Roman Workplaces, Work Practices, and Working Lives:

A MULTI-SCALAR SOCIO-ECONOMIC STUDY OF CERAMIC PRODUCTION IN THE EASTERN MEDITERRANEAN

By Elizabeth A. Murphy

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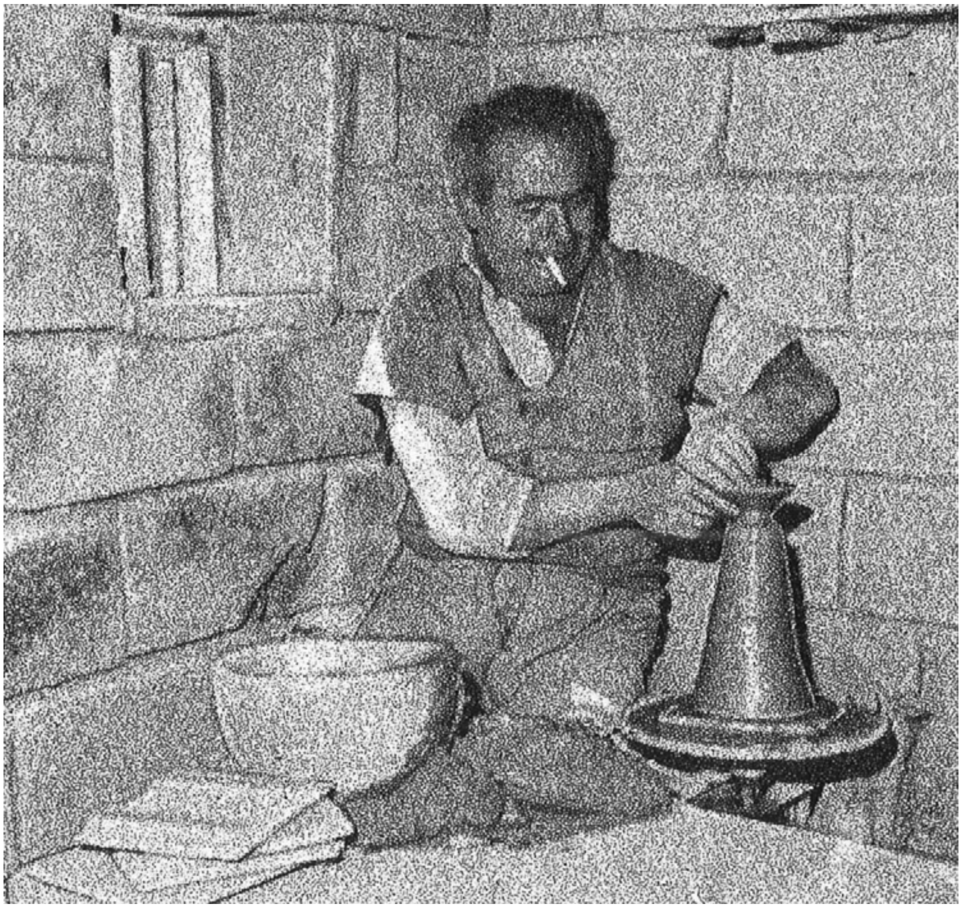

Work is like the spine which structures the way people live, how they make contact with material and social reality, and how they achieve status and self-esteem. As anthropologists we are interested in work because of what it tells us about the rest of society, based on the viewpoint that basic institutions touch all institutions.

(Applebaum 1992)

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Table of Contents

Part I: Introduction

Part II: Defining Production

Part III: Workshop Analyses

Part IV: Conclusions

List of Tables

List of Figures

List of Abbreviations

Ceramic Types

ARS	African red slip ware
ESA	Eastern sigillata A
ESC	Eastern sigillata C
ITS	Italian terra sigillata
LRD	Late Roman D ware
LR1	Late Roman 1 amphora
SRSW	Sagalassos red slip ware

Other Abbreviations

NIE	New Institutional Economics

CHAPTER ONE

An Introduction to Roman Workers, Workplaces, and Work Practices

Much like black figure was to 6th century BC Athens, porcelain was to the 16th century Ming dynasty, and delftware to 17th century Netherlands – Italian terra sigillata, African Red Slip Ware, and Dressel 2-4 amphorae have become archaeologically associated with 'the Romans'. Ceramics of many periods are an invaluable means of archaeological dating – a factor that contributes to the importance of their study, yet the sheer quantities of sherds, their seemingly standardized appearances, and the vast distances that these wares are known to have crossed in the Roman period seem particularly staggering. Imperial contexts certainly bring a wide range of people under a common political umbrella, and such scenarios may facilitate the extension of trade networks and foster the adoption of some shared cultural practices. *Yet, how do such imperial structures actually articulate with the archaeological patterns we observe in ceramic wares and, more importantly for this dissertation, with their contexts of production?*

If we begin to probe this narrative further, the imperial situation becomes even more complicated. This is in part because what we are witnessing archaeologically is, in some sense, a 'cumulative effect' across the Empire that tends to occlude more small-scale social phenomena. As we will see in the course of this study, the patterns that we attribute to these 'standardized' wares often come out of many smaller workshops, which may not even have been in immediate geographical proximity to one another.

For a variety of reasons, Roman archaeology offers much potential with which to investigate these themes of production, economy, and society. First, the Roman economy presents a case in which differing scales of local, regional, and imperial networks were often intertwined. This is particularly important when considering the Roman ceramic industries which could be engaged in anything from extremely long-distance trade to highly localized distribution. Moreover, during this period, technologies of production (e.g., mass-produced mold-made wares) and production-step organizations of labor were developed, which in some cases significantly increased the standardization of some wares and their overall production output. At the same time, small-scale independent workshop organizations were also thriving. This resulted in Roman ceramic industries operating according to very different scales of both production and distribution. The presence of such a wide range of production scales, spread out across vast geographical areas, suggests that organizations of production may also have been diverse. How that diversity is expressed, how it should be interpreted, and how that organization reflects cultural and social practice have, however, remained difficult to address and, therefore, provide central research questions for this study.

Second, the Roman Empire encompassed a massive population with historically different cultures, languages, and traditions. Economic studies of the period have by and large focused on analyzing processes of growth and decline at regional and imperial scales. This has resulted in a widespread understanding of strong regional trends in economic development, with different regions specializing in lines of agricultural and other goods. Additionally, the actions of imperial institutions through taxes, monetary inflation, price fixing, and trade regulation have been seen to play a crucial role in economic growth and contraction in the period. With so much emphasis on the regional and supra-regional scales, it has consequently proven difficult to incorporate small-scale economic phenomena into those narratives. Thus, investigating patterns in the organization of production at both the workshop and production-site scales presents a series of important avenues by which to understand how large-scale, even imperial, economic processes articulated with smaller-scale, local industrial endeavors.

Third, the literary record offers a remarkable body of evidence for the Roman world. Although patchy and incomplete, the records that have been preserved offer important glimpses into actual events and happenings for the period. These documents should certainly be read with care, as single events do not necessarily represent wider habits. Yet they nevertheless establish some range of potential practices that occurred within the Roman Empire. For instance, they hint at business, labor, inheritance, and sociability practices, as well as institutional regulations, such as taxation, building regulations, and legal contracts. In fact, it can be stated that most interest in the intersection of economic and social realms has been amongst historians; archaeology, despite strong calls for the contrary (Greene 1986; Bowman 2009), remains slow to take part and contribute to these discussions. The discipline now, however, is particularly ripe for such an enterprise, as archaeological theory in recent years has focused strongly on themes related to production, technology, technique, and labor organization. These offer important insights that can be used at a methodological level to interpret the archaeological record according to social and cultural practices that can then be tied to issues of social structure. Thus, this dissertation attempts to bridge an historically informed, archaeological study of Roman production with recent trends in archaeological theory.

Dissertation Structure

The dissertation is divided into three parts. The first part of this dissertation (Chapter Two) introduces the topic by situating this study in the framework of trends in archaeology, economic history, and social geography. It also outlines methodologies and types of evidence. The second part of the dissertation ('Defining Production') confronts the issues of regional production (Chapter Three) and definitions of ceramic 'industry' (Chapter Four). Together, these chapters offer more nuanced insight into predominant assumptions regarding regional economies and product-based industry distinctions. The third part of the dissertation ('Workshop Analysis') takes a more refined view of production on the workshop floor. These chapters comparatively analyze archaeological examples of workshops in terms of production practice as expressed through their architectural organization and scales of production (Chapter Five) and technological choices (Chapter Six). Finally, Chapter Seven offers a concluding discussion on the evidence presented in the previous pages.

Chapter Three comparatively analyzes the spatial distribution of urban and rural production sites in six regions. This comparative study offers the opportunity to investigate the distribution of production sites in terms of access to raw materials (primarily water and clay), and the distance to nearby transportation routes (rivers, known roads), natural ports and large (known) cities. This will offer a means to assess the degree to which different patterns correlate to the types of product being manufactured and the degree to which those can be associated with urban versus rural 'industries'. Patterns in the distribution of workshop sites demonstrate chronological shifts, as well as regional trends, in the location of industry. This chapter also considers the location of workshops in terms of their impact on local communities and the construction of topographies of lived experience.

Chapter Four evaluates another set of definitions in ceramic production, that of ceramic industries according to the product repertoire of workshops. Employing workshop abandonment contexts and manufacturing waste deposits, the product repertoire of single workshops are compared in order to assess the degree to which product types were repeatedly produced together and the degree to which 'industry' definitions can be established based on the function and form of the wares, the technology used, and their distribution. This chapter demonstrates that a wide range of products could be produced together in a single workshop, representing not only assorted uses, but also different intended markets. These results undermine simple 'industry' definitions according to product type, and demonstrate that even in workshops manufacturing long-distance trade items (e.g., amphorae), other items were often also being manufactured that more likely were consumed in local markets (e.g., lamps, cooking and common wares).

Chapter Five investigates workshop architecture in terms of its structure and scale in order to understand how space was constructed and adapted by occupants as a function of ceramic production and how that organization reflected relations among workers and the production cycle. The intention of the chapter is to correlate these organizational patterns to divisions in labor through analysis of the architectural remains of workshops. By spatially dissecting the allocation and arrangement of different production tasks within the workplace, as well as visibility and accessibility between tasks, spatial differentiations have been discerned that seem to reflect either personal workspaces or collective work areas. The relationship between different built features is also analyzed in order to assess the degree to which manufacturing scale can be inferred from the archaeological record. These results demonstrate that development in workshop spatial organization was intimately tied to the history of the building itself, as well as to local architectural traditions.

Chapter Six investigates the techniques and technologies of production. Technologies analyzed include the infrastructural remains of kilns, clay basins or vats, and potters' wheels. Spatial and temporal patterns in production techniques and technologies are used to establish traditions of technical styles. Those traditions represent shared cultural knowledge passed down and practiced through generations of craftspeople, and used to reinforce boundaries and ties between different groups. Thus, technological knowledge appears to have been founded at the local level, likely within communities of ceramicists. Moreover, the use of different technologies and techniques of production also appears to have had implications on the standardization of products and overall scale of manufacturing output. Together, these lines of evidence offer a means to identify some of the technical practices that establish styles at the local, regional, or supra-regional levels.

The final chapter summarizes and contextualizes the findings of this dissertation. The concluding Chapter Seven establishes a more nuanced characterization of Roman ceramic production in the eastern provinces, as being neither entirely regional nor entirely local. Generally based in local traditions and maintaining local markets, occasionally workshops distributed their product lines farther afield. Such regional product lines have long been observed and studied by ceramologists. Less widely circulated wares, however, have been less well understood, and through a systematic study of production sites, a more balanced view on the relative proportions of local versus exported goods is acquired. It has long been assumed by economic historians, particularly those of the primitivist school (Finley 1985), that much production was directed to local markets. By privileging long-distance trade items at consumption sites, however, archaeological studies of ceramics have been slower to corroborate these trends.

The results of this study demonstrate that a wide range of wares could be produced in the same workshop and by the same artisans. This local basis to production is reinforced by the nuances of production within the workshop, where patterns in technological transmission and labor organization are demonstrated as being based in local traditions of production. The results of this study establish that region-wide production appears most commonly in the case of amphorae. Yet even in those circumstances, locally consumed wares were also often manufactured. Even less common than regional influences are empire-wide trends which, in the case of ceramic production, appear to be largely associated with military production.

These results demonstrate that features of production organization (i.e., choices in technology, scale and layout of workshop space, location of production) for the ceramic industry tend to be shared across the local and to a lesser extent regional levels, and only occasionally can influences be associated with higher levels of centralized administration. It is supposed, however, that this trend may be industry-specific, as other industries, such as stone and metal extraction, are historically documented as being more directly conducted under imperial auspices and consequently have the potential to be organized in different ways and across different geographic scales. Future work, complementing and building upon this dissertation project, is thereby suggested to compare the organization of several industries and better assess the strategies of economic decision-making in the Roman period.

CHAPTER TWO

Roman Ceramic Production: Theoretical Thoughts and Dissertation Objectives

At a broad conceptual level, this dissertation investigates the relationship between economic organization and social practice. More specifically, it evaluates how socially informed ways of working influence the organization and means of production. The broader theoretical thrust of the dissertation draws on recent trajectories in the study of work and production, both by historians and by social theorists that attempt to highlight not only social and economic happenings within the workplace, but to demonstrate how the 'social' and the 'economic' are inseparable in such a setting and how organizational diversity in those relations is embedded in traditions of practice that traverse local and regional contexts. Moreover, in analyzing the archaeological record of Roman period ceramic workshops in the eastern Mediterranean, this dissertation also attempts to build methodological approaches that can be used to interrogate the material world of ancient production in order to reconstruct the organization and traditions of manufacturing from an often limited and fragmentary archaeological record for the period. Such reconstructions then can be used to analyze models of the Roman economy from smaller-scale socio-economic practices.

Economic Activity as Social Practice

Binford, in his seminal article, ‘Archaeology as Anthropology’ (1962), distinguished between *technomic*, *sociotechnic*, and *ideotechnic* artifact types. These discrete artifact types were said to be indicative of their relative economic, social, and ideological realms, each of which functioned as subsystems within the total cultural system. Following these premises, much archaeological attention was paid in the 1970s and 80s to the analysis of economic systems, which lent themselves to analytical developments in quantitative distribution mapping of artifact types and provenance studies, as well as to conceptual developments in human ecology. As Bauer and Agbe-Davies (2010) note, the popularity of ancient economic studies in the processualist movement experienced a reversal of fortunes with the post-processual critique. Indeed, they argue that post-processual approaches have shown little interest in the area of economic studies, in part because of the close association between processual analytical perspectives and the topic (Bauer and Agbe-Davies 2010: 14-15).

While processual archaeological circles may have been more concerned with systems approaches, economic anthropology’s engagement with the social practices of economic activity can be traced back to what Polanyi (1944) and his substantivists described as ‘embeddedness’, whereby economic activity cannot be explained by economic rationalist frameworks, but rather by influences from institutions within their context of performance. Thus, what more recent work of economic anthropologists references as cultural or social practices would fall into this ‘embeddedness’ of economic activity. More recently, these concepts have been taken up by archaeologists. Laying out a new agenda for the archaeological study of economy, Bauer and Agbe-Davies argue that economic activity is, in fact, social activity, as it fundamentally involves social interaction, and they promote a renewed interest in economic activity that, while using the analytical tools developed by earlier processual schools of thought, can be likewise informed by more recent trends in social theory, particularly as related to agency and practice, materiality, and identity (2010: 22-3).

This position sets a starting point for one of the two themes of this dissertation – the analysis of Roman ceramic workshops and production centers in both social and economic terms. While the general thesis of ‘economic activity as social activity’ is attracting attention primarily in the investigation of exchange and consumption studies (Appadurai 1986; Papadopoulos and Urton 2012), production studies have also established interest in its application and have begun to investigate the premise, through studies of technological choice (Lemonnier 1992), technique (Leroi-Gourhan 2000), and skill (Apel 2008). This production-specific literature, which more closely relates to the material under investigation in this dissertation, will consequently be discussed in greater detail.

The theoretical perspectives outlined in the next paragraphs point out some of the major ways that production can link craftspeople to their (archaeologically detectable) discarded material, to economic activity, and to society. The differing scales of these varying approaches (i.e., from personalized phenomenological experiences of material processing and the transmission of technical styles to large-scale questions of socially constructed labor organization) fit nicely within the parameters of this dissertation, which also attempts to bridge differing scales of analysis. The following sections offer a more detailed discussion of three areas where theoretical work on production serves to inform the analysis of this dissertation. These theoretical discussions are multiscalar and move from the hand of the potter, to shared practices in communities, and finally to institutionalized sets of traditions: (1) production as embodied action, (2) production as cultural practice, and (3) production organization and its relation to social structures.

Production as Embodied Action: Technique

Discussions of production technique are often enmeshed in discussions on technology, as the two topics are in some respects two sides of the same coin. Many production techniques employ tools and technologies, while most technologies cannot be made or operated without technique. Moreover, just as choices on technology use and innovation are learned in social and cultural contexts, so are techniques of production. Techniques, however, additionally represent embodied action that is acquired through practice and the development of motor skills and gestures (Leroi-Gourhan 1993).

Concerns over the relationship between production and material culture have also resulted in different ways of conceptually bridging the vestiges of the archaeological record to broader social theory. One set of approaches focuses on the manufacturing process, itself. It views production as a cycle comprising a series of activity stages that transform raw materials into finished products. By deconstructing production into a sequence of operations, a variety of questions can be posed concerning the relationship of production to cognition and the embodied human-material relationship.

Leroi Gourhan's *chaîne opératoire* (1993), for example, focuses on the sequences of human-enacted action in the manufacture of artifacts, particularly of chipped stone tools - a reductive production technique[1]. Lemonnier (1986) later elaborated on the *chaîne opératoire* for additive production methods. Additive processes, such as with ceramic production, represent a far more flexible process with more occasions to introduce variability into the process. In order to reconcile these issues, Lemonnier (1986) distinguished between *strategic tasks*, which are indispensable to produce a type of object, and *technical variants*, in which variable technological choices can be applied. Lemonnier writes, 'Examining the social control of these moments or *strategic tasks* is a simple and fertile means to bridge the gap between technical phenomena and other social phenomena' (1986:155). Those *technical variants* present points in the production process in which culturally and socially informed decisions are made in material reproduction, while *strategic tasks* are functionally necessary steps in the *chaîne opératoire*.

[1] Reductive production processes are those which require no chemical transformations of the raw material. They employ simple kinetic energy to transform the raw material into finished product. Reductive productions stand in contrast to additive processes which require fundamental changes to the raw material, often through the mixing of different materials and heat-induced or chemical-induced transformation.

Recently, this element of embodied production technique has been elaborated in another stream of research emphasizing the phenomenological perspective of human-material engagement with materials, both tools and the raw materials of production. This work bridges the embodied technique of production with technology and materiality (Sennett 2008; Ingold 2010). Some of these ideas certainly can be traced back to the work of Leroi-Gourhan (1993), particularly in his exploration of the communicative and technical development of early humans, and his conceptualization of early tools as artificial extensions of the human body's *gesture*. More recently, however, Ingold has written that technique and technology have been traditionally associated with modern conceptions of design and production; he distinguishes this from what he describes as *textility of making*. According to this embodied practice-based concept, 'makers have to work in a world that does not stand still until the job is completed, and with materials that have properties of their own and are not necessarily predisposed to fall into the shapes required of them, let alone to stay in them indefinitely' (2010: 93). *Textility* likewise incorporates perceptions of embodiment, agency, materiality, and skill and offers a conceptual bridge between production technology and technique.

Embodiment has also been at the crux of another area of production studies concerning the way that technique is learned and skill acquired in social and cultural contexts. For instance, Apel's study on flint knapping drew on recent bodies of literature regarding cognitive and somatic processes of memory (Apel 2008). He contrasts *knowledge* with *know how*. *Know how* represents an often tacit form of understanding that can only be acquired through physical experience and practice. This type of understanding is often difficult, if not impossible to express verbally, and is sometimes associated with training-style learning. As learned embodied actions, productive techniques acquire routinized behavioral patterns that contribute to an individual's *habitus* and relate to the lived experience of the producer. These processes of inculcating production techniques can be intimately associated with socialization processes within production settings, and is of particular interest for this dissertation as such on-the-job training of apprentices is in fact historically documented for the Roman period (Westermann 1914a, 1914b; Bradley 1985).

In this dissertation, technique provides a means to access culturally learned motor skills and embodied methods of production that can be observed from secondary production marks on ceramics (e.g., wheel, tool, and press marks). By identifying different techniques and the subtleties of *gestures* across the study region it becomes possible to trace the degree to which technical styles vary across spatial scales and the degree to which technical knowledge was exchanged between artisans. This consequently provides a means to trace out networks of artisanal communities across time and space.

<u>Production as Cultural Practice</u>

At another scale, many of these perspectives analyze techniques and technologies in order to reconstruct community-based traditions in production practice (Stark 1998; Shimada 2007). These production traditions thereby have been used to consider culture change or continuity, particularly in contexts of cross-cultural interaction and colonial encounter (Shackel 2000; Silliman 2006; van Dommelen 2005, 2011; Hodos 2009). As such, production techniques are learned and transmitted through generations of crafts workers in a process that results in technical styles of making and consequently form-based styles of artifact types (Lechtman 1977, 1979). Formal analysis of artifacts and material culture assemblages have traditionally been the basis on which social boundaries have been archaeologically defined; however, tracking and studying technical styles offers an even more refined and intimate lens into practice-based social boundaries (Stark 1998). For the purposes of this dissertation, the concept (and analysis) of production practice will be used to analyze the nature of economic activity at the community level.

Technology as Cultural Choice

The material nature of technology and its transmission makes it a particularly central theme in understanding socially-informed methods of production. Technology can and has been defined in numerous ways. Some scholars have emphasized technology as material (i.e., the things that are technology); some have stressed technology as the processes of production; some have focused on technology as social practice[2] (Mitcham 1978, further developed in Ingold 2000). Writings on technology are vast and represent a long-standing academic tradition. Since the work of Marx (who described the relationship between worker and machine (1859 [1972]) and later in the work of Childe (1958), technology has been perceived as a critical factor in understanding the qualitative

[2] For the purposes of this dissertation, technology is largely defined according to the 'things' of production, which will be distinguished from the methods and processes of production (i.e., technique). These technologies include kilns, potters' wheels, levigation tanks, hand tools, and molds, and are used as data to identify technological choices operating at local, regional, and supra-regional levels.

development of past society through the increased specialization and commoditization of labor, which thereby provided a source of social and political capital.

More recent approaches have stressed social constructions of technological choice, as well as practice theory. In a 2004 set of papers in *World Archaeology*, Kuhn, Schiffer, and Killick presented what they deemed to be some of the more pervasive movements in the study of technology at that time. These included evolutionary, behavioral, and social constructionist perspectives, respectively. Evolutionary perspectives emphasize model building of technological change based on evolutionary principles. It tends towards broad sweeping characterizations of change over time and has not been traditionally applied to complex societies (Kuhn 2004). Schiffer's behavioral approach emphasizes systems model-building. These analyses distinguish variables, such as 'performance characteristics' in accordance with 'behavioral chains' ('sequences of specific activities') in order to study technology change (Schiffer 2004). The third contribution by Killick on 'social constructionist' approaches describes perhaps the most diverse and most significant movement in current literature on technology. This description includes agency and practice-theory approaches, discussions on technological choice, as well as material culture studies. He considers the unifying features of these areas to be an interest in 'relating technology to choice', an aversion to grand narratives, and socially situating technology (Killick 2004).

The archaeological study of technology has been very much influenced by larger trends in anthropological theory that consider practice and agency theory. Pierre Lemonnier's

Elements for an Anthropology of Technology (1992) is a prime example. Distancing himself from functionalist and economically-driven interpretations, he demonstrated that choices in technology use and innovation can only be understood when contextually situated within culturally-constructed conceptions of need, function, design, and style. Utilizing ethnographic examples, his studies demonstrate that seemingly arbitrary decisions in designing, making, and using technology are often socially significant, as they represent cultural practices and traditions. Dobres (2000) has been one of the more widely cited archaeologists who employs choice and small-scale social processes in the study of ancient technology; her approach attempts to intersect Leroi-Gourhan's *chaîne opératoire*, gender studies, performance theory, and practice theory. She promotes the notion that technology is 'concerned with people's relationships with each other and how they drew the making and remaking of the material world into their very being' (Dobres 2000). These two examples highlight recent trends in the study of technology that are moving toward agent-based choice and practice theory as a means to situate technological use and development culturally, and their work will appear again in greater detail in Chapter Six.

By analyzing the spatial distribution of various production features (use of technologies and production techniques, organization of manufacturing space and labor, choice of product repertoire), it becomes possible to disentangle different influences in economic decision-making at the local and regional scales. This application of the concepts of production practice, thereby, presents an avenue to evaluate current models on the nature of Roman-period regional economic systems as well as on the extent and sustainability of communities of craftspeople within those systems.

Production Organization and Social Structures

At an economic-systems level, production is seen as part of a broader organization of economic activity embedded in social and cultural norms. As such, it is the structured patterns of behavior that are often of interest as a means to investigate the relationships among people from the perspective of who is producing objects, and how those activities are organized (Brumfiel and Earle 1987). Accordingly, the mobilization of labor, particularly skilled labor, for the production of commodities is seen as a source of economic and social capitals (Childe and Bernard 1996; Bourdieu 1986; Hruby 2007), likewise acting as a font for social differentiation and asymmetrical power relations (Marx 1859 [1972]; Brumfiel and Earle 2008; Leone 2010). Thus, organizations of labor and means of production reflect social structures and differential power relations.

Application of production organization to the investigation of workshops settings renders them an important topic of discussion, especially as one would be hard-pressed to read a production study that does not apply terminology, such as ‘household production’, ‘workshop’, or ‘manufactory’. Although the historiographic development of production organization schemas can be traced back at least as early as Marx, numerous others have been developed subsequently by individuals coming from a broad range of archaeological traditions (van der Leeuw 1977; Rice 1981; Peacock 1982; Brumfiel and Earle 1987;

Costin 1991). Many of these models, which were fashioned between the late 1970s and early 1990s, derived from a contemporary academic interest in ecology, systems thinking, political economy, and ethnoarchaeological studies.

Many such approaches have attempted to make ties between the archaeological record of production and socio-economic organization. These involve interpreting the latter according to an idealized framework of production organization (van der Leeuw 1977; Rice 1981; Peacock 1982; Costin 1991). Such models identify key variables (e.g., scale of production output, technological developments, spatial distribution of production sites) used to classify different organizational types in an attempt to grapple with the diversity of production organizations. Based heavily on ethnographic analogy, models combined variables that were perceived to coincide within the similar production types reflecting common economic and social circumstances. Typologies have been developed for different purposes – e.g., to understand ecological-cultural systems (van der Leeuw 1977), evolution in crafts specialization (Costin 1991) or economic complexity (Peacock 1982).

The conceptual development of production organization models was not lost on Roman archaeology. In *Pottery in the Roman World* (1982), David Peacock presented a production organization model for Roman ceramic making that integrated archaeological evidence from the Roman world with ethnoarchaeological observations of traditional ceramicists working in the Mediterranean. The *modes of production* are organized hierarchically 'from the simplest to the most complex situation' (1982: 8). When applied to the Roman world, the 'simplest' situations (i.e., household productions) are often described in relation to local, Iron Age industries, while the most 'complex' situations (i.e., manufactories) are described in relation to industries more tightly integrated into either upper-class property management or the imperial administration of Roman society.

The degree to which Peacock's modes have (in some archaeological communities) become part of the implicit intellectual background on the topic of ceramic production is noteworthy and long-standing. Theoretical trends in the archaeology of other regions, however, have largely resulted in a move away from large-scale model building exercises and ecological and systems thinking on production, towards smaller-scale social processes based on agency and practice theory. Yet, the utility of such models lies in part in their ability to identify key variables that contribute to diversity in economic and social organization at the community scale. These models have thereby provided the framework of this dissertation; each analytical chapter (Chapters Three through Six) investigates one such key variable in the context of the Roman East in order to systematically deconstruct the diversity and complexity present during the period.

Approaches to the Roman Economy

Production studies in Roman period archaeology have been slower to integrate some of these considerations deriving from social theory. Instead, production studies have been largely relegated to studies on the Roman economy. Economic studies of the Roman world are currently driven by two areas of research — New Institutional Economics and regional economic specialization. As will become evident in the subsequent sections, these two areas are interested in large-scale economic phenomena that most closely correspond to theories of production organization and its modeling outlined in the previous section. Both approaches, to a certain extent, however, have failed to incorporate smaller-scale economic practice of the period into their analyses in order to assess how such practices contribute to and interface with these larger institutional and regional perspectives. The study presented in the following chapters will therefore tender a better understanding of these small-scale production activities (at least in the case of ceramic manufacturing) and their relation to larger economic processes.

New Institutional Economics

For much of the 20th century, scholarship on the Roman economy primarily focused on two competing schools of thought with contradictory views on the qualitative nature of the Roman economy, the primitivist and modernist schools (Harris 1993). Back and forth debates of the primitivist versus modernist nature of the ancient economy still persist in literature on the Roman economy and offer a starting point for any book on the topic (Storey 2004). Although few today would take either a rigid formalist or rigid substantivist view on the nature of the Roman economy, there seems to be a growing consensus that the Roman economy maintained many features of a market economy with social, political, and historical specificities indicative of its time and context (Temin 2013: 2, 2006; Paterson 1998).

More current trends in Roman economic history and archaeology, instead of focusing on this long-standing qualitative debate, attempt to assess both the *structure* and *performance*[3] of the Roman market economy, by drawing heavily upon theoretical perspectives from New Institutional Economics (NIE). This current movement is perhaps best exemplified by the recent volume, *The Cambridge Economic History of the Greco-Roman World* (Scheidel *et al.* 2007), which integrates the theoretical tenets of NIE with the specificities of the period and region. Although the work of Douglass North (1990) is most widely cited by these Roman historians, NIE represents a much wider movement in economic theory (Klein 2000; Bang 2009). Its general emphasis is on not only the descriptive, structural elements of economy, but also on its performance.

NIE places emphasis on the role of institutions in affecting economic *performance*. It recognizes rules and expectations (both formal and informal) that organize transactions. These rules take three primary forms: firms, markets, and governmental structures. One of the greatest critiques of neoclassical economics was that it viewed individual economic exchanges as taking place according to ideal circumstances in which two parties were each privy to full knowledge of the transaction (North 1990). In contrast, NIE incorporates the concept of *bounded rationality*, according to which knowledge of *transaction costs* is asymmetrical between parties (Klein 2000). Furthermore, NIE recognizes that current decisions are embedded in a history of previous economic decisions, and although certain economic decisions may not be efficient, they may be

[3] Morris, Saller, and Scheidel (2007) define *performance* as “the typical concerns of economists – for example, how much is produced, the distribution of costs and benefits, or the stability of production” and *structure* as “those characteristics of a society which we believe to be the basic determinants of performance” (1).

deemed too costly to change. This cumulative decision making results in *path dependency* of economic systems (North 1990: 108).

NIE, in its emphasis on institutions and organizational structures has been very effective in considering large-scale economic process. North (2005) proposes that NIE should ideally move beyond simply identifying rules, laws, and norms to understanding the way that individuals come to perceive costs and benefits and how they socially learn to make economic decisions based on their cognition of choice (22-24). These assertions have not, however, yet been widely adopted. Indeed, Coase (2005) has suggested that so far much work with NIE has tended to ignore how firms actually function. Moreover, by privileging the outputs of production (price theory), rather than the process itself, it has tended to consider production as a sort of 'black box' in the economic system (Coase 2005: 31-33). In general, there appears to be a growing recognition that NIE should consider these smaller-scale socio-economic phenomena, yet has developed neither a methodological, nor a theoretical framework to do so.

NIE has piqued particular interest on the part of medieval economic historians and is more recently gaining traction for the study of the ancient economy. Yet, while NIE takes into consideration the cultural and social norms of a period and sees these sets of practices as formulating institutions, there tends to be less concern over how social relations and norms come about and just how such personal social relations influence economic activity patterns. For present purposes, this study will investigate the small-scale sets of interactions within the workplace and local community in order to better understand how an institution, such as crafts production, is defined and maintained. The integration of a theoretically informed analysis of this institution (i.e., crafts production) here, thereby, will potentially offer some important points of discussion for NIE.

Furthermore, in order to systematically analyze growth and contraction of the economy (i.e., its *performance*), much emphasis has been placed on developing quantitative methodologies using the historical and archaeological records, despite fundamental challenges in doing so (Bowman and Wilson 2009; Harris 1993:13-14). In partial response, this study will likewise consider issues of quantification, particularly in Chapter Five which investigates issues of manufacturing scale. More than reinforcing these attempts to quantify the Roman economy, however, this study highlights how much is lost or obfuscated in narrow interpretations of production sites in exclusively quantitative terms. Instead, qualitative features of the production setting (e.g., types of kiln design, layout of workspace) are emphasized in order to better understand less about the *performance* of the industry and more about the way the industry (as an institution) actually operated in terms of social relations.

Roman Regional Economies

While much current research on the Roman economy by historians concerns the role of institutions in economic performance, work by archaeologists on the issue has tended to focus on other themes. Most notably, these studies have investigated the idea of regional economies. The Roman Empire incorporated a vast geographic area full of ecological, political, historical, cultural, and linguistic diversity. Consequently, analytical divisions of such a large and diverse area can take any number of forms and can be based on any number of factors. The diversity of these lands offered variable sets of economic opportunities and maintained different forms of economic organization. This situation is further complicated by the fact that none of these factors followed static borders and each at various times in the Roman period were shifted, created, and dissolved.

This has relevance to the study of the Roman ceramic production, as studies of workshops in various parts of the Empire have made it clear that many of the 'classic' Roman pottery types, in fact, represent the accumulated production of many smaller workshop sites. Examples are prevalent: Gallic sigillata is known to have been produced at Lezoux, Montans, and La Graufesenque (Bémont 1986); African Red Slip Ware and African Cook Ware were produced first at sites along the coasts of Tunisia and Libya later moving more inland (Bonifay 2004); production of Late Roman Amphora 1 has been identified at Paphos on Cyprus (Demesticha 2001), as well as Elaioussa Sebaste in Cilicia (Burragato 2007; Ferrazzoli 2007). This dispersed model of regional production, not only of industries typically associated with rural production (i.e., amphora production), but also of tablewares, has called into question the use of basic economic concepts, such as 'production center' and 'region', that have so long defined our characterization of ceramic industries in antiquity and their organization (Poblome *et al.* 2002).

The regional economy studies taking place have tended not, as of yet, to investigate the relationship between these trends in regional ware groups and individual workshops. Such analyses hold potential, however, to establish the extent to which such trends may or may not be represented in features of production practices within a workplace. This consequently raises some important questions concerning regional specialization in ceramic production that this dissertation will attempt to address. Namely, do traditions in production practices correspond to patterns of regional specialization? Do regional patterns in specialized wares represent a cumulative effect of many different workshops that 'blurs together' local and workshop based traditions, or do individual workshops demonstrate uniform production practices across the entire region? What types of ware are actually being manufactured on the workshop floor? How specialized are the workshops that contributed to those regional wares? Did they exclusively supply long-distance trade items or did the product repertoire tend to be more diversified based on the demand of its intended markets? This project will revisit some long-standing narratives on regional economies of the Roman world by starting at the workshops themselves, and using what is currently available in the archaeological record to consider diversity in production organization at the workshop, production site, and regional scales.

Social Geography's 'New Regionalism' and Economic Anthropology's 'Local'

Interest in regional studies is not exclusive to Roman archaeology. It is clear that the distribution of workshops across a 'region', however, is often difficult to strongly delineate geographically and is not uniformly dispersed across an area. Moreover, these distributions often fail to correspond with political boundaries known for the period (i.e., Roman provincial borders). This raises the question, then, of how such 'regional' wares should be interpreted. Some theoretical insights can be garnered, however, from other disciplines (especially social geography) that are also working through the conceptual and analytical framework of 'the region'. Indeed, in our modern context the region plays a central role on economic and political stages in relation to world-systems theory, post-Fordist economic forms, and cross-national and intra-national policy development (Wallerstein 1974; Jones and Paasi 2013; Harrison 2013: 57). Such recent conceptual developments in the disciplines of economic, cultural, and political geographies are offering fresh ideas on the concept and definition of the 'region' that hold particular resonance for the present goals.

These studies have highlighted the very timely and modern interest in regional studies, as related to the increasing role of regions in global political and economic discourse. Modern approaches to regional studies are becoming increasingly aware of the limitations of the 'region' as a conceptual and analytical unit, however. This is, in part, due to the bounded and territorially-fixed nature of the region (i.e., it is fundamentally tied to a geographical area), and the recognition that inter-personal networks easily cross-cut and permeate those boundaries (Paasi 2010). Organized and patterned human activities may not therefore correlate to these geographical parameters, and territorial delineations of a region according to one set of variables may not correspond to the parameters of another (e.g., population, economic boundaries, political boundaries, cultural boundaries, religious boundaries, topographic boundaries, etc.) (Massey 1991).

The one-dimensionality of a regional model of nested hierarchy, moreover, has met with critique.

In his overview of ‘new regionalism’, Harrison describes the role of scale in the context of these new perspectives, whereby regions are not defined by nested, fixed spatial scales, but rather by the ‘outcome of those activities and processes to which they in turn contribute’ (2013: 59). That is, it is not a neutral territorial space that defines the scale of activities, but the spatial extent of activities that define the place and gives it meaning. In this sense, social network analysis has come to be seen as a complementary approach for the spatial analysis of these activities, an approach Harrison refers to as ‘network geographies’ (Amin 2004; Harrison 2013: 60). In response to these critiques, a call for more flexible ways of thinking about regions as relational settings for human activities within them has been proposed.

Anthropological research, for much of the latter twentieth century, likewise represented a period of research wherein regional and global levels of analysis featured prominently, citing developments in world-systems (Wallerstein 1974) and postnationalism (Appadurai 1986). As Blanton *et al*. (1996: vi-vii) have noted, ‘Nevertheless, the value of local-level studies has reasserted itself as many are finding that, rather to our collective anthropological relief, global processes are, simultaneously and necessarily, local ones…’ and leading to the conclusion that ‘an inability to understand local systems will lead to poor characterizations of larger ones’. As was the case in recent geography approaches, what appears to be emphasized is the relational geography – between local and 'global' – rather than rigidly bounded classifications of territorial units.

Regional Studies and Economic Implications for the Roman World

These approaches to regions as dynamic and fluid hold relevance for the study of economic activities in the Roman world, which have adopted these premises only in part. While this is particularly the case with studies of the Roman economy, there is, in contrast, a significant body of literature within Roman archaeology that has evaluated the difficulties and ambiguities of relating territory to cultural and social processes. Much of this literature has derived from provincial studies (Woolf 1998; Mattingly *et al.* 2013). However, despite so much emphasis on the regional distribution of specialized economic activities in the Roman world, few of these conceptual frameworks associated with the issue of 'region' have been integrated or addressed there. This dissertation, in contrast, provides some insight into the spatial patterning of production practices which can inform current thinking about the regional character of Roman economy, whereby these spatial distributions of practices provide an avenue to more flexibly define territorial concepts of locality, region, and empire.

Archaeological studies on the Roman economy, in contrast to concerns over cultural identity, have put significant emphasis on the regional-scale of economic patterns. Regional patterns in economic production have been supported by general identifications of product specialization in certain regions (Woolf 2001, 1992). These products could be either foodstuffs or other commodities. In some cases, investment in regional products have come to be seen as entrepreneurial decision-making in response to historically documented actions by Roman imperial institutions (for examples, see Mattingly 1988; Tchernia 1989; Wilson 2002). These suggest that major regional development could take place in the Roman economy. Regional specialization is then instigated by the development of other industries that capitalized on trade networks established by the earlier industries. This has long been proposed for North Africa, in fact, where table and cooking ware industries are proposed to have 'parasitically' latched onto the exchange systems established by extraction of the imperial *annona* (Bonifay 2003; Peña 1998; Ikäheimo 2005). Patterson describes this scenario: 'These micro-economies have their own natural rhythms and structures designed to meet local needs… But at certain periods some of these economies become more closely linked with the wider world and find a wider market for their goods' (1998:164, cited in Storey 2004: 125). These trends have been interpreted by some within the framework of an ancient world-system (Storey 2004).

Ceramology, particularly the study of amphorae and tablewares, has also been treated in this manner, and in the case of amphorae, these vessels have been of prime importance in identifying these regional production and distributive patterns (Hayes 2001; Pieri 2007; Petrides 2000; Empereur and Picon 1988, 1989; Demesticha 2000). These archaeological studies have attempted to understand local and regional decision-making concerning investment in agricultural and artisanal production. In some cases, regional production may be dependent on the availability of raw materials unique to or of high quality across a specific area (e.g., the fine stones of Chemtou, the natron of Wadi

Natrun, the murex shellfish of the north African coast). In general, the resources for making ceramics, by contrast, would have been available in most areas of the empire, albeit in variable qualities. The presence of particularly high quality clays, such as those at La Graufesenque, may have provided extra impetus for the development of its large-scale Gallic sigillata industry (Wilson 2012: 137-138), or along the shore of Lake Mareotis, one of the few clay deposits in Egypt (Blue *et al.*2010). Yet unlike other types of industry, ceramics do not present the same restrictions as some other industries in terms of resource availability, and clays can be manipulated to suit different potting purposes (Sinopoli 1991: 10).

Defining regional production, however, has been complicated to some degree. For instance, production sites of certain vessels have been found in largely discontinuous geographical areas. This is the case with the production of Late Roman Amphorae 1, which has been identified on western Cyprus and in Cilicia (Demesticha and Michaelidis 2001; Burragato 2007; Ferrazzoli 2007), demonstrates that production of certain types does not need to be geographically contiguous. In this case, a bounded geographical region does not correlate with the specialized locations of production. Moreover, the rural locations of many production sites of specialized ceramic goods present some methodological concerns. In the eastern provinces, which maintained long traditions of urban and suburban industry, it is not entirely clear whether this model of regional production can be transferred, nonetheless similar regional product types are increasingly being seen in this light (Gadot and Tepper 2003; Dixneuf 2010; Poblome and Firat 2011). Unfortunately, these scales of analysis also often reflect issues related to archaeological research design, whereby urban studies tend to emphasize the locality and workshops of production by means of the excavation, and rural studies emphasize regional production trends by means of surface survey.

Roman Ceramic Production

While broad modeling of production activities has emphasized regional economic development, smaller-scale studies of production sites and their ceramic products have developed differing methodologies. For the Roman world, two branches of scholarship have centrally considered the issues of ceramic production – one derives from studies of actual production sites and the other works from ceramic products found at consumption sites. These two approaches until now have not been fully considered in relation to one another. Each will be described in greater detail subsequently, but it is important to emphasize here that, although both approaches are interested in understanding the organization of Roman ceramic production, their points of departure, methods of investigation, and motivations for doing so, however, are in many ways incompatible.

Interpretations of workshop sites according to production organization models have relied on data collected through excavation and employ detailed analyses of technologies, techniques of production, and resource extraction. Their interest is motivated by an understanding of the complexity and scale of organization. Such studies have been rather rarely applied for cases in the Roman period eastern Mediterranean. Consumption-driven approaches, in contrast, have placed much greater emphasis on locating sites of known and well-studied wares, thus privileging the widely distributed and mass produced product types. They often rely simply on surface reconnaissance and material studies which serve such purposes with less interest on the nuances of a production site.

This state of the field has largely inhibited a methodological or even conceptual integration of the results of the two approaches. This dissertation, in response, represents a first step in bridging the two. This is of utmost importance as understanding the relationship between the two scales of investigation is critical for assessing how small-scale production practice interlaced with larger-scale economic trends in the Roman period eastern Mediterranean. As production organization models were discussed in some depth earlier in this chapter, they will not be revisited, and consumption studies, instead, will be highlighted.

Consumption Studies

As noted, the second approach to ceramic workshops has started from the perspectives of the products. Much of our understanding of the economic organization of Roman ceramic industries has derived from studies of consumption sites that try to 'work backwards' to understand production organization by associating product types with specific regions or locales (as examples, see Hayes 1972; Themelis 2000: 41). From these typological studies, a specific set of models on the economic organization of ceramic production has emerged, particularly in the cases of amphora and tablewares, based on the assumption that such wares were produced by a skilled workforce on a massive scale (even at a proto-industrial scale) and then traded over great expanses (Dark 1996; Whittaker 2002). The products of those major industries were distributed alongside the product lines of local industries operating at a small-scale and often imitating the product types of the large centers (Hodder 1974). The locations of the large-scale production centers thereby moved to meet demand that changed according to shifting relations with imperial institutions and movements of the military and provincial borders (Hopkins 1980; for specific examples related to ceramic production, see Middleton 1979; Mattingly 1988; Tyers 1996). Narratives such as these have consequently tended to focus on large-scale trends in economic organization that privilege political and military histories in a region over local influences in economic decision-making.

This is primarily a consequence of the nature of consumption studies which start from wares that have already been distributed through trade and which are then re-associated by the archaeologists to their point of origin. In this process, an inevitable bias is placed on the widely distributed wares, as they are present at more sites, and ceramologists have consequently become more familiar with their forms. Increasingly, archaeological attention to production sites has raised awareness of the limitations of retrofitting production organization from consumption assemblages alone and of the need to identify and study the actual locations of production sites (Empereur 1986). In response, this dissertation starts from the point of manufacture in order to understand how production organization operated at a local level; how it organized its workers and work space, how it selected technologies and techniques; where it was located; and why it chose its product lines. By starting from the production site, the organization of economic activity can, in these ways, be better assessed in human terms and can be articulated with larger-scale trends identified already by consumption studies.

Why Ceramics?

Ceramic production is particularly well suited to address these questions for a variety of reasons. First, from a collective perspective, ceramic production was a highly diverse industry. This diversity is expressed, for example, in the range of wares produced (e.g., cooking pots, tablewares, transport vessels, tile, brick, waterpipes, figurines, sculpture). Moreover, the products of some workshops were distributed across the ancient world, while the products of other workshops might never leave their locality. This suggests that workshops operated on very different scales of production and distribution. Variability is also observed in the context of its production environment, with ceramic workshops appearing in urban and rural contexts – contexts, incidentally, which have been unnecessarily dichotomized by the primitivist economy school of thought (Finley 1985; Erdkamp 2001). This variability offers a means to compare how workshops across the eastern Mediterranean differed in terms of their labor organization, scales of production, technical and technological traditions, and relationships with their landscapes.

Second, the fact that ceramic production was such a widespread activity for the period presents a means to investigate rather common types of productive work that may also reflect trends in other industries. This is of particular relevance, as potters are not believed to be among the ‘better offs’ of Roman society. Mayerson (2000) has analyzed quantified figures of potters’ earnings referenced in contracts and estate records from Egypt. Comparing the potters’ wages against those of other types of worker on other lists from the region, he determines that (even given rates of inflation) the earnings of potters were marginal and among the lowest cited in both the 3rd and the 6th centuries AD (Mayerson 2000). If his figures reflect potters more widely, this would suggest that ceramic production was an industry practiced by individuals of rather modest means, and understanding the working conditions of such individuals allows us to fill out our view of their lived experience and of Roman society more generally.

Third, documented ceramic workshops generally appear as private holdings in the historical sources and only rarely seem to have fallen directly under imperial ownership. As such, this industry offers the means to investigate geographical and temporal trends in production development and the ways that modest, private industrial initiatives may have either directly or indirectly interfaced with imperial structures. Political economy studies investigating the role that Roman imperial institutions have on industry are typically focused on very specific types of economic activity under direct imperial domain, for instance, quarrying and mining (Hirt 2010) or purple dye consumption at various times (Jensen 1963). To a lesser extent, the *fabricae* supporting the legions (e.g., arms manufactories) have also been studied from a political economy perspective (Coulston 1998). This approach has tended to consider the motivations and mechanisms of political control over specific productive activities. Such industries, however, seem far removed from the average potter throwing vessels in his workshop. Ceramic industries thereby offer an interesting set of cases with which to consider how local circumstances intertwined with imperial institutions in industries producing mundane goods of relatively modest value.

Fourth, ceramic production, in contrast to many other industries of the period, preserves a wide variety and ample amount of material evidence. Ceramics comprise a massive portion of the retrievable archaeological record for the period making it a (comparatively) more accessible type of artifact material to study. Indeed, some amphorae production sites have left production refuse waster deposits 20 meters high and 30 by 50 meters across ('Atelier 14' in Empereur 1993: 39) - perhaps putting the Roman consumption site of Monte Testaccio with its 580,000 cubic meters of discarded amphorae in perspective. In addition to its products, the infrastructure and technologies of the industry lend it well to detection. Pyrotechnologies, such as kilns, often appear as red scorched earth and black glossy vitrified walls. As a result of their striking appearance in the archaeological record, they are consequently often recorded by excavators to a level of detail not always imparted to other industrial features. Moreover, kilns can, in many cases, be identified using remote sensing techniques, such as magnetometry and offering further evidence through survey techniques. Together, these factors make ceramic production among the better documented industries for the period.

Finally, despite the clear potential in these lines of study, many archaeological projects in the Roman East have tended to be a bit ambivalent towards taking on large-scale or in-depth analyses of ceramic production sites. The most successful endeavors that have been performed, instead, tend to be located in the western provinces at sites such as La Graufesenque, France (Genin 2002; Genin 2007; Schaad 2007), Salles d'Aude, France (Laubenheimer 2001), Lyon, France (Desbat 1998), Yvelines (Dufaÿ 1997), Moorgate, Britain (Seeley 2005), Scoppieto, Italy (Bergamini 2007; Bergamini 2011), Giancola, Italy (Manacorda 2012), and El Rinconcillo, Spain (Cacho 1995; Peacock 1973: 236-242). The results of these projects have contributed much to our understanding of the daily lives of Roman ceramicists, not only at their places of work, but also as part of larger local communities. Many of these projects have highlighted strong local cultural ties of the workers through the worship of local deities, continuity in architectural styles and burial practices.

Yet similar detailed investigations of workshops and their wider contexts have been rarely pursued in the Roman East. Exceptions include workshops at: Sagalassos (Poblome 2001; Murphy and Poblome 2010, 2013), Gerasa (Kehrberg 1997; Ostrasz 1997; Kehrberg 2001; Lapp 2001; Kehrberg 2009), Jerusalem (Arubas and Goldfus 2005), and Sinope (Tezgör 2010). Despite this handful of cases, the current literature is remarkably limited, considering the fact that the eastern Mediterranean had been home to large ceramic industries for well over a millennium before Roman expansion into the region, and the techniques of manufacturing Roman wares were certainly known, if not already practiced, by specialists in many of its regions at the time of political integration (Hayes 1997: 11-14). This was a world with cities and trained specialist craftsmen.

Consequently, what was the diversity of production organization in this part of the Roman world? As of yet, no synthesis has been made of the ceramic production sites in the Roman eastern Mediterranean, a situation whose explanation may be found in the fragmentary and poorly published state of the evidence in a region that has traditionally tended to favor excavations of monumental urban centers, rather than rather modest daily life activities. This dissertation therefore represents a first attempt at such an overview and will re-evaluate the current state of the field on Roman ceramic production sites in the east by placing the workshop site on center-stage.

Parameters, Methodology, and Types of Evidence

Units of Analysis

From Greece to Asia Minor, the Levant, and Egypt, the study region for this dissertation includes the imperial provinces surrounding much of the eastern Mediterranean basin. One of the primary methodological challenges to this dissertation has been establishing units of analysis, particularly spatial units. A map displaying the eastern Mediterranean study-region is provided in figure 1-1. For the purposes of this dissertation, the motivation for defining this area is perhaps as much pragmatic as anything else. That is, it is large enough to provide case studies; with so few ceramic production sites fully excavated, documented, and published in the eastern provinces, no single province or region currently provides enough case studies to pursue the research questions of the dissertation.

Currently, ceramic workshops across this area have never received detailed synthesis nor has a comparative exercise been performed. This is likewise of importance as it contrasts the state of the field in areas immediately to the west. That is, major industries in North Africa and in Italy have been studied and published extensively. These biases result, in part, from different research traditions in some of these western countries, particularly among scholars from Britain, France, Italy, and Germany[4], where comparatively more interest has been placed on the economic and daily life activities of communities in these areas. In contrast, archaeology taking place in the eastern Mediterranean provinces of the Roman world have tended to invest in urban excavations, particularly in the monumental centers. This is perhaps best highlighted in this study by the number of kilns dated to the Late Antique period. As will be discussed in Chapter Three, this is a period when workshops appear to be moving *intro muros*, and as a consequence, many archaeological excavations 'accidentally' encounter Late Antique workshops in areas where they were not expected. Kilns of the High Imperial period, in contrast, tend to be situated *extra muros*, and consequently have been less commonly discovered in the study region.

Moreover, certain production practices common to the area, particularly the use of *instrumentum domesticum*, have attracted much attention and have been used to reconstruct the organization of several industries (Harris 1993; Manacorda 1993). These include stamp analyses on Italian and Gallic terra sigillatas (Pucci 1993; Polak 2000; Marichal 1998), amphorae (Manacorda and Panella 1993; Tchernia 1993), and ceramic

[4] Again, this includes work at sites such as La Graufesenque, France (Genin 2002; Genin 2007; Schaad 2007), Salles d'Aude, France (Laubenheimer 2001), Lyon, France (Desbat 1998), Yvelines (Dufaÿ 1997), Moorgate, Britain (Seeley 2005), Scoppieto, Italy (Bergamini 2007; Bergamini 2011), Giancola, Italy (Manacorda 2012), and El Rinconcillo, Spain (Cacho 1995; Peacock 1973: 236-242).

building materials (Darvill and McWhirr 1984; Steinby 1993; Graham 2006). This has resulted in a much more developed body of scholarship on the topic related to industries in Italy, Britain, France, and Spain. Stamp impressions, in general, appear to have been irregularly employed as means of recording for many industries (Mills 2013: 5) and their use was likewise not always consistent through time (Harris 1993: 9). In fact, use of *instrumentum domesticum* is especially infrequent in the cases of eastern tableware production and in ceramic industries operating in late antiquity, both of which are highly represented in the dataset of this study. In general, due to the geographic bias and lack stamp analyses associated with the wares of the workshops used in this study[5], such studies will be only occasionally incorporated into subsequent discussions.

There is clearly a regional disparity in the state of scholarship on ceramic workshops. So much, in fact, is known about the western industries of Italy and North Africa that if they were to be included in this study, they would certainly introduce an inherent and unavoidable bias into any analysis, and they would come to influence and likely dominate many interpretations on the eastern material. In order to avoid privileging those industries, it therefore was decided to delimit the study region around the more eastern provinces. This inevitably offered a smaller and lesser quality dataset of workshop sites. Yet, by excluding some of these extremely well investigated regions, this series of analyses will provide a truly original contribution to the archaeology of crafts production in the eastern provinces of the Roman Empire.

