SOCIAL COMPLEXITY IN ANCIENT EGYPT: FUNCTIONAL DIFFERENTIATION AS REFLECTED IN THE DISTRIBUTION OF APPARENTLY STANDARDIZED CERAMICS

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Abstract

SOCIAL COMPLEXITY IN ANCIENT EGYPT: FUNCTIONAL DIFFERENTIATION AS REFLECTED IN THE DISTRIBUTION OF APPARENTLY STANDARDIZED CERAMICS

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"Mass-production" of vessels and by extension the emergence of pottery specialists is a function of the economics of monumental constructions in Old Kingdom Egypt (ca 2700 – 2200 BC, historically). Evidence for pottery specialization comes in two forms; widespread similarity in vessel forms known throughout Egypt, and artistic representations. To date, however, it has been difficult to quantify the differences between pottery assemblages. One historically recognized form, often referred to as the "Meidum" bowl (due to its initial discovery at the pyramid site of Meidum) is examined to determine how the rim construction of such vessels varies across space and through time.

Variation in vessel rim form results from the fact that ideas for making pottery are moving through communities of potters and pottery workshops. Therefore, the instructions for making the "Meidum" bowl can be properly considered a "meme." The fidelity with which memes are reproduced results from simple geographic distance between groups charged with making pots, all things being equal. If similarities between assemblages of objects are not consistent with geographic proximity, this opens the possibility of regional scale (as opposed to local scale) factors sorting variation.

While radiocarbon studies challenge traditionally established absolute dates, the large error terms assigned the radiocarbon dates cannot be used to test assumptions about regnal sequences and durations estimated from robust historical reference to astronomical phenomena. As a result, regnal sequences and durations reported in historical documents are used as a highly resolved relative chronological tool.

Objects from sites representing short-term occupations at Kom el-Hisn, Giza, Meidum, Memphis and the Badari region are compared to materials from Elephantine, a stratified long-term occupation. Assemblages are compared using analysis of variance and discriminant function analysis to determine whether differences between locations is a function of simple distance between locations or larger scale factors. It is determined that the distribution of Meidum bowl variants reveals the existence of both regional and local scale factors sorting variation. This indicates that while some communities examined in this study are linked by long distance interaction, others are not.

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DEDICATION

In loving memory of my father, Donald J. Sterling, Jr.
Gang Forward

CHAPTER 1: INTRODUCTION

The elaborate monumental constructions that characterize the Egyptian Archaic and Old Kingdom periods (ca 3000 – 2100 BC) spawned a series of specialized occupations which included stonemasons, coppersmiths, carpenters and potters. A reduction in overall regional scale variation in pottery manufacturing techniques from 3500 – 2600 BC is roughly coincident with the development of mortuary elaboration, thus giving the impression that pottery standardization and monumental constructions are part of the same phenomenon. As more materials and labor were required to build the cemeteries of the Old Kingdom, pottery vessels played a large role as part of the support infrastructure for these massive constructions, manufactured for such diverse functions as baking bread, storing foodstuffs, copper smelting and beer brewing. The reduction in variation in vessels typical of the Old Kingdom relative to the Predynastic period (ca 3500 – 3000 BC) suggests standardization and by extension craft specialization.

The overall reduction of variation in pottery production is part of a larger suite of traits including monumental construction, writing and long distance trade that scholars invoke as evidence of "centralization" (e.g. Baines and Yoffee 1999; Midant Reynes 2000). The research presented here will examine whether Old Kingdom pottery truly meets the expectations of standardization by examining morphological and large scale compositional differences over time and throughout the Nile Valley and Delta, the area encompassed by the Old Kingdom "state" (see figure 1-1).

Craft specialization studies often fall under the rubric of the study of social complexity as a phenomenon, for the obvious reason that a complex society is characterized by some degree of occupational specialization (or functional differentiation). This in turn implies the existence of

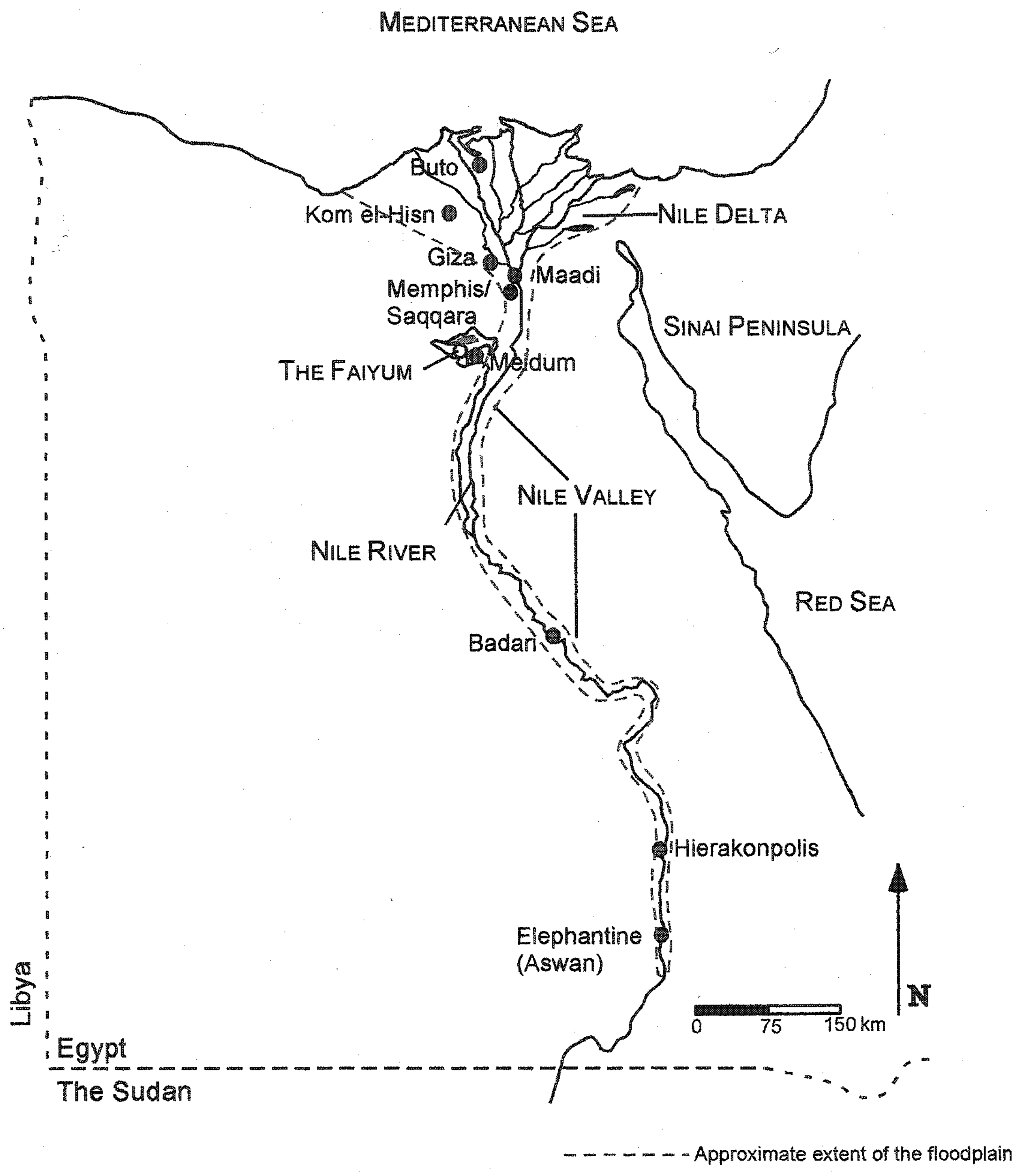


Figure 1-1. Map of sites mentioned in text.

some form of distributional system to support the individuals who engage in the practice of pottery manufacture. The extent to which pottery production is "centralized" therefore, has implications for the scale of economic factors at work that facilitate the redistributive economy. It is generally conceded that more uniformity in production results from a high rate of production and a reduction in the number of individuals involved in pottery manufacture, and this by extension implies economic specialization (Costin 1991; Costin and Hagstrum 1995; Roux 2003:768). A natural focus for the study of the relationship between specialized crafts and larger socioeconomic factors, therefore, would be to examine the degree to which pottery assemblages over space and through time appear to be "standardized."

"Standardization" has been generally defined in the archaeological literature as a relative degree of homogeneity or reduction in variability in artifact characteristics; in the case of pottery, this has encompassed form, decoration and paste composition (Arnold 2000; Blackman et al. 1993:61; Neff et al. 1997; Rice 1991:268). The identification of standardization is usually determined by "comparison of two or more artifact assemblages with differing degrees of homogeneity" (Costin 1991:35; Rice 1991:268; quote from Blackman et al. 1993:61). This implies that a high degree of standardization reflects specialized mass production, while a more heterogeneous assemblage indicates a lower spatial scale of production, often referred to as "household" production (Blackman et al. 1993:61).

Egypt's apparent centralization is attested by regional scale similarities in artistic styles seen in objects such as pottery, structures and artistic representations throughout the Nile Valley and Delta at this time. "Regional" therefore refers to the area encompassed by the Nile Valley and Delta. "Centralization," implies a high degree of integration, such that locations or sites widely separated in space are nonetheless economically connected to each other, in other words exhibit regional scale similarity. Centralized pottery production, therefore, will be reflected in highly standardized or homogeneous assemblage, regardless of geography. Localized pottery production, alternatively, will be reflected in relatively heterogeneous assemblages that track geography. "Local," refers to individual political territories, "nomes," based around flood basins (Butzer 1976:59; Lehner 2000:298).

The tendency to invest large amounts of energy into funerary and ceremonial monuments creates the conditions for the development of complex socioeconomic interactions. This is partially the result of Egypt's environmental structure which is characterized by largely self-sufficient population centers based on flood basin agriculture. Such conditions are not consistent with the expectations of "centralization" or integration, in that long distance exchange in subsistence materials would be unlikely to emerge. Nonetheless, Egypt has been characterized as being "united and centralized" for much of its history (Baines and Yoffee 1998:220), suggesting a certain amount of large scale integration of economic systems, commonly described as a complex social system (e.g. Flannery 1972, 1998; Wenke 1981; Trigger 1993). This observation is at least partially based on observed similarities in pottery vessels of the Old Kingdom period.

"Unification"

In addition to observed changes in ceramic manufacture, evidence of a "united and centralized" Egypt is largely documentary. The earliest known translatable document attesting to this condition comes in the form of the Narmer Palette (see figure 1-2). This object is a slate palette about 63.5 cm tall and 30 cm wide upon which is carved the first readable narrative of Egyptian history. Narmer's name is carved in a serekh frame (the forerunner to the cartouche), one of the earliest uses of a notation that is reserved for the pharaohs of the earliest dynasties. A summary of the translation reads "the king has defeated the delta enemy and Horus takes him prisoner." Narmer is shown on both sides of the object wearing the Red Crown of Lower Egypt

Figure 1-2. The Narmer Palette (after Aldred 1998:figures 41 and 42).

(generally consisting of the Nile Delta) on one side and the White Crown of Upper Egypt (generally consisting of the Nile Valley) on the other. Other images depict the capture of prisoners and the conquest of what appears to be a walled city (Midant-Reynes 2000:244). Thus this object has lead scholars to conceive of an event or period wherein Egypt is "unified" under one ruler.

Indeed, in some ways, it is our general historical conception of the office of the pharaoh that lends the impression of all-powerfulness. By the Archaic period (ca 3200 – 3000 BC), the office of the pharaoh (Narmer/Menes) is "documented" in the form of titles, such as "He who belongs to the sedge and the bee," (titles of Upper and Lower Egypt respectively) and The Two Ladies, indicating he is sponsored by goddesses representing the two halves of the country (Aldred 1998:85-86).

What is noteworthy is the continued representation of Egypt as a duality, the united halves of Upper and Lower Egypt. This observation is reinforced by the emergence of officials during this period bearing titles like "Controllers of the Granaries" (there were two). The distribution of supplies to temples and to an elite group of courtiers and officials was administered from the Office of the Overseer of the King's bounty (Aldred 1998:86). The conventional wisdom seems to be that "…beyond any doubt that Narmer ruled over a unified country" (Midant-Reynes 2000:249).

Archaeological evidence is certainly consistent with the idea of a unified state controlled by the pharaoh. The Old Kingdom period, which follows Narmer, is characterized by an expensive investment in large scale monumental architecture primarily for pharaohs and their courtiers. These constructions necessitated the collection of taxes, which is assumed to be a centrally administrated process (Trigger 1993:64). Other evidence of unification comes in the form of a standardized written language, similarity in general in the material culture, and specifically in the form of pottery from the period.

Ceramic Changes in Egypt from 3500 – 2100 BC

The pottery tells a particularly compelling tale in that it reflects highly localized traditions prior to the onset of the Old Kingdom and apparently "standardized" forms after the onset of the Old Kingdom.

Late Predynastic (3500-3300 BC)

Decorated vessels are found distributed throughout Upper and Lower Egypt (Trigger 1983:32-33). Upper Egyptian pottery from the Late Predynastic, also known as Gerzean in Petrie's time sequence (Petrie 1899, 1901) or Nagada II in Kaiser (1957), is characterized by red-painted ceramics decorated with patterns, representations of boats, trees, birds and animals. This kind of pottery is typical from Badari in the north to Hierakonpolis in the south (Wilkinson 1996:5-7, summarized in Sterling 2001:149).

Less is known about the pottery from the area north of the mouth of the Faiyum to the Nile Delta. During the first half of the 4^{th} millennium B.C. ceramic vessels from this region (as far as is known) are distinct from the pottery of Upper Egypt and are often identified as the Buto-Maadi complex as these two sites are the primary sources of Lower Egyptian Predynastic pottery (Rizkana and Seeher 1987, 1990; Wilkinson 1996:5; summarized in Sterling 2001:151). Maadi ceramics tend to be made of light colored brown paste with occasional painted decorations. The type site of Maadi also features a considerable amount of Early Bronze Age (3000 – 2700 BC) pottery from Syro-Palestine, as well as a few pieces of decorated Upper Egyptian pottery (Kantor 1992:6; Trigger 1983:26). Buto, a site on the western side of the Nile Delta, is interesting in that it appears to be an enclave of Upper Egyptian technology, wherein wares with fabrics typical of Upper Egypt increase in frequency over time, yet appear to be locally made (Wilkinson 1996:7). Buto also contains some examples of the Maadian pottery and a Buto variant of this pottery with distinctive motifs not known from the type site of Maadi (Kantor 1992:6-7; summarized in Sterling 2001:151).

There is some evidence that Lower Egyptian cultures expanded into Palestine during the late Predynastic (Joffee 1991; Wenke 1989). This is indicated by the large number of imported ceramics found in Lower Egyptian sites at this time. Thus during the Predynastic, ceramics as distributed throughout the Nile Valley and Delta do not appear to be standardized and seem to indicate local production at a variety of locations and also that there is some integration in terms of ceramic production between upper and lower Egypt, but the intensity of this interaction is highly variable (Sterling 2001:151).

The Late Predynastic is the first period during which we see the rapid change that precedes the emergence of the distinctive material culture that characterizes the Old Kingdom. Toward the end of this period ceramic traditions appear to change rapidly.

The Archaic (3300 – 2600 BC)

During this period there is more apparent uniformity in ceramic types. Increased interaction with Syro-Palestine is indicated by increased frequency of oil and wine containers clearly made from imported fabrics. Unlike ceramics from earlier periods, there is little apparent regional distinction between Upper and Lower Egyptian pottery (Sterling 2001:151).

Old Kingdom (2600-2100 BC)

The unification of Egypt is at least circumstantially evidenced by the apparent standardization of the pottery known from the Old Kingdom. Pottery styles change dramatically from the more heterogeneous assemblages of the late Predynastic with the more elaborate decoration typical of the Predynastic being replaced by a more homogeneous decorative style featuring red-slipped polished surfaces (Bourriau 1981:51; Reisner and Smith 1955).

The Meidum bowl, the focus of this study, is part of this larger corpus of standardized ceramics (see figure 1-3). These objects were first described by Petrie at Meidum (Petrie et al. 1910) and later by Reisner at Giza (Reisner and Smith 1955) and are now known to have a distribution from the southernmost regions of Egypt to the Nile Delta (Ballet 1987; Bourriau 1981:53; Wenke 1997:126; Wenke and Brewer 1995:281, summarized in Sterling 2001:152). The bowl is described as being a high-quality Nile silt or marl bowl with a beveled rim, rounded base and red polish (Petrie et al. 1910; Reisner and Smith 1955; summarized in Sterling 2001:152). The vessel is chosen because of its ubiquitous distribution and tendency for variants to broadly track dynastic periods (Ballet 1987; Bourriau 1981:53; Wenke 1997:126; Wenke and Brewer 1995:281).

As such, it is hypothesized that attributes of the Meidum bowl are "inherited" or transmitted culturally and that the spatial nature of this transmission will indicate centralized mass-production. Two sets of attributes are assessed; fabric composition and measurements of morphological attributes. Variation in fabric composition informs as to raw material choice; therefore, local production will be reflected in vessels with fabrics that reflect the local geology (*sensu* Neff et al. 1997). Variation in morphological attributes of the vessel inform as to the relative skill of the individuals producing the pots and also provide some indication as to the number of people making pots; more variability indicating a larger number of pottery producers.

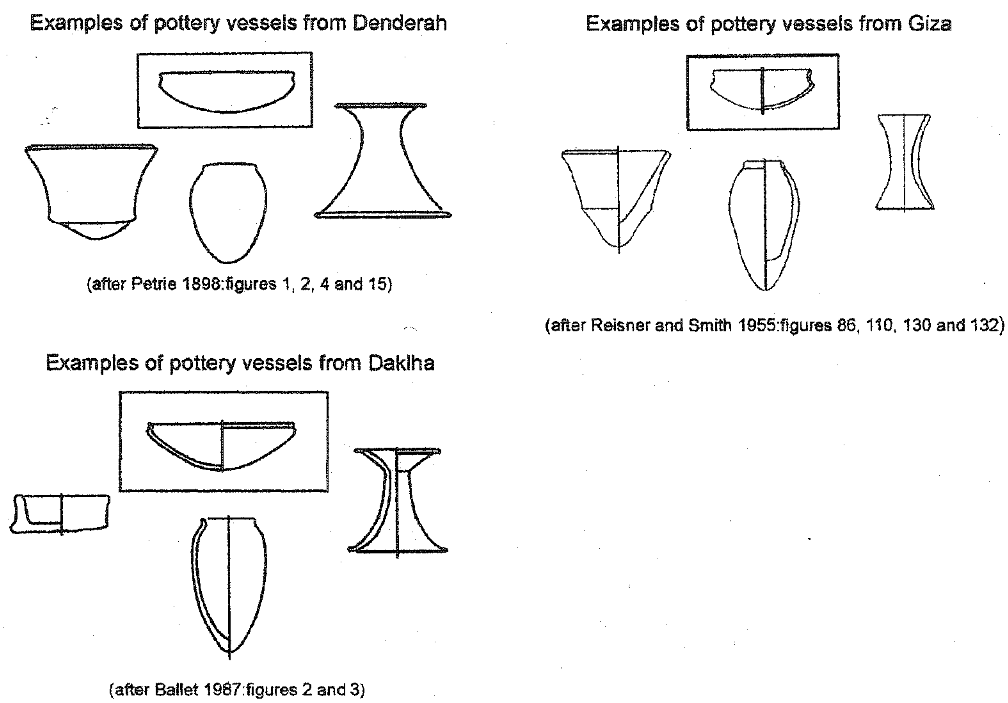


Fig. 1-3. Examples of Old Kingdom vessel forms from various locations in Egypt.

The study of standardization

Generally Old Kingdom assemblages do suggest some consolidation of production and potential standardization of forms. Complete integration of ceramic production implies that all communities in the larger polity of ancient Egypt will be indistinguishable in terms of ceramic assemblage composition and form (decoration other than formal variation is not a characteristic of most Old Kingdom ceramics). Alternatively, differences between assemblages separated in space implies more distributed production.

Relationships between communities can therefore be examined through assessing similarities in ceramic vessels; however, the attributes measured must reflect memetic information that is transmitted explicitly or implicitly between potters (as opposed to similarities related to non human processes)(e.g. Costin and Hagstrum 1995; Lipo 2001; Neiman 1995). Some variation is "intentional" or "active" while some is "mechanical" or "passive" (Costin and Hagstrum 1995:622). Intentional attributes are those controlled by the artisan, such as morphology reflecting function, general size and raw material selection (Costin and Hagstrum 1995:622). Mechanical attributes are those that the artisan does not control, variation is introduced from the type of mass production employed and the limits on the artisan's ability to perceive difference (Costin and Hagstrum 1995:622).

While Costin and Hagstrum (1995:622) state that "(i)ntentional attributes are less likely to inform us about the organization of production," it is argued here that just the opposite is true. Similarity across "intentional" attributes informs as to group interaction in that individuals will share or transmit information for the manufacture of pottery in terms of those attributes they actively control and perceive.

If pottery production is consolidated, then a relatively small number of people are charged with making pots, thus reducing the overall potential variability in manufacturing decisions. The technique introduced by Eerkens and Bettinger (2001) is used here as an external measure to determine if particular attributes of Meidum bowls approach the expectations of standardization

Spatial and temporal variation in paste and measurements of intentionally controlled attributes inform as to whether Egyptian pottery production is characterized by centralized production. This information provides an important component in the examination of Egypt as a complex society in that true centralization of all systems has implications for the health and well-being of the individuals involved in the system. The term "centralization" without elaboration obfuscates our understanding of the anatomy of a socially complex structure, because it assumes homogeneity in the integration of exchange systems. It would seem a more productive approach in the study of social complexity would be to first identify the existence of centralizing or integrating economic factors and their geographic extent.

The implications of centralization

In a simple society or completely decentralized society, an individual can reproduce all the information necessary to facilitate the rearing of offspring for the next generation. In practical terms this means that besides oneself, the only other people whose actions would have fitness consequences for one's life would be the actions of parents or siblings. Functional differentiation, on the other hand, implies that the actions of people unknown altogether and possibly remote relative to one's location can have consequences nonetheless (Dunnell 1978b; Dunnell and Wenke 1980; Lipo 2001). How far away an individual might be from the source of some kind of economic or environmental perturbation and still feel that event's effect, therefore, is of interest in the study of social complexity. Empirically, a purely simple society is virtually nonexistent, most populations being aracterized by some degree of functional differentiation.

A functionally differentiated society is simply characterized by some kind of exchange system that covers some amount of geographic space. The actual size of the area represented by the exchange of mass produced items for subsistence materials is of interest, in that the geographic range of a given functionally differentiated population will dictate how far the effects of environmental and/or economic perturbations impacting subsistence strategies would have been felt in a given region at a given time. In a functionally differentiated society degree of interaction is not a function of simple distance; it is a consequence of the functional structure of a larger integrative unit (Dunnell 1995; Lipo 2001). Recent studies (Lebo and Lohse in prep; Lipo 2001) have shown that similarities across carefully chosen attributes of artifacts in general and pottery in particular can be used to measure varying intensities of interaction over time. The actual population effects of living in a socially complex system result from dependence on long distance trade goods at the expense of local self-sufficiency.

To outline the range of a complexly integrated population or society first requires the identification of networks moving ideas and actual objects through a society or polity. Craft specialization studies provide a good indication of the scale of functional differentiation, as these studies examine phenomena directly relating to the condition of social complexity; trade (the movement of actual objects) and diffusion (the movement of ideas). Similarity across classes of objects over a broad area, often used as an indication of craft specialization, can result from either trade or diffusion. This distinction has implications for whether craft specialization is the mechanism driving large-scale similarity and also for determining the degree of integration between communities.

When trade moves an object, some, if not all attributes of the object are foreign relative to local conditions (i.e. Dunnell and Whittaker 1990). An example of this is provided imported Palestinian wine jars found in various Old Kingdom contexts, wherein the vessels have foreign morphology (relative to the standard suite of Old Kingdom "types"), and foreign fabrics (are made from clay not available in the Nile Valley or Delta). If a large number of objects exhibit similarity over a broad area, while retaining some local characteristics, diffusion of ideas is the source of the observed similarity. An example would be vessels retaining the same rim morphology yet exhibiting different fabric characteristics.

A self-sufficient community potentially features pottery that is produced locally from locally available materials. In contrast, compositionally diverse assemblages are not consistent with the expectations of self-sufficiency (Neff et al. 1997:474). High diversity in assemblage composition can indicate long distance subsistence dependence in that a marginal environment would favor the maintenance of an exchange system over a broad area (Neff et al. 1997:487; Zedeno 1994:102). For the purposes of this study, assemblages of Meidum bowls with variable paste compositions relative to local geology and large measurement *CV*s indicate traded objects. Assemblages with lower *CV*s and paste compositions not reflecting local geology indicate centralized mass production at a remote location. Assemblages with lower *CV*s and paste compositions reflecting the local geology indicate local production. Diffusion drives similarity if objects are observed to have similar measurements but different paste compositions.

Cultural transmission (diffusion of information) moves through a variety of mechanisms or "patterns of socialization by which a given trait or set of traits are transmitted in a given society" (Boyd and Richerson 1985:2). The spatial scale at which cultural transmission is effective is a function of larger socioeconomic factors operative in the society. Of interest in this study, beyond determining the presence of craft specialization, is determining whether Egypt's apparent integration is a monolithic condition or, alternatively whether some communities are integrated in the manner expected of a complex society while others are not.

Pyramid construction and taxation as socioeconomic factors

The greatest economic factor that characterized the Old Kingdom was the infrastructure that moved building materials for monumental constructions, particularly pyramids, along the country. These activities were funded by taxes collected in the form of foodstuffs from nomes up and down the Nile. The Old Kingdom itself is a period characterized by apparent early consolidation (from the Archaic until the late 4^{th} Dynasty) followed by a period of increased power in the hands of local governors or *nomarchs* after the 4^{th} Dynasty (Aldred 1998:118-119). The "feudalization" of Egypt toward the end of the Old Kingdom (the late 5^{th} and into the 6^{th} Dynasties) is simply a reduction in the scale of Pharaonic control (as represented by the ability to collect taxes).

The ability to collect taxes is noteworthy, given Egypt's environmental characteristics. As Barry Kemp notes (1989:31):

> Egypt is particularly interesting because … state formation seems to have taken place in the absence of some of the more obvious factors. It is hard to imagine, for example, that in a land where the population is relatively small and natural resources so abundant competition for resources from sheer necessity was a factor. It also strains the evidence needlessly to promote trade into a major force. Nor was there an external military threat, and the conflicts that developed within the Nile Valley in the period leading up to the 1^{st} Dynasty seem to have been amongst communities already well advanced along the path to statehood.

This casts Egypt in a "feudal" light in that the small relatively self-sufficient nomes are hard to control from a remote location, given the lack of a standing army during the Old Kingdom (i.e. Kemp 1989, Lehner 2000 and Wenke 1989, 1991,1997).

This system removes part of the subsistence base from the area in which it was produced so that the producing area is actually draining its resource base. These taxes in turn supported the class of bureaucrats and scribes that maintained the government. Taxes also supported the massive monumental constructions that characterize the period through foodstuffs used to support artisans and craftsmen involved. "Centralization," therefore, is defined by the Pharaoh's ability to collect taxes in the form of a percentage of the annual crops.

Nonetheless, the nobility of Egypt apparently became increasingly effective at marshalling resources for large-scale mortuary projects and temple complexes as the Old Kingdom progressed, beginning with the 1st and 2nd Dynasty cemeteries for the nobles at Saqqara and Abydos. Large-scale mortuary projects required labor which in turn required foodstuffs be committed to that labor. Scribes and bureaucrats associated with various temples by the same token also needed support. While all indications are that most Egyptians were involved with farming at least part of the time, the expenditures represented by these national projects were doubtless a drain on the resources of the country (Aldred 1998:116-120).

Indeed, monumental, and particularly pyramid construction seems to represent the most powerful economic factor at work during the Old Kingdom and appears to be the impetus for collecting taxes (Butzer 1976:88-89; Lehner 1997). Substantial archaeological and inscriptional evidence suggests that resources from all parts of Egypt, the Sinai and as far away as Lebanon were used for monumental constructions and especially pyramids (Breasted 1906:66, 75; Edwards 1985; Lehner 1997). This indicates that networks existed for moving materials around Egypt, and that despite its homogeneous environment, interactive space (as opposed to simple geographic distance) was structured by the exchange of materials relating to monumental construction.

In the light of taxation, Egypt is an interesting study in the emergence of social complexity in that taxation is a facet of centralized control that directly impacts the overall fitness of a given community. The taxation system in Old Kingdom Egypt entailed payment in actual goods (Aldred 1998:89).

No doubt some parts of the country were more robust than others in the face of environmental shortfall, with those areas having small amounts of arable land, relative to river frontage, being more prone to environmental perturbation. Temple sites, supported by taxation, such as the great pyramid complexes that characterize the Old Kingdom, had relatively high population densities and were thus less likely to be self-sufficient and more prone to long-distance management (in contrast to the more self-sufficient nomes).

At the same time, pyramid and temple sites are supported by donations and collected taxes from more self-sufficient agrarian communities (Lehner 2000:310-311). Such communities are thus only indirectly involved in the economics of monumental construction. These communities, despite proximity to high cost ceremonial sites such as the mortuary complexes at Giza and Saqqara, would be more subject to local environmental variability and would be less likely to be supported by the state maintained granaries.

As such, it is to be expected that sites less involved in actual food production and more tied to the economy of monumental constructions will more likely show spatial connections consistent with the expectations of social complexity. In contrast, more self-sufficient communities should show relative homogeneity and reflect local resources in the form of ceramic raw materials. It is entirely possible, therefore, that vessel manufacture similarity will track both regional and local scales of sorting, depending on the relationship between involved communities. This could potentially result in distinct lineages or trajectories in the distribution of Meidum bowl variants.

Site Selection

Assemblages are chosen to represent a cross section of site variability during the Old Kingdom period. These sites include Elephantine (Aswan), Qau and Badari, Meidum, the Teti pyramid (Saqqara), Giza and Kom el-Hisn (see figure 1-2).

Of interest in this study is determining whether Meidum bowls are similar at a regional scale or at a local scale. Variant distribution informs as to transmission mechanism. The simultaneous appearance of a particular variant with similar composition in assemblages separated in space is consistent with the expectations of centralized mass production.

The Elephantine material, because it represents a long term occupation, provides a baseline for comparison for the other assemblages discussed above to determine whether similarity results from exchange, diffusion or simple trade and also to evaluate questions of diversity. While differences between Meidum bowls from assemblages separated in space result from both temporal and spatial factors, the primary factor constraining variation at Elephantine is time. The Elephantine material therefore has been subdivided into particular dynastic periods. These assemblages of known chronological attribution are then compared to assemblages from other locations from similar time periods. Because overall floodplain width is a good predictor of resource availability in the Nile Valley, Elephantine is also more vulnerable environmentally in that it is located in a relatively narrow portion of the floodplain. Elephantine, therefore, is the site most likely to reflect ceramic assemblage similarities to other assemblages that are not the result of simple distance.

The Meidum, Giza and the Teti pyramid materials all represent settings wherein monumental construction and maintenance are the primary economic activities. These locations will therefore more likely be supported by a resource redistribution system. Meidum is unique among these three constructions because it is an early unfinished pyramid featuring relatively small amounts of granite, the product that ties Elephantine to monumental constructions elsewhere. The Saqqara (Teti) and particularly the Giza necropolises, in contrast, both feature large amounts of granite and diorite.

The Kom el-Hisn and Qau and Badari assemblages represent more provincial settings. Qau and Badari represents a rural cemetery for local nobles and landholders. The Qau and Badari region is located on a relatively wide part of the floodplain, suggesting a relatively robust resource base. Kom el-Hisn enjoys similar environmental abundance as a result of its setting on the delta and is characterized as a domestic site with ambiguous ties to the larger polity (Cagle 2001; Wenke et al. 1988). Both of these locations should feature relatively self-sufficient populations.

Chapter Summaries

The following chapters explore the relationship between the chosen sites with regard to measured similarities in Meidum bowl characteristics.

Chapter 2 outlines the theoretical background for the research design used in this study. Meidum bowl variant distribution will be a function of cultural transmission operative at some spatial scale. To determine if the observed similarities in Meidum bowls is indeed the result of transmission, the Weber fraction is discussed as a means for determining whether variation is potentially the result of intention on the part of the potter, rather than noncultural factors.

Chapter 3 discusses previous work that has been done to explore the nature of Meidum bowl in terms of function, manufacture and the use of variability in the form as a chronological tool. Information about form and manufacture provides some preliminary indication as to what attributes should be measured. This chapter lays out the specific observations made and the measurement system used. A preliminary attribute selection simply examining whether specific attributes vary with space and time is provided. Final attribute selection, wherein coefficients of variation for each assemblage are compared to the Weber fraction and random data, is discussed in Chapter 6.

Chapter 4 outlines the chronological system employed. Observations about vessel changes over time depend on having some chronological control over how assemblages were formed. Because archaeological fieldwork in Egypt predates the use of absolute dating systems, chronological assessments of various archaeological phenomena are based on the presence of inscriptional evidence that ties those phenomena to a particular dynastic period. Chronological questions and determinations in Egypt are somewhat unique relative to other archaeological settings, thus the relationship between the radiocarbon calendar and the dynastic chronology in Egypt is explored.

Chapter 5 discusses contexts from which assemblages were collected and associates them with dynastic time periods. This chapter therefore includes a discussion of Elephantine, Kom el-Hisn, Giza, Meidum, Teti (Saqqara) and Qau and Badari.

Chapter 6 presents the results of the analysis. First differences in paste composition across three assemblages; Elephantine, Giza and Kom el-Hisn are discussed. Then attributes specified in chapter 3 are compared using analysis of variance. Following that, attributes are compared to the indices introduced in Eerkins and Bettinger (2001) to determine which more likely reflect intentional variation. Discriminant function analysis is then used to illustrate the relationships between the pottery groups. It is determined that variability in Meidum bowls is transmitted through at least two spatial scales, suggesting two vectors of development, one more characteristic of regional scale integration, one more characteristic of local scale interaction. Communities featuring vessels exhibiting regional scale integration are those involved with monumental construction.

Chapter 7 discusses the consequences of communities participating in particular economic relationships and how that potentially impacts the health and well being of a given community. This study simply outlines potential scales of interaction operative in the Old Kingdom. However a larger question lies in understanding why and how such an expensive activity (monumental construction) could become fixed, such that some members of the population would trade self-sufficiency for dependence on redistributed foodstuffs.

CHAPTER 2: THE RELATIONSHIP BETWEEN CULTURAL TRANSMISSION AND STANDARDIZATION

The spatial extent of a socially complex entity answers an ecological question in that a "centralized" society is one in which some set of integrating factors connects groups otherwise vastly separated in Euclidean space, such that economic or environmental effects at one location would have implications for the connected community despite distance between the groups. The antithesis of a complex, integrated or centralized society can be characterized as one which consists of an individual or nuclear family (Renfrew 1984:89). If this group lives on a plain across which resources and equivalent population entities are distributed uniformly, then we can predict that the groups any given individual will contact will be those closest to it in Euclidean space (Lipo 2001:34; Neiman 1995). In reality, however, this is rarely the case in that interaction is constrained by the spatial and/or social structure of the population. Communities with long distance economic relationships will nonetheless appear culturally more similar to each other than to communities closer in space as a result of intensified interaction increasing the likelihood of transmission of information between them (Lipo 2001:34).

Of interest, therefore, in such a scenario as that proposed by Renfrew (1984), is how individuals settled in such a fashion would become integrated into a more complex social system. Egypt's general environmental condition almost approaches the hypothetical environment posed by Renfrew (1984), with the exception of Aswan (Elephantine), which is situated at the narrowest portion of the floodplain and which is supported by only one flood basin (see figure 2-1). Using Meidum bowl measurements to assess "relatedness" between populations, the hypothesis can be tested that some sites in Egypt, Elephantine in particular, will be more likely tied to each other in

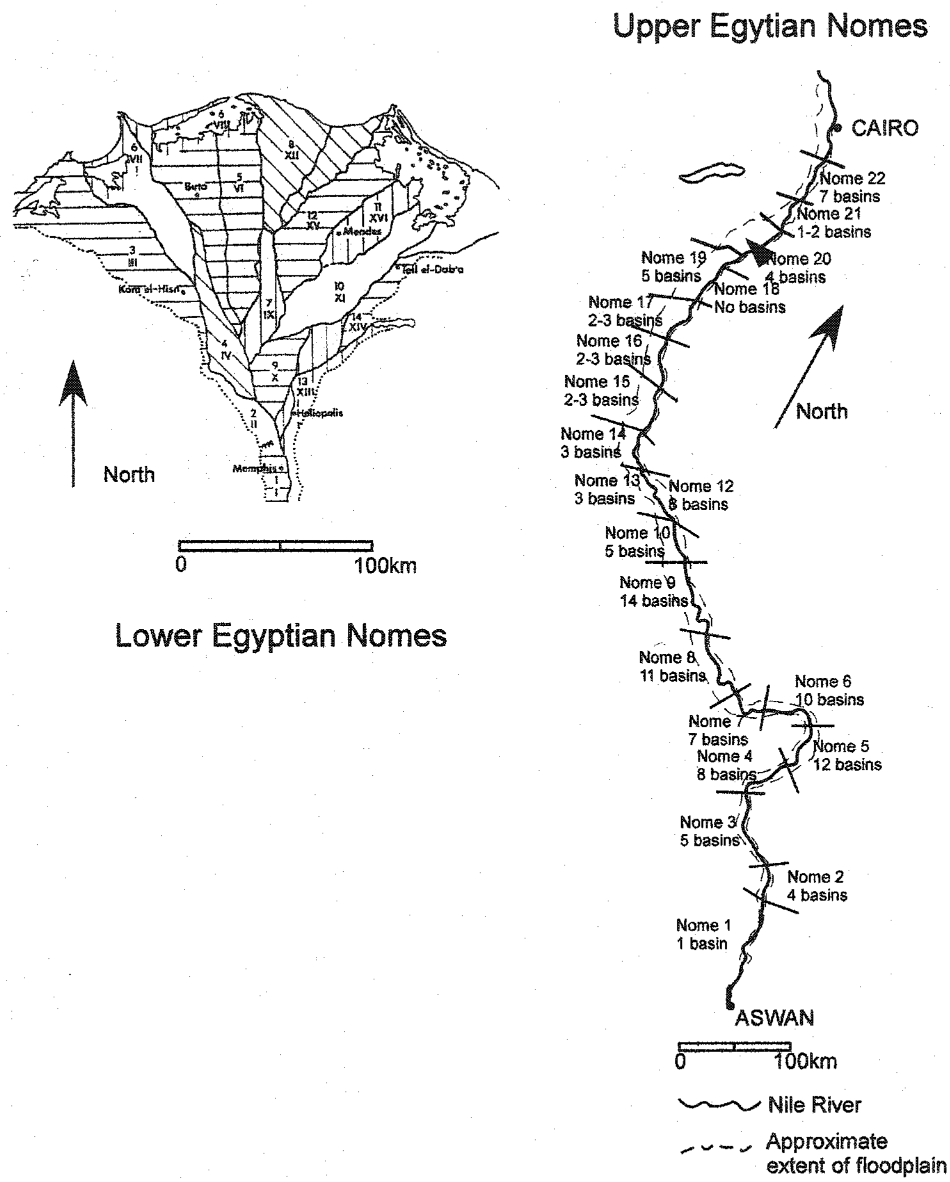


Figure 2-1. Nomes identified in Egypt during the New Kingdom (1539-1075BC). (Upper Egyptian nomes after Lehner 2000, Figure 5; Lower Egyptian nomes after Cagle 2001, figure 1.1 and Bietak 1975).

a manner consistent with the expectations of social complexity if the primary economic activity at that site is large scale monumental construction.

Typical Old Kingdom vessel forms provide an opportunity to test this relationship because the forms are clearly shared throughout the Nile Valley and Delta, but also appear to exhibit some local peculiarities, suggesting that the similarities between the vessel shapes seen in Old Kingdom assemblages result from diffusion of information rather than actual mass production and exchange. Intentional attributes (*sensu* Costin and Hagstrum 1995) relating to morphology are those that are likely to be shared between communities of potters; if variants exhibit local peculiarity, then there is less reason to posit the existence of centralizing factors. Similarly, paste composition will reflect local or foreign manufacture, local manufacture will be typified by compositional diversity similar to that of the local geological environment (Neff et al. 1997:474).

Meidum bowl assemblages will be similar to each other either as a result of actual movement of objects into an assemblage or as a result of diffusion. To determine the nature of the similarity, vessels will first be compared in terms of composition. Egypt's geology dictates the kinds of clays that are more likely to be available at particular locations. Similarity resulting from diffusion (transmission) will be reflected in vessels with widely distributed forms made from clays that reflect local geology. If similarity results from diffusion, then Meidum bowl similarity is properly studied as a phenomenon of cultural transmission. Therefore, Egypt's and environment and geological history are briefly discussed to understand the factors constraining integration and to better understand the raw materials available to ancient Egyptians for ceramic manufacture.

Environment

Egypt is often subdivided into Upper and Lower Egypt. Lower Egypt consists of the Nile Delta, whereas Upper Egypt consists of the Nile Valley south of Cairo (see figure 2-1). As was discussed in Chapter 1, this geographic break historically gives the impression of two political entities prior to the proposed "unification." These areas form two distinct environments within what is considered ancient Egypt. As such, populations of individuals living in these environments will face different environmental constraints on their subsistence strategies. True "centralization" will be reflected in uniformity of ceramic measurements for objects found in both environments.

The delta is where the Nile meets the Mediterranean Sea. During the Old Kingdom period (and up until the construction of the Aswan high dam in 1899 – 1902) several branches of the Nile ran across the delta, creating a broad and swampy landscape (Butzer 1976, 1984). The delta covers 22,000 km2, which accounts for 63% of the habitable surface of the country as a whole.

The Nile valley, in contrast to the delta, is an extremely narrow floodplain surrounded by limestone cliffs (Butzer 1984:104). The cultivable strip of floodplain along both banks of the river is only a few kilometers wide and accounts for less than half of the habitable surface of the country. The maximum width of the floodplain from Aswan to Cairo is 20 kilometers, the average width is 3 kilometers (Butzer 1984:104). As can be seen in figures 2-1 and 2-2, the floodplain tends to narrow in Upper Egypt.

The environs in the vicinity of Aswan/Elephantine are therefore unique in the extreme narrowness of the floodplain. This area is also singular in that it is the most accessible source of minerals such as granite and diorite, which play a substantial role in monumental construction. This exposure results from the geological history of the Nile river bed.

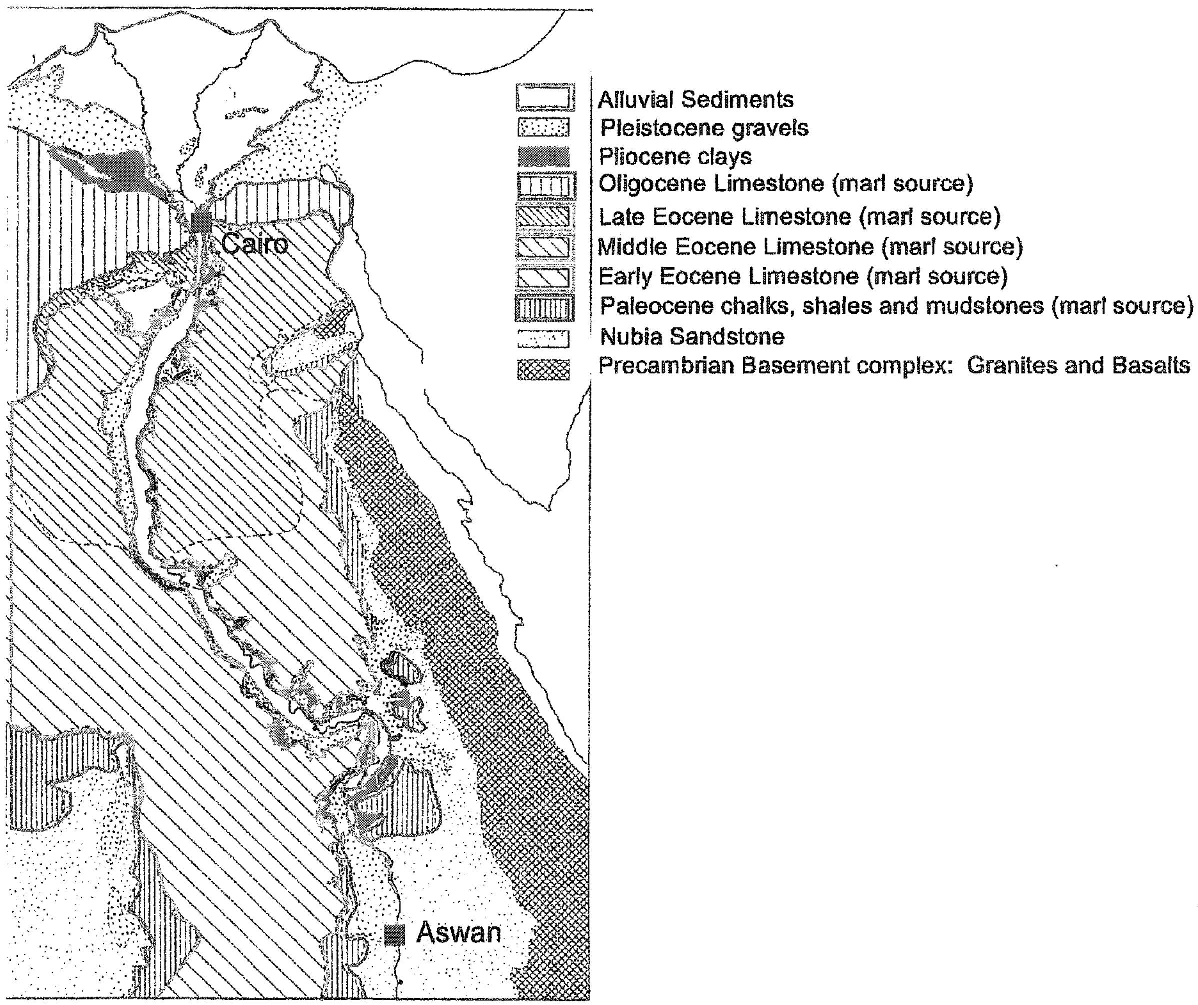


Figure 2-2. Geological deposits in Egypt: Clay sources relevant to this study are in color (after Arnold and Bourriau 1993, p. 157, after original by Dieter Arnold in Arnold 1981, figure 1).

