¹ Rice (2009: 128).

¹⁶² Brysbaert and Vetter's (2010: 27).

Summary and conclusions

So what, then, is a ‘workshop’? I hope this review demonstrates that although the definition and characteristics of the ‘workshop’ might be self-evident to investigators discussing their particular cases, in fact workplaces and labor organization were extraordinarily varied in antiquity. Archaeologists use the term ‘workshop’ to label different phenomena precisely because there *are* different kinds of establishments where specialized production takes place. Few places outside of western Europe, the Mediterranean, or the Middle East conform to a single pattern, especially not to narrow definitions of workshops as special-purpose, internally differentiated places where a full-time staff distinguished by their skills and/or assigned tasks produced large quantities of standardized goods. Even in those places where such organization was present, much specialized production took place in other contexts. Most, if not all, crafts can be practiced at a wide range of scales and the empirical data indicate that organization and infrastructure were often quite varied, even for a single industry within a single community. What is more, throughout the preindustrial world, most craft production – even relatively high-output production in premodern states, often with well-developed exchange/commercial institutions – was part-time, residentially-based, and often part of a ‘multi-craft’ operation.

As noted at the beginning of this chapter, the definition and classification of workplace and work group types is important because we associate different modes of production organization with particular types of sociopolitical organization. Given these implications, what we call things matters. In adopting a rigid, narrow definition of the ‘workshop’ – one which cannot be applied to vast swaths of time and space in the archaeological past – we risk perpetuating the pejorative attitude that differentiates between ‘craft’ and ‘art’, ‘major’ and ‘minor’ works that was born in the Renaissance but still pervades some art historical and even archaeological perspectives. Given the varied usage of the term ‘workshop’, and its myriad economic, social, and political implications, I suggest some possible best practices for our communications moving forward. Most important is explicitly defining what is meant by one’s use of the term ‘workshop’. Second, to the extent that one is dealing with the physical remains of production and there is sufficient evidence to securely and more precisely identify the context, it might be wise to use a modifier, such as ‘domestic workshop’ or ‘palace workshop’, or at least clearly describe the setting in which production was situated.

There is, of course, other nomenclature we could use to label production areas and units. Some seem on the face to be more neutral monikers for the physical location

of production. These terms include production area,¹⁶³ production zone, work area, production location, and production locus. ‘Atelier’ is used occasionally,¹⁶⁴ but this term is not well-defined and carries the ‘baggage’ of its association with European artists’ studios and guild structures. In the absence of evidence for the physical location of production, some suggest using ‘work group’, but this term implies an element of face-to-face interaction among artisans for which we have no evidence. Another possibility is production center, although the term ‘center’ is in and of itself value laden, evoking organizationally centralized production, when in fact objects that share attributes might have been produced by a number of work units who shared a common resource, technology, or decorative template. Art historians are inclined to use the term ‘school’ for objects that share a similar style, but this implies a formal structure of training, assistance, and collaboration. Recently, the term ‘community of practice’ has come into vogue to characterize objects whose shared attributes are believed to derive from a shared ‘way of doing’ that is the result of common training and ongoing interaction. This model, however, does not require that the artisans were part of the same actual work group, a characteristic that is implicit in virtually all conceptualizations of a workshop.

Given the concerns and caveats raised in the discussion above, I am increasingly inclined to back away from some of my earlier assertions that we can identify ‘workshops’ using indirect evidence, whether it is stylistic, iconographic, formal, or material. Perhaps the ‘safest’ approach is to use language that is more cautious, more reflective of the unconfirmable nature of such conclusions. I realize that many investigators will choose to continue using the term ‘workshop’ in the absence of a specific physical locus of production, but in these cases I recommend that they explicitly list not only the assumptions they are making about the connection between patterns in the material record and the organization of production, but also the implications that follow from using this term in the absence of concrete identification of the production locale.

I suggest that we use the general term ‘workshop’ simply for all the places that we can directly identify as *discrete* places where *specialized* craft manufacture physically occurred. Then, rather than concerning ourselves with the attributes of a workshop, we can focus on determining the characteristics of *this* (specific) workshop. Such an endeavor would involve answering a number of questions to the best of our ability, given the archaeological and other evidence available. Was it located in a residential setting or in an ‘industrial’

¹⁶³ Emery (2009); Moholy-Nagy (1997).

¹⁶⁴ Hirth (2009b); Miller (2007).

sector of the community? Or was it associated with administrative or elite architecture? Can we determine how big the production area was, and even guesstimate how many people could have worked there? What do we know about the activities conducted and the products produced there? Is there evidence for task differentiation? What was the full suite of activities that occurred there? Subsequently, these characteristics can be analyzed in the broader cultural, social, economic, and political contexts. Overall, a workshop entails relationships among materials, workers, and space. As Murphy and Poblome have noted, 'the workshop must be considered as a complex network of social, cultural, economic, and technological interactions that constantly influence and recursively are influenced by each other'.¹⁶⁵

Of course, many investigators are already doing this sort of detailed investigation and analysis to a greater or lesser extent; what I call for here are idealized best practices that include defining one's terms and clearly acknowledging what is known (demonstrated) and what is assumed. Such practice will also force us to focus on the evidence at hand. By building our databases of observable structures and processes, we can not only more fully elucidate the range of practices and institutions that developed to supply ancient populations with objects needed and desired, but also more effectively build middle range theory to better understand the social relations of production and how craft economies articulated with and supported other social and political infrastructure.

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¹⁶⁵ Murphy and Poblome (2012b: 30).

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