[5] Notable exception to this circumstance are the workshops outside of Sinope (Demirci, Nisiköy, and Zeytinlik), where stamp analyses have been performed (Fedoseev 1999).

Chronological Parameters

The chronological parameters of this dissertation are set from the 1st to the 6th centuries AD. These dates encompass a considerable period of time. However, it is a period that, again, is long enough to supply an adequate number of well-documented case studies for analysis.

This is also a period, beginning in the 1st century AD, during which the entire study area fell under a common imperial administration. The late end-date of this range will probably raise the most concern, as it encompasses centuries that even in the study area are differentially designated as being either Late Antique or early Byzantine. In many eastern provinces of the Roman Empire, the Late Antique period was a quite active period in production and trade (Sarris 2006: 228-229). Many earlier ceramic traditions were maintained and many ceramic wares (especially North African wares) were produced at a massive scale and distributed throughout the Mediterranean, particularly to the eastern regions (Bonifay 2004; Wickham 2005: 693-824). Amphorae were likewise moving foodstuffs long distances, and the presence of an imperial capital at Constantinople stimulated the collection of a second *annona* (McCormick 2001: 53-63). Cities in many regions were also still thriving and municipal governance was maintained (Saradi 2006). Therefore, with a growing academic recognition that the Late Antique period in many parts of the eastern Mediterranean basin was in some respects a continuation of the Roman Empire, this inclusion of the later case studies seems justified. By the 7th century AD, however, parts of the study region were no longer administered by Constantinople, and in some areas, the political landscape was rapidly changing (Sarris

2006). Thus, the chronological parameters represent a period during which the entire study region was incorporated under a common imperial administration.

Moreover, this long chronological range offers the opportunity to explore changes through time in production practice and organization. Organizing the dataset in such a way as to assess systematically changes through time, however, presented a challenge. Thus, in order standardize the chronological variables, a simplified classification covering the 1st through 6th centuries AD was assigned. The classification distinguishes two-century-long periods: Early Imperial (1st through 2nd centuries AD), High Imperial (3rd through 4th centuries AD), and Late Antique (5th through 6th centuries AD) periods. In practice, the Late Antique period was better represented by case studies than either of the Early and High Imperial periods, so in terms of balancing frequencies of sites across the dataset, the Early and High Imperial periods were often combined in analyses. Joining Early and High Imperial periods also alleviated another challenge related to the fact that each site had different chronological ranges of operation that overlapped, but did not always fall into the predefined temporal ranges. That is, while some workshops operated for less than a century others had dates of operations of two centuries. With the Early and High Imperial periods together, most of the complications concerning occupational date ranges consequently were avoided.

Types of Evidence

Each chapter of the dissertation explores individual themes. Those themes were selected from variables identified as contributing to diversity in production organization (van der

Leeuw 1977; Peacock 1982; Costin 1991). Of those variables, four were selected that were deemed to provide archaeologically accessible datasets. Thus, Chapters Three, Four, Five, and Six focus on the archaeological traces of workshops and the production process. Accordingly, these data ideally derive from the published remains of workshop excavations and artifact studies. Fully or even partially excavated workshop sites are unfortunately, however, rarely published and represent by far the smallest component of the dataset for this study. These publications may include architectural and kiln plans, as well as descriptions of other infrastructural elements, such as potters' wheels or settling vats. Artifact descriptions and profile drawings outlining the product repertoire of the site are also typically available and sometimes detail the production techniques employed. Only rarely are small finds related to production (e.g., tools or personal items) described, and consequently, they are not heavily employed for analysis. Plans of the workshop in relation to other archaeological features or sites are also sometimes provided in these publications. This study, in response, brings together data from workshop sites from the period and region. Until now, very little work had been done to compile and synthesize data of this sort.

The current state of the field has also created some biases in how the available data are interpreted. For instance, in this region, particular academic emphasis has been placed on the implications of *production centers* on broader economic discussions concerning distribution and consumption. Interest piqued in trade and consumption has also impacted the nature of archaeological investigation of production sites, which tends to perceive the significance of production sites as little more than the central point from which all distribution lines radiate. As such, archaeological programs have primarily focused on kilns and the identification of product repertoire. The remains of the workspaces are rarely excavated and even more poorly published. In addition, disciplinary interest in ceramic production has been inclined towards certain, specific types. Most attention has been targeted on amphora and tableware production sites, as these product types have come to be seen as important proxies of economic activity – particularly of long distance trade.

Most other industries, especially small-scale rural or local industries of kitchen or cooking wares, have been sadly understudied. This bias is exacerbated by the fact that industries may not be preserved or identifiable to the same extent. This especially concerns production sites that were less reliant on permanent, high-firing kiln structures – features typically considered the undeniable evidence for a production site. Pit firings, open-air firings, or clamp kilns[6] leave little trace in the archaeological record. Swan (1984) has also noted that, even in cases in which kilns were used, the built structures of kilns become obstructions when fallen into disuse, prompting their deconstruction and eradicating any hint of their earlier presence. These trends in research consequently affect the current state of publication on production sites.

Chapters Three and Four on spatial distribution and product repertoire, respectively, address slightly larger-scale questions, and, in addition to the excavation and material data described above, will employ surface survey or the publication of compiled salvage

[6] Clamp kilns are temporary installations in which the fuel is built up around the wares, as a temporary kiln. The entire structure is set alight and largely destroyed in the process of firing. Ethnographically, these are commonly identified with tile and brick industries (Swan 1984: 2, 53-4).

data from a region (Empereur *et al.* 1991; Ballet 1992). This is particularly true of sites situated in rural or suburban settings. Indeed, several extensive surveys have been performed largely with the objective of locating ceramic production sites in mind (Empereur and Picon 1986, 1992; Autret and Rauh 2010).

Generally, data available from survey reports include only a map indicating the site location in a region, and profile drawings of the product repertoire. Occasionally, exposed kilns, profile cuts, or small sondages are reported, but these are infrequent and are typically limited in scope. Ballet *et al*. (1991) outline the factors that complicate interpreting a production site from the surface material record. According to their work, a high concentration of ceramics is simply not enough, and regarding the identification of wasters, distinguishing a production waster from a pot that was secondarily exposed to heat is not always straightforward. Instead, they justifiably argue that, when kiln remains are undetectable at the surface, artifactual material should be analyzed in terms of the composition of assemblage (i.e., the quantities of ceramic material, their range of types, and the variety of fabric groups). When quantities of material are low, the determination of production sites can be challenging. Moreover, the nature of this data collection influences more refined site definitions. In such cases, the site may be classified as a workshop, multiple workshops, or a production center from surface scatter, and any break observed in the chronology of surface material, is used to suggest different phases of production and thereby different workshops, despite the fact that superposition of later remains may obscure earlier, continual occupations of a workshop. These challenges in interpreting surface material are certainly not unique to production sites, but are issues that complicate material comparability in this study.

Ceramic Definitions

'Ceramics', as an archaeological term, is used to classify any good manufactured in fired clay. Thus, pottery vessels, tile, bricks, waterpipes, and figurines are all included under this heading. With so much apparent diversity in ceramic production it seems difficult to assert that these production settings were components of a common industry. Yet, for the purposes of this study, that which holds ceramic industries together as an analytical category is the fact that the material properties of clay dictate certain techniques of manipulation and transformation in order to result in ceramic wares. These require, at the very minimum, stages of (1) clay collection, (2) clay forming, and (3) the transformation of clay to ceramic through heat. Infinite variations on this theme are possible based on local traditions, availability of resources, product type, and technology (Rye 1981: 1-5; Rice 1987: 3-6). Superseding these distinctions, certain shared technical skills and technological *know how (*Pelegrin 1990) have long been shown to be maintained among modern communities of ceramicists (Balfet 1965; Matson 1965; van der Leeuw 1976; Gosselain 1992, 2008, 2010; Joffre 2008). It is the technical features of working with this material type that holds all ceramic industries in common, and that set the parameters of this study. As will be discussed in Chapter Four, however, modern industry distinctions will be confronted to assess the degree to which they may correspond to ancient definitions.

Datasets

In order to pursue the objectives of this project, this dissertation will focus on many of the better documented ceramic workshops from the region, and will use as many of those sites as possible for each set of analyses. The cases (listed in table 2-1) provide a sort of 'pool' from which to draw adequate data for each set of analyses. It is important to note that this listing is not exhaustive. Indeed, many more kiln sites are reported for the region but only provide brief written descriptions and kiln dimensions (for examples of such compilations of kilns in Greece, see Hasaki 2002; Seifert 1993). Lacking associated products, workshop structures or refined dating, such reports offer little to this discussion. Instead, general emphasis is placed on more comprehensive workshop analyses, including the wider contexts (i.e., production center or landscape) of those sites.

Occasionally, well-published kiln sites lacking investigations of workshop spaces are employed when they are useful in specific discussions or sets of analyses. In order to manage the case studies according to differential levels of excavation and publication standards, a listing of the workshop sites has been constructed noting the availability of different forms of evidence for each and their publication records (see table 2-1). Assessment of data quality was contingent on the availability of the following information on the workshop: dates of operation, site plan, workshop plan, workshop description, kiln plan, kiln description, vessel type profiles, vessel type descriptions, description of production techniques, and clay fabric descriptions. Workshops, in this respect, were not handled on equal terms, but employed to the extent that available evidence permitted each type of analysis. More refined selection criteria for data subsets used in individual analyses are also described in the subsequent analytical chapters (Chapters Three through Six).

In addition to archaeological excavation, survey, and material studies data, ongoing research in other areas will be consulted, such as (modern) social and economic historians studying the Roman period. Throughout the dissertation recent work by social and economic historians is integrated into various discussions on industry, work, and workers from the period. However, it is used as a sort of secondary line of evidence. The textual material is not used to 'explain' the archaeological record, as ties between the archaeological case studies and the textual record are simply too tenuous for direct association. Rather, what they offer is a complement to the archaeological record that can be used to socially and culturally contextualize the archaeological evidence. These include studies of: law codes (Saliou 1994, 1996; Aubert and Sirks 2002; Lippolis 2005; Riggsby 2010: 25-46); lease contracts (Berger 1948; Cockle 1981; Rowlandson 1998; Martin 2001; du Plessis 2006); apprenticeship contracts (Westermann 1914a, 1914b; Bradley 1985; Saller 2011); personal, estate, and municipal administrative documents (Mayerson 2000); and epigraphic data from funerary reliefs with worker title (Wissemann 1984; Zimmer 1985; Trombley 1987; Joshel 1992; Iacomi 2008); and from inscriptions by professional associations (van Nijf 1997, 2002; Liu 2005).

Ethnographies were also consulted. Numerous anthropological studies have been conducted documenting traditional practices in ceramic manufacturing. In general, the geographic range represented by these ethnographies was restricted to the Mediterranean, and parts of India and Pakistan. These regions were selected for specific reasons. First, the Mediterranean presents climate and resource parameters (largely) similar to those of the Roman period, and perhaps more surprisingly, India and Pakistan were chosen as pottery wheel technologies (namely the rod-propelled wheels) common in the Roman period are still used in parts of those countries today. These are the only modern regions, to my knowledge, that still use those types of pottery wheel. Ethnographic studies of traditional distribution and markets were also considered. As was the case with historical sources, these ethnographic case studies were employed as a secondary line of evidence to the archaeological record. A listing of these ethnographic cases is provided in table 2-2, with an accompanying map on figure 2-2.

In conclusion, the areas of scholarship presented in the first parts of this chapter provide a conceptual framework on which this dissertation project builds. This brings together recent trends in economic history of the Roman period, social geography approaches to scale and regionalism, and archaeological theory on production in order to investigate the way in which organization of crafts production and production practices at the small-scale articulate with regional and imperial histories of economic development. Until now, relatively little has been done to pursue these research trajectories in the eastern Mediterranean, and the analyses and conclusions presented will consequently in some areas be tentative and fragmentary, as is the case with any pioneering study. However, it is hoped that this dissertation will foster additional research interest on the topic in the region, so that its results will continue to be developed upon in the future.

CHAPTER THREE

Workshops in Context: Location and Spatial Density of Industry

Location, location, location. The wisdom behind this real estate adage has plenty of application concerning the choice of a production site, both modern and ancient. This is largely because where a workshop is sited has real implications for its day-to-day practices and the networks that can and need to be maintained outside of the workplace. Many of those factors (e.g., accessibility to resources, refuse disposal of production waste, distribution networks, and consumers; organization with the production of other goods; restrictions on available / affordable production space) are centrally focused on economic efficiency of production. Undeniably, those factors need to be accounted for in order to maintain any financially viable workshop operation. Differing contexts, however, also present their own sets of challenges and demands on production activities that consequently pose other issues for discussion. Different climates, topographies, and environments present unique sets of challenges and opportunities concerning accessibility and seasonality of resource availability. Many of these issues also relate specifically to rural versus urban land-use patterns.

To some extent the theme of geographical context can be investigated by tracing out archaeologically identifiable variables that can then be mapped and analytically compared. What is often more difficult to identify archaeologically, however, are the motivations for such spatial organization. Yet in very well-studied archaeological cases in which this has been successfully pursued, it becomes increasingly clear that both economic and social motivations are often at play – e.g., ecology (Arnold 1986), familial relations (Mills 2007), ethnic *barrios* (Brumfiel 2008), ritual ideology (Inomata 2008), and institutional control (Spielmann 2002; Flad 2008). The extent to which it is possible to explore all of these issues in the eastern Roman dataset is to some extent limited based on the current state of the field, yet, when possible, these issues will also be considered.

In order to assess both general factors affecting the choice of location for Roman-period ceramic production sites, as well as more specific studies of sites and regions, a two-phase analysis is presented. The first phase employs a large-scale comparative exercise, whereby variables were selected and analyzed across the entirety of the eastern Mediterranean study region. This will assess widely patterned economic decision-making in relation to the landscape as well as correlations between rural and urban development. Complementing these large-scale analyses, a second discussion on the impact that such decisions might have had on the lived experiences of local communities will be made using historical sources from 3rd century AD Oxyrhynchus, Egypt. These will highlight the extent to which social associations and industry location came to be conflated in local topographies of place. This discussion highlights how economic activity acquires different degrees of social significance within communities.

Regional trends

Methodology

First, approaching large-scale trends, variables were recorded for forty-two workshops associated with thirty sites across the study region (see fig. 2-1 and table 2-1). Variables were related to the wider social, economic, and ecological contexts of a given site. Published accounts of both survey and excavation projects were employed in this data collection, when both these forms of data acquisition provided comparable information regarding landscape and cityscape contexts. Variables were selected based on their use in addressing four topics of particular relevance to the themes of this dissertation: (1) definitions of urban versus rural industries, (2) availability and selection of ceramic raw materials (water, clay, and fuel), (3) accessibility to distribution networks, and (4) concentration of workshops. The definitions of these terms are described in each subsequent section. Additionally, the types of products manufactured and dates of operation were recorded. Variables from each of the four themes were consequently compared in order to identify patterns of variables that might be indicative of structured choices in production location across the dataset.

Urban versus Rural

Although laying out definitional lines between *the* urban and *the* rural has proven frustratingly problematic, there is little doubt among ancient economic historians that investigation of this issue remains central to our understanding of how production and trade was organized in the Roman world. The issue of definitions is nonetheless one that persistently plagues the study of the Roman city, countryside, and suburbium. In addition to uneasiness over applying modern conventions to these definitions, the situation is exacerbated by ambiguities in ancient terminology regarding the transitional space between urban and rural. In the case of Rome it is clear that legal, religious, military, fiscal and infrastructural boundaries could all exist along different perimeters and could be independently shifted and redefined (Goodman 2012: 1-7).

Establishing such boundaries archaeologically has been a long sought-after challenge, and one that has been particularly pertinent in the study of the Roman economy, at least as early as Finley's consumer city model (1985) concerning the mutualistic economic relationship between *astu* and *chora*. According to this model, the hinterland sustains an urban population with all requisite resources, and by taxing and renting countryside peasants, the urban-based elite class was able to extract resources from the countryside and sustain local urban development of industry. In the midst of this economic relationship, the city is conceived as a dwelling place and center for administration, cult, and craft specialists. There is also general agreement that urban development was closely tied to rural economy (Kehoe 2007).

Subsequent studies on the rural – urban economic relationship in the Roman world, however, have offered more nuanced understandings of some of these relationships (Whittaker 1990). As an example, Erdkamp (2001) has likewise noted the role of flexible labor regimes in these scenarios, and differing forms of Roman-period land tenure associated with seasonal changes in labor pools, which could reside both in the countryside and in the associated city. In another vein of literature, Horden and Purcell's Mediterranean 'microregion' (2000) hypothesis also considered long-term social and economic implications of the fractured Mediterranean geography, whereby different rural activities are better suited to different geographical niches, such as upland scrub pastures, terraced slopes for olive and vine, and valleys for grain cultivation.

These models of urban-rural economies often center on the role of agricultural produce and its exchange. Ceramic production in this sense is consequently incorporated into these discussions either as a subsidiary rural industry supplying transport and storage containers for the agricultural products (e.g., amphorae or dolia production) or as the specialized urban crafts production of cooking vessels, tablewares, and other ceramic household items. Tile and brick production, which receives less attention in this dissertation, is also integrated into these models by redefining it as a largely agricultural pursuit developing out of a need for large spaces to manufacture the bulk items. However, ceramic production has been found in a wide range of contexts across the Roman world and in a range that undoubtedly traverses both modern and ancient definitions of rural, suburban, and urban. Specialized tableware production centers, such as La Graufesenque or Scoppieto, at locations in what are typically regarded as 'town' or 'village' contexts, are more difficult to locate in these models. Thus, while the relationship of rural and urban has been conceived as a fundamental factor affecting the organization of regional economies, this chapter attempts to situate patterns in the location of ceramic production sites within their larger landscapes. Using these earlier studies by individuals such as Finley and Erdkamp as points of reference, the ceramic production sites are considered in their relative accessibility to, or isolation from, large settlements.

In response to these research themes, sites were classified as being located (1) within a settlement, (2) extramural or peripheral to a settlement, (3) rural and associated with agricultural production, or (4) rural and not associated with agricultural production. The settlement classifications (i.e., variables 1 and 2 listed above) were determined using published urban plans of the larger settlement and workshop site. Although assigning site classifications (e.g., village, town, city) is difficult to do from the archaeological record, in some cases, it is generally recognized that settlements, such as Pergamon or Gerasa are 'urban'. In other cases, towns or large villages may also fall into this category. Sites such as Buoto are included under this class, as they appear to have maintained certain features typically associated with large settlements (e.g., a settlement wall, a relatively large area of contiguous and dense building, community building projects, a wide range of specialized economic activities). Thus, association of a workshop with a city or town was contingent on the workshop being within the contiguous built space of the settlement, as well as its location relative to any city walls, and, in cases where no wall was known, to its center and the edge of the built environment. Cases not associated with large towns or urban settlements were designated ‘rural’. Presence of agricultural infrastructure (pressing stones and vats) was used to distinguish ceramic sites associated with agricultural production. These are often assumed to be rural estates by the investigators, although rarely was excavation used to confirm this. Absence of these features thereby served to classify sites as ‘rural and not associated with agricultural production’. These might conceivably represent small villages, towns, or even isolated production sites. Unfortunately, rarely are additional data provided to support a site classification of the wider context.

Urban Contexts

When assessing intramural from extramural workshop placement in settlement contexts, it becomes clear that in the majority of cases (n=9, 64%), workshops associated with large settlement sites situate ceramic manufacturing on the outskirts of town. This extramural trend has been noted in many cases throughout the classical world, and the even more specific association between extramural industry and extramural human burials has likewise been observed (Poblome *et al.* 2001: 165). Perhaps most famously, this is demonstrated by the case of Athens’ Kerameikos, where such a separation of industry and burials from the rest of the settlement has been well documented (Knigge 1991: 46). Within the dataset compiled here, this is correlated in 13 cases in which the workshop was in immediate proximity to human burials. Use of those burials may predate, postdate, or be contemporary with the workshop activity, but their co-occurrence is nonetheless noteworthy, as it suggests trends in the urban development regarding the functional allocations of space. This is also supported by Roman-period references in Mishnaic law, which prohibited industrial production within settlements due to their polluting nature (Hirschfeld 1997: 64-65). Other proposals for interpreting these extramural trends in the location of ceramic workshops reference prohibitions based on fire risk. Roman civil laws recorded in the Digest highlight property laws that enforce clean air rights for neighboring property owners (van den Bergh 1992).

When we consider the type of craft industries situated within such settings, it is interesting to note that, while there does seem to be a strong tendency for ceramic production to occur in the area that Goodman describes as 'periurban' (2012), other industries, such as fulling, dying, and textile production at Berytus (Hall 2001; Butcher and Thorpe 1997); bone and ivory carving and bronze working at Alexandria (E. Rodziewicz 1999; Daoud 1999); and glass production at Bet She'an (Mazor and Bar-Nathan 1996) sometimes occur in the city center. Various interpretations can be raised for these distributions. For instance, Wilson (2002) has noted for North Africa that different cities display different distributions of fish-processing industries; in some cities fishing-processing occurred across the central part of the city, while in other cities, it was concentrated together in a zone within the city. He proposes that the different distribution patterns are based on the unique historical development of each city and its relation to the local fish-processing industry. In the case of fish-processing, this seems plausible; however, these are very different patterns than appear for the ceramic industry, perhaps due to concerns over fire risk or need for relatively larger, and therefore more expensive, properties (as noted previously).

To a certain extent, in the eastern provinces, ambiguity also arises when distinguishing workshops from shops in urban settings. Although this situation does not typically concern ceramic workshops, this issue influences how we think about industry of the period. For instance, the term *ergasterion* implies one- or two-roomed spaces used for commercial activities (i.e., shops). The term typically evokes images of porticoed lanes lined with storefronts[7]. At least in the way that it has been applied archeologically, while production may take place on the premises, the saleroom/store front is the defining component of an *ergasterion*. This ambiguity raises issues when applying archaeological distinctions (i.e., production versus distribution) which do not cleanly distinguish themselves into spatially discrete units. In the dataset on ceramic production, workshops manufacturing ceramic goods are never equipped with separate commercial storefronts nor are they situated in the city center along a porticoed street. However, a papyrus from Dura Europos (*P. Dura 126*) suggests that at least in one instance, ceramic production and sales were occurring in the same shop (Baird 2007: 417; Perkins 1959: 396-398).

Perhaps not coincidentally, the Dura Europos ceramic workshops present some unusual characteristics in their location and workshop organization. First, they are the only early- to mid-Roman period cases in the dataset that occur within the walls of a city. In addition, as will be discussed in more detail in Chapter Five on workshop organization, it is far larger than other workshops in the dataset, and it is the only instance in the dataset that likely represents a workshop with possible attached domestic spaces. Thus, the case

[7] Perhaps the best cited of these *ergasterion* arrangements is found at Sardis, but another well studied example includes Dura Europos (Crawford 1999; Baird 2007).

of Dura Europos, in general, presents an outlier for its period, and may represent a local tradition of urban development based on multifunctional spaces for housing, production, and potentially distribution. This conglomeration of these two variables (unusual size due to a large central courtyard and presence within the city walls) may be related, as the location of the workshop is within a densely occupied area. Properties abut one another and narrow streets weave between the exterior walls delimiting each parcel. Thus, in such a crowded urban context, exterior areas available at most other workshops sites may not have been available for drying vessels outdoors, and the large interior courtyard may have served such purposes. Unfortunately, it is unknown what types of wares were manufactured in these workshops, thereby making it difficult to conjecture on the amount of space that may have been necessary, but the correlation between size, courtyard, and urban context may not be coincidental.

The other four cases in which workshops were sited within the walls of a city or town (two cases exclusively intramural and two cases both intra and extramural, 16% of the total dataset) have been dated to the Late Antique period (4^{th} to 6^{th} centuries AD). Moreover, among these instances, intramural production is not restricted to table or kitchen wares, but also includes Late Roman 1 amphorae at Elaioussa-Sebaste and a local series of storage jars at Olympia, product types often associated with rural economic activities. Additionally, at the Late Antique workshop of Olympia, the kilns were actually found in the same building complex as wine presses, demonstrating a full complex for the processing and packaging of wine.

These trends have been less systematically noted before in discussions on urbanism in the Late Antique period, particularly those related to the ‘breakdown’ of urban organization and planning with private commercial and workshop spaces encroaching on formerly public space (Saradi 2006: 187-192). Within these discussions, an increasing presence of agricultural activities taking place within the urban limits has led some to propose a general ‘ruralization’ of cityscapes during this period. This has been interpreted as a transformation in the urban ideal by Zanini (2003), and observable archaeologically in changing activity patterns in urban contexts, such as the collection of manure in former bath complexes at Sagalassos (Baeten *et al*. 2012).

Although the results of this study do seem to suggest a correlation between intramural ceramic activity beginning in the 4th century AD, it is also interesting to note that in half of these instances, extramural ceramic workshops were also maintained, suggesting a more complex and mixed regime of urban development during the period. Moreover, the majority of Late Antique workshop cases in the dataset are still located on the periphery of settlements and in rural areas (n=9, 69% of the late Roman period), and even the majority of workshops associated with urban contexts are still extramural (n=5, 71%). This, however, should not contradict the notable trend in intramural ceramic industry during the Late Antique period (when contrasted to the earlier periods), but rather, as these cases are still a minority for the period, we should likewise be cautious not to use those cases to over-characterize a ‘ruralization’ of cityscapes in this period.

Rural Contexts

Within the dataset, just under one-quarter of the cases (n=9, 22.5%) were situated in contexts classified as 'rural'. These constituted production sites beyond the contiguous built-up area of larger settlements. It is interesting to note, however, that although these nine sites were distinct from the larger settlement area, they were often nonetheless still in proximity to larger towns or cities. In some cases, these distances were only one to five kilometers. Thus, these 'rural' production locations, while beyond the area classified as 'suburban' were nonetheless still accessible to many of these urban sites.

At most of the sites classified as 'rural', agricultural infrastructure has been identified in the areas adjacent to the workshop (n=7 of 9, 78%). In particular, infrastructure for the processing of oil and wine (vats, pressing stones) alongside amphora production highlight the very common occurrence of industrial works integrated into larger agricultural operations. The presence of crafts production on agricultural estates, for example, is well attested in historical sources from the period, particularly those by the agronomists who promoted self-sufficiency on villa estates through investment in crafts (Amouretti 2000). Such crafts might include any range of specializations from blacksmithing to tile and brick production. Indeed, at some villa excavations, such as Chesters Villa, in Gloucester, extensive ironworking has been identified (Fulford *et al*. 1992). Within the study region, unfortunately, excavations have rarely been performed on an entire agricultural complex, making it difficult to fully understand the nature of a site. Where this has been done (e.g., Ashkelon and Khirbet Baraqa), the excavations demonstrate quite elaborate facilities for large-scale wine and amphora production. The co-occurrence of large-scale agricultural equipment requiring major capital investment has consequently been considered as an indicator of farming estates.

According to this interpretation of agricultural estates, these rural ceramic industries are expected to be specialized in amphora production (i.e., as storage and transport containers of agricultural goods) and in tile and brick manufacturing that require large drying and storage spaces that would likely be costly in an urbanized setting. The degree to which these are exclusively specialized product lines, however, will to some degree be contested in the next chapter; yet it is of note here that amphorae were also being produced at extramural settlement workshops (classified here as 'urban'). At Elaiuossa-Sebaste, kilns producing Late Roman 1 amphora were not only found within, but also around the outskirts of the city. On Crete at the sites of Keratokambos, Chersonisos, and Herakleion, similar situations were observed. None of these eight workshop sites appears to have had associated agricultural processing equipment, suggesting these may simply have been ceramic workshops offering wares independently of the agricultural processing of their contents.

It is of particular note that these eight workshops lacking associated agricultural equipment are all coastal sites near significant ports and at the mouths of rivers. In fact, these eight sites manufacturing amphorae comprise over two-thirds of the examples in the dataset that are both coastal and riverine. This geographical positioning would have offered connectivity both inland and abroad. As such, agricultural produce was likely brought down-river where it was then packed and distributed from the city's port. This is significant, as it implies a different production organization behind the packing and distribution cycles in certain regions and varying degrees of investment in the production and transport of containers in rural areas that may not be estate-based. Moreover, this geographical dislocation between the point of agricultural production and industrial production of its containers very likely represents greater independence and a more removed relationship from the agricultural cycle on the part of the urban-based ceramicists.

Remarkably, only two instances of a production center isolated from major settlements and not clearly related to agricultural production were identified in the dataset. This was the case of the Eastern Sigillata C production sites (Loeschke 1912; Empereur and Picon 1986; Poblome *et al.* 2001) and that of Late Roman D workshops (Jackson *et al.* 2012) – both of which were production sites for major, widely distributed wares groups. The workshops associated in these areas are not situated in contiguous built areas, however, and it would be difficult to classify them as 'concentrated'. These two areas of production, instead, appear to have been much more distributed across the landscape, yet without clear indications of larger settlements. Unfortunately, however, these results are still rather preliminary and more work clearly needs to performed.

There are generally assumed preferences for short-distance coastal and riverine travel, and the evidence for locations of ceramic production sites supports this. A few cases, however, present rather outstanding outliers to this trend, particularly the Lake Mareotis district of Egypt and the Ashkelon region of southern Palestine. In both cases, rather extreme features to their landscapes result in reliance on alternative modes of transport. These have been investigated primarily by means of surface survey and consequently provide a good glimpse into the distribution of contemporary production sites in their regional contexts. They, thus, offer extreme examples of how geography places constraints on the availability of modes of transport.

First, over twenty amphorae production sites have been identified along the southern coast of Lake Mareotis (Egypt) manufacturing a range of Egyptian Amphorae (AE 3, 4, and 5) from the Hellenistic to the Late Antique periods. Those production sites appear to be primarily estate properties that situated their wine presses and amphora manufacturing at the edge of the lake. Each was likewise provisioned with its own jetty to distribute finished wine to Alexandria and beyond (via a series of canals that connected to the Nile River). This rather unusual geographic context appears to have been maximized through private investment in transportation infrastructure. Thus, while many regions display agricultural complexes that are distributed across the landscape or along a network of a river system, here we see a very different conglomeration along a densely occupied shoreline, presumably with estates extending to the south or scattered about the landscapes and connected via road systems to their processing complex. The regional case, therefore, presents elements of concentrated industry with rural agricultural features.

In contrast to the Mareotic lake environment, the semi-arid area of southern Palestine displays a very different set of transportation networks. Over twenty amphorae production sites have been identified in the 2,400 km^2 area east of Gaza, Ashkelon, and Ashdod. Those production sites, like the Egyptian examples, appear alongside presses and vats, suggesting they were part of larger agricultural processing complexes. In these cases, however, the workshops tend to be situated on the edges of wadis where clays (and periodic water) were available. The general landscape, however, determines the primary means of transport that appears to have been overland roads. Distances as many as thirty kilometers were likely traversed using cart. It is generally held that land-based transportation in foodstuffs and bulk goods was more costly than riverine, coastal, or sea travel (Duncan-Jones 1974: 368; Laurence 1998). The reliance on land-based travel therefore presents a case in which transport costs appear to have been off-set by a thriving Late Antique wine industry (Israel 1993; Mayerson 1992; Johnson and Stager 1995).

Both of these examples highlight the intimate relationship between production sites and their topographic and geographic context. Moreover, although river accessibility appears to have been a factor in the siting of production facilities, lack of rivers did not necessarily preclude the regional development of amphora production, and resources could clearly be adapted and investment in transportation infrastructure allocated in various ways depending on the context.

Raw Materials

Regardless of whether a ceramic workshop is found in an urban or rural context or what type of object is being made, certain materials (i.e., clay, water, and fuel) are required to transform clay into ceramic. These variables are in this sense universal and comparing the choice of location in relation to their points of extraction offers a means to assess the economic decision-making strategies concerning the choice of production location. This importance has been corroborated by numerous ethnographic studies of traditional potters (Arnold 1985; Rye 1981: 17). Arnold has even identified typical distance 'thresholds' for extracting clay by traditional potters (not using modern forms of transportation) (1985:35-57). These ethnographic observations have already been applied to certain regions of the Roman world, particularly in the western provinces of Gaul and Britain (Verhagen and Gazenbeek 2006; MacMahon 2006).

According to these models, from a perspective of efficiency, access to resources should factor in as a more central concern that even their point of distribution, since the weight and effort of transporting the raw materials to the place of production typically requires greater investment in work and labor than transporting finished ceramics to their distribution network (Verhagen and Gazenbeek 2006). This is not a hard-and-fast rule, yet, as in the bulk production of tile and brick, sites of production are sometimes believed to be situated close to the building site[8], and it is well established that different modes of

[8] Indeed, in addition to fixed-sites of production, cases of itinerate tile and brick manufactures have been documented in Roman Britain, where the same tile and brick stamps appear across the region of Cirencester in a variety of fabrics (Darvill and McWhirr 1984: 254). In the eastern provinces, similar studies have not been performed leaving only fixed-point production sites for investigation.

transportation were considered to have differing associated costs that could be heightened by the long-distance movements of goods (Hopkins 1983; Arnaud 2007). Moreover, ethnographic approaches have considered the choices made in extracting raw materials as founded in traditions of production practice, whereby generations of potters are trained to extract and use specific sources of materials, meanwhile adapting clay preparation recipes according to 'micro-scale' traditions (Gosselain 2008: 70-72).

In consideration of their importance, availability of raw materials was also analyzed across the dataset. Looking at the dataset from the eastern provinces, only very rarely are the locations of available raw material documented in publication, despite the importance placed on raw material selection by modern potters. When noted, however, sites were classed as being (or not being) in immediate proximity to such resources.

Water resources are most commonly referenced, particularly in cases where permanent water infrastructure was incorporated into the built structure of the workshop. Although wider patterns cannot be discerned from the limited dataset, it is possible to identify a remarkable degree of diversity in resource use. For instance, water appears to have been provisioned from wells, cisterns, aqueducts, fountains, piping, rivers and springs, with arid environments, such as those of Bouto, Jerusalem, and Dura Europos, not surprisingly more likely to rely on wells and cisterns.

In the case of fuel, olive trimmings and pressings, brush, grass, and forest wood were all documented in the dataset for the region. Likewise, these appear to have often been contingent on the natural climate and vegetation of the wider area – with brush and grass particularly associated with workshops in arid regions (such as at Zurrabeh). Although the examples are too few to make any quantified analyses, there does seem to be significant variation in the range of raw materials employed based on local availability and regardless of the type of ware being manufactured.

It is well recorded, however, that certain types of wood were sometime preferentially acquired for their firing properties (e.g., maximum heat attained, oxidation or reduction levels, and consistency of heat dissipation) (Shepard 1957: 77-80). Macrobius, a late fourth/early fifth century AD writer describes the avoidance of olive wood for use in the baths (Matson 1966). Similarly, Pliny the Elder describes the relative qualities of 'acorn' wood varieties for use in specific tasks, including for charcoal and wood fuel (*Nat. Hist.* XVI). It is clear that different firing characteristics of various woods were recognized, and these attributes probably played a factor in fuel selection.

Geography, Topography, and Distribution Networks

The natural landscape and built infrastructure of a location have implications on the ease and accessibility for distributing wares to market. Studies of transportation in the ancient world have identified short- and long-distance, inland and sea-based, and on-land and water modes of travel. Calculations by Hopkins (1983) and Arnau (2007) on the relative prices of different modes of transportation in the ancient world have also highlighted potential variables in cost efficiency, with riverine and coastal transport featuring prominently. Terrestrial road travel by cart or pack animal is consequently more expensive, with sea travel being less expensive, yet also fraught with risk.

In order to review the accessibility of a given site to modes of travel, proximity to coastal bays, rivers, and (known) ancient roads was noted for each site. These landscape features provide transportation routes to and from workshop sites, and offer a means to assess the interconnectivity of a production site both inland and through sea navigation. Thus, variables related to these issues were documented. First, excavation reports sometimes reference the presence of a local road, suggesting that a workshop was positioned near a means of immediate connectivity to larger communities. However, these were not regularly identified by excavators (only 16 cases note the presence of a road). Thus, this is a difficult variable with which to perform quantitative analyses.

Consequently, each site was then classified according to whether or not the workshop or larger associated settlement was situated on a 'major road'. This was determined by consulting the Barrington Atlas (Talbert 2000), which provides maps of known sites and ancient roads for the Greek and Roman periods. Thus, if the workshop or its larger associated settlement was positioned along these roads, it demonstrates a clear access to terrestrial networks. Second, local terrain can serve to hamper land-based travel. Thus, sites in mountainous regions were recorded, based on cartography in the Atlas. Third, the Barrington Atlas was also used to identify if a site was on the coast or along a major river, in order to assess water travel.

Across the dataset, workshops appear in a range of contexts with a diverse set of transportation options. In general, only 25% of the sites are located in mountainous regions. In general, there was a much stronger tendency for coastal locations, yet most importantly nearly all of the sites are found in proximity to a river. In fact, four of the cases in which a river was not available were at the very mountainous site of Sagalassos and at the coastal sites of Burg al-Arab on the southern shore of Lake Mareotis and Phocaea and Grynion in southern Asia Minor. In these cases, the shoreline offered access to mouths of major rivers slightly farther along the coast and thus could still be accessed from the site. The region near Ashkelon also has many sites several kilometers from navigable rivers. This represents a rather anomalous situation and will be discussed in the second part of this chapter. There do not appear to be any strong trends in the combinations of transportation access available to a given site. Indeed, coastal and river sites, coastal sites with major road access, and river sites with major road access were tabulated across the dataset, and there does not seem to have been a single location strategy or even preferences in the combination of potential routes available to distribute wares (figure 3-3).

Spatial Concentration and 'Nucleated' Workshops

One way in which the spatial distribution of industry has been analyzed archaeologically is through its *concentration*, i.e., 'how specialists are distributed across the landscape, and their spatial relationship vis-à-vis one another and the consumers for whom they produce' (Costin 1991: 13). Peacock (1982) in his ethnoarchaeological study of Roman ceramic workshops in the western provinces termed concentrated workshops 'nucleated workshops'. Based on ethnographic analogy, he noted that some clusters of workshops capitalized on their close proximity by sharing resources of raw materials and distribution networks (1982: 9). These communities thereby acquired a specialized character in their economic activities. In such studies, it has been argued that close spatial concentration also serves to reinforce shared production features (e.g., techniques, product repertoire, technologies, organization) through intensified interaction of craftspeople.

In response to these wider studies, the eastern Roman dataset was analyzed according to sites that either comprised only a single workshop or sites that appeared to encompass contiguous concentrations of ceramic workshops. The concentration of workshops was recorded for each site distinguishing whether a workshop was thereby either 'isolated' or 'part of a larger production center' (i.e., with additional workshops in the immediate vicinity). In general, both types of site appear in the dataset with nine and fourteen cases observed, respectively. In three cases (Gerasa, Elaioussa-Sebaste, and Dura Europos), however, both single and nucleated patterns were observed in different parts of the larger settlement. Thus, it appears that workshops could develop according to different spatial distributions, even within a single urban context.

In order to better understand these simple tallies, single versus nucleated workshop patterns were assessed in relation to their location in rural or urban environments. This cross-tabulation served to identify some clear patterns in the distribution of workshop concentrations that predominately appear in urban contexts and single workshops that more commonly are found in rural areas. It can be deduced, therefore, that ceramic industrial zones (or potters' quarters) were relatively common features to many urban sites in the eastern provinces. In fact, the contrary (i.e., patterns of isolated workshops in urban environments) is particularly uncommon, and is observed in only two cases (Aswan and the cave workshop at Gerasa). Turning to the rural distribution, rural industries seem as likely to be represented by individual, isolated workshops as urban industries are to be represented by multiple nucleated workshops. This may be related to the fact that these workshops were all producing amphorae as a (or even as *the*) main product type, possibly for local village or estate demand for containers.

These patterns do not appear, however, to have a strong chronological correlation, as the distribution of frequencies between the early-/mid-Roman periods and Late Antique periods is generally consistent (see tables 3-1, 3-2, and 3-3). As was discussed previously regarding intra- versus extra-mural urban industry, this suggests that ceramic workshops continued to operate in concentrated areas in the Late Antique period – both in cases of new workshop foundations (e.g., at the hippodrome of Gerasa and at the workshops at Olympia) and in cases of already established urban industrial quarters (e.g., in the eastern suburbium of Sagalassos). This, again, demonstrates that although workshops may have begun to appear more commonly within a city in the later period, certain features of urban planning (i.e., tendencies for concentrated industry) were nonetheless still maintained.

Impacts of Industry on the Lived Landscape

While many economic considerations have been evaluated in this chapter, it is likewise important to keep in mind how developments in production landscapes recursively serve to frame wider lived experience of local communities. Ingold has highlighted the lived experience of a productive landscape, what he calls a 'dwelling experience' (1993). Ingold notes that the temporality experienced through the performance of daily work creates *taskscapes* that come to be perceived by the routinization of activities and that are intimately intertwined with the natural and the inanimate. As he states, 'This means that in dwelling in the world, we do not act *upon* it, or do things *to* it; rather we move along *with* it.' (1993: 164, emphases are those of the original author). In this sense the landscape, as it is perceived and engaged, is cultural; economic activities from this perspective are inseparable from lived experiences of place which are formulated through daily routine in it.

These theoretical considerations hold relevance for the objectives of this study, as they offer insight into the ways in which social and economic activities become entangled in place-making. Such associations are very difficult to ascertain archaeologically, and we often struggle to understand such nuances of past lived experience from the material record alone. For instance, we can certainly conjecture that the Çanaklı clay beds, exploited for over six hundred years (that is, by circa 24 generations of potters working in workshops at Sagalassos), would likely have acquired some degree of social significance to local artisanal communities and that these locations would have become fixtures in the *taskscapes* of those potters. Moreover, if one is to consider the laborious journey of carrying clay eight kilometers and several hundred meters in altitude to the workshop site where the clay was processed and used, it is easy to imagine how those locations would become places of significance in the lived landscape of those artisans.

The rather unusual trek up the mountainous slopes to Sagalassos, however, is an outlier in the distance threshold of clay exploitation, both within the database of this study and as Poblome (2001) notes in the ethnographic study of potters in Central and South America by Arnold (1986). The extent to which similar patterns of place-making can be inferred for other contexts of production sites is more tenuous, however, from the perspective of the archaeological record alone. Fortunately, certain bodies of textual evidence are also available that provide tantalizing 'nuggets' of information on the multifarious ways that industry was incorporated into the daily-life experience of community space. They concern industries other than ceramics manufacturing, yet they nonetheless offer insight into how workshops were folded into the fabric of local communities.

For the Roman world, similar processes of *dwelling* as that described by Ingold can also be found in the papyrological record in the town of Oxyrhynchus, which describes places and movement in relation to locations associated with work activities. Papyri listing guard-posts situated throughout the town, as well as planned repair works, refer to specific locations within the townscape (Alston 2002). The 3rd century lists seem to have been intended for internal use by municipal authorities for administrative purposes.

Although fragmentary, the locations of guards are predominantly referenced by a series of landmarks based on major buildings (e.g., temples, theater, baths) or the homes of individuals, many of whom are mentioned with their occupation (e.g., the house of Thotos, oil worker; the house of Epimachus, wax-maker; the house of Parion, wine merchant) (P. Oxy. I 43, cited in Alston 2002). These suggest not only that occupational title was employed as a means of identifying inhabitants but also that individuals were recognized by their roles within the community and that workshops were only a part of the wider *taskscape* of tradespeople.

Other examples of places taking their names from production activities are known from the cities of Asia Minor. At Apameia in Phrygia a *plateia* was named after shoemakers, and at Sattai in Lydia a *plateia* was named after linen-makers and shoemakers (Mayer 2012). These cases, while demonstrating similar processes of association between work and locations, are dedicated to collective groups of artisans, and the act of place naming likely reflects the significance of their collective presence within the urban fabric. At Aphrodisias, Smith (2011) notes a further type of naming convention; here, the location of specific workshops was referenced to the presence of public urban monuments, i.e., the basilica and *bouleuterion*. This represents a different set of associations whereby the permanence and prominence of public space becomes attributed to workshops and their location within the built environment of a community. Graham (2006) describes a similar type of relationship in the rural landscape of the Tibur Valley in Italy. In his study of the local tile and brick industry, he suggests that workshops may have taken names referencing nearby landmarks (particularly sanctuaries and temples) along the riverine distribution routes used by traders. Although employing different naming conventions, he also documents a relationship between workshops and their culturally perceived landscapes.

These examples demonstrate different ways in which naming conventions represent the interlacing of workshops into the lived space of a community. In some cases, (particularly village communities) associations are based on individual craftspeople. In other cases, locations in the urban topography come to be associated with collectives of workshops and are given permanence through formal naming conventions of streets. Finally, workshops were certainly not always the focal point of lived experience, as evidenced by workshops that are, themselves, named after major nearby landmarks. Naming conventions offer a glimpse into the sets of associations between workshops and their topographic location. These associations and the formal naming of places in reference to workshops suggest that these workplaces were significant; how significant and to whom were certainly contextually-specific, however.

Such significance is perhaps more easily observed through instances of contestation which demonstrate how seemingly mundane sites of production could become embroiled in urban controversy and resistance. In this case, Mayer (2012: 82) describes an incident whereby Dio Chrysostom (1st century AD) attempted to construct an elaborate colonnaded street in his hometown of Prusa with the intention to beautify the city through generous acts of *eurgetism*. In the process of construction, several blacksmiths were put out of business. The local residents, angered by the dislocation of these workshops, protested, funding was rescinded, and the project was subsequently abandoned. According to Mayer (2012: 82) this episode highlights power relations between elites and the larger populace and, to a certain extent, the influence that crafts people could yield within local communities. According to Ingold's approach to *taskscapes*, however, one could also argue that the importance of such sites as the blacksmiths of Prusa was founded on their integral placement in daily *dwelling*. That is, the location of the workshops at Prusa was brought into contestation exactly for the quotidian reasons of *dwelling* within the urban space and contested claims of authority over the daily lived experience of the community, rather than over legal property rights or elite investment strategies.

These historic cases offer some rare insight into some of the ways that local urban communities of the period engaged the industrial topography. Reference to workshops as landmarks thereby integrated social identification, occupational identification, and place into the mental templates of the town. As parts of the urban fabric, workshops became associated with the broader topography of towns and cities. In smaller settlements, such as Oxyrhynthus, the workshops could become personally associated with individuals in the community. In larger settlements with concentrations of workshops of the same trade, the urban topography became marked by their collective presence and could become flash-points in wider community power discourse. Accordingly, the presence of workshops was a fundamental element of the communal 'dwelling' experience.

Funerary Landscapes

Based on these lines of textual evidence, work landscapes were engaged as routinized *taskscapes* that resulted in their acquiring social associations and making them in some cases ripe for claims of authority. The land of the dead, however, also served as a place for the socialization of work groups and formation of professional identity. As such, these funerary landscapes represent an extension of the working lives of tradespeople. Although certainly households and *collegia* meetings house also represent extensions of the lived experience of those workers, such contexts have been rarely identified or studied. Moreover, as was the case in the previous discussion, these funerary examples are not exclusive to ceramicists, but also encompass a wide range of craftspeople.

Funerary monuments commemorating artisans and tradesmen are useful in that they represent a body of material that relates information on status and occupation from different segments of society (i.e., successful tradesmen[9]). Representing work on funerary monuments seems to have been a less common tradition in the eastern provinces than in the western provinces, and fewer examples have been published[10]. Examples from Asia Minor, however, demonstrate that successful tradesmen and craftsmen were sometimes presented in their work role or in relation to the tools of their trade. Regardless of typological differences and the different ways in which work was

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[9] The cost of erecting grave stelae was beyond the means of many workers, and generally speaking these represent successful individuals.
[10] Many studies have been performed on depictions of work and workers on funerary stelae and monuments in the western provinces, particularly from the region of Central Italy, where they appear most frequently from the 1st to 2nd centuries AD. For references, see Kampen 1981; Zimmer 1985; George 2006.

incorporated into the funerary representation, there is a consensus among scholars that a certain level of occupational pride and *dignitas* motivated the presentation of these images (George 2006).

The best studied of these funerary monuments from the eastern Roman provinces are found in Asia Minor (Waelkens 1977, 1986; Cremer 1991, 1992). These studies have identified that work references cross-cut regional patterns in monument style (e.g., *Türsteine*, stelae with framed scenes). The representations of work on the monuments fall into two categories. The first category depicts hand tools (see figure 3-4). Daily life objects (e.g., flowers, vines, vessels, toiletry instruments) often appear on the monuments from Asia Minor, particularly in Phrygia, and appear to reference aspects of the personal life of the deceased (Waelkens 1977, 1986). In the case of tools, these seem to reference the occupational life of the individual. These tools represent occupationally-specific instruments (e.g., hand axes, pick axes, anvils, knives, awls, and spades) carved in detail[11]. Predominantly agricultural tools are presented, yet tools for crafts production were also depicted.

The second type displays scenes of work activity and has been most thoroughly documented for stele found in the northwestern regions of Asia Minor, particularly in Mysia and Bythnia (Cremer 1991, 1992). These stelae depict multiple images; the more prominent, upper frame most often displays a funerary banqueting scene, while below, a second, smaller frame displays another scene, which in some cases shows individuals at

[11] The location of the tools in relation to the image of the deceased can be variable (in the gable, in the plane below a central framed scene, in the spandrel, running alongside the frame of a central scene).

work as smithies or sculptors (see figures 3-5 and 3-6)[12]. This funerary evidence suggests that certain segments of society commemorated their dead by making references to the ideals of work (Zimmer 1978; Joshel 1992; George 2006). Those ideals placed farmers next to craftsmen and men next to women. Thus, the economic lives of communities experienced through daily acts of *dwelling* were recreated in the funerary landscape.

Most of these representations can be found on relatively modest limestone grave stelae, occasionally they also occur in rock-cut reliefs. Less frequently, full limestone sarcophagi are found with work scenes[13]. Among the most famous and elaborate of the sarcophagi that have been found in Asia Minor is the mid 3rd century[14] example of Marcus Aurelius Ammianos from Hierapolis (Ritti *et al.* 2007)[15]. The sarcophagus lid presents a schematic image of a water-powered stone saw mill – one of the few images of such technology from the Roman period (see figure 3-7). The accompanying inscription associates the deceased's proficiency in making wheel technologies to that of Daedalus (the god associated with wood saws)[16]. This example nicely highlights the symbolic crossovers of occupational material culture, professional accomplishments, and even mythological references in the context of funerary display for successful tradesmen. In this way, the material culture of crafts production was used to commemorate the individual in a larger (albeit funerary) landscape. Moreover, the scope of artisanal

[12] Cremer 1991: B15.
[13] For examples in the East, see Smith 2011; Ritti *et al.* 2007; Waelkens 1977, 1986; Cremer 1991.
[14] This dating is based on a stylistic analysis of funerary remains from the site by Vanhaverbeke and Waelkens (2002), but Ritti *et al.* (2007: 139) seem to be open to a possibly later date.
[15] Ritti, *et al.* 2007.
[16] Ritti, *et al.* 2007: 141.

production is brought out beyond the geographical proximity of the workshop and is featured in a wider urban landscape highlighting an individual's profession and their role in the community.

In addition to figural images, the necropolis of Korykos in Cilicia offers a rich textual record of funerary reliefs inscribed with hundreds of professional titles (Iacomi 2008; Trombley 1987; Patlagean 1977). The reliefs are laid out in such a way that it is believed that individuals of the same profession are clustered together, and this arrangement consequently has been used to suggest that these professional clusters represent *collegia* funerary groups. Such professional associations are known to have paid for funerary expenses and tomb maintenance of its members (van Nijf 1997). Rarely have *collegia* organizations been identified, however, in the eastern provinces[17]. This organization of funerary reliefs, likely also present (yet undocumented) at other sites, highlights the fact that associations among professionals of the same trade could implant and maintain significance in the local urban topography in multifarious ways. Likewise, the nucleation of urban industries in the urban topography in this sense also is imparted through the permanent placement of ritualized concentrations of graves.

In this way, work, landscape, and society are again entangled, and in this case, this entanglement extends beyond the workshop walls. Yet here they leave meaningful and lasting commemorations of the role and prominence of craftspeople within the community. This is, in some ways, reminiscent of the 'space of experience' described by

[17] Ostia and Pompeii, with their well documented meeting houses and funerary sites, remain some of the best studied of the Roman *collegia*.

Gosselain (2008) in his ethnographic work with potters in Africa. According to this ‘space’ he notes that the lived daily experience of working crossed community space that interwove social and professional networks. Often ephemeral, these networks are sometimes difficult to identify archaeologically, yet, in the case of these funerary contexts, the act of commemoration has served to preserve some of these relationships.

Conclusion

This chapter has investigated the relationship between ceramic industry and the geographical context of production in order to understand better how choice of location featured in the daily practice of work at the site and in terms of larger processes concerning urban and rural economic development and performance.

From the analysis of large-scale trends across the dataset in part one of this chapter, it seems clear that workshops are typically sited in locations where multiple modes of transportation are available to a single workshop. Major centers of large-scale production (e.g., ESC, LRC, LR1 amphora) also tend to be located in coastal locations, likely facilitating the distribution of their wares. Some further important points can be raised regarding the characterization of urban versus rural ceramic production. That is, urban workshops tend to be exclusively places of production with little evidence for sales or domestic space.

Thus the *ergasterion* model of workshops, with an integrated manufacture, sales, and domestic space, does not generally seem to apply in the case of ceramic production. In addition, the high imperial period phenomenon of the extramural, nucleated ceramic industry appears as a trend across the region. The presence of suburban 'potters' quarters' seems to be an element of urban development for the 1st – 3rd centuries AD, alongside the common use of such suburban areas for other activities, such as necropoleis. In contrast, rural workshops, particularly those manufacturing amphorae, tend to be single production sites with little evidence for concentrated workshops. Amphora production sites are most commonly found as part of larger production complexes for the processing of oil and wine, as well as for the production of transport containers. These large-scale trends in the evidence offer some important insight into the decision-making strategies influencing patterns in the choice of location for urban and rural industry.

The second part of the chapter took a different vantage point in order to consider how the presence of workshops became integrated into the fabric of an ancient community. The textual record highlights the personalized nature of workshop space, wherein individual artisans become associated with their place of business and how the lived experience of dwelling intertwined economic and social associations onto the landscape. The three parts of this chapter consider workshops and their locations at differing scales of analysis, and each has yielded important observations on decision-making strategies related to the production process, distribution of wares, organization of rural and urban landscapes, and trends in economic performance.