A brief history of the Nile River

During the Miocene, the gradient of an earlier version of the Nile was vastly increased to compensate for the temporary dessication of the Mediterranean Sea (Said 1981, 1993). As a result, the Nile cut a substantial channel as deep as the Grand Canyon. The Mediterranean Sea rebounded 5.5 million years ago. This new sea flooded up stream the "eonile" creating a gulf which flooded the canyon with sediments all the way to Aswan. The bed of this prehistoric bay is formed of three layers of stone. The lowermost are metamorphic and igneous rocks (diorite, granite and quartz), that are exposed primarily south of the second cataract, though there are outcroppings at Aswan and in the eastern desert (see figure 2-2). Overlying that is a layer of sandstone found on the surface in southern Upper Egypt and Nubia. Sandstones are subsequently overlain by sedimentary limestones, shales and clays that form the cliffs overlooking the Nile.

These limestone formations are thickest to the north because the inland sea resided for a shorter period of time in the vicinity of Aswan and southward, thus the basement complex of igneous rocks is exposed on the surface in that part of the valley. These granite outcrops in the channel of the Nile form a series of cataracts, the first and northernmost of which is at Aswan. The action of the water has eroded the granite into a string of rocky islands of which Elephantine is the most northerly (Said 1981, 1993).

As discussed previously, Elephantine's position on this narrow part of the floodplain has implications for subsistence in that area. Productivity in Egypt in general is largely a function of floodplain width and the size of the annual flood (discussed below). While floods are generally considered environmental problems, in the case of Egypt, the flood annually deposited fresh, mineral rich silt on the floodplain, a beneficial process for an agrarian society.

Flooding

Egypt is often referred to as "the gift of the Nile" as a result of minimal rainfall in the Nile Valley on the Delta during any given year. There is little rainfall on the Mediterranean coast, about 15 – 20 cm annually, and the region south of Cairo to Aswan is practically rainless. Therefore, prior to the construction of the Aswan dam, a habitable environment was created by the mineral rich silts deposited by the annual flood resulting from monsoon rain runoff in Ethiopia. The Nile in Egypt itself is fed by three rivers; the Blue Nile and the Atbara in Ethiopia and the White Nile originating in Tanzania. The monsoon rains from the Indian Ocean fall on the Ethiopian plateau from May to September and ultimately swell the waters of the Nile. These rains peak in July and August and by late summer the waters, in the form of a flood, reach Aswan and subsequently the Delta by fall (Butzer 1978:14, 1984:105).

The volumetric increase in the river as a result of the summer flood is substantial, the Blue Nile and the Atbara carry run-off water from winter rains of the Ethiopian plateau, meeting the relatively volume stable White Nile at Khartoum. So violent is the summer flood that the White Nile is backed up and the torrent, at peak in September has risen from 2333 to 116666 cubic meters per second. The Blue Nile contributes 70% of the Nile flood. When the flood reaches Aswan, the gradient of the riverbed drops dramatically causing the river to slow (see figure 2-3). The flood grinds boulders in its bed and carries the finer red-brown silt in suspension for thousands of miles (Butzer 1984:105). This large volume of silt-laden water overflows its banks at Aswan and northward and fills the flood plain with mineral rich sediments. As the Nile moves north it exceeds flood stage and spills into low-lying basins, then recedes back to its channel or evaporates (Butzer 1976:15-17, 1978:14). As the river recedes, it drops its sediment load (the fine red-brown silt). The flood brings with it not only water, but more importantly, nutrient rich topsoil that is crucial for farming. As a result, the timing of the Nile flood is fairly predictable, occurring in between the late

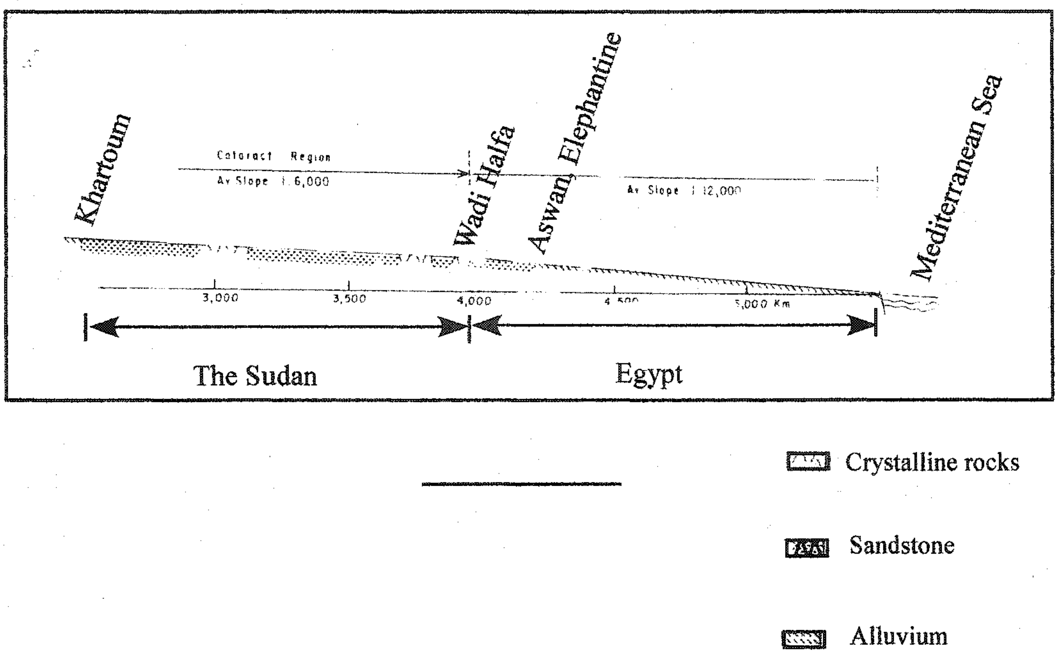


Figure 2-3. Longitudinal cross-section of the Nile from Khartoum to the Mediterranean Sea (after Said 1993, figure 1.4).

summer and early fall (Butzer 1978:14, 1984:105). The volume, however, is not predictable, in that flood volume is directly tied to the amount of rainfall resulting from the rains upriver.

The floodplain accumulates primarily through the bank overflow of suspended sediment, this deposit is generally thicker closer to the bed of the Nile, creating a convex floodplain. A convex floodplain is marked by natural levees that constitute the low water channel banks and that rise a few meters above the seasonally inundated alluvial flats. The convex floodplain of the Nile is an accretionary surface marked by natural levees that rise a few meters above the alluvial flats, and these levees divide the alluvial flats into natural flood basins (Butzer 1976:15-17). When not flooding, the Nile averages 800-1,000 meters wide and is 10-12 meters deep.

Because of Nile flood occurred annually into the natural flood basins acting as collection ponds, there was little need to irrigate fields artificially. The flood would allow, on average, a single crop season over 2/3's of the alluvial surface (Butzer 1976:20). The total alluvial surface is a function of the size of the flood, hence flood level is a robust predictor of relative environmental abundance. Low or short floods generate a smaller amount of silt and clay and increase the salt concentration in waters reaching the fields along the desert margins, resulting in lower overall agricultural productivity (Butzer 1976:52-54, 1984:105). Unusually high floods could also have a negative impact, however. Very high floods encouraged plant parasites, delayed planting by waterlogging fields, and inundated settlements close to the river (Butzer 1984:105).

The geomorphologic nature of the delta is both similar and different to that of the valley. Unlike the Nile valley, salt marshes along the Mediterranean coast also flood into lagoons. There is some rainfall on the delta. Generally, it can be characterized as being similar to the valley, but broader, with levees, and sandy turtleback islands resulting from the action of a more energetic Pleistocene Nile depositing large amounts of sand (Said 1993:73). These islands, composed of "gezira" sands overlook seasonally flooded fields allowing for permanent settlements above the expected level of the annual inundation (Butzer 1974; 1976:25). Thus, the demographic structure of Egypt is largely structured by the floodplain of the Nile.

Nomes: Political units based on flood basins

Throughout much of its history, Egypt as a polity was subdivided into smaller political units referred to as "nomes." Nomes are defined by flood-basins; depressions in the floodplain of the Nile that filled during the annual inundation, leaving collections of water that were used for crop irrigation (Butzer 1976:59; Lehner 2000:298). New Kingdom (approximately 1500 – 1000 BC, Dynasties 18 – 20) texts identify 22 nomes in the area from the first cataract to the Delta (Lehner 2000:305-306)(see figure 2-1). Nomes themselves consist of varying numbers of actual flood basins; each with a district name and a capital city (Lehner 2000:298).

While it is possible that nomes did not exist as formal entities during the Old Kingdom, considerable textual evidence suggests they did. The first known appearance of the hieroglyph that roughly translates as "nome leader" occurs in the 3rd Dynasty of the Old Kingdom. By the 4th Dynasty, the valley temple of Senefru's Bent Pyramid at Dashur lists estates organized by nomes, thus indicating that nomes had been systematized by this time (Lehner 2000:306). Nome administrators apparently brokered the collection of harvest tax for distant temples, the royal house and anyone who had claims to shares of land within the nome territory (Lehner 2000:306).

Nomes thus form a basic and potentially self-sufficient population unit. All individuals living in a given nome are subject to similar environmental pressures, and the overall number of flood basins indicates the potential productivity of any given nome.

Clay sources

The environmental structure of Egypt also dictates to some degree what kind of clay is more likely to be present in a given ceramic assemblage if ceramic production is a local endeavor (see figure 2-2). The clays available in both the Nile Valley and Delta have two possible sources; the limestone cliffs overlooking the Nile and the sediments of the floodplain itself. For clay types known from the Old Kingdom and for the assemblages to be used in this study, we can speak of three different sources 1) the limestone cliffs to the west of Aswan, 2) the Maadi and Mokkatam formations found east and west of Cairo and 3) Nile silts deposited on the floodplain. Marl and alluvial clays can be broadly distinguished from each other through observation of paste characteristics and inclusion types.

Limestones are found on the east bank of the Nile to the east of Esna and Qena (Arnold and Bourriau 1993:158). During the Eocene (55 – 34 million years ago), the formations exposed on the east and west banks of the Nile near modern day Cairo were formed, these are often referred to as the Maadi and Mokattam formations (see figure 2-2) (Arnold and Bourriau 1993:158; Lehner 1997:106). Alluvial deposits were formed during the Pleistocene and Holocene eras as the Nile River came to take up its current course (Arnold and Bourriau 1993:159; Said 1993:5).

Nile silt is relatively fluid, thus straw, ash, dung or sand were often added as tempering added to give it more structure. Nile silts will therefore tend to have more variable inclusion types and pore morphology will tend to reflect burnt out organic particles. Fabrics range from fine to coarse tempered generally. Mica, quartzite, calcite, grog and organic materials are common, apparent porosity is moderate to relatively high. Alluvial fabrics tend to be reddish brown in color (Arnold and Bourriau 1993:169 - 74; Friedman 1994:111-113).

Marl clays come from tefla deposits in the limestone cliffs that rise above the floodplain, (see figure 2-2). Clays originate from calciferous shales and mudstones, deposited together with limestone, and are leached out of deposits by water action at various times, thus making marl clays more locally variable than alluvial clays. As such, marls contain a significant quantity of calcium minerals (Hamroush 1992:43). Marl clay is generally less porous in general than Nile clay (Bourriau 1985:32). Marls are also distinguished from alluvial clays based on pore morphology, with marls being characterized by small highly circular voids (Hamroush 1992:41). Marls are also characterized by fine to medium crushed limestone temper. Fine marl is relatively homogeneous with distinctive small round pores, fine sand and some micaceous particles are also visible. The fabric is hard and firm and the transverse strength is great, so the pottery breaks sharply when struck. Marls tend to be denser than alluvial fabrics as well (Arnold and Bourriau 1993:176; Hamroush 1992:41). Marls vary in color from greenish white, to white to reddish white (Arnold and Bourriau 1993:176). Reddish marl clays tend to be less brown than alluvial clays.

Mixes of both marl and alluvial clays were used as well. It is possible to distinguish between marl and alluvial clays with a 10x hand lens, but in some cases the distinction is not possible because attributes of both are present in one vessel. It is argued here that a reasonable description of such fabrics is "marl/alluvium mix." Some authors find this category useful (e.g. Hope et al. 1981:159 and Hope 1989:4-5), while others, particularly Arnold and Bourriau (1993:165), argue that the heterogeneity of such a mix makes the determination of exact criteria for a marl/alluvial mix problematic.

Arnold and Bourriau (1993:166-67) argue specifically that defining a marl/ Nile group by "what they are not" is an overly vague approach. However, they also note (along with Hamroush 1992) that foreign fabrics are easily distinguished from both groups of Egyptian fabrics "by reason of the size, shape and character of their inclusions."(Arnold and Bourriau 1993:167*)*. Given that, it seems that the identification of a marl/alluvium mix as such is not problematic because there is little risk of accidentally characterizing a foreign fabric as a mix of local materials.

Provenance Studies

Sourcing clays used in the manufacture of the bowls would further resolve production issues. Such studies are only informative, however, if the precision with which one identifies a clay source matches the resolution required by the scope of the problem. Arnold et al. (1991:84) note that many ceramics analyzed compositionally cannot be attributed to a particular source, because the size of the geographic area to which clay is sourced is largely a function of local environmental conditions. The Nile Valley is one regional source in that sediments are difficult to distinguish regionally within the floodplain, based on elemental composition. Widespread homogeneity in Nile alluvial clays thus complicates provenance studies (Hamroush 1992; Hamroush et al. 1992). Marl clays have more potential for sourcing, but as Hamroush (1992:51) points out that to properly source the marl clays used in vessel construction, "... the geochemical characteristics of all the possible local clay resources in Egypt must first be measured..." This scale of analysis on marls and their sources has yet to be undertaken.

Examining Fabric Differences

In the absence of chemical sourcing studies, fabrics were examined visually to first determine if assemblage composition is consistent with geological setting. Arnold (2000) found that there is no simple correspondence between behavior and mineralogical and chemical variability in ceramic pastes, but that paste composition does appear to provide information about the geological context and geographical location of pottery making communities (Arnold 2000:363). Thus it was determined, given the nature of Egypt's environment that a great deal of information could be gained simply by tallying alluvial versus marl vessels in conjunction with a nominal scale assessment of larger mineral inclusions in the ceramic matrix. If ceramic manufacture is a relatively local endeavor, then one would predict more ceramics made from alluvial materials in ceramic assemblages from sites on and close to the delta or in an area in a wider part of the floodplain, while marls would be more common in locations where alluvial sediments are rare. Alternatively, if ceramics are mass produced, it should not be possible to distinguish sites based on clay composition or tempering inclusions.

Three of the six assemblages used in this study were compared in terms of fabrics and inclusions; Kom el-Hisn, Giza and Elephantine. Fresh breaks were taken from sherds from these assemblages to facilitate consistent observation across specimens. Other assemblages were not included because they are represented by museum specimens, thus making it impossible to take a fresh break from the ceramic, or are represented by drawings rather than actual objects.

Chi-squared analysis is used to determine if differences between clays and classes of inclusion types are significantly different between assemblages from Elephantine, Giza and Kom el-Hisn. If significant differences are present across assemblages, it is likely that ceramics are locally produced and that observed similarity results from diffusion, as opposed to trade or mass production.

Cultural transmission

"Transmission" refers to the movement of information, whether genetic (in the form of genes) or cultural (in the form of memes), through a population. Information can move through a population (be introduced and sorted) in three ways; vertically, obliquely or horizontally (Boyd and Richerson 1985:11-12).

Genetic transmission is vertical in that information (genes in this case) moves exclusively from parent to offspring (Boyd and Richerson 1985:11-12). In the case of genetic information, the transmission of variation is constrained by two distinct kinds of factors that serve to remove some subset of variation from a population. First, natural selection wherein an organism with a more efficient strategy for extracting energy from its environment tends to out reproduce less efficient competitors; in this case, environmental factors dictate what variant will be most successful. Second, drift and founder effect, and gene flow, wherein stochastic factors possibly unrelated to reproductive success nonetheless isolate a sample of the population from its parent population, thus facilitating the increase of one variant at the expense of others. In both cases, variation in the population is "sorted" via a two step process wherein variation is first introduced, and second, some portion of that variation is reproduced and some is not (Mayr 1988:97-98). In genetics, natural selection and drift are formal terms describing sorting mechanisms specific to the transmission of genetic information. These mechanisms are tied to the ability of the organism to reproduce, and to the pool of potential variation available to the organism from which mates could be chosen.

Culture acts as an inheritance system as well, but with fewer constraints as to how information can be introduced and sorted. In addition to vertical transmission of information from parent to offspring, individuals transmit and receive cultural information obliquely and horizontally. Oblique transmission refers to cross – generational transmission wherein information does not move from parent to offspring, but rather from someone other than the parent who is in the same generation as the parent (Boyd and Richerson 1985:53-56). Horizontal transmission takes place across individuals of the same generation, and is thus analogous to a pathogen in that acceptance of a cultural variant is "infectious" and has a short lifespan relative to that of its host (Boyd and Richerson 1985:8).

Any archaeological population can be simply described as consisting of teachers (individuals transmitting codes for manufacturing particular artifact variants) and learners (individuals receptive to the transmission of codes for manufacturing particular artifact variants). Information about pottery manufacture can therefore potentially be transmitted vertically, horizontally and obliquely from potter (either specialized or unspecialized) to potter. Patterns of transmission are the phenomenon mapped by archaeological seriation.

Seriation and transmission theory

Lineages of artifact manufacturing traditions are the product of archaeological seriations (Dunnell 1970:313). Seriation is a tool traditionally employed for questions of chronology. But in a broader sense, seriation is an analytic technique which serves to arrange comparable units along a line such that the position of each unit reflects its similarity to other units, with time being the dimension most often chosen (Marquardt 1978:408-409). But many authors (e.g. Cowgill 1972; Deetz and Detlefsen 1965; Dunnell 1970; Lipo 2001) have noted that seriations constructed to answer questions of time must adhere also to the idea that both space and time sort variation, thus care must be taken to control for space when constructing archaeological seriations. Two relevant studies (Lebo and Lohse in prep; Lipo 2001) have used the principles of seriation to model the transmission of information over space. This work modifies the methods and techniques employed in these studies to resolve changes in the geographic scale of interaction during the Old Kingdom by examining changes in the degree of similarity in assemblages of Meidum bowls.

Factors sorting similarity in bowl variants are equivalent to those described by seriation analysis.

Seriation and Time

Traditionally, types or classes of artifacts used in a seriation are considered historically significant if they display a continuous or unimodal distribution through time (Krieger 1944; Ford 1954). This led to a larger awareness that some kinds of variation are more chronologically sensitive than others (e.g. Ford 1954; Rouse 1967). Besides specifying that the types employed in a seriation should pass the test of historical significance, several authors have noted further generalizations to which a seriation must conform to best reflect chronological information (summarized in Dunnell 1970). These are outlined below.

The first requirement of a seriation is that all groups included in the seriation must be of comparable duration (Phillips et al. 1951:223). The classes seriated must be relatively short in duration, or at least represent comparable periods of time (Rouse 1967: 162). If types in the seriation all have relatively short "lifespans," the seriation will allow finer temporal discriminations (Dunnell 1970:311).

The second condition for chronological seriation is that groups must belong to the same cultural tradition (Phillips et al. 1951:223). If types used in a seriation are constructed by two distinct groups occupying approximately the same space but not interacting, those two lineages will not create an order. Therefore, seriation construction itself should allow the evaluation of whether groups belong to the same cultural tradition because "the application of the seriation model will create as many independent orders as there are lineages," (see figure 2-4)(Dunnell 1970:313).

The third generalization to which seriations should comply is that all groups come from the same local area. As a result, the groups incorporated in the seriation must be selected in such a manner as to not include variation in the spatial dimension. Rouse (1967:178) defines a local area as "a clustering of sites within which it is reasonable to suppose there has been little

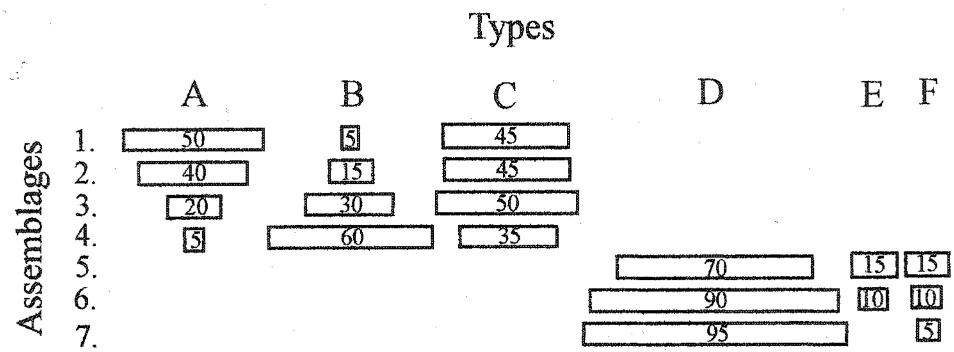


Fig. 2-4. Lineages can be distinguished through the identification of independent orders in a seriation. The order of assemblages 5-7 is arbitrary. (After Dunnell 1970, Fig. 4).

geographic variation in culture. Deetz and Detlefson (1965) have demonstrated that samples of known duration drawn from the same cultural tradition cannot be assumed to be homogeneous through the dimension of space at any given point in time. In other words, space contributes variation that is inconsistent with the expectations of the chronological seriation model.

These generalizations, particularly the local area rule, indicate a constant relationship between space and time in any given seriation. Therefore, chronological problems can result for the seriation model when types are constructed from variation that includes a spatial component. The best way to control this is to construct classes or measure variation that is variable over time and less so over space, and to characterize the spatial distribution of a given lineage so that universally chronological forms are parsed from those that are only useful as chronological tools locally.

Seriation and Space

The final assumption (outlined above) that groups used in the seriation must be from the same local area has implications for understanding the transmission of information over space. The local area is technically the boundary of an interacting population, although in reality this is difficult to detect (e.g. Conkey 1990; Lipo 2001). Furthermore, different kinds of interactions or arrangements will be characterized by different spatial boundaries. Deviations from the requirements outlined above can provide information about spatial characteristics of interacting populations. While chronological problems have been the primary focus of the application of seriation as a technique, the method itself is predicated on the mechanisms inherent in the transmission of cultural information, which operates in tandem with genetic transmission to structure variability in the archaeological record (discussed below). Therefore, the method seriation is a distributional model that can be used to determine how information moves through a population, thus illustrating interaction (Lipo 2001; Lipo and Madsen 2001).

As discussed in the previous section, there are two analyzable components in a distributional model: temporal and spatial (Lipo 2001:30). The temporal component arises because transmission events take time (Lipo 2001:30). Given that packets of information move from individual to individual in the spatial dimension, interaction events have a spatial component as well (Deetz and Detlefsen 1965; Lipo 2001:30).

Deetz and Detlefson (1965:196) have argued that any type used in a seriation should have originated at a single locus and spread out from that point. This conception, combined with the general seriation rules discussed above implies that seriation can be used to measure interaction. For any type to be useful in a seriation, it must occur at two spatially distinct loci. This occurrence at more than one locus can either be interpreted as evidence of the movement of the mental template which was responsible for its production, or as evidence of the independent formulation of this template at each site of its occurrence. As Deetz and Detlefson (1965:196) point out, the latter is unlikely. The movement of memetic templates for Meidum bowl manufacture through time and across space, therefore will reflect the geographic scale of factors active in reproducing that template.

Cultural Transmission and Standardization

The distance between transmitters and receivers of cultural information is affected by temporal and spatial factors (Dunell 1970; 1980, Graves, Lipo and Cochrane in prep, Lebo and Lohse in prep; Neiman 1995; Teltser 1995.) Transmitters are more likely to introduce generated traits for sorting by receivers if they are closer in time or space. How variation is sorted indicates empirical or historical phenomena that influence sorting; such as economic or environmental issues (Lebo and Lohse in prep: 20, Graves, Lipo and Cochrane in prep). Interaction between Old Kingdom communities will be identified via the geographic distribution of lineages. Mass production will result in lineages exhibiting regional scale similarity across Meidum vessel attributes that reflect transmission.

Clarke (1968:156) defines an artifact attribute as "an irreducible character of two or more states," essentially anticipating Dawkin's elucidation of the "meme" (discussed below). Clarke further notes that "each attribute is equivalent to a piece of premeditated and deliberate hominid behavior" (1968:156). Standardization is can be characterized as resulting from an intentional effort to replicate attributes with precision. The identification of standardized attributes is thus a measure of the fidelity with which an attribute is reproduced.

Several authors (e.g. Allen 1996; Close 1989; Dunnell 1978a; papers in Hunt et al. 2001; papers in Hurt and Rakita 2001; Wenke 1997) have argued that neutral or stylistic traits should be parsed from non-neutral traits when comparing artifact type frequencies across assemblages. Distributions of functional traits over time and space are largely indicative of the environmental requirements of artifact performance (e.g. Feathers 1990; Neff 1992; O'Brien et al. 1994). As such, traits relating to vessel performance or some engineering requirement relating to construction will be transmitted with much greater fidelity than those attributes that do not relate to artifact performance.

Transmission theory (*sensu* Boyd and Richerson 1985) is predicated on the idea that certain patterns of variation in particular cultural phenomena through time inform as to how they came to be similar. A strong degree of morphological, technological and stylistic similarity in pottery types is a commonly used indication of craft standardization. In terms of transmission theory, observations of standardization are a function of the fidelity with which "memes" for the manufacture of pottery vessels are repeated through a given community of potters. To better understand the relationship between cultural transmission and craft specialization, it is important to discuss fidelity in memetic transmission.

A meme is a packet of information described as being the cultural equivalent of a gene, but without the observable boundedness manifested by a gene (Dawkins 1976:68, 1982). Dawkins describes the meme as a non-genetic kind of replicator of information residing in the brain. Memes have no empirical component, and thus can only be studied in terms of their effects on the phenotype of the individual bearing them.

As applied to human cultural evolution, the ethereal nature of the meme renders it a problematic analytic unit for some authors (e.g. Atran 2001; Nettle 2002). Critics (e.g. Gatherer and McEwan 1998) take issue with the empirical manifestations of memes, suggesting that part of the problem is a misunderstanding the nature of the meme itself. As Hull points out, a meme is not a characteristic, but rather the code for replicating the characteristic (2001:34). Thus a meme can be best considered as "… the largest units of socially transmitted information that (can) reliably and repeatedly withstand transmission" (Pocklington and Best 1999:389). While some baulk at this approach as being reductionist (i.e. Gatherer and McEwan 1998), Pocklington and Best (1997:80) argue that "…a useful theory of cultural evolution will necessarily use methodological reductionist techniques in order to reduce the complex dynamics of the cultural evolutionary process into operational and tractable parts." The form these parts take depends on the nature of the question posed. The phenotypic expression of the meme might be in the form of words, music, hand gestures, styles of clothes or ways of making pots (Dawkins 1976, 1982:109, Pocklington and Best 1997:80).

For the purposes of this study, therefore, information for manufacturing pottery vessels is the manifestation of a "meme." Memes are equivalent to genes in the sense that they contain a set of instructions that are represented by phenotypic expressions, with the possible difference that memetic expressions are not tied to particular organisms. Memes are transmitted in the same fashion as genetic material, in that variation is introduced and subsequently either replicated or not replicated. The rate of transmission and sorting is much faster than that usually observed in genetic evolution because memetic generations are simply each time a particular idea is reproduced in a population. In other words, a generation is the time elapsed from the time the meme is introduced until the time the meme is reproduced in a population (Hull 2001:36). Several replication and introduction events can take place over the lifetime of an organism such that, for example, "… in the course of his biological lifetime, a geometry teacher may replicate the Pythagorean theorem hundreds of times" (Hull 2001:36).

That memetic generation and sorting take place several times over the course of over the lifetime of one biological organism has implications for the use of the meme as an analytical unit. It is a somewhat overlooked aspect of Dawkin's initial formulation that there is no necessary relationship between genetic fitness and the persistence of a meme in a population (and this holds for genes as well) (Dawkins 1982:111). While the relative survival of a particular meme will depend on its cultural and biological climate, and the genetic makeup of the population into which it is introduced; it will also depend on how it competes with the memes in the meme-pool. Thus memetic "fitness" is related to how often a particular meme is reproduced in a population (Dawkins 1982:111). Because memes can be reproduced by a variety of replicators (parents, schools, books, computers etc), they are not directly tied to any biological organism except in the sense that a meme originates in the brain of an individual. As such, the memes for pottery manufacture, only indirectly affect genetic "fitness," defined as the capacity to reproduce. In fact it is useful to consider genetic studies in evolutionary biology as a special case of evolution wherein the sorting mechanism of interest is natural selection and the desired explanation is to relate the observed differential persistence of particular genetic traits to the survival and reproduction of particular organisms (Lipo 2001:30).

The nature of the meme is necessarily fluid and unstructured, relative to its more well understood relative, the gene, and this will impact how closely a replicated trait will resemble its "parent" trait (Dawkins 1982:109). DNA guarantees a certain amount of trait fidelity across generations because the incidence of random mutations (displacement of base-pairs) is relatively low (Dawkins 1982:112). Catastrophic mutations such as any which kill the organism before it matures, do not persist simply because they kill the vehicle that could reproduce them before it does so. Cultural traits or memes have far fewer constraints and because memes do not necessarily have any direct impact on fitness, both performance related and non-performance related traits are much freer to vary in general.

Fidelity thus refers to the precision with which the meme is replicated by learners or imitators in the population. If one accepts the notion of the code for manufacturing Meidum bowls as a meme, fidelity of transmission is indicated by relative isomorphism across measured attributes of studied objects.

Two kinds of factors constrain the replication of artifact attributes, depending on the role the attribute plays in artifact function. The first of these can be referred to as "guided" or "functional" variation, wherein attributes are replicated according to their ability to perform some sort of task (Beck 1998:25; Boyd and Richerson 1985; Schiffer and Skibo 1987:599). Certain traits will persist over time simply because without them, the object will not be effective in the capacity for which it was constructed (Schiffer and Skibo 1987:599). While these traits do not affect actual biological fitness necessarily, they are sorted similarly in that some environmental need or component drives their frequency of such that the replication of the attribute will increase as a result of the attribute enhancing performance under certain environmental circumstances.

The second force acting on artifact variation is drift, wherein the frequencies of traits appear to describe deterministic distributions through time, but frequencies are driven by sampling bias in the sense that one variant is replicated more often due to factors not related necessarily to performance (e.g. Neiman 1995).

Observations of distance between measurements in combination with the *CV* of particular attribute measurements indicates fidelity. Attributes exhibiting a great deal of transmission fidelity are more likely related to function, insofar as they can be demonstrated to reflect variation related to intention. The less "distance" (Euclidean or some equivalent) between measurements of objects, the higher the fidelity of memetic transmission, all things being equal. If attributes are metrically similar and have relatively small *CVs,* then it can be argued that standardization is a factor in vessel manufacture. However, as Clarke (1968) and Eerkens and Bettinger (2001) point out the identified attributes must result from intentional human action.

Nonetheless, such attributes will still be subject to stochastic factors. Because the ratio scale data collected here are continuous, the separation of stylistic and functional variation is problematic. The external measures of standardization proposed by Eerkens and Bettinger (2001), however allows the determination of which attributes are more or less likely to reflect standardization as well as those with *CV*s approaching the expectations of a sample drawn from a random distribution, such that there is little reason to posit a conscious effort to reproduce a standard form.

Standardization

In terms of cultural transmission, intentional attributes (*sensu* Costin and Hagstrum 1995) will be those attributes that reflect memetic inheritance because the artisan will be aware of the nature of the information that is moving between parties and will consciously want to reproduce it with some degree of fidelity. This kind of variation can be sorted out using a technique employed by Eerkens and Bettinger (2001). It is also the case that similarity below some critical threshold, as summarized by the coefficient of variation could be the result of the use of some sort of measuring device.

Eerkens and Bettinger (2001) (along with Arnold et al. 1991; Blackman et al. 1993; Costin and Hagstrum 1995; Longacre 1999; Rice 1991) note that for every item that is produced there is some degree of tolerance for: "deviation from a standard size, shape, form or method of construction. Higher tolerance increases variability, while lower tolerance decreases variability, leading to standardization" (Eerkens and Bettinger 2001:493). They argue that while several studies use quantitative measures to assess standardization, nothing in the literature offers an independent measure for assessing standardization (Eerkens and Bettinger 2001:493).

Thus they identify "baselines" for the independent assessment of variation (Eerkens and Bettinger 2001:494). They use the *CV* (the sample standard deviation divided by the sample mean) as a "stable and reliable measure of variation" (2001:494-495). The source of these baselines is taken from psychological literature pertaining to the limitations on the human perception of difference. People are prone to "scalar error" when using only their sense to evaluate differences in measurements such as length, weight, color, sound. Error increases proportionally with the "magnitude or size" of the objects or phenomena being compared (Eerkens and Bettinger 2001:494; Montag 2003). In other words, the amount of perceived difference (increment threshold) that can be perceived will increase as the size of the object increases.

Montag (2003) offers the following example "… when you are in a noisy environment you must shout to be heard while a whisper works in a quiet room."

In the mid 1800s E.H. Weber noted that individual's ability to discriminate between objects of different weight depended on the mean weight of the objects involved (Eerkens and Bettinger 2001:494). Human appreciation of heaviness, in other words is not like the sensitivity of a measuring device, but is rather relative to object weight (Eerkens and Bettinger 2001:495). This discovery resulted in the development of the Weber fraction, which demonstrated that objects had to differ by more than two percent for a difference in weight to be appreciated (Eerkens and Bettinger 2001:495).

Human perception of linear distance is similarly scaled with lengths needing to differ by more than 3 percent for there to be a difference in perception (Teghtsoonian 1971). The number varies somewhat, but not significantly by gender, age or within an individual over the course of time (Verillo 1983). It is also reported that the Weber fraction is constant over a wide range of sizes. Regardless of the stimulus introduced, for difference to be perceived, the difference between the phenomena tends to range from 1 – 3%.

As Eerkens and Bettinger note, this discovery has implications for understanding artifact variability. Of particular note is that "scalar error divided by size will be constant in handmade sets of artifacts made without rulers" (Eerkens and Bettinger 2001:495). The *CV* in fact mathematically expresses this relationship. If artifact attributes are being intentionally reproduced to a standard, with only the naked eye to estimate difference in size, then *CV*s for those artifact assemblages should approach the Weber fraction. Alternatively, it is possible that constructions resulting from the use of some sort of measuring or standardizing device will result in measurements with *CV*s below the threshold of the Weber fraction. Table 2-1 summarizes some ranges of *CV*s resulting from machine produced items and the products of modern pottery specialists working without standardizing devices, as well as the hypothetical ranges for Weber fraction *CV*s and *CV*s from a random uniform data set.

Table 2-1: Select *CV* ranges (from Eerkens and Bettinger 2001, table 1)

Data Set	Avg. CV %	Range of CV %	Source
Machine produced items	0.1	0.1-0.2	Eerkens 2000
Weber fraction	1.6	1.6-1.7	Ogle 1950
Pots produced by specialized potters	4	2.0-6.0	Longacre 1999
Random uniform data	58	50-65	Eerkens and Bettinger 2001

Table 2-2: Means, standard deviations and CVs for 10 simulated data sets.

Mean	S.D.	*CV*
111.3	57.04	0.5124888
87.6	56.82	0.6486301
123.6	66.93	0.5415049
112.9	63.44	0.5619132
106.9	52.58	0.4918616
103.3	53.92	0.5219748
102.3	60.65	0.5928641
77.1	48.21	0.6252918

Avg Simulated Mean = 101.09
Avg Simulated SD = 56.79
Avg Simulated CV = 0.566 (0.57)

To define the upper baseline, Eerkens and Bettinger (2001:495-496) describe a simulated data set with the characteristics of a uniform distribution, such that any number in a given range of values will have an equal chance of being drawn. Such a distribution with range from 0 to *X*, and a mean of *X*/2 will generate *CV*s ranging from 50 – 65 % (approximately, see table 2-1).

This result can be simulated using randomly drawn numbers ranging from 1 to 200 and generating random samples of sample size 20 drawn without replacement (no number repeated per simulated sample) from the larger population of 200 numbers. As can be seen in table 2-2, the means and standard deviations for these samples produce the range of *CV*s described by Eerkens and Bettinger (2001:499, table 1). Thus if attribute measurement sets approach this threshold, then differences in measurements are likely the result of chance or a distinterest in precise reproduction of a particular attribute.

Attribute scale analysis as an approach to identifying standardization

Barbara Luedtke (1986:90), argued that a productive approach to understanding the past is entailed in "dimensional descriptive systems" wherein archaeological materials are described in terms of "a series of independent attributes which vary along continua and are measurable." Explaining the distribution of particular attributes of Egyptian ceramics in general and starting with the Meidum Bowl calls for a theoretical framework that will link the phenomenon of close metric similarity to mechanisms of transmission that act to sort variation. This is in contrast to more traditional studies, in that the emphasis is on the objects themselves.

The notion "Meidum bowl," is a descriptive category, and has been used as such in the Egyptological literature (i.e. Hendrickx 2002; Raue in Kaiser et al. 1999). This group of objects is relatively easy to break down into dimensions, however, to better assess changes in variation over time. This object can be described as consistently having a mouth wider than the base (thus making it a bowl), and a recurved or beveled rim. Attribute variation comes in the form of bevel morphology, diameter, fabric and surface treatment (though most objects that exhibit the dimensional characteristics of the Meidum bowl have a highly polished red slipped surface). In order to examine a large sample of bowls, it was necessary to construct a classification for rim sherds, rather than entire vessels. Nonetheless, in the case of the Meidum bowl, the rim sherd retains most of the measurable variation of an entire vessel.

Lineages: inherited vs mechanical attributes

Having identified similarity across attributes hypothesized to result from inheritance, rather than mechanical difference or exchange, it thus becomes possible to begin to identify "lineages" or "vectors" or "trajectories" of bowl forms. These will be reflected in the distribution of intentionally transmitted attributes, as revealed from comparison to the Weber fraction and random distribution thresholds.

A lineage of bowls will result from vertical, horizontal and oblique transmission. If one accepts the idea that the appearance of a type at more than one site indicates the movement of that idea from point A to point B, then it stands to reason that the type or measurement will appear at one site later than at another site. The amount of relative time elapsed since the introduction of the trait or type and its appearance elsewhere thus becomes a function of factors acting to sort variation at various scales. Factors that sort variation can thus be identified through seriation, which in this case can be taken to mean the assessment of similarities and differences in Meidum bowl forms and general composition over time and across space.

It is not uncommon for varying degrees of "standardization" to coexist across pottery assemblages produced by "complex" societies (e.g. Blackman et al. 1993). Blackman et al. (1993:77) underscore a particularly relevant point, namely that standardization indexes of all kinds are more effective the closer one gets to isolated production events and workshops, suggesting that production is rarely completely centralized. Multiple spatial scales of interaction will result in multiple lines of development in vessel forms. Such developmental trajectories are equivalent to lineages if it can be shown that the similarities result from transmitted attributes.

CHAPTER 3: MEIDUM BOWLS AS OBJECTS OF STUDY

Ceramic study has long been a focus in Egyptian archaeology, starting with Petrie's (1899) ingenious sequence dating system. Most efforts to categorize Old Kingdom pottery (with the exception of Hendrickx et al. 2002) have been to identify forms with chronological utility, following the success of Petrie's system for ordering Predynastic graves. Because of the relationship between interaction and chronological seriation, studies of Meidum bowl forms as chronological tools has lead to the identification of attributes that generally track time.

However, one of the challenges entailed in the study of vessel morphology is the accurate measurement of attributes beyond simple dimensions such as diameter or overall vessel height (e.g. Wenke and Brewer 1995:282). Digital photography allows more elaborate measurement of these vessels that has until recently has not been possible using more traditional measurement tools. The study of Meidum bowls has also been somewhat curtailed by the fact that archaeological objects excavated in Egypt must remain there. Previous research focusing on Meidum bowls has served to highlight important attributes, digital photography allows previously inaccessible attributes to be measured.

Ceramic Study in Egypt: Previous research

Ceramic manufacture has long been a research focus in Egypt. The earliest and most sophisticated work involving Egyptian ceramic vessels has focused on Predynastic, rather than Dynastic ceramics, largely because the Predynastic immediately precedes the Dynastic period and is a time during which the written system that becomes common during the Old Kingdom is developed. As such written material is not as detailed or comprehensive as it is during the later Dynastic period. Long before the invention of radiocarbon dating, scholars have been interested in determining the sequence of construction and interment events that are known from the Predynastic period. Ceramics have thus often been employed as chronological indicators. The limited success of Petrie's sequence dates influenced other analysts (and Petrie himself) to create chronological types for later Old Kingdom ceramic assemblages as well (e.g. Petrie 1910; Reisner 1931; Reisner and Smith 1955.) These types, like those created by Petrie for the Predynastic period are based on whole vessels. This focus is largely the result of early archaeological efforts in Egypt focusing on funerary contexts, wherein complete vessels were often interred in sealed contexts and dated to particular Pharaonic reigns.

W.M.F Petrie's sequence dates (1899) are an early example of innovative and productive type creation in that the sequence dates he was able to generate with his types produced chronological estimates that are generally supported by later radiometric studies (e.g. Hassan 1988; Savage 2001). Petrie inventoried the frequencies of whole vessels of distinctive types contained in 900 graves at Nagada and Ballas, a Predynastic cemetery (4000 - 3000 BC, see figure 3-1 for location). He was interested in determining the chronological order in which they were deposited, given the assumption that the goods in a particular grave would represent much of the decorative variation at a given time. Using this technique, Petrie was able to arrange 900 Predynastic graves into 51 arbitrary groups numbered 30-80. These numbered groups (sequence dates) provided a rough relative dating system that could be used to order other Predynastic deposits. For comparative purposes, he conducted similar analyses at the cemeteries of Abadiyeh and Hu. Altogether, he identified 700 pottery forms in terms of fabric, decoration and chronological factors (Savage 2001:1256).

To infer chronology from this ordering, Petrie assumed that a) wavy handled jars ("w-ware") evolved from a globular form with clearly functional handles to an upright cylinder with only a wavy painted line representing the handle. He then subdivided the 900 graves into 50

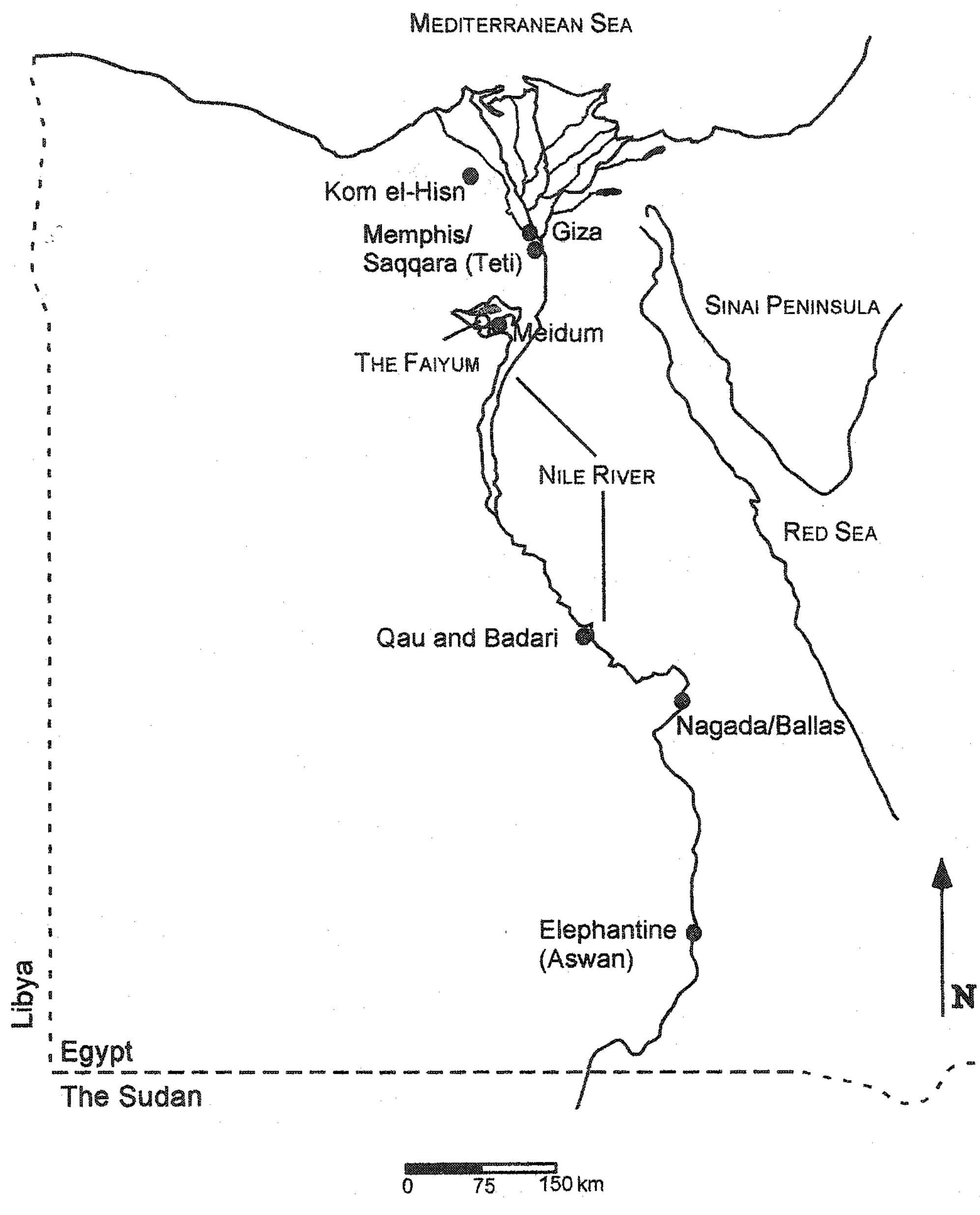
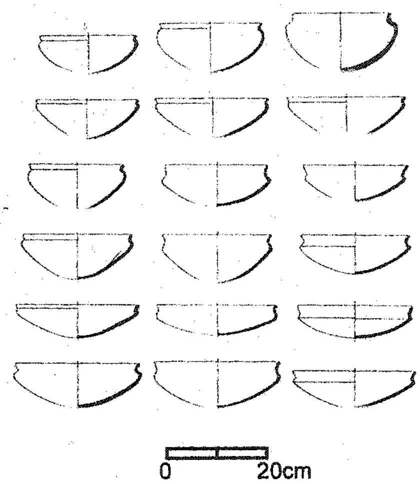


Figure 3-1. Map of sites mentioned in text.