CHAPTER FOUR

Product Repertoire, Specialization, and Production Practice

As archaeologists, we have come to define artifacts according to material categories (e.g., ceramics, metals, glass, stone, worked bone). For pragmatic purposes, these divisions are contingent on the ways in which the field has developed professional specializations. However, when those material-based classifications are imposed on the way in which we think about ancient production and 'industries', it becomes more difficult to lay out clear definitional lines that correspond to any archaeologically-imposed material categories. Moreover, this methodological approach is only one way of conceiving ancient industries and their products; indeed, there are infinite ways to define an industry, both according to modern and ancient standards.

Until now, the range of wares produced at individual, archaeologically identified workshops has not been studied comparatively across the Roman eastern provinces. General observations are regularly made on the product repertoire of individual workshop sites or production waste 'dumps' and on the range of wares associated with production 'centers'; but by comparing these site-specific observations across the eastern Mediterranean, patterns may be discerned that represent larger trends in economic decision-making in ceramic production. The results of this investigation also have implications for the interpretive weight attributed to patterns of consumption. That is, it offers insight into the way we characterize specialized production in the Roman world, the definitions of ceramic 'industry', and whether long-distance trade goods represent the full range of objects being manufactured at a workshop or production site or just one type manufactured alongside other goods distributed more locally. This final observation provides a means to recognize patterns in economic strategizing in ceramic production whereby diversification of production repertoire is interpreted as a means to supply different markets, and to offer an explanation, in part, for the wide-spread presence of 'imitation' wares in the Roman world by situating their production within socially learned and informed practice.

In response to these thoughts, this chapter will investigate the relationship between product repertoire and site(s) of production. Although the thrust of this chapter will attempt to understand the organization and definition of ceramic production from the material remains of workshop refuse, that analysis will be preceded by a short and related discussion on ancient linguistic terminology and definitions of industry.

Roman Textual Sources: Professional Distinctions and Specializations

As an activity tightly integrated into daily life, it is not surprising that the topic of work specialization has been characterized in so many culturally specific ways in both the past and present. *What constitutes work? How are occupations defined? Who should perform* *it and where?* These are questions that can only be answered when situated within specific social and cultural frames. Latent in this perspective is the understanding that work cannot be disassociated from broader social, economic, and institutional frameworks, as those frameworks serve to both ask and answer the series of questions listed above.

Turning to the Roman world, although the textual record from the period offers little in the way of recording the social and economic lives of ceramicists, the few references that we do have are useful in attempting to establish intra-trade specialization. Distinctions in professional title, for example, offer a means to evaluate specializations among potters and ceramicists that may or may not correlate with the archaeological evidence for the production of specialized product types. Moreover, it is well established that professional titles offer a means to consider the degree and range of specialization among tradesmen. The significance of professional titles is of additional salience, as the holding of one appears to have held legal weight in the Roman world. Martin (2001) demonstrates that, in cases of fault or damage, a tradesperson could be legally liable based on expectations of skill associated with job title. For the purposes of this chapter, distinctions among worker titles will be evaluated in order to assess whether titles associated with individuals correspond to definition of ceramic 'industries' (e.g., amphora maker, tableware potter), and those distinctions will then be juxtaposed with archaeological evidence of craft specialization in product types in order to assess the degree to which specialization in worker title is reflected archaeologically.

Across all professions, Wissemann (1984) compiled a compendium of trade titles mentioned in Latin literature in order to analyze the degree of specialization in Roman crafts professions, and Zimmer (1986) has analyzed work scenes and associated job title on funerary monuments. Their results consistently construct a picture wherein both general and specialized (and in some cases, highly specialized) work titles were used to distinguish tradesmen based on the types of wares they produced[18] (Wisseman 1984). Their results also demonstrate that, across both the eastern and western provinces, the textual evidence for ceramicists is scant in comparison with other trades, and the references typically refer to 'potters' generally, with little additional specification in reference to technologies used or products manufactured. In the listing of 177 job titles by Wisseman (1984) analyzed from Latin literary references, only one, maker of flasks (*ampullarius*), relates to a profession associated with the production of vessels, and only even in this case it is unclear if they are vessels of clay.

When evaluating Latin or Greek literary sources on professional tradespeople, it becomes clear that potters or ceramicists are rarely noted, even when compared with references to other craftspeople. It has been proposed that this may reflect the status of professions too poor to have erected funerary monuments or too penurious to be referenced in major laws, and only derogatorily in literature (Joshel 1992). This is also supported by Mayerson (2000) who performed an analysis on potters' wages from three well-known Oxyrhynchus papyri [*P.Oxy*. 3595-7] (Bowman 1983). He suggests that the wages of these craftspeople working on rural estates were extremely low in contrast to other

[18] Examples of specialized work title, as noted by Wisseman (1984), include examples, such as trouser maker (*braccarius*), tailor of hooded mantles (*paenularius*), and bean seller (*lupinarius*).

professions of the time. What is not entirely clear is the degree to which these wages compare with potters working in other contexts, yet it does reinforce a general picture of low economic status for the profession.

Perhaps of greater relevance to the issue of specialization is the corpus of funerary reliefs from Korykos in Cilicia Trachis dated between the 5th and 6th centuries AD (Iacomi 2008; Trombley 1987; Patlagean 1977). The funerary reliefs comprise 600 inscriptions stating the profession, office, and/or rank of the deceased and demonstrate variability in trade titles from a single site for approximately one century. This is due to a rather unusual[19] local habit of using professional title in the context of personal commemoration within the community. In contrast to the image painted by Mayerson of impoverished potters, of the 456 instances of trade title from Korykos, over 5% (29 cases) are associated with ceramics production. This frequency has been used to suggest that potters were a relatively important component of the workforce and significantly participated in the economic life of the town.

Indeed, as Iacomi (2008) has noted, this region is known to have maintained a flourishing wine industry supported by ceramic production, such as at the archaeological workshop site found at the nearby city of Elaioussa Sebaste. The primary title used on the Korykos reliefs regarding ceramic production is that of ‘potter’ or *kerameus* (κεραμεύς), appearing 27 times, but two other titles are also used in relation to ceramic production – maker of earthenware vessels, *ostrakarios* (οστρακαριος), and maker of lekane pots and pans,

[19] The use of professional titles is certainly known at other sites, particularly Ostia, but the frequency of such habits is unusual in the case of Korykos.

lekaniourios (λεκάνιουριος). These latter two titles, however, appear only once each in the corpus (Iacomi 2008). It seems that here, again, the more general term of *kerameus* was most often used with relatively little recognition of a more specialized work title related to product type.

This trend in epigraphic funerary evidence is to some degree supported by the job titles used in legal settings as well. For instance, in the Oxyrhynchus pottery lease contracts (and as will be analyzed in greater detail in Chapter Five), two examples stipulate the hiring of additional workers within a pottery workshop, and those workers are described using terms specifically related to their production task (i.e., potters who form the vessels, stokers of the kiln, and assistants) (see Appendix One). The term *kerameus*, however, is only reserved for the leasing potter, thereby possibly differentiating him as a sort of 'master potter'. Another papyrus from Dura Europos [*P. Dura*. 5], describing a 3rd century AD decision by a tribune regarding a legal dispute over a pottery workshop, is consistent with this legal terminology, as it also favors the use of the term *kerameus* (Perkins 1959).

When we compare the leases with one another, a further point should also be raised: each of the leasing potters was producing the same range of wares (i.e., Oxyrhynchite four-choes jars, double ceramia, and two-choes jars) in variable quantities (see table 4-3). That they were intended as containers for agricultural food items (particularly wine) is inferred from the fact that the vessels needed to be provided in time for the estate's harvest. In each of these cases the term *kerameus* is used to describe the leasing potter, and in two of these three cases, an additional mention is made of their specialization in a type of ware, 'a potter who makes wine jars' or 'a potter who makes earthenware jars'[20] (κεραμεύς οἰνικοῦ κεράμου). This specification suggests that the term *kerameus*, in and of itself, was a general and sufficient term for a skilled potter and additional mentions of product type do not appear to be entirely necessary.

Having considered both legal and funerary textual records of the period, it appears that the professional lexicon offers little evidence for systematic and regularized specialization among potters. Indeed, across corpora of textual traditions the general term of 'potter' (*kerameus*) appears to have been heavily privileged. Only occasionally does the title include an added degree of differentiation, and in those cases they are more often in terms of the specialized production task (forming or kiln stoking) or rank (assistant) within a workshop, rather than in terms of a larger industry specialization based on product repertoire. This inconsistency in distinguishing between potters specialized in product types is of note, as this pattern is in keeping with trends observed in the archaeological record, which will be described in the next part of the chapter. Those observations demonstrate great variability in the types of products being manufactured, suggesting a low degree of product specialization among ceramicists during the period.

[20] The term, κέραμος, references anything made in clay and is can be translated as either earthenware jar or wine jar (Liddell-Scott-Jones).

Archaeological Approaches to Product Repertoire, Standardization, and Industry

'Specialization' is a term that has been rampant in archaeological literature on crafts production for decades and yet one that has been equally difficult to define (Blackman et al. 1993: 60). Typically, specialization is used to reference the labor occupation of the craftsperson (i.e., the percentage of time that craftspeople spend on a single economic activity). This often implies that the specialist is 'freed in part from subsistence pursuits' (Arnold and Munns 1994), and expresses itself through a high level of skill, thereby restricting the ratio of producers to consumers (Rice 1981). Moreover, specialization of the producers tends to have implications on the type of product manufactured: manufacturing a small range of certain items, while precluding production of other types of goods (Longacre 1999; Blackman *et al.* 1993).

Most studies of the Roman world – indeed of most complex societies – assume a high degree of crafts specialization in accordance with this definition, one that really goes back to V. Gordon Childes' inclusion of craft specialization as part of the 'urban revolution' (1950). Certainly textual accounts from the period support such views regarding many ceramic industries (e.g., labor contracts, occupational titles, distinctions between skilled and unskilled labor). Such specializations are then typically defined according to the type of objects being made; however, rarely is that range of items defined. Raising the questions, w*hat is the range of objects being produced by specialized workers? How specialized were the specialists, in terms of their production repertoire?* As ceramics encompass a notoriously wide range of product types (e.g., storage vessels, transport vessels, figurines, cooking pots, tablewares, tile, brick), the degree of variability in ceramic production has the potential to be great.

The range of product repertoire also has implications in how we consider typological groupings. The Roman period, in particular, has been noted for its rather consistent sets of typological 'families'. Whether amphorae or tableware, similarities in form and finish can be found in vessels produced in workshops at opposite ends of the Empire. For instance, red slipped wares or sigillatas with a reddish surface coloration were common tableware types across the Mediterranean world from the 1st century BC to the 7th century AD; more refined typological works, however, identify commonalities in fabric, surface appearance, and form that define ware groups within the Roman tableware class of pottery.

Various interpretations have been made of these typological 'families'. For instance, some have emphasized a more regional character of production repertoire; that dispersed workshops in the same region tended to produce generally similar types of material culture, a phenomenon described as '*koine'* (Poblome *et al.* 2013: 3) or 'faciès géographiques' (Bonifay 2004: 7) by various scholars. In other cases, it is argued that product lines mimic more widely distributed (and presumably more popular) product lines from large-scale production centers (e.g., African red-slip ware, Italian terra sigillata, North African cooking ware, Late Roman 1 amphora) (Hayes 2001; Arthur 2007: 162-3). The analyses performed in this chapter will provide a means for determining the extent to which product repertoire reflects a gamut of specialized, 'international' wares and a mix of local and supra-regional influences in material culture.

Methodology

This chapter investigates these issues to the extent possible from the current state of the field on workshop studies. It will operate on two levels of analysis. First, it analyzes the range of product specialization from single workshops. In thirty-two cases[21], the product repertoire of individual workshops has been identified – either based on the abandonment context of an excavated workshop or based on a production refuse deposit. These deposits had been noted by excavators as either certainly or likely from a single workshop, based on its nature (i.e., associated with a workshop structure) and composition of the material (i.e., unfired wares from a single kiln load, restricted chronological range, repeated and unusual features of the type variants).

Second, in order to also assess the degree to which patterns in repertoire of individual workshops compare to those of larger production centers, these issues will also be investigated at the larger site level, which serves as a stand-in for what is typically termed 'production center'. Sixteen cases were used for this purpose. Each case represents a concentrated and contiguous area of multiple workshops. Evaluation at the site level is based on material collected through surface survey, general studies of the ceramic typologies from known locations of production (these are typically urban sites), as well as

[21] These thirty-two Roman period cases are also supplemented by nine Hellenistic-period cases in order to offer analysis of chronological change.

the repertoire of multiple excavated workshops from a site, which were combined in a single classification. This latter set of analyses obviously was limited in terms of what was represented by those methods (i.e., surface material offers a much less refined view on production repertoire than more detailed ceramological studies of refuse deposits), and it is unlikely that they represent the full range of types produced at a production center at any given time. They do, however, offer an effective means to determine the extent to which the product repertoire of the (better documented) individual workshop deposits corresponds to or differs from a representative sample of the wider production site.

Both the workshop-specific and the site-level repertoire were recorded according to a single framework, distinguishing functional categories and more refined morphological types in a four-tiered hierarchical classification (see table 4-1). This hierarchical classification allowed different types of analyses to be conducted based on factors such as functional class and morphological form. This classification is closely based on the 'pottery template' developed and used by the Sagalassos Archaeological Research Project. That template distinguishes between different levels of functional attribution. The highest level is the 'General Functional Category' (i.e., cosmetic implements, household implements, furnishings, agricultural production, architectural fittings and miscellanea). Next, 'Functional Category' more specifically, distinguishes between classes of kitchen wares, tablewares, transport, and storage vessels), and the 'Specific Functional Category' differentiates sub-groups of preparation, cooking, serving, and consumption vessels. Finally, the 'Object' Class is the most specific and distinguishes between morphological forms: cups, bowl, plates, platters, basins, jugs, jars, lamps, tiles, bricks, hypocaust tiles, etc. In cases in which the form was not specified, but the functional class was indicated in the published report, a single 'indeterminate' status was assigned within the functional class (e.g., indeterminate kitchen ware). In addition, the number of clay fabrics was also noted, as available from publication records. Using this framework, the set of analyses described below evaluates the relationship between the production site, range of object functions, and perceived markets.

General Observations

In general, certain observations can be made across the entire dataset. First, most workshops produced a range of different types of wares. This is not to say that workshops specializing in a single functional group of products (i.e., tablewares, kitchen wares, transport vessels) were absent in the data. Indeed, the cases of Sagalassos' tableware workshop, Kefar Hananya's specialization in only two forms of kitchen ware, and workshops at Paros and Khirbet Baraqa producing only amphorae, each demonstrate that (functionally-based) product specialization could occur at the workshop level.

Despite their occasional occurrence, however, such a high degree of functional specialization was rather uncommon. Instead, the majority of cases of workshops (n=27, 84%) and all the cases of production centers (n=14, 100%) in the dataset manufactured a mix of different ceramic ware types, both in terms of functionality and (regarding ceramic vessels) morphology (see tables 4-2, 4-5, and 4-6). The nature of reportage suggests that certain products often appeared in higher frequencies thereby acting as the ‘primary’ product line with other types serving as supplementary wares, although unfortunately a quantification of this trend was not possible from the published data. Indeed, even in cases in which the main product line comprised a major, internationally traded ware, such as Late Roman D tableware or Late Roman 1 amphorae, other types of goods appear to also been produced.

Second, production sites were not found for many types of wares and functional categories known from the period and region. This suggests that some biases must exist in the current state of recovery and identification of production sites. Of particularly note is the absence of manufacturing sites for many types of ceramic building materials (i.e., bricks, hypocaust tiles, water pipes) or workshops of small decorative items (e.g., beads and pendants).

Third, surprisingly few workshop reports described vessel types in relation to clay fabric studies, leaving a series of important questions regarding the specialization of different raw materials for different wares and at different workshops. More frequently mention of fabrics is made at the scale of the production center. Based on the 12 cases available, more than half of the production centers (n=8, 67%) appear to have used a single fabric type in the production of all its wares. It can be said, however, that centers making wares in refined clays (i.e., ‘fine wares’) are also documented. For example, in the case of Delphi such ‘fine wares’ were manufactured alongside wares produced in unrefined clay (i.e., ‘coarse wares’). In general it seems that most production centers relied on single clay sources and recipes in their production.

These general observations offer a good overview of the data, which initially suggest a low degree of specialization, as well as great diversity in the wares that were manufactured together. Those wares could be manufactured in a variety of clay types, but tended not to be so. Moreover, methodological concerns regarding the representiveness of the current archaeological record should be kept in mind. In order to acquire a better assessment of these observations, more refined investigations into these three issues will therefore be presented in the subsequent sections.

Individual Workshop Repertoire: Amphorae Specialization?

Using the dataset of 32 workshop deposits, the range of wares produced at each locale was analyzed in terms of functional category (i.e., kitchen wares, tablewares, transport vessels, lighting, architectural items) in order to assess the degree to which individual workshops specialized in wares for the same market. A quick glance at the product repertoire of the ceramic workshops testifies to the fact that ceramic industries neither fall together under a single model of production (i.e., as a single ceramic industry), nor do they fall into discrete categories based on product functionality (see table 4-2). That is, a workshop producing amphorae may also have produced cooking pots, tile, brick, or storage containers, and a workshop producing tableware vessels may also have been manufacturing figurines or oil lamps. Destined for different consumer markets, the workshop repertoire does not appear to be based on functional classes.

This tendency for a diversity of wares to be produced in a single workshop is paralleled in the texts of lease contracts for potteries on rural estates in Egypt dated between the 2nd and 6th centuries AD. These contracts – three 3rd century examples from Oxyrhynchus [*P.Oxy* 3595-7] and two 6th century examples from Hermopolis and Aphroditopolis [*P. Lond*. III 994, p. 259 and *P. Cair*. Masp. I 67110] – stipulate the types and number of vessels expected to be produced each year by the leasing potter (Cockle 1981; see Appendix One). In three contracts, multiple types of vessels are specified for production (Oxyrhynchite four-chous jars, double ceramia, two-chous jars), which appear to have been containers of variable size. According to the details of the arrangements, different numbers of each of the vessel types are to be produced within a given period of time; the largest four-chous jars being the primary product specified (with anywhere from 4,000 to 15,000 vessels), followed by the double-*ceramia* and two-*chous* jars, respectively[22] (see table 4-3). This diversity in production is consistent with the archaeological evidence for amphora production sites in the dataset, whereby 10 of the 13 sites (77%) produce not only amphora, but also one or two other functional classes of ceramics. Of the other three cases producing exclusively amphorae, two workshops manufactured multiple types (or type variants) of those amphorae at the same time, and only one workshop site produced amphorae of a single type. Thus, only one workshop in the entire dataset specialized exclusively in a single form of a single functional category. In the other 10 cases, there is little consistency in terms of what is produced alongside the amphorae, but, in general, the amphorae appear to be the primary product type with the other types as subsidiary wares.

[22] The terms *chous* and *ceramia* are local measures referencing the quantities contained within the vessels.

Although the majority of sites producing amphorae also manufactured other ceramic goods, amphora sites (such as those at Paros and Khirbet Baraqa) do display a greater tendency for single-product manufacturing than sites primarily manufacturing other types of wares. Nearly 13% of the workshops in the dataset (n=3) specialized exclusively in amphora production, in contrast to 3% for both tableware (n=1) and kitchen wares (n=1). Although this is clearly a very small sample, this relatively higher number may be related to the market that was being supplied by their production (i.e., agricultural produce) and perhaps to the often rural location of their production, which could lack local markets for the consumption of other types of ware. However, these may also reflect regionally-specific trends in specialized ceramic production, as in the case of the Gaza jar amphorae production at Khirbet Baraqa, this product specialization is also consistent with technological specialization through the use of an unusual set of 'sunken' kiln types. Thus, reinforcing a rather unusual link between product specialization with associated technological specialization. This technological specialization will be discussed in detail in Chapter Six.

Individual Workshop Repertoire: 'Primary' and 'Secondary' Products

As noted, some sites seem to have both 'primary' and 'secondary' product lines manufactured in the same workshops. Various functional categories fall under this 'secondary' product description, but more commonly this seems to be the case with lighting and kitchen wares, and this trend is especially clear in the case of lamps. Lamps, and more specifically molded lamps, seem to be produced alongside a wide range of other wares in nearly one-third of the cases (n=9) and never appear as the sole product of a workshop.

Explanation for this predominance of lamps can be interpreted on the basis of two factors. First, nearly all of these lamps were produced using molds, suggesting a fast and easy means of manufacture that could be used to supplement other primary product lines. Indeed, in numerous instances the surmoulage method of mold production was documented. The surmoulage method, employing a finished (lamp) product as an archetype from which to make molds, would not even require manufacturing molds from scratch, and it is perhaps not surprising then that imported decorated lamps were regularly selected as archetypes for this purpose. Such examples are noted at Gerasa, Jordan, using a one-hundred year old lamp as archetype (Kehrberg 2011); at Kastelli, Crete, using an imported Egyptian lamp (Markoulaki et al. 1989); and at the Late Antique workshop at Olympia, Greece, using imported lamps (Schauer 2010: 34).

Second, lamps, as Peña has noted, were inexpensive ceramic items, whose sometimes kitsch decorations and relative ubiquity, may have made for quick and inexpensive discard (2007: 28, 56). Peña notes that, according to Diocletian's Price Edict (I.I), the cost of lamps was based on sets of ten for the relatively inexpensive price of four denarii (2007: 28). Second, Peña (2007: 39-60) has comparatively analyzed the use-lives of different types of wares based on ethnographic analogy. He determines that the wares most prone to quick use and discard are kitchen wares and lamps – with replacement averaging once per year (2007: 56-58). This is also supported by a large body of ethnoarchaeological literature that confirms, if the methods of production, local climate, socio-economic context of use, and regularity of use, are all consistent across pottery goods, that types more frequently exposed to handling and heat have shorter use-lives than pottery used in other ways (Shott 1996; Deboer 1974; Longacre 1972). Lamps, through their saturation of oil and through their common use as votive and grave offerings, are proposed to have had short use-lives, while the risk of thermal shock increases the likelihood of breakage in the case of cooking wares.

This suggests a potentially higher overall demand for lamps and cooking wares. Moreover, coupled with the relatively inexpensive nature of lamps and the rarity of kitchen wares being transported any distance[23] (Leitch 2008; Ikäheimo 2005), this analysis appears to corroborate the wide-spread production of these wares, potentially to supply a (relatively) high and constant demand in local markets. Interestingly, these same workshops in many cases concurrently maintained a central product line that provisioned medium- to long-distance trade networks in other products (e.g., Sagalassos red-slip tableware, Late Roman 1 amphorae at Elaioussa Sebaste, Cretan Amphorae Types 1 and 2 at Kastelli Crete, slipped tablewares from Bouto, and Gaza jars from Khirbet Baraqa).

Individual Workshop Repertoire and Production Techniques

The predominance of lamp production raises another important observation concerning the dataset. When analyzing the types of technology used between different workshops, it

[23] Well-known exceptions to this trend are Pompeiian red-ware cooking pans and North African cooking wares.

is clear that although all the workshops employed kilns for firing their wares, there was some diversity in the forming technologies employed. Wheel-forming is without a doubt the most frequent means of production, and is used as the exclusive means of forming in the majority of cases (65%, n=20). Distinguishing more closely between wheel-thrown and molded wares, however, there also appears to be some degree of specialization in decorative molded wares with three cases (10%) from three sites displaying a repertoire of exclusively molded objects. These objects include a range of functional types (lighting, figurines, antefixes, plaques, vessels)[24]. Perhaps more surprising is the high frequency of workshops (26%, n=8) producing both molded and wheel-thrown wares, and in each of these instances, lamps were the sole molded ware being produced.

This supports, again, the proposition made earlier regarding the subsidiary nature of lamp production; yet, conversely, the fact that other types of decorative molded wares (e.g., figurines, antefixes, plaques, vessels) *only occur in workshops exclusively making molded wares* suggests a high degree of product specialization based on manufacturing technology. This may be related to the specialized skill necessary for carving molds and stamps by hand, rather than simply employing *surmoulage* methods, as was observed in many of the cases of lamps manufactured alongside thrown vessels.

Individual Workshop Repertoire and Product Morphology

Analysis was also conducted in order to determine whether products of similar morphology tended to be produced in the same workshop, thereby representing a

[24] The analysis excluded tiles and bricks (which although technically formed in large molds, create very different technological restrictions due to their size and drying demands).

specialization in vessel shape (and associated technical skills). A subset of 28 workshops was used for this analysis, and classifications were made according to workshops producing exclusively open forms (e.g., plates, bowls, cups); exclusively closed forms (e.g., *unguentariae*, *ampullae*, jugs, jars, amphorae); or a combination of both open and closed forms. The results of this analysis are listed in tables 4-5 and 4-6.

According to this classification, workshops did not normally specialize in either open or closed forms. Well over half the cases (59%, n=17) present in the dataset produced both open and closed shapes. Among the other 43% of cases, however, there does seem to be a much stronger trend towards specialization in closed forms. That is, while open forms are rarely produced exclusively (3.5%, n=1), closed forms, in contrast, are regularly produced alone (38%, n=11). Even having removed the cases in which the product repertoire included exclusively amphorae, the tendency for closed forms to be produced together (i.e., to the exclusion of open forms) is still notable (at 22%, n=5).

Interpreting these trends of workshop specialization in closed forms may be related to the technical demands and skill sets necessary for throwing closed vessels in multiple parts. However, if this was the case, we would expect open vessel shapes, which carry their own set of technical challenges, also to occur in specialized workshops. It seems more likely, instead, that the specialization of closed forms relates to their function as containers. Amphorae may be the most well known in terms of their function as transport containers, but wine jars could be procured in a variety of sizes and shapes. Indeed it is well established that shipwrecks often contained amphorae of variable size within the same load (Tchernia *et al.* 1978; Royal 2012: 215-216), and lease contracts from Egypt (described in the earlier discussion on textual sources) specify the co-production of larger transport amphorae with smaller wine jars (Cockle 1981). Moreover, Mayerson has noted that 38% of 'Gaza' jars mentioned in epigraphic sources were transported empty (1992), and Gadot and Tepper have suggested that these empty vessels may have served to measure standardized sizes (i.e., to function as measuring vessels) (2003: 151).

It is therefore possible in these cases that the production may be intended as containers for other products. Often these jars and jugs are assumed to be used as kitchenware, but it may be worthwhile considering alternative functions in light of their context of production.

This set of observations also raises an important methodological concern regarding the use of functional categories as an analytical framework. For instance, when ceramologists differentiate storage jars from transport jars, what is the basis of that distinction? Throughout this analysis, the distinction of the published terminology was privileged. When jugs and jars were removed from their more refined functional classification (tableware, kitchen ware, storage), however, this tended not to influence the overall results of the analysis. That is, other tablewares, kitchen wares, and storage wares were often also being manufactured, making no impact on the cumulative functional analysis of the workshop repertoire.

Production Centers and Product Repertoire

Turning to the relationship between the product repertoire and its center of manufacturing, general observations can be made across the dataset. First, as was the case for individual workshop assemblages, those attributed to a production center or larger site also produced a wide range of functional classes. Generally, the range of functional classes represented at the production centers ranges between two and five different functional groups, while workshops tended to represent one to four functional groups. This greater product diversity at the level of the production center is also demonstrated in the number of forms (e.g., bowls, amphorae, lekane) represented at each site, with a range of two to 17 forms, as compared to individual workshop deposits, which range between one and nine forms. This suggests that workshops tended not to produce the full range of wares, but rather were to some degree limited to small segments of the wider product line of a given center. This follows a model of specialized manufacturing within the production center.

This exercise also raised an important concern regarding the use of survey data as representative of production repertoire. Comparing the range of ceramic types documented through surface survey techniques versus ceramic analysis of excavated remains, not surprisingly, data from excavated remains provide a much more refined picture of the repertoire from a site (tables 4-7, 4-8, and 4-9). The survey data, on the whole, tended to identify approximately half the ranges found with excavation data, and conspicuously absent are ceramic types (i.e., lamps and small household items) that have been identified above to function as ‘secondary’ wares. This trend also does not appear to be related to the functional classes being manufactured (e.g., kitchen wares, tablewares, transport vessels), as those sites under consideration are represented by a range of product types. This disparity thus seems more likely to be a function of the methodology of data collection at the site, which tends to favor either the recovery of the ‘primary’ wares (which may be more prevalent at the surface level) or more widely distributed wares that are more familiar to ceramologists and consequently attract greater scholarly attention.

Given these methodological concerns, care was consequently given to isolate excavated material from survey material within the dataset. This provided a type of control on the different methods of material collection. Thus, in order to investigate the contribution of individual workshops to larger trends in product repertoire at a single site in more detail, the functional and formal ranges of four excavated production centers were compared with those of individual excavated workshop deposits at those same centers. The individual workshops included Sagalassos’ tableware and coroplast workshops; Gerasa’s cave workshop, hippodrome cavea workshop deposit, the Temple of Zeus deposit; Kefar Hananya’s workshop site; Bouto’s Workshop Secteur P1 Kilns 5 and 6, Workshop Secteur P1 Kilns 36 and 40, Workshop Secteur P3 Kilns 6 and 7, and Workshop Secteurs P3 and P4 (see table 4-10). In each case, the range of wares produced per workshop represents only a portion of those documented from the production center (33% to 66%). This suggests that some degree of workshop specialization may have been common among the local product repertoire. Thus, despite a rather limited degree of (functional) product specialization between production centers, within a production center workshops clearly specialized in a portion of the local repertoire.

A great range can be observed in the duration of production between sites (from half a century to five centuries); yet this does not appear to have any correlation with the number of types or range of wares manufactured at a given site. That is, one might expect that over so many centuries of activity, longer-running production sites might display greater diversity in the number and types of vessels produced. Rather, some sites produced a wide range of wares, and others less so, regardless of duration. What might be inferred from this lack of correlation between the number and range of wares and the duration of production is continuity in repertoire through time. This is not to say that the production sites were static in their wares. Certainly, (as will be demonstrated) styles changed through time. Yet sites of longer duration did not tend dramatically to expand the ceramic repertoire of their industry through the types or functions of wares manufactured.

Turning to ethnographic evidence for such patterns of workshop product repertoire in relation to the repertoire of a larger site, this seems to be a particular function of small scale production units. For instance, Curtis (1962) performed an ethnographic study of pottery workshops in southern Spain where he observed villages specializing in ceramic production. In his study, he noted that the ceramic industry of Bailén, which relied on family-based workshops and small ‘factories’ produced a much wider range of vessel forms than the larger, consolidated factories in the nearby town of La Rambla.

Competition may also be at play, as Vossen (1984: 346) has noted in Salvatiera de los Barros, when competition becomes too high among potters, those struggling may leave a community to go elsewhere with less competition.

Other ethnographic studies, such as that by Nicholson and Patterson (1985a, 1985b) in Ballas, Egypt, demonstrate that in close-knit communities of ceramicists producing similar functional types, potters often can differentiate their wares from one another by sight and some middlemen are documented as preferring the wares of certain potters based on relatively minor differences, such as the weight of a storage jar or color of the fired clay. In the case of Jodhpur and Udairpur in Rajasthan, this diversification intentionally serves to dissipate competition among artisans manufacturing stylistically similar wares, while maintaining cohesion within the larger community (Kramer 1997: 77-78). Thus, specializations in part of the product line from the site and variations in the rendering of similar products serve a means to maintain social and economic ties within a community and balancing the potentially negative social effects of competition.

Another example offers further considerations on the diversity of wares manufactured at a production site. Van Veggel (1999) in his study of traditional muleteers of Miravet, in Spain, describes how distributors (i.e., the muleteers) likewise attempted to ease competition within a community of potters and distributors. Most potters and muleteers were connected by family relations, and muleteers reported to avoid markets where other Miravet distributors were known to peddle wares in order to not to "bother each other" (Van Veggel 1999: 321). Potters mostly worked from commissions by distributors, who likewise possessed local information regarding demands in pottery types associated with specific villages, as well as information on changes in the distribution of ceramic wares from other production sites to those markets. Thus, social mechanisms intending to alleviate competition, in this case among distributors, served to influence choices in product repertoire of associated workshops.

The case of the Hellenistic to Roman production sites at Binyanei Ha'uma in Jerusalem demonstrates a rather different pattern than those seen at the other sites. The site appears to have been established in the mid- to late 1st century BC when it produced kitchen wares. In the 1st century AD, after the AD70 sacking of the Temple, the site takes on the production for the tenth legion *Fretensis*, as evidenced by the presence of stamped items bearing legionary insignia (Arubas and Goldfus 1995: 104-105). The earlier Hellenistic wares have been studied in some detail by Berlin, who identified seven primary types manufactured at the site across four chronological sub-phases (see figure 4-1). Produced in a single fabric, the forms include: four types of cooking pots (distinguished as high necked, flanged rim, triangular rim, and small), jugs, casseroles, and annular stands. Her refined chronological phasing demonstrates early preferences (during phases one and two) for the high-necked cooking pots, and triangular-rimmed cooking pots more prevalent in the later (two through four) phases (see figure 4-1). Although not a static product line, the Hellenistic production appears to have been consistently specialized on a small range of kitchen wares. This contrasts with the range of wares produced post-AD 70.

A comparable study of the legionary wares has not been performed; however, the functional range of wares manufactured at the site, alone, is strikingly more assorted, including bricks and roof-tile, kitchen wares (cooking and food preparation wares), and tablewares. This change in functional repertoire represents a rather dramatic shift in product repertoire. As will be developed in subsequent chapters, these changes are likewise reflected in the organization of the workshop spaces and the choices of technology. Overall, this site seems to be an outlier to the general trends observed in the dataset, which show more subtle changes through time.

Discussion

This analysis suggests that workshops were often diversified in terms of the types of wares they were producing and those wares covered a wide variety of functional types. This pattern of diversified industrial development is consistent with observations made regarding other sectors of the Roman economy, particularly agriculture. Intensive, yet diversified, estate production during the period is documented by ancient agronomists, such as Columella, Cato, and Varro, who advocate a mixed agricultural regime that often included such items as fruits, vegetables, wine, olive oil, wheat, livestock and fish (White 1970: 47-52). While Kron has argued that this diversified agricultural regime provisioned a much richer diet for the average Roman (2012: 160- 161), Kehoe has further noted that this diversification was also motivated by concerns over economic risk (1988, 2007; see also Neeve 1990). In order to accommodate and manage economic risk related to poor yields, changing markets, and labor pools, diversified field practices and tenancy laws were developed to help dissipate such risks. He views the roles of institutions as critical in this context, as they encouraged investment by the well-to-do by encouraging a stable labor force and more reliable return on their capital.

This general milieu of conservative, risk-averse economic strategizing through diversification may also offer some thoughts on the degree to which the ceramic industries were specialized in their product repertoires. The range of wares manufactured in a single workshop suggests that a variety of different consumer markets could be supplied by a single workshop. That same workshop could supply the needs of transport containers, household cooking wares, or dining plates. Certain types of wares (i.e., kitchen wares) are known to have been very rarely traded across long distances, while others such as amphorae were designed for such purposes. Thus, workshops could simultaneously supply both local and regional markets adding another level to diversification and risk-management.

In other cases, it is known that transport ships often contained mixed cargos. For instance, in the case of the famous Madrague de Giens shipwreck, crates of tableware vessels were placed above the primary cargo load of amphorae (Tchernia *et al.* 1978). It is not often clear that such tablewares were from the same workshop and, in fact, in many cases this is not the case; yet it does suggest a patterned behavior of economic investment in diversified goods for the period, even in distribution circuits. In this sense, the patterns in economic organization through product repertoire seem to be situated in larger contexts. Kehoe's conclusions regarding the institutionalized (legal) reinforcement of these types of diversified endeavors may also hint at larger, structural influences to economic decision-making across the Empire and across a range of different economic activities (e.g., agriculture, industry, trade).

Style and Product Repertoire

The analysis described above employed a simplified typological framework, which served to facilitate cross-site comparisons and to privilege attributes that could be associated with consumption-driven markets. In this section, a more refined stylistic and chronological view is given to five case studies in order to assess the degree to which patterns observed in functional classes, and assumed to be related to local and regional markets, is or is not reflected in stylistic details of some of these very same bowls, cups, and amphorae. The same classificatory framework, as used in the previous discussions, was not used in this section, however, as full stylistic discussions were not available for all the case studies. Moreover, those studies often failed to employ comparable typological terminology. Instead, the material under investigation here derives from workshop excavations that have received rather extensive typological and chronological attention and that have considered earlier material produced at the same site. These examples offer a means to assess Hellenistic- to Roman-period changes in style at a single site, and observed patterns at each of the sites will be compared in order better to assess production technique, product form, and stylistic execution.

Workshops, Production Centers, and Artifact Style

Ceramic products can be manufactured in infinite combinations of ways. Sets of techniques and technologies are often established through the routinized practices of craftspeople acquired through skills training (in either formal or informal contexts of instruction) (Apel 2008). As an activity learned in social and cultural contexts, the combination of techniques and technologies can thereby be situated in specific frameworks that are culturally informed (Stark 1998). The transmission of production practice among artisans has served in part to explain the formally identifiable traditions of material culture, as expressed through styles.

Relating specific sets of manufacturing techniques to groups of workers or locations of production is certainly not a new approach for the study of the Roman (and Classical) past. Indeed, when referring to the production of sculpture or silver-plate, the *workshop* has been used by art historians to define sets of production features that are inferred to have been learned and practiced among a small group of artisans, presumably in the same workshop (Heilmeyer 2004). The application of the term *workshop* in this manner is reminiscent of the Beazleyan ways that ancient Greek pottery, particularly Attic wares, have been studied (Beazley 1944). Art-historical approaches, such as these, largely remain object-focused, however. Heilmeyer consequently observes a scholastic gap between art-historical definitions of workshop and archaeological findings of workshops. They remain to be integrated despite the fact that 'These two approaches meet in the products themselves' (2004: 403-404).

Within archaeological circles, more specifically, material culture investigations have also employed suites of artifact features as a means of attributing goods to a common production location. In the case of ceramic production in the Roman world, observations on object form, clay fabrics, and slips are often utilized to define typologies based on the technical means of production (for a well known example, see Hayes 1972). Their location of production is then sometimes inferred based on high frequencies in distribution patterns. In these instances, however, the term *production center* is typically applied rather than *workshop*, yet similar inherent assumptions concerning shared technical styles as a means of defining an industry are present in both cases (Poblome *et al.* 2002). These definitions are typically based on consumption studies and/or pedestrian survey data, and have been highly successful in coming to terms with large bodies of ceramic evidence. However, as will be shown, these typological definitions rarely incorporate details on the excavated workshops or on their wider patterns of product repertoire at a given site. The study presented in the following section addresses these lacunae.

Amphorae Variants and Ideal Forms

At several sites in the dataset, minor variations from well-established ceramic types among the workshop remains have been noted. Slight ridging to an amphora toe, added detailing to a rim – these minor variations have in some cases been used to suggest workshop-specific stylistic rendering, as well as different techniques of production. Yet the choice of form and finish for amphorae acquires an added dimension of complexity. This is in large part due to their function as containers for other products, rather than being the primary product. As such, there is general agreement that the form of some amphora types was closely associated with its contents, and could serve as a sort of product recognition or identification of the place of origin (Peacock and Williams 1991; Rauh *et al.* 2013).

The details of this association are not always clear-cut, however, for several reasons. For instance, it is often difficult to associate forms with (now lacking) contents, the same form is sometimes known to have contained different types of products (Lund 2004; Mayerson 1992; Oked 2011), and production centers of the same form, such as Late Roman 1 amphorae, could be produced in locations as far apart as Cyprus and Egypt (Pieri 2008). Thus, the formal rendering of the amphora may have been motivated by a variety of factors that were directed by consumer marketing, standardized measures, and agricultural cycles. This is echoed in the products specified in the lease contracts preserved on Oxyrhynchus papyri, which specify quantities, known shapes, and measures of the vessels expected to be produced.

Despite the standardized sizes and shapes of certain amphorae lines, more detailed studies of vessel form inevitably result in typological variation. Indeed, typologies are largely based on formalized ideal types that fail to accommodate the full range of ceramic variation found in actual archaeological contexts. One need only look at the study of Egyptian amphorae by Dixneuf (2011) to be made aware of the numerous intra-type variations present within a relatively small region (see figures 4-2 and 4-3). In some cases, this variation likely reflects changes through time too refined to be picked up using archaeological chronometric data (i.e., differences between generations of potters). In many instances, these variations are relatively minor, such as different modeling of the toe or handles. When correlated to distinct fabric groups, Dixneuf associates these morphological variations with individual production sites.

In other, rather rare, cases, typological variations can be attributed to individual workshops. Such is the case for amphora production at Buoto, which in the Hellenistic period displays unusual production features of well established Egyptian amphorae types (AE types 1 and 2). Most notable is the use of differently tempered clays for different parts of the amphora vessel. Bourriau (2003) notes that the bodies of some amphorae from the larger production site have vessel walls in full clay (without added temper) and attachments such as necks, rims, handles, and toes are produced in plant-tempered clay. She supposes that the differences in clay would lighten the weight of the vessel. As only a fraction of the amphorae display this technique, she proposes that this may be a technique of a single workshop (2003: 256). A similar circumstance can also be cited at the 6^{th}-7^{th} century AD Late Roman 1 amphora production site at Paphos, where Demesticha (2000) uses detailed analysis of the production techniques observable on the workshop material to propose workshop-specific traditions that result in variations in the rendering of handles. She even promotes the use of manufacturing traditions as a means of developing alternative classifications of known pottery types.

These examples of amphora production sites demonstrate unusual technical features that serve to deconstruct oversimplified classifications of formal, ideal types; they highlight intra-type variation of objects, and even variation within a single production center, to demonstrate the often highly localized character of production technique; and they also raise caution regarding the interpretation of amphorae forms on the basis of stylistic factors alone, as these vessels also served a specific function as containers for other goods. This contrasts with the discussion to follow, which focuses on vessels that were consumed as primary products and ones used in contexts of dining and social display.

Decorated Wares

Ceramics with surface treatments offer an opportunity to consider not only details of morphological treatment, but also its correspondence to or rupture from trends in other variables, such as surface treatment and decoration. Three examples will be used to highlight the relationship between the development of a production center and changing stylistic choices in its product line.

First, the site of Bouto presents the case of a long-established production site manufacturing wares from the Hellenistic through the early Byzantine periods. The wares include a range of functional classes, including table and kitchen wares. The Hellenistic period repertoire at the site notably includes black-gloss wares with a transition to red-slipped wares in the High Imperial period (1^{st} – 2^{nd} centuries AD) deposits (Ballet and Vichy 1992). Associated technological changes have also been noted in the kiln designs at the site (Ballet 2003: 237-238). The high imperial material likewise demonstrates the introduction of new shapes, including collared bowls and handled cups (see figure 4-4). Despite this technological shift and introduction of several new forms, many of the same forms appear to be continued into the red-ware repertoire of the Roman period, notably a predominance of in-turned rims and hemispherical bowl forms. The case of Bouto presents an important example of a well-established ceramic tradition that integrates surface coloring styles popular in the wider eastern Mediterranean during the early Roman period, while still maintaining certain features (i.e., vessel forms) of local traditions. Those local traditions were not static, however, and changes can be discerned in their surface treatment and decorative elements.

Second, the case of Sagalassos (SW Turkey) presents a story similar to Bouto, except the production center in the eastern suburbium of the city was founded in the 1st century AD[25]. From its initiation, it appears to have been producing red-slipped wares, although earlier examples of production in the region have been indentified (Braekmans 2011; Braekmans *et al.* 2011). The early product lines at Sagalassos conform to certain stylistic trends of early Roman table-wares, namely bright reddish-orange slipped surface treatments. The choice of vessel morphologies of these same products, however, much more closely follows traditional forms popular at the site in the late Hellenistic period, as demonstrated by an emphasis on *mastoi* (form 1A130) and hemispherical cups (forms 1A140, 1A160) (Poblome *et al*.; Waelkens *et al.* 2011: 64-65; see figure 4-5). Unlike nearby sites, such as Perge or Sardis, the *mastos* is the most popular type of drinking cup

[25] A Hellenistic kiln has been found at Sagalassos on the western side of the city, under the Odeon. Its associated production repertoire is not known, however (Poblome *et al.* 2013).

produced locally in the Hellenistic period at the site, and seems to represent a highly localized tradition echoed into the early and high imperial Roman (phases 1-5) product line of parabolic cups (particularly form 1A130) at Sagalassos (Poblome *et al.* 2013: 180-181). In this case, similar patterns as those observed at Bouto can be observed, yet the repertoire developments at Sagalassos appear to be highly localized and distinct from those of even nearby sites.

A third production site of decorated wares in the surroundings of Petra demonstrates different stylistic patterns in the late Hellenistic and early Roman periods. During the Hellenistic period, Nabataean wares are notable for their very distinctive thin walls and detailed red- to brown-painted surfaces depicting vegetal and geometric motifs (Homès-Fredericq 1986: 190-191). In the early Roman period, several typological changes can be observed in the (by that period) long-established production tradition - most notably an integration of ring-based hemispherical bowl shapes into the pre-existing bowl and plate repertoire. At other contemporaneous production sites, such as Pergamon, these bowl shapes were typically rendered in red slip, yet the examples being produced at Zurrabeh outside of Petra were painted using traditional styles and motifs (Franken 1986: 185-189). In addition, Homès-Fredericq even notes that, among the cooking wares, certain jug forms show continuity in the production repertoire from the Hellenisitic Nabataean to early Byzantine periods (1986: 197-198). Thus, while Bouto and Sagalassos productions demonstrate traditional forms with new decorative finishes, the case at Zurrabeh, in contrast, displays traditional painting applied to vessel forms associated with material culture traditions of other regions, where they are typically slipped.

These three cases provide different local responses to changing styles in the early Roman period and responses that occur at different scales. Similar situations have been observed in other circumstances in the Roman world outside of the study region of this dissertation. In early Roman Campania, Roth interprets the black-gloss tableware produced in fabric VI as representing a ‘hybrid product’ (2007: 143). Blending local clays and shapes with a foreign surface treatment (i.e., black-gloss), the fabric VI pottery products are presented as material hybrids. Roth considers the integration of foreign elements into this table-ware repertoire to be a result of ‘competitive emulation’, whereby certain features of more costly, elite-associated goods (i.e., black-gloss tableware produced in fabric VII) are imitated in order to portray a higher level of social status. However, competitive emulation is not a simple process of direct mimicry; rather, according to Roth, status acquisition is a multi-referential process. As such, the hybridity of ceramic style is a reflection of cultural *bricolage*, in which the material form is ‘translated’ and consequently distorted by the experience of and materials available to the maker.

In analyzing the North African wares from the 5th to 7th centuries AD, Bonifay has demonstrated variety in the forms, decoration, use of technologies, and iconography across the region. This variety he relates to earlier Punic ceramic traditions, Roman ceramic traditions, and ceramic traditions from the eastern provinces. He associates changes in the repertoire of North African ceramics, however, to large political and economic shifts of the region. These large-scale developments coincide at this late period, with the movement of workshops out of the countryside and into towns and cities. Moreover, different regions variably experienced periods of economic growth or regression at this time, expanding or restricting the long-distance distribution of wares from certain regions (Bonifay 2013: 153). Building on the work of Mackensen (1998) and Peña (1998), Bonifay relates these changes to the overall composition of the ceramic repertoire (and the technical knowledge necessary for their production) during the period to these larger economic processes which influenced the movement of potters.

Production Practice as Hybrid Practice

In archaeological typology discourse, objects, such as those described in this section, are often referred to as 'imitations', with consequent allusions to inferior quality and design and with implications of cultural emulation and dominance. In more recent material culture studies approaches, these changing styles are often referred to as object 'hybrids' (Antonaccio 2005) or evidence of 'cultural bricolage' (Roth 2007; Terranato 1998) - adopting stylistic features of wares associated with other cultural groups, while maintaining certain characteristics of local traditions in material culture styles. However, it is not the objects themselves which are hybrid, but rather the practices in which they are entangled.

In perhaps the most well-known work on hybridity, Homi Bhabha's *The Location of Culture* (2004) presents hybridization as a process of cultural translation. This translation takes place in what Bhabha describes as the 'third space'. This third space is a liminal zone between the socially-constructed boundaries of otherness among cultures.

Processes of translation within these cultural boundaries necessitate cultural distortions that produce hybridity. Thus, translation is a form of imitation, but because that which is translated has innumerable meanings, it can never be fully mimicked, because its essence cannot be essentialized or reproduced (Byrne 2009: 30-33). Although Bhabha's development of hybridity emanated from postcolonial contexts with associated power discourse, Pieterse has argued that, as pure forms (of anything) do not exist, in some sense everything can be conceived as hybridity (2001: 227), and this postcolonial 'fetishism' of boundaries is merely a by-product of living in the modern globalized world of our times (2001: 221).

Objects in this sense are the products and facilitators of 'hybrid' social practices, which in the context of this dissertation hold particular relevance to production practice, as these production practices are, in fact, socially-informed economic activities. On the one hand, such potters appear to be responding to perceived changes in consumer demand. This, moreover, fosters the professional development of different techniques and in some cases technologies. On the other hand, production practice is often deeply embedded in long traditions of social practice (i.e., the *habitus* of how things are made and used, as related to expectations of object form) (Bourdieu 1977; van Dommelen 1997; Silliman 2006; Hodos 2009) and learned embodied actions that are acquired through muscle memory (i.e., the embodied execution of the production process) (Apel 2008; Loney 2007). It is these hybrid production practices that are expressed through the stylistic analysis of the object.

Returning to the dataset from the eastern provinces regarding decorative treatment and form, similar processes of hybrid practice can be observed through the stylistic decisions in ceramic production sites in the 1st century AD. At each of the three sites described above, the new influences can be perceived in the locally manufactured material culture. They, however, do not result in a whole-sale replacement of one material type with another. Indeed, in these locations, pre-existing traditions in production practice are 'intermingled' with new choices in product form likely introduced through expanding trade and movements of people and goods across the Mediterranean at this time, and the consequent opening up new markets and exposure to a greater range of material culture types and choices.

Thus, in cases of well-established local production centers, these new ideas and forms of material culture are 'translated' through hybrid practices and the product repertoire of these production sites at this time demonstrate influences in ceramic style from other Mediterranean regions, while still maintaining certain aspects of traditional production practice. The expression of these patterns is not, however, uniform across the three sites demonstrating differential selection and privileging of formal and decorative traits through the production process. The fact that many of these forms were produced for many generations likely reflects the development of a sustained local market and new sets of production skills and practices.

Conclusions

This chapter has worked through various issues concerning the types of ceramic products manufactured in workshops in the eastern provinces of the Roman Empire. Analyzing both funerary and legal texts in reference to professional specialization, as suggested from professional title, it appears that, as regards ceramic production, general terms were more commonly applied. Moving to the archaeological record of workshops and production centers, the range of functional types manufactured at individual sites was analyzed. This investigation demonstrated a strong tendency in the data for diversified product types at the workshop level.

At the level of production center, individual workshops appear to have contributed small portions of the larger repertoire from the site. This suggests a product specialization negotiated among workshops at the local level. These investigations also identified what appear to have been primary and secondary product types among the repertoire of workshops, not only diversifying the range of goods, but also conceivably the destined market being supplied. Based on the functional types of these secondary products, it is proposed that individual workshops often supplied both regional and local markets with different types of wares. This first part of the chapter served to highlight the relationship between workshop specialization, product repertoire, and economic decision-making.

The second part of the chapter focused more extensively on production technique and vessel repertoire. Analyzing features of shape and decoration, amphorae and decorated wares are given particular attention. Cases of amphorae production were used to demonstrate the diversity of morphological and technical variation that is often overlooked through more form-based, ideal type classifications. Next, decorated wares from three sites are demonstrated to show both elements of traditional product types as well as influences from other regions. These wares are then considered in relation to theoretical considerations of 'hybridity' and socialized practice in the production and reproduction of material culture in order to better understand uniquely local responses to wider stylistic influences. These considerations balance understanding of production repertoire in terms of both economic decision-making and socially learned production practice.

Analysis of the ceramic goods manufactured in the workshops offers much to the themes of this study, as it explores the sets of relations between product repertoire, economic specialization, and production practice within the context of a workshop and its production center. In this respect, the choice of product types manufactured in these contexts is demonstrated to draw together both social and economic considerations, as well as situating those choices within local and regional markets. Economic strategizing is expressed through the diversification of product lines and perceived market demands. These economic motivations are thereby consistent with other trends in economic risk-management elsewhere during the period, while also being founded on production practices based in local communities of artisans.

CHAPTER FIVE

The Roman Ceramic Workshop: an Analysis of Structure, Scale, and Organization

Scale and structure of economic activity are long-established focuses of Roman economic history at the empire-level. Structure has been evaluated in terms of communication and trade networks, institutional regulation and taxation, and political and social organizations (Duncan-Jones 1990). The scale of economic activity has been foundational in assessing the growth and contraction of the Roman economy through time, yet has been hampered by difficulties in acquiring and analyzing quantifiable data for the period. Various archaeological proxies have been employed for this purpose, including coins, amphorae, oil presses, and shipwrecks (Greene 1986; Bowman 2009).

Together, structure and scale are seen to characterize the ancient economy – by the organization and by the dimension and extent of economic activity. The long-standing interest in structure and scale contributed to Neoclassical Economic approaches to the Roman period – particularly concerning the relations between supply and demand, and costs and prices (Duncan-Jones 1990; Finley 1985). Those factors were then integrated with political history to assess imperial policy and ancient economic rationalism. More recent emphasis on New Institutional Economics has reinvigorated interest in economic structure and scale by relating these studies to larger processes of economic performance through history (Scheidel 2007). Regardless of the larger conceptual argument being promoted, structure and scale have continually been seen as fundamental means to characterize the Roman economy, and they consequently provide the framework of this chapter.

Applying concepts traditionally used to evaluate empire-wide trends for workshop studies necessitates some reframing, however – namely, how do structure and scale define the nature of productive activity at small scales? Can trends be observed in the organization of work activities and the scale of production that are suggestive of either wider institutional influences or local practices? In pursuit of these questions, this chapter analyzes the relationship of the built environment of workshops to the structure of work activities (in Part One) and the scale of production (in Part Two). This is not to say that the wider contextualization of the workshop is not of significance, indeed as was discussed in Chapter Three.