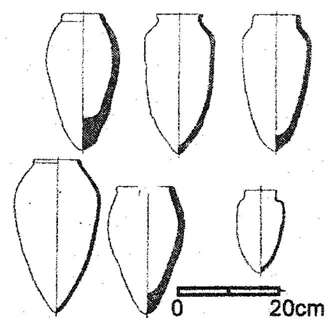
groups, each containing 18 graves, which he arbitrarily assigned numbers 30 – 80 (he left room at the beginning of the sequence in case an earlier Predynastic phase was discovered, which it was, by Brunton and Caton Thompson (1928) at Badari [Midant-Reynes 2000:164-165]) He then used his sequence dates to create three phases of the Predynastic; the Amaration, Gerzean and Semainean (Savage 2001:1257).

Although there has been substantial reevaluation of Petrie's sequence dates in Predynastic pottery studies (Friedman 1994:40 - 49) Petrie's effort stands as an example of useful type creation. Kaiser (1957) attempted to subdivide Petrie's groups, using materials from Armant and dividing them into three main periods based on the relative percentages of ware classes defined by Petrie. In a broad sense Kaiser's three subgroups or *Stufe* (Nagada I, II and III, subdivided into smaller groups Ia, Ib, IIa, IIb etc) match Petrie's three groups, thus validating them to a certain degree (Patch 1991:160; Savage 2001:1258). In general, however, the finer the ceramic subdivisions, the greater the role of space in determining whether that subgrouping has any chronological utility, therefore, Kaiser's subdivisions are often combined into broad phases (Patch 1991:160). Petrie and Kaiser's work therefore has broad chronological utility, with nonetheless noteworthy spatial limitations (Savage 2001:1258).

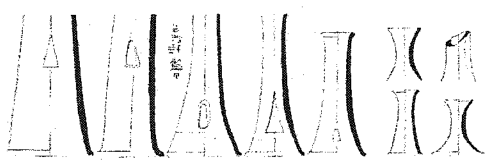
In an effort to use Old Kingdom vessel forms in a manner similar to Petrie's sequence dates, Reisner (1931; Reisner and Smith 1955) divided the ceramics excavated from the valley temple of Menkaure (Mycerinus), the tomb of Hetep-heres, mother of Khufu (Cheops) and other ceramics found in Old Kingdom contexts from Giza cemeteries into loosely "functional" types (jars, jar stands, bread molds, bread trays etc). He then further subdivided the types into rough shape categories (see figure 3-2 for some examples). These types have formed the basis for ceramic typologies constructed for assemblages throughout Egypt (Bourriau 1985). It is the observation of this author that this habit tends to result from 1) the fact that in general Old



From Reisner and Smith 1955, fig 110, examples of Meidum bowls from various Giza mastabas



From Reisner and Smith 1955, fig 85, examples of jars from Giza mastabas



From Reisner and Smith, figs 129 - 130, jar stands from Giza mastabas

Figure 3-2. Examples of Old Kingdom forms identified by Reisner at Giza.

Kingdom pottery does exhibit a lot of similarity in form throughout Egypt, and 2) because of this broad similarity, Reisner's types can be expediently employed in other settings (although most ceramicists working with Old Kingdom materials are aware of the limitations of this, i.e. Bourriau 1985) and 3) a standard type language does facilitate communication between analysts working in a variety of settings. Hence, type names such as "Meidum bowl," "beer jar," and "bread mold," are commonly recognized among ceramicists working with Old Kingdom materials as denoting particular vessel forms.

In technical terms, a Meidum "bowl" is a modified unrestricted sphere (Rice 1987:219). The modification comes from the addition of a recurve, or bevel in the rim (see figure 3-3). Raue (in Kaiser et al. 1999: 181) introduced the idea that the recurve might result from the Meidum bowl's being derived from a round squat jar (see figure 3-3). The implication of Raue's hypothesis is that, for one reason or the other, the jar, which may have retained the beveled rim for functional reasons, evolved into an unrestricted sphere, maintaining the bevel, but with the function of the recurve apparently diminishing over time (Raue in Kaiser et al. 1999: 181).

The type, Meidum bowl, was first described by W.M.F. Petrie in 1892, at the Pyramid of Meidum (see figure 3-4). At the time, this site, attributed to the Pharaoh Senefru in the early 4th Dynasty, ca 2575 - 2525 BC (approximately, see following chapter for a discussion of the radiocarbon vs historical calendars), was considered the oldest dated site in Egypt (Petrie et al. 1892:35). Possibly the coincidence of this type with that early observation, led to its employment as a chronological tool. Petrie noticed a type among the pottery found at the site that was different from the pottery of the later periods. This he described as a hard-polished, thin-walled, hard ceramic. "More often than not, the bowls in the Meidum assemblage (see figure 3-5 for examples) were of fine quality, but a smaller percentage came in a coarser quality. Some forms had a beaded edge, or were turned with a hare-lip" (Petrie et al. 1892:35). The waste heaps left

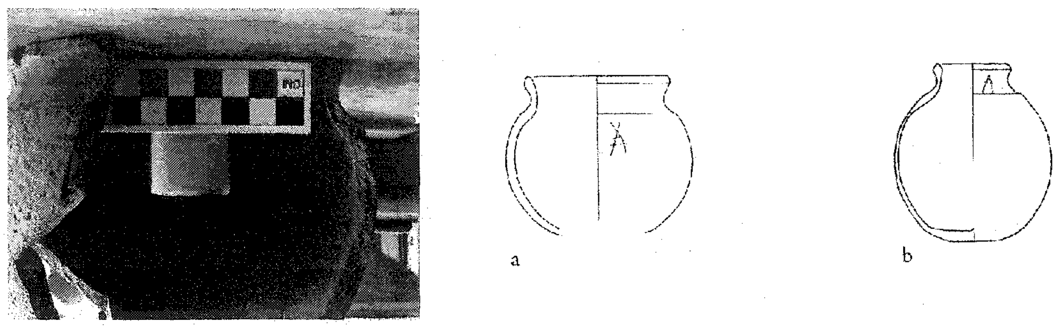
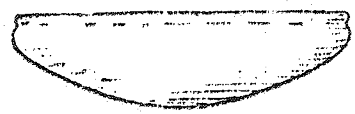
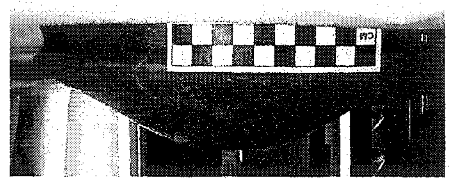


Figure 3-3. Photo to the left is a 2nd Dynasty jar from Elephantine. Drawings to the left are examples of similar vessels from el Kab (el Kab drawings after Hendrickx et al. 2002, Figure 2).

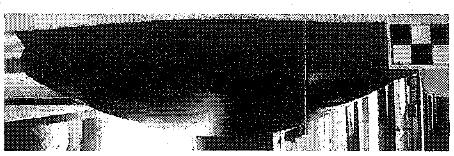
Figure 3-4. Looking north toward the Meidum pyramid.



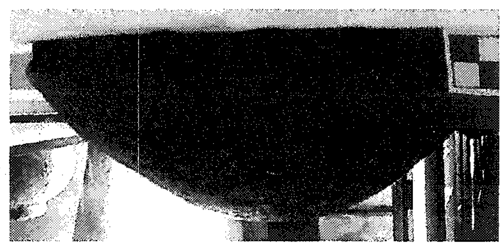
after Petrie et al. 1892:plate XXX



Petrie Museum object #17588:
Collected from tomb 57 at Meidum



Petrie Museum object #17616,
collected fromtomb 29 at Meidum



Petrie Museum object #17592,
collected from the Senefru foundation
deposit at Meidum

Figure 3-5. Examples of bowls collected by Petrie at Meidum.

by the Meidum pyramid builders constitute the first described context from which such bowls were excavated, hence the designation "Meidum" bowl. In the same publication, Petrie notes similar forms were identified by at Giza in the 4th Dynasty.

Reisner discovered one of the more significant deposits containing Meidum bowls associated with the tomb of Hetep-heres (Mother of Khufu) at Giza in 1935 (Reisner and Smith 1955:60, also referred to as G7000 X). The tomb was sealed, several whole vessels were found intact. Reisner reports however, that much of the pottery was smashed and disturbed by looters. This suggested to Reisner that the tomb was a reburial, rather than a primary internment (Lehner 1997: 117). The first name on the tomb was that of Senefru (historically 2575 - 2550 BC), further textual evidence suggested that this was Senefru's wife, which mayor may not have meant that she was the mother of Khufu, although Senefru was the father of Khufu (Lehner 1997: 117). Regardless of this debate, the association with Khufu and Senefru places the contents of this tomb within the early 4th Dynasty (historically 2575 - 2525 BC). This assemblage represents the types of Meidum bowl popular at this time. Two hundred and eighty one complete or semi - complete (largely reconstructable) vessels were recovered from the tomb (Reisner and Smith 1955:60).

Reisner identified two semi - complete bowls in the Heteperes assemblage (Reisner and Smith 1955:60). Reisner formally identified the Meidum bowl as type C-XXXII "a round bottomed bowl with a recurved rim." Between Petrie and Reisner, these vessels are identified in two separate dated contexts: funerary deposits on the Giza Plateau and the Meidum Pyramid foundation deposits. Meidum bowls in general are also found among domestic and workshop debris Among the various contexts in which Meidum bowls have been found, a Middle Kingdom cemetery is noteworthy because Meidum bowls were found smashed around the cemetery perimeter, suggesting that in that particular case they served some ceremonial purpose (Spencer, *personal communication*).

Meidum Bowls

Hypotheses regarding the possibly function of Meidum bowls range from food serving and milk processing (e.g.Hendrickx 2002) to decorative vessels used for floating lotus blossoms (Bourriau 1981:52). One must also bear in mind that there is no one "function" of these bowls, although there are strong indications that the vessels were built for the purpose of holding liquids. The bevel would reduce sloshing and the bowls are almost always coated with a thick red slip, presumably to reduce porosity. It is the ubiquity of these bowls in so many settings that makes them an attractive focus of study.

Meidum bowl function: A recent study

A recent study of the potential economic and social functions of the Meidum bowl suggests that at least earlier versions of the bowls were produced to contain liquids in general and milk in particular (Hendrickx et al. 2002:290). This is evidenced by the beveled shape of the rim, which acts to prevent spillage of liquids. The consistent presence of this feature is the primary trait shared by all vessels in the larger descriptive category "Meidum bowl." Another relatively consistent feature of the Meidum bowl is the highly polished read slip which acts to reduce the overall porosity of the vessel (Hendrickx et al. 2002:290).

Hendrickx et al. (2002:284) argue that the particular function of the Meidum bowl is in milk processing and that this statement is substantiated by certain inscriptions on early jars taken to be the predecessors of the Meidum bowl. In the case of Elephantine, the jars appear primarily in 2nd Dynasty (prior to the Old Kingdom proper) contexts, which contain no Meidum bowls, whereas once Meidum bowls appear during the 3rd Dynasty, the bevel-rimmed jars are no longer present (Hendrickx et al. 2002; Raue in Kaiser et al. 1999). They argue for this connection based on general similarity in the rim morphology of the 2nd Dynasty jars and the earliest Meidum bowls.

Whether this relationship is justified, it certainly points to the bevel as a persistent attribute. Given the bevel as a "fixed" trait, the focus of this study is thus on quantitative frequencies of particular measurements across vessel bevels. By focusing on these traits, rather than presence or absence of bevel per se, it is possible to compare changes in the frequencies of particular values for dimensions defining a subset of overall bevel morphology and thus assess the overall diversity, in the form of coefficients of variation for measurements taken on particular assemblages.

Along with the vessels Raue describes at Elephantine, versions of the same jars, referred to as "early Maidum (*sic)* bowls" (Hendrickx et al. 2002:282-283) are known from the Nagada IIID (2nd Dynasty) period sites including: Qau, Badari, Abu Roash, Tura, Lahun and Saqqara.

Previous studies of chronological variability in Meidum bowls

The work presented here is not the first measurement-based study of Meidum bowls. Pascale Ballet (1987) conducted a study of Meidum bowls collected from Dakhla oasis. She was able to demonstrate some overall temporal trends in bowl morphology, generally noting that the height of the shoulder (see figure 3-6) increased over time at Dakhla.

Wenke and Brewer (1995:281-282) applied Ballet's artifact measurements at Kom el-Hisn and Mendes in Lower Egypt and found some comparability with Ballet's findings, but because of the restrictions imposed by the requirement that archaeological objects must remain in Egypt, they were unable to examine large numbers of objects. They note that the vessels at Kom el-Hisn and Mendes, both located on the Nile Delta, seem similar to those described by Reisner at

Figure 3-6. Location of the vessel “shoulder.”

Giza (Wenke and Brewer 1995:282). They also note some variation in diameter measurement between the two sites, but were not able to conduct further analysis (Wenke and Brewer 1995:282).

Large scale regional comparisons of Meidum bowl assemblages however, have thus not been attempted to date. Given the seriation model presented in the previous section, however, unless centralized mass production is the factor driving similarity between bowl assemblages, space will effect the distribution of Meidum bowl variants.

Generally, although the role of space in seriation has long been acknowledged for Predynastic materials, because of the general appearance of similarity in the Old Kingdom materials, the role of space as a factor in the employment of chronological types has apparently been neglected. Thus the universal chronological utility of particular Meidum bowl forms must be posed as an hypothesis to be tested. Several previous studies have addressed just this issue with regard to the Meidum bowl in particular and Old Kingdom pottery in general.

Indications of local variability in the later corpus of Old Kingdom ceramics is discussed in Seidlmayer (1990). Following the end of the 6^{th} Dynasty, the apparent unification of Egypt dissolves and the region enters a period referred to as the First Intermediate Period (FIP)(Aldred 1998:122). Seidlmayer examined ceramic vessels from nine 6^{th} – 12^{th} Dynasty (ca 2100 – 1975 BC, historically) reports of material collected from funerary assemblage contexts, including pottery.

Seidlmayer examined published whole vessel forms and followed subdivisions of types outlined in Reisner and Smith (1955) to examine variation in 6^{th} – 12^{th} Dynasty assemblages. From this, he observed that materials from sites between Beni Hassan and Elephantine/Aswan were generally more similar to each other than to materials in Lower Egypt. Seidlmayer's study suggests that ceramic assemblages track this break, in that FIP ceramics in Upper Egypt show a distinct break from earlier Old Kingdom traditions, while ceramics from Lower Egypt during the FIP show continuity with Old Kingdom traditions (Seidlmayer 1990: 443). Thus space clearly plays a role in the distribution of variation of other ceramics during the Old Kingdom.

As discussed in Chapter 2, patterns of mass production, trade or diffusion will be reflected in vessel attributes resulting from memetic transmission. Understanding the process of manufacture of Meidum bowls will identify those attributes that are likely to vary as a result of the intentional actions of potters.

Manufacture

Several studies (e.g. Arnold and Bourriau 1993; Bourriau 1981, 1985; Vandiver and Lacovara 1985/1986) have focused on manufacturing techniques of Old Kingdom vessels in general and Meidum bowls in particular.

Clay Collection

The use of marl as opposed to alluvial clays entails different costs of acquisition. Alluvial clays are relatively low cost in terms of acquisition as they are available along the banks of the Nile or from cultivation fields. Large amounts of Nile mud were also generated as the result of the digging and dredging of irrigation canals. Canal banks would have been a source of "naturally levigated clay" as a result of standing pools of water resulting from the annual inundation. Marl clays, in contrast, are relatively high cost in terms of acquisition, requiring trips to the high desert above the flood plain; the movement of large quantities of marl would have required some organization and possibly the use of donkey caravans for transport (Arnold and Bourriau 1993:11). Furthermore, once acquired, marl bearing teflas would have to have been levigated for some time (Arnold and Bourriau 1993: 71). Marls also require higher firing temperatures, which also costs in terms of wood for the kiln fire, a relatively scarce resource in ancient Egypt (Bourriau 1985:32).

All things being equal therefore, if available, alluvial clay would be the lower cost choice for raw material. In contrast, the abundance of marl in an assemblage would suggest a relatively curtailed availability of marl clays, or exchange (receipt of mass produced products). If production is localized, however, it is more likely that sites closer to the floodplain or the delta would feature larger amounts of alluvial clays.

Construction

Before any raw clay material can be shaped, it must be prepared to make it suitable for use (Arnold and Bourriau 1993; Bourriau 1981:14; Rice 1987:118). Rarely is it the case that unmodified raw clay can be employed in vessel manufacture. In general clays must be levigated (mixed with water to settle large particles out of suspension)(Rice 1987: 118). Temper is added to make clay less plastic and therefore more workable, and its primary function is probably to reduce drying shrinkage (in reality, however, it is often difficult to distinguish added temper from particles that occur naturally in the raw material [Rice 1987:118-119]). After tempering agents have been added the material must be kneaded with the hands or the feet to eliminate air pockets to increase the homogeneity of the clay in terms of moisture and distribution of inclusions (Rice 1987: 118-119).

Tomb illustrations dating to the Old Kingdom provide some insight into how the bowls specifically may have been manufactured. A classic illustration from the tomb of Ti, a 5th Dynasty nobleman historically 2450-2345 BC) buried at Saqqara, depicts what was apparently his pottery workshop (see figure 3-7). Along with other information about pottery manufacture, the illustration depicts a potter using a simple wheel with a separate top to finish a bowl rim. The

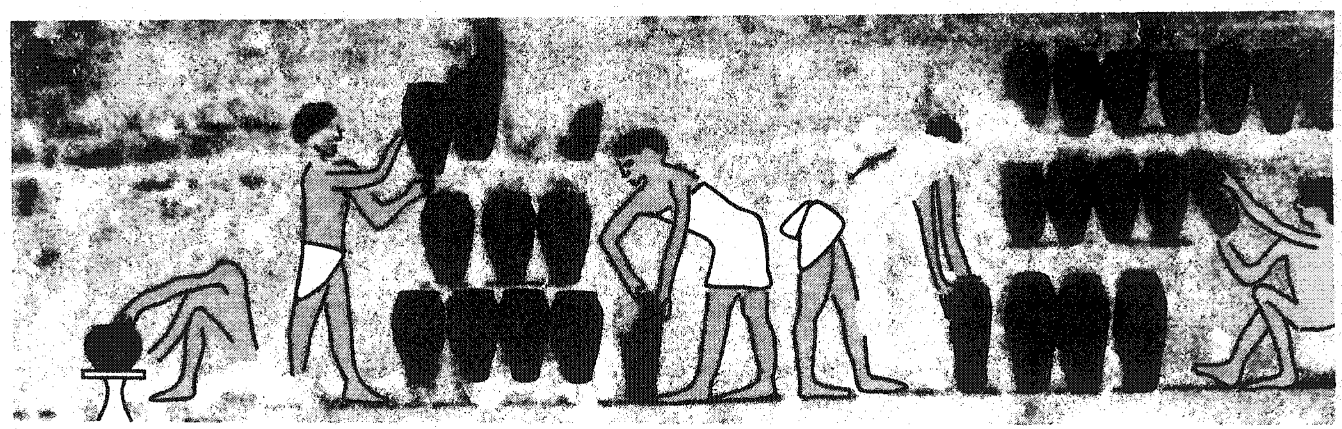


Figure 3-7. Illustration from the 5th Dynasty Tomb of Ti.

morphology of the bowl depicted is similar to that of a Meidum bowl. The device illustrated might properly be considered the ancestor of a potter's wheel. In this case, the "wheel," is a revolving platform which spins on an axial pole, held in place by a socket and pivot system (Arnold and Bourriau 1993:41). Thus, we can infer some information about the manufacture of Meidum bowls from this picture.

The illustration from the tomb suggests that closed vessels jars and bowls with flaring rims are made in a two step process. If one reads the illustration in figure 3-7 from right to left, in the right panel, a man finishes a pot with no rim, which is different from those pots shown on the shelves. To the left, another potter, working on another pot, is shown holding the rim between his fingers (Arnold and Bourriau 1993:39).

To understand the complications introduced by adding a rim to a pot, we must consider the example of typical Old Kingdom storage jars, known as *dwjw* pots in Ancient Egyptian (the standing jars illustrated in 3-7). These jars often bear marks consistent with the smoothing and scraping actions typical of hand manufacture, while the neck and rim bear fine parallel lines consistent with rotation on a turning device of some kind. This bolsters the impression offered by the illustration in Ti's tomb, that the addition of a shaped rim is an additional step after the formation of the body of the pot (Arnold and Bourriau 1993:40).

Vandiver and Lacovara (1985/6) also observed that 4^{th} and 5^{th} Dynasty Meidum bowls were made in two separate pieces. They describe the body of the bowl consisting of a sheet of clay that clearly overlaps at the juncture of the carination and the lower body of the bowl. This suggests that the bowl was made as outlined above, with the rim being added on the turning device. This observation is consistent with what this author has observed about the morphology of Meidum bowls, namely that at that point (where the beveled rim meets the body of the bowl), it does often appear that two separate pieces of clay have been joined together. There would be little observable variation without this added feature.

The two step process requires that the base of the pot be dried before the rim is added. The far left panel of the tomb illustration shows a potter holding a bowl on a turning device while simultaneously shaping a rim. One way to accomplish this would be to hold the base of the pot in a depression in the block -like base of the turning device. For the base of this pot to be stable enough to undergo this technique, it must have been dried previously, as is suggested by the scenario in Ti's tomb (Arnold and Bourriau 1993:40).

Arnold and Bourriau (1993:21-22) suggest an alternative manufacturing technique for earlier (4th - 5th Dynasty) to explain certain consistent features of Meidum bowls. They suggest the possibility that bowls were made using a "core" or "hump." They base this assumption in the observation that there is a clear distinction between marks left on the rims as opposed to the bodies of the vessels. To construct a vessel using a core, a flat disk of clay is fitted over the core. During the course of pressing the clay over the core, the vessel takes on the round shape of the core. Arnold and Bourriau argue that the use of this technique explains the even shapes of the bodies and also the compacted nature of the thin walls and bodies (1993:22).

If Vandiver and Lacovara (1985/1986) and Arnold and Bourriau (1993) are right, and the bowls are formed in a two step process, measurements of Meidum bowl attributes should exhibit different degrees of coefficients of variation, with the lower portion of the vessel producing lower coefficients of variation than the upper portion.

Measurement

A classification of the rim bevel of a Meidum bowl was constructed by breaking the over-all form down into various dimensions. To maximize potential sample size, this classification was constructed for rim sherds, rather than complete vessels. To be counted, the rim sherd has to retain the complete s - shaped rim. There is simply no way to relate body sherds without any portion of the rim represented to a Meidum bowl or another form. Most of an entire vessel (with the exception of the rounded base) can be reconstructed from a rim sherd that retains the entire s - shaped bevel, provided it retains a measurable portion of the diameter. By counting only Meidum bowl rim sherds which are large enough to estimate a reconstruction, there are no issues of over-estimating the number of vessels or counting particular parts of the same vessel twice. The drawback to this approach is that it no doubt underestimates the total number of Meidum bowls represented in a particular assemblage, but this shortcoming is deemed preferable to over-estimating the number of bowls in the assemblage.

One reality of fieldwork in Egypt is that all excavated materials must remain on site, therefore most artifact analysis takes place on site. There are good historical reasons for this restriction, but this necessarily limits the amount of time spent analyzing artifacts to time in the field, which can be prohibitively expensive. It is therefore difficult for scholars to make cross-site comparisons of abundance of any artifactual material from Egypt because objects generated from excavation are difficult to access. Barta (1996: 131), for example, provides preliminary information about the possibility of a volume standard in Old Kingdom beer jars, but laments "The question of volume standard, if there was any at all, could become the subject of further discussion... , but before this can be done, we need to have many more samples of such jars from a greater number of sites." Barta implicitly raises the issue of cross-assemblage comparison.

To counter this problem, project ceramicists for all missions document their finds by drawing and describing the pots in their assemblages. It is often the case, however, that there is not enough time to prepare detailed drawings of all diagnostic pieces (i.e. rims and bases) (e.g. Hope 1991:24).

Drawings as data

Drawings are robust ways to record ceramic information. While these are certainly generated using reliable and tested techniques, they are time consuming to produce and require the curation of the generated drawings. Furthermore, access to the generated drawings is limited and the drawings are usually incompletely published. Given the expense and time involved in producing publications, this generally means there is a lag between the time material is excavated and the time the information is available.

Pottery illustrations are intended to make comparison of vessels simpler by reconstructing on paper as much of the vessel form and decoration as possible (Orton et al. 1993:87). There is much debate about the utility of drawing all the pottery in an assemblage (Orton et al. 1993:87-88). However, in the interests of conservation, the more assemblages that are available for analysis in publications, the less necessary field work becomes for large scale regional studies. As Orton points out, "it is often the illustrations which enable early archaeological pottery collections to be re - examined and new analyses to take place (1993 :88). An online database of ceramic images will offer the same advantage and will be available more expediently.

Because this study was envisioned as a cross-assemblage comparison of explicitly created types, it was necessary to develop a recording technique that would allow the rapid, collection of profile data in a variety of locations and that this material be stored digitally. The measurements employed here are complex and because field time in Egypt is limited. It was deemed preferable, therefore, to measure artifacts outside the field. To do this, the recording and system employed required measurements be taken from images, rather than the artifacts themselves. Nonetheless, there are some measurements that have to be conducted in the field. Digital and field measurements are discussed in turn below.

Scaled images can provide a great deal of information about artifact types and generated can be considered equivalent to taking measurements on actual objects (i.e. O'Brien et al. 2001; Pierce 1998). Technical drawing is really the process of translating the parameters of three dimensional objects to a two dimensional surface. Formal pottery drawings are similar to map construction in this regard. Although a map is a two - dimensional representation of a three dimensional land surface, meaningful linear measurements are still possible. A pottery drawing should properly record the orientation of a vessel, given just a rim sherd. This can be accomplished in a variety of ways. Many analysts use a carpenter's formagauge (a device consisting of several loosely attached metal pins that mold to any particular shape) to record the shape of the vessel on paper, but using such a device does introduce some errors "... more attention is paid to drawing the device than the vessel (Orton et al. 1993:89)." Alternatively the sherd can be oriented by rolling the rim until all points of the rim are in contact with a flat surface and the profile traced on paper.

Given that pottery is often the most abundant artifact class from many archaeological contexts, many authors have pondered ways to mechanize the process so as to increase precision in representation. Holladay (1976), for example, advocates using a saw to slice through every rim and then tracing the profile. It is not always feasible to slice every rim sherd in the field, however. There are other published descriptions of simple gadgets which some practitioners have found valuable, some more productive than others (e.g. Terrell and Osborne 1971; Trump 1972; Edwards 1974, summarized in Orton et al. 1993:89 - 93).

The study presented here builds from these formative efforts. Once the profile is recorded, assuming proper scaling (and most pottery drawings are 1: 1, such that a measurement taken from a drawing should reflect a measurement taken directly on the object), the drawing can be used as a limited data source. Digital image analysis software allows both documentation and measurement of artifacts. In a study that anticipates the technique outlined here, Turner et al. (1990) have suggested a system based on a probe to input profile data directly into a computer. In a similar effort, Pierce (1998) employed a digitizing tablet to measure scaled drawing of Poverty Point Objects from Louisiana.

A rim sherd provides information about vessel size and shape. Rim profile size plus estimated diameter (using a device such as a diameter chart) allows the vessel to be partially reconstructed in a drawing, although when dealing with rim sherds, not all the area below the rim is visible.

Digital measurements

While pottery drawings can be done relatively expediently, the relationship between the object drawn and the drawing will always be unknown to some degree. If a camera is used to perform the same task as a drawing, therefore, that relationship becomes less ambiguous. Scaled pottery illustrations have acknowledged potential as a data source. This potential can be enhanced with careful photography in a controlled setting. To make a photograph the equivalent of a measured drawing, a scale is placed next to the object to be photographed as closely as possible to the measurement plane of the profile in question. The result should be that 2 cm on the scale should be equivalent to 2 cm on the artifact. This is easily evaluated by comparing measurements made on the actual artifacts with measurements made on a scaled photo or drawing

Currently, there are two general ways to record photographic images. The first is the traditional film camera. Film is coated with light - sensitive silver compounds (halides). When the film is exposed to light, the halides become activated (altered) where light falls, but not where it does not (QPB Science Encyclopedia 1998:575-577). Because the final product is printed on photographic paper, a small amount of distortion is introduced from film and paper shrinkage. Film and developing are also relatively expensive. A further disadvantage is that to employ a computer in the measurement of profile shapes, the photographs must be first be scanned to transform them into digital pictures, thus adding an additional step.

Alternatively, a digital camera uses a charge - coupled device (CCD) to record image information. Unlike film, a CCD forms images electronically, using a layer of silicon that releases electrons when struck by incoming light. The electrons are stored in pixels and read into a computer on the other end of the exposure (QPB Science Encyclopedia 1998: 150,229). Therefore, the expense of film, development and scanning is eliminated. Because the images are digital they are much cheaper to curate in large volumes (relative to paper drawings or photographs), and can be easily stored online.

The traditional protocol for illustrating rim profiles can enjoy improved precision and reduced curation cost through the use of digital photography. Some controls must be implemented to minimize distortion as the three - dimensional rim sherd in profile is reduced to two - dimensions. First, the rim must be oriented properly. Second, the camera and the table where the rim is positioned should be level (this insures that the camera's image capturing plane and the plane upon which the sherd is situated are parallel). Third, because data are gathered in the field, the system should be functional under a variety of conditions.

To minimize distortion in resulting from the photographic environment, I constructed a relatively simple device to hold the rim sherd at proper orientation while being photographed (see figure 3-8). A binder clip was attached to the end of an electricians vice (designed to hold wires steady in a variety of positions). The rim sherd is clamped in the binder clip. To orient the sherd consistently, I used half of an old cassette tape box, some modeling clay and a plastic cutting grid. The sherd is rolled until all points on the rim are in contact with the cassette tape box top.

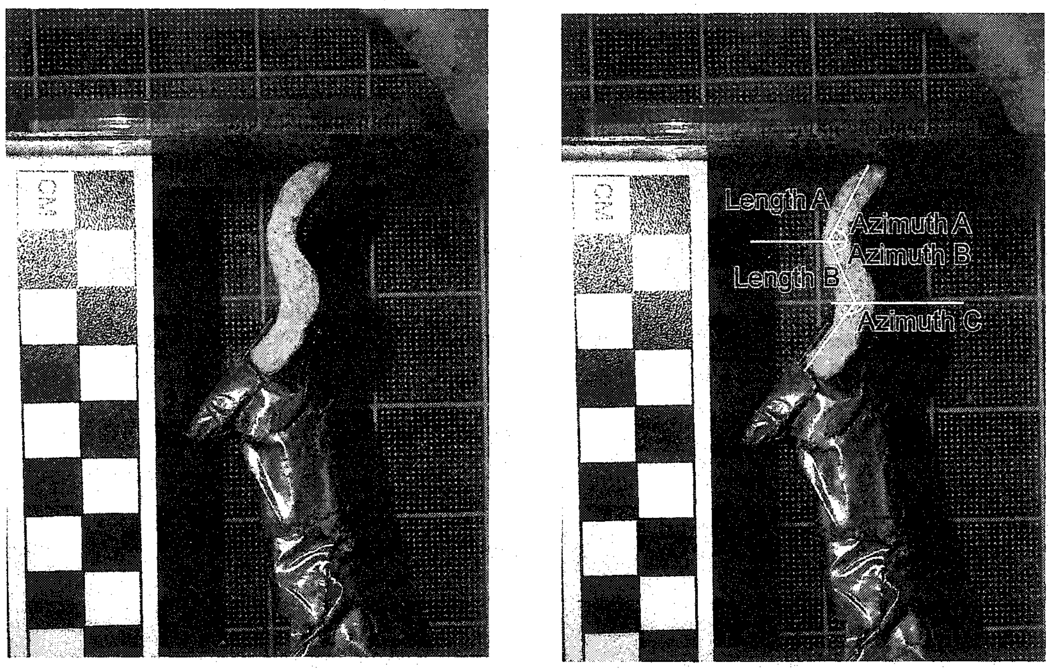


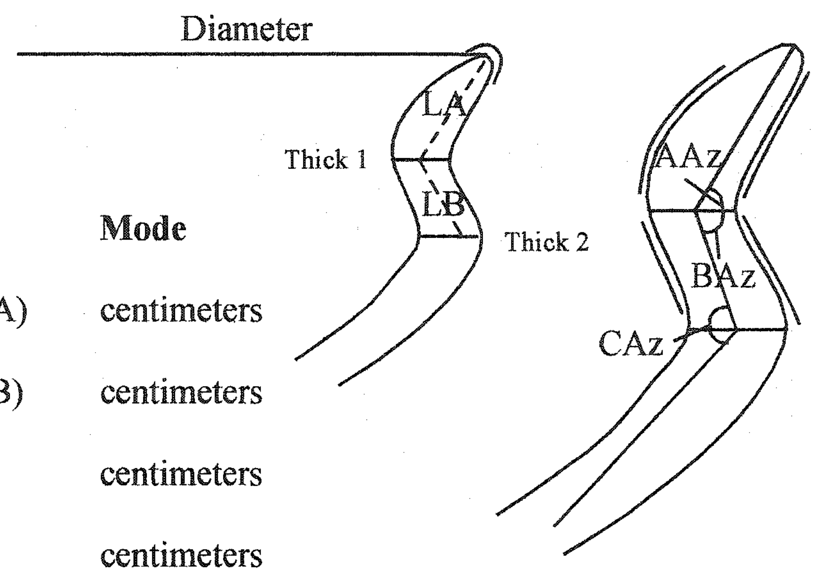
Figure 3-8. Example of rim profile pictures, examples of measurements are illustrated in the right hand photo.

The box top is aligned along the grid lines of the cutting mat and held lightly in place by the modeling clay. This allows some flexibility in placement of the sherd in the frame of the photograph. Finally a photographic scale is inserted flush along the cassette tape box top at the same level as the sherd (this is accomplished by placing the scale on an adjustable column of modeling clay). The end product of this can be seen in figure 3-8. A target bubble and a standard camera tripod allow for the leveling of the camera and the table. These materials are relatively easy to transport.

In some cases, this system cannot accommodate a sherd (usually if the sherd/vessel is relatively complete). For vessels at least 25% complete (the smallest amount of rim necessary for the vessel to be stable in an inverted position), the orientation of the vessel can be recorded by inverting the vessel and photographing with the profile cross section vertical and parallel to the plane of the photograph. Therefore the inverted vessel images can be rotated to reflect the stance of the sherd profiles described above.

These digital images can then be measured using the metric facilities of a computer drafting program (Canvas, a product of Deneba software). The use of the drafting program increases precision, because the act of measurement is less dependent on human dexterity. A further advantage of this technique is that multiple measurements can be made quickly (e.g. Pierce 1998). The graphics program also allows the object to be enlarged several times, thus increasing the accuracy and precision of the measurements.

The graphics program Canvas is used in lieu of more traditional measuring devices, such as calipers, rulers, formagauges etc. Line tools in Canvas are designed to draw lines at any angle. As the line is drawn, a display reports the azimuth (in degrees) of the line drawn as well as its length (in centimeters). This tool is easily adapted to image measurement and is thus ideal for implementing measurements. Controls within the program allow the generation



Attribute	**Mode**
Length A (LA)	centimeters
Length B (LB)	centimeters
Diameter	centimeters
Thick 1	centimeters
Thick 2	centimeters
A azimuth (AAz)	1-90 degrees
B azimuth (BAz)	91-180 degrees
C azimuth (CAz)	181+ degrees

Figure 3-9. Implemented measurements.

of a perfectly horizontal (90 degree) or perfectly vertical (180 degree) line. This feature can be used to measure the thickness of the sherd at any point on the cross section.

To measure the image, the picture is first scaled 1: 1. The line tool is then employed to measure the attributes outlined. Measurements are repeated three times and averaged to guard against measurement blunders. (large errors resulting from improper implementation of measurement techniques)(Dunnell 1986). See figure 3-9 for the implemented measurements.

Diameter measurement

Diameter was estimated using a standard diameter rim chart. The rim is rotated until all points are in contact with the surface. The sherd is then moved along the chart until its curve matches a diameter ring. This is taken to be the *estimated* diameter. All diameter measurements were taken directly from the objects in the field.

Morphological Attributes Chosen

The profile of the sherd is broken into measureable segments by arbitrarily establishing two horizontal reference lines, positioned as closely as possible to changes in inflection on the curve of the rim (see figure 3-9). From these reference lines, additional lines are drawn to the landmarks designated in and their azimuths and lengths are recorded.

To determine what attributes are most chronologically and spatially sensitive, assemblages were grouped initially by location and secondly by dynasty. The Elephantine assemblage represents the 2nd through the 6th Dynasties. For this preliminary examination, the assemblage was not subdivided by time period; a more specific subdivision follows in Chapter 6. In addition, assemblages from Qau and Badari and Meidum are composed of complete museum specimens. Because of the nature the curved rim, it was not possible to implement the thickness measurements outlined in figure 3-9, nor was it possible to record a cross-section photographically.

Differences in attribute measurement across space

As can be seen in figure 3-10, some attributes vary with regard to space. As one would expect, the Elephantine assemblage, as an amalgam of several time periods, exhibits the greatest amount of variation across all attributes except thickness.

Lengths A and B and thickness are measured in centimeters. Thickness measurements exhibit hardly any variation when compared to measurements for Lengths A and B. It would seem reasonable to posit therefore, that thickness shows little spatial sensitivity, across the assemblages for which this measure could be assessed.

Differences in attribute measurements over time

As can be seen in figure 3-10 all attributes except thickness appear to vary substantially over time as well as space. As above, thickness measurements are minimally variable relative to measures for Lengths A and B. Therefore, thickness is no more sensitive to time than it is to space, across the attributes for which it could be assessed.

Initial Attribute Selection

The results of this preliminary exploration of measurement behavior over time and space suggest that all attributes except thickness will differ between dynasties and locations. Therefore, in addition to the fabric descriptions, lengths A and B and azimuths A, B, C and diameter were considered in the final analysis. These attributes will be further examined with regard to the Weber fraction in Chapter 6.

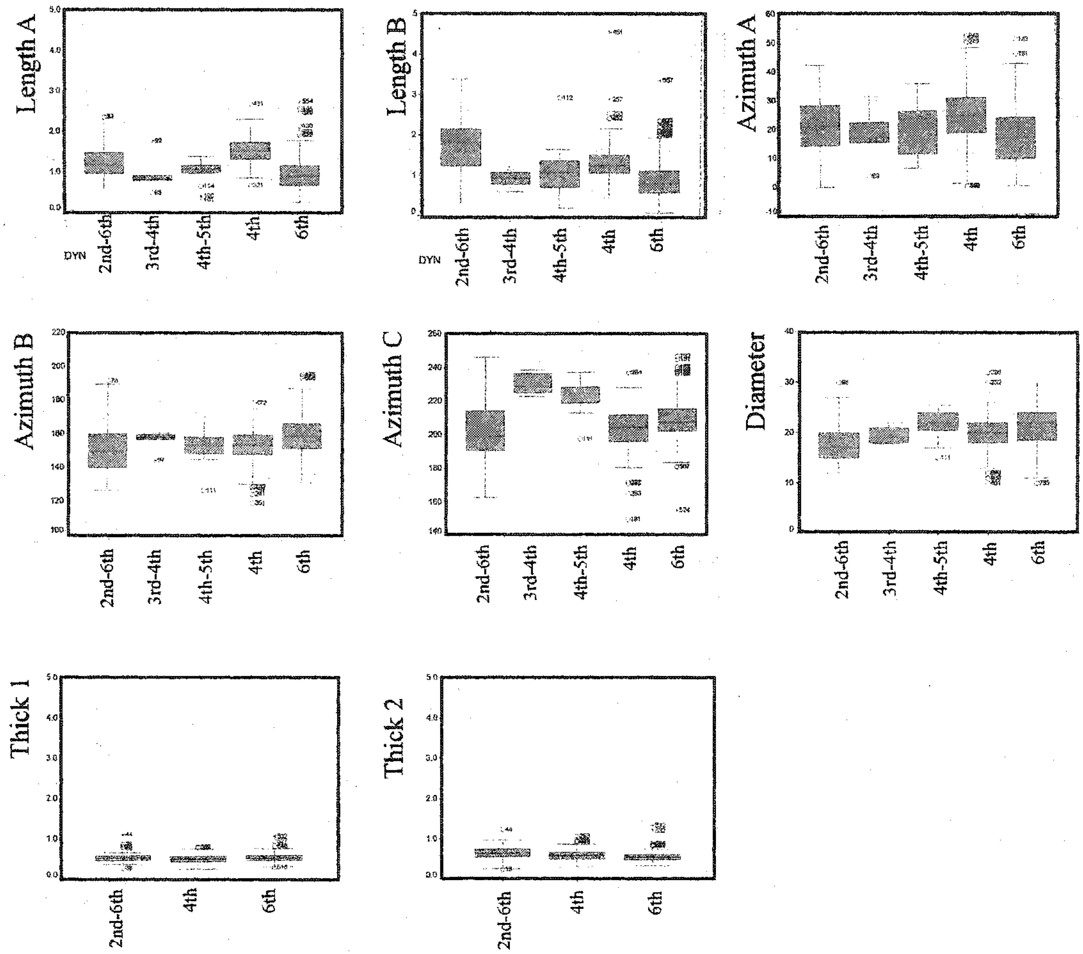


Figure 3-10. Box plots of specified attribute measurements subdivided by time. Because materials from Meidum (3rd - 4th) and Qau and Badari (4th-5th) are museum specimens, thickness measurements were not available.

Choice of statistical techniques, ANOVA and DFA

One-way analysis of variance (ANOVA)(conducted using both Systat and SPSS software packages) is a statistical technique that uses the principle of regression to determine the probability that means of particular prechosen groups exhibit differences through chance alone. This technique produces a coefficient, which is the slope of the regression line if two categorical variables are assigned numbers and used as independent variables in a regression analysis. The constant calculated is the mean of all the data used in the analysis, and is also the regression intercept. The slope of the line is the effect by which a categorical variable affects some numerical measurement, in other words how much one particular mean of a given categorical variable differs from the overall group mean (SYSTAT manual:384). ANOVA therefore compares variance between groups to variance within groups (Drennan 1996:175-176). This in turn allows a determination as to whether the means of the assemblages compared are likely to have been drawn from the same population.

In assessing how information for the manufacture of Meidum bowls is transmitted through time and across space, "(t)he problem becomes: given the division of vessels between sites, is that division reproduced when we attempt to divide up the vessels on the basis of the variables defining their shape"(Read 1982; quoted by Shennan 1997:220). Because the measurements taken are ratio-scale, it is possible to test for covariance and collapse multiple variables into a smaller number of canonical functions. Discriminant function analysis (DFA) is chosen because unlike other numerical classification techniques, this approach assumes observations have been divided into groups on the basis of some criterion (Shennan 1997:350).

Groups of rim sherds were separated based on approximate Dynastic attribution and location. The following chapters discuss the specific nature of the dating system commonly applied in Egypt and its relation to the radiocarbon calendar and following that, the subsequent chapter discusses the nature of the sites from which assemblages were chosen.

CHAPTER 4: CHRONOLOGICAL ISSUES

Ancient Egypt has been the focus of archaeological excavation since Pharaonic times when Middle Kingdom scholars (historically given as 1975-1640 BC) first identified what they thought to be the tomb of Osiris (god of the underworld) at Abydos (Quirke and Spencer 1992:66). This tomb later turned out to be the final resting place of Djer, a 1st Dynasty Pharaoh (ca 3000 BC, the reckoning of this date is discussed in detail below), but since that time, curious enthusiasts and scholars alike, from Egypt, Greece and Rome, and Europe (and later the rest of the world), have been fascinated with the archaeological record of Egypt. At the heart of this fascination has been an ongoing effort to reconstruct the history of this singular civilization from mostly partial documents and by extension, to tie historical events in Egypt to other parts of the ancient world. This work had been ongoing long before the advent of radiometric dating; thus much of what is known about the chronology of ancient Egypt has been accomplished in the absence of such techniques.

By the mid-20th century, the chronology of ancient Egypt from the earliest Dynasties until the Roman era had been established from ancient records. Stratigraphic deposits from Old Kingdom sites with long term occupations have since been ordered based on Dynastic attributions, thus records of the regnal sequence and duration of particular Pharaohs has long been used as dating tool.

When Willard Libby set out to test the radiocarbon method for the first time, therefore, he chose the archaeological record of Egypt as a control (Hassan and Robinson 1987:119). The first radiocarbon date ever collected was taken from acacia wood in the tomb of Djoser, the first Pharaoh of the 3rd Dynasty. The results of this initial study were close enough to the estimated historical date to demonstrate the technique's effectiveness, but subsequent adjustments were needed, the most significant perhaps being the realization that dates needed to be calibrated to adjust for changing isotopic carbon ratios (Libby 1980:1018, summarized in Hassan and Robinson 1987:119-120;).

Recent work, particularly Haas et al. 1987, Hassan et al. 1987, Bonani et al. 2001 and Savage 2001 have attempted to rectify the historical calendar derived from Pharaonic documents with the radiocarbon calendar. While these efforts have yielded dates in some cases that are consistent with the expectations entailed in the historical data, there are inconsistencies. This chapter will therefore summarize the logic behind historical dating, and then summarize the results from recent radiocarbon studies.

Historical dating

Toward the end of the Predynastic period, Egypt developed a writing system that ultimately gave rise to a formalized calendrical system (Clayton 1994:10-11). After Champollion translated hieroglyphs, it soon became possible to reconstruct the Egyptian's calendrical system and to tie events in various ancient documents to it (Clayton 1994:10). Chronologically useful classes of data, therefore consist of two kinds; reconstructions of "king lists" such that the order and span of particular pharaonic reigns can be estimated relative to each other and, textual references to the heliacal rising of Sirius as a way to tie the relative chronology established by the king lists to the Julian calendar.

Because Egyptian historical dates are commonly referenced across a wide variety of disciplines, they are provided in table 4-1 along with associated pharaohs and dynasties and any available radiocarbon dates.

Table 4-1: The relationship between the historical and radiocarbon calendars.