The Workshops

Analyses conducted in this chapter rely on workshops that have been entirely (or largely) excavated. As a result, only a limited number of workshops can be used. These include: Sagalassos' Mold-made Wares Workshop, Sagalassos' Tableware Workshop, Pergamon's Unit 2 (north), Unit 2 (south), and Unit 3, Jerusalem's 10th Legion

Workshop, Delphi's Secteur Sud-Est Workshop and Gerasa's Hippodrome Workshops[26]. All excavation details of these sites derive from the original publication, unless otherwise noted; the original reference for these works is listed in table 5-1. In general, the dataset is small and has some clear biases – most importantly that they all are situated in urban or suburban contexts (except Jerusalem), resulting in a bias for workshops in more densely occupied areas. There is also an over-representation of fine wares and an under-representation of tile and brick production sites (n=1). This situation is not exclusive to this study, however, as very few kilns have been excavated for the Roman period, in general (Mills 2013). Another notable absence is that of pithoi production. Again this situation is not exclusive to this study. In fact, according to Giannopoulou (2010: 54), no specialized pithos kiln site has been identified from the Late Bronze to the Byzantine periods, and pithoi, in general, remain especially understudied for the Roman period. In case of brick, tile, and pithos productions, this has been explained, in part, through the ancient use of temporary kiln structures. Indeed, workshops employing pit and open-air firing techniques[27] are rarely identified archaeologically (anywhere and from any time period), and as such, no examples are represented in this analysis, although they surely existed. These biases reflect the current state of the field in workshop studies, however, and cannot be avoided.

As the dataset employed in this chapter is unfortunately small, whatever interpretations are made from those patterns will consequently be preliminary. In order to further substantiate interpretations on these trends, two bodies of comparative material will also

[26] Only one hippodrome *cavea* unit was used in this analysis, as a representation of the common trends at the site.
[27] This is the case with hand-formed wares, where potters' wheels would not have been used.

be brought into the discussion: ethnographic case studies and examples of workshops from contemporary Roman workshops operating in the western provinces. Each of the two bodies of evidence is used at different levels of analysis, however. The ethnographic material is used to support interpretations from the material record of the workshops, particularly related to functional concerns about the work cycle. The comparative archaeological material from the western empire is used to substantiate interpretations specifically related to Roman social and economic contexts of production. Ethnographic analogy, as described in Chapter Two, has a long history of use in archaeology, and especially in the study of archaeological ceramics and their production. Although the use of analogy is methodologically and conceptually fraught with a variety of problems and preconceptions, they nevertheless afford different and important ways of thinking about the material record of production – particularly regarding functional concerns over the techniques and technologies of production (David 2001).

Workshop Structure, Workflow, and the Organization of Work Activities

Any built structure mediates the actions of its inhabitants. This is done either by facilitating the movement of people and materials (through the construction of doors, windows, stairways, and corridors) or by restricting the movement of people and materials (through the construction of enclosed spaces and partitioning walls or by blocking access ways). Built structures can also encourage or discourage movement between specific spaces by setting them in proximity or at distance to one another and by establishing open or closed accessibility.

These basic factors (accessibility and distance) affect the use of any space. Workshop spaces, however, are a particular type of space. As settings of ceramic production, the allocation of space is contingent on the needs of the workers to accomplish the production cycle. The built environment thereby structures work activities, yet those activities can recursively adapt and manipulate the constructed space to the needs and expectations of its workers. Although certain types of actions need to be performed in this cycle, the way those actions are spatially distributed reflects a variety of economic choices (e.g., perceptions of efficiency, avoidance of risk), as well as perceptions on how stages in the work cycle are socially distinguished (e.g., distinctions in worker specialization and workgroups). The workshop thereby serves to create and reinforce a cultural environment of work through its organization of daily rhythms of dwelling – from the practicalities of work activities to the power relations inherent amongst workers (Vis 2009).

Methodology: the Chaîne Opératoire and the Built Environment

Analysis of the built environment was conducted using architectural plans and feature drawings. Many of the comparisons made in the subsequent sections are based on certain assumptions concerning the ceramic production process, as well as its relationship to the built environment; namely that certain steps in the production process may have infrastructural correlates that can be perceived archaeologically. This assumption, when used as a means of building a methodological framework, comes with some cautions, however – namely, only workshop spaces with permanent, task-specific infrastructure can be analyzed, and when spaces contain task-specific infrastructure, the entire space or room is assigned that function (i.e., tanks and vats denote clay preparation spaces, potters' wheels denote throwing spaces, kilns denote firing spaces). Certainly, spaces containing infrastructural features (e.g., kilns, potters' wheels) could also be used for other types of activities; workshops were flexible spaces. However, despite these very real concerns, the installation of permanent or semi-permanent infrastructure does suggest that some activities were to some degree 'fixed' to certain spaces of the workshop. Furthermore, without more detailed analysis of small finds and non-permanent features (which are generally unavailable), it is not possible to spatially establish activity patterns in more refined ways.

Second, the production process of each workshop has been reconstructed using Leroi-Gourhan's *chaîne opératoire* (1993). Tracing out the production process from the acquisition of raw materials, to the production and use of the product, the *chaîne opératoire* focuses on how these production sequences are executed through human action and production technique (Leroi-Gourhan 1993). When turning to the *chaîne opératoire* of ceramic production, certain *strategic tasks* are imperative to the production of ceramics (Lemonnier 1986). These are outlined in table 5-6. The means of performing these tasks can be highly variable, yet they are nevertheless essential to transform clay into finished ceramic. For cases in the Roman world, these *strategic tasks* are sometimes represented by permanent or semi-permanent infrastructural correlates (i.e., clay levigation vats/basins, potters' wheels, and kilns) or by the characteristics of the built spaces (i.e., windows, accessibility).

Portable objects would also assist in identifying activity patterns within the workshop; however, such small finds have only been published in the case of the workshops at Sagalassos. Possible infrastructural indicators for each strategic task are noted in table 5-6, as well as technical considerations that may influence the choice of their location within a workshop. Identification of these technical considerations have derived largely from ethnographic work with modern potters employing traditional, non-electric technologies and have come to be established through more general handbooks on pottery production, such as those by Shepard (1965), Rye (1981), Rice (1987), and Sinopoli (1991). These technical considerations offer a sort of idealized framework by which to evaluate archaeological workshops.

Previous spatial applications of the *chaîne opératoire* to archaeological sites of ceramic production have focused on the architectural remains of the site in relation to the movement of materials (from raw materials to finished product) through it. For example, at the site of La Boissière-École (Yvelines, France), Dufaÿ *et al.* (1997) demonstrated that the organization of the production site changed over time through the expansion and contraction of independent, parallel, production units. Poblome *et al.* (2001) have also used the *chaîne opératoire* to track work patterns at the archaeological sites of Pergamon and Sagalassos (specifically for the tableware industries) and to compare production organization between the two sites. Similar (ethnoarchaeological) analyses have been performed at Thasos by Papadopoulos (1995), who demonstrated that changes in the organization of the workshop through time were related to changing compositions of workers and their personal life histories.

Workflow Movement and Distances Crossed

The way individuals move through production spaces in daily to seasonal routines of work can result in strikingly different work experiences. Organizational patterns can reflect ideas on efficiency that minimize the distances traversed through the work cycle, time investment in goods, or risk. By comparing the organizational layout of the workshops in this dataset, patterns will be established and differences assessed which can open further discussion on the interplay of social experience in economic settings. Plans of each workshop site are provided in figure 5-1, and the location of different stages in the production cycle are indicated on each plan, as available from the excavation reports.

In order to establish how the built environment facilitated or restricted movement through the workshop, access graphs were constructed for seven of the more thoroughly excavated workshops. These were made for the Sagalassos Tableware and Mold-made Ware workshops, Pergamon's Unit 3 and Unit 2 (north), Dura Europos Workshops 1 and 2, and Delphi's Secteur Sud-Est Workshop (figure 5-1). Access graphs schematically outline the connections between rooms and spaces. They are useful for analyzing the workshop plans for three reasons. First, they reinforce the overall layout of the workshop; is it an open plan or more restricted plan? Second, they demonstrate how the built structure manipulated movement between spaces; how did people move through the workshop? Third, when comparing the access plan to the archaeologically reconstructed movement through the *chaîne opératoire*, it is possible to trace out manufacturing movements in the space; by which routes did artisans move through the space during the production process?

Across the dataset, we can see that production tasks are typically allocated separate areas for clay preparation, object forming, drying, and firing. Only in the cases of Gerasa and Delphi is this not the case. The numbers of distinctive spaces ranges between three and ten rooms. These access graphs highlight the diversity in the spatial organization of workshops, with some constructed with open access and others with a recessed series of rooms (see figure 5-1). The workshops of Pergamon Unit 3, the two Dura Europos Workshops, and the Delphi workshop all display an organization around a main courtyard space. The type of infrastructure in that central court is not standardized, however, and clay basins, wheel stations, or kilns might all be present. Other cases, such as the two Sagalassos workshops and Pergamon's Unit 2 (north), show a more recessed organization, with rooms leading into one another and with the major series of connected spaces occurring in the back of the building.

With three sites offering two largely contemporaneous workshop examples each (i.e., at Dura Europos, Pergamon, and Sagalassos), it is possible to assess the degree to which workshops at the same site were organized alike or differently (see figure 5-1). At a very superficial level, both Sagalassos workshops are oriented in a relatively linear access pattern. These are marked by a preliminary corridor or forecourt that eventually opens up into a backroom from which a series of other rooms can be accessed. The degree to which access was restricted was more pronounced, however, in the Mold-made Wares Workshop. Both workshops were largely constructed atop earlier remains, yet only in the case of the Mold-made Wares Workshop were small sections of earlier walls integrated into the workshop construction. Earlier architectural plans therefore would have only minor influence on the later constructions. The two were both constructed against large terraces that provided standing back walls to the workshops. The entire eastern suburbium in which these workshops are located is constructed along a system of terracing, and other buildings in this part of the eastern suburbium, including tombs and workshops, also abut the terracing and orient towards the rear of the building. These construction techniques may be related to the recessed organizations of the workshops.

The two Dura Europos examples tend to be based around large courtyards where the kilns were located. Dura Europos Workshop 1 displays two sets of rooms organized around two courtyards – a large courtyard with a kiln and a smaller court with a well. This may suggest that the two 'branches' or rooms may have had different functions. These Roman-period workshops appear to have been installed into the remains of earlier households that were organized around a central courtyard. Thus, the adoption of these spaces may explain the open plan of these two workshops. Yet significantly, the courtyard arrangement does not appear to have been severely renovated by the later artisanal inhabitants, but rather reinforced architectural traditions of local households that were taken on as industrial buildings. Similar maintenance of central courts in later phases of occupation can be witnessed in living quarters in the larger, surrounding neighborhood, thereby fitting the workshop adaptations into broader trends in the area.

The two Pergamon examples show little in common, as Unit 3 is organized around a central courtyard and Unit 2 North is organized according to a maze of small rooms. Although it was not possible to produce access graphs for the other workshops at Pergamon, they appear to follow the organizational structure of Unit 2 (north) more closely. What emerges from this site, in comparison to the previous two, is the intra-diversity of workshop spatial organization. Each organizational scheme is unique and, for the most part, it is difficult to make site-based generalizations here based on architectural plan alone.

When comparing the plans of the ceramic workshops, nearly all workshops spatially segregate work activities, and this does not necessarily seem to reflect work specialization or organization. What patterns can be discerned, however, suggest that where those tasks are performed in relation to one another may be more significant (see figure 5-1). In order to interrogate this possible relationship, the *chaîne opératoire* was then compared to the access graphs to track the number of spaces traversed when passing from one *strategic task* to the next. For instance, in Pergamon Unit 3, two thresholds were passed when moving wet vessels from the wheel into the drying room. When we compare the number of spaces crossed between different stages in the production cycle, certain transitions seem to involve less movement through spaces. The movement from clay preparation to throwing/forming is typically among the least numbers of spaces being traversed in this transition (only zero to one spaces), meaning that these areas were either situated in the same or adjacent spaces. This is of interest, as the rooms in which clay preparation occurred were sometimes in more recessed spaces of the workshops (i.e., in Sagalassos Mold-made Ware Workshop room five and Tableware Workshop room six, and Delphi workshop room 2), and transporting the raw material into the workshop, therefore, would have required considerable effort. That is, the emphasis was on maintaining efficiency of the work cycle by provisioning the wheel-throwers with clay, rather than on provisioning the clay preparation with raw material.

Regarding the movement between clay preparation and wheel throwing areas, an explanation for this may be found in ethnographic examples describing the quantities of clay consumed in pottery production. For instance, Rye and Evans noted that a potter working in Shadiwal Village in Pakistan used 2.5kg of clay to throw a single, medium-sized dish with a diameter of 35cm (1976). With two potters throwing simultaneously, as much as 100kg of clay could be consumed at a wheel per day (Rye 1976). Therefore, supplying multiple potters with clay from the preparation area represents a major task that could create a 'bottleneck' in the production process by upsetting the working rhythm of the potter at the wheel (if they would need to move away from the wheel in order to acquire the clay themselves). It therefore seems that the close proximity of clay preparation areas in the archaeological examples may demonstrate a concern for that supply.

Across the archaeological dataset, when drying spaces were identified by the excavators, their placement seems to have been less easily accessible (with movements crossing between zero and two spaces), and at any given workshop both indoor and outdoor areas could have been employed for this purpose (see figure 5-1). Lesser accessibility to the drying space may be attributed to a combination of factors related to the properties of the clay, temperature, humidity, movement of air, and adequate space (Shepard 1965). As Shepard notes, 'certain precautions are necessary in drying pottery because strains result from too rapid drying and there is danger of cracking' (1965: 72). In the Sagalassos cases, indoor drying areas with unusual architectural features (e.g., volcanic sand floors and rooms lacking windows) were noted, and may suggest particular concern in the drying of fine ware production (such as that produced at Sagalassos and Pergamon), as these wares require especially controlled and even drying. In the Gerasa example, however, the workshops were likely too small to accommodate interior drying spaces of adequate size, and therefore exterior (undocumented) areas were probably utilized instead. As will be discussed below, this seems to have been a function of the workshops moving into the preexisting hippodrome structure.

Locations of kilns also follow less regular patterns. Generally, they tend to appear in the corners of exterior spaces, which at some sites (i.e., Dura Europos, Petra, and Sagalassos Mold-Made wares workshops) take the form of courtyards. They are typically built into pre-existing structures or walls, using those walls as supports. When a series of workshops are situated next to one another (i.e., Petra, Gerasa, and Sagalassos Mold-made wares workshops), the kilns tend to be placed in proximity in a sort of kiln 'zone' situated slightly apart from the main workshop areas. The development of these 'zones' may be motivated by shared risk of fire and smoke avoidance or, as will be discussed subsequently, by the long-term historical development of the built space. It also demonstrates inter-workshop planning within a community of artisans.

The paragraphs above outline the general tendencies that can be gathered from the access-graph and workflow analyses. So far, many of these organizational choices made to the built structure can be explained according to efficiency-based production reasoning. However, two cases contrasting these trends emerge as strong oddities. First, kilns at Gerasa were established some distance (at least 12m) from the outer walls of the hippodrome (and thus the workshop spaces) and, in the case of the southern kiln zone, the kilns were actually sited on the opposite side of an active road. The ethnoarchaeological study of potters in Thasos by Papadopoulos suggested that movement between spaces was purposely limited – particularly at 'risky' points in the production process, such as with the movement of unfired vessels, which were more susceptible to breakage (1995). In contrast, the workflow patterns at Gerasa appear to have been to some extent dictated by the fact that the workshops moved into a pre-existing building that was not originally designed for industrial activities and occupied part of the town with an established road system. Instead, spaces were renovated and adapted and may have resulted in a certain degree of negotiation in the development of shared work spaces or more informal agreements in the use of exterior spaces. As the hippodrome also hosted households (in the eastern *cavea* spaces), the workshop activities appear to be only one aspect of a wider community organization. Community networks thereby facilitated such negotiations.

As discussed previously, throughout most of the dataset there seems to be an effort made to minimize the distance traversed between clay preparation and throwing areas; however, it is interesting that the case of Jerusalem is different. Although access graphs could not be made for this case (as the site was only partially excavated), certain pertinent observations can be made nonetheless. At this site, the clay preparation area was not immediately accessible to the throwing rooms, but the two areas appear to be closed off from one another. Retrieval of clay by the potters themselves would have thus been more disruptive to the work process than in the other examples, and there is little additional space available in the three throwing rooms for short-term clay storage. This may suggest a different type of organization of workflow wherein different stages of the production process were divided among specialized workers (i.e., task specialization of workers), alleviating the need to minimize this distance for the sake of the potter.

This is undeniably a small dataset, yet some generalizations can already be made from the above observations. First, the layout of workspaces was largely unique to each workshop. Some minor architectural tendencies can be proposed at the site-level (i.e., Dura Europos workshops made use of courtyards and Sagalassos workshops had restricted access from the front door), but these trends are relatively minor compared to the overall organization of the plan. Workflow patterns were also highly variable, but certain trends, especially related to the proximity of clay to throwers and the distancing of kilns, seem to emerge. These latter observations can largely be explained according to concerns over efficiency, particularly workflow efficiency.

Division of Space, Division of Labor?

The presence of multiple wheels in a workshop suggests that even the most modest of workplaces could employ several workers, but what were the workers' relationships to one another and to the work cycle? The example of the Jerusalem workshop has already been used to propose that production sites composed different sets of workers. When we turn to the historical evidence for labor organization in the Roman world, different forms of labor status were legally recognized: slaves, hired wage earners, and independent free workers[28]. The jurist Paulus, however, noted that it was difficult to distinguish between a slave and free man (*Dig*. 18.1.5). In some cases it is possible to document that individuals with different statuses worked side-by-side. For example, at the ceramic production site of Arezzo, stamps on Italian terra sigillata document legal statuses of workmen and demonstrate that slaves and freedmen worked together in the same workshop, performing the same jobs. Unfortunately, for the Roman eastern Mediterranean, fine wares were less commonly stamped with the names of potters. In a similar vein, Bodel has noted that free-work was not differentiated from slave-work and that slaves and free workers could perform the same tasks (2011), with private and imperial properties employing both slaves and wage labor.

Specialized work roles within the workshop can also be inferred from a 3rd century AD papyrus from Oxyrhynchus [P.Oxy. 3595] describing the lease of a pottery on a rural

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[28] Of these labor statuses, unfortunately little is known concerning free individuals working independently on their own land/workshop, as that status required less legal documentation.

estate. The text stipulates, that although the lease is held in the name of a single potter (κεραμεύς), presumably what we would refer to as the 'master potter', additional positions could be filled by other workers – specifically potters or molders (πλάστης), assistants (ὑπουργός), and kiln stokers or (literally) 'one who burns [things] up' (ὑποκαύστης). Thus, according to the distinctions made in this lease, there does appear to have been some differentiation between craftspeople involved in different stages of the production process and at different levels of skill or experience. It is perhaps of interest that plural terms were also used for each of those three specializations, suggesting multiple individuals performing the same manufacturing role. As will be demonstrated in the subsequent analysis, such production-step specializations in work tasks are echoed in the architectural layout of many of the workshops in the dataset. It is also of interest that the term used to describe the hired πλάστης ('potter', or perhaps more fittingly translated as 'modeler') is a different term. This may suggest a higher degree of skill associated with the leasing potter (κεραμεύς) in addition to the specialized role of vessel-forming, noted above, within the lower ranks of workers in the workshop.

Further evidence for apprentices and master craftsmen can be found in Roman textual sources. Dated between the 1st to the 3rd centuries AD, 29 apprentice contracts are preserved on papyri from Egypt (Bradley 1985). As legal contracts, these documents outline the arrangement whereby a youth is instructed in a craft or trade. Based on this information, it seems that (at least in Roman Egypt) freed boys, slave boys, and slave girls[29] would normally be apprenticed between the ages of 10 and 15. In the case of crafts production, apprenticeships typically had a duration of 0.5 to 5 years in length

[29] Freed girls are importantly not attested in these documents.

(depending on the trade), and at the end of that period, it was expected that he/she was proficiently skilled in that occupation (Westermann 1914). A variety of trades is represented by these arrangements (e.g., weaving, wool-carding, copper smithing, building, nailmaking) (Westermann 1914; Bradley 1985). Some masters also appear to have trained multiple apprentices at a time. The presence of children in ceramic workshops has been substantiated by fingerprint analysis of impressions on molded wares from Kôm el-Dikka (Egypt), dated to the 6th century AD (Dzierzykray-Rogalski 1991). Identification of age-based papillary lines on the fingerprints has verified the ceramic work of children as being between 10 and 14 years of age.

Saller has remarked that the most common and important form of labor organization for the period was likely the family-based production unit (2011). It is also the one for which we have the fewest textual sources. Concerning the role of women and wives in labor, gendered work activities appear in literary ideals scripted by male writers, in which wives are associated with domestic textile production and overseeing the household, in parallel with images on grave stelae in which men are paired with occupational tools and the female with the spindle and distaff (Waelkens 1977, 1986; Zimmer 1985). Preserved examples of apprenticeship contracts from Egypt, however, seem to suggest that full-time trades were also taught to girls – particularly slave girls in the textile industry. In addition, Saller further references women at work in stores or tabernae with their husbands and as agricultural workers in Egypt (2011). These examples suggest that the hyper-gendered image of work presented by the textual tradition is probably too rigid. Specifically concerning the ceramics industries for the period in question we have, as of yet, no evidence of women working as potters (Lund 2009). All names associated with the trade are male. However, it would seem surprising that women would not, at least informally, take part in the production process, and leases have been preserved on Egyptian papyri naming women as workshop property-owners (Cockle 1981).

Thus, although historical texts suggest that a single workshop could bring together workers of different skill-sets, ages, ethnic backgrounds, legal statuses, and genders, these types of diversity cannot normally be specifically identified at archaeological workshops. Differentiation between workers can sometimes be perceived archaeologically, nevertheless. Spatial division of workstations and units dedicated to specific production steps can suggest distinctions between worker activities. Yet these may not immediately translate into the sorts of divisions (age, gender, legal status) noted historically.

Clearly some differences can be discerned in the organization of workers across the workshop space*, but what do those differences mean in professional and social terms?* When we turn to the ethnographic evidence, in cases where more than one wheel is found within a workshop, these are often associated with individual potters and represent a sort of ‘workstation’. The archaeological cases suggest that potters were throwing alongside one another and formed a sort of work unit, and similar scenarios can be demonstrated by the ethnographic cases of Thasos, Greece (Papadopoulos 1995), Kangan, Iran (Whitehouse 1977), or Dahkla Oasis, Egypt (Henein 1997). In these instances, each potter was provisioned with his own wheel-station, while assistants and apprentices took care of many subsidiary tasks, thereby minimizing the potters' time away from the wheel. Other ethnographies recount that social distinctions can be present in a workshop and reflected in their work task. Generally, apprentices and assistants were allocated different tasks than fulltime potters and over time would take on work tasks with increasing responsibility. At Bailen, Spain, for example, young apprentices were charged with applying handles to jugs drying in the courtyard (Curtis 1962), and at Kangan, Iran (Whitehouse 1977), and Dakhla Oasis, Egypt (Henein 1997) assistants prepared clay and brought it to the potters at work on their wheels.

The most archaeologically visible workstations in the dataset are potters' wheels. At the sites of Jerusalem, Pergamon, and the Sagalassos Tableware Workshop, potters' wheel sockets[30] were found *in situ* indicating the locations of workstations. In these three cases, the wheels were clustered together in the same space. Pergamon's workshops 2 (south) and 3 each preserve a small room with two wheel-sockets each. Jerusalem had one throwing space with four to five wheels, and the other two throwing rooms with two wheels each. The Sagalassos Tableware Workshop contained three to four wheel stations in one of its rooms.

At Jerusalem, the three pottery workgroups seem to have been allocated work areas in different ways, suggesting that they may have operated under semi-independent organizations. This is also reinforced by their spatial separation across three different rooms of the complex. The case of Jerusalem is interesting as there seem to be three

[30] The socket held the wheel in place, while the wheel turned inside a receptacle on the upper face of the socket.

workgroups each throwing pots in separated rooms, while the other stages of production occurred in common, centrally located spaces. It is not possible to determine whether the different work units in this case were producing different wares, but it is clear that the production cycle follows an integrated organization in the clay preparation and firing stages, while the throwing and forming of pots was split across different, parallel workgroups, suggesting a very different organizational structure to the Jerusalem production site.

The distribution of throwing workstations appears to reflect different intra-workshop workgroups in at least two cases. First, in the case of the Sagalassos Mold-made Ware Workshop, the forming stage of production is unusually 'spread out', with working stations located in different rooms of the workshop. One potters' wheel installation was found in the far NW corner of the workshop, while another was centrally located in another room near the front door. Two other workstations have been proposed for the SE room located immediately next to the clay preparation area. Those work-stations have been interpreted as molding-stations. It seems in this case that the work flow distinguished between molding and throwing stages of forming by spatially separating throwers and molders. This may reflect specialized workers provided with different working spaces. As one of the main products manufactured in these workshops, the *oinophoros*, represents a composite of molded and throwing techniques (i.e., the body is molded, while the neck and mouth are thrown), this suggests that objects would pass between different working groups.

The built environment of a workshop structures production organization by directing the movement of workers and materials through the workspace. As has been observed, there can be much diversity in the organization of workshop spaces. Some trends seem to be based on architectural trends at the local level. Many of the odd examples noted in the dataset seem to relate to the adaptation of pre-existing buildings for the purpose of ceramic production. In general, many choices concerning the organization of the spaces reflect an interest in maintaining an efficient work flow and keeping potters busy at their wheels. The wheels offer another important point of discussion. As individual workstations, the wheels provide a means to assess parallel infrastructure. In nearly every workshop for which they are attested, wheels come in multiples. These are not the type of one-man potter operations so typically cited in modern ethnographies. These workshops were often employing multiple skilled workers performing the same basic task, who worked in close proximity to one another – an organizational pattern that inevitably fostered the exchange of technical knowledge and know-how among its artisans – a topic that will be examined in the next chapter.

Scales of Production

The scale of Roman ceramic production has been an issue of debate that is often raised among economic historians. Often cited as evidence for pre- or proto-industrial manufacturies, the tableware industries of Italian terra sigillata, Gallic sigillata, and African red-slip ware have been noted for their tremendous volume of production, as well as their immense distribution patterns, in some cases stretching as far as modern India

(Peacock 1982; Dark 1996; McCormick 2001; Whittaker 2002; Kehoe 2007). Investigations at the Gallic sigillata production site of La Graufesenque (southern France) have uncovered, in addition to several large, tubular-style kilns, the well-known 'kiln dockets' (i.e., vessels with writing inscribed on the surface and subsequently fired hard). These dockets document the counts of vessels contributed by individual potters to communal kiln firings (Marichal 1988). Original estimates on the firing of these kilns were upwards of 10,000 vessels per load, yet these numbers have been subsequently critiqued (Schaad 2007). Regardless of the exact numbers, it is clear that ceramic production in the Roman world could be conducted at a considerable scale. Yet, just how typical were such circumstances? Does that level of economic investment and output reflect trends in other parts of the Roman world that were producing different types of wares? These questions, however, can only be answered by looking at workshops more broadly, as well as the relationship between the built environment and production scale.

The built environment reflects the level of capital investment in the workshop, as well as its potential volume of manufacturing. The proportion of the space allocated to different tasks may be associated with the types of products being made, or possible 'bottlenecks' in the production process. For instance, extensive storage areas imply that wares were not being quickly distributed out of the workshop facility. The workshop scale also reflects aspects of the lived experience of work, such as the spatially-induced intensity of interaction between different workers, the (relative) number of workers employed in a facility, the distribution of workgroups, as well as the degree to which workers may be specialized in different segments of the production process. Scale of production can be interpreted as either the scale of the built environment (referred to here as *workshop scale*) or as the quantity of products being made within a given period of time (referred to here as *manufacturing scale*). In some cases the two types of scale may correlate. However, it is not clear whether this should be assumed, and if so, then what other factors were at play in determining workshop size, and how these spatial organizations related to the overall scale of production.

Workshop Scale and Workshop Size

Most cases (i.e., the Sagalassos Mold-made Ware Workshop and Tableware Workshop, Pergamon Units 2 [north] and 3) display internal organization in which the entire work cycle could have been performed within the relatively tight confines of the workshop walls. In most cases, small-scale units operated independently or alongside other small-scale units. This predominance of small-scale production units becomes clear when we lay out the plans of the sites and compare their surface areas. Accordingly, plans of the workshops (to scale) are provided in figure 5-2, and the associated measured values are outlined in tables 5-3 and 5-10. The surface-area values are based on measurements made from the published plans of the sites. They also assume that the workshop space was single-storied, based on the reports by the original excavators. When we compare the overall surface area that can be attributed to workspace for the eight workshops, they generally fall between 90 and 300 m^2. In general, the workshops are relatively modest in size. Three groupings can be discerned: Delphi, Gerasa, Petra, are all quite small (< 90 m^2); Pergamon's three workshops, Sagalassos' two workshops are moderately sized (130-

300 m²) fall into a small cluster; while the Dura Europos and Jerusalem cases (ranging between 450 and 1,700 m²) stand out amongst the others as rather strong outliers. The interior space of the workshops (when interior and exterior can be established) range between 50 and 320m², with most under 125 m².

Just to situate the size of the Roman workshops within a wider comparative framework, when we measure those figures against ethnographic examples, it is clear that the ancient workshops fall on the smaller end of the spectrum. For instance, seven of the ethnographic cases outlined in table 5-11 had overall workshop surface areas ranging between 148.32 and 2300 m². These ethnographic workshops are therefore consistently larger overall when compared with the archaeological examples. Yet the interior spaces of the ethnographic workshops, ranging between 29 and 217 m² are generally in keeping with the archaeological cases. There also does not seem to be a correlation between the size of interior to exterior spaces in the ethnographic sample.

Identification of individual potters' wheel workstations offers a means to assess how workers were organized and the experience of going to work everyday – the number of potters at work, the proximity of their working quarters and the intensity of interaction facilitated by the workshop structure. The allocation of workstations in seven spatially discrete throwing areas at three sites was calculated by dividing the total area of the throwing space by the number of wheels situated within it. These values are listed in tables 5-2 and 5-7. In general, the space allocated to workstations ranges between 6.85 and 15.05 m². The two Sagalassos workshops have the most tightly packed workers

(6.85 and 7.74 m^2). The two Pergamon workshop units display much larger allocations of space, and that range is rather consistent between the two workshops (13.11 to 15.05 m^2). In contrast, Jerusalem's three throwing rooms show a slightly larger spatial range (8.82 to 13.49 m^2). The consistencies between the two workshops at Sagalassos and between the two workshops at Pergamon imply that workers may have been provisioned with similar ranges of 'office space' based on local expectations of worker density in the workplace. The spatial proximity of workers in those spaces was also very tight, with workers separated by only a few meters.

In two ethnographic case studies, multiple wheel stations were indicated on workshop plans offering a means to compare the ancient data with modern traditional pottery works (see table 5-2). These two cases included workshops at Oristano in Sardinia and at Dakhla Oasis in Egypt. Although a small dataset, the workspace allocated to individual potters at their wheels was much smaller than any of the archaeological examples. Thus, while the modern workshops tend to be much larger in overall size, the working conditions for throwers are more cramped. This reinforces the point that Roman working conditions and overall experience may have been different than those documented for modern potters using traditional technologies.

Next, an assessment was made on how space was distributed across the workshop for different production activities. It was hoped that this would establish the areas provisioned with additional space or identify possible 'bottlenecks' where spaces might be inadequate for the production process. Pie charts were made for each of the workshops indicating what proportion of the workshop space was allocated for different work tasks (i.e., clay preparation, throwing and forming, drying, firing, indeterminate, or other). In cases where these tasks were not identified by the excavators, those tasks were not allocated on the pie chart, but rather unidentified spaces were classified under the 'indeterminate' or 'other' class. From these charts, it is clear that each workshop allocated space in very different ways. In the case of firing spaces (which were indicated for every case), these spaces could take up one-fifth to five-eights of the total workshop area. The clay preparation area of Pergamon unit 3 is quite large, while such a space was not even identifiable in the case of Unit 2 (north).

Manufacturing Scale and Infrastructure

Common-sense might understandably lead one to believe that the output of production (i.e., manufacturing scale) would be reflected in the overall size of the production facilities and its infrastructural features. In order to assess any possible correlation between *workshop scale* to the size and number of infrastructural features (e.g., kilns, potters' wheels, clay basins), bivariate correlation analyses were performed using the JMP statistic analysis software to assess whether any of these factors could be related – that is, to determine whether large workshop size correlated with the infrastructural capacity to produce more goods. Then, bivariate correlation analyses were performed to assess whether different types of infrastructural feature correlated with one another – that is, if more potters' wheels were found in workshops with more or larger kilns. Table 5-12 outlines the R^2 (correlation) values when workshop size (as represented by surface area) was compared with (1) kiln size (as represented by the surface area of the firing chamber), (2) number of kilns, (3) number of potters' wheels, and (4) the combined size of clay preparation areas. Of these analyses, only the potters' wheel counts offered a strong correlation at the exclusion of both 0.5 and 0.9 outliers.

The results suggest that overall size of a workshop may not necessarily reflect the *manufacturing scale* or size of workforce. This becomes evident when we look across the entire dataset at the relationship between the workshop size and the size or number of infrastructural features (i.e., the mechanisms that support production). In our archaeological dataset, neither kiln count nor kiln size show strong correlations with the overall size of the workshop's floor plan. This lack of correlation may seem particularly surprising as one might expect larger workshops to have either larger or more kilns to sustain larger production output. However, other factors appear to be at play in the case of kilns.

This is supported when we look more closely at the case studies – specifically, at the combined kiln size (based on chamber surface area) of workshops with similar overall size (based on surface area of the plan), but which have very different firing capacities. For instance, the two workshops at Pergamon Unit 2 (south and north workshops) are roughly of the same overall size (130.5 versus 130.9 m^2), yet the kiln firing capacity of Unit 2 north is over twice that of Unit 2 south (5.11 versus 2.01 m^2). A similar situation can be observed between the two Sagalassos workshops where the Mold-made Ware

Workshop is slightly smaller than the Tableware Workshop (150.6 versus 154.2 m^2), yet possessing over one-third more kiln size (3.29 versus 2.00 m^2).

A useful point on this issue can be raised from ethnographic studies on production volume. Certain studies on these issues have identified that infrastructure can play only a minor role in the overall output potential of a workshop. Work rates and temporal rhythms of production, such as seasonality, are undeniable factors that when combined with infrastructure determine the output potential of a workshop.

For instance, Vossen (1984), comparing between large and small traditional ceramic workshops in modern Morocco and Spain, calculated that a larger kiln, typically fired only 10-25 times annually, can produce 60,000-250,000 vessels per year, while a single smaller kiln, typically fired 10-100 times annually, produces far less (3,000-30,000 vessels per year). This was largely due to the fact that parallel firing infrastructure offered more 'rapid' firing routines. That is, while one kiln was cooling down, another was heating up. In contrast, workshops with single kilns necessitated fully cooling and then slowly reheating the kilns (which cumulatively took more time). The question is therefore raised: why invest in additional infrastructure, if it was not operating to full capacity, particularly in the case of kilns, which require not only initial construction costs, but which must be maintained with mud plastering? This question will be investigated in detail in the subsequent chapter on technology.

Outside this general characterization, a few outliers emerge strongly. First, the workshops at Dura Europos are notably large in *workshop scale.* This may be related to the fact that the workshops are situated in what was once a residential area. It is possible that some of the 'workshop' rooms were likewise used as dwelling spaces, but the excavation reports were incomplete. If this is the case, it might explain the large surface area of the workshops, but the lack of supporting infrastructure. None of the other workshops offered any indication of domestic activity, which is of consideration, as it suggests that work activities were commonly practiced in locations away from the home.

Second, the case of Jerusalem is of particular note in regards to scale. Its layout represents a similar organization of production space as the other workshop examples. That is, segments of the production cycle were distributed in spatially discrete areas throughout the complex. What is exceptional about this production site is that it appears to have operated on a much larger scale than any other example in the dataset. Although still only partially excavated, more potters' wheel stations are found clustered in a single room and more kilns are associated with a single workshop than in any other example in the dataset. The wheels in this scenario are clustered in three separate rooms, suggesting three distinct throwing workgroups.

The fact that the complex operated as a single production unit with high frequencies of repeated infrastructure clustered together is unusual. As was the case with the other workshops, multiple potters worked alongside one another in spaces that spatially restricted them from all other parts of the production process (e.g., clay preparation, product drying, and kiln firing). Other segments of the production process (e.g., drying, storage) have not been archaeologically identified. The Jerusalem example is unusual in that a line of five kilns was in operation at the same time – the only example in this study of kilns that could be used in combination. Ethnographically, this is attested at Gujrat in Pakistan by Rye and Evans (1976). In this scenario, adjacent kilns were fired alternately; while one kiln heated, the other cooled down. As neither kiln required firing a 'cold' kiln, this procedure saved fuel.

Scale is a critical factor for assessing the volume of production and the numbers of workers it would have employed. Scale, however, is notoriously difficult to quantify and can ambiguously be used in reference to different factors of production. In this discussion, *workshop scale* and *manufacturing scale* were distinguished, and their relationship tested in order to determine that *workshop scale* does not seem to correlate to the potential product output of a workshop. This is important, as it established that other, archaeologically undetectable factors were likely at play (e.g., rates and temporal rhythms of production). When analyzing different infrastructural features that, which seems to offer the greatest potential for referencing the *manufacturing scale* of a workshop, is the number of potters' wheels. However, a larger dataset is necessary before additional claims can be made regarding its impact on production output.

Most importantly, it is quite clear from these analyses that the majority of (published) workshops in the Roman eastern Mediterranean operated on a modest to small-scale, yet offered larger individual pottery wheel stations. The majority of workshops were smaller, in fact, than many attested ethnographically today. Moreover, there does not appear to be a strong trend in how space is allocated across production steps, suggesting that the way each workshop used its space was dictated by its own unique set of needs. As was also the case with the structure of workshop activities, the scale of workshops seems to have been heavily affected by the unique historical development of the space, particularly when that space was secondarily adopted and adapted for production activities.

Discussion

The previous pages have analyzed the structure and scale of workshop sites in an attempt to understand how these economic factors affected the built environment of individual workshops. What has emerged most strongly is that there is no single model of production organization that can characterize the ceramic workshops of the eastern Mediterranean. Although based on a small corpus, the organization of workspaces was still highly variable across the dataset, as was the allocation of workshop space for different activities. At the site-based level, there do seem to be certain trends in architectural organization, and some of these seem tied to local architectural traditions; however, even at the site level, diversity outweighs commonality. Occasional differences emerge in the organization of workgroups related to different types of wares, for instance in the case of the Mold-Made Wares of Sagalassos, suggesting that product repertoire played an unexpectedly major influence on the organization of space and work activities.

Eastern Roman Ceramic Workshops: General Trends

Despite the clear diversity of production organizations, a few general trends should be noted. First, nearly all of the workshops presented in the dataset represent relatively small-scale operations. The *workshop scale* is modest, and infrastructure rarely exceeds four wheels and two to three kilns. Spatially, they tend to range between 80 and 150 m^2 spread across three to five spaces. When permanent infrastructure was recorded, it became clear that spatial differentiation by work task was common. There also appears to have been some concern over efficiency and ease of work. This is most evident in the movement of clay to wheels, as clay preparation areas are typically situated in adjacent spaces to the throwers.

Across the dataset, however, correlations between workshop scale and manufacturing scale cannot be asserted. Infrastructural investments do not seem to relate directly to the overall manufacturing potential of the workshops. This suggests that there are other organizational features at play in the workshops. Those factors, which cannot be easily detected archaeologically (e.g., timing of firings and rates of throwing), may be of major significance. Methodologically this has implications in how we assess the scale of production archaeologically and the difficulties of quantifying such variables. In general, minor trends in the scale and organization of workshops that can be seen are found at the site-based level. Workshops at the same site seem to be of generally the same overall size; workstations are situated in similar proximity in workshops at the same site; and spatial organization sometimes seems to relate to local architectural trends of the time.

Historical Development of Work Spaces

A further trend that can be seen in the architectural development of these sites is that many of them moved into pre-existing structures. This, again and again, can be seen to have a dramatic affect on the scale and organization of the workshop. Like all buildings, the workshops presented here are structures that were uniquely constructed and renovated to accommodate those working there. Such practices of occupation are visible in the examples presented here through the organization and scale of space and work activities. Renovations and use of pre-existing architecture are observable, for example at the Mold-made Wares Workshop at Sagalassos. Two of the kilns of that workshop were constructed into the partially-standing (circa 40 cm tall) walls of an earlier, underlying building. Excavations of workshops at Petra also demonstrate that multiple phases of production activity took place in adjacent workshops. Blocked doorways, noted in workshops at Petra, Sagalassos, Gerasa, and Pergamon, likewise indicate changing patterns of access and work movement through time. These adaptations demonstrate that the built environment could be adapted to meet the changing needs of its inhabitants.

The case of the Gerasa hippodrome workshops is perhaps the most obvious example of this phenomenon. This is largely due to the fact that the structure was (obviously) not originally designed for industrial activities. In the 3rd century AD, the supporting buttresses of the hippodrome *cavea* were 'opened up' and the hollow spaces converted into workshops and houses. From that point onwards, the hippodrome hosted working spaces. Each workshop appears to have been preparing its own clay and forming objects within the reused *cavea* spaces. The inside spaces of the workshops were notably small (averaging 5m x 10m) and represent the smallest work units in the dataset (see table 5-8, for listing). Although renovations were occasionally made to expand the workshop spaces, most remained one-unit in size. Such tight working conditions likely necessitated a greater reliance on external areas for production stages, such as drying and firing vessels, yet only rarely were exterior spaces architecturally demarcated.

This trend is important from a social perspective because it verifies that the urban and suburban buildings into which a workshop might move greatly impacted the subsequent work activities of its occupants. Perhaps more importantly, it also suggests that workshops in these contexts often lacked major capital investment to initiate production; few workshops were constructed from scratch. This economic interpretation has been proposed before in the eastern Mediterranean for the Late Antique period, particularly in the 6th century AD (Saradi 2006). Examples of such practices have been noted at Delphi (Pétridis 2010), and Olympia (Schauer 2010). The cases in this study demonstrate, however, that similar processes of 'industrial encroachment' were occurring as early as the 1st and 2nd centuries AD at sites such as Dura Europos. These trends are further corroborated at other workshop sites not employed in this chapter (due to their only partial excavation) – for example, the 2nd century AD workshop at Eretria (Schmid 1999). These findings suggest that the trends in capital investment and expansion of industrial activities were more closely tied to local and regional economic climates than imperial forces.

Imperial Institutions

In one consistently unusual case, large-scale industrial phenomena emerge from the dataset that suggest that, under certain circumstances, larger economic influences and capital investment may have been at play. The case of Jerusalem is a constant outlier – both in terms of its structure and scale. As previously noted, the organization presented unusual features. Although the entire workshop complex appears to have been centrally organized, the forming and throwing segment of the production process was split into smaller workgroups. Moreover, the scale of the workshop was enormous and well beyond any other site noted in the dataset. The *workshop scale* is complemented by a significant *manufacturing scale* represented by a large kiln complex. In general, the scale of the Jerusalem complex is extraordinary in the dataset.

The closest parallel to both the organization and scale of the Jerusalem complex can be found in two areas far removed from our study region: one at Holt, Britain (Grimes 1930) and one at Holdeurn, Holland (Holwerda and Braat 1946) (see figure 7-1). Holt's legionary production follows a similar organization with a 'kiln plant' comprising a line of six (and later seven) kilns, each specialized for the firing of different wares. The Holdeurn site (associated with the legionary camp at nearby Neijmegen) comprised five and later seven kilns built together. The collective scale of these kiln plants is comparable to that at Jerusalem, as is the range of wares being produced (i.e., common pottery, tile, and brick). The sites of Holt and Holdeurn were excavated in the first-half of the 20^{th} century, and parts of the excavations are not well understood. Consequently, it is not possible to reconstruct the internal working spaces of the workshop rooms at either of the sites, which might offer information on whether the throwing and forming stage of production was divided across different workgroups, as was the case at Jerusalem. However, perhaps of greater interest, the Holt workshop excavations documented the nearby presence of a large barracks where the artisans are believed to have resided. A similar barrack-style housing complex was also found just west of the legionary workshops at Jerusalem.

In conclusion, throughout the analyses performed on this dataset, it seems very difficult to make generalizations on the scale and organization of the eastern Mediterranean ceramic workshop that could be used to track similar shifts in regional or supra-regional influences on production organization or scale. Most organizational trends seem to be local in character and to be affected by the circumstances of moving into pre-existing structures designed for other types of activities. The level of investment and scale of output appears normally to have been modest, particularly as concerns urban and suburban industry. The case of Jerusalem may represent a situation in which imperial institutions direct ceramic manufacturing, and the strength of that institutional influence can be seen even in the relatively minor details of its organization (e.g., kiln placement, organization of worker housing). Such a case, however much an outlier it may be, reinforces the observation that organizational structures could be imposed on ceramic production, yet also underscores the rarity of its implementation.

CHAPTER SIX

Technologies of Ceramic Production: Choices and Transmission

In any discussion on workshops and crafts production concern over how things were made is understandably of prime importance. Pottery and ceramic manufacturing requires some sort of clay preparation, object forming, and firing, yet the execution of these production steps can be achieved in various ways and using various technologies. Variability in the development and use of technologies can be a function of the specificities required in making certain types of good and using certain types of raw materials based on technical knowledge. These reflect functional concerns aiming to avoid what Schiffer (2004) has referred to as the 'hassle effect' and to use technology more efficiently.

Technologies can also be developed and used in ways that do not exclusively relate to their functional success. Lemonnier has termed these 'secondary' features, in that they represent socially-influenced ways of doing things that have been acquired through experience and training within a community (Lemonnier 1986, 1992). These technological choices serve to influence the design and detail of technologies based on an assumption of 'that's just how it is done'. More flexible approaches to the social anthropology of technology studies view *all* technological decisions as being socially constructed – from the choice of raw materials to the design of production infrastructure (Pfaffenberger 1992). Regardless of the differing degrees of social constructivism expressed in these perspectives, any analysis of technological choices should to some degree represent socially informed decision making, and technical knowledge should be seen as transmitted through time and space by means of interaction among artisans.

When turning to the archaeological investigation of technology, these social processes are largely studied 'in reverse'. Unlike the anthropological works of Lemonnier and Pfaffenberger, which observe contemporary social contexts in order to understand technologies of living groups, archaeology relies on distribution patterns in technology types, in order to infer some degree of interaction among craftspeople. The nature of interpersonal relations is often difficult to ascertain archaeologically, but differentiating traditions of making and technological styles offers a means to gauge the choices made in developing or adopting technologies (Stark 1998). This tie to social and cultural practice is what makes the analysis of production technology important to this dissertation. That is, just as the allocation of workspaces was seen to reflect traditions in work organization, trends in the transmission of technological knowledge will be evaluated here in order to discern if and how production traditions are reflected in the execution of the production process.

These theoretical considerations are particularly pertinent to the objectives of this study. As differing perspectives contest the extent to which productive activities were organized at regional or local levels, tracking technological choices offers a means of understanding spatial and temporal patterns in manufacturing, with further inferences for relations between crafts people. On the basis of these factors, technological infrastructure (e.g., clay vats, potters' wheels, and kilns) will be analyzed in this chapter in order to ascertain if temporal and spatial patterns can be discerned among potting traditions.

Technology versus Technique

As stated in Chapter Two, the distinction between production technique and technology is ambiguous and is largely dependent on the definitions employed by the observer. For the purposes of this study, technology is defined according to the material culture used in the production process, which will be distinguished from the methods and processes of production (i.e., technique). Production techniques are defined according the series of actions performed to complete a finished object (i.e., its *chaîne opératoire*). Those production techniques may (or may not) employ technologies in their execution. Some artifacts can be intimately incorporated into the action of the production process, representing what Leroi-Gourhan describes as an extension of the bodily *gesture* (Leroi-Gourhan 1993). In contrast, infrastructural technologies (e.g., kilns and clay settling tanks) operate through chemical and heat-induced transformative processes more detached from the man-powered actions of production (Ingold 1988).

This is at some level a subjective distinction. Yet it is an important differentiation to make for the purposes of this study, as infrastructural technology often requires greater time and financial investment. As fixed features, infrastructural technologies are imposed on the fabric of the workshop architecture, and therefore represent a commitment to certain manufacturing methods. This chapter therefore examines infrastructural technologies of production in relation to wider workshop settings, while the next chapter analyzes the techniques of manufacturing in relation to the *chaîne opératoire* and its finished products.

Roman Ceramic Technologies

In some characterizations, the Roman world has been described as one that used and developed technologies on a sophisticated and large scale (Rostovtzeff 1957; White 1984; Kevin 2009). Evidence of ceramic production technologies has not been excluded from such discussions (Peacock 1982). However, much of this evidence derives from excavations in western provinces and has been based exclusively on kilns. In particular, large, tubular, 'terra sigillata' kilns are perhaps the best-known of ceramic technologies developed during the Roman period (Cuomo Di Caprio 2007). Following a basic updraft design, these specialized kilns employed pipes to direct smoke and fumes through the upper firing chamber. This configuration served to radiate heat into the chamber, yet cut off the vessels from exposure to the reducing effects of the firing atmosphere, thereby insuring a bright luster to the red-orange surface treatment (for schematic reconstruction, see figure 6-1).

Examples are known almost exclusively in the western provinces at Colchester (Hull 1963), La Graufesenque (Schaad 2007), and Montans (Martin 1996), where they seem to be expressly associated with the manufacture of red-slipped tablewares from the 1st

century BC to the 3rd century AD[31]. The absence of such technologies in the eastern provinces at major contemporary red-slipped tableware production centers, such as Pergamon, suggests that technological knowledge may not have passed into or was not adopted in these areas. However, as will be discussed subsequently, kilns with tubular features have been observed at the tableware workshops of Buoto and the amphora production site of Demirci. Later 3rd – 7th centuries AD kiln technologies at North African production centers seem to reflect a related, yet inverted, technological design for red-slipped ware production (Bonifay 2004; for schematic reconstruction, see figure 6-2). Lacking the tubular piping of the terra sigillata kilns, these African kilns instead stack the tablewares into larger, protective vessels (known as cassettes or saggers). When loaded, the saggers served to isolate saleable wares from the reduction environment in the firing chamber. Although there is some possible sagger use at the site of Sagalassos, this firing technique likewise has not been widely identified in the eastern provinces for the Roman and Late Antique periods.

The inconsistent distribution of such well known kiln technologies suggests that regional and local factors may have been at work in the dissemination and adoption of technological knowledge and know-how, at least in the eastern provinces. Moreover, the close association between these specialized kiln technologies and product types (in the above cases, tubular kilns and red-slipped wares) suggests that there may be a correlation between product repertoire and the adoption of specific types of technology at large

[31] Examples of tubular-type kilns have been proposed in the eastern Mediterranean at the sites of Buoto, Egypt, and Sinope, Turkey. Some doubt has been raised concerning the interpretation of these kilns as tubular-types, most notably by N. Cuomo di Caprio (*pers. comm.*). However, this analysis will follow the original publication record.

production centers. In response to these two observations, permanent (i.e., infrastructural) technologies will be analyzed in this section in order to determine the types of technological choices being made in the workshops from the study area and to determine the extent to which spatial and temporal patterns in technological development and adoption can be detected. Although kilns have attracted the greatest attention from scholars, three types of technological infrastructure can be preserved in the archaeological record of workshops. These include clay vats or basins, potters' wheels, and the remains of kilns. As the best documented of these three are kilns, they offer the largest dataset on technological infrastructure and will consequently receive the most extensive evaluation.

Clay Preparation Infrastructure: Basins

Most clays require some sort of preparation prior to their use for making ceramics. The methods and materials employed in this stage can vary based on the properties of clay, the natural state of the clay when collected (i.e., presence of particulates and organics), and the intended functional properties of the finished ceramic product. Some methods of clay preparation can require little to no built infrastructure. These include techniques such as drying the clay, 'beating' apart the clumps, and sieving or picking out the coarse fraction, as well as kneading the clay with the feet or hands and picking out particulates (Rye 1981). In other cases, built infrastructure can be used to soak and 'levigate' the clay by means of water suspension. In this process, the water is added to the unrefined clay, the clay is brought to a suspension and the coarse fraction is settled out leaving fine clayey water (often suitable for slip) and a ‘clean’ clay body. Clay preparation infrastructure can take various forms, but often is recognized as basins and vats situated with accessibility to water. Large ceramic containers, such as pithoi, could also serve this function, but are less commonly identified for these purposes archaeologically.

As so few complete workshops have been excavated in the study region, the data currently available for clay preparation are unfortunately quite limited. A total of 14 basins from eight sites are discussed here, and measurements are only available for 12 basins from six sites (for listing, see table 6-1). Although quantitative analysis is not possible with such a small dataset, some observations can be made regarding the remarkable diversity of basin types, the relative sizes of clay basins at different workshops producing different types of ware, and the ways in which these features are incorporated into the built environment of the workshop.

First, three types of basin can be proposed from this overview. The most conspicuous and commonly cited is a walled basin with a thick, water-resistant plaster lining (nine cases at four sites). The walls are constructed in either stone or mudbrick, and some of the basins are slightly sunken below floor level. This type represents the greatest degree of labor and time investment in its construction. Second, an unspecified number of unplastered pits are cited at Sagalassos and Jerusalem. At Sagalassos these appear to be rather irregular in plan and are interpreted as ‘soaking pits’. They essentially represent holes dug into the ground used to hold clay. Third, at the amphora production sites of both Khirbet Baraqa and Demirci an abandoned kiln was reused as a large soaking vat for clay. In these cases, the side walls of the kilns were maintained after the lower part of the kiln had been filled in, leaving the upper-most section of the kiln open for use as a large basin.

Some observations can be made from these types. First, within this relatively small dataset the degree of diversity in clay preparation basins is striking. Second, the reuse of infrastructural features (i.e., kilns) for other industrial purposes is also of note. As will be highlighted in a subsequent discussion, this type of kiln reuse is part of a larger trend, which includes their reemployment as lime kilns and storage silos/cisterns. Third, estimating the size of these basins is unfortunately problematic, as vertical heights are rarely reported. Based on surface area alone, the basins range in size from 1.16 to 12.56 m^2, with workshops specifically associated with amphora production at the higher end of this range. This relation between amphora production and large clay preparation basins is not surprising as amphorae consume much greater quantities of clay in their production. Yet investment in basins at sites specialized in smaller tableware products - such as at Pergamon, Sagalassos, and Zurrabeh - may be related to their use of a very fine clay body and slip.

Based on these observations, conspicuous investment in clay preparation appears to occur more often in situations where either very large quantities of clay or very refined clay are necessarily consumed – factors directly related to the type of product being manufactured. However, the types of product being manufactured do not necessarily dictate the type of basin used. This demonstrates the points in which technological choices take on a local ‘flavor’.