Pharaoh	Dyn	Historical dates	Yrs	Associated contexts and material dated	Bonani 2001, highest probability (two sigma, cal BC)	C14 range
Nebka	3rd	2649 - 2630 BC	19			
Djoser		2630 - 2611 BC	19	Burial chamber, mortar wood	2816-2668	148
				Temple complex	2784-2574	210
Sekhemkhet		2611 - 2603 BC	8	Charcoal, threads, grass, straw	2823-2658	165
Khaba		2603 - 2599 BC	4			
Huni		2599 - 2575 BC	24			
Senefru	4th	2575 - 2551 BC	24	Meidum pyramid burial chamber	2860-2579	281
				Tomb 17 (associated with Meidum pyr.) straw, grass, charcoal	2501-2280	221
				Bent pyramid (Dashur), mortar charcoal	2788-2617	171
Khufu		2551 - 2528 BC	23	Mortar charcoal from Khufu Pyramid at Giza	2783-2658	125
Djedefre		2528 - 2520 BC	8	Pyramid temple, straw	2882-2621	261
				Mortar charcoal from Djedefre pyramid at Abu Roash	2814-2676	138
Khafre		2520 - 2494 BC	26	Mortar charcoal from Khafre pyramid at Giza	2819-2663	156
				Royal Production Center at Giza	2704-2558	146
Menkaure		2490 - 2472 BC	18	Mortar charcoal from Menkaure pyramid at Giza	2708-2618	90
Shepseskaf		2472 - 2467 BC	5	Mortar charcoal and mudbrick straw	2878-2618	260
Userkaf	5th	2465 - 2458 BC	7	South pyramid temple of Userkaf at Saqqara	2461-2115	346
				Queen's pyramid of Userkaf, mortar charcoal and brick straw	2496-2265	231
Sahure		2458 - 2446 BC	12	Mortuary temple, mortar charcoal and mudbrick straw	2462-2193	269
Neferirkare		2446 - 2426 BC	20			
Shepseskare		2426 - 2419 BC	7			
Raneferef		2419 - 2416 BC	3			
Niuserre		2416 - 2388 BC	28			
Djedkare		2388 - 2356 BC	32			
Unas		2356 - 2323 BC	33	Mortar charcoal and straw	2575-2509	66
Teti	6th	2323 - 2291 BC	32	Pyramid of Teti at Saqqara, mortar charcoal and straw	2836-2469	367
Pepi I		2289 - 2255 BC	34			
Merenre		2255 - 2246 BC	9			
Pepi II		2246 - 2152 BC	94			

Royal Annals

Information about the history of the Old Kingdom period comes primarily from four documents, all of which are partial: the Palermo stone, the Royal List of Karnak, the Royal List of Abydos, and the Royal Canon of Turin (Clayton 1994:10-12; Quirke and Spencer 1992:30-31).

The Palermo stone is only the middle portion of a large diorite slab, estimated to be approximately 2.15 meters long and little 0.5 meters high, standing on the long edge (Breasted 1906:52; Clayton 1994:11). Royal annals, recording regnal events through the 5th Dynasty and beginning with sparse records of the reigns of Predynastic kings are written on both sides (Breasted 1906:52). The annals reported in the Palermo Stone record such information as: designations of taxation events (year of the occurrence of the numbering), flood levels and other records of commerce. The item is referred to as the "Palermo Stone" because the bulk of the document resides at the Palermo Museum in Sicily, smaller fragments are also located at the Cairo Museum and the Petrie Museum, University College, London (Clayton 1994:11).

The Royal Canon of Turin provides the lengths of particular regnal spans, but many pieces are missing (Clayton 1994:12). This papyrus document is attributed to the reign of Rameses II (late 19th Dynasty, historically given as 1280-1220 BC). It begins with the dynasties of gods, followed by the dynasties of the earliest pharaohs along with the exact length of their reigns in years, months and days. Unfortunately, this information is incomplete as this papyrus document was badly damaged and large pieces of it are missing (Clayton 1994:12).

Finally, two additional royal lists provide chronological information. The Royal List of Karnak, housed at the Louvre, provides a list of Kings running from the first to the reign of Tuthmosis III (mid 18th Dynasty). The Royal List of Abydos provides a list of 76 kings running from the first king (1st Dynasty, historically given as 3000 BC) to Seti I (early 19th

Dynasty, historically 1291-1278 BC) (Clayton 1994:11). Together, these documents, in combination with the Palermo Stone and the Turin Canon provide a fairly detailed account of regnal sequences and durations.

A somewhat later summary of Dynastic chronological information comes in the form of Manetho's *History* (a collection of notes in various publications written in Greek by an Egyptian priest in the 3rd century BC)(Quirke and Spencer 1992:30). Manetho divided Egyptian history into 30 dynasties (ruling lineages) from the unification of Egypt (1st Dynasty) to the death of Nactanebo II, the last native Egyptian pharaoh at around 300 BC (Clayton 1994:9). His sources were mixed, but as a priest he had access to temple records in the form of papyri, sacred books and inscriptions on the temple walls themselves (Clayton 1994:10). The designation of Dynasties is, therefore, somewhat arbitrary, with most attributions imposed by Manetho working literally thousands of years later from potentially incomplete sources (Breasted 1906:54).

Breasted (1906:38-39) estimated the beginning of the 1st Dynasty from the Turin Royal Canon, a document that contains Manetho's king list which established the traditional division of the historical period in Egypt into dynasties. Manetho said that the time elapsed from the founding of the 1st to the end of the 8th Dynasty was 955 years. Based on these data, and the Sothic cycle (discussed below) and working backward from known dates for later periods, Hayes (1970) calculated the beginning of the 1st Dynasty to be either 3119 or 3089 BC.

Egyptian Calendar and the Sothic Cycle

Egyptian history has also been coopted into a kind of absolute dating system in terms of the connection of various Pharaonic reigns to cyclical astronomical events, particularly the heliacal rising of Sirius and the coincidence of this event with the Egyptian civil New Year (a

1460 year period known as the Sothic cycle). To understand how the Sothic cycle is used to connect Dynastic periods to the Julian calendar it is important to understand that during Pharaonic times and doubtless before, the Egyptians used two calendars; the solar calendar and the civil calendar.

The civil calendar was constructed of 360 days with five days added at the end, almost, but not quite matching the solar year of 365 ¼ days (Breasted 1906:26-27; Quirke and Spencer 1992:29). The Egyptians did not correct for the additional ¼ day, therefore the civil calendar did not match the solar calendar by ¼ of a day. Therefore, every four years the civil year moved back a day relative to the solar year and every 120 years it moved back a month. The simultaneous ending of the civil and the solar year occurred once every 1460 years (Breasted 1906:28-29; Quirke and Spencer 1992:29). In terms of the Egyptian calendars, therefore, this cycle ends when the heliacal rising of Sirius occurs on the first day of the first month (Breasted 1906:26). If referenced as occurring on some other day during some other month, the year relative to the particular positioning of Sirius on the first day of the first month can be estimated. Calendrical dates noted below are derived from historical documents. The 360 days are divided into the flood season, the sowing season, and the harvesting season. Each season had four months, simply numbered (e.g. the first month of the flood season, the second month of the sowing season etc.)(Breasted 1906:26-27; Quirke and Spencer 1992:29).

Censorinus, a Roman writer, recorded a heliacal rising of Sirius on the first day of the civil year in AD 139, an event which would mark the end of one Sothic cycle (Quirke and Spencer 1992:30). The discrepancy between the civil and solar calendars rights itself every 1460 years, but only for four years. Therefore it is possible to calculate that a similar coincidence of the rising of Sirius and the first day of the civil year would have occurred in the Pharaonic period in 1321 – 1317 BC and 2781 – 2777 BC, assuming the calendar was used that early (Quirke and Spencer 1992:30). These would be times when the civil New Year coincided with the heliacal rising of Sirius (Clayton 1994:13).

Three textual references to the Sothic cycle allow the assignment of calendrical years to particular documented events. This evidence comes in the form of records of Senusret III during the 7th year of his reign (1874 – 1855 BC, therefore ca 1867 BC), Amenhotep I (historically given as 1525 – 1504 BC) and Thutmose III (1479-1425 BC) (Breasted 1906:29-32). Of these three observations, the most robust observation of the heliacal rising of Sirius is recorded during Senusret's time as being during the 16th day of the 4th month of the 2nd season (Clayton 1994:13). By calculating what date this is relative to the first day of the Civil New Year (sometime in June or July) it becomes possible to tie this observation in the Egyptian calendar to years in the Julian calendar. Without necessarily knowing the actual date of the Civil New Year, it is still possible to estimate what year this represents by the amount of time elapsed from the beginning to the end of a Sothic cycle. In the case of the observation from Senusret's time, the 4th month of the 2nd season is about 2/3's of the way through the year. Of note is the fact that 1867 – 1872 BC is 906 years after 2773 BC and 550 years before 1317 BC, or about 2/3's of the way through the cycle.

As discussed above, however, the documents outlining the sequence and duration of various reigns are partial and in some cases compiled centuries after the fact. Therefore, working backward from the known dates discussed above is "no better than dead reckoning" (Breasted 1964:17; quoted in Savage 2001:1256). Astronomical coincidences also depend on the calendrical system being used consistently since early Dynastic times, an assumption which cannot be tested (Quirke and Spencer 1992:30).

Radiocarbon dating

Absolute dating can provide an independent test of the chronological hypotheses entailed in using partial historical documents as a dating tool. While not an exhaustive list, four studies undertaken since Libby's initial radiocarbon experiments highlight the relationship between the Dynastic and radiocarbon calendars; Hassan and Robinson 1987, Haas et al. 1987, Bonani et al. 2001 and Savage 2001. The results of these studies are variable relative to the assumed dates of the dynastic calendar, with some studies generating results that meet expectations while others generate results that contradict expectations.

Savage 2001

Savage used data from cemetery 7000 at Naga ed der to test the dates inferred from Petrie's Sequence Dating system at Naga ed Der, because of the unique opportunities afforded by carefully collected organic objects taken from well-documented graves (Savage 2001:1261). The author argues that cemetery assemblages are a better test of the radiocarbon technique because they can be dated more precisely (simply because of the short duration of the burial event).

Savage's results place the assumed Predynastic materials (based on pottery styles) within the date range prescribed for the Predynastic, with 2 sigma date ranges spanning the years from 3800 – 3090 BC (combined results of 12 dates, summarized in Savage 2001, table 2), more or less approximating the historical assumption (Savage 2001:1265). Hassan (1988:138) has argued for a three phase Predynastic chronology: Early (4000 – 3900 BC), Middle (3900 – 3650 BC) and Late (3650 – 3300 BC), based on radiocarbon analyses. Savage

(1998:242-248) identified four Predynastic phases at Naga ed Der, which corresponded with four radiocarbon based phases.

These results suggest that the end of the Predynastic, in radiocarbon years, correlates relatively well with Hayes's estimate of the Archaic beginning ca 3119 -3089 BC. Savage cautions that these results are only for materials from cemetery 7000 and that given the great amount of local variability in the timing of the appearance of particular ceramic styles during the Predynastic, further results from similarly secure contexts at other locations are required (Savage 2001:1274).

Dynastic period radiocarbon studies

Radiocarbon results from Old Kingdom contexts present a greater challenge to the historical calendar than the results from the Predynastic. Three studies: Hassan and Robinson 1987, Haas et al. 1987 and Bonani et al. 2001, have used radiocarbon dates to estimate the dates of the construction of Old Kingdom pyramids, temples and associated complexes. Three locations discussed in all of the above radiocarbon studies are of importance for the pottery analysis presented here; the Meidum pyramid, the Menkaure pyramid and the Teti pyramid.

Hassan and Robinson's work focused on Djoser's 3rd Dynasty pyramid at Saqqara, however, dates were collected from a variety of monuments with various Dynastic attributions, including the locations mentioned above (Hassan and Robinson 1987:124). Eight dates were collected on sycamore and acacia wood collected from Djoser's tomb. Four of the eight measurements provided an average date of 2680 +/- 104 BC. This agrees closely with the 2686 BC historical age attributed to Djoser's pyramid (Hassan and Robinson 1987:123). In general, Hassan and Robinson found good agreement between radiocarbon estimates of particular

Dynastic dates, with the qualification that further refinement of the technique as applied to Egyptian materials is required (1987: 129).

A study conducted in the same year (Haas et al. 1987), however, presents somewhat different results. These authors collected a large number of radiocarbon dates at the Giza and Saqqara pyramids and came up with dates 300 – 400 years older than the historical chronology (Close 1988:153; Haas et al. 1987:585). Some factors have been identified that may have contributed to this large discrepancy, especially the likely use of old wood in a largely wood scarce desert country. Over 76 samples were collected, ranging from "...wood beams projecting from the core of Djoser's Step Pyramid at Saqqara to unburnt reeds from mudbrick walls incorporated into some of the pyramid complexes" (Haas et al. 1987:587). The authors note that the radiocarbon age estimates based on mortar (in particular) from a given pyramid probably range over a period of 100 to 150 years (almost half of the discrepancy noted above), compounded by the fact that Egyptian monuments of the Old Kingdom took several decades to complete (Haas et al. 1987:588).

Haas et al. (1987) did establish that the construction sequence of Old Kingdom monuments was roughly born out by the C14 calendar, even if the dates didn't match up (Bonani et al. 2001:1297). This prompted a second analysis designed to correct for any potential problems that might have been introduced in the first analysis. Therefore, many of the members of the original 1987 dating project went back to collect additional samples, albeit of similar materials (Bonani et al. 2001:1297). Straw, grass and read fragments used to strengthen mudbricks were collected from mudbrick structures, such as temples. Ashes added to mortar mix were collected from mortar seams on the stone monuments (as with the Haas et al. 1987 study). In both cases, the deposition of the building material (if not the death of the organic material) can be tied to the construction event, however the problem of old wood in the mortar mix remains (Bonani et al. 2001:1297).

Bonani et al. (2001) collected radiocarbon dates from contexts used in this larger study of Meidum bowls including; material from the Meidum pyramid, the Menkaure pyramid and environs and the Teti Pyramid at Saqqara. The results of this radiocarbon study show that the Menkaure and Teti pyramids are still older than their historical dates would suggest, though less so (see table 4-1). This study also added a component from the "Giza Logistic Center" which is a context from which Meidum bowls used in this study were collected (areas A1, A5 and A6 at Giza, discussed in the following chapter). As can be seen in table 4-1, the dates for the Menkaure and Meidum pyramids indicate they were constructed simultaneously, with the Giza Logistic Center also dating to the same period.

The dates in each group are tested for their probability of belonging to the same construction event (Bonani et al. 2001:1299). Dates were standardized using the Stuiver and Pearson chronological scales. Because multiple samples were collected from various locations, several possible ranges for each construction event are reported (Bonani et al. 2001, appendix 2). The range with the highest probability of containing the date is reported in table 4-1.

These results bear out some interesting chronological patterns. Bonani et al.'s radiocarbon results for materials collected from the Djoser pyramid are somewhat older than the dates estimated by Hassan and Robinson (1987). The Meidum pyramid construction event date range is the shortest. Furthermore, the date for the construction of the Meidum pyramid has the best correspondence to the Dynastic chronology. This is doubtless related to the fact that burial chamber logs are the source of the date for the Meidum pyramid, while mortar charcoal is the source of the date for the other monuments and the Giza Logistic Center.

Historically, however, these events should have taken place some years apart, even without attaching actual years distant, genealogically there are two generations between Senefru (associated with Meidum) and Menkaure (associated with the Menkaure installation and the Menkaure pyramid)(Clayton 1994:46)

All the radiocarbon ranges are long relative to a typical human generation (ca 25 years), which is generally approximated by a typical pharaoh's reign (see table 4-1). The longest Old Kingdom reign is that of Pepi II (2246 – 2152 BC on the historical calendar) of 94 years. This duration is exceptional (and no doubt questionable), however, the next longest reign is that of Merenre (2255 – 2246 BC on the historical calendar) of 34 years. Several Old Kingdom pharaohs have regnal spans in the 25 – 30 year range.

Synthesizing Calendars

There is conflict between the historical and the radiocarbon calendar, especially in terms of the absolute dates assumed for the construction of these monuments. Lacking the historical information about the order of pyramid construction and regnal succession, it would seem reasonable to assert that the Menkaure pyramid was built simultaneously with the Meidum pyramid, based on the data presented in table 4-1.

However, the historical data are difficult to ignore, given the peculiar rigor entailed in astronomical observations being used as chronological tools, in addition to the robust relative information afforded by records of regnal sequences and durations. Also, in some cases, the historical data do find good correspondence between the historical and radiocarbon dates, for example, dates associated with the Meidum and Djoser pyramids (Bonani et al. 2001; Hassan and Robinson 1987). Savage's work also suggests a good relationship between the radiocarbon calendar and the more traditionally calculated dates of the Predynastic (Savage 2001). While clearly flawed, the documentations of heliacal risings of Sirius are at least broadly in the range of expectation. Finally, four independent, though partial documents consistently report similar regnal sequences and spans (Breasted 1906).

So while the absolute historical dates associated with the pyramids (derived from the admittedly tentative reports of events in the Sothic cycle in ancient documents) are potentially falsified by Haas et al. (1987) and Bonani et al. (2001), the order and spans of particular reigns are not.

Consider the ranges of the Meidum, Menkaure and Teti dates discussed in table 4-1: 56 years, 90, and 101 years. Senefru reigned from 2575 – 2551 BC (ca 24 years) while Menkaure reigned from 2490 – 2472 BC (ca 18 years)(see table 4-1). The entire time elapsed from the beginning of Senefru's reign to the end of Menkaure's reign is 103 years which approximates the reach of any of the error terms described above. Therefore, the error terms attached to these sets of dates are inadequate for resolving the order of construction for these monuments. Even abandoning the actual calendar years represented, if three generations have elapsed between the construction of the Meidum and Menkaure pyramids, and using 25 years as an average generation, this would suggest 75 years elapsed between the beginning of Senefru's reign and the end of Menkaure's, a period of time contained within the reported radiocarbon ranges.

It seems unwise to abandon the highly resolved relative information offered by historical documents and astronomical observations. It also seems unwise ignore the more scientifically robust information offered by the radiocarbon dates, especially in the face of the partial nature of the historical documents. Dates calculated do suggest that Old Kingdom monuments are on average older than they should be in some cases (with the exception of two pyramids in the fifth dynasty and Tomb 17 at Meidum).

While there are clearly some questions as to whether exact dates can be attached to the Old Kingdom, regnal sequences are not falsified by the radiocarbon results presented above. The Dynastic calendar is therefore used here as an ordinal scale chronological tool. This approach is deemed reasonable for three reasons 1) questions about the nature of cultural transmission between sites used in this study require relative, but not absolute chronological control, 2) Because a given Pharaoh is recognized as Pharaoh more or less simultaneously throughout the Nile Valley and Delta, Pharaonic inscriptions and sealings provide a robust independent chronological framework against which changes in vessel morphology over time can be compared and, 3) not all the assemblages used in the ceramic study presented here are associated with radiocarbon dates.

The reader is referred to table 4-1 for cross references of Old Kingdom historical dates, dynasties and radiocarbon results produced by Bonani et al. 2001. For the duration of this analysis, chronological references will be phrased in terms of dynastic attributions, as opposed to calendrical years.

CHAPTER 5: ASSEMBLAGES USED IN ANALYSIS

Six assemblages spanning locations from the Nile Delta to Aswan were examined in this study (see figure 5-1); Elephantine, Qau and Badari, the Meidum Pyramid, the Teti pyramid, the Giza Plateau, Abbasiya and Kom el-Hisn. Of these assemblages; Elephantine, Giza and Kom el-Hisn are represented by field collections of relatively large numbers of objects. Qau and Badari and the Meidum pyramid materials are represented by museum specimens. The Teti pyramid materials are represented by field drawings. Below are general descriptions and discussions of sites used in this study. Appendix 2 provides detailed deposit descriptions.

Elephantine

Meidum bowls collected from the German Archaeological Institution's long running excavations at Elephantine comprise the southernmost assemblage analyzed. Elephantine is situated at the first cataract of the Nile and was the capital of the first Egyptian nome by the early Dynastic period. Archaeological deposits at Elephantine are concentrated on the southern end of a rocky island in the middle of the Nile, west of the modern city of Aswan on the east bank of the Nile.

The general environment of Elephantine and Aswan (see figure 5-2) is rocky relative to other locations throughout the Nile Valley and Delta. This fact doubtless affected the subsistence strategy of the occupants of the island, and it is commonly held that this population may have been involved in an exchange of minerals for food with villages farther to the north from earliest times. The name Aswan, in fact, is derived from *swenet*, the ancient Egyptian word for trade (Baines and Malek 1982:72). Elephantine's position on a rocky outcrop in the middle of the Nile allowed the formation of highly stratified cultural deposits.

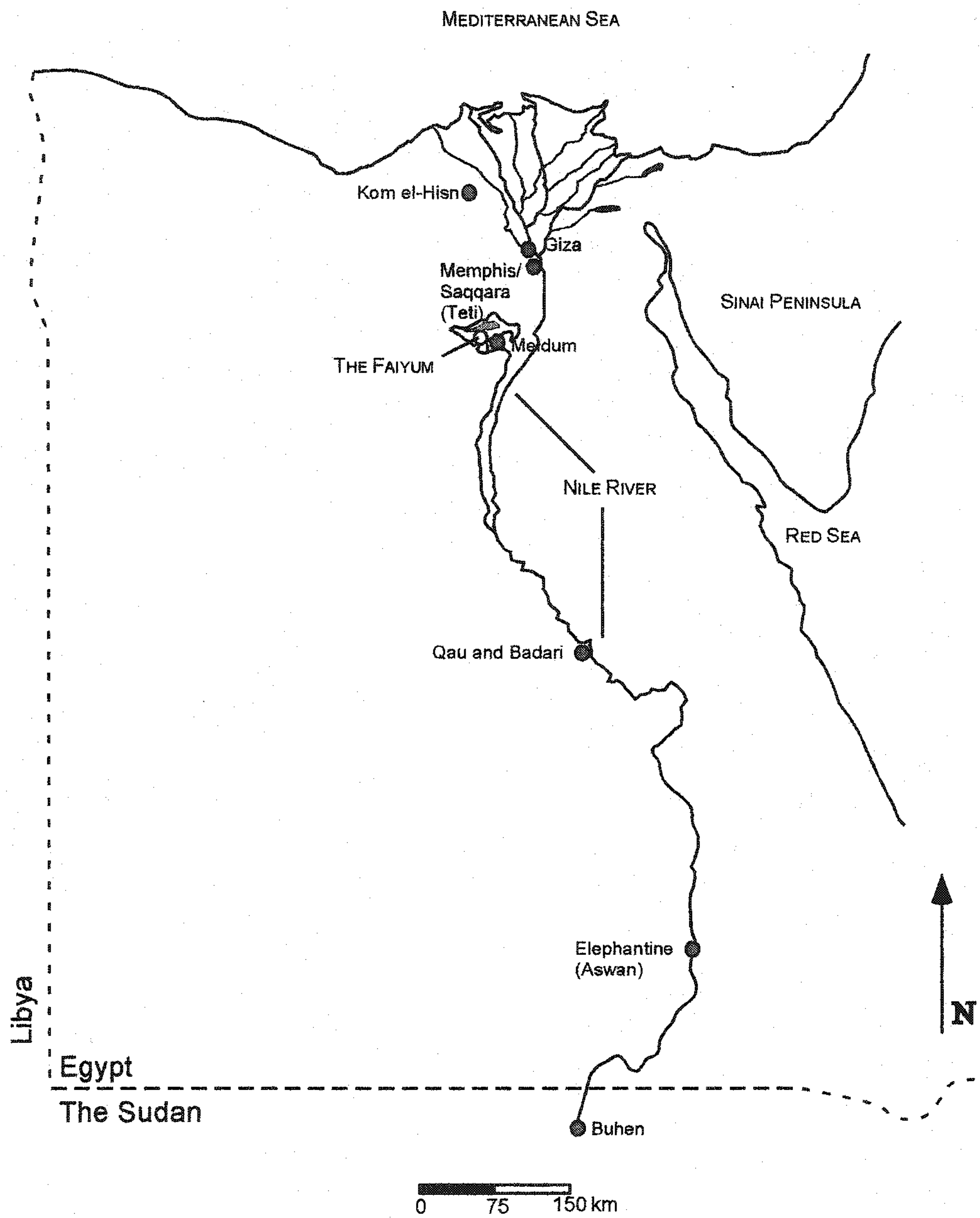


Figure 5-1. Map of sites mentioned in text.

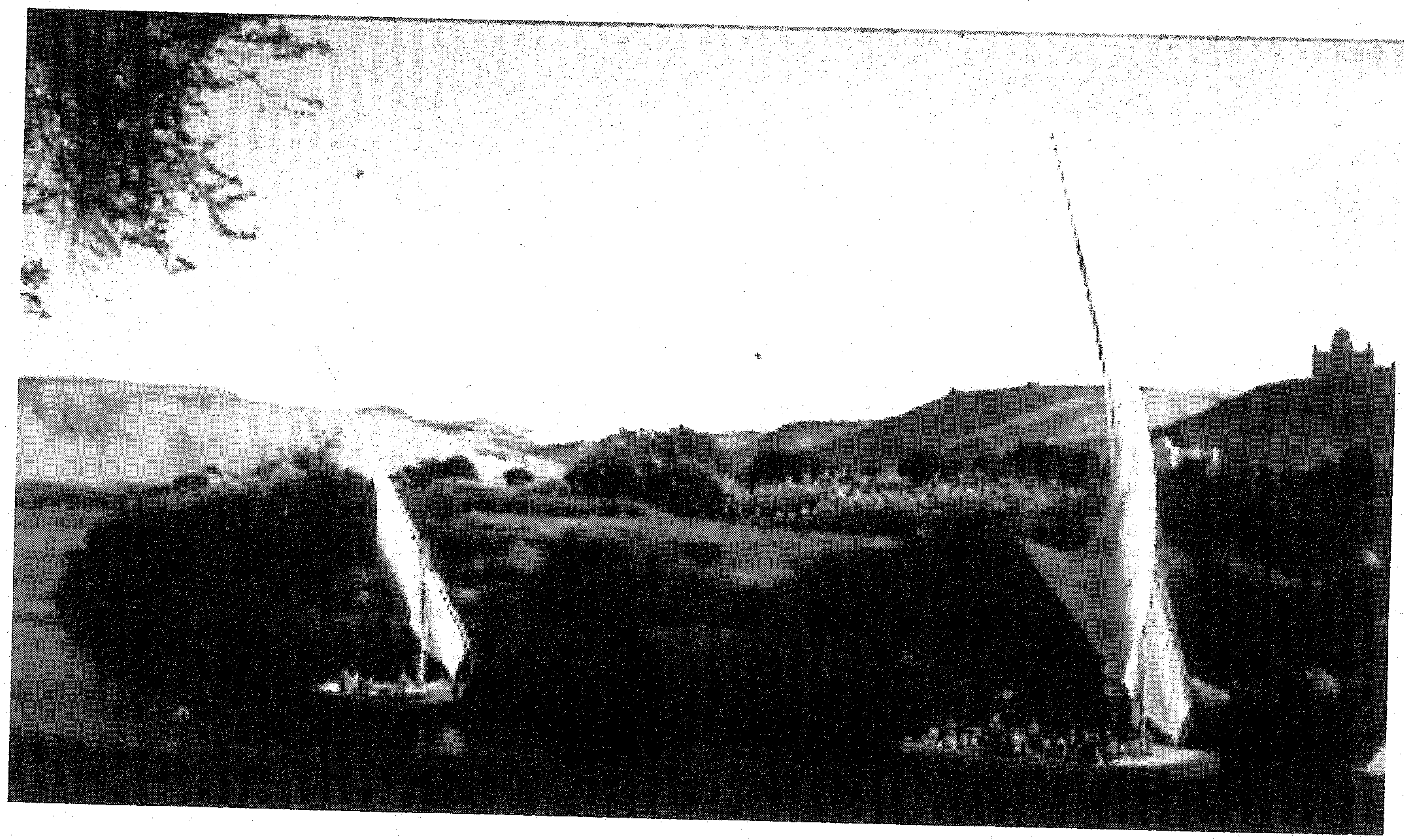


Figure 5-2. Elephantine Island environs.

Therefore, archaeological material representing the period from the Predynastic onwards through modern times is accessible, including Dynasties 2-6, the earliest through the latest period of the Old Kingdom.

Elephantine is also known as the cult center for the god Khnum (see figure 5-3) (Kemp 1989:74; Quirke and Spencer 1992:61). The cult of Khnum is represented at Elephantine by an Old Kingdom temple on the eastern side of the island as well as a later 18^{th} Dynasty temple at the southern edge of the island (Kaiser et al. 1999). In addition to his distinctive appearance, Khnum is known from legends to have fashioned humanity from a potter's wheel (Quirke and Spencer 1992:61). In general, Elephantine's position as a cult and trade center make it a unique Old Kingdom settlement.

Geomorphologic Setting

The granite typical of the environs around Elephantine and Aswan represents the basement complex of Egypt's general geological sequence. The Nile emerges as a river during the Miocene (ca 25 - 3 million years) ago. Prior to this time, the Mediterranean Sea extended south into Egypt, at times as far south as the northern Sudan, forming an ancient bay (Said 1993:33). The bed of this ancient bay generally (with a large number of local exceptions) consists of three layers of stone. The first of these is the basement complex consisting of metamorphic and igneous rocks (diorite, granite and quartz) exposed in the cataract region, with the first cataract representing the northernmost extent of this exposure. Above this is a layer of sandstone, often referred to as "Nubia sandstone" also found on the surface in the area around Aswan and into the Sudan. Overlying the sandstone is a layer of sedimentary limestone, shale and clay formed from the deposition of marine sediments, found exposed in the oases of the western desert and the northern part of the river valley (Said

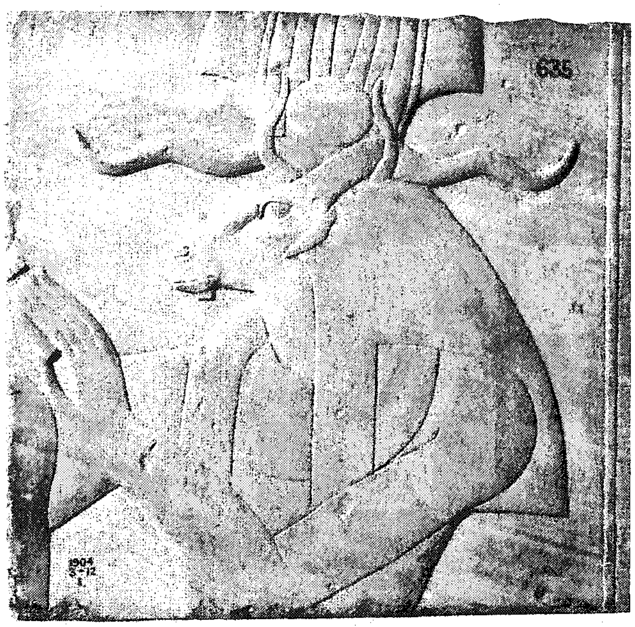


Figure 5-3. Image of Khnum (after Quirke and Spencer 1993:figure 43).

1981:40-50). Because the region in the vicinity of Aswan and Elephantine was not submerged as long as northern Egypt and the Delta, limestone deposits are not as thick as they are to the north and the basement complex is more likely to be exposed.

Aswan represents an inflection in the behavior and nature of the Nile, between a river with a rocky channel and relatively steep gradient to a river with a broader channel with a relatively shallow gradient (see figure 2-3). The course of the Nile can generally be considered to have two parts (Said 1981:81). The first course can be considered the stretch from the mouth of the Atbara (one of the Nile's three tributaries, located in Ethiopia) to Aswan. This portion of Nile is characterized by a relatively rocky channel with alterations of rapids and reaches of gentle slope wherein the river is primarily eroding its bed. The second part can be considered the part from Aswan to the sea where the river traverses its floodplains. This portion of the river is primarily slower, as the gradient of the river channel reduces drastically at Aswan (Said 1981:81). The velocity of the river both in flood and low volume is greatest in the region of the six cataracts (Said 1981:81).

Generally, the area around the cataracts is characterized by rocky outcrops, some of which form islands in the middle of the Nile, such as Elephantine. The island of Elephantine rises high above the river, and because of the relative speed of the river as it approaches the island, the settlement at Elephantine was not historically subject to the kind of alluvial deposition generally typical in ancient sites located in the Nile Valley and Delta.

The archaeological deposits at Elephantine are built on an uneven surface consisting of granite outcrops, therefore the construction of later architecture did not obliterate earlier constructions and Old Kingdom deposits are readily accessible (Kemp 1989:69). At other, less rocky, locations throughout the Nile Valley and Delta, the remodeling and expansion of temples and villages during later periods could potentially obliterate earlier constructions

(Kemp 1989:69). The topography at Elephantine is not as level as it is generally at other locations farther north, therefore, rather than removing or destroying previous constructions situated within gaps in the boulders, said gaps were filled in and paved over, using the detritus of earlier occupations as packing. This practice thus preserves earlier material and also makes excavating it less problematic than it might be in other settings. See figure 5-4 for an example of the nature of the stratigraphy at Elephantine.

Early material built in between gaps are filled in and paved over, often sealing early material under later material, thus providing a series of stratified deposits that predate, include and postdate the Old Kingdom (Kemp 1989:69-70). These granitic outcrops also set Elephantine apart from most other locations in Egypt because there are few agricultural fields available here for cultivation (Seidlmayer 1996:108-109).

Because the town of Elephantine in general is partially built over a series of granite outcrops and ridges, it has an an irregular oval plan, raised above the river, covering approximately 1500 square meters (see figure 5-5)(Kaiser et al. 1999; Kemp 1983:99). Ancient materials (dating generally to the Pharaonic era) are concentrated on the southern portion of the island, distributed over two granite ridges. These ridges have been designated the eastern and western "islands." During the inundation, these outcrops were often divided by a temporary channel of the Nile with the eastern island being considerably larger than the western island (Seidlmayer 1996:111). While both areas feature Old Kingdom deposits, only material collected from the eastern island is used in this study due to availability.

Architectural Features

The town at Elephantine appears to have come into maturity during the Old Kingdom, however, its signifance was known from earlier times. The Satet temple (see figure 5-5) is a

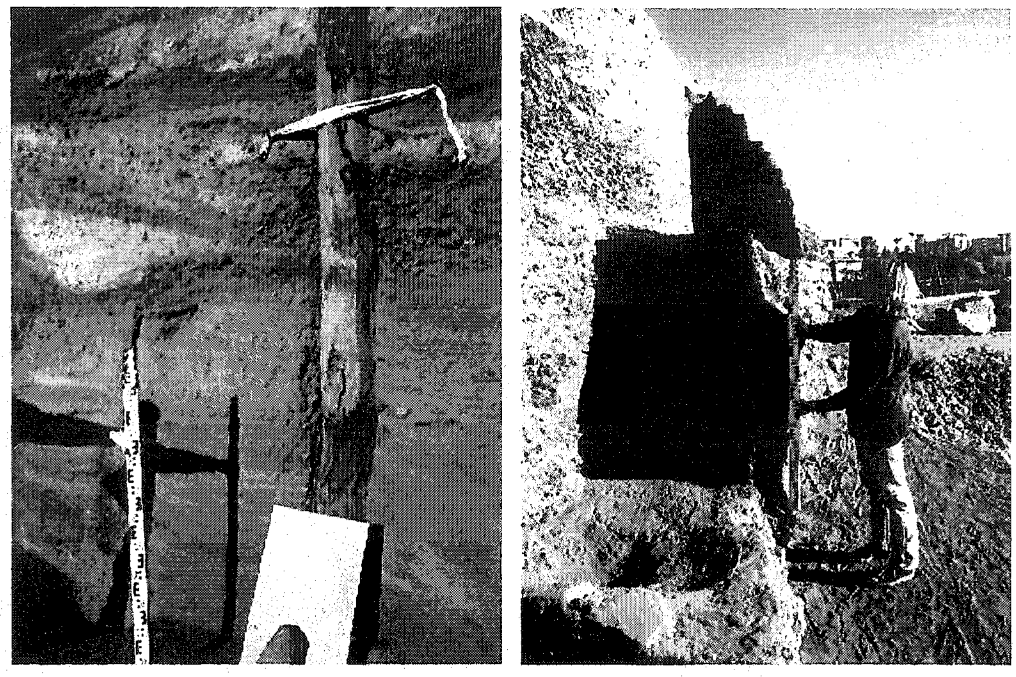


Figure 5-4. General nature of the stratigraphy at Elephantine.

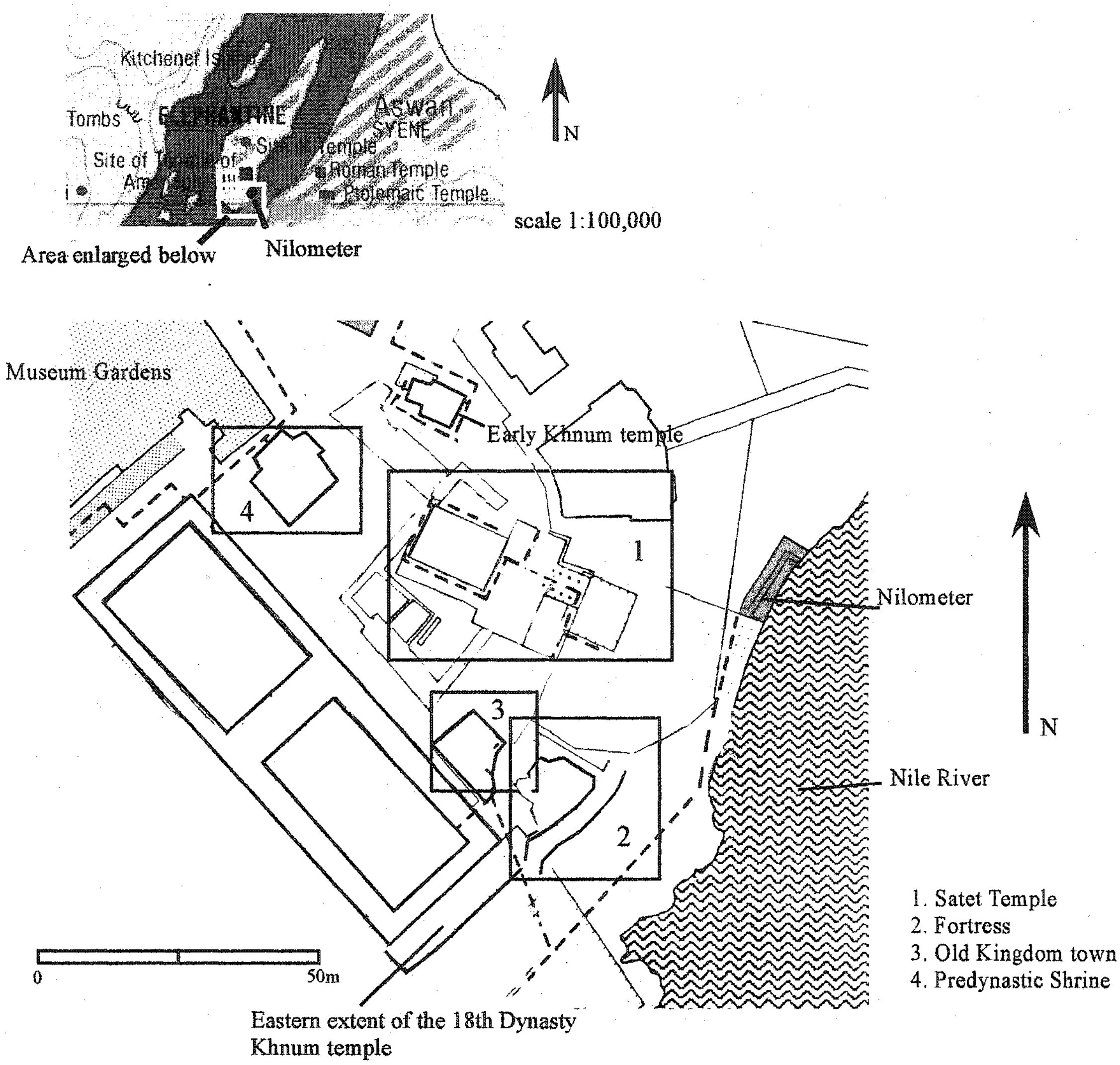


Figure 5-5. Areas of the Elephantine excavation from which materials used in this study were collected. For the lower map, dotted lines represent excavated architecture, solid lines represent standing architecture. (Upper map after Baines and Malek 1982:72, lower map after Kaiser et al. 1999, figure 1).

central feature of the Eastern Island and has been used and remodeled from Predynastic to Ptolemaic times (Seidlmayer 1996:112). To the southeast of the Satet temple is a fortress associated with the 1st through late 3rd/early 4th Dynasties (Kaiser et al. 1993:140). Lying southwest of both of these features is an Old Kingdom town which was occupied through the 6th Dynasty (Kaiser et al. 1999). The earliest deposits at Elephantine are located in front of the aforementioned Satet temple, dating to Nagada II phase of the Predynastic period. These features are discussed in detail below.

Satet Temple

Elephantine has been continuously occupied from the Nagada II period of the Predynastic to the present day. Evidence of a connection between Elephantine and other Upper Egyptian population centers comes in the form of votive figures found in the lower deposits of the site, similar to those known from Predynastic contexts at Hierankonpolis (Baines and Malek 1982:72; Kemp 1989:73).

The hypothesized use of the Satet temple during the Predynastic indicates that the ritual significance of this location predates the Pharaonic era. This shrine is positioned in a squared off space occupying a natural niche in the boulders. An unknown cult image was placed in two brick rooms. Pottery found in the lower deposits of this installation are typically Early Dynastic, however the presence of some Predynastic types indicates the potential time depth of the occupation (Kemp 1989:69). This basic form of the shrine as a niche in the rock served by modest brick shelters was maintained into the Old Kingdom proper (Kemp 1989:69).

Fortress

The fortress also contains a large amount of Early Dynastic/Old Kingdom material. This fortification consisted of double walls, perhaps originally at least three meters high, built in straight lines over the uneven rocky ground and reinforced by short, transverse connecting walls (Seidlemayer 1996:112). The walls of the fort are distinguished by at least six round and six square towers (Kaiser et al 1993:137, figure 1; Seidlmayer 1996:112). The fortification, while bearing no specifically militaristic attributes, nonetheless represents a different architectural character than the earlier Old Kingdom village. The fort and earlier settlement coexisted throughout the Old Kingdom, but the fortress was not built to incorporate the earlier village, or the Satet temple (Kaiser et al. 1988; Seidlmayer 1996:112). The fortress itself underwent several remodeling episodes (Kaiser et al. 1993; Seidlmayer 1996). Early in the 2nd Dynasty, it was extended north in a less "formal" arrangement. Following this, construction extended to the south to include the settlement and temple. Early in the 3rd Dynasty, the old fortress walls were removed to form a continuous settlement area (Kaiser et al. 1993; Seidlmayer 1996:113).

Settlement

The Eastern Settlement lies southwest of the Satet temple and the fortress, extending over much of the Eastern island. Like the Satet temple, the earliest portions of this settlement date to the late Predynastic. This assessment is based on the observation that deposits located in the village contain evidence of postholes that may have defined reed huts typical of other Predynastic settlements known from Upper Egypt (Kemp 1989; Hassan 1988).

During the early Dynastic, occupants of the Eastern Settlement construct mudbrick dwellings, initially primarily domestic in function, but evolving into a combination of dwellings and what are apparently official "state" workshops (Kaiser et al. 1999:73-74). By the end of the Old Kingdom, the village appears to have served as a granary as well. It should be noted that although the German Archaeological Institute's excavations are ongoing, large portions of the Eastern Settlement are as yet unexcavated (Kaiser et al. 1999; Seidlmayer 1996).

General Architectural History

The final report on the 1999 field season at Elephantine outlines the history of construction on the eastern portion of the ancient town, temple and fortress at Elephantine (Kaiser et al. 1999:71). During the 24th season of the German Archaeological Institute excavations at Elephantine, they focused on an early occupation of the island. The area excavated is located between the museum garden and the early Khnum temple on the eastern edge of the island (Kaiser 1999:71).

The earliest construction is the early Satet temple, dating to the Predynastic, but modified throughout the Old Kingdom. The eastern city is another early feature at Elephantine that nonetheless postdates the initial construction of the Satet temple. The earliest levels of the city are attributed to the mid-2nd Dynasty (Kaiser et al. 1999:71). The buildings on the eastern portion of the city of Elephantine are possibly the oldest known examples of state production architecture in Egypt (Kaiser et al. 1999).

The settlement is northwest of the fort and shares an immediate border with remodeled portions of the surrounding wall, which lies to the east (Kaiser et al. 1993:136). The fortress construction was initiated during the 1st Dynasty. After excavating a series of more recent levels, excavators noted a solitary building layer representing the foundation of the fort.

Because this material underlies material dating to the early 2nd Dynasty, it is assumed to represent the late 1st Dynasty (Kaiser et al. 1999:136).

The material that overlies the 1st Dynasty foundation is largely attributed to the 2nd Dynasty, based on its architectural location relative to other materials. This early material is primarily a fortification. Because this material is found at the lower levels of the fort, but not at the base, it is assumed to represent the 2nd and 3rd Dynasties. Epigraphic evidence recovered from this layer bear the names Horus Sechem-ib/Horus Chasechem, commonly held to be kings of the early second dynasty (Kaiser et al. 1999:172).

Information collected by the 13th and 16th seasons of Elephantine excavations (Kaiser et al. 1993), wherein areas to the north and northwest of the fortress were investigated indicate the bulk of the fortress was constructed during the 2nd Dynasty. Construction in this portion of the site is similar to other identified Old Kingdom living and official quarters seen at other locations in the Nile Valley, particularly the city of Chentkaues at Giza (Kaiser et al. 1999:73). Buildings at both locations share a particular style of corbelled roof. Also both locations are characterized by having living quarters and official quarters separated by a long corridor (Kaiser et al. 1999:73-74). Corbelled roofs in general are typical construction features of the 2nd Dynasties (Spencer 1979; Sterling 1995).

Levels associated with the 2nd Dynasty are concentrated in the vicinity of the settlement, which is bounded on its eastern edge by a fortress wall, on the eastern island. The construction of the fortress, tower, buildings and silos to the west of the wall began in the 2nd Dynasty. Material attributed to the 2nd Dynasty generally comes from building phase VI.

Unlike the material collected from Phase VI, which was a combination of official and domestic debris, material in phase VII is associated with administrative functions that develop during the 3rd Dynasty. Third Dynasty material is associated with the Satet temple and an extension of the fortress. Architecture associated with Phase VII extends to the northwest of the older fortress construction (Kaiser et al. 1999:72). As with the 2nd Dynasty construction discussed above, the determination of the official character of this building is indicated by the preplanned nature of the walls. This material is represented by a 350 m² area surrounded by a wall and subdivided into a series of small rooms (Kaiser et al. 1999:72). The building was remodeled from a city wall and the intervening surface with an irregularly cut structure built upon it. To the north they were able to fortify further by incorporating the intervening building A. A sealing from this building phase is attributed to Djoser and is thus late 3rd, early 4th Dynasty.

Fourth dynasty material is known from a variety of locations throughout the site and is generally assigned to building phase VIII (Kaiser et. al. 1999:71). It should be noted that while building phase VIII is associated with the 4th Dynasty, because of the nature of the German excavation strategy of removing levels, rather than discrete deposits, some 3rd and 5th Dynasty material is also associated with building phase VIII.

During this phase, the official building discussed above is remodeled into stone workshop identified by abundant stone working debris. This construction is attributed to the 4th Dynasty. Toward the end of Phase VIII, the northern buildings were again converted into official buildings by the middle of the 4th Dynasty (Kaiser et al. 1999:84-85).

Following the construction of the stone workshop during the 4th Dynasty, courtyards were formed by breaking parts of the inner surface of the city wall during the 5th Dynasty. This break allowed the settlement to extend to the east (Kaiser et al. 1999:84-85). A series of grain silos were constructed within newly built courtyards on the western side of the eastern settlement, within the area defined by the fortified walls. These courtyards seem to be associated with the storage of grain as indicated by large ceramic vessels located in their centers. These courtyards date to as late as the 6th Dynasty, according to excavation notes.

Excavation Protocol and Level Descriptions

Excavation units at Elephantine are defined by particular building events. The focus of the German excavations has been on architectural development and tying such developments to particular time periods. Because the German Archaeological Institute's focus is on reconstructing relative building sequence, fill deposits were removed in flat levels, 10-20 cm deep, which use architectural features as boundaries. Sealing impressions and general pottery types are therefore used to assign relative time periods to particular architectural features, but in some cases, the chronological assignment of a given context is listed only as (for example) "mixed into the 5th Dynasty." While the location of various excavation units is noted and located on maps, levels are not described in sedimentary detail. Once the contents of various levels were examined, they were assigned to a particular building phase. Building phases are a combination of several excavation levels taken to represent the same relative time period.

Levels at Elephantine were assigned feature numbers as excavated. Publications and excavation notes were used to tie excavation levels to the Dynastic chronology. It should be noted, however, that the author had only partial access to excavation notes from Elephantine. While it is always possible to identify the general location of a given level excavated, it was not always possible to determine the precise stratigraphic relationship between that level and those adjacent to it. In some cases, the contents of several levels attested to be part of the same building phase are combined.

Summary

The bulk of the Meidum bowls from this assemblage come from the eastern island and are associated with the 1) settlement just outside the fortress, 2) Environs of the Satet temple and 3) courtyards associated with the Eastern Settlement later in the Old Kingdom. The assemblage consists of bowls representing time periods from the 2^{nd} – 6^{th} Dynasties. Therefore, the Elephantine materials were subdivided into dynastic groups as best as could be determined. The large amount of production debris suggests a population at least partially characterized by craft specialists.

While the Elephantine assemblage consists of over 100 measurable objects, when broken down into time periods, subassemblages consisting of objects presumed to be contemporary are small.

Giza

While Elephantine can be characterized as a trading and manufacturing center, the material from the Giza plateau comes from two communities explicitly established for the workers and craftspeople involved with the construction of the Menkaure pyramid. These communities would most likely be supported by imported material, thus like Elephantine, the inhabitants of the Giza plateau are not directly involved in their own food production.

Two areas on the Giza plateau, which have both have been the focus of the excavations of the Giza Plateau Mapping Project (GPMP) provide data for this study (see figure 5-6 for general overview of the plateau). The impetus for the large scale archaeological investigation undertaken by the GPMP has been to understand more about settlement and support infrastructure pertaining to pyramid construction. To answer some questions about

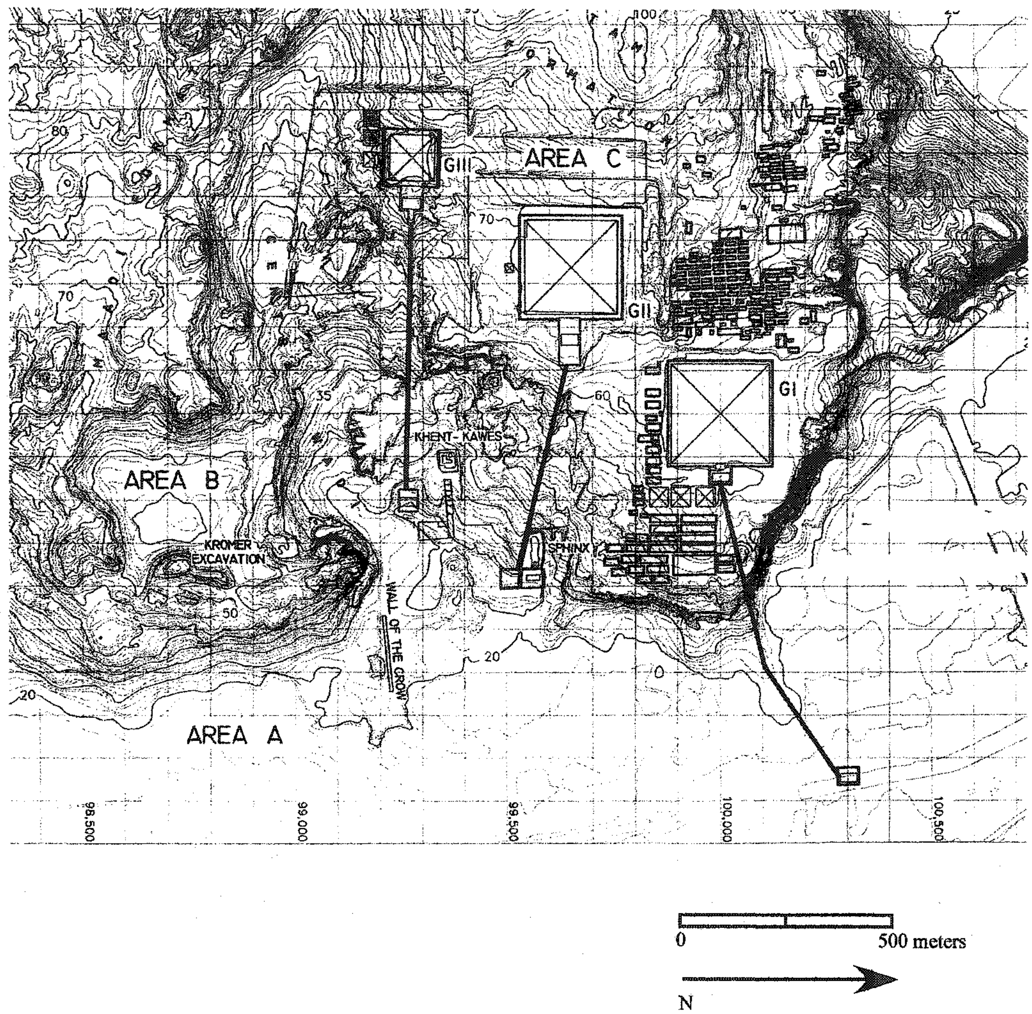


Figure 5-6. Overview of the Giza Plateau (after Conard and Lehner 2001, Figure 1.)

the logistics of pyramid construction, investigators considered three areas on the plateau. These areas of the plateau (A, B and C) were chosen in hopes of finding domestic or settlement architecture that may have housed workers who built the pyramids. Area B was eliminated from consideration due to a lack of visible architecture. Therefore, since 1988, the GPMP has focused its efforts on areas A and C (Lehner 1992:2).

Area A was excavated in two different phases from 1988 to the present. Area A generally consists of an area SE of the Wall of the Crow and running to the eastern slope of the Maadi formation. Area A was subdivided into AA, A7 and A8 during the 1988-1991 seasons. From 1997 to the present, work has been conducted in a large grid covering much of the area south of the Wall of the Crow.

The earlier phases of work in Area A focused on ruins along the eastern slope of the Maadi formation. This area contained a rectangular building about nine meters long (N/S) and six meters wide (E/W)(Lehner 1992:3). This area is now referred to as area AA to distinguish it from later excavations in the same general region, now referred to as Area A. Excavators also opened an excavation at the foot of what is now known as the Wall of the Crow during the 1988 – 1991 seasons.

Area C was excavated by the GPMP in 1988 – 89. This area was initially investigated by W.M.F Petrie in 1880 – 82 (Petrie 1883:101 – 103). Area C was initially identified by Petrie as “workmen’s barrracks” (Conard and Lehner 2001:23, Petrie 1883:101 – 103). Material in this area consists of a series of comb – like galleries west of the Khafre Pyramid.

Excavated material from both areas of the Giza Plateau produced examples of Meidum bowls. Excavation records for these areas are made available through the cooperation of Mark Lehner, director of the Giza Plateau Mapping Project.

Area A

For all phases of the GPMP in Area A space is controlled through the construction of squares which are usually 5 x 5m. Occasionally squares of different dimensions were required and these are discussed below. Archaeological material recovered from Area A are collected in units called "features." Features are essentially cultural strata, identified based on their internal consistency relative to features underlying, overlying or adjacent to them. With the exception of the naturally deposited modern sand layer which overlay the entire Area A exposure, features represent cultural rather than geological events. By extension, any given feature identified was probably formed within the 50 year period represented by the reigns of Khafre and Menkaure, making most features representative of relatively short duration events. Walls, for example, are assigned unique feature numbers because their construction represents a distinct event. Fill (material deposited between walls, after the construction of the structure, possibly for the purposes of remodelling an older structure) is considered a feature for the same reason.

Criteria for identifying features are based both on observed disjunctions between features and also on artificial boundaries. For example, a fill feature that crosses the square boundary will have two separate numbers despite essentially representing the same depositional event. For most features described as fill, information about general color, dominant particle size, relative compactness and matrix texture are recorded. Relative abundances of pottery, bone, charcoal are noted and top and bottom elevations are also recorded.

Areas AA, A7 and A8

From 1988 – 1991 the GPMP focused on three areas south and east of the Wall of the Crow; AA, A7 and A8.

The nine by six meter building in AA (noted above) is divided down its long axis by a central wall, and on either side are a series of low rectangular pedestals, ca 50 – 70cm wide and 120 cm long. Seal impressions from this area attest to the *w'bt* of Menkaure; *w'bt* generally meaning workshop (Lehner 1992:3). During the early 1988 season, this area was simply designated 'a.' The building was revealed during the course of excavation in 5 x 5 m squares (see figure 5-7, labelled A1 – A6). During the 1991 season, squares A7 – 14 were added.

Also during 1991, the Egyptian Antiquities Organization (EAO) noted that a backhoe had gouged a 5 x 11 m hole 135 meters northeast of area AA and 135 meters southeast of the large stone wall discussed above. This area was designated A7 (see figure 5-7) and was initially dug in a 15 x 25m unit. Within this area were a series of N/S oriented wall foundations composed of stone rubble in a compact surface (Lehner 1992:4). Two of the rooms defined by these walls were revealed during later excavation to be bakeries. This area was later incorporated into a large grid system designated area A (discussed below).

In 1991, the GPMP opened a new area, labelled A8, located at the bottom of a sandy crater surrounded by excavation dumps from the 1930's (Lehner 1992:3). Investigation in this area revealed a large gateway into the Wall of the Crow.

Excavations within the GPMP Grid (1997 – 2000): Area A

Old Kingdom features in Area A are mostly unobscured (with the exception of an intrusive Ptolemaic cemetery) by later occupations. Prior to excavation (which began in

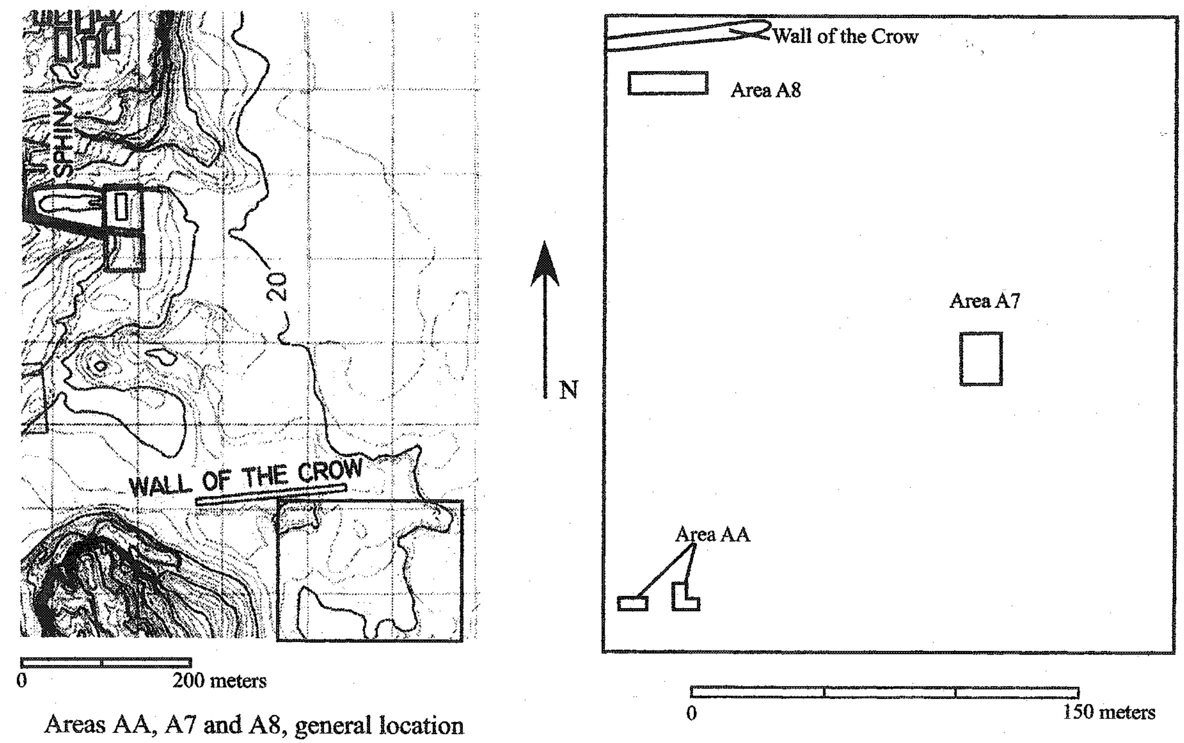


Figure 5-7. Locations of areas AA, A7 and A8. Map on left after Conard and Lehner 2001, Figure 1.

1991) this area was covered with clean sand. Underlying the layer of clean sand were outlines of apparently planned structures, often partially obscured by what Lehner (2000) refers to as "mudmass." Mudmass is a ubiquitous feature type found throughout Area A, resulting from continuous inundation from annual Nile floods further eroding already toppled structures; often incorporating a mix of pottery, bone and other artifactual material. The mudmass is usually described as hard, grey, compact sediments with inclusions of artifacts, along with limestone and mud wall tumble.

Excavation in area A is controlled by a 5 x 5m square grid system tied to a larger coordinate system extant throughout the entire plateau. Squares are named by intersections of tiers (E/W trending, identified by letters) and ranges (N/S trending, identified by numbers). At the time of data collection (1999 – 2000) Area A covered a 200 x 200 meter area south and east of the Wall of the Crow (see figure 5-8).

The primary excavation goal at Area A during the 1997 – 2000 seasons was to remove the modern clean sand and clarify the outlines of exposed Old Kingdom architecture embedded in the mudmass deposits. A secondary focus was the removal of overlying mudmass in some locations to examine cultural deposits underneath.

Area A is dominated by three sets of roughly N/S trending long corridors or "galleries" in the NW, SW and SE quadrants of the exposure (see figure 5-8). Each gallery set is 34.5m N/S by 52m E/W. The galleries are separated by an E/W trending paved street, 5.2 meters wide. Within the western gallery set are eight galleries, ranging in width from 4.5 to 4.8 m between the walls. The galleries share some general features; inside the galleries, internal walls towards the south end of each gallery form chambers, with the middle and northern parts of each gallery being more open (Lehner 2002). The open northern ends of the

Figure 5-8. Map of Area A, the GPMP grid, as of the 2000 field season. Map on left after Conard and Lehner 2001, Figure 1. Grid map (right) courtesy of Mark Lehner.

galleries contain layers of concentrated ash over marl paved floors. The southern ends are often partitioned into two roughly equal N/S oriented halves, approximately 2.0 m wide.

The gallery plan itself indicates a large - scale production facility. The southern chamber of the gallery set II (square L11) produced thick features of concentrated ash as well as large amounts of ceramic type referred to as a "bread mold," usually associated with baking individual loaves of bread. The southern end of gallery set III (squares D17 and D17x) also contained large amounts of ash as well as large concentrations of copper slag, unfinished tools and vitrified pottery vessels; all consistent with waste products generated from copper working. The volume of artifactual material and the consistent placement of ashy features suggests a planned community that produced large amounts of bread and copper tools (Lehner 2000).

To the east of the gallery set in the SW quadrant, a third gallery set appears to have been remodeled. In the north-south range of squares, short fieldstone walls form a series of oblong units, about 2.0 m wide and 4.0 m long, oriented E/W. The units are divided into two chambers by a partition wall, with evidence of cooking in the rear (west) chamber. Four of the units have low rectangular platforms or bins in the east room against the west wall. The function of these structures is unclear. But, like the larger gallery system, they were apparently built simultaneously. It is likely these modular structures postdate the construction of the gallery system, given that they were built within the gallery walls (Lehner 2000).

Another intriguing feature of the Giza site is the presence of what appears to be an early version of a hypostyle hall (a roofed open – air structure, with the roof being supported by a colonnade)(see figure 5-8, ranges 19 and 20). The modular units are attached to this hall. The hall itself is oriented N/S and covers an area of 15 m x 25 m. The floor is covered with a series of low troughs and benches, about ankle height off the floor, plastered in marl (tefla) and oriented north-south. The benches are about 30 cm wide at the top and 40 cm at the base (Lehner 2000). The troughs that separate the benches are 10 to 20 cm wide. Under the center bench in each group of three are a series of fine limestone column bases, each about 52 cm in diameter, set at intervals of 2.62 m. The east and west rows of column bases are about 2.62 m, from the east and west walls of the hall.

The dimensions of the structures described above indicate the planned nature of this site. Several of the walls are of standardized width, conforming to the span of one cubit or multiples of cubits (ca 52 centimeters, the official measurement standard of Ancient Egypt). For example, the gallery walls described above are consistently about 1.5 m or approximately three cubits wide, while the entire area covered by both gallery sets is 52 meters (100 cubits N/S). Although the cubit itself is not a useful measurement in that textual evidence suggests that the value of the cubit changed over time (Bell 1970), the effort to conform the structures at Giza to a standardized measurement scheme suggests the site was planned.

Lehner (2002) dates this exposure to the late 4th Dynasty (ca 2520 – 2470 BC). This provisional date is based primarily on inscribed sealing mud. During the Archaic and Dynastic periods, bags, boxes, jars and doors possibly locked with string, cloth or reed, were then sealed with fine mud that hardened when dried. Before the mud dried, it was impressed with the name of an institution, official or king. These sealings; like pottery, bone, charcoal and lithics occur relatively frequently in the archaeological record of Egypt (Lehner 2002).

In the case of Area A, a total of 1427 sealing fragments have been recovered from seasons up to 2002, 300 of which were inscribed. Of the 300 inscribed sealings, 50 have legible royal names. Eighteen of these fragments are inscribed with unambiguous royal namesl; six are Khafre (the builder of the second pyramid), and 12 are Menkaure (the builder of the third pyramid). No other kings are clearly represented in the corpus. Of the remaining

32 sealings that contain royal names, three may be restored as Khafre and 29 as Menkaure. There is little evidence to suggest the area was in use after the reign of Menkaure. The site, therefore, apparently fell into disuse around 2470 BC. Features in this area, therefore, were probably formed during a 50 year period (Lehner personal communication).

Copper Workshop –D17x

This portion of Area A (see figure 5-8) is located in both square D17 and D17x in the southeast corner of the excavation grid as it was exposed in 1999-2000. D17x was designated as a result of excavators noting part of an apparent industrial installation emerging south and west of square D17 proper.

Area C

Area C was excavated to determine whether the archaeological material was consistent with expectations of what a "workmen's barracks" might look like (Conard and Lehner 2001:23-26). Petrie (1883) hypothesized that a series of 111 gallery-like enclosures , oriented both E/W and N/S encompassing an area 450 m long by 80m wide (see figure 5-9) were housing for the workers who built the Khafre pyramid. Conard and Lehner conclude that while this area had multiple functions, "barracks" are not likely (2001:59). They argue instead that the galleries may have served as storage features for materials relating to funerary practices, based on the presence of food stuffs, raw craft material, manufactured copper objects and statue fragments (Conard and Lehner 2001:60). Eleven Meidum bowls collected during the excavation of area C are included in this study.

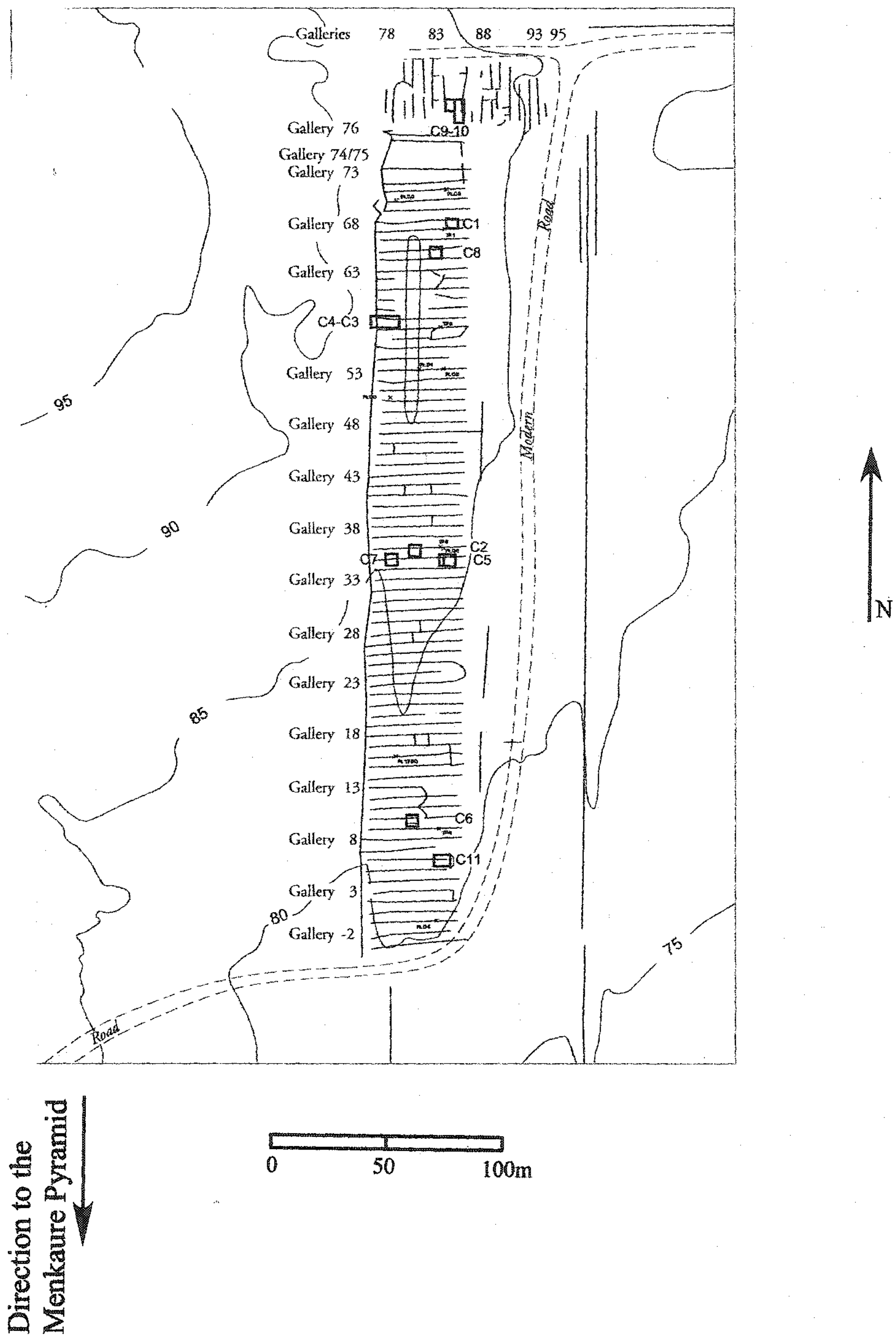


Figure 5-9. Area C excavation units. (After Conard and Lehner 2001, Figure 2).

Petrie (1883) and Conard and Lehner (2001) argue these constructions date to the reign of Khafre, and may have extended to the reign of Menkaure. This estimation is based on three factors; 1) galleries are aligned to the Khafre pyramid, indicating the Khafre pyramid was already in place when the galleries were constructed and 2) walls are the same style as other large fieldstone and clay walls west and north of the Khafre pyramid and 3) toward the east of the gallery installation, the northern wall of the Menkaure pyramid's secondary enclosure wall, joins the earlier southern wall of the Khafre secondary enclosure. The two walls are offset from each other and joined by an elbow. Conard and Lehner (2001:59) argue that if the southern wall of the enclosure around the Area C galleries was built in the reign of Menkaure, the galleries would have been accessible from the south during the building of the Menkaure pyramid. Meidum bowls from this assemblage, therefore, should date to the mid 4th Dynasty (ca 2500 BC).

Only a small percentage of the over 450 galleries present in Area C were excavated. Investigators wanted to explore the front, middle and back parts of the galleries through a series of randomly selected small excavation units (Conard and Lehner 2001:26). To accomplish this, investigators divided the galleries into three 10 meter parts by surveying north – south lines. Investigators focused particularly on galleries that deviated from the typical gallery pattern (Conard and Lehner 2001:26). Investigators were also particularly interested in the front parts of the galleries as these areas tended to contain more cultural material than the middle and back portions of the galleries (Conard and Lehner 2001:26). Eleven units were chosen for excavation; five of these units produced identifiable rim sherds.

Units varied in size from 5 x 5m to 5 x 10m. Units were excavated stratigraphically. As in area A, deposits (features) were defined as sediment deposits that are internally consistent relative to deposits above, below and adjacent to them (Conard and Lehner 2001:26).

Summary

The assemblage collected from Areas A and C on the Giza plateau constitute the largest assemblage used in this study. Both areas feature highly regular architecture with walls built to apparently standard lengths and thicknesses, indicating a preplanned community. Large amounts of charcoal, fish and animal bones and other settlement debris indicates a relatively large population. Lehner (1992, 2000) suggests that most of the foodstuffs brought to Area A in particular were imported from other locations.

Also of interest is the presence of the copper workshop and the series of structures designated *wb't* of Menkaure. These features are likely associated with the large scale construction of the Menkaure pyramid (5-10). The material from this assemblage therefore, like that of Elephantine represents a community tied to the economics of producing monumental architecture.

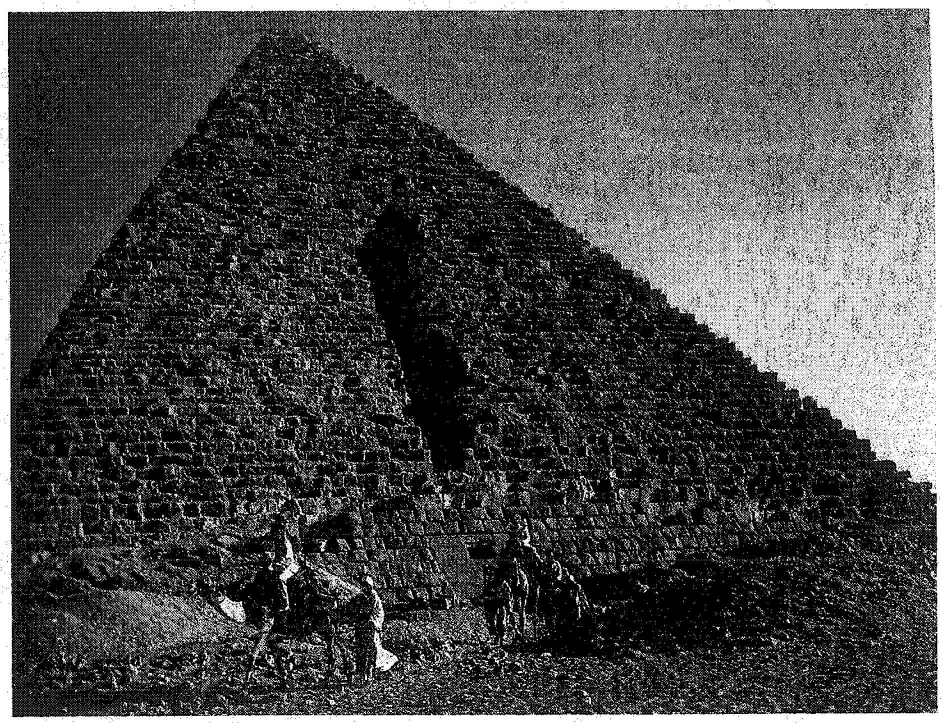


Figure 5-10. The Menkaure Pyramid (after Lehner 1997:137).

Kom el-Hisn

Unlike Giza and Elephantine, Kom el-Hisn is likely to represent a self-sufficient community, given its location on the relatively fertile Nile Delta. The site of Kom el-Hisn lies is located on the west side of the Nile delta on geographical coordinates 30 degrees 48 minutes north and 30 degrees 30 minutes east latitude (see figure 5-11). This delta assemblage is important in that it is one of the few sets of archaeological deposits from Lower Egypt because Old Kingdom deposits are exposed with relatively little overburden. Similarities in Meidum bowl types from Kom el-Hisn, relative to types described in the Nile Valley, contributes to understanding interaction between the Nile Valley and Delta.

Old Kingdom deposits at Kom el-Hisn are located on "gezira" sands. "Gezira" refers to sandy geological deposits on the Nile Delta. These deposits rise above the delta in gentle relief and consist of medium sand – sized particles (1.5 to 2.0 phi) (Buck 1990:60). At Kom el-Hisn the gezira is 700 meters long by 400 meters wide and rises to an elevation of just over seven meters above sea level (Buck 1990:55). These geological features account for the unique visibility of the Old Kingdom deposits at Kom el-Hisn. These sand mounds and flats doubtless provided a "commanding view of the surrounding landscape" which would have made them attractive settlement locations (see figure 5-12 for a topographic map) (Said 1993:70).

Gezira sands are likely the product of a middle Pleistocene ancestor of the Nile known as the Prenile (Said 1993:73). This earlier river was more energetic than the modern Nile and deposited large loads of sand and gravel well into the Mediterranean Sea. Approximately 400,000 years ago, this protodelta formation reached a size approximately four times the dimensions of the modern Nile delta (Said 1993:70-73). Said suggests, therefore, that the "turtlebacks" (gezira mounds) were carved out of this earlier version of the

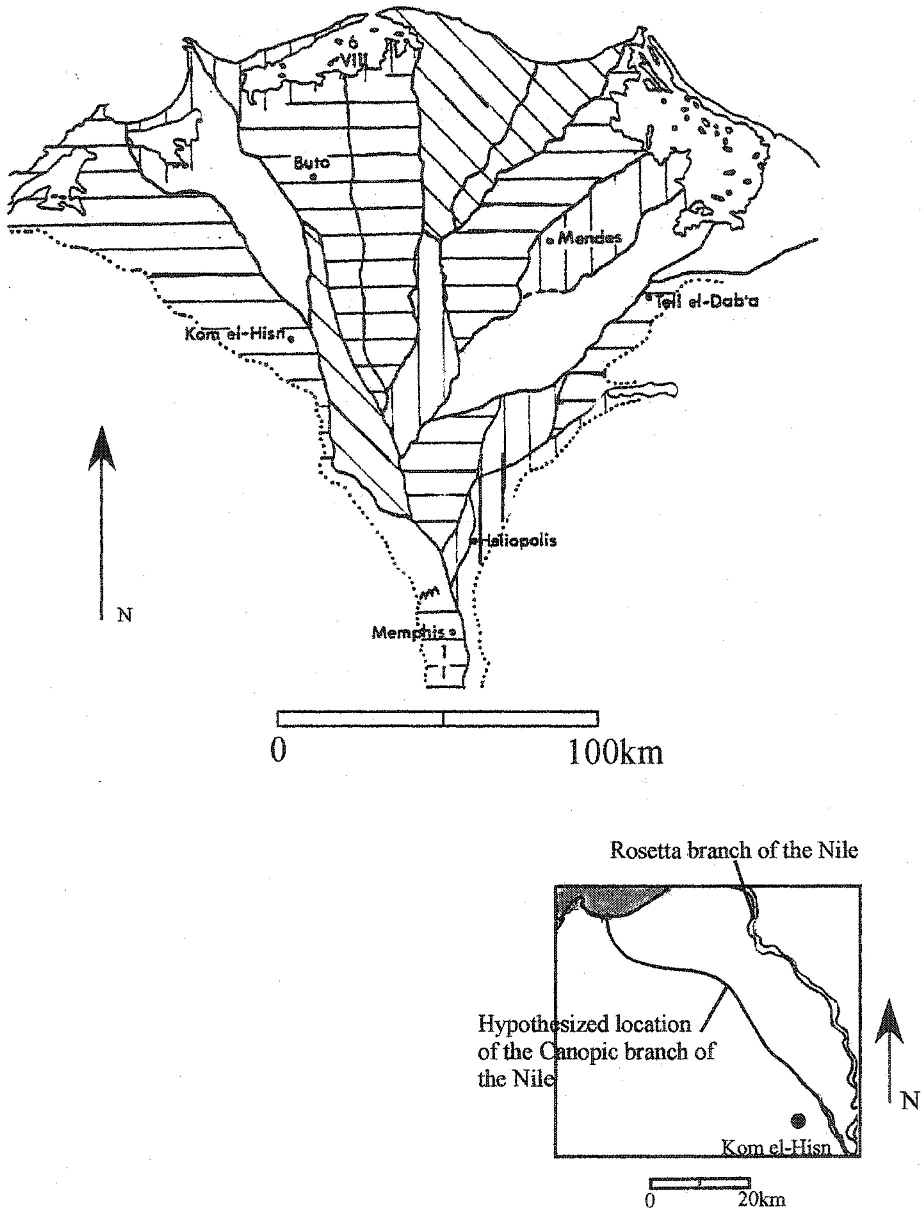


Figure 5-11. Left: Kom el-Hisn on the Delta, subdivided into nomes (represented by hatched areas within solid lines)(after Cagle 2001, figure 1.1 and Bietak 1975, figures 36-37). Right: Approximate location of the Canopic branch of the Nile (after Said 1993, figure 1.3).

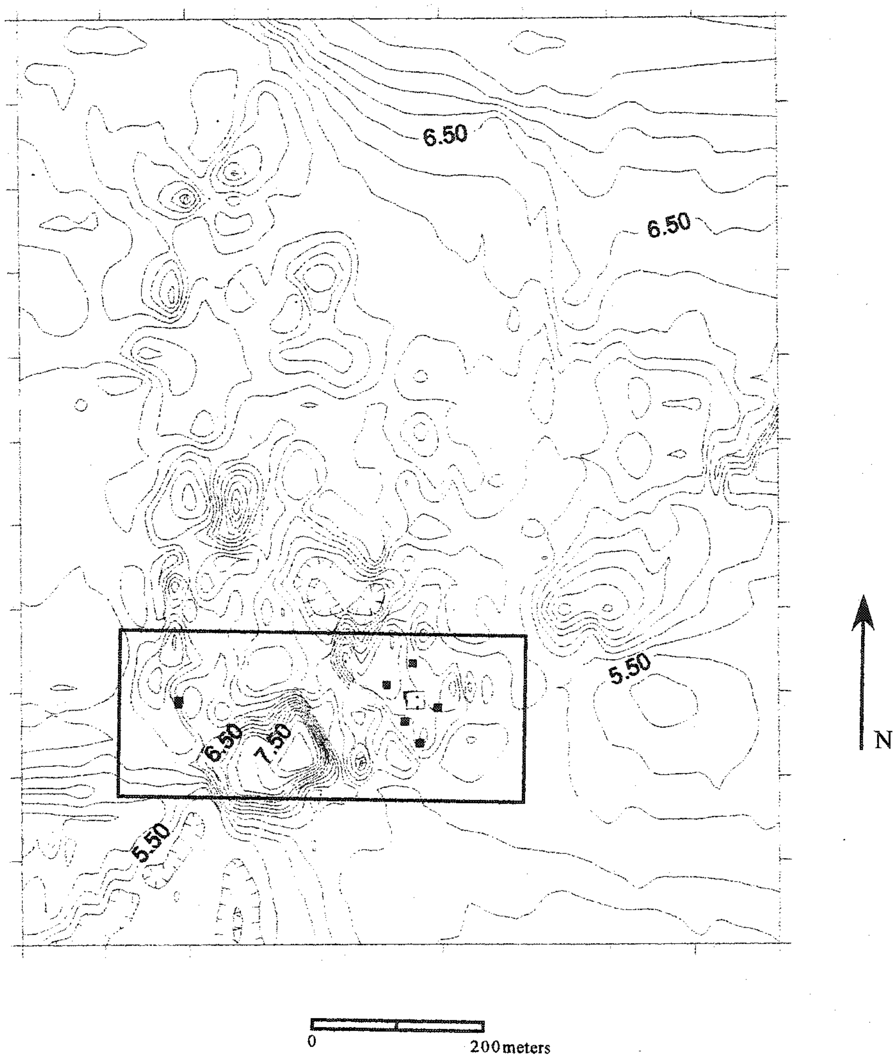


Figure 5-12. Topographic map of the Kom el-Hisn area. Black boxes represent excavation units. Contour intervals are meters above sea level. (after Cagle 2001, figure 2.4).

floodplain (Said 1993:70). The relief created by these mounds then evolved into stabilized sand dunes during the more arid Holocene (Said 1981).

Buck (1990) subdivides the larger gezira deposit into three types; unconsolidated gezira (consisting primarily of loose sand), consolidated gezira (consolidated, somewhat indurated with abundant gastropod shells) and Nile mud (a mixture of silt and clay deposited by the modern Nile). The gezira sands form an island rising above Nile mud deposits on all sides. The initial occupation of Kom el-Hisn rests on a stabilized sand dune adjacent to a former tributary branch of the Nile which flowed northeast of the site (Buck 1990:72). Because of the relief represented by the gezira, alluvial deposits that typically overlie Old Kingdom material on the Delta are not present. Buck (1990) provides evidence that supports an aeolian origin for these sands. He bases this assumption on the presence of well sorted sand, to the exclusion of silt and sand in the upper levels of the dunes (1990:66). One radiocarbon date of 11,344 +/- 241 B.P. was taken from the base of the dune, where the sediments are more consolidated, suggesting an aeolian deposit overlying an earlier surface. This early date is taken from the surface of the consolidated gezira.

Consolidated gezira underlies the gezira sands proper and are likely fluvial in origin (Buck 1990:68). These fluvial deposits might be due to the presence of an ancient branch of the Nile. Buck (1990:68) notes the presence of consolidated gezira deposits on the eastern side of Kom el-Hisn and argues these deposits represent ancient levees of the ancestral Canopic branch of the Nile that may have flowed to the east and northeast (see figure 5-11 for hypothesized location of the Canopic branch). Ball (1942) estimated that the Canopic branch of the Nile flowed within 6 km of the present location of Kom el-Hisn.

While there are only two primary distributaries for the Nile now (the Rosetta and Damietta, see figure 5-11 for location of the Rosetta branch), in the past, during Old Kingdom times, there is extensive geological evidence for nine branches in the past (Cagle 2001:38, Tousson 1922). Along with the Canopic branch discussed above, a smaller distributary, the Alexandria branch is shown to have flown along the western boundary of Kom el-Hisn and emptying into Lake Maryut (Tousson 1922).

Along with the advantageous view, settlement on top of these gezira deposits would also keep the hamlet out of the way of the annual flood, a trend noted throughout the Delta (van den Brink 1987:28). Kom el-Hisn appears to follow general trends noted throughout the Delta. First, cemeteries are often found on the highest parts of the Gezira. Second, habitations are of ten located on the sides of the Gezira mounds. Van den Brink (1987) also notes that while the bulk of the sites found on the Delta are near waterways, which suggests that while Kom el-Hisn is not currently located by an observable waterway now, it may have been at some point in the past.

Chronology

Kom el – Hisn is, therefore, a relatively rare phenomenon, wherein Old Kingdom deposits are not obscured by overlying deposits from later time periods. Much of the site is covered with a layer of coarse, salt- encrusted sediment containing large amounts of ceramics (Cagle 2001:41). Cagle (2001) refers to this ubiquitous material as "upper pottery layer," or "UPL." The bulk of the ceramics recovered from the UPL are typical of the Old Kingdom in general. Radiocarbon dates (see table 5-1), artifact styles and epigraphic evidence primarily in the form of mud sealings further suggest that the bulk of the occupation at Kom el-Hisn took place during the 5th and 6th Dynasties (2500 – 2290 BC)(Wenke et al. 1988).

However, the radiocarbon dates reported by Wenke et al. (1988) as centroids corrected for BC calibration range from 3043 +/- 59 years (essentially the late Predynastic) to 2084 +/-

Table 5-1: Radiocarbon dates from Kom el-Hisn (after Wenke et al. 1988:16, table 1).

Sample #	**Context**	**Material**	**c14 yrs**	**date(BC)**
SMU 1438	St-1,SU 37, 22	shell	4173+/-59	3043
SMU 1440	1156S,1000S, SU 28	shell	3882+/-200	2683
SMU 1882	1261S, 1074E, SU 17	shell	4030+/-60	2606
SMU 1627	1184s, 1013E, SU13	carbon	3790+/-90	2230
SMU 1569	1200s, 1088E, SU 17	carbon	3680+/-340	2084
SMU 1552	St-1, SU37	carbon	11344+/-241	9770
Teledyne I-13,318	1983 test	carbon	3970+/-130	2481

340 years. Besides the Pleistocene date discussed above, the earliest date of interest is 3102 BC, while the latest is 2104 BC. SMU 1882 and 1440 indicate occupation ranging as far back as the 3rd dynasty. SMU 1440 was taken from shells intentionally placed under the corner of a mudbrick wall (Wenke et. al. 1988:16, table 1). Diregarding the dates with error terms over 100 years (too large to resolve the occupation of Kom el Hisn to particular dynasties), these data suggest the occupation of Kom el-Hisn extends back into at least the 4th Dynasty and possibly earlier.

Royal sealings dating to the 5th and 6th Dynasties provide the bulk of the evidence of a later Old Kingdom occupation at Kom el-Hisn. Sealings dating to the 5th and 6th Dynasties in particular were found near the surface in parts of the site where there are between two and three meters of underlying cultural deposits, suggesting a relatively deep occupation, possibly back to the 4th Dynasty, which is consistent with the radiocarbon dates (Wenke et al. 1988:15). This information suggests that some of the occupation of Kom el-Hisn overlaps with the occupation of Giza.

Depositional Sequence

Cagle (2001) uses geoarchaeological techniques to reconstruct the sequence of deposit formation for the bulk of the excavated features at Kom el-Hisn; broadly assigning deposits to levels 0-5, with 0 being the most recent. The surface deposits are designated Level 0, comprising all material later than the Old Kingdom and including most of the UPL. The next set of deposits are designated Level 1 and are the dumps deposited after this portion of the site was abandoned and the walls collapsed and after the area was used as a cemetery. Level 2 deposits are those associated with burials (discussed below). Level 3 deposits are those directly associated with the uppermost habitation structures and generally representing the main Old Kingdom deposits. Level 4 deposits are those that are one collapse event below level 3. Room 18 features a Level 5 deposit, which is separated from Level 3 deposits by two collapse and rebuild events.

In general, he found that deposits occur in the following sequence from the lower levels to the UPL surface: floor, wall collapse and then either a final depositional episode of UPL deposit or subsequent deposits of floor and then wall collapse. In many instances, dump deposits overlie layers of wall collapse. Of the 14 dumps that had an underlying deposit (all but those not located at the bottom of a stratigraphic column), nine were resting on some form of wall collapse indicating that dumping most often occurred after a building had at least partially collapsed (Cagle 2001:85-86). Most of the dump deposits discovered are on top of stratigraphic columns, suggesting that refuse disposal is a relatively late activity on site (Cagle 2001:85). There are only four cases of dumps lying directly on floor deposits; 1235/1056 and rooms 12, 17, and 23. This pattern of dumping only after walls had partially collapsed is consistent with the expectations outlined by Hoffman (1974), as this suggests that the buildings fell into disrepair and were used as dumps only after an apparent period of abandonment.

Level 2 designations are reserved for those deposits associated with three adult burials and partial infant burials (these are apparently so disturbed that it was difficult to estimate the number of infants represented from the remains). The adult burials were contained within plaster coffins. Burials in rooms 15 and 20 were housed in specially constructed mudbrick tombs. All the burials are intrusive into existing and earlier Old Kingdom structures. Ceramic assemblages (some of which contain examples of Meidum bowls) directly associated with the burials were typical Old Kingdom types, suggesting that while the burials are later and intrusive, they are still attributable to the Old Kingdom.

Cagle (2001:87) notes especially that in room 15, overlying the deposits associated with the burial and its immediate environs is a layer of typical dump material containing abundant burned bone, charcoal and exclusively Old Kingdom ceramics. Layers overlying this also contained Old Kingdom ceramics with a small percentage of more typical Middle Kingdom ceramics (Cagle 2001:87). This sequence indicates that the tomb was constructed after the room containing it (also associated with room 10) was abandoned, then left for sometime during which the coffin and surrounding walls collapsed, with more Old Kingdom material accumulating on top (Cagle 2001:87).

In several cases throughout Kom el-Hisn, therefore, certain excavation units contain evidence of multiple occupation and remodelling episodes. Therefore, unlike Giza, where the range of potential dates of occupation is relatively tight, the Kom el-Hisn assemblage represents a greater percentage of the duration of the Old Kingdom.

Architecture

Mudbrick architecture is usually found within centimeters of the surface (Cagle 2001:41). Some units, primarily concentrated in the eastern portion of the excavated area, indicate a Middle Kingdom occupation (ca 1890 BC). The observed architecture is primarily domestic (Wenke et al. 1988:17). This assessment is based on the presence of numerous animal bones, smoke blackened pottery, and burned organic materials (Wenke et al. 1988:17).

Bones found are a combination of fish, mammal and bird (Wenke et al. 1988:17). Domesticated mammals, sheep/goats and pigs, in particular constitute a large percentage of the faunal assemblage. Cattle bones are relatively rare and most are under two years of age. Plant remains are primarily cereal straw; field weeds and appear to come almost exclusively from the burning of dungcakes in domestic cooking (Moens and Wetterstrom 1988).

These excavations revealed that the bulk of the Kom el – Hisn occupation is domestic over a 900 x 900 meter area. The site itself is at least partially ringed with a large enclosure wall, underlying the modern village. This wall and the extensive Old Kingdom architecture found west of the bulk of the excavation suggest that the contemporary village near the step trench may cover a small, walled segment of the Old Kingdom settlement, with the rest of the community extending for hundreds of meters to the southeast and northwest (Wenke et al. 1988:17).