Forming Infrastructure: Potters’ Wheels

Certainly vessel forming does not require rotational technologies, for example in the case with many techniques of hand-forming vessels. No examples of production sites forming vessels by hand are documented from the study area and period. Pottery wheels, however are certainly recorded. Pottery-wheel technologies can take a variety of different designs, and ethnographic classifications of (non-electric) wheels are based primarily on the means of propelling the wheel, namely with the hand, foot, or rod / stick (Rye 1981). Another factor that is often raised regarding wheel classifications is the speed that the wheel turns. This has resulted in distinctions between fast-turned wheels, slow-turned[32] wheels, and turntables. The speed of the wheel has technical implications on the force with which the clay is ‘pulled up’ when throwing, and it has been a point of discussion in certain pottery studies circles, particularly those studying ancient Egyptian material (Hope 1982; Spencer 1997).

It is not uncommon to see modern reconstructions of Roman potters’ wheels that portray a kick-wheel design[33]. Kick wheels are probably the most common type of (non-electric) wheel used today. Their design comprises a lower flywheel affixed to a vertical axle that is then set in a second, upper wheel on which the vessels are thrown (see figure 6-3). The

[32] Slow-turned wheels are sometimes referred to as *tournettes.*
[33] Examples of such reconstructions can be found at the museum of Amphoralis in southern France, and the museum of Antalya, Turkey.

lower wheel is propelled by a kicking motion with the foot. As Loebert notes, however, there is no evidence for the use of kick wheels in the Mediterranean until the medieval period (Loebert 1984). He rightly points out that every depiction and archaeological example that has survived from classical antiquity is consistent with rod-propelled or hand-propelled wheel types[34]. Two images from the Roman period can be cited (Dufaÿ 1997). The well-known image of a potter at his wheel - the only depiction of a potter *by* a potter from the Roman period - likewise shows a rod-propelled wheel type (see figure 6-4). This image was stamped onto an African Red Slip Ware bowl and depicts a potter seated on a stool low to the ground with a stick leaning against his leg. Another representation is found on a Pompeian wall fresco in the House of the Vettii (see figure 6-5). This image depicts a work scene in a pottery. The *putti* throwing vessels use a similar type of wheel. These depictions are consistent with rod-propelled wheel types still used today in parts of Pakistan and India (Rye 1976).

While the pictorial evidence for wheel technologies for the period is rather slim, archaeological examples of fast-turning potters' wheels have also been found and documented in France and Italy. At Gallic and Italian workshop sites, a variety of designs have been observed with which Dufaÿ *et al.* (1997) have developed the most reliable typology (see figure 6-6). They have all been interpreted as hand- or rod-propelled types. This typology classifies rod-propelled, fast-turning wheels according to the parts of the wheel that rotate and the means of supporting the vertical axle. While several examples of potters' wheels have been published from the western provinces, it is

[34] A greater number of potter images exist from Classical Greece, and they are all also consistent with the rod, foot, or hand propelled types (Hasaki 2002).

striking how little attention they have received in the eastern cases, even when publications mention their presence and identification. With wheels described at only four sites (i.e., Sagalassos, Jerusalem, Pergamon, and Demirci), the dataset for wheels is consequently inadequate to perform any sort of quantitative analysis. Moreover, as examples from the western provinces have shown, preservation of certain parts of a potters' wheel – in particular the vertical axle and lower support beams – are sometimes difficult to identify as they were sunken in pits or constructed of material that does not preserve (i.e., wood). These factors consequently circumscribe the discussion on wheel technologies.

In general, certain observations can be made across the dataset. First, the examples found *in situ* are positioned in such a manner that the wheel head would have been set close to the ground. They are also accompanied by a low bench or seat at Sagalassos and Pergamon. This arrangement exempts them from being kick wheels. However, the means of propulsion are still not clear. Rod-propelled types documented ethnographically typically feature notches or grooves on the wheel head (either on the upper face or the side edge) into which the rod is inserted and the wheel spun (Rye 1976; Sinopoli 1991), while hand-propelled wheels typically lack any such notches. Partial wheels may not preserve the diagnostic notch, making the distinction between hand and rod propulsions difficult to determine.

It is also possible that some of these wheels had a detachable palette or secondary wheel head affixed to the top that has not preserved. This latter idea is supported by the fact that at the sites of Pergamon and Dermirci perforated, ceramic wheel-heads have been documented. The hole in the wheel may have been used to fix the wheel-head onto a vertical axle. When mounted, they would not have provided a flat throwing surface, however, and they consequently would have required an additional (missing) palette on top of this perforated ceramic phalange. At the tenth legion kiln site at Jerusalem, the wheels were fashioned in limestone, yet the surfaces were only lightly smoothed. The excavators believe that an additional palette (perhaps in wood) may have been fixed to the stone wheel to offer a larger wheel with a smooth throwing surface (H. Goldfus, personal communication). All wheels that have been identified have been either stone or ceramic varieties. The use of these two materials for wheels can be documented in the Middle East at least as early as the 4th millennium BC (Simpson 1997: 50) and 2nd millennium BC (Middleton 1997; Simpson 1997), respectively.

When considering intra-site technological variability, Sagalassos provides some of the most extensive evidence for potters' wheels. There seems to be some diversity in the types present at the site (Murphy 2012). The 4th to 6th centuries AD Mold-made Wares Workshop included five stone wheel supports that appear as vertical, column-shaped drums embedded in the dirt floors of the workshops. A short distance (approx. 30-40 cm) from the support a second, flat stone is typically present, which seems to offer a seat for the potter. The stone column support functioned as a receptacle for the turning wheel, which necessarily would have been provisioned with a protruding boss on the underside. Unfortunately, such wheel-heads have not been found at the site, suggesting they may have been made of perishable materials or were curated. This wheel form falls into the *tour-toupie* type described by Dufaÿ *et al.* (1997) (see figure 6-6). All evidence indicates that the wheels of this type were used exclusively in the complex – regardless of internal workshop divisions.

The case of intra-workshop technological diversity observed in the Late Antique molded wares workshop at Sagalassos is similar to the case of Jerusalem, where wheel sockets are more or less standardized across the complex. Here, wheels are situated side-by-side along the walls of throwing rooms. Only one wheel head has been found at the site, yet the standardized appearance of the socket holes suggests that they were all of the same type. As stated previously, the limestone wheel head is equipped with a cone-shaped socket that is fitted to a limestone receptacle embedded into the workshop floor. The size (circa 30 cm diameter) of a solid stone wheel suggests that it was a largely non-portable, specialized feature of the workshop rather than a personalized tool. This wheel evidence reinforces an impression of centralized organization already noted in the previous chapter in the architectural layout of the production site.

In contrast to the situations described above, the 4th to 5th centuries AD tableware workshop at Sagalassos displays both the type of wheel found in the mold-made wares workshop complex as well as what seems to be a another wheel design that is sunken in a pit. The vertical supports of these wheels do not seem to have been preserved, but chinking stones encircling the pit were found still *in situ*. This suggests that they were not disturbed from the removal of a stone support and that a different material was likely employed instead. Unfortunately, the pits were not excavated, so little more can be said except that this pit arrangement is more similar to the type excavated in Yvelines by Dufaÿ *et al.* (1997) and at Lyon by Desbat *et al.* (2001) (see figure 6-6). Variability in material and perhaps even design suggests the co-occurrence of different technological choices within a single workshop. This level of individual decision-making within the Late Antique tablewares workshop contrasts with the patterns observed in the mold-made wares workshop, as well as the variability in other technologies, such as kilns.

Finally, the ceramic works at Sagalassos offer evidence for the use of turntables. This appears on a set of industrial containers that are large, straight-sided containers with a flat base. The workshop site for these wares is still not known, but they are produced in a local, coarse fabric ('Sagalassos Fabric 3') typically associated with tile and brick production. Several of these vessels display the negative impression of hypocaust *pila* tiles on the underside of their bases (see figure 6-8). The *pila* tiles were used in this case as a sort of make-shift turntable on top of which the container was formed. Thus, despite the widespread use of wheel technology for tableware production at the site of Sagalassos, it seems that this local industry chose to use other technologies to form its vessels.

The observations on pottery wheel technologies offer some points for discussion. First, there is evidence for intra-site diversity in wheel type, even sometimes within the same workshop. Different ceramic industries at a site may employ different technologies, and different workshops at the same site may have had varying ranges of wheel type diversity. Second, there appears to be a tendency to use the same wheel types where other factors, primarily architectural layout, seem to suggest some degree of centralized property organization. This is the case with the Jerusalem legionary kiln works – where the spatial distribution of work rooms spatially separated each production step, as well as with the Late Antique mold-made wares workshop complex – where five to six workshops sharing common walls and roofing were likely under the same property ownership. This suggests that in such cases, technological choices (at least in pottery wheels) may have been made at a higher level than that of the individual potter.

Firing Infrastructure: Kilns

The physical appearance of red scorched earth and blackened kiln slag is often especially conspicuous in the archaeological record. Kilns provide particularly appealing lines of evidence, not only because they can be so clearly identified, but also because they provide a means by which to pursue a more nuanced discussion on the selection and use of technology, as well as how technological choices relate to other archaeologically observable factors, namely production specialization, concentration of industry, and scale of production. As such, they (far more than any ceramic production technology) have received great attention by archaeologists.

From a technical point of view, when considering ideal forms of kiln design and construction, Rhodes[35] outlines a set of design rules that affect kiln performance. They

[35] Various modern technical treatises have been written on pottery production (e.g., Zamek 1999; Rhodes 1968; Leach 1948, as well as more ancient treatises, such as the 16th-century example by Piccolpasso (1934). It is important to note that very few of these 'rules' can be assessed directly from the archaeological remains of kilns or from the published record.

include: '(1) a simple rectangular or cylindrical shape, (2) ample fireboxes and room for combustion to take place, (3) good circulation, (4) adequate flue, and (5) a sufficiently large and tall chimney' (1968). These variables set certain functional parameters according to what Lemonnier described as 'primary' features, which directly affect technological performance (Lemonnier 1986, 1992). It is probable that the archaeological kilns discussed here largely met these criteria, while other concerns related to specific raw materials and product types may also have factored into the kiln design and construction. However, kilns are also themselves products of skilled labor that follow technological styles and traditions of their own, which can be expressed through any number of shapes, sizes, and constructions. Thus, in addition to functional concerns, nuanced differences in design may also express what Lemonnier describes as 'secondary' features, which reflect non-functional design choices that are socially and culturally learned.

One means by which variability in kiln design has been investigated in the classical world is through the use of kiln compendia and typologies. Various kiln typologies have been developed for different regions in this manner: Roman Britain by Swan (1984), Italy and Sicily by Cuomo Di Caprio (1992, 2007), Greece by Hasaki (2002) and Seifert (1993), and Hungary by Vamos (2010). These have identified variations in size, plan, construction material, and mechanisms for the dispersion of heat/flame/smoke (for outlines of different kiln typologies, see figures 6-9 and 6-10). Some kiln typologies have been effective in teasing out trends in kiln design and construction at the regional level while the most inclusive also consider product repertoire and workshop scale. Most notably, Swan's investigation using a very well documented corpus in Roman Britain has been successful in identifying the prevalence of local traditions in kiln designs (1984). For the Roman eastern Mediterranean, the data have not generally been of comparable quality, and the more detailed analyses presented below will be among the early attempts at such investigations.

Analysis

For the analysis performed here, 109 kilns from 23 sites were examined. These kilns represent cases for which detailed information on the kiln design, construction, and the associated product repertoire is available, or situations in which numerous kilns were described from the same site (to analyze contemporary, intra-site variation). With a wider range of variables compiled in addition to simple kiln morphology, it becomes possible to investigate potential correlations between kiln size, construction and design, products manufactured, site location, and chronology. In order to assess these factors from often poorly preserved kiln remains, quantitative and qualitative variables were selected that were both archaeologically visible and regularly recorded by excavators.

First, regarding kiln design and construction, the variables of (1) construction material and (2) plan-shape were selected for analysis. These were utilized as proxy variables since oven floors, floor supports, or superstructures are infrequently preserved. In contrast, the overall shape of the kiln's chamber plan and its construction material are generally described by excavators. These features were therefore analyzed as they provided the largest dataset for this analysis. First, construction techniques were considered in relation to the material of construction (i.e., fired brick, mudbrick, stone with mud plastering). Different materials necessitate different techniques of kiln construction and maintenance. Generally, oven floors, floor supports, and kiln superstructure (i.e., upper walls and roofing / covering) are so rarely preserved that they were not considered here. Second, distinctions were made according to circular, oval[36], and rectangular plans, although it became apparent that the oval versus circular distinction was often unwarranted. That is, as ancient kilns were never perfectly rounded, it is often difficult to classify kilns in one category or the other, and the techniques of construction were largely the same between them. This was further substantiated in the course of analysis when it became clear that where circular kilns occurred, oval kilns were often also found.

Functionally, as Rhodes (1968) outlines, rectangular and circular kilns are both effective means of firing ceramics. Therefore, establishing where and when one plan was chosen over the other was of pertinence to this study. Some suggestion has already been made by scholars that chamber shape may relate to product shape, particularly that rectangular kilns fired rectangular tile and brick (see discussion in Hasaki 2002: 166). Swan notes that the introduction of square and rectangular kilns in Pannonia in the 1st century AD was associated with the arrival of the Roman army, and she suggests that similar processes may have occurred on the Rhineland (Swan 1984). As will be shown

[36] The oval type includes kiln plans described as 'pear shaped' by the excavators, while 'key-hole' shaped kilns were divided between oval and circular types depending upon the general shape of their firing chamber.

subsequently, however, neither of these interpretations fits the evidence for the eastern Mediterranean.

Second, kiln size was assessed based on interior surface area of the firing chamber, as calculated from the published dimensions[37]. As no entirely full-standing kiln exists from the Roman period, the vertical height is difficult to estimate in every case. Consequently, the horizontal surface area is used here as a proxy for size. That there is typically a correlation between horizontal kiln dimensions and vertical height is corroborated in the handbook on ceramic production by Leach (1949), who proposed ideal kiln proportions that directly relate horizontal and vertical dimensions. Although such ideal proportions are certainly too rigid[38], Leach's handbook does reinforce the fact that functional efficiency in kiln design relies on certain correspondences in horizontal and vertical proportions, which validates the use of horizontal dimension as proxy for overall kiln size.

Third, product types manufactured in the kilns were classified. Product repertoire was first investigated using the functional-typological descriptions provided by excavators. Subsequent analyses were then performed to determine if the patterns (or their absence) were related to specific characteristics of the products. Thus, features that would directly be impacted by kiln design were selected for analysis. First, surface treatment of the object (i.e., *slipped*, *painted*, *unslipped*) and the coloration (i.e., *oxidized, reduced*), as related to environment of firing, were investigated. The amount of plastic inclusions in

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[37] In cases in which the firing chamber was not preserved, the dimensions of the combustion chamber were instead used.

[38] Rhodes (1968: 117) corroborates the rigidity of Leach's model.

the fabric (*fine*, *fine to moderate, moderate, moderate to coarse, coarse*) was analyzed, since different clay bodies are more or less susceptible to vitrification during firing. Finally, general size of the products was also considered, particularly concerning *large* (e.g., amphorae and tile), *medium* (e.g., cups, bowls, platters, jugs, jars), and *small* (e.g., lamps and figurines) types of object. In cases in which different sized objects were fired in the same kilns, *small to medium* and *medium to large* designations were assigned. Size of the products affects not only the load capacity of the kiln, but also the susceptibility of the objects to firing conditions, particularly to over-firing.

Fourth, location of the kiln was considered. In 15 cases, the excavators associated kilns with specific workshops, some of which possessed multiple kilns each. Therefore, some patterns could be assessed at the workshop level. Next, kilns clustered at the same site (most often at urban sites) were also analyzed; 25 sites were analyzed this way to demonstrate inter-workshop variation.

General Observations

When discussing the variables of kiln design, certain common features should be discussed. First, all of the kilns discussed here are updraft types in which the fire is stoked in a combustion chamber situated beneath a firing chamber filled with vessels. In this arrangement, the heat moves upward to fire the vessels above. A schematic diagram of a simple updraft kiln with kiln terminology used in this discussion is provided in figure

6-11[39]. The covering of the superstructure is difficult to determine, as so few examples can be reconstructed. Moreover, it is often impossible to determine whether the kiln originally was open or whether the roofing simply was preserved. In only 19 cases at four sites can beehive-shaped or domed roofing be inferred in the dataset. At two sites, variants on a domed simple updraft kiln design have been reported (see figure 6-12 and 6-13). At workshops at Demirci and Buoto, the excavators (independently) suggest that their updraft kilns were domed and equipped with tubulars (which can take the form of pipes or broken sections of amphorae). Although the design of the tubulars is different between the sites, they both offer a means by which oxygen is introduced into the kiln load of vessels in order to induce an oxidizing environment and possibly higher temperatures.

When turning to the variable of kiln plan, more kilns were designed with a circular or oval plan (67 kilns at 17 sites) than with a rectangular plan (34 kilns at eight sites). At four sites (Sagalassos, Athens, Jerusalem, and Dura Europos) both types of kiln were noted. Regarding building material, fired brick was slightly more common, but at fewer sites. Construction in fired brick and/or tile occurred with 49 kilns at 10 sites, while construction in mudbrick was observed in 36 cases at 13 sites. A single example of a kiln constructed in stone was also noted.

[39] There is some variability in terminology used in literature to describe parts of kilns (e.g., firebox is sometimes used for combustion chamber; chamber is sometimes used for firing chamber). The terminology noted in figure 6-11, however, will be consistently used across this study.

Spatial Trends

Other general trends can be discerned in the dataset that seem to suggest that the primary factors motivating kiln construction and design are related to locally transmitted practices of kiln building. First, if we observe the shapes of the firing chamber plan (i.e., circular, oval, or rectangular) at a workshop or at a site, it is clear that only rarely are both rectangular and circular/oval kilns used contemporaneously at the same site. Rather, sites tend to have kiln plans of one type or the other (see tables 6-2 and 6-3). Never do rectangular and circular kilns occur in the same workshop and only rarely do they occur at the same production center (see tables 6-2 and 6-3). When we move to the provincial scale, the patterns are less clear with a greater likelihood of different kilns plans occurring together, suggesting that choices in technological traditions are more likely transmitted within local communities of potters than they are influenced by larger scale phenomena.

These observations are also paralleled in the use of construction materials (i.e., fired brick, unfired mudbrick, stone walls lined with mud plaster) whereby all the kilns at a given site tend to be constructed in the same material. The choice of materials used in kiln construction does not always correspond to the choices of construction material for the workshop building, reinforcing the supposition that the construction techniques and material were more strongly based on functional concerns related to ceramic firing than local patterns in building practice. For example, at Sagalassos all the kilns thus far excavated were constructed of fired brick with a mudplaster lining, while the workshop buildings were constructed of mudbrick on a stone socle. A similar situation is noted at

Demirci. At Zurrabeh, the workshop buildings appear primarily to have been constructed in stone, while the kilns are fashioned from fired brick. This suggests that kiln walls were designed and constructed with their specific technological function in mind, rather than following local trends in construction techniques.

Although contemporary use of similar kiln design appears most clearly at the workshop and site levels, one strong regional trend is apparent, and that is with the sunken kilns found predominately in Judaea. These amphora kilns are specifically associated with the manufacture of the 'Gaza jar' product line. That is, the kilns at Khirbet Baraqa, Giv'ati Junction, Khirbet Irza, and Ashkelon exhibit a subterranean combustion chamber that was artificially and deeply dug out during its construction. The floor of the combustion chamber can be as deep as five meters below the associated outdoor walking surface and in all cases appears to have been accessed via a vaulted stairway and short subterranean corridor. At contemporaneous amphora production sites located in other regions, such as Elaioussa Sebaste and Demirci, these construction features do not appear.

Deeply sunken kilns also make an appearance at other sites in the dataset and most notably at Zurrabeh, Jordan, where the seven kilns were sunken below the outer walking surface to a depth of approximately 1.5m. They were accessed by way of stone-built corridors. There may have been technological advantages to the sunken placement of the combustion chamber, particularly for increasing the kiln's heat refraction and (consequently) decreasing the amount of fuel expended during firing. In naturally arid regions with few trees, this may have been an important means of conserving costly fuel[40]. At Zurrabeh, the excavators proposed the use of wild bushes for kiln fuel. Brush is a notably poor fuel source for kiln firing. Although fuel efficient, these sunken kiln arrangements would also have created very intense working conditions for the individuals stoking the fire who would have been exposed to high temperatures within the small, restricted space.

Temporal Transitions

There do not seem to be any discernible general trends in changing kiln technologies in the dataset. Different kiln designs and construction materials were used throughout the six centuries documented in this corpus. This does not seem to be exclusive to this dataset either, as Hasaki (2002) has made a similar observation on kilns from Greece. When we focus in on smaller-scale temporal trends particularly at the site level, however, some patterns do seem to emerge. Within the dataset, several sites have excavated kilns dated to different periods (see table 6-2). These cases offer a means to assess the degree of diversity in kiln design and construction at a site through time, and in some cases where numerous (i.e., more than six) kilns have been excavated, it can offer a means to analyze how technological choices may or may not change through time at a single production site producing similar sets of wares.

Across the dataset, it becomes clear that each site follows its own pattern, suggesting a local transmission of technological knowledge. In some cases, little to no change in either kiln design or construction can be discerned through centuries of activity. In other

[40] Also the fact that these estates seem to have been specializing in wine production may have contributed to the lack of fuel, as vine cultivation, in contrast to olive, offers little in the way of agricultural trimmings, which can be used for fuel (Forbes 1996: 84).

cases, the design may be consistent while the construction materials change, or *vice versa* the design may change while the construction is in accordance with earlier traditions. Very rarely can an entire 'break with the past' be discerned whereby kilns take on an entirely different design and construction technique. As concerns kiln size, to be discussed subsequently in this chapter, this seems to be closely correlated to product repertoire across the dataset. In a few cases, however, changes in kiln size (devoid of major changes in production repertoire) can be discerned. These are always in cases in which other changes to either kiln design or construction also occur.

Some sites exhibit little to no change in either the range of kiln design or construction materials. For example, strong conservativism in kiln construction is exhibited at Zurrabeh, Jordan, where the kilns, spanning a period of five centuries, are all deeply sunken, constructed in mudbrick, and circular/oval in plan with traverse arches supporting the oven floor and a domed superstructure. The range of kiln types excavated at Athens also displays no change through the three centuries of documented activity at the site. In contrast to the situation at Zurrabeh, however, the Athenian kilns in every period represent a diversity of design types, and it is the range of those design types (both circular and rectangular) along with construction material (fired brick and tile) that is constant.

Examples of the second scenario of kiln change (i.e., change in design with no change in construction material) are also present. For instance, the case of Dura Europos suggests a shift from larger, oval-shaped kilns, with a central round pilaster supporting radiating arches for an oven floor, to rectangular kilns with transverse arches. All are constructed in mudbrick. Unfortunately, however, the number of cases of Hellenistic kilns is too small to do more than merely suggest this trend. The case of Demirci demonstrates a situation in which slight changes are made to a kiln design, seemingly is a function of producing different types of wares, yet the construction materials are the same. The kilns, spanning a period of two centuries, are all oval to circular in plan, with closed superstructure domes constructed of tubulars and walls constructed of tile and brick with a mud-plastering. The tubulars used in the earlier kilns at this site are all filled with clay while the later kilns have tubulars that are open for air flow. Tezgör *et al*. (2010) propose that this affected the firing atmosphere of the kiln, whereby the closed tubular induced a reduction (oxygen-starved) firing environment and the open tubular induced an oxidizing (oxygen-rich) firing environment. This transition in kiln design corresponds to changes in amphora typology and coloration (i.e., from reddish-brown colored Sinope Group C amphorae to cream and buff Sinope Group D amphorae (Tezgör 2010:103).

A similar situation in which a variant of the tubular design changes through time can be seen at the site of Buoto. At this site, across three centuries of production, domed kilns were used. From the 1st century AD, a portion of these domed kilns preserve a small conduit made of amphora necks and formal tubulars. The conduit runs from a small exterior open-air chamber, through the kiln wall, and into the firing chamber. It is believed that bellows situated at the end of this conduit would have been used to rush the chamber with oxygen, thereby enhancing the red coloration of the ware. Earlier Hellenistic examples of kilns at the site show a similar design without the tubular conduit, while in the Roman period both domed and tubular domed kilns have been observed. This may be related to the local industry transitioning a portion of its product repertoire from black gloss to red-slipped ware production, and the later use of the domed updraft kiln was building out of earlier Hellenistic production traditions at the site.

It is known that Buoto produced black gloss wares during the Ptolemaic period. In order to create the reduced environment necessary to fully blacken a slip, kilns must be designed in such a way as to control airflow into the firing chamber. That is, closing off the chamber starves it of oxygen and results in reduced wares. This type of firing can be achieved with a domed or beehive-shaped kiln. Such kilns are also known in depictions dating to classical antiquity (see figure 6-14). That similar technologies were known in the region during the late Ptolemaic period is evidenced at Tell Atrib - another production center of red-slipped wares located approximately 150 km from Buoto. The kilns at Tell Atrib preserve small conduits lined with amphorae sherds running into the chamber from outside the kiln (Scholl 1995). This suggests that the use of this tubular-style kiln design may be based in local traditions associated with earlier slipped-ware productions, rather than (as the excavators suggested) deriving from technological influences of contemporary Roman tableware production centers in Italy, Gaul, and (later) North Africa. Another trend that can be noted in the kilns at Bouto is a change in construction materials with a transition from kilns constructed in mudbrick with mud mortar, to fired brick with mud mortar. This change seems to occur in the second century AD, yet does not impact the general design of the kiln.

The same trend is noted for the kilns at Sagalassos. After the late 2nd century, Poblome (1999) has observed that all the kilns are constructed of fired brick and tile (cut to size). Prior to this, the kilns were all constructed with mudbrick walls. He notes that this transition correlates with the new use of fired brick in major building projects in the city. Thus, in the case of Sagalassos, choice of kiln construction material seems to relate to broader trends in the building industry at the time. Yet it is interesting to note that, despite the use of fired brick for kiln construction, the associated workshop structures continue to be constructed in mudbrick. This demonstrates a complex use of construction material at the site – likely related to cost and functionality. From a functional point of view, kiln walls constructed in fired clay bricks and heavily plastered with mud would sustain repeated heat exposure for longer than sun-dried mudbrick walls. As Rhodes (1968: 83) notes, 'Once clay has been fired it becomes very stable and may be reheated again and again with little change occurring'. Sagalassos also presents a situation where there seems to be a shift in the range of kiln designs used at the site. In the early imperial period, three kilns appear to be circular /oval in plan with a single example of a large rectangular kiln. By the 4th century AD all 11 excavated kilns are circular / oval in plan. They also become slightly smaller in size, despite the fact that the average size of SRSW vessels increases.

The site of Jerusalem presents a rather dramatic case in which kiln design, construction materials, and size change through time. Here, two Hellenistic /early Roman kilns dated between the 1st century BC and AD 70 have been uncovered; both are simple updraft kilns with a circular plan shape built in mudbrick with a central round pilaster to support the oven floor. The better documented example has an interior diameter of 1.40 m, and is smaller than any of the later kilns. The middle Roman kilns (70 AD – late 3rd century AD) display multiple sub-phases of construction / renovation. During each of those sub-phases, the predominant kiln shape is rectangular with transverse-arch floor supports (four in the first sub-phase and two in the second sub-phase) and all are constructed in fired brick. However, each sub-phase also has a circular- or oval-shaped kiln built into the works that was afterwards converted into a rectangular type.

These renovations to the production areas demonstrate, first, that multiple kiln technologies were known and used alongside one another and, second, that the establishment of the later workshops did not involve a total replacement of technological types (i.e., from circular/oval to rectangular). Rather, there seems to be a recurring tendency over time to use rectangular kilns. Changes in kiln design at Jerusalem seem to be paralleled in changing patterns in their distribution across the industrial area, whereby in the late Hellenistic / early Roman period they appear as individual examples lacking a unifying organization to their installation. Moreover, they are oriented with the stoke hole facing different directions. The later legionary production, in contrast, features a series of kilns built one against another. In general, this example offers the greatest disjuncture between succeeding phases of production at a single site and the strongest evidence for a 'replacement' of kiln technologies.

The element of change through time is also observable in the use-life of individual kilns. After being abandoned for ceramic firing, kilns were not always deconstructed or left to fall into ruin (although examples of both cases are quite common). At Demirci, for example, abandoned kilns were sometimes used as rubbish pits. However, they could also be repurposed, as demonstrated by the previously discussed examples of kilns refashioned as clay-preparation basins. Other examples include the reuse of kiln structures as storage silos or cisterns. Buoto possesses two examples of kiln shafts relined for those purposes; in those cases, kilns were clearly refashioned for a variety of purposes other than ceramic firing. At Athens (Evangelismos Station site), Buoto, and Sagalassos, ceramic kilns were also adapted for lime burning. The adaptation of these kilns involved stripping out the oven floor in order to create an uninterrupted shaft. Deposits of burnt lime were found in the bottom of the combustion chamber floors. Their design and construction material clearly makes abandoned kilns useful as containers and as furnaces for other industries, and it is perhaps not surprising that similar applications can be seen at different sites across the dataset. In general, however, these cases of refashioning seem to be related to the specific histories of the workshop and site and their changing needs through time. For instance, at Sagalassos eight kilns were converted for lime burning. The eight kilns refashioned in this way are all located in the same production complex, and they represent all but one of the kilns in the complex. Their conversion seems to occur in the same phase, indicating a centralized change across the entire complex from ceramic to lime production in the mid to late 6th century AD.

Product Specialization and Technological Choices

Product repertoire of a workshop also seems to have been a factor influencing the choice of kiln. Observations relating product line to kiln types were first made using the functional-typological designations provided in the original publication (i.e., cookware, fine ware, storage, transport). These initial observations identified a tentative relationship between certain types of products being manufactured and the composition of kiln sizes used by a workshop. That is, lamps and figurines tended to be fired in small kilns, while amphorae were fired in very large kilns. This cursory analysis, however, presented some limitations as functional attributions by ceramologists lump multiple variables together. For instance, the designation of tableware presumes a small to medium-sized vessel, fine clay body, and often some sort of surface treatment. Thus, in order to assess whether one or more of these variables more directly associated with kiln design and construction, three variables that would have been affected by kiln firing conditions were also analyzed – specifically, surface treatment, vessel size, and clay body. These variables were set against variables associated with the kiln design – plan shape, roof structure, size, and construction material.

Significantly, few correlations could be found relating the product repertoire to the kiln design and construction. The properties of the finished product, therefore, do not appear to have been a major factor influencing these technological choices. However, as was noted in the preliminary set of analyses, one set of correlations was very strong - the relationship between vessel size, clay body, and kiln size. For example, when a workshop produced small (i.e., lamps and figurines) and small-medium (i.e., cups, bowls, plates) objects, it possessed at least one kiln with a chamber surface area between 0-2 m^2 (see tables 6-5 and 6-6). In contrast, workshops producing medium-large to large objects (i.e., platters, large jugs, basins, amphorae, and tile) have kilns ranging between 2 and 43m^2 in chamber surface area. This suggests that the products being manufactured in the workshop influenced kiln size, but not kiln design. This correlation was also reflected in relationship between kiln size and clay fabric. In this case, fine to moderate clay types were fired only in smaller kilns (with interior surface area of firing chamber under 14 m^2), while moderate-coarse to coarse clay types were fired in kilns that spread across a much wider size distribution (with interior surface area of firing chamber between 1 and 43 m^2). This trend was thereby also reflected in the analyses comparing vessel size and clay body. That both clay fabric and product size correlate is perhaps unsurprising as smaller objects (i.e., lamps and common wares) often tend to be produced in finer clays, while larger objects (i.e., amphorae, tile, and brick) often tend to be produced in coarser clays.

In the case of small object production, the correspondence of small kilns to small objects seems reasonable, as the firing temperatures and conditions created in smaller kilns are easier to control than in larger kilns, and as smaller vessels (with high surface area to body mass) are more susceptible to overfiring. In the firing of large objects, there may have been an interest in using kilns of adequate size so as to reduce the rates of firing the kiln. This may reflect an interest in conserving fuel, as heating up a 'cold' kiln expends the greatest quantity of fuel during firing (Shepard 1965). These technical considerations of kiln size, perhaps unsurprisingly, demonstrate a working knowledge of ceramic material properties and technological choices that facilitate the manufacturing of particular product types on the part of potters working in all regions of this study.

Perhaps of greater significance, the composition of kilns of varying size used by a single workshop offers insight into the degree of product specialization of the workshop and its relative *manufacturing scale* of different ware types. As stated previously, the presence of two kilns of (roughly) the same type and dimensions can dramatically increase the *manufacturing scale* of a workshop. However, when kilns of notably different sizes appear in the same workshop (e.g., at Sagalassos in the Late Antique mold-made wares workshop, Elaioussa Sebaste, Kastelli), they typically appear in circumstances in which a wide range of wares is being produced, particularly wares of differing sizes. In such instances, it is possible to suggest that kilns specialized in small-wares (i.e., lamps) and in large-wares (i.e., amphorae). For instance, the mold-made wares workshop at Sagalassos was equipped with two large and two small kilns. Based on its product repertoire of *oinophoroi* and dishes (medium-sized wares) and lamps and figurines (small-sized wares), the kilns demonstrate that the workshop did not predominantly specialize in one or the other products, but was seriously invested infrastructurally in both types.

One further point that should be addressed is the potential relationship between the shape of the firing chamber and the product types being fired in the kilns. As noted, some have suggested that rectangular kilns were specifically used for the firing of brick and tile, as rectangular kilns would be better suited to hold rectangular products (Martin 1965; Orlandos 1966; Hasaki 2002 for more extensive discussion on the issue). Other scholars have suggested that rectangular kilns followed legionary ceramic production (Swan 1984). The dataset under investigation here offers no such correlation. Rectangular kilns are associated with nearly all sizes and types of products; however, they do occur in slightly higher rates with unslipped oxidized wares and fine clay bodies. Unfortunately, there is a notable underrepresentation of tile and brick workshops in the corpus. In fact, the Jerusalem 10th legion site is the only manufacturing site for which tile and brick production is attested, and it did employ rectangular kilns. Yet it is also interesting to note that the Jerusalem workshop manufactured other types of products (e.g., common wares, cooking wares, and tablewares) that seem to have likewise been fired in rectangular kilns of the same design. Moreover, within the dateset, rectangular kilns also appear at sites (i.e., Dura Europos, Chios, Elaioussa Sebaste, Pergamon, and Athens) associated with a range of other product types from amphorae to tablewares.

In conclusion, having used this dataset based on kiln data, it becomes evident that a number of factors has been identified as influencing technological choices. These factors include introduction of new construction materials in an area, the properties of the products (and their clay) being manufactured, as well as the degree of specialization in different product types being manufactured. The multiplicity of factors influencing the choice of technologies demonstrates complex relationships between production needs and the technological material expression responding to those needs. These responses are shown not to be exclusively efficiency-driven, but also rooted in local traditions.

Discussion

Many patterns observed in technological choices can be explained by efficiency-based production rationale, such as that described in Arnold's ceramic ecology model (Arnold 1985). However, the choices of technologies suggest that different ways of designing and constructing these technologies emphasize different functional considerations that were not necessarily unique to one site versus another. That is, some show greater concern over fuel expenditure, surface coloration of the products, and size and clay body of the products. For example, fuel costs are typically a major concern for most workshops, but only a handful of workshops in the dataset went to such lengths as to adapt their kilns for better heat conservation. In these cases, it is not so much of interest that technological design was adapted to meet functional concerns, but rather the material record of workshop infrastructure demonstrates that certain concerns were emphasized over others and the material expression of those adaptations could be quite variable.

In some cases, spatial and temporal patterning in that variability was discerned. Such patterns constitute what Lechtman has called technological styles and manifest as ingrained traditions of technological choice (Lechtman 1977, 1979). According to Lemonnier these technological choices are culturally and socially reinforced through shared practice and represent the means by which technological traditions are maintained and transmitted within communities. Most technological choices in clay basins and kiln design seem to follow local trends at the workshop and site levels, with few significant regional patterns. This offers some points of consideration regarding the nature of local influences on regional reconstructions of the Roman economy; namely, specific sets of variables were considered of such significance that technologies were specifically adapted to address them. These trends in technological choice mostly seem to have occurred locally and were based in local traditions prevalent at the site level. This places the production center in a key role for innovations in manufacturing.

The only clear case of a strong regional trend in production traditions seems to be found in the case of Judaea and its production of 'Gaza Jars'. The use of an unusual, sunken kiln design is of note, as it also appears at workshops in other arid regions, such as at Zurrebeh, Jordan. The sunken arrangement would have refracted heat and conserved fuel in arid regions with limited (long-burning) wood fuel supplies. However, the spatial distribution across the entire Judaea region sets this case apart, as the regional distribution of Gaza Jar workshops sites parallels the distribution of this kiln type. The same cannot be proposed in the Jordanian cases.

In contrast to dispersed, regional trends in technology use, standardized technology use at a single site is also apparent in cases in which the architectural layout of the workshop suggests a degree of centralized organizational structure. This is evidenced in the universal use of a specific wheel and kiln design in all the workshop units in the Sagalassos Mold-made Wares Workshop Complex, as well as at the Jerusalem legionary kiln works. This suggests, not so much that the workshop properties may have fallen under a common ownership (that fact was established in the previous chapter using the spatial organization of the workshop), but rather how such centralized ownership can be expressed materially.

CHAPTER SEVEN

Economic Activity as Social Activity: Resituating Roman Ceramic Production

The intention of this study was to investigate the relationship between the organization of economic activities and social practice by applying recent theoretical approaches developed by economic anthropologists and archaeologists. From this set of perspectives, economic activities are seen to be not only 'embedded' in social and political contexts, but also as expressions of socialized practices. This was analyzed archaeologically by investigating the material traces of economic decision making. As practice represents socially informed ways of doing things, it offers a means to establish how economic strategizing was formulated in relation to larger social structures and orthodoxies of behavior (Bourdieu 1977). Investigating these theoretical themes within the context of the Roman East consequently offers a means to better understand not only how the Roman economy operated in different parts of the Empire, but also how work activities in such contexts were performed on smaller-scale economic stages.

The Roman economy, in some scholarly circles, has come to be characterized by its long distance trade networks that moved regionally-specific product types around the Empire. The findings of this study, in contrast, very much emphasize the local nature of much economic decision making, at least as regards ceramics production. They demonstrate that the regional character of many ‘major’ ceramic types derives from cumulative effects of small workshop production units. These small-scale economic phenomena are likewise contributing to observations of intra-ware variability. Such interpretations are not entirely new for ceramic production studies and have been recognized by Bonifay (2004), Cau *et al*. (2011), and Poblome and Firat (2011). While successfully identifying regional trends in ceramic production, their studies have tended, however, to be fixed at the regional and production-site levels by an absence of reliable workshop data. In response, the series of investigations laid out in this study have compiled information from numerous published production sites in order to establish a more nuanced understanding of the relationship of decision-making strategies between workshops and production sites, as well as the composition of their wares.

Interest in Roman period regional economies finds important crossovers with recent work in social geography, which also employs the region as a critical unit of analysis. Regional studies have moreover begun to consider the region in more flexible ways - seeing space not as territorially fixed, but rather as defined by patterns in human behavior. Those patterns are situated within interpersonal networks that serve to define (rather than be defined by) space. Although these conceptual developments derive from social geography, they find parallel with spatial patterns that Gosselain (2008) has ethnographically observed with modern African potters and which he describes as the ‘space of experience’ of artisans. These ‘spaces’ (or ‘regions’) are defined by regularized activity patterns that are at the same time social and economic.

These conceptual approaches to regions have sat at the background of the spatial findings of this study, which highlight decision-making strategies across variable spatial scales. Instead of demonstrating clear-cut territories of production tradition, various types of economic activities appear to be affected by influences occurring at different spatial distributions. In this way, the results of this study correlate with the difficulties of establishing narrowly defined regional trends described by geographers and anthropologists for modern groups. When translated into a social interpretation, these spatial patterns seem to represent networks of artisanal communities, whose ties were defined and reinforced by socially learned traditions of production practice. It is these sorts of spatial continuities in the practice of reproducing material culture that help to define what Stark (1998) has described as the archaeology of 'social boundaries'. In addition, different social boundaries can be traced around different variables affecting production organization. Thus, the influences affecting production organization (including product repertoire) are neither exclusively local nor regional, but represent a socially constructed space.

Production organization models, and their close association with ethnographic work on production, have provided a useful starting point in approaching the workshop data, as they have played an important role in identifying key variables influencing the organization of work (e.g., location, product repertoire, technologies, scale of production). Their emphasis on static formal characteristics of workshop organization and classification, however, often results in descriptive exercises of case studies in relation to ideal types. Consequently, their applicability for these investigations has been rather limited. Instead, they were employed here to identify and define variables that were then analyzed for evidence of production practice and decision-making strategies.

These variables provided the framework for the dissertation, with each chapter investigating one of these areas through comparative analyses of workshops from the study region. The results of these findings have identified certain patterns within the dataset of workshop and production sites regarding the four themes of analysis: location, product repertoire, organization and scale of workspace, and technologies. Trends in these areas represent structured workshop decision-making, and although identified throughout the previous chapters, they still need to be related back to the social context of the Roman world. This contextualization is provided in the following section; it will serve to situate the ceramic industry among other types of crafts and will also provide a means to interrogate the archaeological results with historical records for the period.

The subsequent discussion consequently attempts to tie together the observations made in the previous chapters into a larger picture of Roman economy and society. The first two discussions attempt to come to terms with organizational similarity and difference across the dataset. In the first part, general trends will be used to outline common features of ceramic production sites for the period. Such characterizations highlight general working conditions for the period. The second discussion raises the issue of organizational diversity and patterning in that diversity at different scales of analysis. This highlights that certain types of decisions regarding the internal organization of work activities seem to be influenced by disparate sets of actors and community networks, which span various scales. Some decisions (such as the internal organization of work tasks) appear to have been workshop-specific, while other aspects of organization (such as technological choices and certain features of product repertoire) appear to have been shared among artisans working in different workshops.

The second set of discussions attempts to situate these results within wider studies of the Roman economy. First, trends observed in the four variables of analysis (location, product repertoire, workspace organization, and technologies) are considered in relation to economic strategizing. Those variables formed the main analytical chapters of this study (Chapters Three through Six). Diversification of production type and siting workshops at locations with multiple means of distribution both appear to have similarity with the organization of other types of economic activity, in particular those that attempt to minimize the risk of capital investment loss. Second, following an interest in New Institutional Economics by economic historians for the Roman world, the results were considered in relation to larger institutional features which may influence the organization of production. This discussion serves to identify influences of municipal property law and highlights the rarity and peculiarity of imperial interventions in ceramic production.

Eastern Mediterranean Ceramic Workshops: Some General Trends

Characterizing the eastern Mediterranean ceramic workshop is a challenge; remarkable diversity in the organization of production and use of technologies, such as wheels, clay preparation vats, and kilns, has been observed throughout this study. When common traits can be noted across the dataset, however, they appear to relate to large-scale, general trends concerning labor, working conditions, and industry for the period. These trends therefore have implications for how we situate the role of ceramic manufacture within the institution of crafts production more generally. It should be stated, however, that outliers also have been identified for each such characterization and uniformity of practice should not necessarily be assumed at all sites.

Excluding the legionary production site at Jerusalem (which will be discussed later in this chapter), the workshops tend to be small in size, typically ranging from 80 to 300 m^2, and far smaller than most modern workshops documented ethnographically. This area thus would have supported rather modest workgroup sizes, with some hints for their size based on the range of two to five pottery wheel workstations per workshop. Task-based division of labor is also suggested in the workshops with multiple wheel-stations suggestive of workers with specialized work roles each performing parallel tasks. This is corroborated by the Oxyrhynchus lease contract [P. Oxy. 3593], described in Chapter Five, that refers to different types of workers according to different work titles (i.e., 'stoker', [clay] 'modeler', 'assistant', and 'potter'), which are likewise related to their work tasks. This evidence supports a characterization of ceramic labor centered on the size and organization of workgroups for the period, with typically small workplaces, yet with a fair degree of internal specialization among workers.

Moreover, urban and periurban ceramic workshops do not appear to fall into the *ergasterion* model of workshops. For the most part[41], ceramic workshops appear to be spaces exclusively designed for manufacturing, with no areas clearly allocated for sales or domestic space. In this sense, they are economically specialized workspaces of production. This is of interest as it contrasts with the placement and organization of other types of crafts production, and suggests that the relationship between potter and customer may have been likewise different (i.e., more removed or less regular). Lack of domestic space moreover suggests a separation of working lives from other types of social experience. Yet this may also be related to the typically periurban location and the regular proximity of workshops to necropoleis, which (as will be described in greater detail below) were typically taboo for areas of dwelling. Thus, as ceramic workshops and human burials often coexisted in the same area, domestic activities may have been relegated to other parts of the settlement according to custom.

Another major class of workshops has been characterized as individual workshops operating in rural contexts. While not concentrated among other workshops producing similar goods, these pottery works, rather, represent subsidiary industries to other nearby production activities. Indeed, in regions as far apart as southern Palestine (Khirbet Baraqa, Khirbet Izra, and Ashkelon), Black Sea Sinope (Zeytinkli and Demirci), the

[41] This excludes the possible site of Dura Europos, which may have associated domestic space, but the excavations failed to document functional areas more closely.

southern coast of Cilicia (Syedra and Bickici), and the southern shores of Lake Mareotis, ceramic workshops appear alongside oil and wine presses and occasionally vats. These workshops have all specialized in transport vessels associated with agricultural processing of food stuffs. These appear to have been part of conglomerate complexes, performing complementary production activities and spatially discrete from larger settlement sites or other such complexes.

Such spatial arrangements raise a series of questions about the context of working in such environments. For instance, the immediate community of laborers supporting such production complexes must have been composed of wider networks of collaboration that spatially encompass larger areas than the potters of the concentrated urban workshop. Networks of professional information among potters might likewise pass through different channels and across different scales at sites that were home to a limited number of ceramicists. It is then, perhaps, less surprising that the technological choices in kiln design at these workshops are often shared across the region, rather than simply at the production-site level. This is the case with the unusual sunken kilns of the Ashkelon region in southern Palestine, the 'tubular' kilns of the Sinope region on the Black Sea, and the rectangular kilns of Elaioussa-Sebaste. Moreover, tied to the agricultural cycle, production must have followed different rhythms than other types of production and with different technical challenges. This raises questions regarding the extent to which other types of ceramics production can be used to characterize these rural contexts.

In conclusion, these general observations have important implications on how we think about Roman-period ceramicists, their workshops, and institutional features to ceramic production across the region. To some extent it becomes possible to comment on working conditions based on the rather small overall size of workplaces (compared to ethnographic workshops), and how these likely resulted in intense interaction in a small workplace. It also becomes possible to speculate as to the inner workings of labor and specialist hierarchies among workers. In addition, there does seem to be a real distinction between the working lives and professional engagement of potters working in the countryside in an operation involving a wider range of workers, and urban ceramicists who tend to be part of larger communities of other potters. This has implications on the transmission of technical knowledge among artisans, which can be detected in different spatial distribution patterns for the adoption of kiln technologies. The urban model of production with its periurban placement further suggests that the ceramic industries located in the immediate vicinity of cities may have acquired a different character than other types of *ergasterion*-style workshops, which were often intramurally situated.

Organizational Diversity

One of the major findings of this study has been the identification of a diverse range of sizes and organizations of ceramic workshops, as well as variability in the contexts of production. Diversity often appears to be embedded in workshop-specific and site-specific traditions of organization and production. These importantly demonstrate that choices made in the organization and execution of production were informed by numerous influences operating at different scales. For instance, many decisions seem to be made by the workgroup according to the opportunities or limitations of their workplace. This is evidenced by the organization of workspace (i.e., recessed versus open arrangements around a courtyard), the allocation of areas for different production tasks, and the placement of kilns. This diversity was more clearly observed in instances when a building was reappropriated for ceramic use (see later discussion), but even in cases when the workshop was constructed anew, workshops at the same site displayed remarkably different spatial organizations.

Other features appear consistently among workshops at the same site and, although far less frequently, of the same region. This has been observed in the choice of technology and the choice of construction materials for the workshop. While the organizations of workshop space currently lacks comparanda with other forms of vernacular architecture at the site (e.g., lower class housing), workshop building materials do appear to be related to wider traditions in building from the area. This is of further interest, as the building materials for the workshop were not always the same as those used for kilns. Divergent use of building materials for workshops and kilns implies different decision-making strategies in their construction and differing technological choices.

Technological choices, particularly in cases of nucleated workshops, tend to be shared among workshops at sites. For instance, workshops at a production site seem to show strong trends in following a similar kiln design; workshops at a single site prefer to use either circular or rectangular kiln plans, as well as to construct their kilns using similar types of materials. In fact, micro-histories of kiln designs highlight, in some cases, the locally embedded nature and development of technological choices; for instance, earlier Hellenistic design features of tubular kilns in Deltaic Egypt seem to be appropriated for the production of red slipped wares during the Roman period. At Sagalassos, fired brick was adopted for kiln construction in the 2nd century at the same time that fired brick came into use for large-scale building programs in the city center. Yet the overall kiln design was maintained. The fact that such decision-making strategies appear to have been shared at sites with multiple workshops suggests that technical knowledge was shared and transmitted both horizontally (among potters) and vertically (through time).

These networks facilitated the establishment of production traditions tied to the locality. Although it is in some cases difficult to definitively establish the extent to which production organization was informed by influences outside of the workplace, the fact remains that certain variables were shared between workshops at the same site while differing from workshops at other sites. Building from these inferences, the pattern that emerges from this dataset is that potters across the study region tended to make decisions that were very much embedded in local practices and that technical knowledge was transmitted among community networks of artisans.

The consequent question, then, is how these technique and technologies were transferred. Theoretical approaches to production have emphasized that skill and technique are learned and that choices in technology are formulated based on traditions in material culture. This is acquired through formally or informally apprentice-style training employing hands-on experimentation and repetition of tasks. Such practices become internalized in the way that a craftsperson thinks about production and embodied in the motor skills of working (Wendrich 2012).

An important social institution in regard to professional training is the family. Indeed, for the Roman period children, and especially for wealthy children, it is well known that much education occurred within the household (Bradley 1985: 313). Saller (2011) has even suggested that the family, rather than the firm, should be considered as the fundamental economic unit of the Roman world (117), and that instruction of professional crafts and farming, in addition to domestic tasks, was conducted by family members (124). As such arrangements were not legally contracted, however, we lack textual evidence concerning its organization. Moreover, as ceramic workshops lack domestic spaces, linking the workplace to specific types of social groups becomes more tenuous.

For the Roman world, we also have evidence for legally defined apprenticeship arrangements; apprenticeship contracts are preserved on Egyptian papyri and mostly concern the textile industry (Bradley 1985; Westermann 1914a, 1914b). In many cases, these outline the training regime of the child, which involves the child gradually (over the course of months or years) taking on greater responsibility and larger parts of the production process. This gradual introduction of hands-on training is consistent with much theoretical literature on skill acquisition and the transmission of production traditions through time (Wendrich 2012; Stark 1998). The role of formal apprenticeship organizations would serve to maintain traditions through generations of craftspeople. Apprenticeships would also, however, serve to establish and transfer technical knowledge (horizontally) within communities of artisans, as apprentices established their own workshops.

These observations hold particular relevance to the issue of ‘economic practice as social practice’, as these findings suggest that Roman ceramicists relied on interpersonal networks of production knowledge to inform their workshop decision-making. The question raised then is, how information about product types and material culture was introduced into the practices of these local communities of potters; that is, how production changed. Roman ceramic studies sometimes give the impression of standardized forms and surface treatments, even in the case of some ‘ware groups’ produced in workshops separated by considerable distances. In the discussion on local typologies in Chapter Four, however, it became clear that ideal forms often became ‘translated’ into typological variants through hybrid production practices at the local level. Thus, local groups were adopting new ideas for their products, but appropriating them through their own traditions of production practice. Yet this does not explain the *mechanisms* behind the information transmission of these ideal forms and leaves open the question for debate: who decided what should be produced, and why?

Certainly the mechanisms for such information must have been multivalent. It is certainly possible that trends in production types may have become popular within a community through the creative experimentation of local potters (i.e., endogenous change). Another mechanism might also be proposed based on the Egyptian ceramic workshop lease contracts described in several of the previous chapters (and particularly in Chapter Four). Those contracts suggest that the leasing workshop owner may have had a role in deciding the product types manufactured. If these contracts represent wider practices in workshop organization, then it would introduce a line of decision making or influences on product form originating from outside of the community of potters (exogenous change). As was the case for modern potters in Miravet, socially tied distributors placing commissions often informed potters of changing demands among consumers (van Veggel 1999). For the Roman world, work on market cycles in North Africa by de Ligt (1993) reconstructs a similar type of market organization, as that described ethnographically, thereby opening up the possibility of similar types of arrangements and input from distributors. Additionally, following the work by Vickers and Gill (1994), typological influences are also well established to have come from other types of crafts production manufacturing similar items. Thus, cross-craft influences have been suggested based on object skeumorphism, and suggest that artisans working in different media were influencing one another.

These are surely only a few of the ways in which such decision making processes were negotiated, but they present some considerations on the range of actors involved in the typological development of the period, both within and beyond the workshop walls. These are all important considerations as the extent of the network includes actors from outside of the local ceramic communities. That is, in some cases property owners may have engaged in other types of practice that introduced them to different ideas about material culture and what was marketable. Other craftspeople, moreover, might also be engaged in artisanal networks of a different nature that extended along different spatial scales and involved different sets of actors and information exchange.

To sum up, the Roman East was the home to a wide range of ceramic workshops. As has been demonstrated, the decisions made regarding the organization of workshops, the choice of technologies constructed and employed, and the types of wares manufactured were embedded in local sets of influences. Some of those decisions appear to have been bound to the physical constraints of the built environment, others seem to be rooted in networks of knowledge transmission, and still more seem to be based on input from parties outside of ceramic production.

Economic Strategizing

In attempting to reconstruct patterns in the organization and practices of ceramic production, certain repeated features of economic decision-making have been noted, demonstrating that economic endeavors in ceramic production met certain challenges and opportunities that were structural in nature. These structural features included issues related, for instance, to the organization of transportation in the ancient world and relationships between urban and rural economic development. Among the strongest lines of evidence for these common decision-making strategies is evidence for production diversification in supplying variable markets, which will be discussed in the next section.

Diversification and Risk Aversion

One of the primary problems that most production models for the Roman world face is that they work from an assumption that 'industries' existed in past cultures and that those industries naturally equate to centralized places of production (i.e., production centers). Recent work by Bonifay (2004), Reynolds (2005), Cau *et al.* (2011), and Poblome and Firat (2011), has begun to underscore a greater geographical distribution of workshop sites contributing to these 'ware groups'. Diversity in production location has been likewise used to interpret typological and archaeometric diversity. The results of those studies support the concepts of typological variability according to *faciès géographiques* (Bonifary 2004) or *koine* (Poblome and Firat 2011). These analyses are opening up new avenues in the study of ceramic typologies, including the attribution of such typologies to places (or perhaps now, regions). However, those studies have tended to employ the production-site as the smallest unit of analysis, and detailed workshop studies have simply not kept pace with studies of consumption deposits. Moreover, identification of many production sites have been contingent on surface survey material, which (as demonstrated in Chapter Five), is not very reliable in assessing the full range of products being manufactured at a site.