Wenke et al. (1988:17) argue that Kom el-Hisn may have been spatially arranged such that some activities or groups were east of what is now a modern village, while other groups were west of it. This leads Cagle (2001:43), to potentially interpret a subdivision between sacred and profane portions of the site, with a small, potentially ceremonial occupation at the SW end of the site (Cagle 2001:43, Wenke et al. 1988:17). The ceremonial occupation is indicated by a thick mudbrick wall that partially rings the site (Wenke et al. 1988:17). In general this makes Kom el-Hisn similar to other Old Kingdom centers, wherein ceremonial functions were performed in a restricted, possibly walled portion of the town.

Field Data Collection

Field work was conducted on the gezira during field seasons in 1984, 1986 and 1988. The initial stages of field work consisted of topographic mapping, mapping of surface deposits, shallow coring of the gezira and shallow trenching (Buck 1990:54). Elevations above sea level were determined from an Egyptian Geological survey marker indicated on an EGS 1:25,000 map. Elevation of the EGS marker is 6.04 meters above sea level. Excavations on the gezira were controlled by a grid system using the above elevation datum as an origin point. From this point, an arbitrary baseline was established, oriented magnetic north (Buck 1990:54).

Old Kingdom deposits at Kom el-Hisn were excavated in two stages (Cagle 2001:41). The grid system (discussed above) was used to locate the corners of 1 x 2 m test pits. During the 1984 season (the first stage of excavation), several such units were randomly selected for excavation. In addition to these units, two trenches were excavated and a 1 x 2 m pit, the location of which was chosen based on surficial architectural features. The results of these excavations led to a stratified random sample used to select several 2 x 2m pits, located using the same grid system. Investgators established two step trenches to evaluate whether the depression between the main area of the excavations and a modern village was formed by previous excavation or, alternatively by an ancient water-course. A 72 square meter complex of mudbrick buildings, exposed on the surface was defined. Finally, a 2 x 4 meter area of newly (at the time) discovered Old Kingdom deposits west of the main settlement area was also excavated. Investigators used auger samples to further estimate the extent of Old Kingdom material (Cagle 2001; Wenke et al. 1988:12 – 13).

The second phase of excavation took place in 1988. The goal for this season was to clear a wider area to expose more architecture (Cagle 2001:41). The bulk of this work was conducted near the large complex of mudbrick architecture (see figure 5-13). This area was emphasized because the architecture here was particularly well – preserved and close to the surface (Cagle 2001:41). The purpose of the supplemental 1988 excavations was to resolve ambiguities between architectural features uncovered during the 1984 and 1986 field seasons.

The largely domestic context at Kom el-Hisn has implications for the general ceramic types represented. Investigators saved all sherds and all sherds were described minimally in terms of weight and fabric type. Diagnostic sherds (rims and bases) were further typed

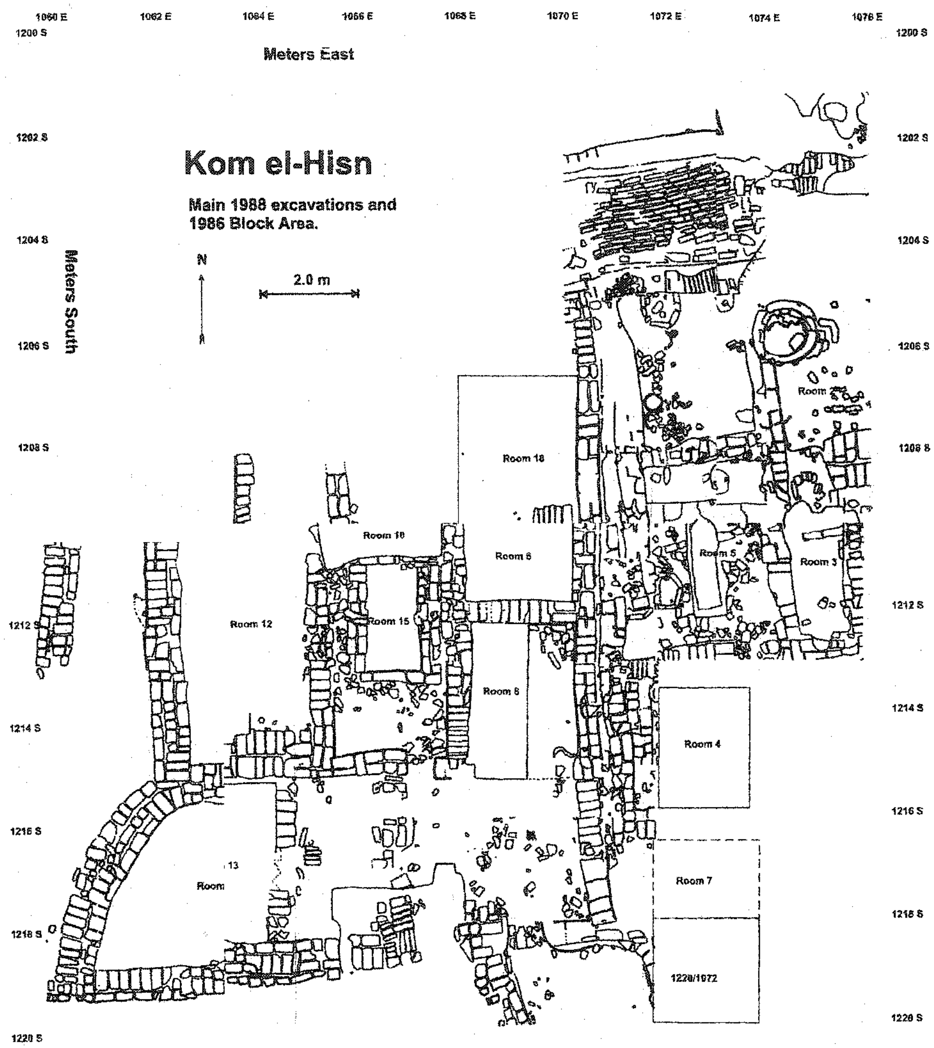


Figure 5-13. Mudbrick architecture complex at Kom el-Hisn
(after Cagle 2001, foldout).

according to a system based loosely on Reisner's (1931; Reisner and Smith 1955) types (as discussed previously). Cagle (2001) identified 27 types, consisting primarily of bowls, jars, bread molds and trays. Of interest for this study is the identification of type H, which is similar to Reisner's type C-XXXII, otherwise known as the Meidum bowl (Cagle 2001:230).

Excavation Protocol and Feature Description

Initially, excavation units were identified by the grid square coordinates of their SE corner in relation to the EGS survey datum (e.g. 1156s/1060e). These units were selected randomly during the 1984 and 1986 seasons (Buck 1990:81). Subsequently, during the 1988 season, architecture uncovered during the previous field seasons was used to identify excavation units, thus shifting the focus from grid squares to rooms (assigned numbers for identification, i.e. room 1).

Regardless of the nature of the excavation unit, deposits within either rooms or grid squares were excavated stratigraphically. The basic unit of the excavation is referred to as the Sedimentary Unit (SU). The SU is distinguished by internal sedimentary homogeneity relative to surrounding sediments (color, content, structure, texture etc) (Buck 1990, Cagle 2001:62). SUs often represent subsets of larger depositional events.

Cagle grouped various deposit types using paradigmatic classification. Following widely held geoarchaeological principles, especially those stated in Harris (1977, 1979), Cagle defines deposits based on mode of deposition (source, transport agent, depositional environment and post-depostional alterations experienced by the particles making up the deposit). This distinction is important, because it only describes the last set of processes that impacted all the sediments in the deposit, given that the current positions all artifacts in any archaeological context are the product of the last event that moved and deposited them (Cagle

2001:56). Cagle then argues that each class of deposits is assessed in terms of distribution over space and association with other deposit classes and architectural features, with an eye toward reconstructing the site's depositional history.

It is also important to realize that in any study of deposited material, analysis necessarily entails two phases, description and interpretation. Cagle and Buck's work both provide detailed considerations of the mode of deposition (discussed above) and then a secondary discussion of how these descriptions can be interpreted. Thus it becomes possible to make a clear distinction between primary and secondary deposits. Cagle's general goal was to test the null hypothesis that a particular class of artifacts is randomly distributed across particular deposit types. The work presented here provides additional typological resolution of one particular artifact kind. Given that Cagle has provided actual tallies of various artifact types per deposit, this information and Cagle's deposit descriptions are more consistent than the raw field notes. Field notes were consulted in some instances for clarification, these instances are noted when relevant.

Diagnostic sherds were sorted by the typology generally employed by the Kom el – Hisn team, which is largely based on Reisner's 1931 Giza typology used throughout Egypt. Rims and bases were separated from body sherds and then sorted into types. Body sherds were sorted into general fabric types (Nile A, B and C).

General

Unlike Giza and Elephantine, Kom el-Hisn represents a more self - sufficient domestic site. Cagle does note some differences in materials found onsite, however. The presence of numerous sickle blades in different stages of manufacture and use suggests local farming activity (Cagle 2001:313). This is further supported by the presence of locally obtained fish.

In contrast, however, sheep and cows appear to have been imported, suggesting Kom el-Hisn is connected to a larger redistributive network (Cagle 2001:313). However, relative to Giza and Elephantine, Kom el-Hisn is proximate to quite a bit more arable land. Thus Cagle (along with Wenke et al. 1988) concludes that Kom el-Hisn is neither completely integrated nor completely independent from the larger state system (Cagle 2001:315).

Museum Collections

Although the bulk of the material used in this study comes from Elephantine, Giza and Kom el-Hisn; supplemental information comes also from much smaller assemblages collected from various locations throughout the Nile Valley. While small, these assemblages provide bowls with clear Dynastic assignments which can thus further clarify the morphological and chronological relationship between sites. The assemblages consist of curated museum objects or are represented as field drawings. In many cases, therefore, it was not possible to conduct the same degree of analysis as was feasible for the archaeological collections. Also, given that much of this material was excavated during archaeology's formative years, sample sizes are small and doubtless biased by unspecified collection strategies. Finally, because the actual objects discussed here are from museum collections, it was not possible to get a fresh break to examine paste and temper characteristics. Nor was it possible to describe the fabrics of the items from the Teti pyramid environs represented by field drawings.

Following are brief summaries of the general archaeological contexts from which supplemental samples were collected. Four museums in the US and UK generously granted access to Meidum bowls in their collections. In addition, Josef Wegner of the University of Pennsylvania Expedition to Saqqara kindly donated profile drawings of Meidum bowls generated during excavations at Teti pyramid Temple I and environs. In addition to the Teti material, examples of Meidum bowls come from Meidum and Qau and Badari (see figure 5-1).

Meidum

The Meidum pyramid complex is located approximately 30 km south of the ancient capital of Memphis and 4 km east of Lake Moeris in the Fayuum. This tower – shaped pyramid is attributed to Senefru, the first pharaoh of the 4th Dynasty (Baines and Malek 1982:36; Lehner 1997:97-99). Although there has been some speculation that this pyramid was built by Huni (the last pharaoh of the 3rd Dynasty), there seems little to support this hypothesis. Lehner (1997:97-99) argues that the fact that the ancient name for Maidum is *Djed Seneferu*, and that Senefru's name, unlike Huni's, appears in various texts found in the vicinity of the pyramid are a strong indication that the apparently unfinished pyramid was in fact initiated by Senefru. It should also be noted that the combined regnal spans of both pharaohs is only 50 years. Regardless of pharaonic attribution, therefore, the construction of this pyramid can be tied to the late 3rd, early 4th Dynasty.

The work conducted by Petrie and his colleagues at Meidum was ambitious for its time. Meidum's unique shape relative to other pyramids (see figure 3-4) prompted an interest in understanding how it was built.

Edwards (1985:70), describes the pyramid as resembling "a high rectangular tower." This condition most likely resulted from the fact that the pyramid was unfinished, its construction possibly abandoned by Senefru in favor of the apparently superior location at Dashur. Edwards (1985:70) and Lehner (1997:97) both describe the pyramid at Meidum as "the first true pyramid," in the sense that this construction is the first time the Egyptians attempted to build a monument with a square base and sides sloping towards a point at the summit (Edwards 1985:70). Its unfinished condition, therefore, allowed Petrie and his colleagues to trace the sequence of construction of this singular pyramid.

One of the unique features of the pyramid is its foundation (Edwards 1985:72). The pyramid rests on a platform of stone blocks which are underlain by a layer of sand to compensate for the unevenness in the rock, referred to as "foundation deposits." Petrie's colleague, G.A. Wainwright, bored a tunnel through the foundation deposits at the base of the pyramid, from the east face almost to the tomb-chamber.

The purpose of this work was to determine the age of this monument relative to other pyramids. The field season had two goals 1) clearing the east face of the pyramid and tunneling into the rock beneath it, 2) tracing out the great approach or causeway which was infilled before the pyramid itself was finished (Petrie et al. 1910:6).

The causeway leads up from the cultivation to the level surface of the desert on the eastern side of the pyramid and is cut into the rock to a depth of 6 - 8 feet (1.8 – 2.4 meters) (Petrie et al. 1910:6). The approach has been filled and concealed by the debris of the building of the pyramid. These debris are stratified to a certain extent (see figure 5-14), with sand overlying a limestone chip layer of varying thickness. The limestone chip layer overlies a layer of marl, which in turn overlies a layer of concreted sand. The western end of the approach, which is nearest the pyramid, is filled with the concreted red sand resulting from surface clearance. The red sand thins and disappears toward the eastern end of the approach.

The layer of limestone chips is of particular interest. The layer increases in thickness as it extends to the east, such that the eastern-most extension of the causeway consists only of limestone chips. Petrie (et al. 1910:7) observed that this debris was clean and white, having never been exposed to the sun and thus suggesting to the authors that the limestone chips

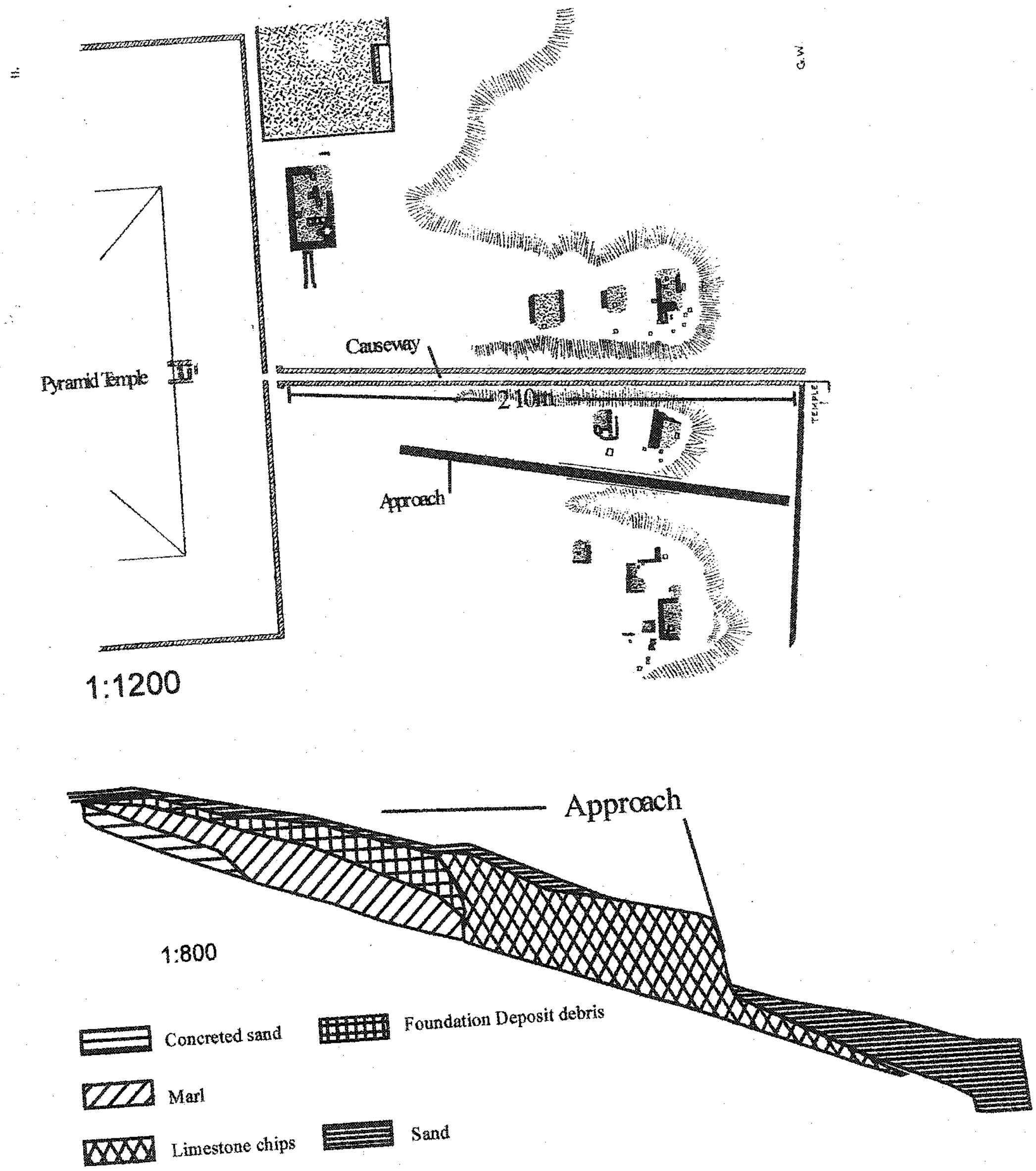


Figure 5-14. Cross-section and plan of the Meidum Pyramid approach (after Petrie et al. 1910, Plates II and III).

resulted from the stone-dressing for the building of the pyramid and was thrown into the causeway by the pyramid-builders themselves.

Wainwright (in Petrie et al. 1910:7) further suggests the approach was constructed prior to the construction of the pyramid. The first layer of rubbish consists of material generated by the excavation of the foundation deposit for the pyramid. Therefore, the trench represented by the causeway must have existed before the pyramid foundation was constructed. Petrie et al. (1910:8), suppose that the pyramid itself was remodeled from an earlier mastaba, which was possibly the source of the earlier causeway. Material collected from these excavations can thus be assumed to be contemporaneous with the construction of the pyramid, in other words the late 3rd, early 4th Dynasties. Meidum bowls were collected from the foundation deposit, which was likely constructed after the causeway and prior to or contemporaneous with the building of the pyramid itself.

Petrie (et al. 1892) first identified the ware (red polish, recurved rim) that exemplifies the Meidum bowl during the course of the excavations at this pyramid. Petrie describes this ceramic material as being different from that of later periods, being highly polished, with a red slip on the interior and exterior surfaces. Of this material, Petrie observed bowls were the most common, coming in a finer and coarser variety with a beaded edge or a hair lip, similar in appearance to the material found at Giza (Petrie et al. 1892:35). Meidum bowls from Meidum proper were recovered from two general contexts; the foundation deposits of the pyramid and tomb contents. Material collected during Petrie's early excavation of the pyramid foundation and area surrounding the pyramid is housed at the University of Pennsylvania Museum of Anthropology and the Petrie Museum of Archaeology, University College, London.

Three complete vessels were recovered from the foundation deposits material. Material from Petrie and Wainwright's excavations of the Senefru foundation deposits are housed at the Petrie Museum at University College, London.

Additional material was collected from tombs in the environs of the pyramid. Vessels held at both the Petrie Museum and the University of Pennsylvania Museum were collected from tombs 27, 29, 57 and 518. These tombs are all attributed to the 4th Dynasty.

One complete vessel was recovered from grave 57 in the far western cemetery. This cemetery in general is characterized by rectangular shaft graves, with average dimensions of 221 cm by 101 cm, and about four to 11 meters deep (Petrie et al. 1910:24). These shaft tombs are assumed to be the same age as the pyramid. Although catalog records attribute this object to the 4th Dynasty, Petrie's initial assignment is the 3rd Dynasty. This tomb was initially identified as a well in the pavement of the desert. This tomb may have been reused in the 22nd Dynasty, therefore the context is not intact (Petrie et al. 1910: 25). Tombs 27 and 29 are located in the southern cemetery, located approximately 300 meters south of the pyramid itself. Several robbed out shaft tombs were identified, and dated using the pottery on the surface, which Petrie argues dates to the 4th Dynasty (Petrie et al. 1910:35-36). Because the tombs were robbed out, they were not published by Petrie. Two complete vessels were recovered from this material.

Tomb 518, also attributed to the 4th Dynasty produced one complete vessel. Petrie did not publish any information about this particular tomb, though the catalog card for item 31-28-248, collected from this tomb, at the University of Pennsylvania Museum indicates a 4th Dynasty date.

Qau and Badari

Both sites are located on the east bank of the Nile, north of the Qena bend and south of Asyut and information about these sites is often combined with information about the sites of Mostagedda and Matmar. Alternatively some authors (i.e. Holmes and Friedman 1989; Wilkinson 1999), simply refer to the whole area as the Badari region. The floodplain on the east bank of the Nile is quite wide at this point and is bounded by a line of limestone cliffs (Wilkinson 1999:356). Archaeological material from this region is dominated by cemetery assemblages. Over time from the Predynastic to the Early Dynastic period, the distribution of cemeteries shifts to the south (Wilkinson 1999:356). The Badari region is also characterized by a series of small settlements of limited economic and political power (Wilkinson 1999:357). Nonetheless, some elaborate 2nd and 3rd Dynasty tombs suggest there were powerful nobles in this region whose wealth may be attributed to the relative agricultural richness of this area (Wilkinson 1999:356-357).

This region is primarily characterized by a series of cemeteries of various sizes, spanning the Predynastic period into the Middle Kingdom. Badari is well known as an early Predynastic site, however this location also features a well-developed Dynastic component. Qau is known as a cemetery throughout the Dynastic Period (Midant-Reynes 2000:152). During the 4th and 5th Dynasties necropolises were constructed at Qau and Badari. Cemeteries throughout the region are identified by numbers. Materials collected by Petrie (1910) and Brunton et al. (1927) from the cemeteries at Qau and Badari are housed at the Petrie Museum and the British Museum.

Qau cemeteries include material from cemetery 900, generally attributed to the 4th Dynasty and cemetery 7000, generally attributed to the 5th Dynasty (Brunton et al. 1927). Badari material comes from cemeteries 400, 1000, 5000, which spans the Early Dynastic (ca

2700 BC by the historical calendar) into the 5th Dynasty. The dating of these cemeteries is primarily based on inscriptions and tomb or grave morphology (Brunton et al. 1927). Altogether, the Qau tombs produced 10 complete vessels. Badari tombs produced eight complete vessels. Material from the British and Petrie Museums encompasses the period from the early dynastic to the 5th Dynasty.

Teti Pyramid

Teti is considered the first king of the 6th Dynasty (ca 2300 BC, but see below for discussion of radiocarbon dates). Teti's pyramid is located in North Saqqara, somewhat NE of Djoser's Step Pyramid. The pyramid itself presents a puzzle because the valley temple, pyramid town and causeway (standard features of the Old Kingdom pyramid complex) are apparently missing (Lehner 1997:156). The pyramid follows the prototype established by the pharaohs of the Vth Dynasty, with dimensions almost identical to those of the pyramid of Djedkare-Isesi (late 5th Dynasty) and the plan of Teti's pyramid is also followed by his successors Pepi I, Merenre and Pepi II (the last king of the 6th Dynasty)(Lehner 1997:156).

The Teti Pyramid was also part of the larger data set used in the Pyramids Radiocarbon Dating project (discussed in Chapter 4). Fifteen radiocarbon samples were collected here, from various contexts. Eight of these consisted of straw collected from mudbrick used to build the core of the pyramid.

The University of Pennsylvania Expedition to Saqqara excavated the satellite pyramid of Teti I and environs in 1994-1995. This smaller pyramid is located along the eastern side of the Teti pyramid itself, south of the sanctuary (see figure 5-15). Because the pyramid is within the enclosure wall, which was doubtless built at the same time as the pyramid itself, it

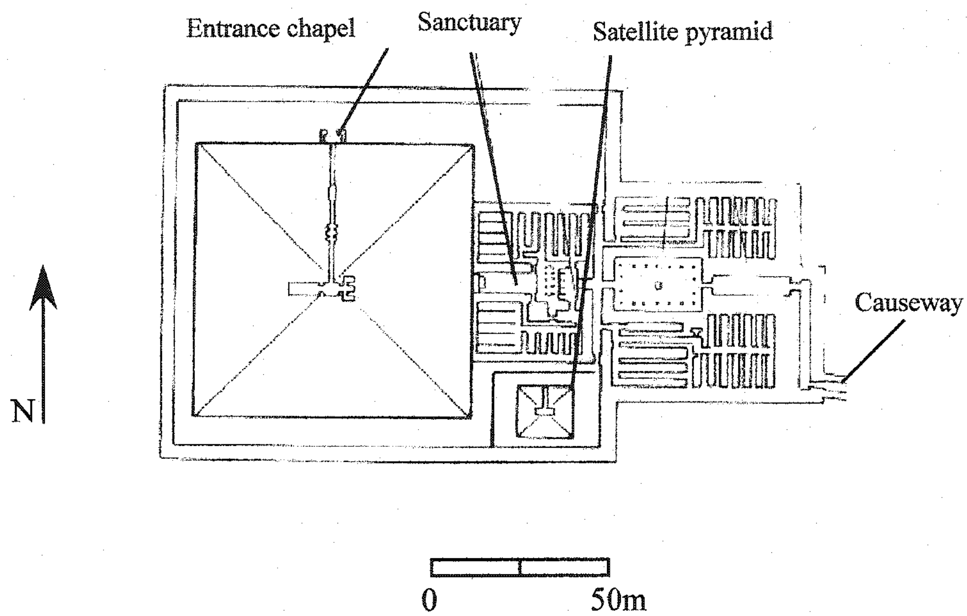


Figure 5-15. Plan of the Teti Pyramid and environs
(after Lehner 1997:157).

is reasonable to assume that material associated with the satellite pyramid is roughly contemporary with the construction dates for the Teti pyramid itself.

The environs around the Teti pyramid contain a variety of materials that are probably from earlier dynasties, however (Kanawati et al. 1984:7). The Pennsylvania expedition also collected material from the spoilheap associated with the construction of the pyramid and this material has a less secure chronological attribution. Therefore the material from the spoilheap could represent a range of dynasties, with the reign of Teti being the terminal date.

Unlike other Meidum bowl examples employed in this study, the Meidum bowls from the Teti pyramid are represented by rim-sherd profile drawings contributed by the University of Pennsylvania Expedition to Saqqara. Meidum bowl profile drawings produced by excavations at the Pyramid of Teti the 1st, Pyramid temple 1 (the aforementioned mortuary temple)(early 6th Dynasty, ca 2500 BC) were generously donated by Professor Josef Wegner of the University of Pennsylvania. In all, 24 separate vessels from this 6th Dynasty context are represented by the drawings donated by Wegner. From the Teti environs, with less secure dynastic attribution come 36 additional drawings for a total of 60 drawings. This assemblage can be considered comparable in size, therefore, to the major assemblages discussed in previous chapters, with the limitation that the actual fabrics were not made available. It is therefore not possible to determine whether given object was made from marl or alluvium.

CHAPTER 6: RESULTS

If Egypt exhibits centralized regional-scale (as defined by the Nile Valley and Delta) mass production of ceramics, this should be reflected in regional-scale sorting of variation in production, such that objects from Elephantine to Kom el-Hisn are indistinguishable in terms of morphology and fabric (*sensu* Rice 1987:201). Alternatively, if morphological similarities are driven by transmission or diffusion, rather than by centralization, space should play a stronger role in sorting variation. In the case of truly centralized production, therefore, space plays a minimal role in structuring variation. Alternatively, the lower the spatial scale of the socio-economic factors shaping variation in bowl manufacture, the greater the overall heterogeneity a given area will exhibit across paste composition and measurements. Diffusion may also be indicated by similarity in measurements in combination with differences in fabric classes across space (observed at 10x magnification).

Because time and space are intrinsically linked, whether or not Meidum bowls are being made locally has implications for using particular common subvariants of Meidum bowls as chronological indicators for all of Egypt. The scale of production and distribution of Meidum bowls indicates the extent of what can be considered a "local area." The nature of this space changes over time, thus identifying the extent of the "local area," as the term is used in seriation analysis, indicates the space across which particular subvariants have chronological utility.

In particular, it is often assumed that ceramic forms in Egypt exhibit a uniform temporal trend, regardless of space. This would be the case if centralized mass production characterizes the entire Old Kingdom period. If similarities between vessels are the result of diffusion, however, then there exists the possibility of multiple lines of development, depending on connections between individual communities. The dynastic calendar discussed in Chapter 4 provides an independent relative chronological tool against which Meidum bowl variants are compared. All assemblages are also compared to their approximate chronological counterparts in the Elephantine assemblage to examine the effect of space on variation and whether that effect changes over time.

Elephantine is therefore a critical assemblage in this study for three reasons. First, this collection comes from deposits representing all of the Old Kingdom period. Second, Elephantine's environmental setting is unique in that it is positioned at the narrowest portion of the floodplain, relative to the other assemblages chosen and is alone situated in a nome with only one flood basin. Third, Elephantine is located near the most accessible source of granite in the Nile Valley. Therefore, given the model of social complexity discussed previously, of all the assemblages used in this study, Elephantine is most likely to be co-opted into a more complex social system as a result of being able to supply granite for monumental constructions.

This hypothesis is tested by examining ceramic materials from Elephantine to other assemblages. Elephantine should exhibit similarity to other assemblage in one of three ways. First, if Egyptian ceramic production is truly centralized then there should be no differences between any assemblages geologically or morphologically. Such similarity might be typical of a truly economically integrated community. Second, if Elephantine could ceramics exhibit similarities to those found at sites involved in monumental constructions regardless of geographic distance, thus indicating integration between those communities or nomes only. Third, all assemblages could exhibit local scale similarity only, in which case the Elephantine materials would be expected to most closely resemble assemblages from locations proximate to it in space, this indicates little integration between nomes.

Assemblages are compared in terms of observable paste attributes and form. Only Elephantine Kom el-Hisn, Giza and Elephantine are involved in the fabric comparison. Then all materials discussed in Chapter 5 are compared to the material from Elephantine to determine whether or not measurement similarity tracks Euclidean distance between populations. Morphological attributes are then compared to the baselines introduced in Eerkens and Bettinger (2001) to determine which groups of measurements have *CVs* approaching the expectations of standardization. Attributes with *CVs* approaching random data are parsed from those approaching the Weber fraction. Attributes behaving similarly are combined and compared using discriminant function analysis to illustrate relationships between assemblages.

The results are presented in four parts; fabric description comparisons, ANOVA comparisons of attributes, attribute selection with regard to the Weber fraction, and DFA illustrations.

Results Part 1: Comparison of Fabrics and Inclusions

Fabric descriptions are used to determine whether there are local patterns of distribution particularly across tempering agents and clay types, as these attributes are more likely to inform as the relationship between the pottery assemblage and the local geology. Fabrics were described in terms of inclusions (temper described in detail below) and clay type (marl, alluvium or marl/alluvium mix). Described below are differences in clay types and temper particles. Pure marl and pure alluvium were identified using the criteria discussed in Chapter 3. Marl and alluvium mix is an intermediate category for those fabrics that do not fit either definition. Fabrics were assessed by clipping a small portion of the ceramic to more precisely describe the interior paste. Other attributes, such as relative porosity, particle size and firing regime were also recorded but are not discussed. Complete fabric descriptions are given in appendix 1.

Differences across larger inclusions are examined separately from differences in the clay matrix, (particles in the clay matrix that are less than 0.002 mm in diameter [Orton et al. 1993:67]). This approach allows a flexible, yet replicable description of clays employed at various locations.

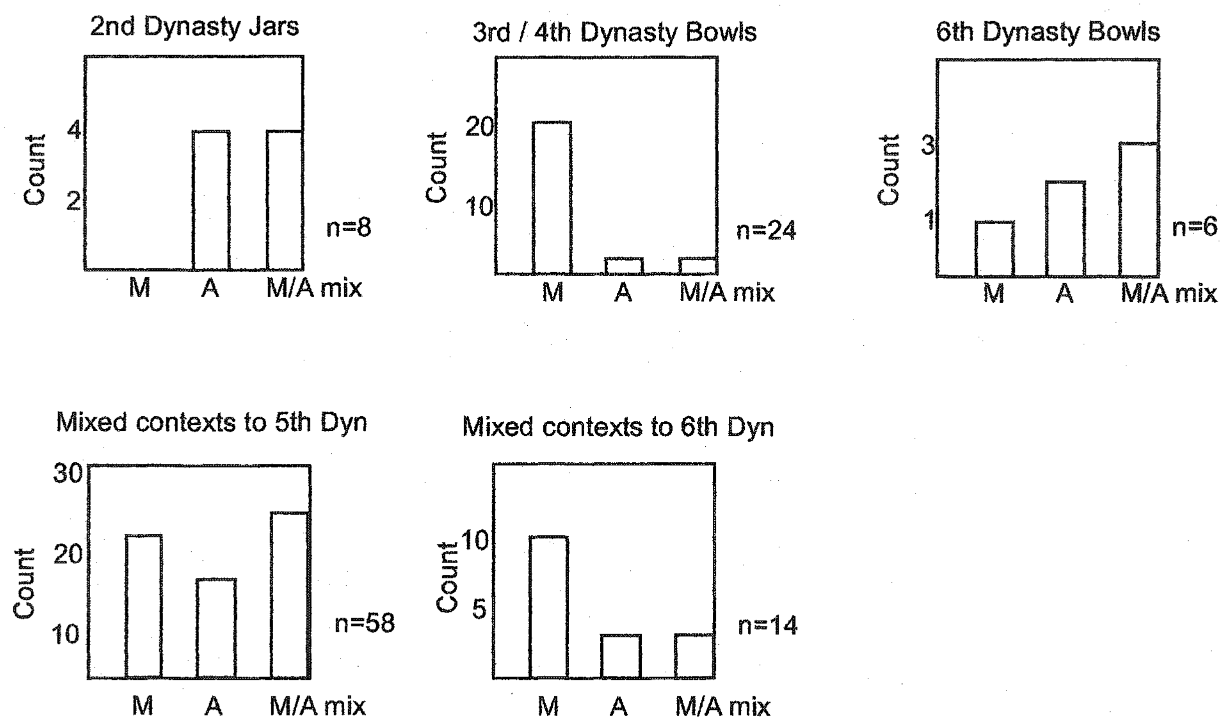
Elephantine, Giza and Kom el-Hisn each occupy slightly different geomorphological provinces in Egypt. If similarities in Meidum bowls are the result of global (Nile Delta and Valley combined) scale manufacturing, then there should be little difference across clays and tempering agents. Elephantine is located at the First Cataract of the Nile where the Nile floodplain is quite narrow, making alluvial clay less available. Giza is located just off the floodplain on the Mokkatam and Maadi limestone formations, therefore, marl and alluvial clays are available. Kom el-Hisn is located on the Nile Delta, where primarily alluvial clays are available. Fabric and inclusions are compared with histograms and chi-squared analysis.

Clay comparison

Differences in clay types are first examined at Elephantine to determine if there is a potential difference in raw material choice over time. The Elephantine materials are then compared to the Giza and Kom el-Hisn materials using chi-squared analysis to determine if there are significant differences in proportions of clay types in particular assemblages.

Elephantine over time

At Elephantine, marl and marl alluvium mix is the dominant clay type across all dynasties (see figure 6-1). The 2nd Dynasty assemblage consists of the round squat jars taken



M = Marl
A = Alluvium
M/A = Marl / Alluvium mix

Figure 6-1: Comparison of clay types across dynasties at Elephantine to be the precursors to the Meidum bowl, none of which were made from pure marl. Marl is clearly the dominant clay choice during the 3rd and early 4th Dynasties. Materials associated with the 5th and 6th Dynasties show an increased frequency in vessels made of alluvium. The large assemblage of objects assigned to "mix to 5th Dynasty" shows an approximately equal distribution of objects across all clay types, but with marl and marl/alluvial mix dominating.

Materials from the 2nd Dynasty and the 6th Dynasty appear to differ somewhat from the other groups. This is likely to be the result of small sample sizes. It is also possible that the early and later assemblage represent imported objects.

Elephantine in comparison to other locations

Material from Giza can be considered contemporary to the material from the 3rd and 4th Dynasties at Elephantine. While no bowls from this time period at Elephantine were made from pure alluvium, alluvium is the most frequently encountered clay type from Giza (see figure 6-2). The late 5th/ early 6th Dynasty assemblage from Kom el-Hisn is dominated by alluvium, and a similarly large number of marl/alluvium mix and a vanishingly small number of vessels being made out of marl. Comparison of the Giza material with the Kom el-Hisn material indicates there is little difference between these two locations in terms of the frequency of particular clay types represented.

Chi-square comparison

The entire Elephantine assemblage was compared to both the Giza and Kom el-Hisn assemblages using chi-squared analysis to determine if the differences in clay proportions across sites are significant.

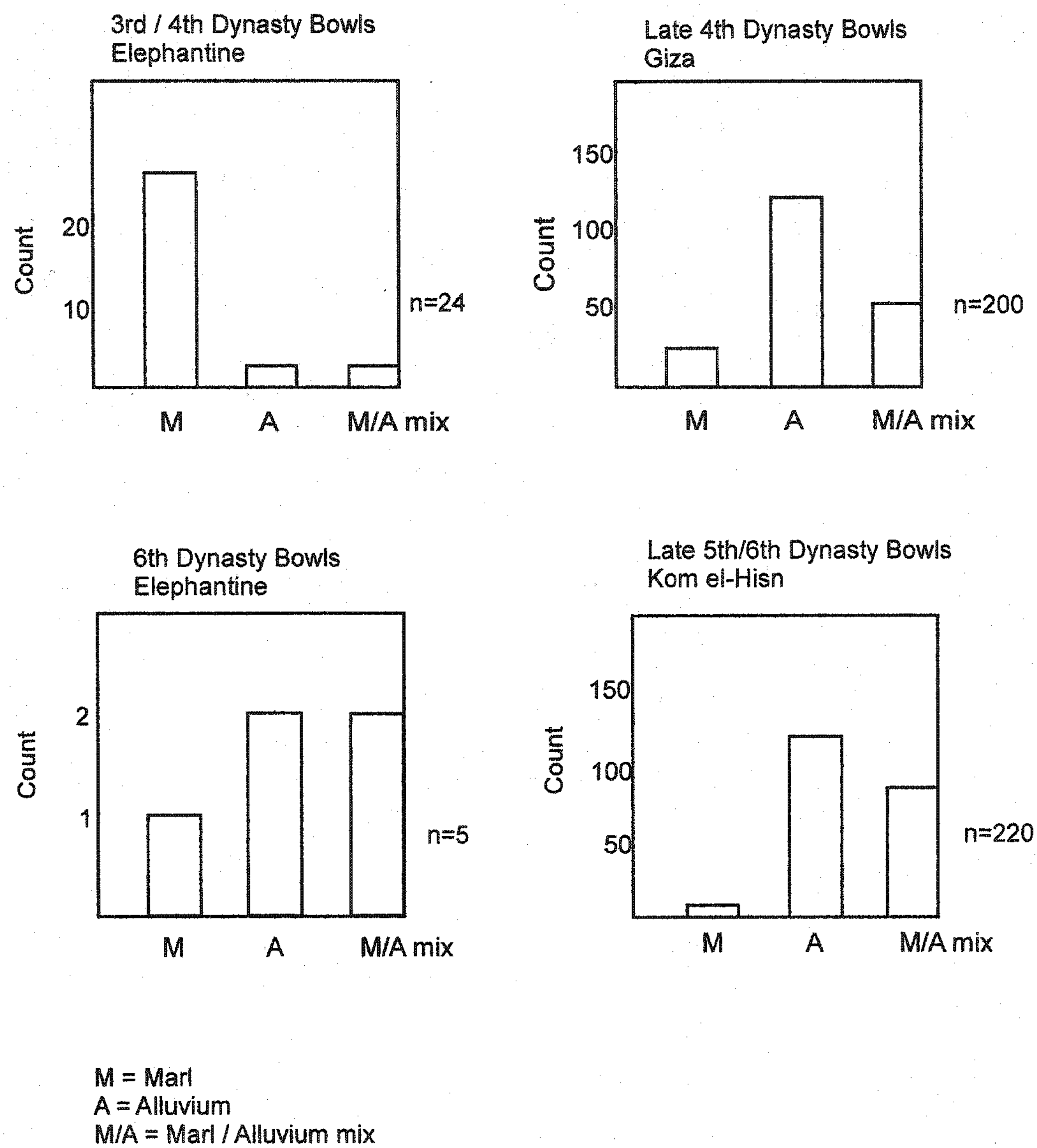


Figure 6-2. Comparison of clay types from the 4th/5th Dynasty at Elephantine vs clay types from the late 4th Dynasty at Giza and 6th Dynasty material from Elephantine vs late 5th and 6th Dynasty bowls from Kom el-Hisn.

Table 6-1 provides the results of the three comparisons and shows that proportions of clay types across all groups are significantly different. Of particular interest is the fact that Giza and Kom – el Hisn feature larger numbers of alluvial fabrics than expected, while Elephantine features a larger number of marl fabrics than expected. This result is consistent with local, rather than global scale production.

Tempering agents

In general, pottery analysts consider pottery fabrics to consist of two elements 1) Matrix consisting of minerals less than 0.002mm across and 2) inclusions which are larger (Orton 1993:67). The particles described here are those which are visible and could be distinguished either with the naked eye, or by using a 10x hand lens, and are thus larger than those defined as matrix.

As Rice (1987:406) points out, particulate inclusions in vessel fabrics may or may not be intentionally added. In general, quartzite, calcite and mica can occur in clay matrices naturally. Grog (broken pottery) "is used to bring proper texture, consistency, hardness, etc by mixing with something or treating it in some way" as is fiber (Rice 1987:406). Therefore the latter two categories of tempering agents are more likely to result from intentional manufacturing choice, as opposed to being naturally occurring inclusions.

In this study, tempering agents or inclusions are used to indicate the general geomorphologic province from which the material was collected. Five inclusion types were identified for this study: mica, calcite, quartzite, fiber and grog. These were used as dimensions in a classification based on the presence or absence of each type in the ceramic. In all, 14 combinations of temper particle were identified across the three assemblages. These 14 combinations were assigned numbers 1-14 and are listed in table 6-2. Of these 14 temper

Table 6-1: Comparison of clay types across the Elephantine, Giza and Kom el-Hisn assemblages.

Site	Marl	Alluvium	Mix	N
Elephantine				112
Observed	52	24	36	
Expected	*19.5*	*51.45*	*41.03*	
Kom el-Hisn				221
Observed	6	129	86	
Expected	*38.5*	*101.54*	*80.96*	
Totals	58	153	122	333
			Chi-squared	104.594
			df	2
			significance	0.00

Site	Marl	Alluvium	Mix	N
Elephantine				112
Observed	52	24	36	
Expected	*24.9*	*54.91*	*32.15*	
Giza				198
Observed	17	128	53	
Expected	*44.1*	*97.08*	*56.84*	
Totals	69	152	89	310
			Chi-squared	74.02
			df	2
			significance	0.00

Site	Marl	Alluvium	Mix	N
Kom el-Hisn				221
Observed	6	129	86	
Expected	*12.1*	*76.47*	*73.37*	
Giza				198
Observed	17	128	53	
Expected	*10.9*	*121.44*	*65.68*	
Totals	23	257	139	419
			Chi-squared	267.06
			df	2
			significance	0.00

Table 6-2: Fourteen total temper classes. Classes compared in analysis are highlighted.

Temper Class	Temper Type	Class No.
001000	**calcite**	**1**
001001	**calcite and grog**	**2**
001100	**quartzite and calcite**	**3**
001101	**calcite, quartzite and grog**	**4**
010000	**mica**	**5**
010010	mica and fiber	6
010100	mica and quartzite	7
010101	mica, quartzite and grog	8
011000	**mica and calcite**	**9**
011001	**mica, calcite and grog**	**10**
011100	**mica, calcite and quartzite**	**11**
011101	mica, calcite, quartzite and grog	12
011110	mica, calcite, quartzite and fiber	13
000000	unidentifiable	14

combinations, eight of which have class memberships greater than five (the minimum number of class members for a reasonable comparison [Shennan 1997:124-125]). The classes compared are highlighted in table 6-2.

In general the tempering agents used follow a pattern similar to that observed for clay choices, with calcite (a component of limestone), being persistently present in the Elephantine assemblage (see Figure 6-3). There is little chronological sensitivity to the kinds of tempering particles used. The 2nd Dynasty jars show a relatively restricted set of tempering choices, though this could be related to the small sample size. Temper categories remain approximately the same from the 3rd to 5th Dynasties.

There is a change during the 6th Dynasty. The apparent reduction in over all temper choices noted during the 6th Dynasty is likely the result of the small sample size. However, the assemblage of mixed to 6th Dynasty tempering agents also indicates an overall change with mica and calcite becoming the dominant tempering type, coincident with a slight decrease in pure calcite temper. Other types are still present, however, but in comparison to the mixed to 5th Dynasty assemblage, there appears to be less heterogeneity overall.