Ceramological work on these ware groups is beginning to offer a more robust view on the contribution of individual production sites. The analysis performed for this dissertation thereby fills in some of those smaller-scale sets of analyses, and in doing so, finds further degrees of product variability at the workshop level. This has involved disentangling the production repertoire of a single workshop from the larger production site and understanding the extent to which well known ceramic types comprise all, most, or a minor portion of the total workshop repertoire. These studies have demonstrated that the relationship between individual workshops and their larger contexts of production is not straightforward, nor is the relationship between workshop repertoire and current definitions of 'industry'.

Thus, one of the major findings of this study has been to highlight the range of diversity in the production repertoire for a single workshop. It long has been assumed that there were local variants of product types, but the diversity of production lines, in terms of their functional class, the duration of their use life, their likely intended market (local versus long distance trade), is of particular relevance for these definitions of 'industry'. At site after site, it became very clear, however, that product specialization was much less narrow than previously thought. A wide range of wares was typically produced in a single workshop, and those wares are very difficult to classify according to the established 'ware groups'. Product diversification appears most prominently in the cases of different functional classes (with tablewares produced alongside kitchen and cookwares). Lamps, in particular, appear in a wide range of contexts along with anything from amphorae to figurines. Some specialization clearly occurred in the case of molded wares (other than simply lamps) and occasionally in the case of amphorae. However, features associated with product specialization rarely appear in the dataset.

The diversification of wares, when coupled with recent use-life studies, demonstrates that in many cases the wares produced together would have differing rates of consumption (with cooking wares and lamps consumed faster than amphorae) and mixed monetary value (with lamps believed to be especially inexpensive as they appear to have been sold in batches). These aspects may suggest that either a single workshop was distributing to different market groups (with high consumables going to local markets and transport vessels such as amphorae headed to long-distance markets) or high consumables were added to long distance distribution loads as 'parasitic' goods. Moreover, these 'secondary' product lines were not simply one-offs added to fill a kiln. In several cases in which lamps were produced alongside other wares, for example, investment was made in the construction of small-dimension kilns specifically for their firing.

Another element of diversification can be seen in the choice of location for workshop sites. In general, most workshops display multiple means of accessibility, including via both on-land and water modes of transportation. Nearly all rural workshops (excluding those in arid regions) were situated on a river. Locations on such crossroads provide not only means of accessing raw materials, but also of distributing wares to potentially different markets.

Ceramic workshops thus appear to have adapted to different markets through a variety of means, including diversifying their product lines and locating their operation on the crossroads to multiple networks of distribution. This economic strategizing observed for ceramic workshops finds parallel with activities in other economic sectors, namely agriculture. Kehoe (1988, 2007) using textual evidence by agronomists and estate records, has suggested a generally conservative approach to capital investment on the part of elites. He considers this part of a general mentality of 'risk aversion' whereby diversification in the types of agricultural production and tenancy arrangements ensured consistent agricultural return on investment and stability in available labor. Unlike Finley's model of ancient economic 'mentalities' (1973), Kehoe's 'risk aversion' is explained by *bounded rationality* and the availability of information in making economic decision. Thus, elsewhere in the Roman economy it has been proposed that similar approaches to diversified production represented economic strategizing and risk aversion on the part of many property owners.

An added dimension to this economic strategizing through diversification of products has been observed when there are multiple workshops at a single production site. In these contexts there seems to be a tendency for workshops to specialize in only a segment of wares being manufactured at the larger production site (anywhere from one-third to two-thirds of the total wares from the site, with most instances on the lower end of the spectrum). Thus, workshops appear to have distinguished their range of product types between one another, contributing to a wider range of products from the site and workshop specialization within the larger community.

Such processes have been observed ethnographically at nucleated workshop sites as well. In these instances, potters are often aware of the wares being produced by other ceramicists in the community, and can often even distinguish their (seemingly similar) wares from one another. Thus, in what might appear to be minor differences in product types to an outsider, members of the workshop community hold those to be significant. Product specialization by certain workshops then, based on ethnographic analogy, is seen as a means of diffusing competition within a community, by distributing high demand product types between potters at a production site. As discussed in Chapter Four, this serves as a sort of self-imposed regulation within tight-knit communities of potters (as well as distributors), which serves to sustain important professional ties, while spreading out opportunities for market success. This also results in more diversified collective product line from the site.

In this sense, then, the wares associated with a single production site in fact represent an accumulation of the specializations of different workshop repertoires. Indeed, if we start to deconstruct the archaeological record starting from the perspective of the workshop, it becomes apparent that there was no coherent 'tableware industry' or 'amphora industry' comprised of specialized workshops. The organizations of workshops, in contrast, highlight much more variable sets of product types determined by smaller-scale decision-making strategies for risk-aversion and community cohesion.

These community-level mechanisms to alleviate stress associated with competition can also be observed in other types of industry. One example in which this clearly appears to have occurred is documented on a papyrus text outlining the rules of membership for the association of salt dealers at Tebtunis in Egypt. Included among these rules are protocols that can only be termed as price-fixing on the products of its members (van Minnen

1986). This same association also appears to have allocated sales districts amongst members. These measures clearly were prescribed in order to protect the trade interests of its constituents and to relieve competition among members. Although the sole example of such practices, it is assumed by van Nijf (1997) that such measures were more common to *collegia* than is preserved on these documents (13). For the purposes of this study, however, the example is important as it demonstrates social rules (and in this case formalized *collegia* rules) which restricted the actions of individuals for the interests of the collective.

The previous summary looked at the evidence for (1) the product repertoire of individual workshops, (2) distribution among individual workshops of the contemporary product range from a production site, and (3) the range of transportation routes available to a single production site. When considered together, there seems to be some pattern in the type of economic strategizing taking place, across the dataset, concerning these variables. Namely, there seems to be a tendency toward diversification. That diversification serves on the one hand to maximize the market potential of a workshop's product line, by meeting the demand of multiple markets and getting the wares to those markets. This is consistent in many ways with what Kehoe (2007: 549) has described as risk-aversion economic strategizing, whereby diversification in the investment of capital, particularly on agricultural estates, offered more stable long-term profits over short term, risky ventures.

On the other hand, product specialization also appears to limit the range of wares being produced by a single workshop at a nucleated production site. This could be interpreted as a means of focusing labor and resources on successful product types. However, when comparing these data to similar ethnographic cases, it is also possible that those product restrictions to some extent may be self-imposed by the potters. That is, in small communities of specialized ceramicists, producing wares that are different than those of your neighbor can serve to alleviate social pressures deriving from uninhibited competition. Such socialized 'mechanisms' to minimize competition can help to insure long-term goodwill within communities that likewise rely on shared resources, networks, and community-based technical knowledge. Thus, these diversification strategies interpreted in the context of ceramics production appear in some respects to be market-oriented, with the intention to avoid risky investments in product lines while at the same time appearing to avoid risky social engagements among neighboring professionals.

Institutions

In many respects, the organization of ceramic industry in the study region perhaps demonstrates what Verboven (2011) described as 'local life' in his description of 'Romanness' being an imagined community. In the case of this study, a strong embeddedness in local production traditions and economic micro-histories is clearly a primary driver influencing production organization. As a consequence, the ceramic dataset has shown itself to be a less sensitive industry gauge for processes directly influenced by the 'hand' of *imperium*. Rarely can a clear association be made regarding imperial administration or other institutions taking a direct role in the organization of ceramic production. Indeed, even associating (non-imperial) social structures with production organization is tenuous. For instance, it is well known from textual records from the period that imperial and municipal authorities engaged in a variety of activities that directly or indirectly affected industry. These institutions could provision and oversee key infrastructure (e.g., roads, water supplies[42]), regulate and enforce building laws, and organize a variety of industry-specific tax collections (e.g., head taxes for apprentices, trade and sales taxes) (Westerman 1914; Harl 1996; Rathbone 2007). Such taxes were later (by the 4th century) collected through another important trade institution, the *collegia*[43].

A variety of associations existed in the Roman world, and many of them appear to have been organized around members sharing a common trade. The *collegia* offered an avenue to participate in forms of social activity that otherwise might not normally be available to the lone tradesman, such as patronage systems (van Nijf 1997: 245; Harland 2005). Although Finley (1973:81) disputed such activities by *collegia*, it seems that in some cases these organizations used those connections for negotiating and establishing trade relations for its members, as well. Moreover, Liebeschutz (1972: 223) and Buckler

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[42] The significance of water supplies to industry may be suggested by honorific inscriptions, such as that at Thyateria (Asia Minor) in which the collegia of dyers honored the donor of an aqueduct or by the construction of a water channel in Antioch (Asia Minor) specifically for the town's fullers (Feissel 1985; van Nijf 1997).

[43] Taxes appear to have been a major concern for craftsmen, as evidenced in the attention paid to them in apprenticeship contracts (Westermann 1914). Tax collectors were notoriously despised. Harl notes at least forty different types of taxes, rents, licenses, and other payments in the town records of Karanis, Egypt, alone (1996), and a craftsman might face head taxes for himself and his workers, as well as trade and sales taxes (Rathbone 2007). In early imperial period Egypt, trade taxes were collected through the *collegiae* (van Minnen 1986; Rathbone 2007), and by the 4th century, *collegiae* throughout the eastern empire had also taken on this function. This in essence gave governmental sanction to the professional associations as an organizing body within the civic community.

(1923) describe an inscription by stonemasons in Sardis that records an oath taken by its members ensuring that the work be completed on time lest the organization incur fines, suggesting that *collegia* could also be used to maintain industry standards and insure the reputation of its members for quality work performed in a timely manner.

Historical records offer a unique glimpse into the relationship between imperial and civic institutions and craftspeople. Unfortunately, little of the nuance of these cases can be observed archaeologically, and almost none of them reference ceramic production. Yet occasional organizational aspects affected by institutional influence, regulation, or even more formal interventions can nonetheless be suggested in the dataset. Most notable are (1) the organization of urban space and what appear to be civic traditions concerning industry and (2) the imposition of production facilities supplying the imperial military. As will be demonstrated, these institutional factors served to influence features of production organization observed in the analyses performed in Chapters Three through Six.

Urbanism and Municipal Law

Urban ceramic workshops in the dataset from the early and middle Roman periods demonstrate a very strong trend towards periurban locations. Indeed, all (excepting one rather unusual instance at Dura Europos) of the workshops dated to the early and middle Roman periods are situated in extramural locations. The consistency of this feature in urban ceramic industries raises questions concerning the extent to which such contexts were officially regulated by authorities or more informally shaped by social norms and expectations. The overwhelming consistency of the practice may more convincingly suggest the former, and is further supported by a shift in this trend that appears in the Late Antique period, during a period noted for changes in urban planning and municipal regulation.

For the early and middle Roman periods, the textual evidence also suggests that laws concerning urban planning attempted to place restrictions on where some industries could be located. Most of these regulations appear to have been related to the property rights of neighbors, and restrictions were often in place to regulate the activities of industries which introduced the ever-present risk of fire, such as potteries and gypsum workshops (Lippolis 2007). Moreover, unpleasant fumes and smoke were also a major concern, and several laws protected the air quality of other nearby properties (Saliou 1994). For instance, an action against a cheese-making establishment in Latium is cited in the *Digests* (D.8,5,8,5 as cited in Wacke 2002: 6). These passages document a case where smoke was blowing into the premises of an upper-storey neighbor. The workshop leasee was then held accountable for the air pollution caused by their production activities. This highlights that legal stipulations seem to have upheld protections for property owners against unpleasant by-products of neighboring workshops. Similar protections seem to have been in place to protect water and light rights (Saliou 1994; van den Bergh 1999; Wacke 2002). Such legal restrictions on air, water, and light likely influenced the placement of a wide range of industries, including ceramics production.

Although legal cases suggest a certain degree of civic regulation against the unpleasant effects of local industry this, of course, was not universal, and cases to the contrary can certainly be referenced. Perhaps the most well-known example is the dye works of Tyre. Strabo describes that, despite the wealth brought to the city from its murex dyeworks, the industry had made it an unpleasant place to live (*Geography* 16. 23.172). With experimental archaeological projects describing the "terrible odour" of murex production as akin to garlic-breath and stinky-feet (Ruscillo 2005:105), Strabo's description may have some validity. However, at least for Tyre, it appears that the wealth, influence, and history of the industry in the city, may have influenced its urban development.

Additional laws regulated the workshops as built structures, particularly concerning the adjacent streets and portico spaces. For much of the Roman period, the space fronting a workshop or shop was used as an extension to the interior of the workshop and could be used to display wares for sale, and cities of the eastern provinces were well-known for their porticoed streets lined with shops and workshops (Saradi 2006: 195-196). Beyond those porticoes, the *Digests* document that streets were to remain unencumbered. Exception was made, however, in the cases of fullers and carpenters, who utilized the front space as an extension of their workspaces, i.e., for drying textiles and for placing their carpenter wheels, respectively (Saradi 2006: 196).

The ceramic workshop evidence also shows a major transition in the Late Antique period that likely reflects changes in the nature of urban living. Those changes resulted in workshops for the first time in any frequency moving *intra muros* at major settlements.

Moving into town has recursive impacts on the organization of workshops that set up shop there. Namely, workshops not only occupied spaces that previously had been used for other purposes (villas, baths), but they also refashioned those buildings to some extent for industrial use. This is perhaps most interestingly represented by the case of the hippodrome workshops at Gerasa, where the *caveae* were transformed for use as workshops. The uniform spaces were reconfigured, doorways opened and others blocked, to provision space for the industrial works. Moreover, certain features, such as the distance travelled to the ceramic kilns (i.e., outside of the hippodrome across an existing road), appear to result from the spatial requirements of placing kilns in open and well ventilated spaces. For other reasons, the hippodrome presents a highly unique reuse of a building for industrial purposes. For example, the use of the eastern *cavea* for dwellings and the later addition of a church to the south of the hippodrome suggest the monument became a central place for the construction of artisanal community development just outside of the city.

Already in the early and middle Roman periods, workshops demonstrate great intra-site variability in their layout with many features specific to the building itself (i.e., organization of space, allocation of space for different tasks). This is evidenced even in cases where workshops are situated in the nucleated areas with multiple workshops (e.g., at Pergamon, Sagalassos). In these Late Antique period contexts, however, such trends are accentuated by the fact that workshops are less frequently constructed from scratch, and rather rely on pre-existing architecture that was uniquely adapted and reorganized.

Late Antiquity has been recognized as a period that witnessed urban and suburban change in many (but certainly not all) cities, with changes occurring at various times, in different regions, and expressed in assorted ways at differing rates (Mattingly 2010; Johnson 2010). The issue of extramural and intramural activity patterns is of concern here, and transitions in the spatial reorganization of urban activities have been interpreted in multifarious ways, including external threats and redefinitions of political landscapes (Latimer 2010), power shifts in imperial, provincial, and local administration (Johnson 2010; Speed 2010), and broader cultural shifts in the organization of society (Polci 2003; Sodini 2003) and urban ideals (Zanini 2003). Emphasis is increasingly placed on reorganization and adaptation in urbanism, rather than decline (Christie 2010).

These observations for ceramic workshops are in some ways consistent with patterns observed in urban changes across the study region. Saradi (2006) offers her own interpretation on this phenomenon, specifically in reference to the eastern Byzantine world. She proposes that at an urban level, municipalities were thrown into major economic hardship in which cities became hard-pressed to find individuals willing to take on liturgies and other eurgetistic civic duties. The porticoes of many shops thereafter began to be used for more permanent installations altering the appearance of the porticoes (Saradi 2006: 195-196). Traditionally interpreted as evidence for the decline of civic organization, more recent evaluation of municipal records demonstrates that the use of these spaces served as a means of the civic administration to acquire additional rental spaces from which to collect taxes (Saradi 2006; Lippolis 2007).

Returning to the ceramic workshop evidence, however, what is perhaps of equal significance is the fact that, despite some clearly major changes in the organization of development and planning of cities at this time, at the majority of sites most industrial activities remain extramural. This suggests that the shifts in urban development in the study region between the 4th and 6th centuries may be a bit more varied than expected, and may represent differing economic pressures on cities.

In general, the ceramic workshop evidence suggests that in the early and middle Roman periods (1st – 4th centuries AD) certain practices of urban planning were being imposed on the siting of ceramic industries. This corresponds to literary sources that are known from the period highlighting that, through institutions of civil property laws and municipal regulation, the placement of some industries in an urban context faced certain proscriptions. Interestingly, similar types of regulations are also recorded in the 6th century *Digests*, yet the archaeological record suggests that such regulations may not have been enforced as uniformly in the Late Antique period. This is corroborated by other historical sources that suggest civic structures were adapting to financial hardship through reorganization or public spaces and regulation.

<u>Imperial Interventions</u>

As stated, very rarely in these analyses was it possible to propose any sort of direct imperial intervention in the organization of ceramic manufacturing. The one anomalous case is the legionary production center at Jerusalem, which in nearly every analysis displayed unusual features in its production organization. The excavators, Arubas and Goldfus (1995), noted the close parallel of the Jerusalem site with another legionary ceramic site from the far end of the Empire – that at Holt, in Wales. More specifically, they call attention to the similar arrangement of multiple kilns constructed together in a single line (see figure 7-1). Although not noted by the Jerusalem excavators, a similar arrangement was also found at the legionary production site at Holdeurn, in Holland (Holwerda and Braat 1946) (see figure 7-1). Their comparison of legionary sites is clearly well founded, but it is only through the larger comparative exercise performed by this dissertation that the truly unusual character of the site can be fully appreciated in its regional context. Indeed, the legionary site bucks every trend across the dataset. It is nearly three times the surface area of the next largest workshop at Dura Europos (630 m^2)[44], and eight times the surface area of the average of all the other workshops in the dataset (1690 m^2 versus 215 m^2) (see table 5-3). It manufactured a much wider range of wares than the other sites, representing a larger set of functional classes.

Moreover, unlike the strong trend for traditional influences in product range and technological choices in the dataset, the case of Jerusalem presents an abrupt rupture from earlier Hellenistic ceramic manufacturing traditions at the site. This is clear from the shift in the types and the range of products from the site, as well as from the later preference for rectangular kilns constructed in different materials. This general trend represents a break from traditional knowledge and techniques at the site, which may be interpreted as the presence of different groups of artisans trained in different traditions or

[44] It is argued elsewhere in this study that the Dura Europos workshops were also likely domestic units, and their unusual size may be attributed to their multifunctional use.

(higher level) managerial decisions influencing production choices of local potters. This is further supported by the unusual features of workshop organization at the site. For example, this is the only clearly documented case of pooled infrastructure in the entire dataset.

The elements of pooled infrastructure suggest that the entire organization of workers and workgroups at this site may have been organized differently, so much so that workgroups became spatially regimented. That is, clay preparation appears to have been isolated to two adjacent rooms, while throwing was spatially distributed across several rooms, each with two to five wheels, and firing was conducted in a shared space. Spatial segregation of work tasks suggests that they may have been performed by different sets of workers, and among workers performing similar tasks, individual workstations were allocated in throwing rooms. This supports a reconstruction of multiple workgroups specialized in different segments of the production process. Thus, not only is the production cycle organized differently at this site, the organization of workers and workgroups was likely also dissimilar, with greater specialization in work tasks and workgroup activities.

Clearly such close parallels with sites as distant as Britain and Holland suggest that legionary production sites, at least at Holt and Holdeurn, followed certain models of organization. Further questions arise, however, regarding the degree to which these trends are unique to legionary kilnworks or whether similar features in their layout are influenced by patterns in military organization more generally (e.g., building groups, arms manufacturing). Another possibility is that they are features incorporated from civilian models of organizing work, a point of especial interest as similar examples of pooled infrastructure appear at contemporary ceramic production sites from Gaul and Italy.

The case of Jerusalem is extremely important as it demonstrates features of its organization that (as of yet) have not been identified at other workshop sites across the admittedly still chronically under-studied region. The legionary production site highlights just how massive and integrated production organization can be when imperial interests are involved. This case also has implications for how substantial such interventions can appear in the archaeological record, when compared with examples of private industrial initiatives. Furthermore, the working experience in such an establishment would have been fundamentally different from an average potter elsewhere – not only in terms of the number of workers and scale of facilities, but also in terms of the intensity of daily interactions among members of workgroups, and levels of anonymity within the workplace. From work experience to cultural traditions, the Jerusalem Tenth Legion site presents a critical outlier with significant potential for future research.

Conclusion

These final discussions have attempted to tie together the various analyses performed in Chapters Three through Six. Those chapters each investigated a variable which had been identified by models as central factors to the overall organization of production activities.

Thus, by identifying patterns in the data that appeared throughout those four chapters of analyses, certain larger-scale interpretations could be made regarding the practices of production common among the case studies and the nature of economic decision-making strategies in the Roman period eastern Mediterranean. These interpretations, having been complemented with historical sources concerning industry more widely from the period, offer some insight into the complex combinations of actors and institutions that directly or indirectly influenced what otherwise might be perceived as the simple process of making a pot.

In conclusion, this dissertation project has investigated ceramic workshops of the Roman eastern Mediterranean in order to better understand the socialized practices of work. Economic and social activities have too often been compartmentalized into different realms of human experience. Recent work in various fields is undermining the categorical treatment of such perspectives and is coming to see work and economy as performed practices that are learned through social encounters.

This study has pursued those themes for the Roman world, by investigating a rather mundane type of production (that of ceramics) and, consequently, has provided some important results on our understanding of regional economies and their relation to smaller-scale workshop and production site organizations. The nature of such regional relations has also come to be seen as the cumulative effect of decision-making by ceramicists and one that follows more fluid spatial definitions of 'region'. This decision-making can be seen to be influenced by day-to-day practicalities of working in certain environments, in specific workshop buildings, and with particular materials. These economic decisions, however, also are embedded in traditions of production practice transmitted within networks of workgroups and communities of artisans. Institutional influences appear to have played a less (archaeologically) visible role in these patterns of decision making and suggest that ceramic workshops may have been even more embedded in local life than previously thought.

At another level, this study has also successfully compiled published data from a wide range of sources across a large geographic area; this has likely been the most extensive data collection and comparative exercises for the Roman-period ceramic workshops in the eastern Mediterranean. Despite the (comparative) ubiquity of ceramic production in the region, workshop excavations remain chronically understudied and published, with important details on organization and workshop structures rarely reported. Consequently, there are significant gaps in our current knowledge on the topic, which in coming years may begin to be filled in. It is certainly possible that, with a larger dataset of detailed workshop excavations, in the future some of the findings of this study will be revised or reversed. Such is the archaeological process, and one can only hope that such is the case, as it will indicate a new level of interest in these sites.

Future Directions

These results demonstrate that features in production organization (i.e., choices in technology, scale and layout of workshop space, location) for the ceramic industry tend to be shared across the local and regional levels, and only occasionally can influences be associated with higher levels of centralized administration. It is supposed, however, that this trend may be industry-specific, as other industries (such as stone and metal extraction) are historically documented as being under imperial auspices and consequently have the potential to be organized in different ways and across different geographic scales. Consequently, further work is necessary that complements and builds upon this dissertation research by expanding both the range of industries under investigation and the extent of the study region, while maintaining its multi-scalar analytical approach and conceptual framework of economic activity as social activity.

In pursuit of this, workshop sites should be further investigated in order to compare the trends observed in ceramic workshops at a site with the organization and economic decision-making strategies pursued by other types of production. Patterns across industries at the local level may thereby help to disentangle industry-specific features of production organization (e.g., Lemonnier's (1986) *strategic tasks* for production). In urban contexts, this can foreseeably involve workshop case studies of other crafts in different urban contexts. In rural contexts, the organization of associated agricultural work should also be examined, particularly evidence for the organization of pressing facilities in complexes of joint amphora and pressing activities.

Analyses from multicraft perspectives (Shimada 2007) would also be critical in order to track patterns in raw material selection and design features to technological choices. These may help to establish the degree to which artisans of different crafts interacted, formed communities, and transferred technical knowledge. In addition, the extent to which distributions of workshops followed patterns across a cityscape or landscape might highlight regulations of industry by civic or local authorities. Such future work is more ambitious in scope, and will include a wide range of industries, including: metal extraction and working; ceramic manufacture; glass production and working; textile production and finishing; milling and baking; bone working; stone extraction and working; tanning; and wine, garum, and oil production.

Other possible avenues of inquiry can be suggested. Certainly the aspect of 'pooled infrastructure' only clearly found at Jerusalem among the eastern workshops finds parallel with well studied production sites in Gaul and in Italy. Two examples can illustrate this point.

First, the well-known Gallic sigillata ceramic production site of La Graufesenque (Southern France) has often been noted for its peculiar organization of kiln firings, wherein independent potters 'pooled' several thousands of vessels for collective firing in large tubular kilns (Marichal 1988; Schaad 2007). Similar dockets have also been found at Pisa and Arezzo (Camodeca 2006; Johnston 1985), and pooled infrastructure for clay-processing and kiln-firing has likewise been noted at Scoppieto in Italy (Bergamini 2007). This organization is not particularly well documented for ceramic production in either the western or the eastern provinces, yet similar types of cooperative organization can be observed in other economic contexts in the Roman world where specialized technologies were unavailable to certain segments of the productive community. For example, numerous rural estates with large-scale wine and oil press installations are believed to have been used to press the harvests of local tenants and independent farmers (Brun 2004), and at Pompeii, individuals independently prepared bread loaves and brought them to the baker where they could be baked in a common oven (Pucci 1993).

Moving outside of the realm of ceramic production, industries, such as glass and metals production – industries for which raw materials were costly, difficult to transport, and reliant on technically specific infrastructure (with associated technical knowledge) – often demonstrate a two-part production process. Metals manufacture has a long history of primary and secondary production models in the Mediterranean, with ore-processing and smelting often occurring at one location (or nearby locations) and ingots distributed to other locations for secondary working and forming. In the Roman world, glass production unusually followed a similar model, whereby large, primary production centers prepared raw glass in bulk. That material was then distributed to smaller secondary production centers where it was fashioned into finished products often by means of glassblowing. Shipwrecks, such as the Ouest-Embiez 1 off the coast of southern France and containing over eight tons of raw glass, demonstrate the scale of such operations (Foy and Jézégou 2004). The question then arises, why did the glass industry adopt this form of organization that is more often associated with metals? What features of the technologies used in the production led them to rely on such organizations, and what social and economic structures reinforced and supported this organization?

Such examples highlight how similar organizational patterns might appear in different industries (i.e., ceramic manufacturing *vs*. wine and oil pressing *vs*. baking, glass *vs*. metal productions) and in very different economic contexts (i.e., conglomerated workshops, rural estates, urban neighborhoods). Acquiring a better understanding of the nuances of not only these, but numerous other contexts, has the potential to provide new insights into the structural features of the Roman economy that encouraged patterning in what were often localized, industry-specific, decision-making strategies. These future endeavors directly build on this dissertation study, and should offer a means to better understand, not only economic decision-making, but also its embeddedness in the social realities of work in the Roman world.

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TABLES

Table 2-1. Listing of archaeological workshop sites with their state of publication. Grey fields indicate absence of investigation on individual workshops.

Map Legend	Regional Study	Site Name	Workshop Name(s)	Modern Country	Roman Province (2nd c. AD)	Full Workshop(s) Excavation	Partial Workshop(s) Excavation	Kiln(s) Excavation	Survey Investigation	Publication
1		Olympia	Workshop north of the Prytaneion	Greece	Achaea	yes	yes	yes	no	Schauer 1991, 1998, 2010
2			Epitalio, Elia	Greece	Achaea	no	yes	yes	no	Themeles 1969.
3		Delphi	La Villa au Sud-Est Workshop	Greece	Achaea	no	yes	yes	no	Badie *et al.* 1997; Bommelaer *et al.* 1998; Petridis 1996, 1997, 1998, 2007, 2010
4		Athens	Kerameikos	Greece	Achaea	no	no	yes	no	Knigge 1979, 1989
			Evangelismo Station	Greece	Achaea	no	yes	yes	no	Parlama *et al.* 2000.
			Rue Demophontos 5	Greece	Achaea	no	yes	yes	no	Parlama *et al.* 2000.
			Route d'Archarnes	Greece	Achaea	no	no	yes	no	Huber and Varalis 1994
5	North Crete	Kastelli, Crete		Greece	Cyrene & Crete	no	yes	yes	no	Markoulaki, Empereur, Marangou 1989
		Herakleion, Crete		Greece	Cyrene & Crete	no	no	no	yes	Empereur, Kritzas, and Marangou 1991
		Chersonisos	Workhop 1	Greece	Cyrene & Crete	no	no	no	yes	Empereur, Kritzas, and Marangou 1991
		Chersonisos	Workhop 2	Greece	Cyrene & Crete	no	no	no	yes	Empereur, Kritzas, and Marangou 1991

6	South Crete	Keratokambos West		Greece	Cyrene & Crete	no	no	no	yes	Empereur, Kritzas, and Marangou 1991
		Keratokambos East		Greece	Cyrene & Crete	no	no	no	yes	Empereur, Kritzas, and Marangou 1991
		Tsoutsouros East		Greece	Cyrene & Crete	no	no	no	yes	Empereur, Kritzas, and Marangou 1991
		Dermatos, Crete		Greece	Cyrene & Crete	no	no	no	yes	Empereur, Kritzas, and Marangou 1991
7	Paros	"Ateliers" 1-6, 9-10		Greece	Achaea	no	no	no	yes	Picon and Empereur 1986a, 1986b.
8	Antiparos	"Atelier" 11		Greece	Achaea	no	no	no	yes	Picon and Empereur 1986b.
9	Naxos	"Ateliers" 7-8		Greece	Achaea	no	no	no	yes	Picon and Empereur 1986a, 1986b.
10	Chios		Southern manufacturing area	Greece	Asia	no	no	yes	no	Opait and Tsaravopoulos 2010
11		Grynion		Turkey	Asia	no	no	no	yes	Empereur and Picon 1986
12		Candarli		Turkey	Asia	no	no	no	yes	Loeschcke 1912
13		Pergamon	Workshop 1	Turkey	Asia	yes	yes	yes	no	Poblome *et al*. 2001
		Pergamon	Workshop 2	Turkey	Asia	yes	yes	yes	no	Poblome *et al*. 2001
		Pergamon	Workshop 3	Turkey	Asia	yes	yes	yes	no	Poblome *et al*. 2001
		Pergamon	Workshop 4	Turkey	Asia	yes	yes	yes	no	Poblome *et al*. 2001
		Pergamon	Workshop 5	Turkey	Asia	yes	yes	yes	no	Poblome *et al*. 2001
14	Sinope Region									Doonan 2004, 2002; Garlan and Kassab Tezgör 1996; Vnukov 2010
		Demirci, Sinope Region	*Several partial workshops and kilns*	Turkey	Bithynia & Pontus	no	yes	yes	yes	Tezgör Kassab 1996, 1999, 2010; Tezgör and Özsalar 2010; Tezgör and Tatlican 1998
		Zeytinlik, Sinope Region		Turkey	Bithynia & Pontus	no	yes	yes	yes	Garlan and Tatlican 1997, 1998, 1999
15		Sagalassos	Tablewares Workshop	Turkey	Galatia	yes	yes	yes	yes	Murphy and Poblome 2010, 2012; Poblome *et al.* 2001
		Sagalassos	Mold-made Wares Workshop	Turkey	Galatia	yes	yes	yes	yes	Murphy and Poblome 2010, 2012

16	Kestros River Valley	POI199		Turkey	Asia	no	no	no	yes	Jackson *et al.* 2012
		POI213		Turkey	Asia	no	no	no	yes	Jackson *et al.* 2012
		POI216		Turkey	Asia	no	no	no	yes	Jackson *et al.* 2012
		POI261		Turkey	Asia	no	no	no	yes	Jackson *et al.* 2012
		POI389		Turkey	Asia	no	no	no	yes	Jackson *et al.* 2012
		POI411		Turkey	Asia	no	no	no	yes	Jackson *et al.* 2012
		POI511		Turkey	Asia	no	no	no	yes	Jackson *et al.* 2012
17	South Cilicia	Syedra Kiln Site		Turkey	Cilicia	no	no	no	yes	Autret and Rauh 2010; Rauh and Slane 2000
		Bickici Kiln Site		Turkey	Cilicia	no	no	no	yes	Autret and Rauh 2010; Rauh and Slane 2000
		Antiochia ad Cragum		Turkey	Cilicia	no	no	no	yes	Autret and Rauh 2010
		Soli		Turkey	Cilicia	no	no	no	yes	Autret *et al.* 2010
18		Eliaussa Sebaste	Fornace 1	Turkey	Cilicia	no	no	yes	yes	Ferrazzoli and Ricci 2010a, 2010b; Ricci 2007
		Eliaussa Sebaste	Fornace 2	Turkey	Cilicia	no	no	yes	yes	Ferrazzoli and Ricci 2010a, 2010b; Ricci 2007
		Eliaussa Sebaste	Workshop with Fornace 3	Turkey	Cilicia	no	no	yes	yes	Ferrazzoli and Ricci 2010a, 2010b; Ricci 2007
		Eliaussa Sebaste	Fornace 4	Turkey	Cilicia	no	no	yes	yes	Ferrazzoli and Ricci 2010a, 2010b
19		Dura Europos	Îlot B2 workshop 1	Syria	Syria	yes	yes	yes	no	Allara 1992, 1994
			Îlot B2 workshop 2	Syria	Syria	yes	yes	yes	no	Allara 1992, 1994
20		Kefar Hananya		Israel	Judea	no	yes	yes	yes	Adan-Bayewitz 1991, 1993
21		Khirbet Irza		Israel	Judea	no	no	yes	no	Israel 1997
22		Gerasa	Hippodrome Cavea Workshops	Jordan	Arabia	yes	yes	yes	no	Kehrberg 1995, 2004, 2006, 2007, 2009, 2011a, 2011b; Kehrberg and Ostrasz 1997; Ostrasz 1997, 1989
		Gerasa	Cave Workshop	Jordan	Arabia	no	yes	no	no	Iliffe 1945
23		Jerusalem	Jerusalem Tenth Legion Site	Israel	Judea	no	yes	yes	no	Arubas and Goldfus 1995, 2005
24	Ashkelon Region									Israel 1995; Johnson and Stager 1995; Mayerson 1992
		Khirbet Baraqa	Khirbet Baraqa	Israel	Judea	no	yes	yes	no	Gadot and Tepper 2003
		Ashkelon	Third-mile Estate Site	Israel	Judea	no	no	yes	no	Israel 1993, 1995
		Giv'ati Junction		Israel	Judea	no	no	yes	no	Baumgarten 1997
25	Petra	Zurrabeh	Unit A.6 and A.7 Workshop	Jordan	Arabia		yes	yes	no	Amr 1991; 'Amr and a-Momani 1999; Homes-Fredericq and Franken 1986; Zayadine 1981, 1982

26		Buoto	*Several partial workshops and kilns*	Egypt	Egypt	no	no	yes	no	Ballet *et al*. 2006; Ballet and Vichy 1992; Ballet and von der Way 1993; Charlesworth 1967, 1969; Hartung et al. 2007
27	Lake Mareotis			Egypt	Egypt	no	no	no	yes	Blue 2010; Dixneuf 2011; el-Fattah 1998; Empereur 1986, 1993, 1998; Empereur and Picon 1986, 1998, 1992; Rodziewicz 1983, 1998a, 1998b
			Burg El-Arab	Egypt	Egypt	no	no	yes	no	el-Ashmawi 1999
			Marea	Egypt	Egypt	no	yes	yes	no	el-Fakharani 1983
28	Dakhleh Oasis Region	Deir el-Haggar		Egypt	Egypt	no	no	no	yes	Hope 1978
		Muzzawaka		Egypt	Egypt	no	no	no	yes	Hope 1978
		Site 33/390-D8-1		Egypt	Egypt	no	no	no	yes	Hope 1978
29		Douche, Egypt		Egypt	Egypt	no	no	yes	no	Ballet 1990, 1988; Ballet and Vichy 1992
30		Aswan (Egypt) 1st - 3rd c. AD		Egypt	Egypt	no	no	no	yes	Ballet 1990, 1988; Ballet and Vichy 1992

Table 2-2. Listing of ethnographic workshop sites with their publication.

Map Legend	Site Name	Country	Citations
1	Salvatierra de los Barros	Spain	Vossen, Rüdiger. 1984.
			Llorens Artigas, Jose, Jose Corredor-Matheos. 1970.
2	Agost	Spain	Vossen, Rüdiger. 1984.
3	Bailen	Spain	Curtis, Freddie. 1962.
			Vossen, Rüdiger. 1984.
			Foster, George M. 1960
4	Oristano	Sardinia	Annis, M. Beatrice. 1985
5	Chalkis	Greece	Matson, Frederick R. 1973
6	Thasos	Greece	Papadopoulos, Stratis. 1995
7	Eceabat	Turkey	Tekkök, Billur. 2004.
8	Akköy	Turkey	Tekkök-Biçken, Billur. 2000.
9	Datbey	Turkey	Crane, Howard. 1988
10	Beit Shebab	Lebannon	Hankey, Vronwy. 1968.
11	A'qabet Jaber	Palestine	Salem, Hamed. 1986
12	Deir-el-Gharbi	Egypt	Nicholson, Paul T., Helen L. Patterson. 1985a.
			Nicholson, Paul T., Helen L. Patterson. 1985b.
13	Dakhla Oasis	Egypt	Henein, Nessim. 1997.
14	Kangan	Iran	Whitehouse, David. 1977.
15	Hays	Yemen	Posey, Sarah. 1994.
16	Zahel Bala, Pakistan	Pakistan	Rye, Owen S., Clifford Evans. 1976
17	Quetta Baluchistan, Pakistan	Pakistan	Rye, Owen S., Clifford Evans. 1976
18	Gujrat, Panjab, Pakistan (Garhi Maqbulabad)	Pakistan	Rye, Owen S., Clifford Evans. 1976
19	Gujrat, Panjab, Pakistan	Pakistan	Rye, Owen S., Clifford Evans. 1976
20	Uttar Pradesh, India	India	Perryman, Jane. 2000
21	Jodhpur, India	India	Kramer, Carol. 1997.

Table 3-1. Changes in the frequency of 'urban' sites, where workshops occurred in intramural, extramural, or both intra and extramural contexts. Grey indicates Early to High Imperial Roman period sites (1^{st} – 4^{th} centuries AD), and white indicates Late Antique period sites (4^{th} -6^{th} centuries AD).

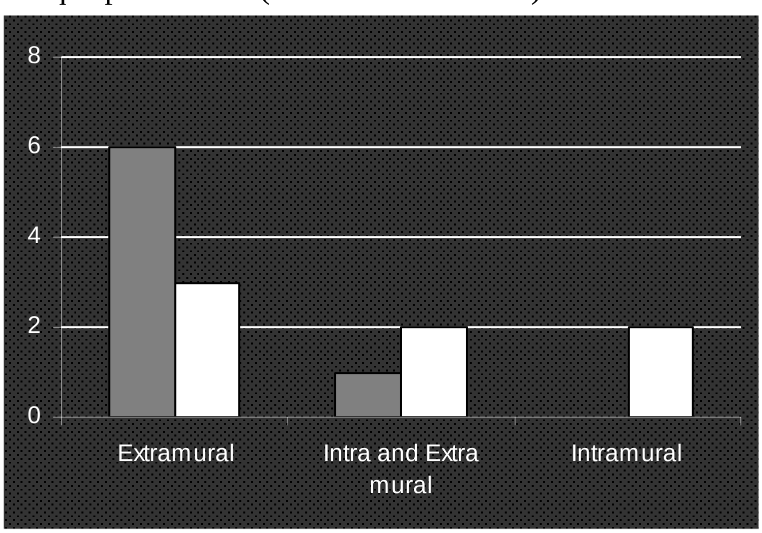


Table 3-2. Frequency of sites between periods and their location in both urban and rural context classifications.

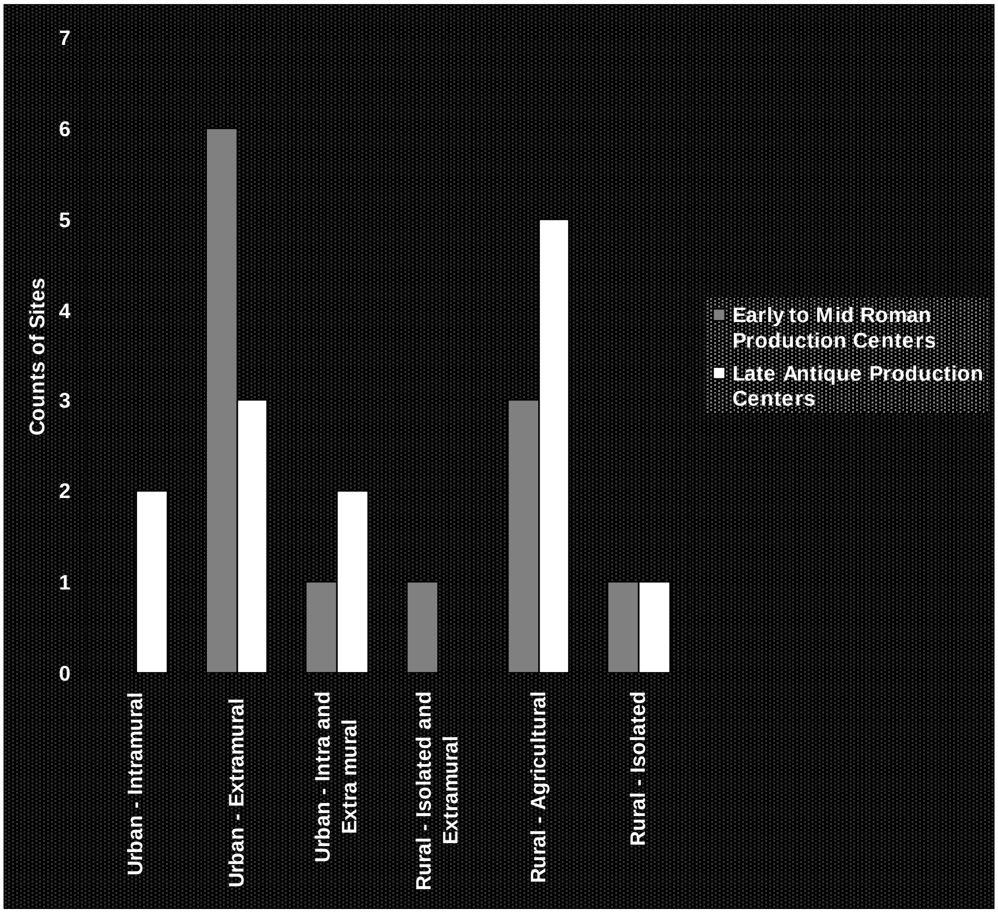


Table 3-3. Cross tabulation at the site level of workshop concentration variables (isolated, nucleated, and both) with their locations in urban versus rural contexts.

Concentration and Location				
	Single Workshop Centers	Nucleated Workshops	Both single workshops and nucleated	*Totals*
Rural	8	3	0	*10*
Urban	1	11	3	*14*
Totals	*9*	*14*	*3*	*2*

Table 3-4. Workshop frequencies and access to various means of transport.

Accessibility						
	On a Road	Town on a 'Major' Road	Not on a Major Road	On a River	Coastal	Mountainous
Total Workshop Count (n=42)	18	19		34	18	8
Total Site Count (n=26)	n/a	13	13	24	15	6

Table 3-5. Frequencies of sites with different types of concentration (isolated, nucleated, both).

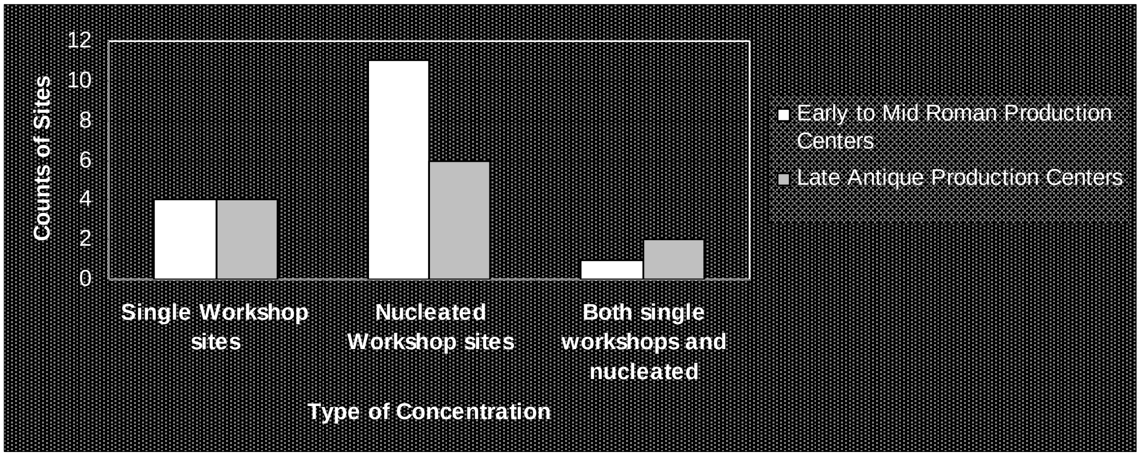


Table 4-1. Pottery template used as classification for analyses.

General Functional Category	Functional Category	Specific functional category	Object
Toilet Articles, Surgical and Cosmetic Instruments			unguentaria
Household Implements	Kitchenwares	Preparation	lékane/krater
			jar/jug
			mortaria
			bowls
		Cooking	indeterminate
			chytra
			lopas
			operculum/lid
	Tablewares	Serving	jar/jug
			oinophoroi
			lékane/krater
			plates/trays
			lid
		Consumption	cups
			bowls
			dishes
			ledge handle
		indeterminate forms	
Furnishings	Lighting	Lamps	wheelmade
			mouldmade
			indeterminate production
	Figurines		mouldmade
Agricultural production	Transport		amphora
	Storage		jugs
			indeterminate
			stand
			funnel
	Beehives		Beehives
Miscellaneous		Sewing and Spinning Equipment	loom weights
Architectural Fittings	Construction		tile
			wall fittings

Table 4-2. Counts and percentage of the number of workshops producing various combinations of functional classes within the dataset.

Functional Classes	Count	Relative Frequency
Kitchen ware	1	3.13
Kitchen & Table	2	6.25
Kitchen & Table & Lighting	2	6.25
Kitchen & Table & Lighting & Architecture	1	3.13
Kitchen & Table & Beehives	1	3.13
Kitchen & Transport	1	3.13
Kitchen & Transport & Architecture	2	6.25
Kitchen & Storage	3	9.38
Table ware	1	3.13
Table & Lighting	3	9.38
Table & Toilet & Lighting	1	3.13
Table & Transport & Lighting	1	3.13
Table & Transport	1	3.13
Table & Lighting & Weaving & Figurines (all molded)	1	3.13
Table & Lighting & Figurines (all molded)	1	3.13
Transport vessels	3	9.38
Transport & Lighting	1	3.13
Transport & Storage	2	6.25
Transport & Architecture	2	6.25
Lighting & Figurines & Architecture (all molded)	1	3.13
Storage & Toilet	1	3.13

Table 4-3. Counts of vessel types noted in Oxyrhynchus papyri.

	Four-chous jar	Double ceramia	Two-chous jar
P. Oxy. 3595	15,000	150	150
P. Oxy. 3596	4,000	100	15
P. Oxy. 3597	8,000	100	30

Table 4-4. Frequencies of forming techniques used per workshop.

Forming Technique	Count	Relative Frequency
Wheel Thrown	20	62.50
Molded	3	9.38
Wheel Thrown & Molded	9	28.13

Table 4-5. Frequencies of vessel morphology per workshop.
This table includes 6 workshops that specialized exclusively in amphora production.

Vessel Morphology	Count	Relative Frequency
Open	1	3.45
Closed*	11	37.93
Open and Closed	17	58.62

Table 4-6. Frequencies of vessel morphology per workshop.
This table excludes six workshops that specialized exclusively in amphora production.

Vessel Morphology	Count	Relative Frequency
Open	1	4.35
Closed*	5	21.74
Open and Closed	17	73.91

Table 4-7. Comparison of number of forms (functional category and object class) observed at production centers using different data collection methodologies.

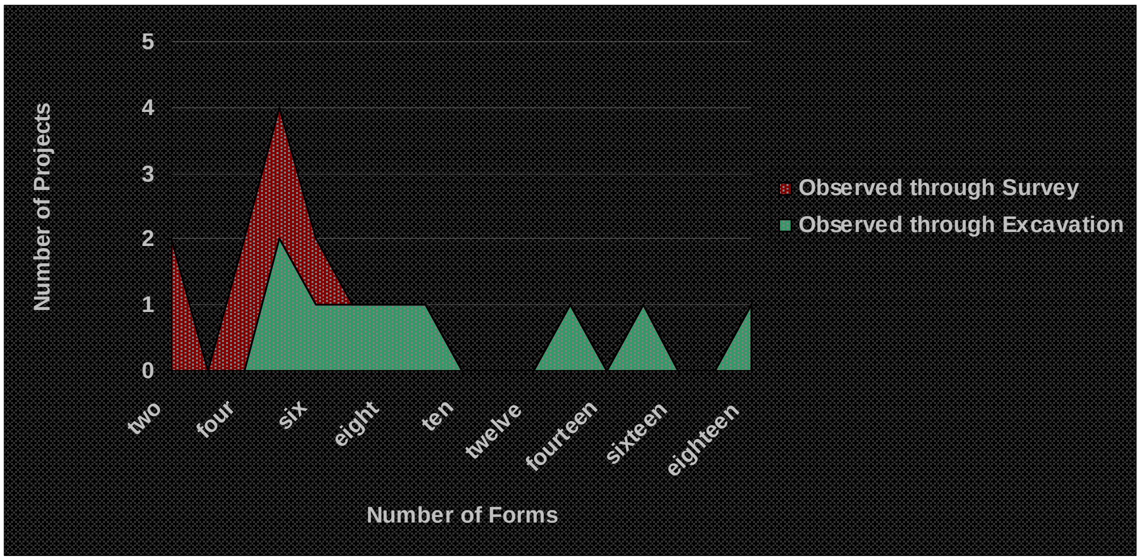


Table 4-8. Representation of functional classes at individual production centers based on excavation data.

Excavation Studies Functional Classes	Count
Kitchen & Table & Lighting & Transport	2
Kitchen & Storage	1
Kitchen & Table & Lighting & Transport & Household & Other	1
Kitchen & Table & Lighting & Toilet & Storage	1
Kitchen & Table & Architecture	2
Table & Toilet & Lighting & Transport & Household & Other	1

Table 4-9. Representation of functional classes at individual production centers based on survey data.

Survey Studies Functional Classes	Count
Kitchen & Table & Transport	2
Kitchen & Transport & Architecture	1
Kitchen & Transport	2
Kitchen & Table	1
Kitchen & Transport & Household	1

Table 4-10. Number of forms (functional category and object class) manufactured in individual workshops in contrast to the overall number of forms (functional category and object class) documented from the large production center.

Production Center	Number of Forms	Individual Workshop	Number of Forms
Sagalassos	17	Tableware Workshop	4
		Molded Ware Workshop	4
Gerasa	13	Cave Workshop	3
		Hippodrome Cavea Workshop	8
		Bazaar Workshop	7
Kefar Hananya	5	Workshop Site	2
Buto	9	Secteur P1 Kilns 5 and 6	6
		Secteur P1 Kilns 36 and 40	5
		Secteur P3 Kilns 6 and 7	3
		Secteurs P3 and P4	3

Table 5-1. Archaeological workshops used in the analyses of Chapter Five.

	Site	Workshop designation	Ware types	Dates of operation	Publication(s)
1	Sagalassos	Table Ware Workshop	fine wares	4th - 5th c. AD	Murphy and Poblome 2012, 2010
2	Sagalassos	Molded Ware Workshop	fine wares	4th - 6th c. AD	Murphy and Poblome 2012, 2010
3	Pergamum	Unit 2 (north)	fine wares	1st c. BC - 1st c. AD	Poblome, Bounegru, Degryse, Viaene, Waelkens, and Erdemgil 2001
4	Pergamum	Unit 2 (south)	fine wares	1st c. BC - 1st c. AD	Poblome, Bounegru, Degryse, Viaene, Waelkens, and Erdemgil 2001
5	Pergamum	Unit 3	fine wares	1st c. BC - 1st c. AD	Poblome, Bounegru, Degryse, Viaene, Waelkens, and Erdemgil 2001
6	Delphi	Secteur Sud-Est Workshop	common wares	6th c. AD	Bommelaer et al. 1998; Petridis 1996, 1997, 1998, 2007; Badie et al. 1997
7	Zurrabeh, Petra	Workshop 1	fine wares	1st c. (?) - 4th c. AD	Homes-Fredericq and Franken 1986; Zayadine 1981, Zayadine 1982; 'Amr 1991; 'Amr and a-Momani 1999
8	Jerusalem	10th Legion Workshop	tile, brick, common wares, fine wares	1st c. BC - 6th c. AD	Arubas and Goldfus 1995
9	Dura Europos	Workshop 1	unknown	1st c. BC- 2nd c. AD	Allara 1992, 1994
10	Dura Europos	Workshop 2	unknown	1st c. BC- 2nd c. AD	Allara 1992, 1994
11	Gerasa	Hippodrome Cavea Workshop	common wares, fine wares	4th - 7th c. AD	Kehrberg and Ostrasz 1997; Kehrberg 1995, 2004, 2006, 2007, 2009, 2011; Ostrasz 1997, 1989

Table 5-2. Distribution of the space of individual workstations per site. Bars in grey represent modern ethnographic examples. *All calculations are based on size of throwing room divided by number of potters' wheels.*

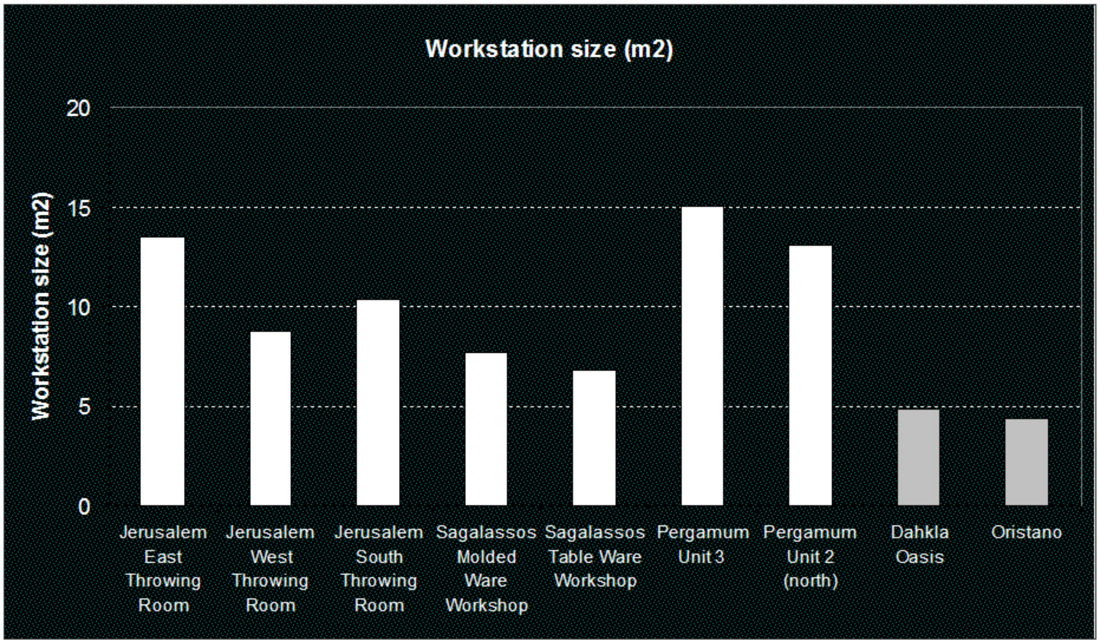


Table 5-3. Distribution of surface areas of individual workshops.

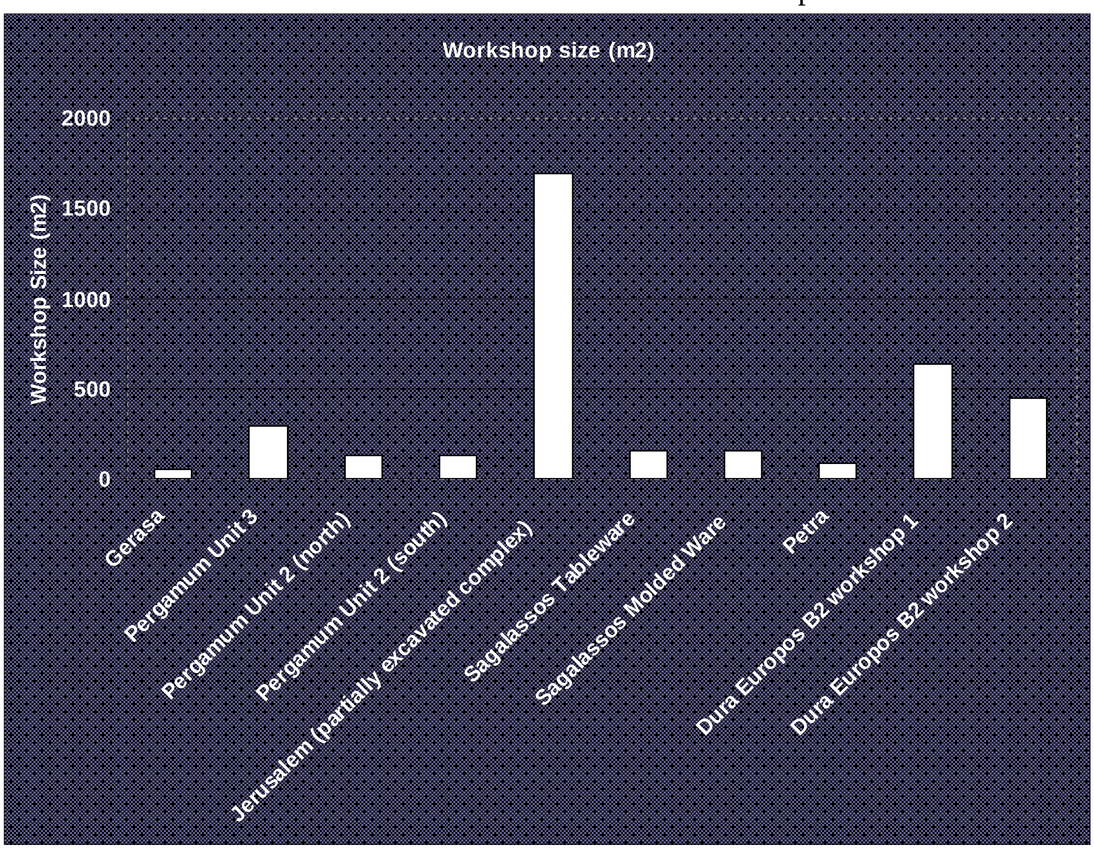


Table 5-4. Surface areas of the Jerusalem Legionary production site in contrast to the average of all other workshops in the dataset (n=9).

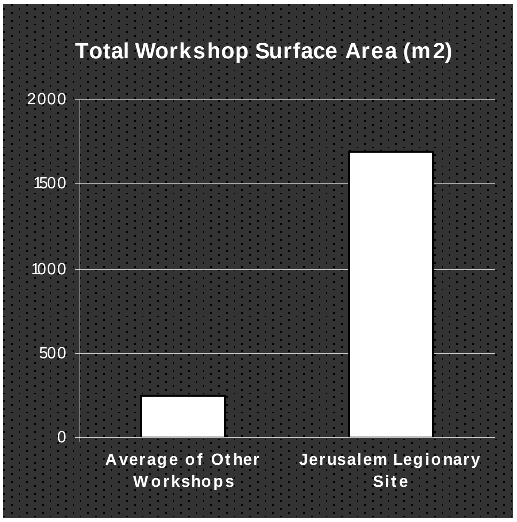


Table 5-5. Pie charts showing the proportional distribution of space for different work activities: light blue - clay preparation, dark teal green - throwing/forming, light green – drying, orange – firing, dark blue – other function / indeterminate.

Table 5-6. *Strategic tasks* of the ceramic *chaîne opératoire*.

Strategic task	Infrastructural indicator	Technical considerations affecting location
Raw material acquisition	doorways and means of access	adequate means of entry for large quantities
		storage space outside of workshop
Clay preparation	Water Tanks, Basins, Vats	Regular water access
	Wedging and Storage Spaces	ease of access from workshop door
		adequate space
Product Forming	Potters' Wheel	adequate light and space
		wall behind
		near to drying area
Drying	Open Space	regulation of heat and wind
	Rooms and shelving	protection
		adequate space
		near to firing area
Firing	Kiln	draft
		ventilation
		heat refraction
Storage	Open Space	protection
		adequate space

Table 5-7. Amount of space allocated to individual workstations.

Site	Workstation area (m2)
Jerusalem East Throwing Room	13.49
Jerusalem West Throwing Room	8.82
Jerusalem South Throwing Room	10.41
Sagalassos Molded Ware Workshop	7.74
Sagalassos Table Ware Workshop	6.85
Pergamum Unit 3	15.05
Pergamum Unit 2 (north)	13.11

Table 5-8. Workshop and infrastructural indicators of workshop scale.
Fields in grey are data unavailable from the excavation reports.

Workshop	Overall workshop size (m2)	Clay prep area size (m2)	Throwing / Forming Space m2	Drying Space m2	Combined Kiln Size (m2)	Number of Spaces	Number of Wheels / Workstations	Number of Basins	Number of Kilns
Gerasa	50.00					1			
Delphi	81.76	26.91			6.48	3		2	2
Petra	87.20				8.07	4			2
Pergamum Unit 2 (north)	130.50		26.22		5.11	4	2	0	3
Pergamum Unit 2 (south)	130.90	60.31			2.01	3		1	1
Sagalassos Molded Ware	150.60	4.65	22.69	5.86	3.29	5	4	0	4
Sagalassos Tableware	154.20	31.81	27.4	31.4	2.00	5	4	1	2
Pergamum Unit 3	294.40	108.35	30.1		4.55	7	2	1	2
Dura Europos B2 workshop 2	442.28				2.31	6			1
Dura Europos B2 workshop 1	632.79				35.05	9			2
Jerusalem (partially excavated complex)	1693.70	148.3	114.53	68.68	26.41		8		5

Table 5-9. Overall surface areas of archaeological workshops.
Fields in grey are data unavailable from the excavation reports.

Workshop	Overall workshop size (m2)	Clay prep area size (percentage of workshop area)	Throwing / Forming Space (percentage of workshop area)	Drying Space (percentage of workshop area)	Firing Space (percentage of workshop area)	Other / Indeterminate (percentage of workshop area)
Delphi	81.76	32.91%	32.91%	32.91%	32.91%	32.91%
Petra	87.20					
Pergamum Unit 2 (north)	130.50					
Pergamum Unit 2 (south)	130.90	46.07%	46.07%	46.07%	46.07%	46.07%
Sagalassos Molded Ware	150.60	3.09%	3.09%	3.09%	3.09%	3.09%
Sagalassos Tableware	154.20	20.63%	20.63%	20.63%	20.63%	20.63%
Pergamum Unit 3 (partially excavated)	294.40	36.80%	36.80%	36.80%	36.80%	36.80%
Dura Europos B2 workshop 2	442.28					
Dura Europos B2 workshop 1	632.79					
Jerusalem (partially excavated complex)	1693.70	8.76%	8.76%	8.76%	8.76%	8.76%

Table 5-10. Surface areas of archaeological workshops.

Archaeological workshop	Interior surface area (m2)	Total workshop surface area (m2)
Petra (possibly partially excavated)	20.66	87.20
Gerasa	50.00	unknown
Sagalassos Molded Ware	67.66	150.60
Delphi	81.76	unknown
Sagalassos Tableware	124.2	154.20
Dura Europos B2 workshop 1	247.45	442.28
Dura Europos B2 workshop 2	319	632.79
Pergamum Unit 2 (north)	unknown	130.50
Pergamum Unit 2 (south)	unknown	130.90
Pergamum Unit 3	unknown	294.40
Jerusalem (partially excavated)	unknown	1693.70

Table 5-11. Surface areas of ethnographic workshops.

Ethnographic workshop	Indoor surface area (m2)	Total surface area used (m2)
Oristano, Sardinia (phase 2)	28	148.32
Kangan, Iran	37.5	unknown
Al-Qasr, Dahkla Oasis, Egypt	50	2299.5
A'qabet Jaber, Palestine	51.17	353.71
Akkoy, Turkey	68.58	440.14
Deir el-Gharbi, Egypt	81.06	865.8
Eceabat, Turkey (Unit I)	145.06	425.9
Eceabat, Turkey (Unit II)	216.6	1112.7

Table 5-12. Results of correlation analysis between different infrastructural features and overall workshop size.

			R^2	n	Outliers excluded	Significant?
Size v. Distribution of Space						
	Workshop Size to					
		Number of Workshop Spaces	0.60	9	0.9	yes
			0.44	6	0.5	no
Size v. Infrastructural Features						
	Workshop Size to					
		Kiln Size	0.21	8	0.5	no
		Kin Count	0.07	9	0.9	no
			0.00	7	0.5	no
		Clay Prep Area Size	0.66	6	0.9	yes
			0.11	3	0.5	no
		Potters' Wheel Count	0.79	5	0.9	yes
			0.98	3	0.5	yes
Distribution of Space v. Infrastructural Features						
	Number of Workshop Spaces to					
		Kiln Size	0.08	8	0.9	no
		Kin Count	0.00	9	0.9	no
		Clay Prep Area Size	0.26	5	0.9	no
		Potters' Wheel Count	0.05	4	0.9	no
Size / Count to Other Infrastructural Features						
	Kiln Count to					
		Clay Prep Area Size	0.00	4	0.5	no
		Potters' Wheel Count	0.61	5	0.9	yes
			0.75	3	0.5	yes
	Kiln Size to					
		Clay Prep Area Size	0.13	4	0.5	no
		Potters' Wheel Count	0.74	5	0.9	yes
			0.83	4	0.5	yes
	Potters' Wheel Count to					
		Clay Prep Area Size	0.86	4	0.5	yes

Table 5-13. Number of spaces traversed between each production stage.
Fields in grey are data unavailable from the excavation reports.

	Saga Table Ware Workshop	Saga Mold Made Wares Workshop	Pergamum Unit 2 (north)	Pergamum Unit 3	Dura Europos Workshop 1	Dura Europos Workshop 2	Delphi Secteur Sud-Est Workshop
Entrance to Clay Prep	2	2		2			2
Clay Prep to Throwing/Forming	1	0		1			1
Forming Space to Drying	1	2		2			0
Drying to Secondary Cutting/Forming	1	1 or 2		2			0
Secondary Cutting/Forming to Drying	1	1 or 2		2			0
Drying to Firing	2 or 3	2		1 or 2			1

Table 6-1. Clay preparation basin and vat data.
Fields in grey are data unavailable from the excavation reports.

Site Location	Vat Designation	Products	Dimensions	Surface Area (m2)
			* dimension measured from plans	
Petra, Jordan (Zurrabeh)	Basin 1	painted wares	L=1.20m, W*=1.20m, MPD=0.42m	1.44
Pergamum	Feature A, in Unit 1	table wares	2.8x2.2m	6.16
Pergamum	in Unit 2 (south)	table wares	2.88x1.49m*	4.2912
Pergamum	in Unit 3	table wares	2.55x2.15m*	5.4825
Pergamum	in Unit 4 (north)	table wares	1.53x1.44m*	2.2032
Pergamum	in Unit 4 (south)	table wares	2.26+ x 1.46m*	3.2996
Delphi	Feature 313*	amphorae & common wares	2.02 x 0.61m*	1.2322
Delphi	Feature 314*	amphorae & common wares	1.94 x 0.60m*	1.164
Khirbet Baraqa	Structure A	amphorae	4m diam	12.56
Kefar Hayanya	unknown	cooking ware	unknown	
Demirci	Four A.I,1	amphorae	2.30m diam	4.15265
Demirci	Four A. IV	amphorae	3.65 - 2.76m diam (slightly deformed)	8.064
Sagalassos Augustan	Sondage 99-1 & 2000 Trench 1 Soaking Pits	table wares	irregular and incompletely excavated	

Table 6-2. Kilns used in this chapter analysis. Green text indicates kilns dated to the Hellenistic period.

	Site Location	Kiln Designation	Dates	Products	Plan Shape	Roofing	Interior Dimensions (Combustion Chamber) * dimension extrapolated from plans
1	Zurrabeh (Jordan)	Kiln I +	3rd -4th c. AD	painted cups, plates, molded lamps and figurines	circular	domed	2.87x3.30m
2	Zurrabeh (Jordan)	Kiln II +	3rd -4th c. AD	painted cups, plates, molded lamps and figurines	oval	domed	0.90m diam
3	Zurrabeh (Jordan)	Kiln III ~	2nd c. AD	painted cups, plates, molded lamps and figurines	oval	domed	1.39-1.59m diam
4	Zurrabeh (Jordan)	Kiln IV ~	2nd c. AD	painted cups, plates, molded lamps and figurines	oval	domed	1.08m diam
5	Zurrabeh (Jordan)	Kiln V	6th c. AD	painted vessels	circular	open?	unknown
6	Zurrabeh (Jordan)	Kiln VI ^	1st - 3rd c. AD	unknown	circular	domed	1.60m diam
7	Zurrabeh (Jordan)	Kiln VII ^	1st - 3rd c. AD	unknown	oval	domed	1.70mx2.30m
9	Deir el-Haggar, Dakhleh Oasis (Egypt)	Kiln 1	Roman	pigeon pots	circular	unknown	1.81-89 m.
10	Deir el-Haggar, Dakhleh Oasis (Egypt)	Kiln 2	Roman	unknown	circular	unknown	1.40m.
11	Deir el-Haggar, Dakhleh Oasis (Egypt)	Kiln 3	Roman	unknown	circular	unknown	1.95m

12	Muzzawaka, Dakhleh Oasis (Egypt)	Kiln 4	Roman	unknown	circular	unknown	1.42-1.66m diam
13	Dakhleh Oasis (Egypt)	Kiln 5	Roman	unknown	circular	unknown	1.75m diam
14	Dura Europos (Syria)	îlot B2, Kiln 1	Roman	unknown	rectangular	unknown	7.8 x 4.20m
15	Dura Europos (Syria)	îlot B2, Kiln 2	late 2nd - 3rd c. AD	unknown	rectangular	unknown	3.14x0.73m* (exterior 4.1x1.60-1.70m)
16	Dura Europos (Syria)	îlot B2,Kiln 3	Roman	unknown	rectangular	unknown	2.59x1.13* (exterior3.4x2.2m)
17	Dura Europos (Syria)	îlot B2,Kiln 4	Roman	unknown	rectangular	unknown	2.89x0.80m* (exterior 3.7x1.70m)
18	Dura Europos (Syria)	in town, Kiln 5	50 BC-1st c. AD	unknown	oval	unknown	3.16x2.59m* (exterior 4.8x3.10)
19	Dura Europos (Syria)	in town, Kiln 6	Roman	unknown	rectangular	unknown	1.78x1.40* (exterior 3.95x1.90m)
20	Dura Europos (Syria)	îlot B3, Kiln 7	e. 1st c. AD	unknown	rectangular	unknown	3.01x0.81m* (exterior 4x2m)
21	Dura Europos (Syria)	îlot G7, Kiln 10	l. 2nd c. AD	unknown	rectangular	unknown	2.51x1.58m* (exterior 3.20x2.30-2.50m)
22	Kastelli, Crete (Greece)	Kiln 1	1st c. AD	amphorae (AC1)	circular	unknown	1.44-1.83m diam*
23	Kastelli, Crete (Greece)	Kiln 2	2nd c. AD	lamps	circular	unknown	0.94m diam*
24	Olympia (Greece)	Kiln 1	5th c. AD	common wares	circular	unknown	2.24m*
	Olympia (Greece)	Kiln 1	Hellenistic second-half 4th c. BC	unknown	rectangular	unknown	2.9m

25	Chios (Greece)	Kiln 1	early Roman	amphorae (Dr24), stands, spacer rings, possibly tile, ampullae, unguentaria jugs, funnels	rectangular	unknown	3.5x2.55m
26	Chios (Greece)	Kiln 2	early Roman	amphorae (Dr24), stands, spacer rings, possibly tile, ampullae, unguentaria jugs, funnels	rectangular	unknown	0.70x0.90m
27	Delphi (Greece)	Kiln 1 (312)*	6th c. AD	common wares	rectangular	unknown	2x1m
28	Delphi (Greece)	Kiln 2 (309)*	6th c. AD	common wares	rectangular	unknown	1.80x1.80m
29	Khirbet Baraqa, Ashkelon Region (Israel)	Kiln A	?-6th/7th c. AD	amphorae (Gaza Jars), jugs, bowls	circular	domed	4.0m diam
30	Khirbet Baraqa, Ashkelon Region (Israel)	Kiln B	?-6th/7th c. AD	amphorae (Gaza Jars), jugs, bowls	circular	domed	3.12m diam
31	Khirbet Baraqa, Ashkelon Region (Israel)	Kiln C	?-6th/7th c. AD	amphorae (Gaza Jars), jugs, bowls	circular	domed	3.0m diam
32	Kefar Hananya (Israel)	Kiln 1	late Roman	cooking pots and cooking bowls	circular	unknown	2.9m diam
33	Giv'ati Junction (Israel)	Kiln 1	l. 4th c. - 6th/7th c. AD	gaza' amphorae?	circular	domed?	4.2m diam
34	Khirbet Irza (Israel)	Kiln 1 (locus 10)	"Byzantine"	Gaza-type jars	oval	unknown	2.1m diam
35	Khirbet Irza (Israel)	Kiln 2 (locus 14)	"Byzantine"	Gaza-type jars	oval	unknown	unknown
36	Buto (Egypt)	P1 Four 3	Roman Imperial	red slip table wares	circular	unknown	0.97m diam*
37	Buto (Egypt)	P1 Four 4	Roman Imperial	red slip table wares	circular	unknown	0.88x1.0m*
38	Buto (Egypt)	P1 Four 5*	l. 1st - e. 2nd c. AD	red slip table wares	circular	unknown	0.89m diam*
39	Buto (Egypt)	P1 Four 6*	l. 1st - e. 2nd c. AD	red slip table wares	circular	domed	1.60m diam

40	Buto (Egypt)	P1 Four 7	Roman	unknown	circular	unknown	1.80m diam
41	Buto (Egypt)	P1 Four 36^	Roman	red slip table wares - jug, bowls	circular	domed	1.64m diam*
42	Buto (Egypt)	P1 Four 40^	Roman	red slip table wares - bowls, plates, lamps	circular	domed	1.5m diam*
43	Buto (Egypt)	P3 Four 6+	2nd - 4th c. AD	common ware jugs and cooking pots	circular	unknown	1.60m diam
44	Buto (Egypt)	P3 Four 7+	2nd - 4th c. AD	common ware jugs and cooking pots	circular	domed	1.62m diam
45	Eliaussa Sebaste (Turkey)	Kiln 1	4th - 6th c. AD	LR1 Amphorae, common wares	rectangular	unknown	unknown
46	Eliaussa Sebaste (Turkey)	Kiln 2	4th - 6th c. AD	LR1 Amphorae, common wares	rectangular	unknown	5x5.60m
47	Eliaussa Sebaste (Turkey)	Kiln 3 *	4th - 6th c. AD	LR1 Amphorae, common wares	rectangular	unknown	7x5m
48	Eliaussa Sebaste (Turkey)	Kiln 4 *	4th - 6th c. AD	Lamps, small vessels	rectangular ?	unknown	1.5x0.70m
49	Jerusalem (Israel)	Kiln 1 +	70 AD - 3rd c. AD	tile, brick, cook wares, fine wares	rectangular	unknown	1.47x2.79m*
50	Jerusalem (Israel)	Kiln 2 +	70 AD - 3rd c. AD	tile, brick, cook wares, fine wares	rectangular	unknown	2.85x1.36m*
51	Jerusalem (Israel)	Kiln 3 +	70 AD - 3rd c. AD	tile, brick, cook wares, fine wares	rectangular	unknown	2.96x1.46m*
52	Jerusalem (Israel)	Kiln 4 +	70 AD - 3rd c. AD	tile, brick, cook wares, fine wares	Phase I circular, Phase II rectangular	unknown	phase I diam 2.94m; phase II 2.71x1.22m*
53	Jerusalem (Israel)	Kiln 5 +	70 AD - 3rd c. AD	tile, brick, cook wares, fine wares	rectangular	unknown	2.31x3.17m*
54	Jerusalem (Israel)	Kiln 6 +	1st - 3rd c. AD	tile, brick, cook wares, fine wares	rectangular	unknown	2.75x0.55-1.05m*
55	Jerusalem (Israel)	Kiln 7 +	1st - 3rd c. AD	tile, brick, cook wares, fine wares	rectangular	unknown	unknown

56	Jerusalem (Israel)	Kiln 8 +	1st - 3rd c. AD	tile, brick, cook wares, fine wares	Phase I oval, Phase II rectangular	unknown	phase I 2.48x1.85m; phase II 2.91x0.71m*
57	Jerusalem (Israel)	Feature 502	1st c. BC - AD 70	cook wares	oval	unknown	1.4m*
58	Pergamon (Turkey)	Kiln 1 ~	1st c. BC- 1st c. AD	table wares	oval	unknown	1.02m diam* (exterior 2.4m)
59	Pergamon (Turkey)	Kiln 2 ~	1st c. BC- 1st c. AD	table wares	circular	unknown	1.93m diam* (exterior1.8m)
60	Pergamon (Turkey)	Kiln 3 ^	1st c. BC- 1st c. AD	table wares	circular	unknown	1.5m diam
61	Pergamon (Turkey)	Kiln 4 ^	1st c. BC- 1st c. AD	table wares	oval	unknown	1.44m diam * (exterior 2.5x1.9m)
62	Pergamon (Turkey)	Kiln 5 ^	1st c. BC- 1st c. AD	table wares	oval	unknown	1..48m diam * (exterior 2m diam)
63	Pergamon (Turkey)	Kiln 6 ^	1st c. BC- 1st c. AD	table wares	oval	unknown	1.6m diam (exterior 3x3.3m)
64	Pergamon (Turkey)	Kiln 7 *	1st c. BC- 1st c. AD	table wares	oval	unknown	1.8m diam (exterior 2.7x2.7m)
65	Pergamon (Turkey)	Kiln 17 *	1st c. BC- 1st c. AD	table wares	oval	unknown	1.6m diam
66	Pergamon (Turkey)	Kiln 8 +	1st c. BC- 1st c. AD	table wares	oval	unknown	unknown
67	Pergamon (Turkey)	Kiln 9 +	1st c. BC- 1st c. AD	table wares	oval	unknown	1.5m diam (exterior 2.3x2.5m)
68	Pergamon (Turkey)	Kiln 10 +	1st c. BC- 1st c. AD	table wares	rectangular	unknown	unknown
69	Pergamon (Turkey)	Kiln 11 +	1st c. BC- 1st c. AD	table wares	oval	unknown	2m diam

70	Pergamon (Turkey)	Kiln 12	1st c. BC- 1st c. AD	table wares	oval	unknown	1.7m diam
71	Pergamon (Turkey)	Kiln 13	1st c. BC- 1st c. AD	table wares	circular	unknown	1.6m diam (exterior 3.4x2.8m)
72	Desert Road Alexandria-Cairo (Egypt)	Km 203 Amphora Kiln	late Roman	amphorae	circular	unknown	5.76m diam*
73	Burg El-Arab, Mareotis Region (Egypt)	Kiln 10	late Roman	Dressel 2-4 amphorae	circular	unknown	7.40m diam
74	Burg El-Arab, Mareotis Region (Egypt)	Kin 12	late Roman	unknown	circular	unknown	1.60m diam
75	Kerameikos, Athens (Greece)	1977-Kiln 1	4th - 6th c. AD	unknown	circular	domed	1.71m diam*
76	Kerameikos, Athens (Greece)	Kiln 1	3rd -4th c. AD	lamps	rectangular	unknown	0.72x0.84m*
77	Kerameikos, Athens (Greece)	Kiln 3	4th - e. 5th c. AD	lamps	rectangular	unknown	1.22x0.75m*
78	Kerameikos, Athens (Greece)	Kiln 4 ^	4th - e. 5th c. AD	lamps	rectangular	unknown	1.23x1.16m*
80	Kerameikos, Athens (Greece)	Kiln 10^	4th - e. 5th c. AD	lamps	rectangular	unknown	1.10x0.95m*
81	Kerameikos, Athens (Greece)	Kiln 6	3rd -4th c. AD	lamps	rectangular	unknown	1.01x0.95m*
82	Evangelismos Station, Athens (Greece)	Kiln 3	early to mid Roman	coarse ware	circular	unknown	2.20 m
83	Demirci, Sinope Region (Turkey)	A.I,1*	first-half 4th c. AD	Amphorae Sinope Group C	oval	tubular domed	2.4x2m
84	Demirci, Sinope Region (Turkey)	A.I,1 bis*	second-half 4th c. AD	Amphorae Sinope Group C	oval	tubular domed	2.4x2m

85	Demirci, Sinope Region (Turkey)	A.II,2	second-half 4th c. AD	Amphora Sinope I	oval	unknown	2.90x2.60m
86	Demirci, Sinope Region (Turkey)	A.I,2	early 4th - end 5th c. AD	unknown	oval	unknown	unknown
87	Demirci, Sinope Region (Turkey)	A.II,3	early 4th - end 5th c. AD	Amphorae Sinope Group C, III (early red fired)	oval	tubular domed	2.77x2.23m
88	Demirci, Sinope Region (Turkey)	A.IV	early 4th - end 5th c. AD	amphorae	oval	unknown	3.65x2.76m
89	Demirci, Sinope Region (Turkey)	A.III,1	5th c. AD	Amphorae Sinope Group C, II and III (early red fired)	circular	tubular (filled) domed with tile fitted over roof	1.57m diam
90	Demirci, Sinope Region (Turkey)	B.II,1	5th c. AD	Amphorae Sinope Group C, II and III (early red fired)	oval	tubular (filled) domed with tile fitted over roof	1.48x1.41
91	Demirci, Sinope Region (Turkey)	A.III,2	6th c. AD	Amphorae Sinope Group D, III (later buff fired)	oval	tubular (open tubulars) domed with tile fitted over roof	2.92x1.77m
92	Demirci, Sinope Region (Turkey)	B.II,2	6th c. AD	Amphora Sinope Group D, III	circular	tubular (open tubulars) domed with tile fitted over roof	2.47x2.39m
93	Demirci, Sinope Region (Turkey)	A.I,3	6th c. AD	Amphorae Sinope Group D, I (later buff fired)	oval	unknown	unknown
94	Demirci, Sinope Region (Turkey)	B.III	6th c. AD	Amphorae Sinope (later buff fired)	oval	tubular (open tubulars) domed with tile fitted over roof	2.45x1.85m
95	Nisikoy, Sinope Region (Turkey)	Kiln 1	Hellenistic until l. 3rd/e. 2nd c. BC		circular	unknown	2.10m diam
97	Zeytinlik, Sinope Region (Turkey)	Kiln 1	Hellenistic after 3rd c. BC	amphorae	oval	unknown	2 - 2.5 m diam
98	Sagalassos (Turkey)	Tableware Workshop Kiln 2	4th - 5th c. AD	table wares	circular	unknown	1.05 diam

99	Sagalassos (Turkey)	Tableware Workshop Kiln 4	4th - 5th c. AD	table wares	circular	unknown	1.2 diam
100	Sagalassos (Turkey)	Coroplast Workshops Kiln 1 ~	6th c. AD	molded wares, figurines, lamps	circular	unknown	1.27 diam
101	Sagalassos (Turkey)	Coroplast Workshops Kiln 2	6th c. AD	molded wares, figurines, lamps	circular	unknown	1.23 diam
102	Sagalassos (Turkey)	Coroplast Workshop Kiln 4	6th c. AD	molded wares, figurines, lamps	circular	unknown	1.17 diam
103	Sagalassos (Turkey)	Coroplast Workshop Kiln 5 ~	6th c. AD	molded wares, figurines, lamps	oval	unknown	1.47 diam
104	Sagalassos (Turkey)	Coroplast Workshop Kiln 6	6th c. AD	molded wares, figurines, lamps	circular	unknown	0.91 diam
105	Sagalassos (Turkey)	Coroplast Workshop Kiln 7 *	6th c. AD	molded wares, figurines, lamps	circular	unknown	0.78 diam
106	Sagalassos (Turkey)	Coroplast Workshop Kiln 8 *	6th c. AD	molded wares, figurines, lamps	circular	unknown	0.74 diam
107	Sagalassos (Turkey)	Coroplast Workshop Kiln 9 *	6th c. AD	molded wares, figurines, lamps	circular	unknown	1.15 diam
108	Sagalassos (Turkey)	Coroplast Workshop Kiln 10 *	6th c. AD	molded wares, figurines, lamps	unknown	unknown	1.31 diam
109	Sagalassos (Turkey)	PQ Sondage 99-3 Kiln 1	pre- l. 1st c. BC - e. AD 1st c.	table wares	oval	unknown	1.85m diam
110	Sagalassos (Turkey)	PQ2001 Kiln 4	pre- l. 1st c. BC - e. AD 1st c.	table wares	rectangular with double firing chambers	unknown	5 x 2.8m
111	Sagalassos (Turkey)	PQ 2001 Kiln 5	l. 2nd c. to l. 3rd century AD	table wares	circular	unknown	2.10 diam
112	Sagalassos (Turkey)	PQ 2002 Kiln 6	early Roman	table wares	circular	unknown	1.8m diam

113	Epitalio, Elia (Greece)	Kiln 1	2nd c. AD	common wares painted & unpainted plates, cooking pots	circular	unknown	4.5 diam
114	Tell Atrib (Egypt)	Overview of c. 20 Hellenistic Kilns	4th c. BC to late Ptolemaic	slipped bowls, plates, jugs	circular	domed?	c. 0.7m diam
115	Tell el-Haraby (Egypt)	Overview of 2 Hellenistic Kilns	Ptolemaic	amphorae	circular	domed?	c. 5.0m diam
116	Kom Dahab (Egypt)	Kiln 1	late Ptolemaic	amphorae	circular	domed?	2.85m diam

Table 6-3. Frequencies and relative frequencies of kiln design type per site.
NB: only cases when the site had more than one kiln is listed.

Site Location	n	Freq. Circular	Freq. oval	Freq. rect	Rel. freq. circular	Rel. freq. oval	Rel. freq. circular & oval	Rel. freq. rect
Pergamon	14	10	3	1	71.43%	21.43%	92.86%	7.14%
Demirci, Sinope Region	12	4	8		33.33%	66.67%	100.00%	
Sagalassos	12	11	1		91.67%	8.33%	100.00%	
Dura Europos	8		1	7		12.50%	12.50%	87.50%
Jerusalem	8	1	1	6	12.50%	12.50%	25.00%	75.00%
Buoto, Egypt	7	7			100.00%		100.00%	
Zurrabeh (Petra)	7	4	3		57.14%	42.86%	100.00%	
Kerameikos (Athens)	6	1	5		16.67%	83.33%	100.00%	
Eliaussa Sebaste	4			4			0.00%	100.00%
Deir el-Haggar, Dakhleh Oasis Region	3	3			100.00%		100.00%	
Khirbet Baraqa, Ashkelon Region	3	3			100.00%		100.00%	
Khirbet Irza	2		2			100.00%	100.00%	
Kastelli	2	1	1		50.00%	50.00%	100.00%	
Chios	2			2			0.00%	100.00%
Delphi	2			2			0.00%	100.00%

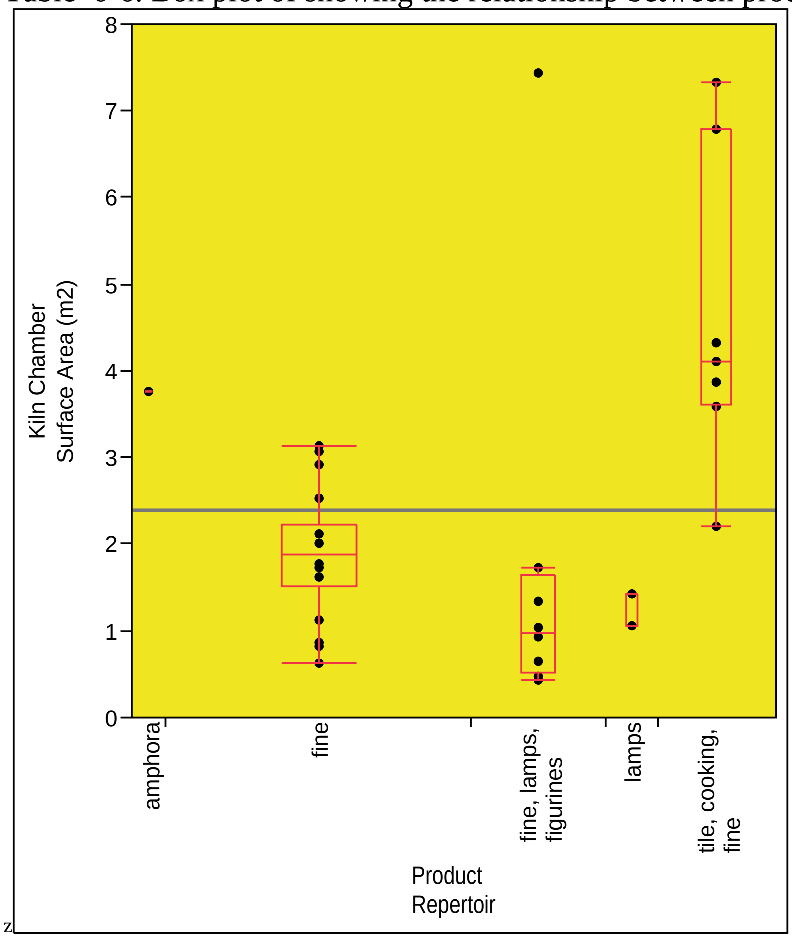
Table 6-4. Frequencies and relative frequencies of kiln construction material per site. Sites with both kilns constructed in both mudbrick and fired brick are indicated in orange text.

	Frequency Fired Brick	Mudbrick	Unknown	Relative Frequency Fired Brick	Mudbrick	Unknown
Petra	7			100	0	0
Dakhleh Oasis		2	3	0	40	60
Dura Europos		8		0	100	0
Kastelli		2		0	100	0
Chios	2			100	0	0
Delphi	2			100	0	0
Khirbet Baraqa		3		0	100	0
Khirbet Irza	2			100	0	0
Buto	2	7		22	78	0
Elaiussa Sebaste		4		0	100	0
Jerusalem	8			100	0	0
Mareotis	1	2		33	67	0
Athens	7			100	0	0
Demirci	12			100	0	0
Sagalassos	12	2		86	14	0

Table 6-5. Kilns sizes within same workshop. Kiln sizes in workshops that produce lamps (in part) are highlighted in orange text indicating that in cases in which lamps are produced, at least one kiln is always <1m² in surface area.

Workshop Location	Product description	Surface Area of Kiln Floor (m2)
Zurrabeh	fine wares, lamps, figurines	7.43
		0.64
Zurrabeh	fine wares, lamps, figurines	1.73
		0.92
Eliaussa Sebaste	amphora, common wares, lamps	35.00
		1.05
Athens (Kerameikos)	lamps	1.43
		1.05
Sagalassos	fine wares, lamps, figurines	0.48
Sagalassos		0.43
Sagalassos		1.04
Sagalassos		1.35
Zurrabeh	fine wares	2.01
		3.07
Buoto	fine wares	0.62
		2.01
Buoto	fine wares	2.11
		1.77
Jerusalem	tile, cooking, fine ware	4.10
		3.88
		4.32
		6.79
		7.32
		2.20
		unknown
		3.60
Pergamon	fine wares	0.82
		2.92
Pergamon	fine wares	1.77
		1.63
		1.72
		2.01
Pergamon	fine wares	2.54
		2.01
Pergamon	fine wares	unknown
		1.77
		unknown
		3.14
Demirci	amphora	3.77
		3.77
Sagalassos	fine wares	0.87
Sagalassos		1.13

Table 6-6. Box plot of showing the relationship between product type and kiln size.



FIGURES

Figure 2-1. Map of archaeological case studies used in the dissertation. Labels correspond to those noted in Table 2-1. Blue points indicate single workshop sites. Green points indicate multiple workshops at a production site or production area.

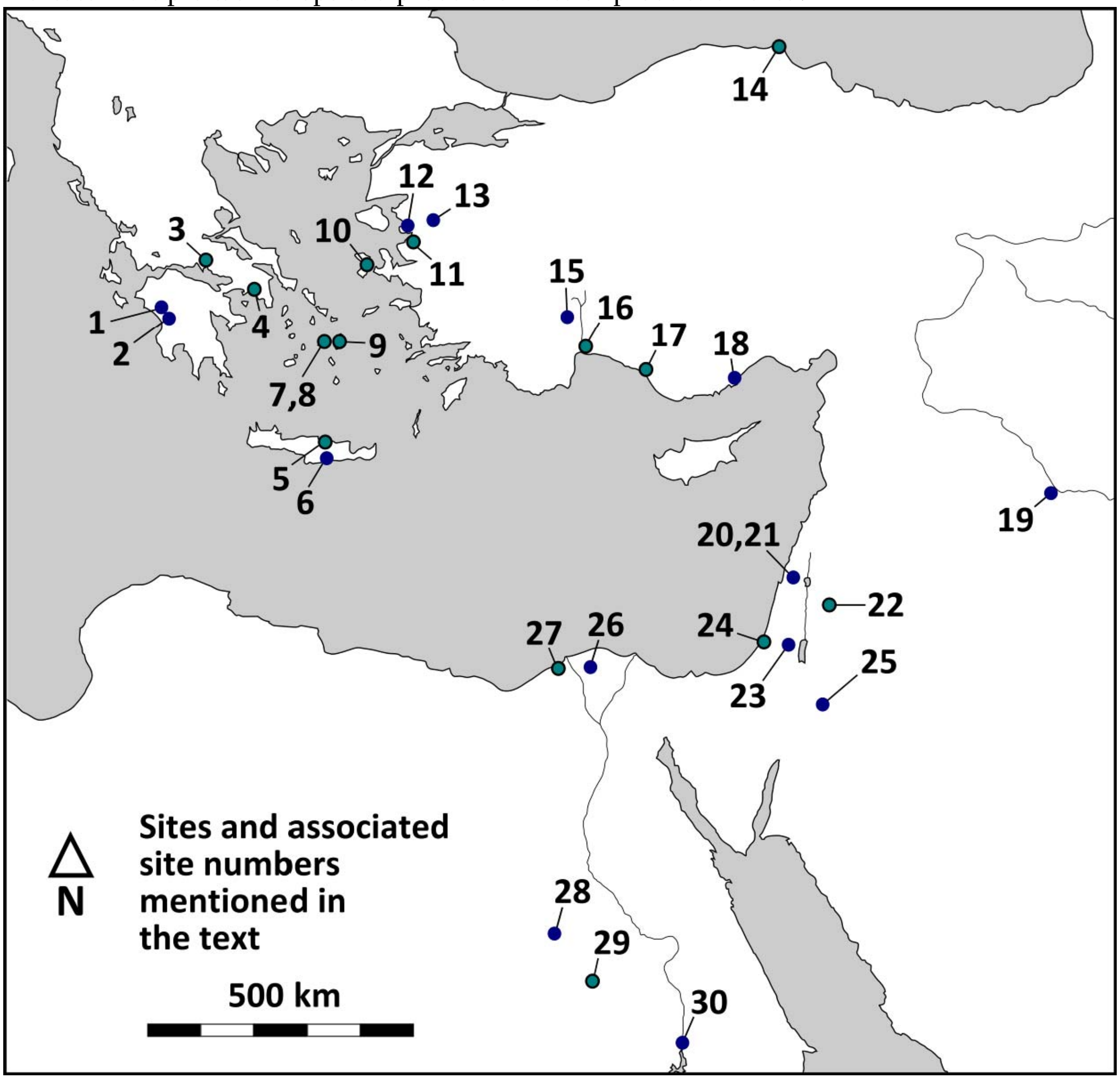


Figure 2-2. Map of ethnographic case studies used in the dissertation. Labels correspond to those noted in Table 2-2.

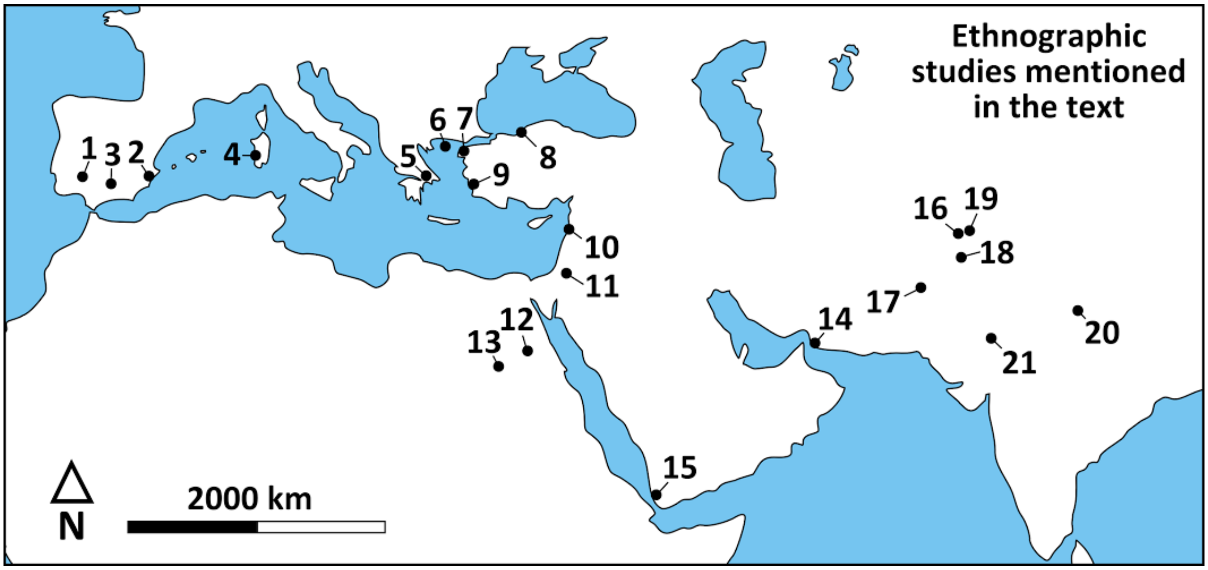


Figure 3-1. Map of western Lake Mareotis with amphora production sites indicated. From Empereur and Picon 1998: 76, fig. 1.

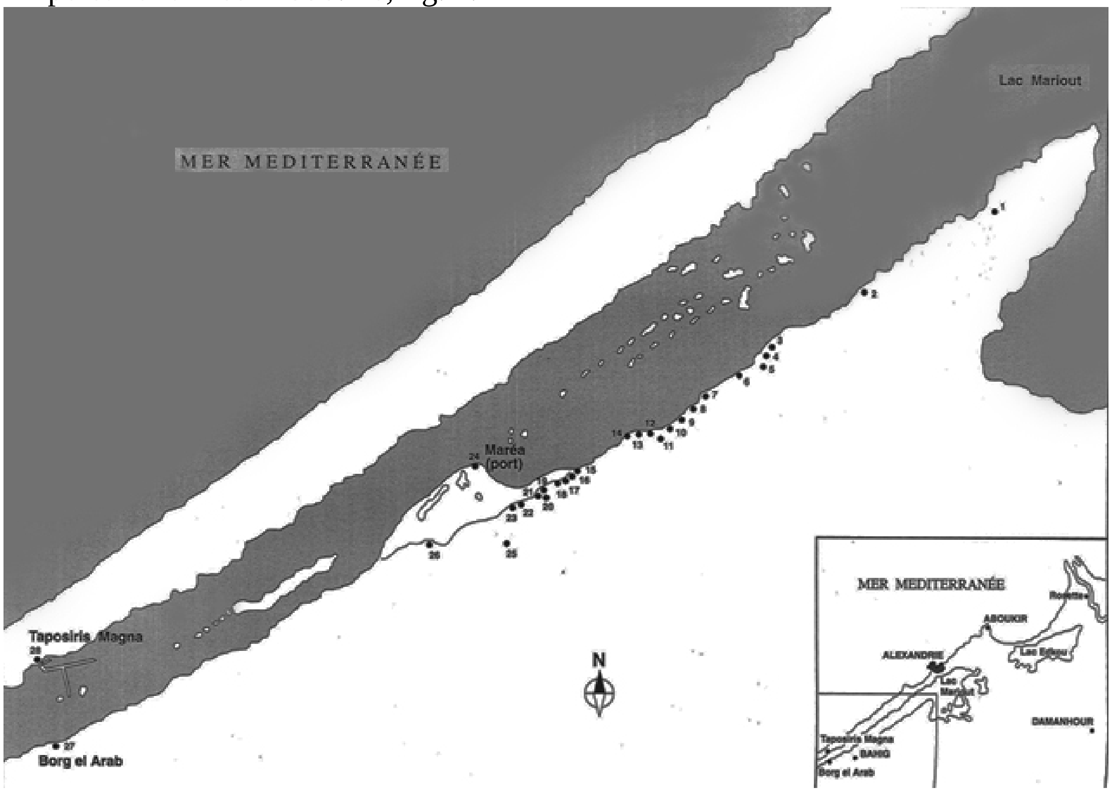


Figure 3-2. Egyptian Amphorae Types. From Empereur and Picon 1998: 77-78, figs. 2-5.

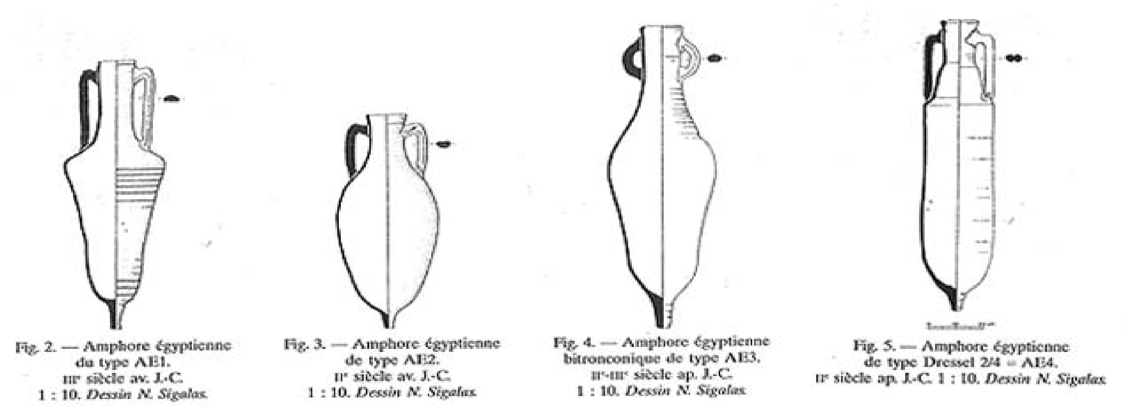


Figure 3-3. Map of southern Palestine with evidence of amphora production. From Israel 1995: 106, fig. 111.

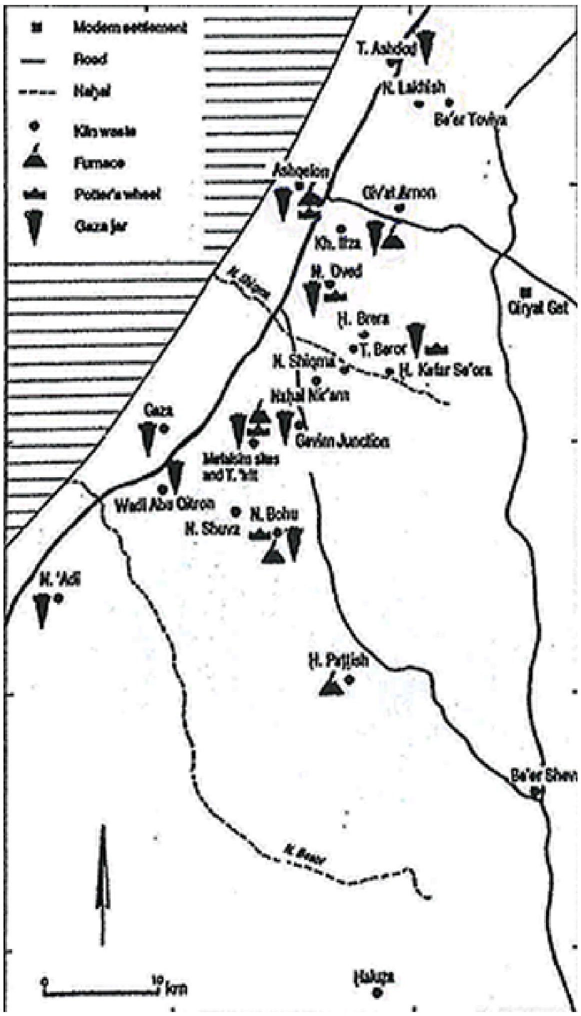


Figure 3-4. Triple *Türsteine* stele with hand tools depicted in the arches. Left arch contains a stick and bells (of a herder). Middle arch frames a perfume bottle, hand mirror, and comb (of a woman). The right arch frames a hammer, pliers, and an anvil (of a smith). From Waelkens 1977, no. 387, pl. 52

Figure 3-5. Stele with blacksmith work scene.
From Pfuhl and Möbius 1977, no. 1170, pl. 175.

Figure 3-6. Stele with blacksmith work scene.
From Pfuhl and Möbius 1977, no. 1169, pl. 175.

Figure 3-7. Sarcophagus lid of Marcus Aurelius Ammianos from Hierapolis.
From Ritti, Grewe *et al.* 2007: 138-40, figs. 2 and 3.

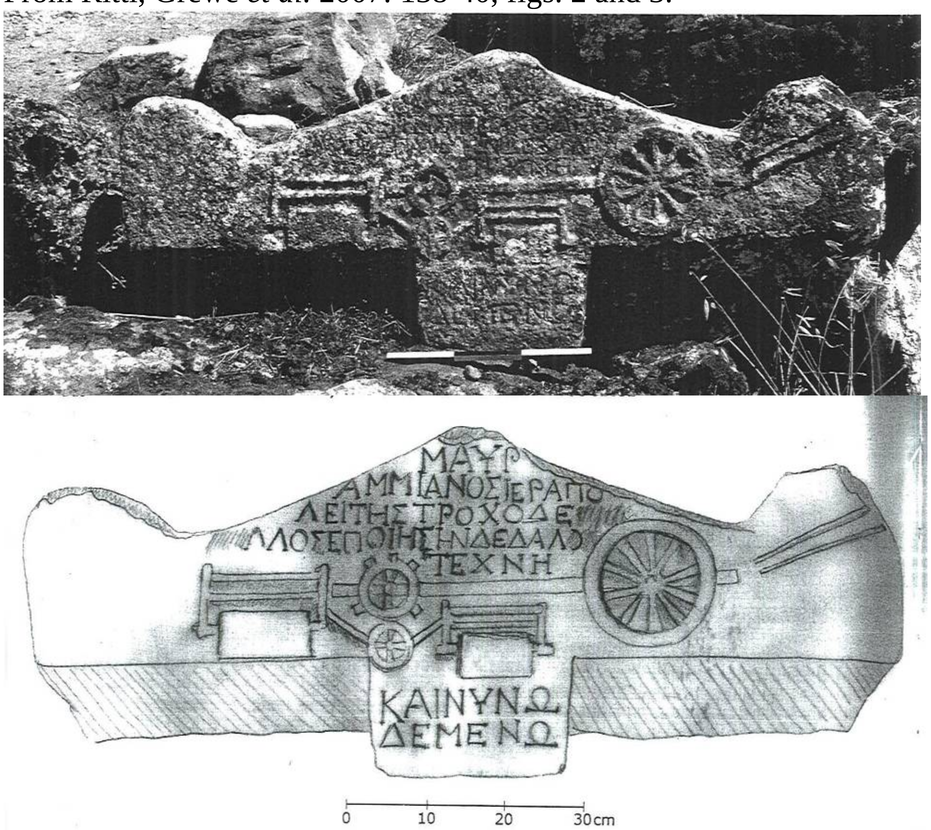


Figure 4-1. Four phases of Hellenistic production at the Jerusalem production site. From Berlin 1995: 32, fig. 2 and tab. 3.