According to Neff et al. (1997) and Arnold (2000) standardization will be reflected in relatively homogeneous fabric compositions. Giza and Kom el-Hisn, despite having much larger sample sizes indicate far more homogeneous temper choices (see figure 6-4 for comparison). In general Giza and Kom el-Hisn have approximately the same proportions of various tempering agents, with mica and calcite being the dominant combination, followed by mica, calcite and quartz. Elephantine, in contrast, suggests more heterogeneous temper decisions, which could potentially indicate imported vessels (this possibility is also reflected in the clay types seen in the 2nd and 6th Dynasty assemblages). More vessels from Elephantine have pure calcite temper and more vessels have grog inclusions than noted at Kom el-Hisn or

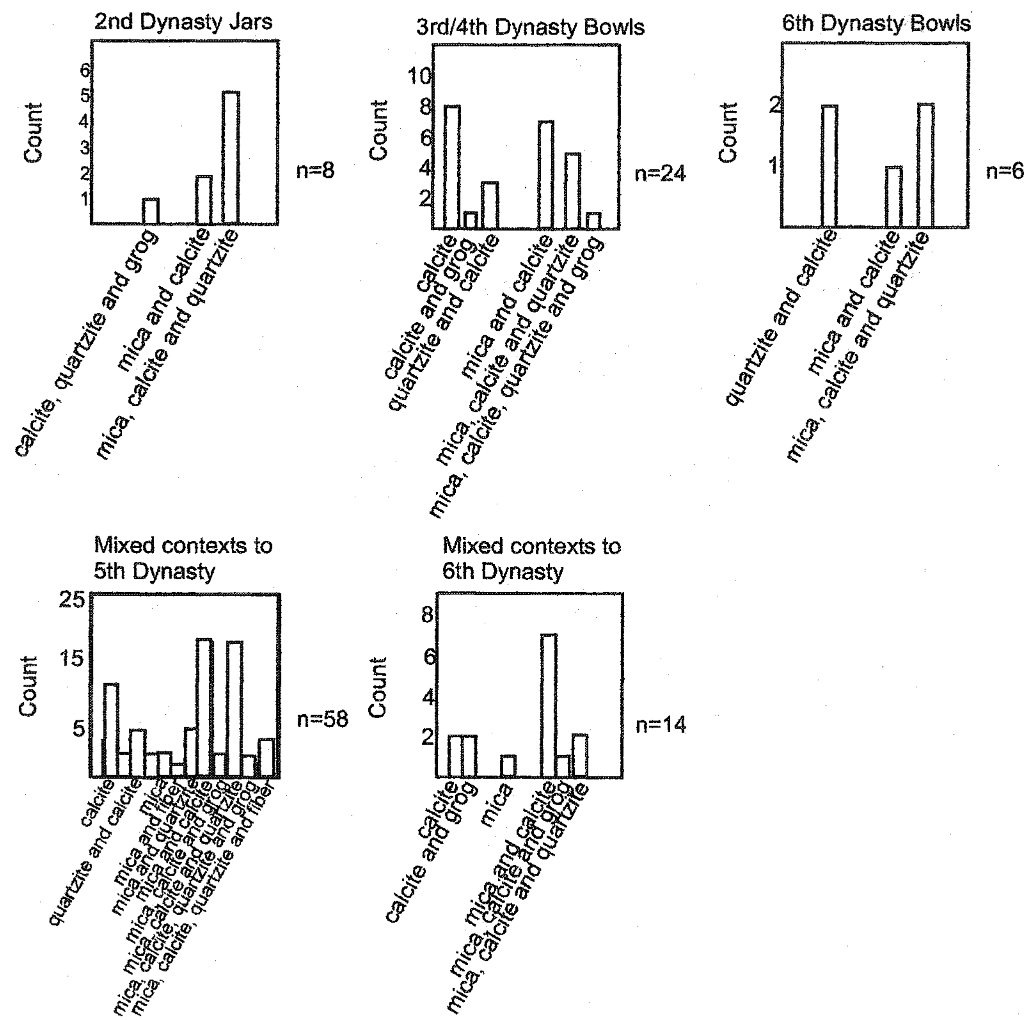


Figure 6-3. Changes in inclusion types over time at Elephantine.

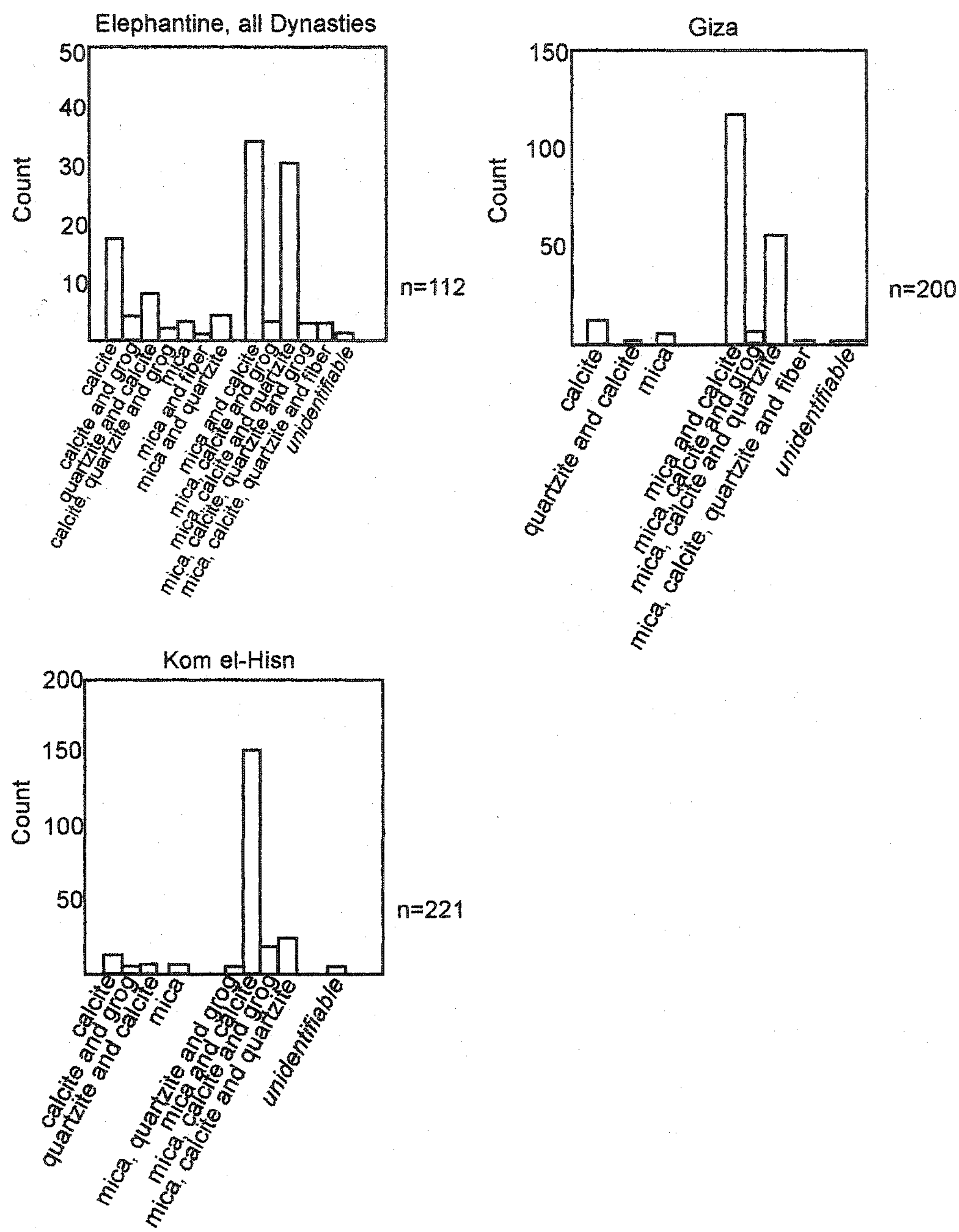


Figure 6-4. Differences in inclusion types across space: Elephantine, Giza and Kom el-Hisn.

Giza, with quartzite (a mineral common to alluvial materials) playing a diminished role in the Elephantine assemblage.

Chi-squared comparison of temper classes indicates that all three assemblages are also significantly different across temper classes with differences generally reflecting expected geological differences (see table 6-3). Generally Elephantine tends to have a higher than expected frequency of temper classes with calcite, a component of marl, whereas Giza and Kom el-Hisn have lower than expected frequencies in those classes.

General Observations regarding clay and inclusions

Both the vessel matrices and observable inclusions indicate that the Giza and Kom el-Hisn materials are more similar to each other than they are to the vessels from Elephantine. These results suggest that the clay sources for all assemblages are different from each other. Vessels from Elephantine are more likely to be made out of marl and are more likely to have pure calcite temper. It is interesting, however, that the 6th Dynasty bowls from Elephantine and the mix to 5th Dynasty bowls show an increase in alluvial vessels materials, and also that the Elephantine assemblage is generally characterized by more heterogeneous temper choices. According to Neff et al. (1997), compositional heterogeneity in an assemblage signals the likelihood of traded objects. It is possible that Elephantine features more imported objects than Giza or Kom el-Hisn.

Results Part 2: ANOVA comparison of assemblages across all specified attributes

The fabric descriptions discussed above indicate local manufacture of Meidum bowls in that the three large assemblages compared reflect different raw material sources. This suggests that the perceived similarity in Meidum bowls results from diffusion and exchange

Table 6-3: Chi-squared comparison of temper classes.

Site	Class 1	Class 2	Class 3	Class 4	Class 5	Class 9	Class 10	Class 11	N
Elephantine									103
Observed	17	4	24	6	3	17	2	30	
Expected	*9.24*	*2.55*	*10.84*	*2.86*	*2.86*	*52.29*	*5.42*	*16.9*	
Kom el-Hisn									220
Observed	12	4	10	3	6	147	15	23	
Expected	*19.75*	*5.44*	*23.15*	*6.13*	*6.13*	*111.7*	*11.57*	*36.09*	
Totals	29	8	34	9	9	164	17	53	323
								Chisquared	92.26 sign=0.00
								df	7
Elephantine									103
Observed	17	4	24	6	3	17	2	30	
Expected	*10.02*	*1.38*	*13.13*	*3.45*	*2.76*	*41.476*	*1.38*	*29.37*	
Giza									195
Observed	12	0	14	4	5	103	2	55	
Expected	*18.97*	*2.6*	*24.86*	*6.54*	*5.23*	*78.52*	*2.61*	*55.62*	
Totals	29	4	38	10	8	120	4	85	298
								Chisquared	54.1371 sign=0.00
								df	7
Kom el-Hisn									220
Observed	12	4	10	3	6	147	15	23	
Expected	*12.72*	*2.12*	*12.72*	*3.71*	*5.83*	*132.53*	*9.01*	*41.34*	
Giza									195
Observed	12	0	14	4	5	103	2	55	
Expected	*11.27*	*1.87*	*11.27*	*3.28*	*5.16*	*117.46*	*7.98*	*36.65*	
Totals	24	4	24	7	11	250	17	78	415
								Chisquared	146.57 sign=0.00
								df	7

rather than mass production. This assessment is further tested by examining selected metric attributes to determine if these measures exhibit spatial sensitivity.

For this portion of the analysis, samples for which fabric descriptions were not available were added to the Kom el-Hisn, Giza and Elephantine assemblages. These include the drawings from the Teti pyramid complex (at Saqqara), museum objects collected from tomb and construction contexts at the Meidum pyramid and museum objects collected from tomb contexts at Qau and Badari.

Measurements on bowls from these assemblages were compared by individual dynasties (e.g. the frequency distribution of diameter measurements from 6^{th} Dynasty contexts at Elephantine are compared to those from the 6^{th} Dynasty at Kom el-Hisn etc).

All measurements with the exception of the ratio of length A to length B are unmodified. The raw ratio of length A to length B is equivalent to dividing the opposite side over the adjacent side of some angle θ in Cartesian space. The numerical distance between ratios is not a linear function; as the arithmetic difference between length A and length B increases, the numerical ratio increases geometrically. Therefore, the ratio is converted to its arctangent to create equal class intervals.

The size of length A relative to the size of length B, and whether length A is shorter or longer than length B is of interest here. If the ratio arctangent conversion results in a number greater than 0.785 (the arctangent in radians of 1), then length A is longer than length B. If the arctangent conversion results in a number smaller than 0.785, then length A is shorter than length B.

Using ANOVA to compare assemblage means

One-way analysis of variance (conducted using the SPSS software package) is a statistical technique that uses the principle of regression to determine the probability that means of particular prechosen groups exhibit differences that can't be explained by chance alone. This technique produces a coefficient, which is the slope of the regression line if two categorical variables are assigned numbers and used as independent variables in a regression analysis. The constant calculated is the mean of all the data used in the analysis, and is also the regression intercept. The slope of the line is the effect by which a categorical variable affects some numerical measurement, in other words how much one particular mean of a given categorical variable differs from the overall group mean (SYSTAT manual:384). ANOVA therefore compares variance between groups to variance within groups (Drennan 1996:175-176). This in turn allows a determination as to whether the means of the assemblages compared are likely to have been drawn from the same population.

Underlying the technique is the assumption that the variances of the samples are equal (even if the means are not). The Levene test is used to determine this. "The computations of the Levene test … use the deviation … from each case to its group mean as data in an analysis of variance" (SPSS manual:58). This test is largely unaffected by sample size problems and non-normal distributions (SPSS manual:58). For variances to be considered equal, the F statistic generated for the Levene test should not be significant.

Elephantine comparisons

Before comparing Elephantine to other assemblages used in this study, I discuss differences noted over time in the Elephantine assemblage. Raue (in Kaiser et al. 1999) has suggested that the form of the Meidum bowl evolved initially from round squat jars.

Therefore the first comparison discussed will be differences between some of the earliest examples of Meidum bowls at Elephantine dating to the late 3rd / early 4th Dynasty, as compared to the jars that are hypothesized to have filled the same function of the bowls during the 2nd Dynasty. I will then add material from the 4th / 5th Dynasty and the 6th Dynasty to the comparisons. The following discussion, therefore, pertains to metric comparison of objects of known Dynastic attributions from Elephantine.

2nd Dynasty vs 3rd/4th Dynasty

This initial comparison entails determining whether the differences in attributes assumed to be differing only in terms of time across the 2nd and into the 3rd and 4th Dynasties are what would be expected given that the primary difference between these assemblages is the difference between bowls and jars.

The difference between what is considered a "bowl" and what is considered a "jar" is indicated by a "jar" a) being necked and b) having a height greater than its maximum diameter. In contrast, a "bowl" does not have a neck (but can have a restricted orifice) and has a height "varying from one-third the maximum diameter of the vessel to equal the diameter" (Rice 1987:216). In more general terms, the real difference between a bowl and a jar is somewhat arbitrary (Rice 1987:216-217). In the case of the objects discussed here, the primary difference is depth (generally indicated by a relatively vertical measurement for Azimuth C).

Table 6-4 and figure 6-5 illustrate the differences between 2nd Dynasty jars and 3rd and 4th Dynasty bowls from Elephantine. Only one attribute (diameter) indicates a statistically significant difference from the 2nd to the 3rd / 4th Dynasty. All other attributes show no statistical difference (meaning that the frequency of measurements for both sets of objects

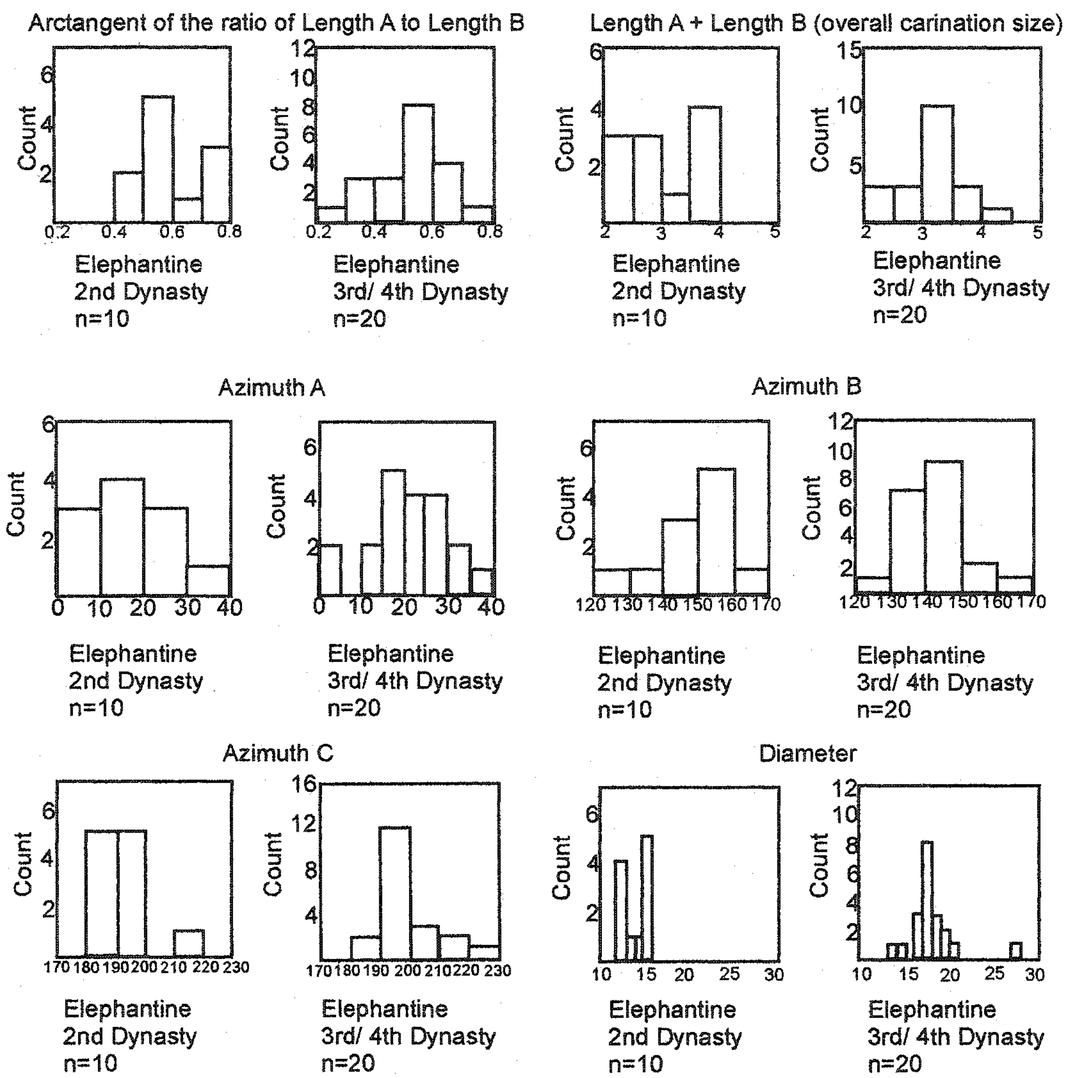


Figure 6-5. Comparison of 2nd Dynasty jars to 3rd/4th Dynasty bowls, original data.

Table 6-4: Differences in attribute measurements across 2^{nd} and $3^{rd}/4^{th}$ Dynasty material from Elephantine.

Dynasty	N	Mean Ratio, length A:B	St.Dv.	St.Er.	Levene St signif	F- stat	Signif.
2nd Dyn	10	0.5736	0.1213	0.003659	0.851	2.591	0.118
3rd-4th Dyn	20	0.502	0.1171	0.002617			
		Mean Length A+B			Levene St signif	F- stat	Signif.
2nd Dyn	10	2.97	0.643	0.1939	0.171	1.299	0.264
3rd-4th Dyn	20	3.21	0.5166	0.1155			
		Mean Azimuth A			Levene St signif	F- stat	Signif.
2nd Dyn	10	16.18	8.71	2.62	0.882	1.726	0.199
3rd-4th Dyn	20	20.68	9.33	2.08			
		Mean Azimuth B			Levene St signif	F- stat	Signif.
2nd Dyn	10	147.39	9.56	2.88	0.7	2.593	0.118
3rd-4th Dyn	20	142.03	8.48	1.88			
		Mean Azimuth C			Levene St signif	F- stat	Signif.
2nd Dyn	10	192	9.88	2.98	0.789	2.05	0.162
3rd-4th Dyn	20	197	10.72	2.39			
		Mean Diameter			Levene St	F- stat	Signif.
2nd Dyn	10	13.6	1.5	0.4761	0.398	16.377	0.000
3rd-4th Dyn	20	17.5	2.74	0.6134			

could have been drawn from the same population). All comparisons of pass the Levene test of variance equivalence.

A shift from a jar form to a bowl form entails some expectations as to the direction of morphological change that will be exhibited. According to the definition outlined above, diameter of the opening should increase and depth (as indicated by a more horizontal azimuth C) should decrease. There is no necessary change in the overall shape of the bevel. The observed changes in vessel measurements over time are consistent with Raue's hypothesis that 3^{rd} / 4^{th} Dynasty bowls are "descended from" 2^{nd} Dynasty jars. Diameter does increase over time. Depth, however, does not, at least initially (although bowls do become shallower during later Dynasties, see discussion below).

3^{rd}/4^{th} Dynasty vs 6^{th} Dynasty

The shift from the 3^{rd} / 4^{th} Dynasties to the 6^{th} Dynasty involves more morphological changes. From the 2^{nd} Dynasty to the 3^{rd} and 4^{th} Dynasty, the only significant difference between the earlier "jars" and the later "bowls" is in terms of diameter. In contrast, from the 4^{th} to the 6^{th} Dynasty, all attributes are significantly different with the exception of azimuth A. All attributes with the exception of the ratio arctangent of length A to length B pass the Levene test for variance equivalence. Only those comparisons that passed the Levene test are discussed.

The overall size of the carination, as indicated by the measurement of length A + length B, declines over time. Azimuth B tends more toward the vertical (180°). Azimuth C tends more toward the horizontal (270°) and diameter increases, indicating a shallower, more wide mouthed bowl. The top flare of the carination (azimuth A) is not significantly different across assemblages (see table 6-5 and figure 6-6).

Table 6-5: Differences in attribute measurements across $3^{rd}/4^{th}$ and 6^{th} Dynasty material from Elephantine.

Dynasty	N	Mean Ratio, length A:B	St.Dv.	St.Er.	Levene St signif	F- stat	Signif.
3rd-4th Dyn	20	0.502	0.1171	0.002617	0.002	17.84	0.00
6th Dyn	6	0.81	0.2637	0.1077			
		Mean Length A+B			Levene St signif	F- stat	Signif.
3rd-4th Dyn	20	3.21	0.5166	0.1155	0.798	31.913	0.00
6th Dyn	6	1.86	0.4904	0.2002			
		Mean Azimuth A			Levene St signif	F- stat	Signif.
3rd-4th Dyn	20	20.68	9.33	2.08	0.373	1.861	0.185
6th Dyn	6	26.88	11.25	4.59			
		Mean Azimuth B			Levene St signif	F- stat	Signif.
3rd-4th Dyn	20	142.03	8.48	1.88	0.45	11.528	0.002
6th Dyn	6	156.22	10.64	4.34			
		Mean Azimuth C			Levene St signif	F- stat	Signif.
3rd-4th Dyn	20	197	10.72	2.39	0.491	19.23	0.00
6th Dyn	6	220.49	12.31	5.02			
		Mean Diameter			Levene St signif	F- stat	Signif.
3rd-4th Dyn	20	17.5	2.74	0.6134	0.986	15.747	0.001
6th Dyn	6	22.33	2.06	0.8433			

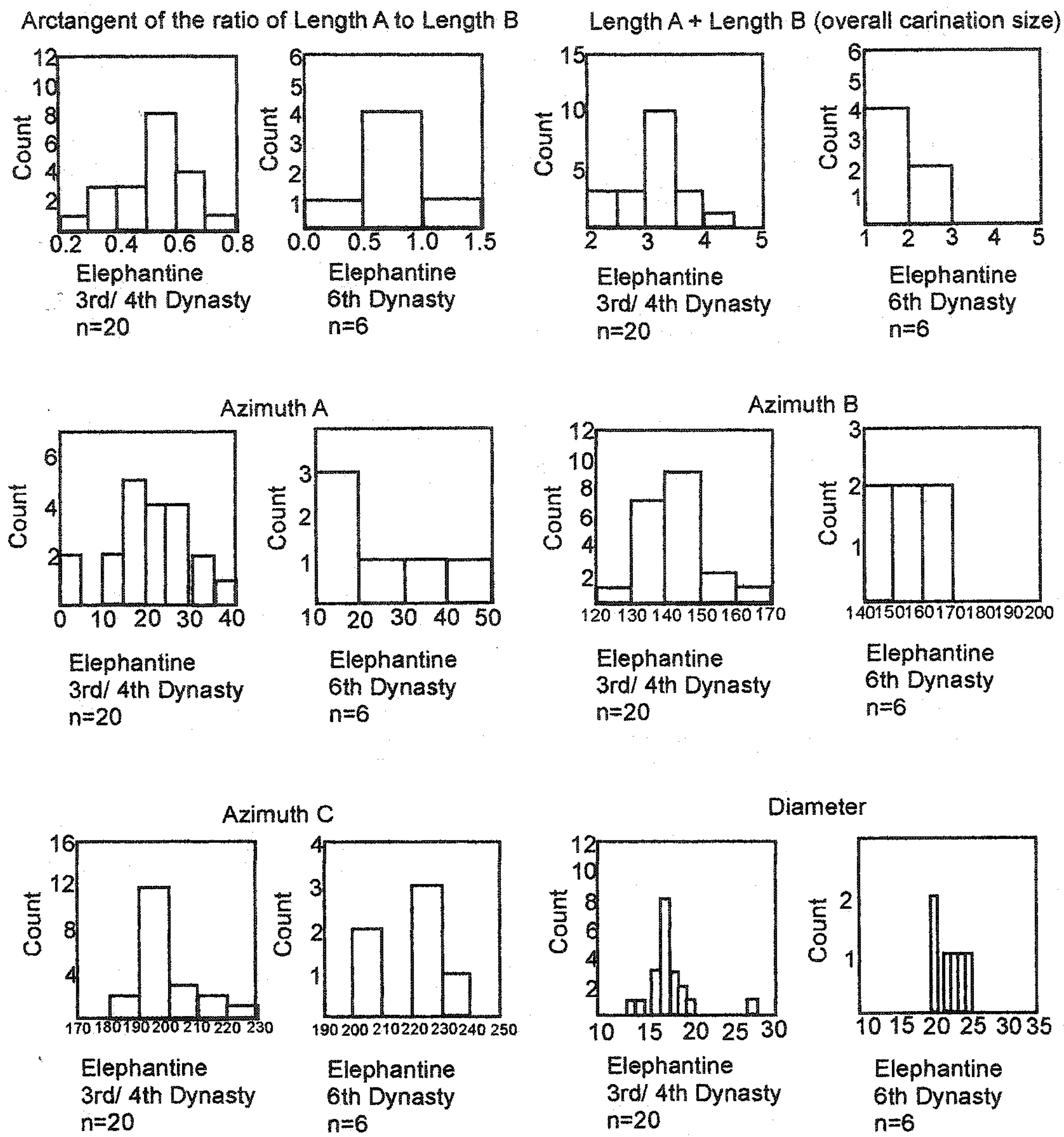


Figure 6-6. 3rd/4th Dynasty versus 6th Dynasty vessels from Elephantine.

Summary of Elephantine Chronological Trends

Measurements of ratio arctangent indicate that from the 2nd to 4th Dynasty, length B is longer than length A (on average). The overall size of the carination seems to stay approximately the same from the 2nd to 4th Dynasty, becoming smaller on average by the 6th Dynasty. There also seems to be a shift in the ratio of length A to length B, with length B increasing in size and length A decreasing in size over time (however, the comparison between the 3rd and 4th Dynasty ratio measurements relative to 6th Dynasty material is compromised by the failed Levene test).

Azimuth A tends toward the horizontal up until the 4th Dynasty and then trends back toward the vertical by the 6th Dynasty. Azimuth B shows a general tendency toward more verticality.

As discussed above, azimuth C is a general indication of depth, with a more vertical (closer to 180°) measurement generally indicating a deeper bowl. The general trend over time indicates a shallower bowl with larger angular measurements (toward 270°) indicating a shallower vessel. This result, combined with diameter, which increases over time, suggests that vessel volume changes through time.

In summary, two trends can be outlined, a general change in the carination from larger to smaller with a possibly significant change in length ratios such that length B increases as length A decreases. In addition to changes in carination morphology, the vessel diameter increases as the vessel becomes shallower.

Elephantine and the 4th Dynasty

Assemblages from other 4th Dynasty contexts are compared to the identified 3rd and 4th Dynasty materials from Elephantine. As was discussed in the previous chapters, three assemblages used in this study have 4th Dynasty components, the largest of which is the Giza assemblage. Materials from the 4th Dynasty at Meidum and the 4th/5th Dynasty at Qau and Badari are also included. These assemblages are compared to both the 3rd/4th and 6th Dynasty materials from Elephantine.

3rd/4th Dynasty material from Elephantine and Meidum

Both locations feature material associated with the reign of Senefru (the early 4th Dynasty). The Meidum material was collected from both tomb and construction contexts, whereas the Elephantine material is taken from a domestic setting. Despite the strong association with the reign of Senefru at both sites, it is interesting to note that generally measurements taken on these assemblages are significantly different from each other, with the exception of azimuth A and diameter. All comparisons pass the Levene test in the original data sets (see figure 6-7 and table 6-6).

The ratio of length A to length B and overall carination size both exhibit significant differences. This indicates that vessels from Meidum have different carination morphologies than those from Elephantine. Ratio measurements indicate that the bulk of the Elephantine carinations from this time period are characterized by length B being consistently longer than length A. In contrast, vessels from Meidum feature carinations wherein length A and length B are approximately the same.

Meidum, despite chronological equivalence to the 3rd/4th Dynasty material from Elephantine, nonetheless features vessels with a significantly smaller overall carination height. Azimuths B and C are also significantly different between the two assemblages. Bowls from Elephantine indicate a more horizontal tendency in azimuth B than the bowls from Meidum. Bowls from Elephantine are deeper than bowls from Meidum, as indicated by the clear

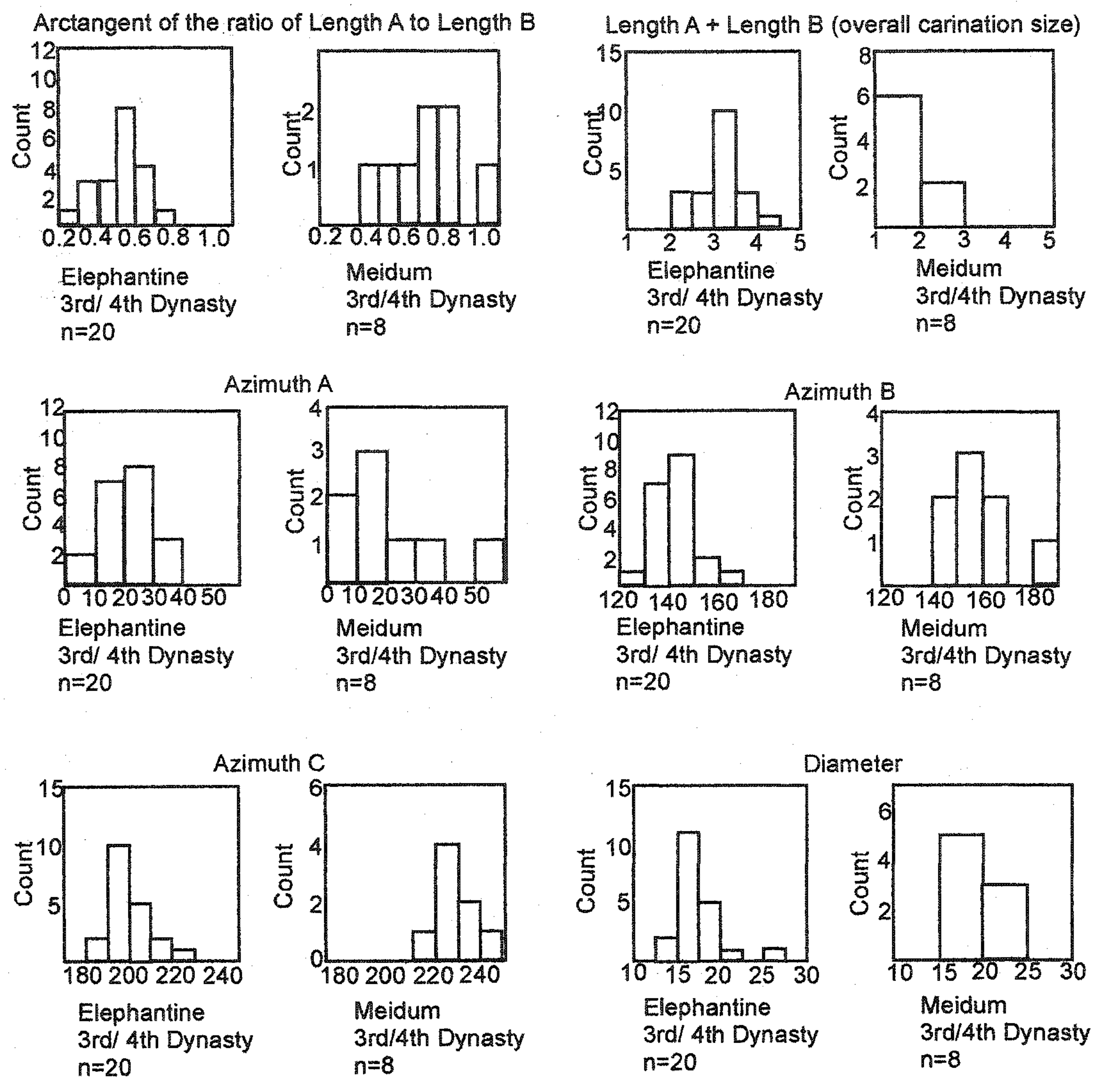


Figure 6-7: Comparison of 3rd/4th Dynasty bowls from Elephantine to 3rd/4th Dynasty bowls from Meidum.

Table 6-6: Differences in attribute measurements across 3rd/4th Dynasty materials from Elephantine and Meidum.

Location	N	Mean Ratio, length A:B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
Elephantine	20	0.502	0.1171	0.002617	0.283	18.574	0.000
Meidum	8	0.7425	0.17	0.00601			
		Mean Length A+B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
Elephantine	20	3.21	0.5166	0.1155	0.67	38.779	0.000
Meidum	8	1.82	0.5768	0.2039			
		Mean Azimuth A	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
Elephantine	20	20.68	9.33	2.08	0.16	0.001	0.971
Meidum	8	20.5	15.55	5.49			
		Mean Azimuth B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
Elephantine	20	142.03	8.48	1.88	0.427	14.29	0.001
Meidum	8	158.24	13.9	4.94			
		Mean Azimuth C	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
Elephantine	20	197	10.72	2.39	0.807	53.578	0.000
Meidum	8	229.95	9.93	3.51			
		Mean Diameter	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
Elephantine	20	17.5	2.74	0.6134	0.909	2.761	0.109
Meidum	8	19.25	1.8	0.6376			

difference between deeper measurements for azimuth C from Elephantine as opposed to shallower measurements azimuth C measurements from Meidum. Diameter measurements, however, are indistinguishable between assemblages. Generally, though, the early 4^{th} Dynasty Meidum material appears to feature vessels similar to those common during the 6^{th} Dynasty at Elephantine.

4^{th} Dynasty material from Giza and 3^{rd} / 4^{th} Dynasties at Elephantine

The Giza material is slightly later then the Elephantine material to which it's compared, representing the later 4^{th} Dynasty whereas the Elephantine material represents the late 3^{rd} and early 4^{th} Dynasty. The Giza material generally differs from the 3^{rd}/4^{th} Dynasty Elephantine material, but not in the same manner as the Meidum material. Despite great sample size differences, all attribute comparisons pass the Levene test of variance equivalence (see table 6-7 and figure 6-8).

Attributes exhibiting significant differences are length ratio, length A and length B (overall carination size) azimuth B and diameter. Attributes that don't exhibit significant differences at the 0.01 level are azimuth A and azimuth C (this difference is significant at the 0.05 level, however).

The Giza bowls, therefore are somewhat shallower and somewhat wider than the early Elephantine bowls, but not to the degree exhibited by the 6^{th} Dynasty Elephantine material and the 3^{rd} / 4^{th} Dynasty material from Meidum. The Giza bowls feature a carination wherein length A and length B are approximately the same. Azimuth B tends more toward the vertical in the Giza assemblage

Table 6-7: Differences in attribute measurements across $3^{rd}/4^{th}$ Dynasty materials from Elephantine and 4^{th} Dynasty materials from Giza.

Dyn/Location	N	Mean Ratio, length A:B	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
3rd/4th Ele	20	0.502	0.1171	0.00261	0.08	81.69	0.00
4th Giza	337	0.8544	0.1719	0.0009364			
		Mean Length A+B	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
3rd/4th Ele	20	3.21	0.5166	0.1155	0.618	11.111	0.001
4th Giza	337	2.84	0.4692	0.00255			
		Mean Azimuth A	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
3rd/4th Ele	20	20.68	9.33	2.08	0.774	2.798	0.095
4th Giza	337	24.22	9.18	0.5006			
		Mean Azimuth B	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
3rd/4th Ele	20	142.03	8.48	1.89	0.607	33.309	0.00
4th Giza	337	154.168	9.17	0.4996			
		Mean Azimuth C	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
3rd/4th Ele	20	198.21	10.51	2.35	0.381	4.56	0.033
4th Giza	337	203.7433	11.28	0.6147			
		Mean Diameter	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
3rd/4th Ele	20	17.5	2.74	0.6134	0.156	9.822	0.002
4th Giza	337	19.71	3.09	0.1685			

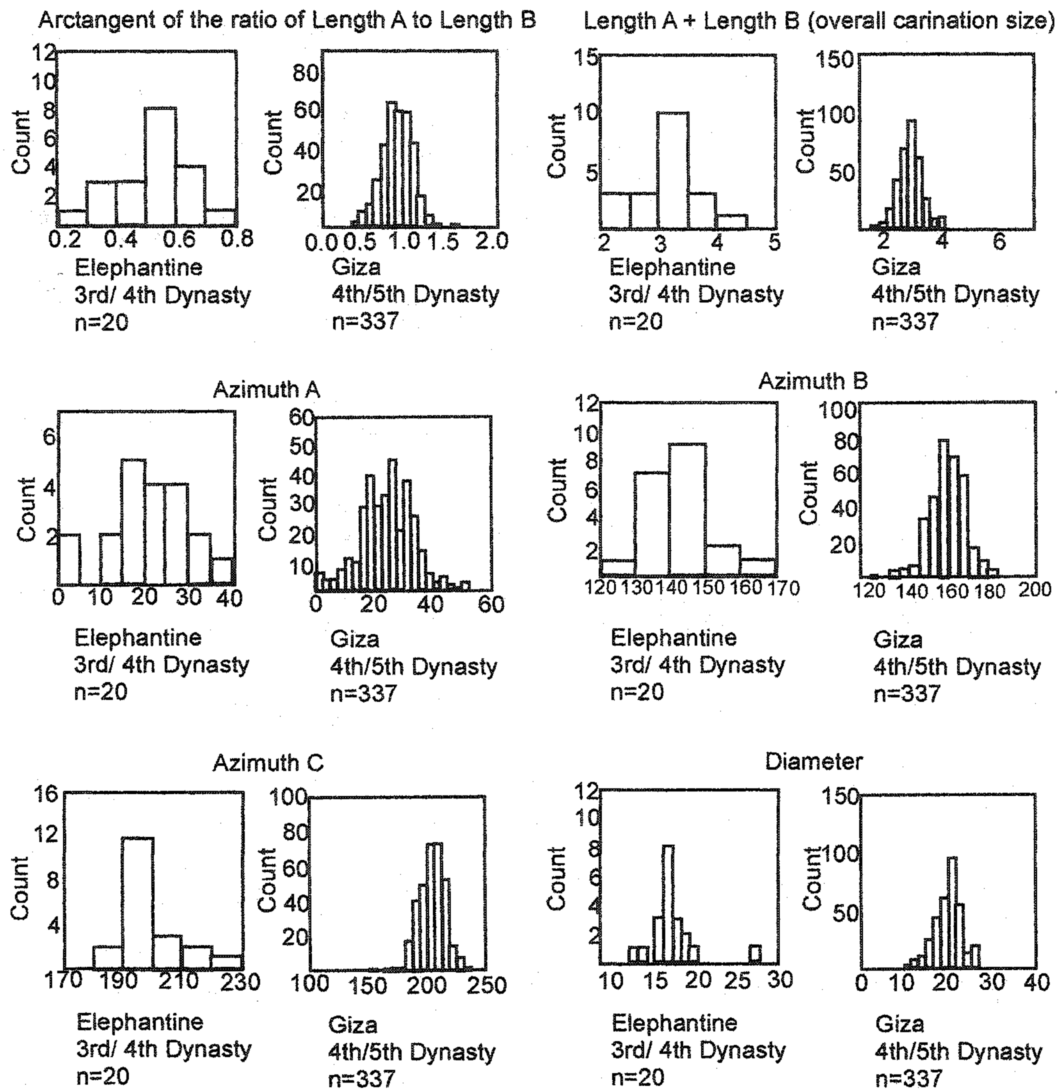


Figure 6-8. Comparison of 3rd/4th Dynasty bowls from Elephantine to late 4th Dynasty bowls from Giza.

4th/5th Dynasty Qau and Badari and the 3rd / 4th Dynasty at Elephantine

The Qau and Badari material represents the late 4th and early 5th Dynasties, whereas the Elephantine material represents the late 3rd and early 4th Dynasty. All attribute comparisons pass the Levene test of variance equivalence. All attributes are significantly different, with the exception of azimuth A (see figure 6-9 and table 6-8).

Comparison of Elephantine 6th to other 6th Dynasty Assemblages

Elephantine and Teti

The 6th Dynasty material from Elephantine is not significantly different from the Teti assemblage (see figure 6-10 and table 6-9). All comparisons pass the Levene test of variance equivalence.

Elephantine and Kom el Hisn

Despite sample size differences, all comparisons pass the Levene test of variance equivalence (see table 6-10 and figure 6-11). However, in contrast to the Teti assemblage, there are more statistically significant differences in measurement averages. Both assemblages suggest that carination morphology is approximately the same. This tendency is mirrored by the Elephantine assemblage. Overall carination size is approximately the same in both assemblages.

Vessel curvature differs across the two assemblages. Azimuth A tends more toward the vertical at Kom el-Hisn than it does at Elephantine. Azimuth B is not significantly different across assemblages. Azimuth C shows a great deal of significant difference across

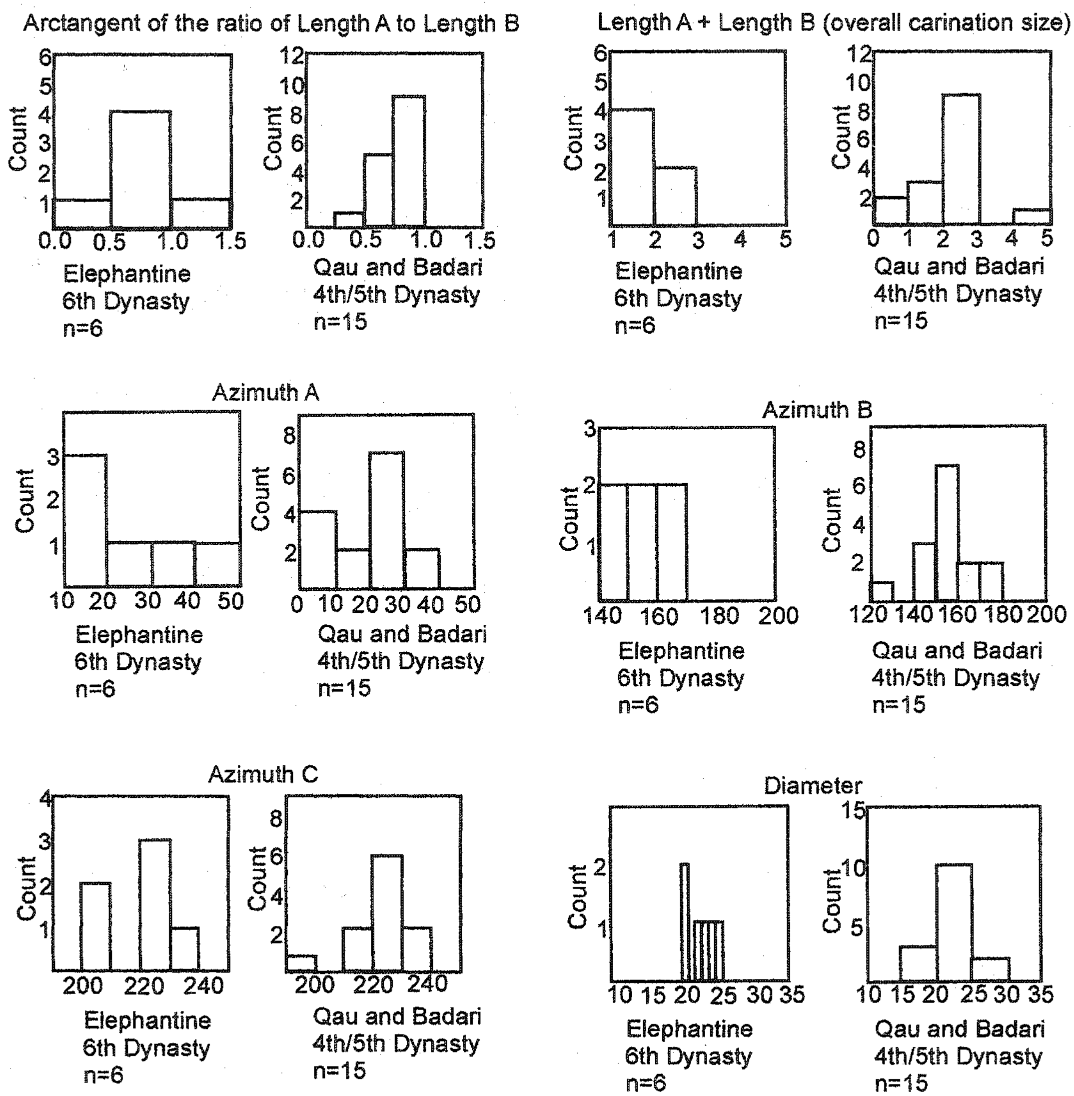


Figure 6-9. Comparison of 3rd/4th Dynasty bowls from Elephantine to 4th/5th Dynasty bowls from Qau and Badari.

Table 6-8: Differences in attribute measurements across 3rd/4th Dynasty materials from Elephantine and 4th/5th Dynasty materials from Qau and Badari.