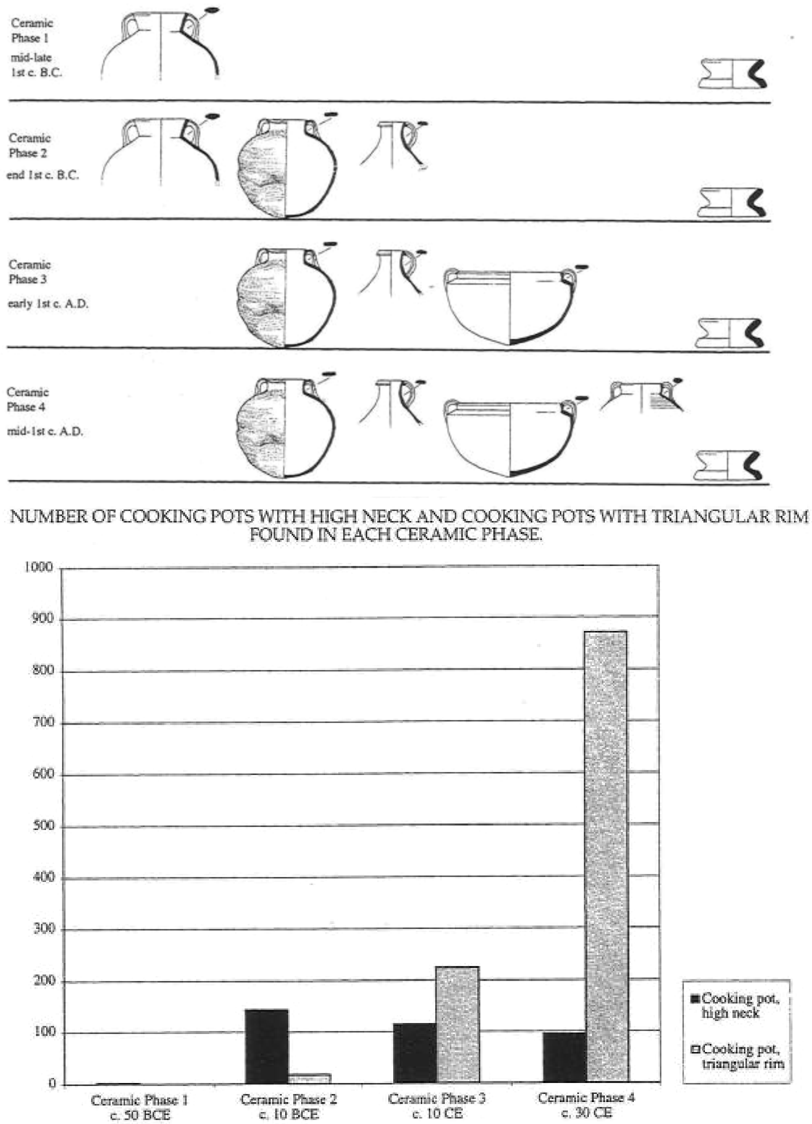


Figure 4-2. Sub-type variations in the production of Egyptian Amphora toes. From Dixneuf 2011: 380, fig. 174.

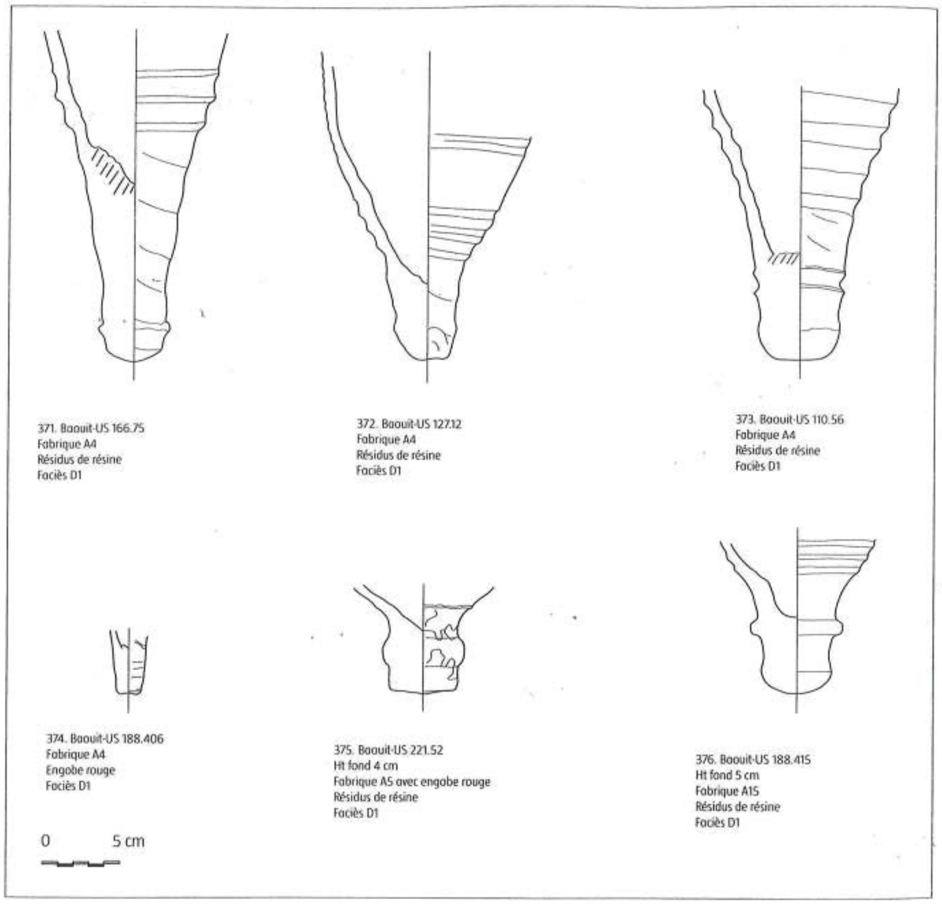


Figure 4-3. Locations of Egyptian Amphora production sites from the Hellenistic and Roman periods. From Dixneuf 2011: 387, fig. 181.

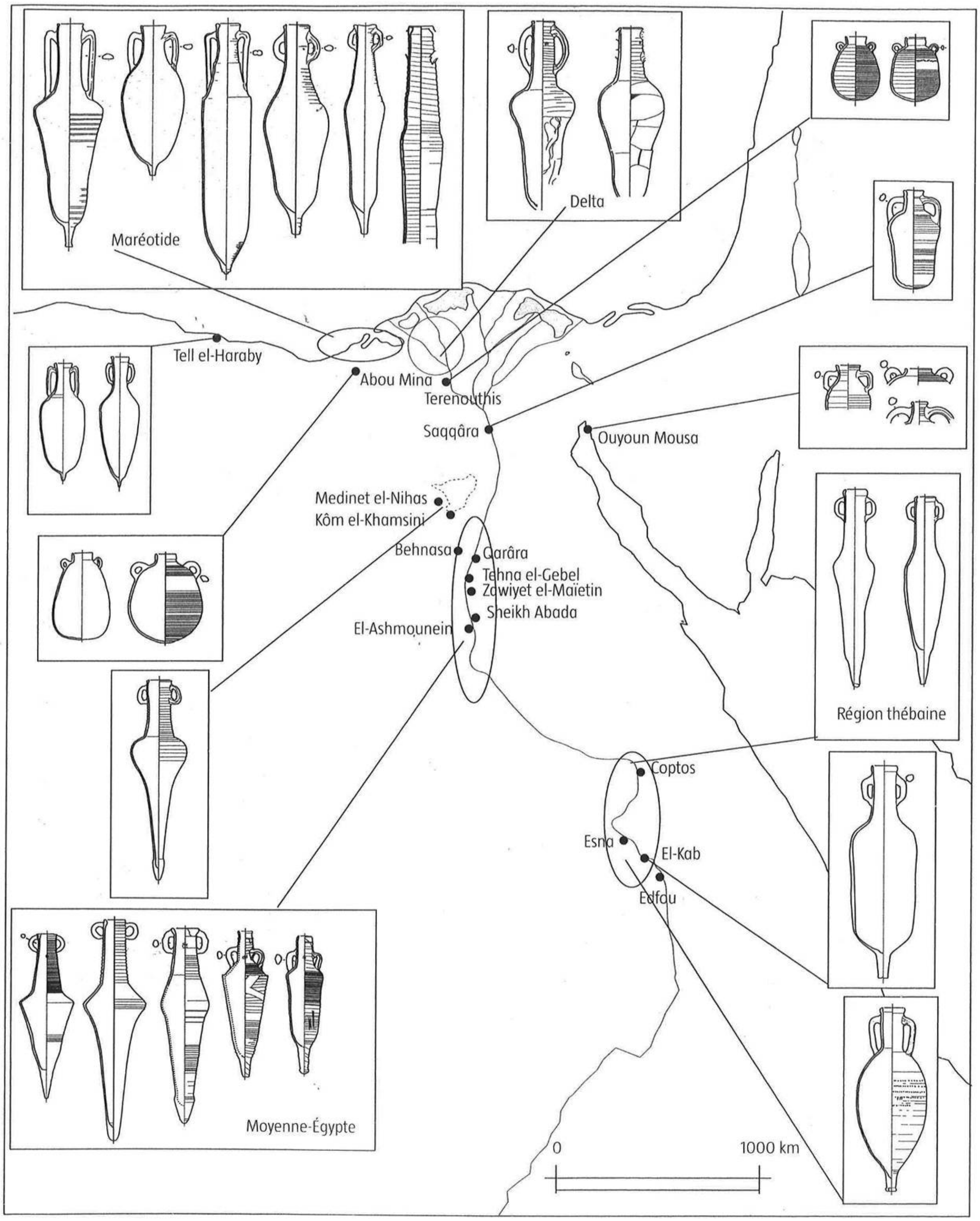


Figure 4-4. Range of forms, including hemispherical bowls, *skyphoi*, and collared cups, manufactured by a 1^{st} – 2^{nd} c. AD workshop at Buto, Egypt. From Ballet *et al*. 2006: 29, fig. 12.

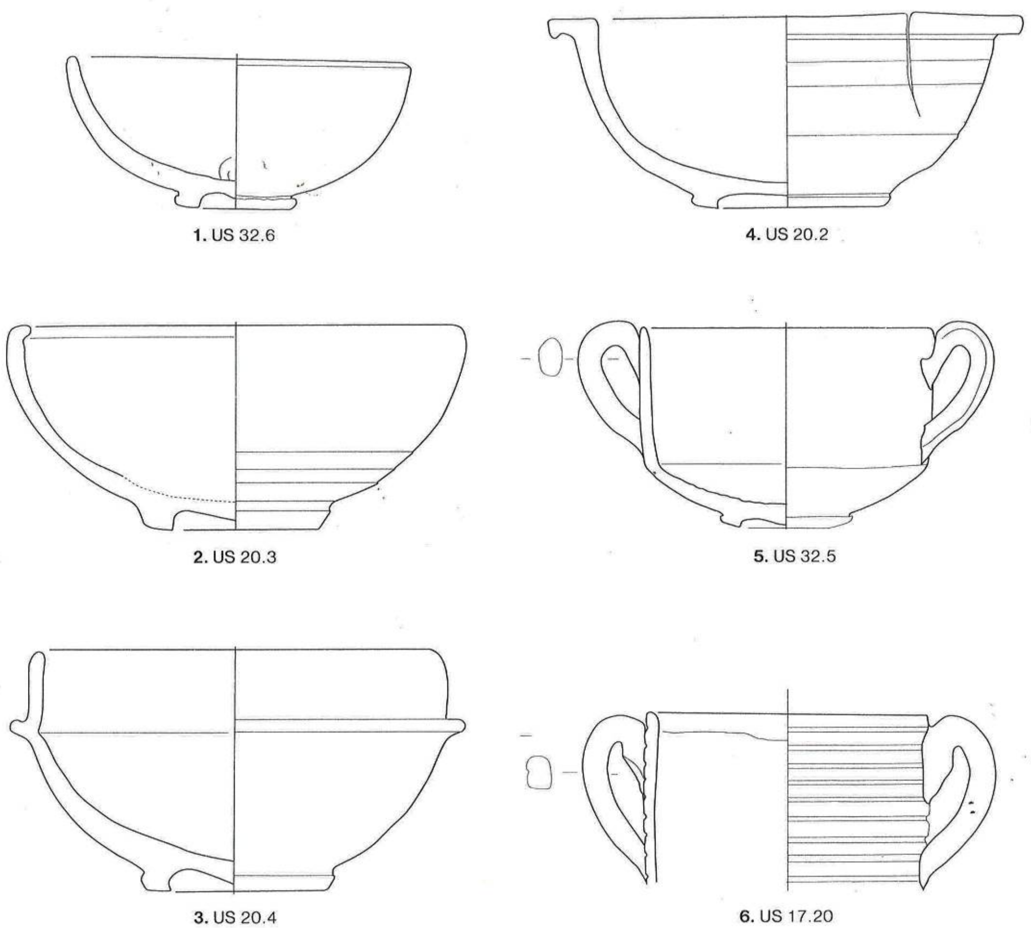


Figure 4-5. Example of a Sagalassos red slip ware *mastos* cup (1A140). From Waelkens *et al.* 2011: 65.

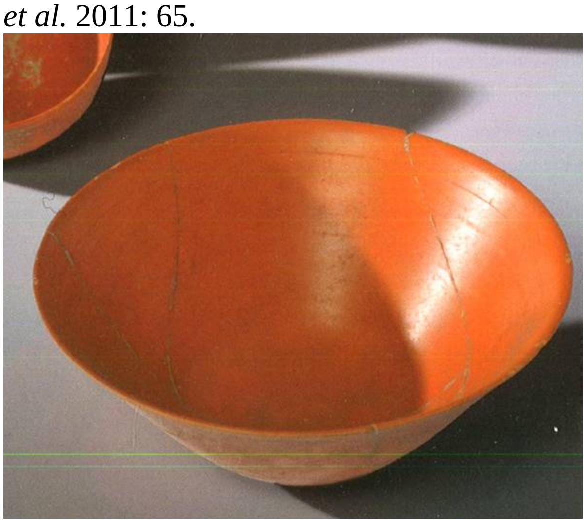
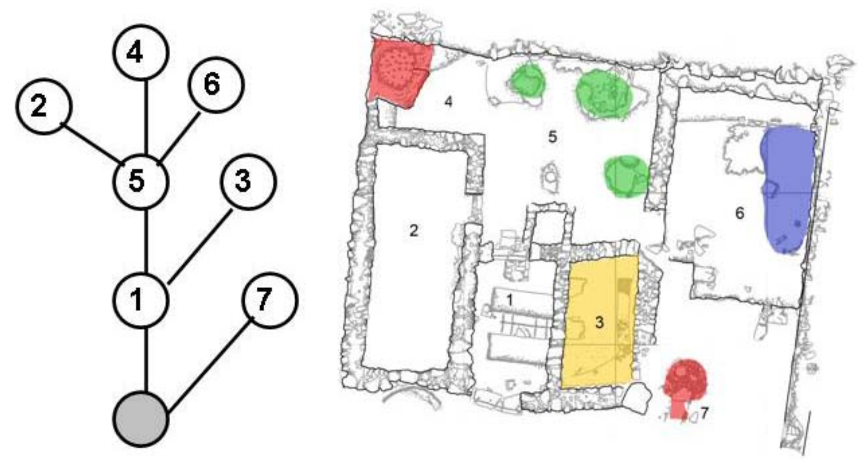
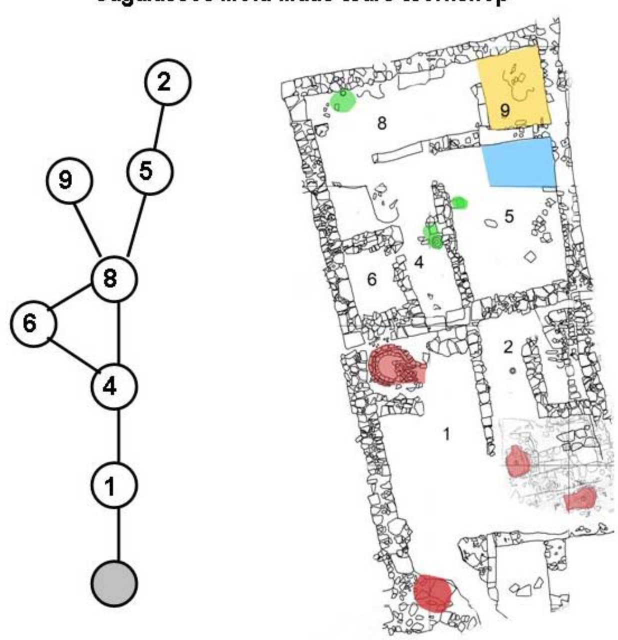


Figure 5-1. Access graphs of with plan marking the locations of different of infrastructure, when such information is available. All room numbers were assigned anew and do not necessarily correspond with the assigned by the original excavators. *blue* – clay preparation, *green* – throwing/forming station, *yellow* – drying space, *red* – kiln.

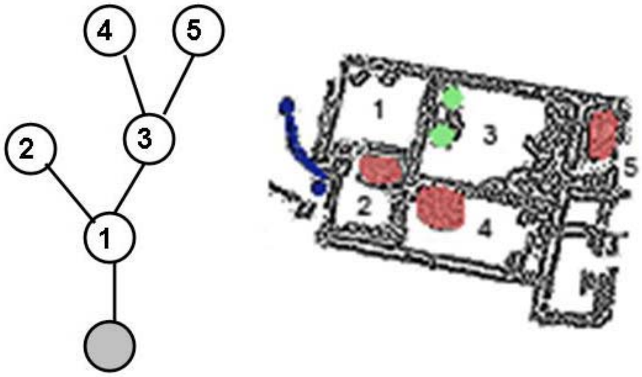
Sagalassos Table Ware Workshop



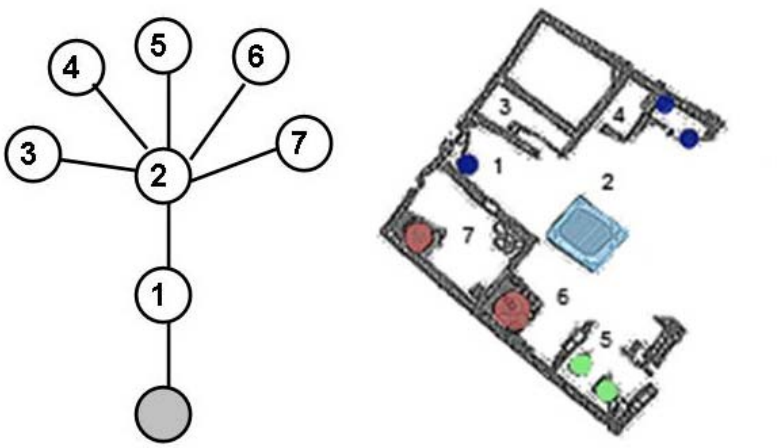
Sagalassos Mold Made Ware Workshop



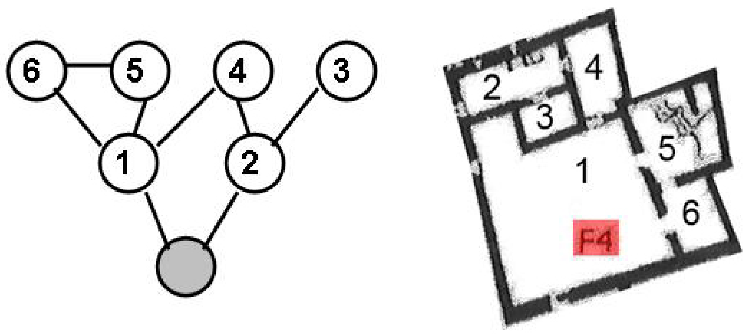
Pergamum Unit 2 North



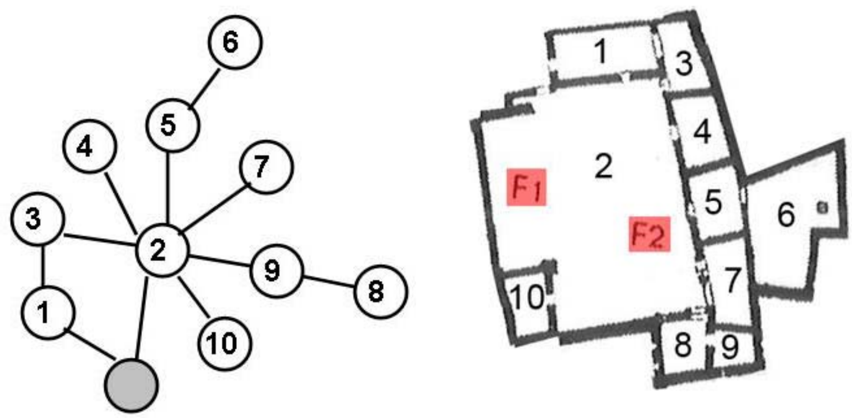
Pergamum Unit 3



Dura Europos Workshop 1



Dura Europos Workshop 2



Delphi Secteur Sud-Est Workshop

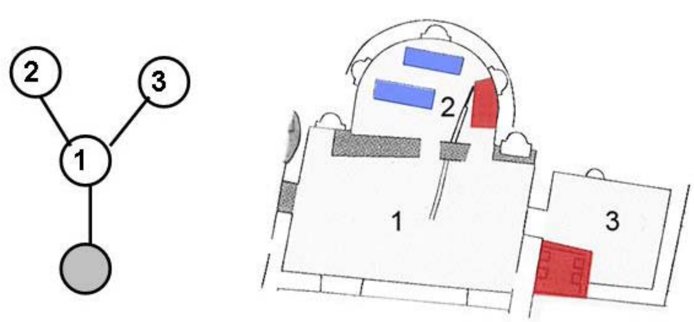


Figure 5-2. Relative Size of Workshop Units (all plans to same scale). Labels as follows: (a) Jerusalem Complex, (b) Dura Europos Workshop 1, (c) Dura Europos Workshop 2, (d) Sagalassos Mold-Made Wares Workshop, (e) Sagalassos Tableware Workshop, (f) Pergamum Unit 2 north, (g) Pergamum Unit 3, (h) Zurrabeh, Petra Workshop, (i) Gerasa Hippodrome *Cavea* Workspace, (j) Delphi Secteur Sud-Est Workshop.

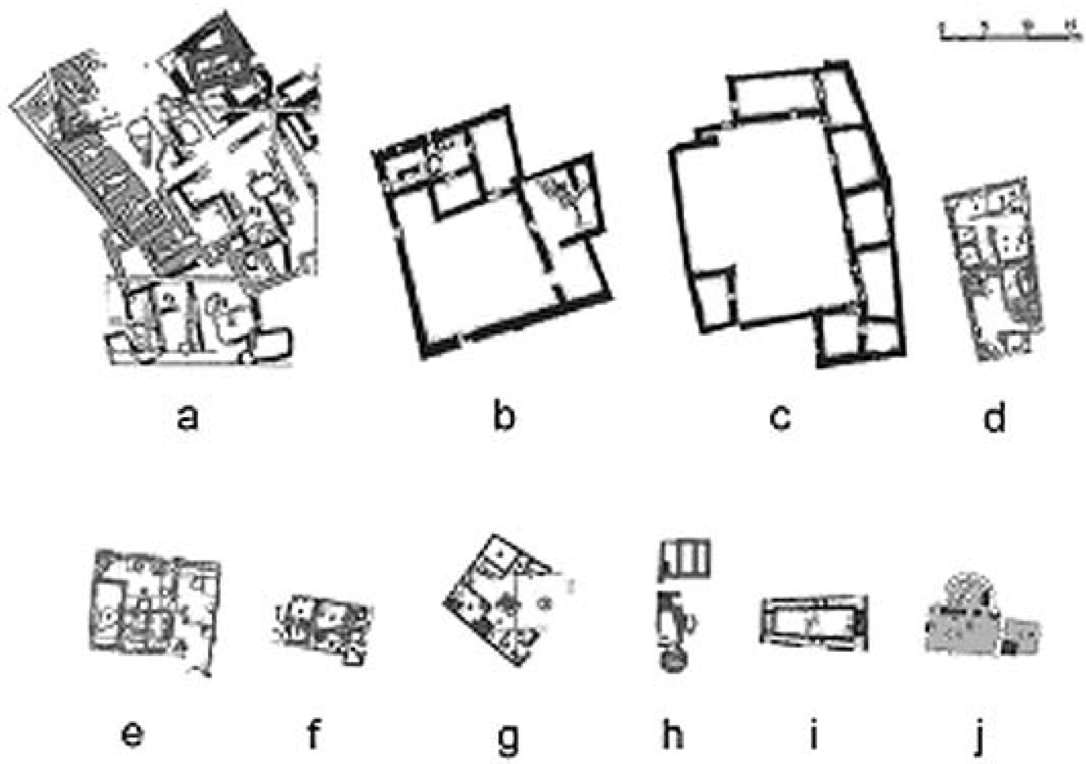


Figure 6-1. Reconstruction of tubular 'terra sigillata kiln'. From Martin 1996: fig. 29.

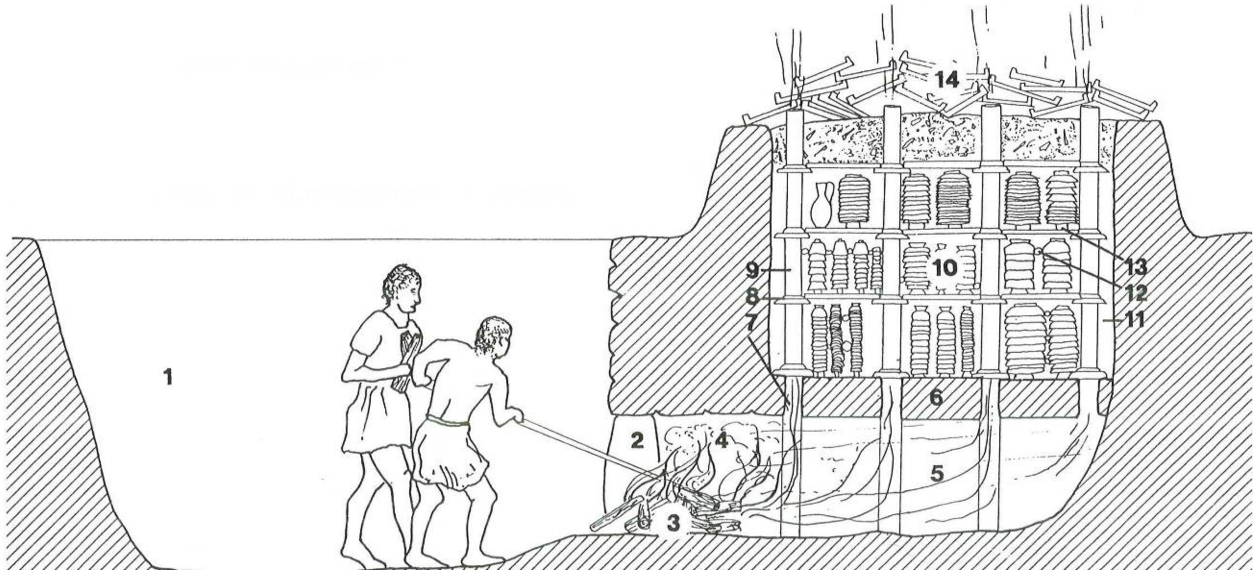


Figure 6-2. Reconstruction of ARSW kiln with cassettes (or saggers) indicated. From Bonifay 2004: fig. 32b.

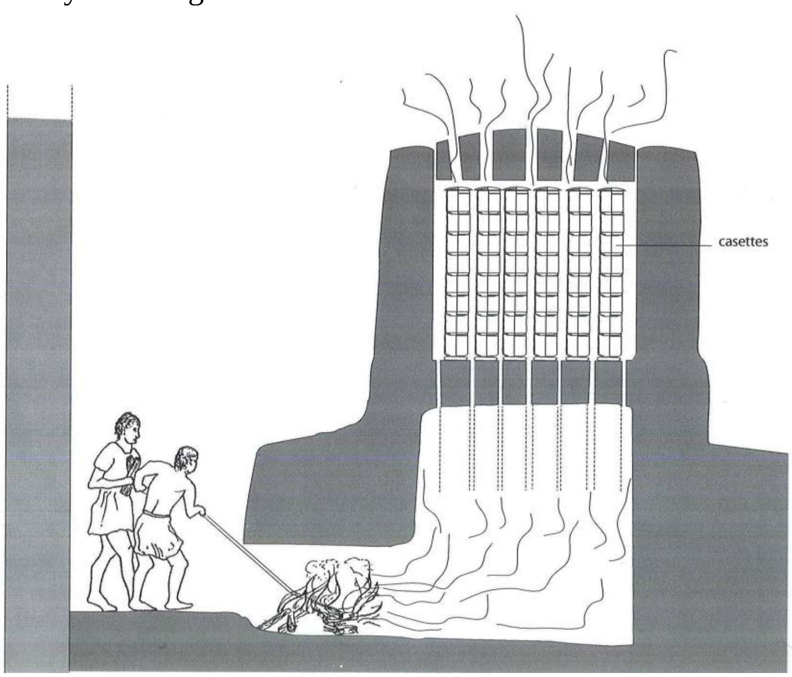


Figure 6-3. Plan of a kick wheel. From Rice 1987: fig. 5.9d.

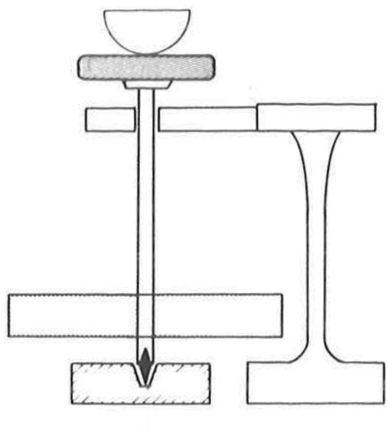


Figure 6-4. Image of a potter at his wheel, stamped impression on an ARSW vessel. From Mackensen 1993: fig. 12.

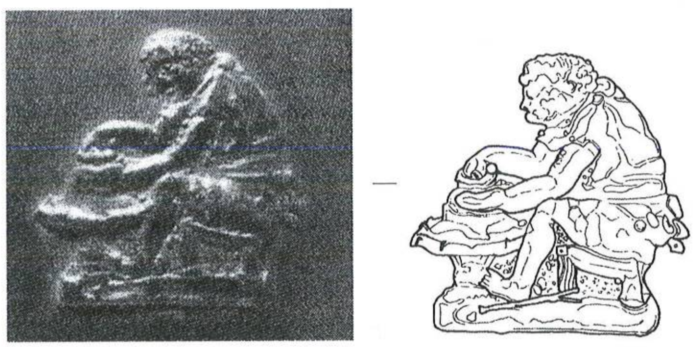


Figure 6-5. Drawing of wall fresco showing <u>*putti*</u> at work in a pottery in the House of Vettii, Pompeii. From Dufaÿ *et al*. 1997: fig. 34b.

Figure 6-6. Pottery wheel typology. From Dufaÿ *et al*. 1997: figs. 34-8.

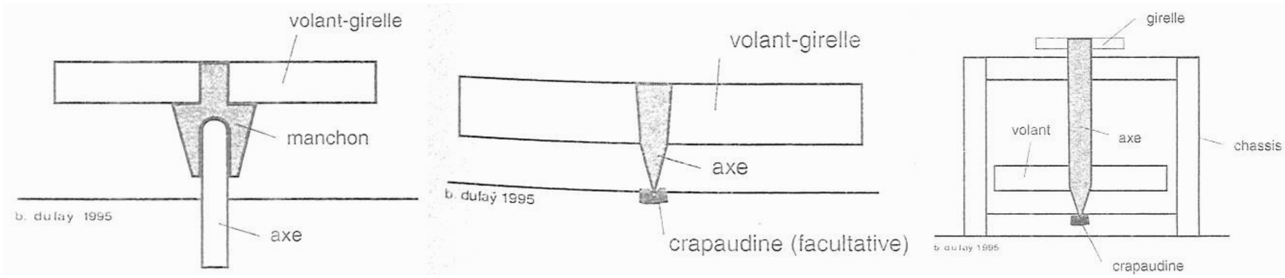


Figure 6-7. Archaeological examples of pottery wheels. Labels as follows: (A) from Demirci (From Tezgör 2010: fig. 1); (B) from Sagalassos Mold-Made Wares Workshop (image kindly provided by the Sagalassos Archaeological Research Project); (C) from Jerusalem Complex (image kindly provided by H. Goldfus); (D) from Sagalassos Tableware Workshop (image kindly provided by the Sagalassos Archaeological Research Project).

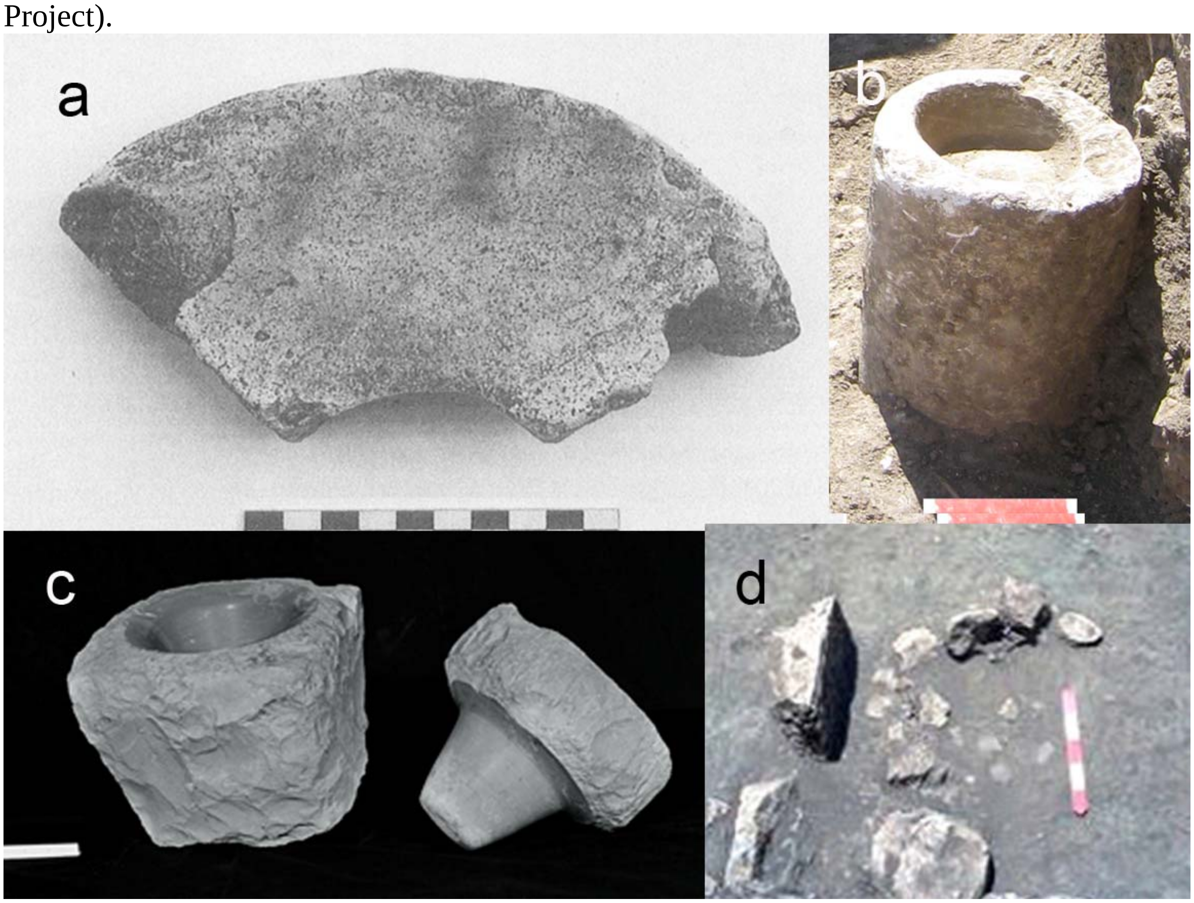


Figure 6-8. (A) *pila* hypocaust tile with base fragment, (B) fragments of the undersides of a Sagalassos Fabric 3 container bases with hypocaust *pila* tile impressions, (C) example of nearly complete Sagalassos Fabric 3 container. Images courtesy of the Sagalassos Archaeological Research Project.

Figure 6-9. Kiln typology. From Swan 1984: figs. II and III.

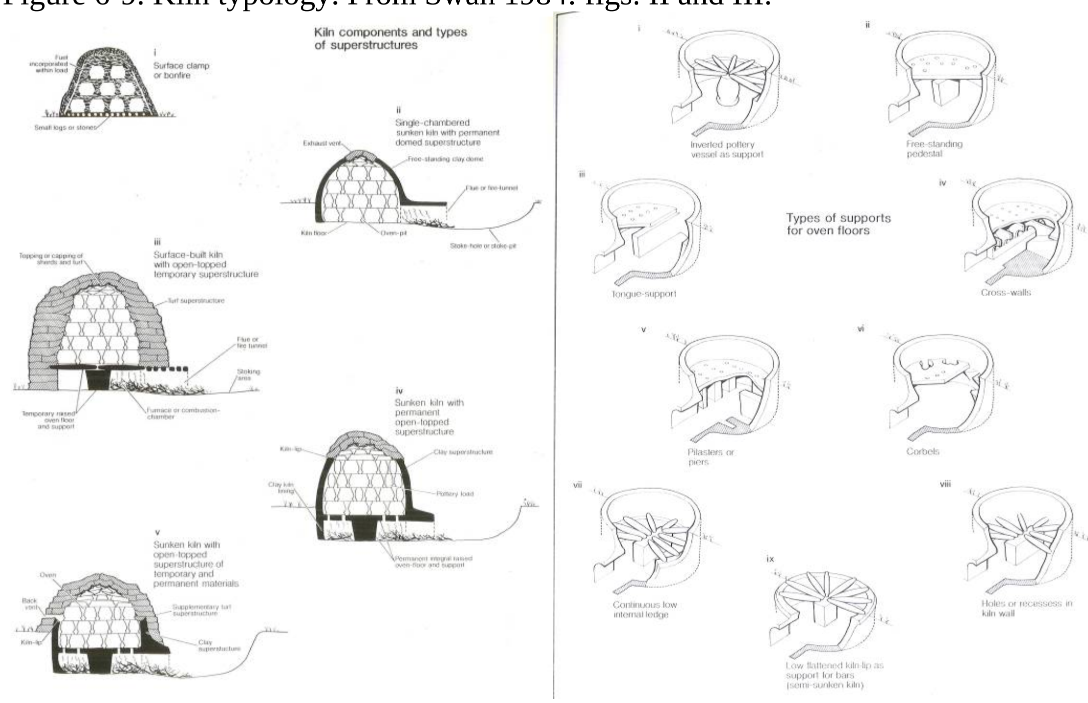


Figure 6-10. Kiln typology. From Cuomo di Caprio 2007: figs. 168-169.

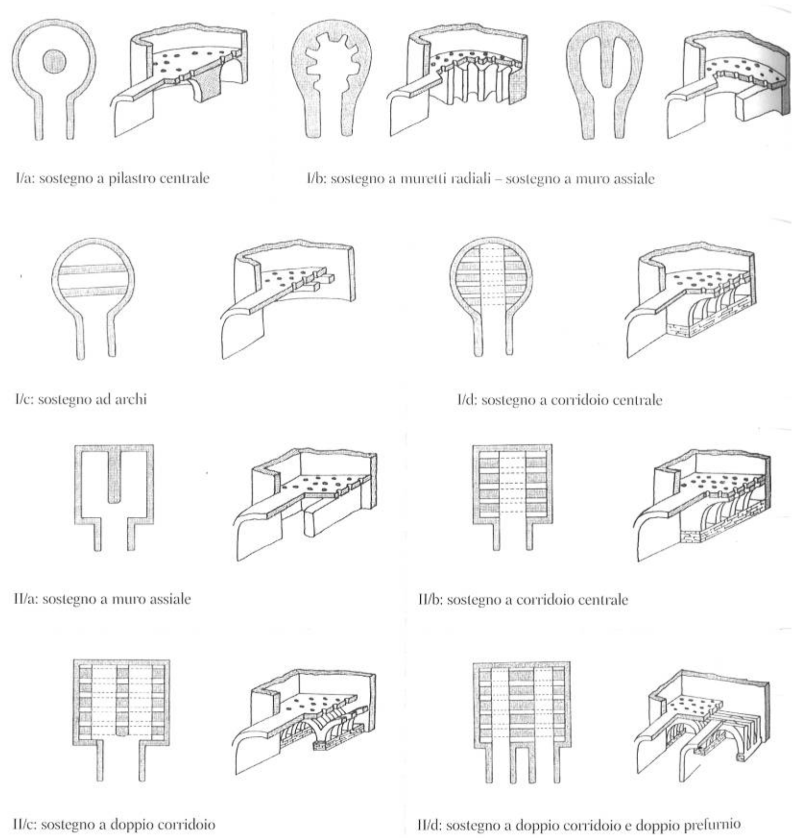


Figure 6-11. Schematic of a simple updraft kiln with parts mentioned in the text: (A) Temporary Superstructure Roofing or Covering, (B) Firing Chamber, (C) Combustion Chamber, (D) Flue, (E) Stoke Hole. From Rice 1987: fig. 5.22. [Letters added here.]

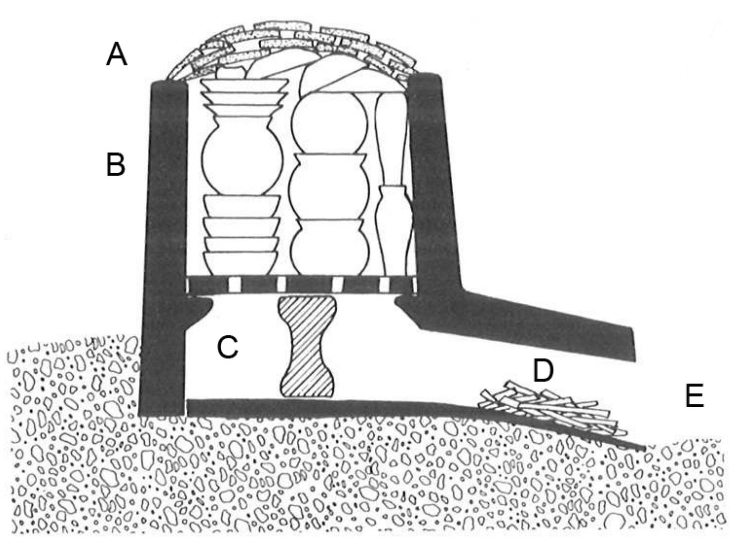


Figure 6-12. Demirci reconstruction of tubular kiln. From Tezgör 2010: fig. 1.

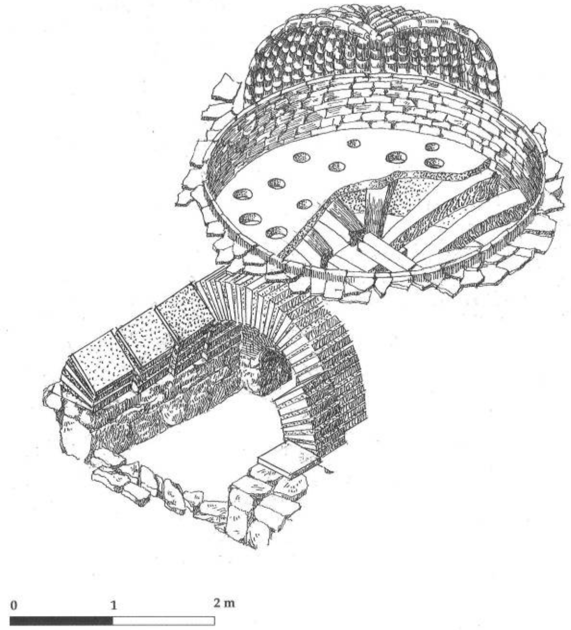


Figure 6-13. Buto tubular kiln section drawing. From Ballet *et. al* 2006: fig. 4.

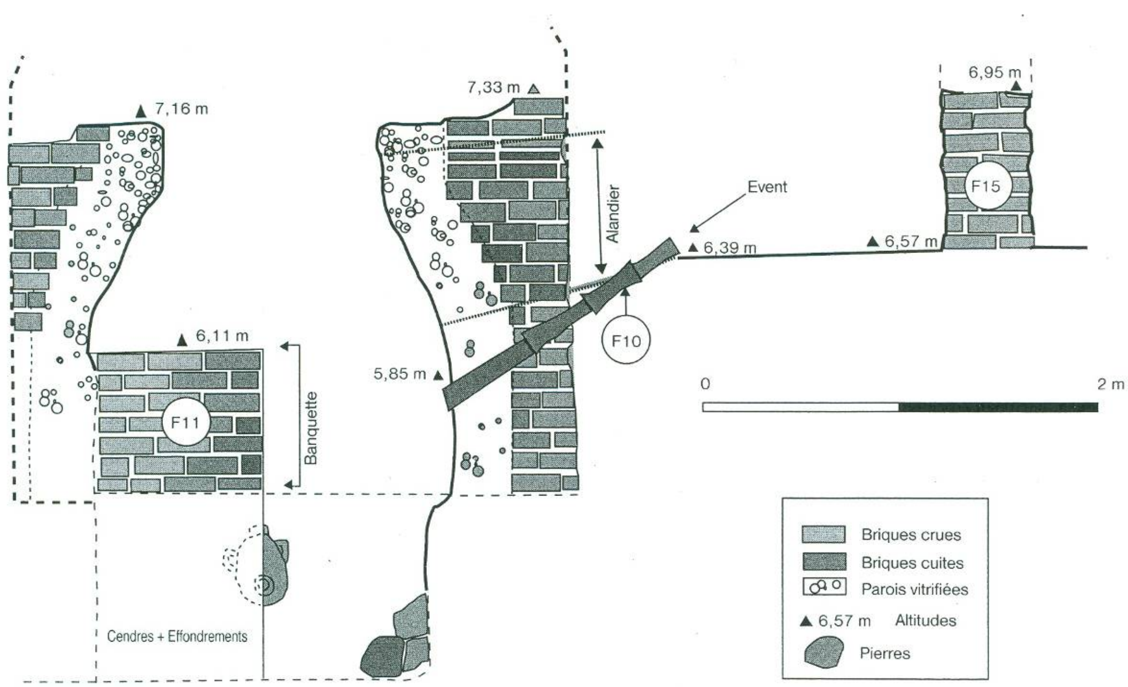


Figure 6-14. Classical period depiction of beehive kiln. Corinthian plaque F611. From Hasaki 2002: fig. 21.

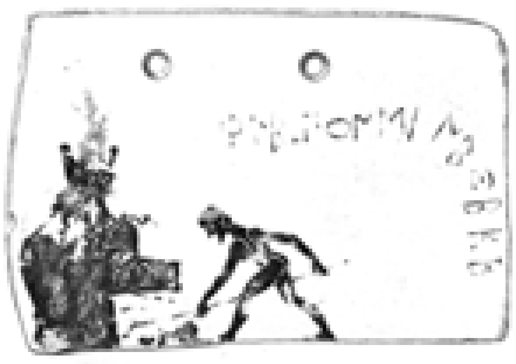
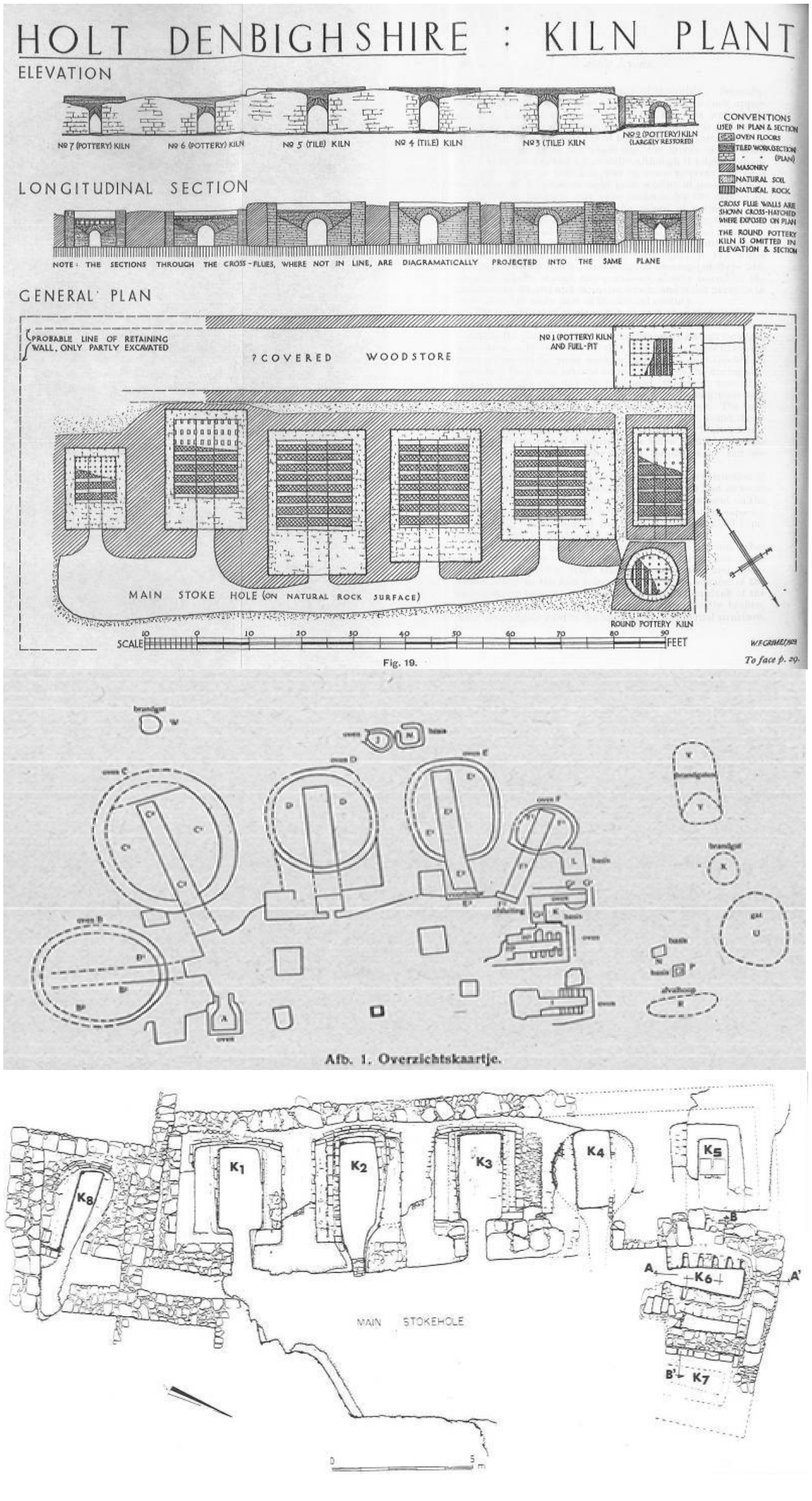


Figure 7-1. Comparison of the kilnworks of the legionary production sites at Holt in Britain (top), Holdeurn in Holland (middle) and at Jerusalem in Israel (bottom). Top image from Grimes 1930; middle image from Holwerda and Braat 1946; bottom image from Arubas and Goldfus 1995.



APPENDIX 1

P. Oxy. L 3593 Transl. in Cockle (1981) and Bowman *et al.* (1983).

'To Aurelia Leontarus(?) *and Aurelia Plusia and however you are styled through Aurelius…odorus your guardian from Aurelius Paesis son of Helpaesutas and Thaisus who lives in the village of Senepta, a potter who makes wine jars. Of my own free will I undertake to take on lease for a period of two years from the current month Thoth of the present seventh year the pottery for the making of wine jars which belongs to you in the large farmstead of your estate around Senepta together with its store rooms, kiln, potter's wheel, and the other equipment on condition that each year I make for you, fire, refire, and coat with pitch what are termed Oxyrhynchite four-chorus jars to the number of fifteen thousand, one hundred and fifty double ceramia, and one hundred and fifty two-chous jars, while you provide the friable earth, the sandy and the black earths, sufficient firing material for the kiln, water for the cistern, and for coating with pitch twenty-six talents of pitch in weight by the measure of Aline for the ten thousand jars and I provide for myself sufficient potters, assistants, and stokers and receive for the price of the single ceramia only, thirty-two drachmas per hundred and as special payment for the ten thousand jars two ceramia of wine and two ceramia of sour wine. The total payment of four thousand eight hundred drachmas I shall receive annually in the following installments: from Thoth to Pachon four hundred drachmas a month, in Payni and Epeiph for firing five hundred drachmas a month, and in Mesore the remaining two hundred drachmas. If over and above the aforesaid number I make other jars and you have need of them, you will be able to take them provided I receive from you the equivalent price and the pitch and the other things in the same way as for the aforesaid number. If my undertaking is confirmed, I shall hand over the aforesaid jars on the drying-floors of the said pottery from the winter manufacture, well fired and coated with pitch from the foot to the rims, not leaking and excluding any that have been repaired or are blemished, each four-chous jar holding up to the rim twenty Maximian cotylas and at the end of the period I shall hand over the said potter free from ash and sherds. The right of the execution is as is proper and the account of whatever I may appear to owe shall remain outstanding. The undertaking is irrefutable and in answer to the formal question I gave my assent. The seventh year of the Imperator Caesar Marcus Antonius Gordianus Pius Felix Augustus, Thoth 7.'*

(2nd hand) 'I, Aurelius Paesis son of Hephasetas, have taken the pottery on lease and shall carry out the making of the aforesaid fifteen thousand jars, one hundred and fifty double ceramia, and one hundred and fifty two-chous jars for the above price and special payments and I shall hand them over as aforesaid and in answer to the formal question I gave my assent. I, Aurelius Theon, also called Asclepiades, wrote for him because he is illiterate. The account is outstanding as specified above.'

P. Tebt II 342
2nd century AD papyrus text on confiscated property, which includes a description of the property of a pottery workshop. Translation accessed from <papyri.info> .

(Col. III) *And the several plots in accordance with the survey-list presented in Hathyr of the 12th year by Noumenios the agent; that which was previously drawn up by Orpheus* […] *Starting on the south of the southern road* […] *adjoining on the east is the pottery formerly belonging to Lepton and leased to Tothes (according to an agreement made) in the 24th year which is also the 1st year* […], *of which it was reported that a lease was made in the 3rd year through Tothes son of Thothes son of Hermesion of Hermopolis, registered in the West Guardhouse quarter and resident at the village Somolo, and Amenneus son of Petepsais of Sesoncha in the Mochite toparchy, resident at the said Somolo, who took over, for 7 months from the 1st of the month Mecheir of the 3rd year until the 5th intercalary day of the said year and for 3 years from Thoth 1 of the 4th year, the newly fitted pottery at Somolo together with all furniture and with stones in good order, and supplied with everything including two potter's stools* (?) *and as many doors in position as the aforesaid pottery and its furniture need, and with keys and windlass for watering and well for the pottery, at the rent of the aforesaid 7 months of* […] *pots, and from the 4th year for the remaining period of 3 years at the yearly rent of 1*[…] *pots, all of which they shall deliver every year at the drying place of the pottery in good order, being of winter manufacture and of the pattern of the Oxyrhynchite potteries of the god; and after the yearly rent they shall further deliver at the price* […] *2000 pots in good order of the aforesaid pattern, which* […] *shall receive. They shall also be provided with the vacant space surrounding the pottery on the south for digging earth, porous clay and sand, they themselves doing the digging and the transport of the same to the pottery at their own expense. They shall further receive in the aforesaid period of 7 months an advance without interest of 640 silver drachmas in three installments* […] (Here the papyrus breaks off)