Dyn/Location	N	Mean Ratio, Length A:B	St. Dev.	St. Er.	Levene St signif	F- stat	Signif.
4th/5th Q and B	15	0.7653	0.1524	0.00393	0.343	33.512	0.00
3rd/4th Ele	20	0.502	0.1171	0.002617			
		Mean Length A+B			Levene St signif	F- stat	Signif.
4th/5th Q and B	15	2.13	0.9003	0.2325	0.161	20.034	0.00
3rd/4th Ele	20	3.21	0.5166	0.1155			
		Mean Azimuth A			Levene St signif	F- stat	Signif.
4th/5th Q and B	15	20.28	9.5	2.45	0.461	0.015	0.9
3rd/4th Ele	20	20.68	9.33	2.08			
		Mean Azimuth B			Levene St signif	F- stat	Signif.
4th/5th Q and B	15	154.374	11.43	2.95	0.522	13.476	0.001
3rd/4th Ele	20	142.03	8.48	1.89			
		Mean Azimuth C			Levene St signif	F- stat	Signif.
4th/5th Q and B	15	223.574	9.87	2.54	0.857	52.456	0.00
3rd/4th Ele	20	198.21	10.51	2.35			
		Mean Diameter			Levene St signif	F- stat	Signif.
4th/5th Q and B	15	21.56	2.96	0.7651	0.389	17.59	0.00
3rd/4th Ele	20	17.5	2.74	0.6134			

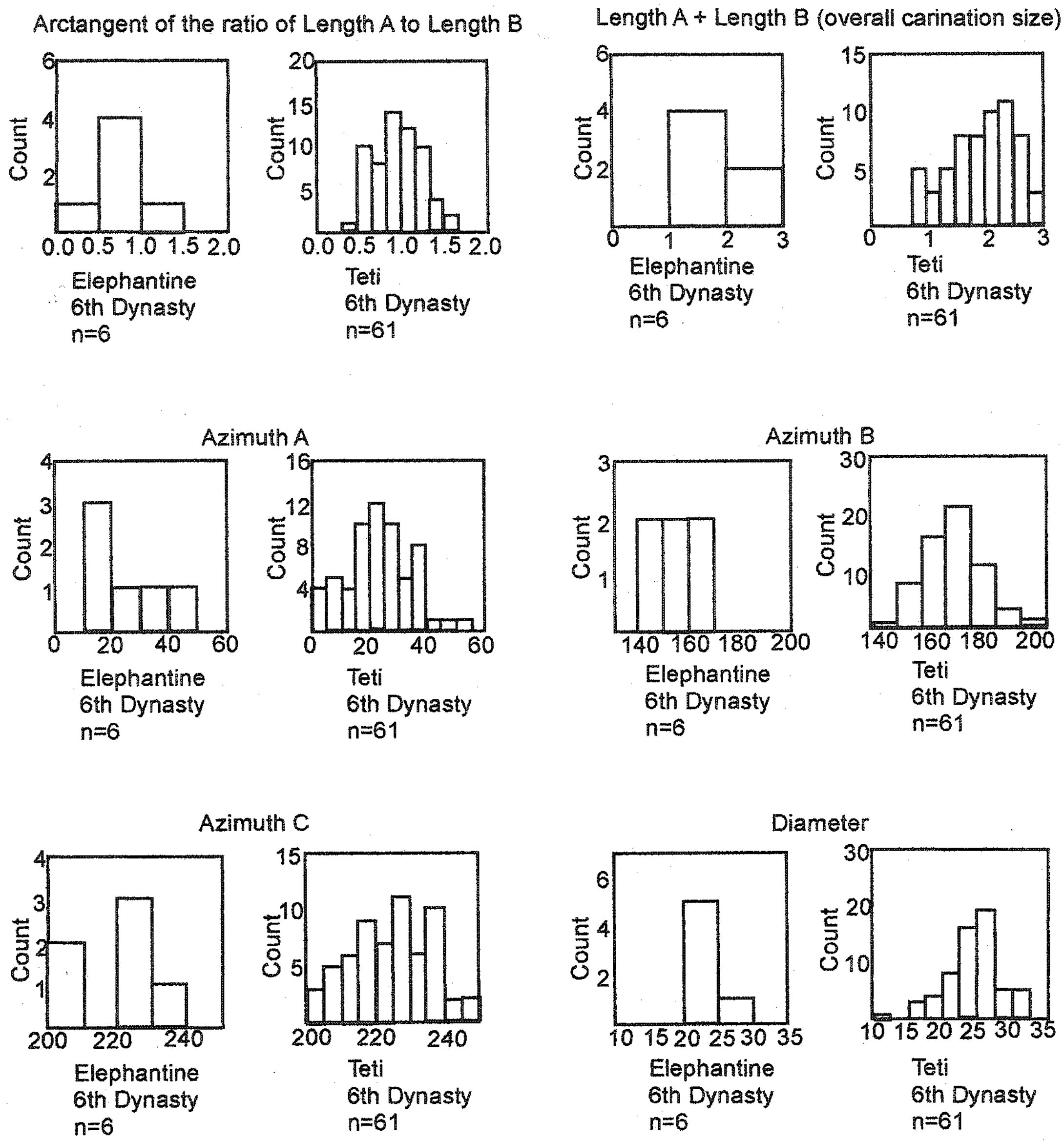


Figure 6-10. Comparison of 6th Dynasty bowls from Elephantine to 6th Dynasty bowls from the vicinity of the Teti pyramid.

Table 6-9: Differences in attribute measurements across 6th Dynasty materials from Elephantine and the vicinity of the Teti pyramid.

Dyn/Location	N	Mean Ratio, Length A:B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	0.81	0.2637	0.1077	0.906	1.69	0.198
6th Teti	61	0.96	0.277	0.00354			
		Mean Length A+B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	1.86	0.4904	0.2002	0.627	0.153	0.697
6th Teti	61	1.96	0.566	0.00725			
		Mean Azimuth A	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	26.8	11.25	4.59	0.9	0.785	0.379
6th Teti	61	22.59	11.32	1.44			
		Mean Azimuth B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	156.29	3.61	4.34	0.804	1.54	0.219
6th Teti	61	162.49	11.9	1.52			
		Mean Azimuth C	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	220.49	12.31	5.02	0.885	0.552	0.46
6th Teti	61	224.15	11.42	1.46			
		Mean Diameter	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	22.33	3.2	1.3	0.256	1.171	0.283
6th Teti	61	24.09	3.9	0.4999			

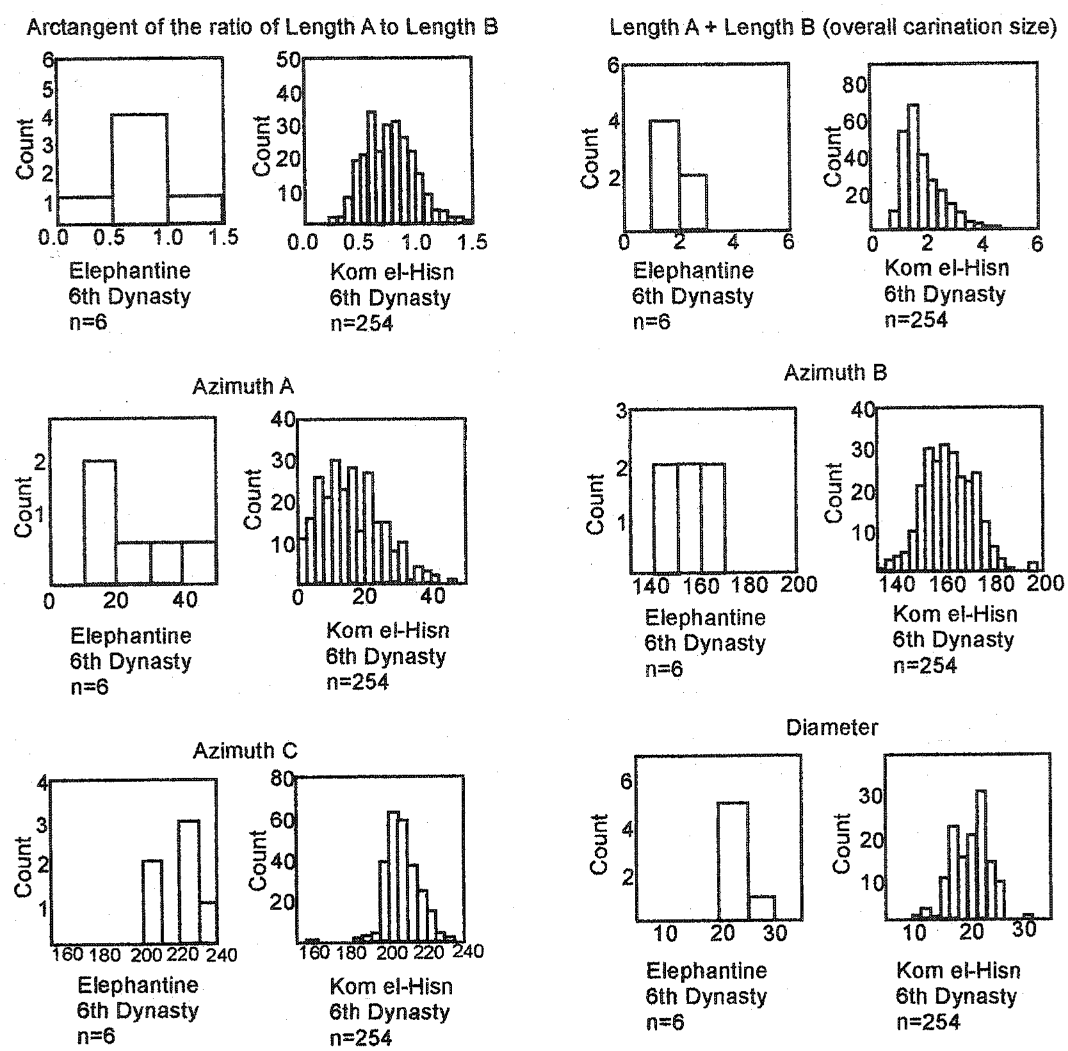


Figure 6-11: Comparison of 6th Dynasty bowls from Elephantine to 6th Dynasty bowls from Kom el-Hisn.

Table 6-10: Differences in attribute measurements across 6th Dynasty materials from Elephantine and Kom el-Hisn.

Dyn/Loc	N	Mean Ratio, length A:B	St. Dv	St. Er.	Levene St signif	F- stat	Signif.
6th Ele	6	0.815	0.2637	0.1077	0.525	0.278	0.599
6th KEH	254	0.7655	0.2268	0.00144			
		Mean Length A+B	St. Dv	St. Er.	Levene St signif	F- stat	Signif.
6th Ele	6	1.86	0.4904	0.2002	0.473	0.005	0.942
6th KEH	254	1.84	0.706	0.00443			
		Mean Azimuth A	St. Dv	St. Er.	Levene St signif	F- stat	Signif.
6th Ele	6	26.88	11.25	4.59	0.437	8.179	0.005
6th KEH	254	15.82	9.32	0.585			
		Mean Azimuth B	St. Dv	St. Er.	Levene St signif	F- stat	Signif.
6th Ele	6	156.2217	10.64	4.34	0.943	0.644	0.423
6th KEH	254	159.7387	10.61	0.6658			
		Mean Azimuth C	St. Dv	St. Er.	Levene St signif	F- stat	Signif.
6th Ele	6	220.49	12.31	5.02	0.227	13.592	0.00
6th KEH	254	206.6185	9.04	0.5673			
		Mean Diameter	St. Dv	St. Er.	Levene St signif	F- stat	Signif.
6th Ele	6	22.33	2.06	0.8433	0.157	2.015	0.157
6th KEH	254	20.43	3.25	0.2045			

assemblages, with the bowls from Kom el Hisn generally featuring deeper bowls. Diameter shows no significant difference across assemblages.

Earlier Assemblages in comparison the 6th Dynasty material from Elephantine

Because the Meidum material appears more similar to the 6th Dynasty material at Elephantine as opposed to the 3rd/4th Dynasty material from Elephantine, earlier assemblages were compared to the 6th Dynasty material from Elephantine.

Elephantine 6th and Meidum

Unlike the relationship between the 3rd / 4th Dynasty bowls and the early 4th Dynasty material from Meidum, the Elephantine 6th Dynasty material is virtually indistinguishable metrically from the earlier 4th Dynasty material from Meidum. All compared attributes pass the Levene test of variance equivalence. The only attribute that shows significant difference is diameter. This is interesting because diameter is the only attribute shared by the 3rd/4th Dynasty material at Elephantine and the early 4th Dynasty material at Meidum (see table 6-11).

Elephantine 6th and Qau and Badari

All attribute comparisons pass the Levene test of variance equivalence at the 0.01 level. Unlike the relationship between Qau and Badari and the early material, these bowls cannot be distinguished from the Elephantine 6th Dynasty material across any attribute set (see table 6-12).

Table 6-11: Differences in attribute measurements across 6th Dynasty materials from Elephantine and earlier material from Meidum.

Dyn/Loc	N	Mean Ratio, length A:B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	0.81	0.2637	0.1077	0.14	0.393	0.542
3rd/4th Meidum	8	0.7425	0.17	0.006011			
		Mean Length A+B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	1.86	0.4904	0.2002	0.883	0.024	0.879
3rd/4th Meidum	8	1.82	0.4692	0.00255			
		Mean Azimuth A	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	26.88	11.25	4.59	0.664	0.719	0.413
3rd/4th Meidum	8	20.5	15.55	5.49			
		Mean Azimuth B	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	156.22	10.64	4.34	0.922	0.087	0.773
3rd/4th Meidum	8	158.2488	13.99	4.94			
		Mean Azimuth C	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	220.49	12.31	5.02	0.591	2.54	0.137
3rd/4th Meidum	8	229.9575	9.93	0.6147			
		Mean Diameter	St. Dv.	St.Er.	Levene St signif	F- stat	Signif.
6th Ele	6	22.33	2.06	0.8433	0.811	8.841	0.01
3rd/4th Meidum	8	19.25	1.8	0.6376			

Table 6-12: Differences in attribute measurements across 6th Dynasty materials from Elephantine and earlier material from Qau and Badari.

Dyn/Location	N	Mean Ratio, Length A:B	St. Dv.	St. Er	Levene St signif	F- stat	Signif.
6th Ele	6	0.81	0.2637	0.1077	0.045	0.299	0.591
$4^{th}/5^{th}$ Q and B	15	0.7653	0.1524	0.00393			
		Mean Length A+B	St. Dv.	St. Er	Levene St signif	F- stat	Signif.
6th Ele	6	1.86	0.4904	0.2002	0.461	0.459	0.506
$4^{th}/5^{th}$ Q and B	15	2.13	0.9003	0.2325			
		Mean Azimuth A	St. Dv.	St. Er	Levene St signif	F- stat	Signif.
6th Ele	6	26.88	11.25	4.59	0.605	1.8	0.188
$4^{th}/5^{th}$ Q and B	15	20.28	9.5	2.45			
		Mean Azimuth B	St. Dv.	St. Er	Levene St signif	F- stat	Signif.
6th Ele	6	156.22	10.64	4.34	0.901	0.116	0.737
$4^{th}/5^{th}$ Q and B	15	154.374	11.43	2.95			
		Mean Azimuth C	St. Dv.	St. Er	Levene St signif	F- stat	Signif.
6th Ele	6	220.49	12.31	5.02	0.4	0.363	0.554
$4^{th}/5^{th}$ Q and B	15	223.574	9.87	2.54			
		Mean Diameter	St. Dv.	St. Er	Levene St signif	F- stat	Signif.
6th Ele	6	22.33	2.06	0.8433	0.469	0.332	0.571
$4^{th}/5^{th}$ Q and B	15	21.56	2.96	0.7651			

Elephantine 6th and Giza

Giza and Qau and Badari represent approximately the same time period, yet Giza differs from the 6th Dynasty Elephantine material along more attribute measurements. All comparisons pass the Levene test of variance equivalence. Two of the six chosen attributes (carination size and azimuth C) are significantly different at the 0.01 level, while diameter is significantly different at the 0.05 level. Length ratio, azimuth A and azimuth B are not significantly different (see table 6-13).

General Observations

Chronological trends and deviations from Elephantine are summarized in table 6-14. All comparisons discussed above feature some attributes that show significant difference across assemblages. This suggests that space is playing a role in sorting variation and indicates the existence of multiple manufacturing sites. These results are not consistent with the expectations of mass production.

Diameter however, is consistently similar across assemblages taken to be contemporaneous. In general, diameter increases over time, but for any given time period, diameter is the same, regardless of distance from Elephantine.

It also appears to be the case that over all carination size declines over time if Meidum is not considered. Azimuths B and C could also be said to show a unilinear trend over time, if the Meidum assemblage is not considered. Generally the Meidum assemblage appears curiously similar to the later Elephantine, Teti and Qau and Badari materials, with the exception of diameter, which it shares with contemporaneous assemblages.

Diameter and azimuth C both relate to vessel volume, but azimuth C does not behave the same way as diameter over time. It would appear therefore that out of all the attributes

Table 6-13: Differences in attribute measurements across 6^{th} Dynasty materials from Elephantine and earlier material from Giza.

Dyn/Location	N	Mean Ratio, length A:B	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
4th Giza	337	0.8544	0.1719	0.00094	0.058	0.304	0.582
6th Ele	6	0.81	0.2637	0.1077			
		Mean Length A+B	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
4th Giza	337	2.84	0.4692	0.00255	0.57	25.806	0.00
6th Ele	6	1.86	0.4904	0.2002			
		Mean Azimuth A	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
4th Giza	337	24.22	9.18	0.5006	0.366	0.491	0.484
6th Ele	6	26.88	11.25	4.59			
		Mean Azimuth B	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
4th Giza	337	154.168	9.17	0.4996	0.605	0.294	0.588
6th Ele	6	156.22	10.64	4.34			
		Mean Azimuth C	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
4th Giza	337	203.7433	11.28	0.6147	0.761	12.96	0.00
6th Ele	6	220.49	12.31	5.02			
		Mean Diameter	St. Dv.	St. Er.	Levene St signif	F- stat	Signif.
4th Giza	337	19.71	3.09	0.1685	0.435	4.24	0.04
6th Ele	6	6	22.33	2.06	0.8433		

Table 6-14: Summary of measurement trends relative to Elephantine material.

Summary of Elephantine trends relative Elephantine 2nd Dynasty							
SITE	DYNASTY	Ratio LA:LB	LA+LB	AAZ	BAZ	CAZ	DIAM
Elephantine	3rd/4th	na	na	na	na	na	larger
Elephantine	6th	LB+LA-	shorter	na	to vertical	to horizontal	larger
Summary of differences from Elephantine 3rd and 4th Dynasty and other assemblages							
SITE	DYNASTY	Ratio LA:LB	LA+LB	AAZ	BAZ	CAZ	DIAM
Meidum	3rd/4th	LB+LA-	shorter	na	to vertical	to horizontal	na
Giza	4th	LB+LA-	shorter	na	to vertical	na	larger
Qau and Badari	4th/5th	LB+LA-	shorter	na	to vertical	to horizontal	larger
Elephantine	3rd/4th	LB+LA-	shorter	na	to vertical	to horizontal	larger
Summary of differences between early assemblages and the 6th Dynasty material from Elephantine							
SITE	DYNASTY	Ratio LA:LB	LA+LB	AAZ	BAZ	CAZ	DIAM
Meidum	3rd/4th	na	na	na	na	na	smaller
Giza	4th	na	longer	na	na	to vertical	smaller
Qau and Badari	4th/5th	na	na	na	na	na	na
Summary of differences between Dyn 6 Elephantine and other Dyn 6 Assemblages							
SITE	DYNASTY	Ratio LA:LB	LA+LB	AAZ	BAZ	CAZ	DIAM
Teti	6th	na	na	na	na	na	na
Kom el-Hisn	6th	na	na	to vertical	na	to vertical	na

LB-LA+	Length A increases as Length B decreases
LA+LB-	Length B increases as Length A decreases
AAZ	Vertical toward 0
BAZ	Vertical toward 180
CAZ	Vertical toward 270
na	no significant differences in attributes at the 0.05 level

discussed, only diameter is similar at the regional scale, variation in which is sorted at a regional scale.

Results Part 3: Attribute selection

As discussed in previously, the coefficient of variation is a robust indicator of over all standardization if that measure can be compared to an external measure such as those proposed by Eerkens and Bettinger (2001). Table 6-15 provides the coefficient of variation for all assemblages and all attributes measured as well as the threshold measurements for random or unperceivable variation. As discussed in Chapter 2, the lower threshold *CV* represented by the Weber fraction = 1.7% while the upper threshold representing the *CV* for a random uniform distribution, ranging from 50-65%.

Results listed in table 6-15 are sorted by absolute *CV* size from smallest to largest. As can be seen, sample size has little effect on over all *CV* values. The measurement that consistently has the lowest *CV* is azimuth C, while the measurements with the highest *CV*'s are ratio arctangent, length A+ length B and azimuth A.

Low *CV* s

Azimuth C

Azimuth C is consistent with the expectations of standardization, with *CV* ranges between 4.3-5.6%. As can be seen in table 6-15, the *CV*s for this measurement fall within the range of ethnographically observed specialized potters (*sensu* Longacre 1999).

There is a general tendency for azimuth C to become more horizontal over time, indicating shallower bowls are more typical during the later dynasties. Three assemblages exhibit particularly low *CV* s for azimuth C; Meidum, Qau and Badari and Kom el-Hisn. Giza,

Table 6-15: Coefficients of variation for measurement sets.

Measurement	Site	Dynasty	Mean	St. Dv	N	CV
Azimuth C	Meidum	3rd/4th	229.95	9.93	8	0.0431833
Azimuth C	KEH	6th	206.62	9.04	254	0.0437518
Azimuth C	Q and B	4th/5th	223.57	9.87	15	0.0441472
Azimuth C	Teti	6th	224.15	11.42	61	0.050948
Azimuth C	Ele	2nd	192	9.88	10	0.0514583
Azimuth C	Ele	3rd/4th	197	10.72	20	0.0544162
Azimuth C	Giza	4th	203.74	11.28	337	0.0553647
Azimuth C	Ele	6th	220.49	12.31	6	0.0558302
Azimuth B	Giza	4th	154.17	9.17	337	0.0594798
Azimuth B	Ele	3rd/4th	142.03	8.48	20	0.0597057
Azimuth B	Ele	2nd	147.39	9.56	10	0.0648619
Azimuth B	KEH	6th	159.74	10.61	254	0.0664204
Azimuth B	Ele	6th	156.22	10.64	6	0.0681091
Azimuth B	Teti	6th	162.49	11.9	61	0.0732353
Azimuth B	Q and B	4th/5th	154.37	11.43	15	0.0740429
Azimuth B	Meidum	3rd/4th	158.24	13.9	8	0.0878413
Diameter	Ele	6th	22.33	2.06	6	0.0922526
Diameter	Meidum	3rd/4th	19.25	1.8	8	0.0935065
Diameter	Ele	2nd	13.6	1.5	10	0.1102941
Diameter	Q and B	4th/5th	21.56	2.96	15	0.1372913
Diameter	Ele	3rd/4th	17.5	2.74	20	0.1565714
Diameter	Giza	4th	19.71	3.09	337	0.1567732
Diameter	KEH	6th	20.43	3.25	254	0.1590798
Diameter	Teti	6th	24.09	3.9	61	0.1618929
LA+LB	Ele	3rd/4th	32.1	5.2	20	0.1619938
LA+LB	Giza	4th	28.4	4.7	337	0.165493
Ratio LA:LB	Q and B	4th/5th	7.7	1.5	15	0.1948052
Ratio LA:LB	Giza	4th	8.5	1.7	337	0.2
Ratio LA:LB	Ele	2nd	5.7	1.2	10	0.2105263
LA+LB	Ele	2nd	29.7	6.4	10	0.2154882
Ratio LA:LB	Meidum	3rd/4th	7.4	1.7	8	0.2297297
Ratio LA:LB	Ele	3rd/4th	5	1.2	20	0.24
LA+LB	Ele	6th	18.6	4.9	6	0.2634409
LA+LB	Teti	6th	19.6	5.7	61	0.2908163
Ratio LA:LB	Teti	6th	9.6	2.8	61	0.2916667
Ratio LA:LB	KEH	6th	7.7	2.3	254	0.2987013
LA+LB	Meidum	3rd/4th	18.2	5.8	8	0.3186813
Ratio LA:LB	Ele	6th	8.1	2.6	6	0.3209877
Azimuth A	Giza	4th	24.22	9.18	337	0.3790256
Ratio LA:LB	KEH	6th	18.4	7.1	254	0.3858696
Azimuth A	Ele	6th	26.88	11.25	6	0.4185268
Ratio LA:LB	Q and B	4th/5th	21.3	9	15	0.4225352
Azimuth A	Ele	3rd/4th	20.68	9.33	20	0.4511605
Azimuth A	Q and B	4th/5th	20.28	9.5	15	0.4684418
Azimuth A	Teti	6th	22.59	11.32	61	0.5011067
Azimuth A	Ele	2nd	16.18	8.71	10	0.5383189
Azimuth A	KEH	6th	15.82	9.32	254	0.5891277
Azimuth A	Meidum	3rd/4th	20.5	15.55	8	0.7585366

Elephantine and Teti all exhibit relatively high *CVs* (although all statistics are within the range of what has been observed for specialized potters.) The *CVs* for the Giza and the 3rd/4th Dynasty material from Elephantine material are notably similar.

Azimuth B

Azimuth B reflects slightly higher *CV*'s that nonetheless fall within the range of what would be expected for specialized potters, ranging between 5.9 and 8.8%. Again, the *CVs* for the Giza and 3rd/4th Dynasty Elephantine materials are notably similar.

Diameter

CV's for diameter are generally beyond the range of what might be expected for pots made by specialized potters. This measurement is also the largest absolute measurement made in this study. According to the Weber fraction literature (Eerkens and Bettinger 2001:496-497), all things being equal, larger measurements will have larger *CVs*. Despite that, diameter has lower *CVs* than the smaller upper rim measurements, ranging between 9.2% and 16.2%. Diameter *CVs* overlap slightly with *CVs* for length A + length B.

The *CVs* measurements split into two groups. The 2nd Dynasty material from Elephantine, the Senefru material from Meidum and the 6th Dynasty material from Elephantine all have relatively small *CVs*. All other assemblages have relatively high *CVs*. As with azimuths C and B, the *CVs* for the Giza and 3rd/4th Dynasty Elephantine materials are notably similar.

High *CVs*

Although the measurements for azimuths C and B and diameter show a tendency toward standardization, attributes relating more to carination morphology; length A + length B, ratio of length A to length B and azimuth A, have *CVs* approaching the range expected for random data.

Length A + Length B and Length A to Length B ratio (expressed as arctangents)

Length A + Length B produces *CVs* ranging from 16.1% to 42.3%. This range overlaps with those of ratio arctangent and azimuth A. The upper value approaches the value expected for random data (ranging between 50 – 60 %). Ratio arctangent values range from 19.9% to 32.6 %

Azimuth A

Of all the attributes used in this study, azimuth A features the most incidences of insignificance in the ANOVA comparisons and also has the highest *CV* values. Four assemblages; Meidum, Kom el-Hisn, Elephantine 2nd Dynasty and the Teti pyramid material all feature *CVs* for ratio arctangent within the range of what would be expected from uniform random data.

General

Figures 6-12 and 6-13 are scatterplots of *CVs* versus Dynasty; as can be seen Meidum has the highest *CV* and Giza the lowest. The relationship between Giza and the 3rd/4th Dynasty material at Elephantine is moderately maintained.

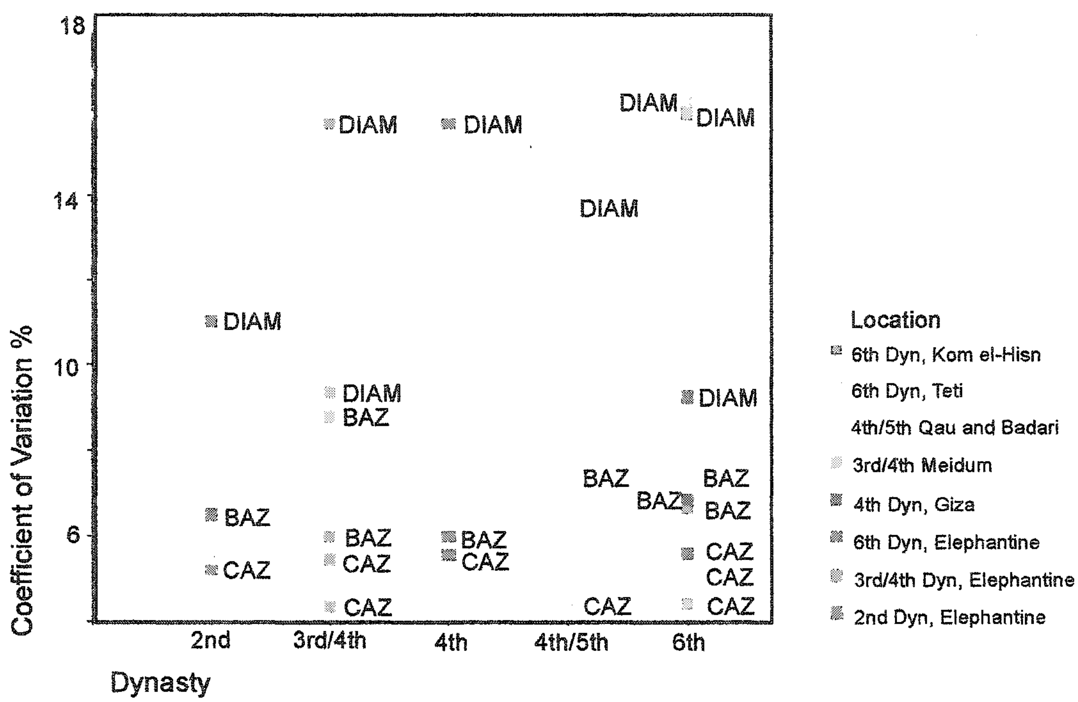


Figure 6-12: Measurements Azimuth C (CAZ), Azimuth B (BAZ) and Diameter (DIAM)versus Dynasty.

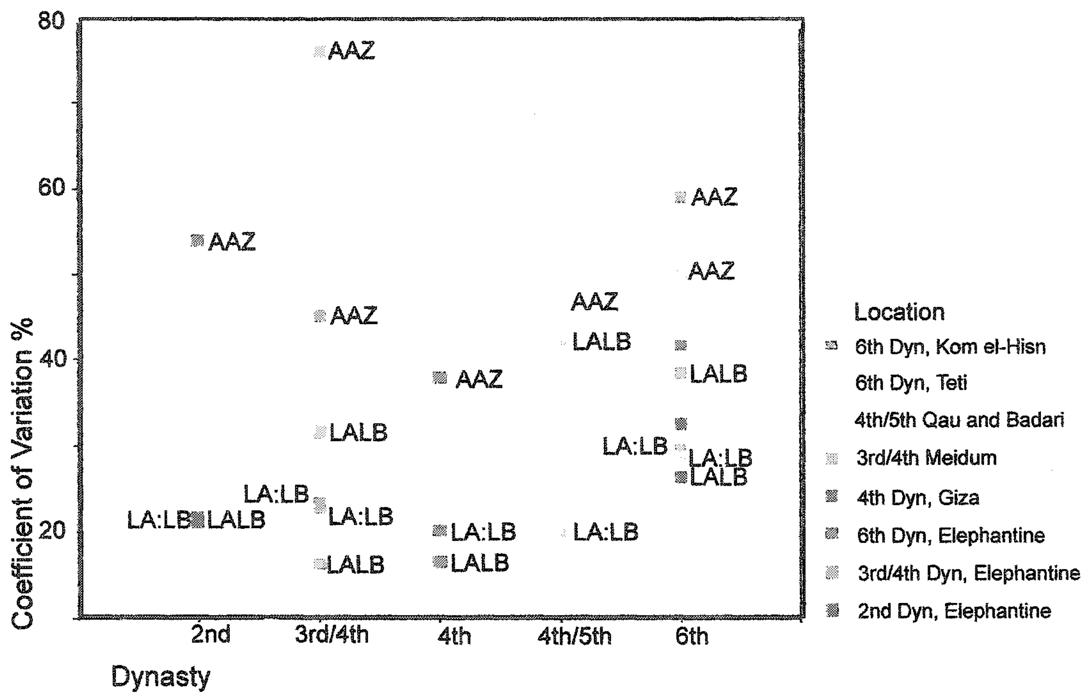


Figure 6-13. Measurements Azimuth A (AAZ), Length A:Length B (LA:LB) and Length A + Length B (LALB) versus Dynasty.

In keeping with the general thoughts expressed by Costin and Hagstrum 1995 as well as Eerkins and Bettinger 2001, there is a relationship between coefficient of variation and standardization. Two of the six attributes discussed above feature coefficients of variation within the range of ethnographically observed specialized potters. Diameter also features coefficients of variation that approach that standard.

In contrast, measurements pertaining to upper carination size and shape; azimuth A, length + length B and the ratio of length A to length B have much higher coefficients of variation. Azimuth A approaches the range expected for random uniform data. Azimuth A also is the only attribute that exhibits almost no significant differences across assemblage comparisons.

These divisions are of interest relative to the discussion by Arnold and Bourriau pertaining to the potential shaping of the Meidum bowl using a form or hump. Such a practice would reduce variability in the lower measurements (azimuth C and azimuth B). Diameter behaves in such a way that suggests that over time there was some attempt to standardize diameter at the regional scale (and this is the only attribute that behaves this way). Length A + length B and the ratio of those two measurements are, in contrast, indicate less of a tendency to standardization. Of interest is, given the hump hypothesis, is that these attributes reflect the second stage of manufacture, wherein the rim is added (*sensu* Vandiver and Locovara 1985/1986).

Attributes reflecting specific processes should be studied separately. Therefore, the relationship between azimuth C and B and diameter across assemblages will be examined separately from the relationship between length A + length B and the ratio of those lengths. Azimuth A, because it rarely differs across assemblages and has such high *CV* values will not be used for comparison.

Results Part 4: Discriminant Function Comparisons

Measurements on bowls from these assemblages were compared by individual dynasties (i.e. the frequency distribution of arctangent measurements from 6th Dynasty contexts at Elephantine are compared to those from the 6th Dynasty at Kom el-Hisn.). To determine over-all distance between metric measurements, the metrics are combined into discriminant functions which are then plotted across space and through time to map the intensity of particular interactions throughout the Old Kingdom.

In assessing how information for the manufacture of Meidum bowls is transmitted through time and across space, "(t)he problem becomes: given the division of vessels between sites, is that division reproduced when we attempt to divide up the vessels on the basis of the variables defining their shape"(Read 1982; quoted by Shennan 1997:220). Because the measurements taken are ratio-scale, it is possible to test for covariance and collapse multiple variables into a smaller number of canonical functions. Discriminant function analysis (DFA) is chosen because unlike other numerical classification techniques, this approach assumes observations have been divided into groups on the basis of some criterion (Shennan 1997:350).

The variables constructed maximize the differences between the defined groups, rather than maximizing the amount of variance accounted for by particular variables (Shennan 1997:350). The first canonical function maximizes the differences between the means of groups, defined by location and Dynastic period. The second canonical discriminant function represents the maximum dispersion of the means in a direction orthogonal to the first direction. The third canonical variable represents dispersion in a dimension independent of the first two dimensions. These functions are factors that optimally discriminate between the group centroids relative to dispersion within the groups (SPSS applications guide:246).

DFA is typically used in two capacities; to describe the differences between previously identified groups and to assign fresh classes to previously identified groups. If the technique is being employed for the latter purpose, the expectations of the model (that the group is a random sample of the population and that each group exhibits equal variance) must be adhered to (Doran and Hodson 1975:209). However, since this study is not being used to develop an actual classification technique this set of assumptions is acceptably relaxed (Doran and Hodson 1975:211). DFA is only employed to quantitatively describe the differences and Mahalonobis distances between the known assemblages (Doran and Hodson 1975:209).

The eigenvalues calculated for each discriminant dimension are used to quantify the degree of dissimilarity between assemblages. Eigenvalues are calculated from the overall correlation between any given attribute and the function that maximizes the differences between the predefined groups. Therefore it is possible to determine which attributes are the most effective at discriminating between assemblages over time and across space.

Eigenvalues calculated for each discriminant dimension are presented, including the percentage of variation accounted for by the dimension and the variables that are most strongly correlated with each dimension (only correlations of over 0.5 are reported, however variables are listed if they show their highest overall correlation with a particular dimension, even if that correlation is less than 0.5). If assemblages have a similar structure in terms of their overall covariance, it can be assumed that the variables measured are behaving the same way and are being sorted by the same factor. The more difference in variance structure of other sites from the structure observed across the Elephantine assemblage alone (used here as before because one can assume that space is playing a minimal role in sorting variation), the lower the fidelity in transmission of information for vessel construction.

Assemblage comparisons

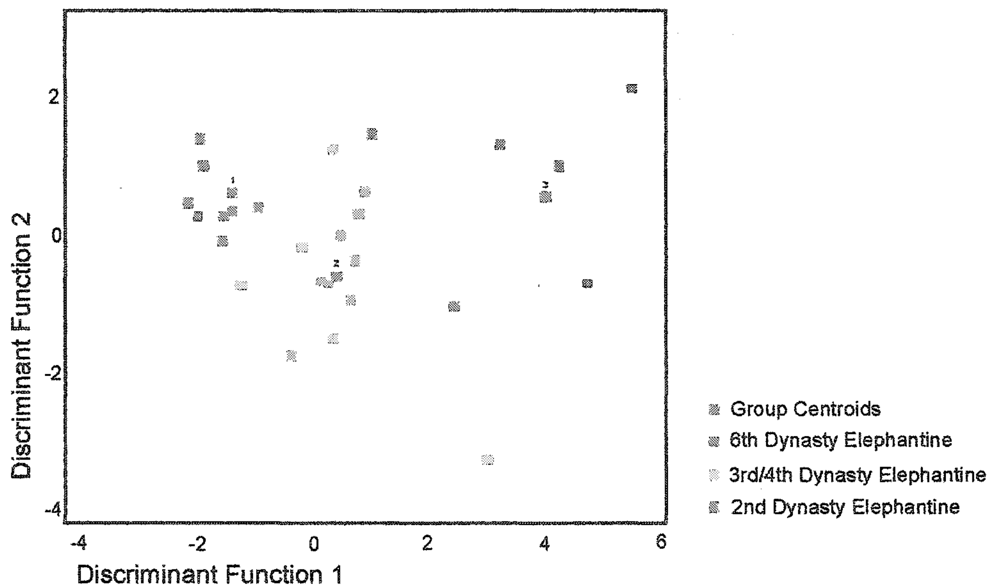
Assemblages from Elephantine are first compared to each other to determine how variation sorted primarily by time behaves. Other assemblages are then compared to the Elephantine to determine whether the role of space in sorting variation changes over time. For each comparison, two analyses are performed, one where the assemblages in question are compared in terms of azimuths B, C and diameter and a second wherein assemblages are compared using length A + length B and the ratio of length A to length B. The bootstrapped sample stats are not reproduced, because of the modifications in overall variation introduced by the bootstrapping.

Elephantine 2nd to 6th Dynasties

As can be seen in figure 6-14 and table 6-16, eigenvalue 1 accounts for 91 % of the overall variation in the original sample. Diameter and azimuth C are highly correlated with this dimension. Azimuth B plays a minimal role.

For the second comparison, eigenvalue 1 is similarly powerful, accounting for virtually all of the variation observed in the comparison. Length A + Length B is highly correlated with dimension 1, whereas the ratio between the two lengths is negatively correlated with the same dimension.

As can be seen in figure 6-14, depending on what attributes are compared, the relative position of the groups in discriminant space changes. This is a function of the fact that ratio is negatively correlated with dimension 1. The comparison of the original data indicates little overlap across groups in the first comparison. For the second comparison, it would appear that distinguishing the 2nd Dynasty material from the 3rd/4th Dynasty material is problematic, although the 6th Dynasty material remains distinct.



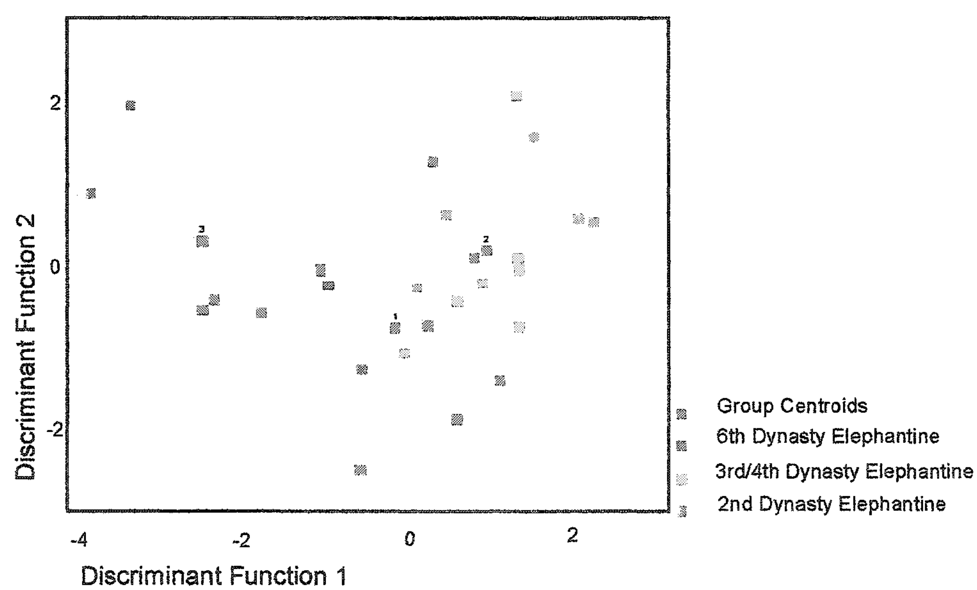


Figure 6-14. DFA plot for Elephantine assemblages. Comparison using CAZ, BAZ and DIAM,top plot. Comparison using LA:LB and LA+LB, bottom plot.

Table 6-16: DFA of Elephantine, all Dynasties.

Dyn/Location	N	Eig 1 cumulative var.	Eig 2 cumulative var.	Corr DF 1	Attribute	Corr DF 2	Attribute
Ele 2nd	10	91	9	0.744	Diam	0.782	BAZ
Ele 3rd/4th	20			0.612	CAZ		
Ele 6th	6						
Ele 2nd	10	99.9	0.1	0.72	LA+LB	0.784	ratio LA:LB
Ele 3rd/4th	20			-0.62	ratio LA:LB		
Ele 6th	6						

This latter observation is consistent with the ANOVA results.

Elephantine and Meidum

Despite robust indications that the Meidum material and the 3rd / 4th Dynasty Elephantine material are both contemporary with the reign of Senefru, the bowls from the two locations are quite different from each other, as was observed in the ANOVA comparison. Also noted in the ANOVA comparison, Meidum appears to be a lot more like the 6th Dynasty materials at Elephantine than the material with which it is contemporaneous (see figure 6-15 and table 6-17).

When azimuths C, B and diameter are compared using DFA, it can be seen that dimension 1 accounts for 85% of the observed variation, whereas dimension 2 accounts for 13.8%. Dimension 1 is highly correlated with azimuth C, whereas dimension 2 is highly negatively correlated with diameter (essentially, the value of dimension 2 decreases as diameter increases). The Meidum material tends to be closer to the 6th Dynasty material from Elephantine.

When length A + length B and the ratio of the two are compared it can be seen that the unexpected relationship between the 3rd/4th Dynasty material from Meidum and the 6th Dynasty material from Elephantine continues. In this case, dimension 1 accounts for the bulk of all variation with overall carination size (length A + length B) being highly correlated with this dimension and ratio moderately negatively correlated with this dimension.

Elephantine and Giza

Giza material is compared to the 2nd, 3rd / 4th and 6th Dynasty material from Elephantine (figure 6-16, table 6-18). Despite enormous sample size differences, there appears to

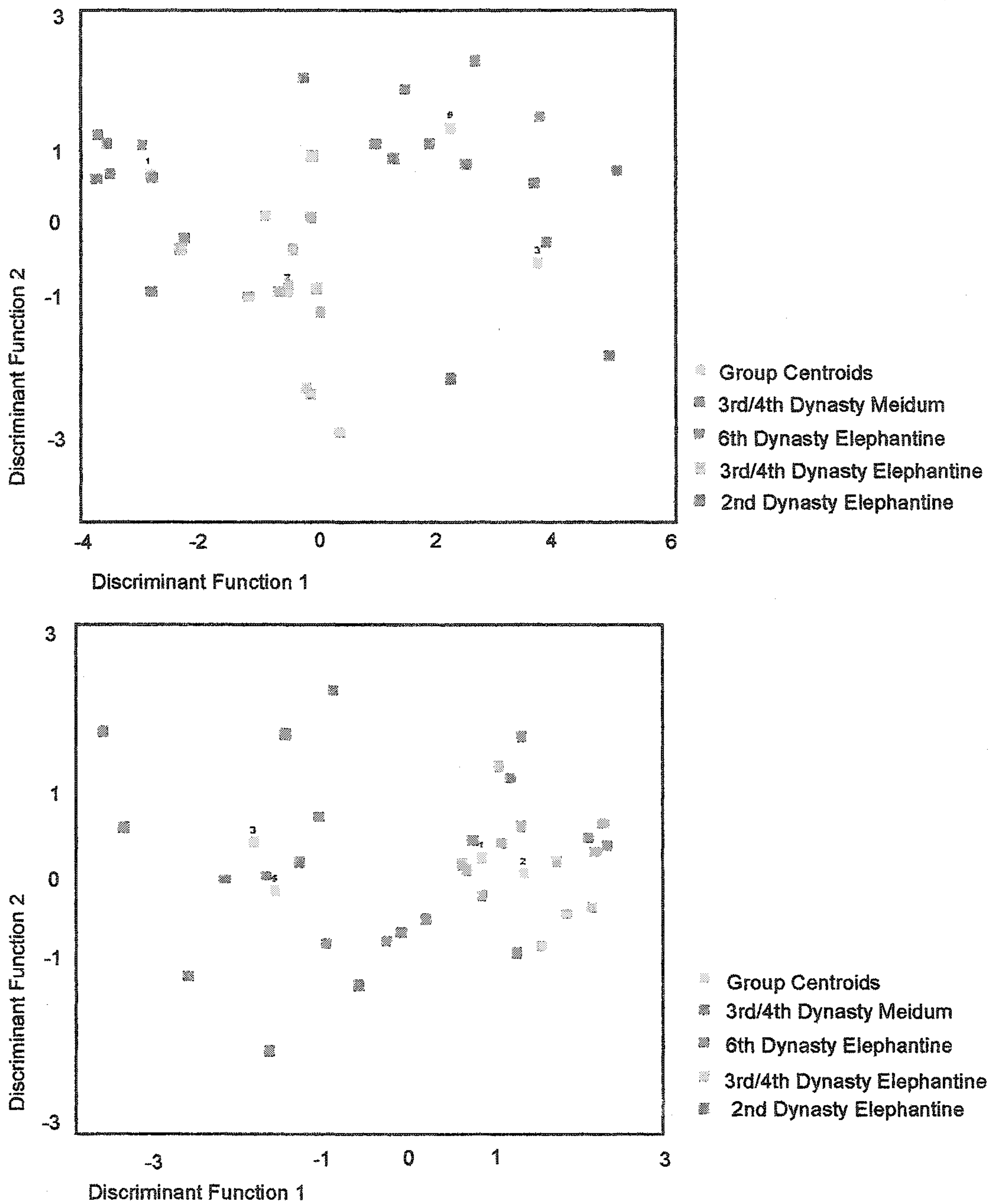


Figure 6-15. DFA plot for Elephantine and Meidum assemblages. Comparison using CAZ, BAZ and DIAM, top plot. Comparison using LA:LB and LA+LB, bottom plot.

Table 6-17: DFA of Elephantine, all Dynasties and Meidum.

Dyn/Location	N	Eig 1 cumulative var.	Eig 2 cumulative var.	Corr DF 1	Attribute	Corr DF 2	Attribute
Ele 2nd	10	85	13.8	0.789	CAZ	-0.755	Diam
Ele 3rd/4th	20			0.612	CAZ		
Ele 6th	6						
Meidum 3rd/4th	8						
Ele 2nd	10	99.4	na	0.725	LA+LB	na	na
Ele 3rd/4th	20			-0.519	ratio LA:LB		
Ele 6th	6						
Meidum 3rd/4th	8						

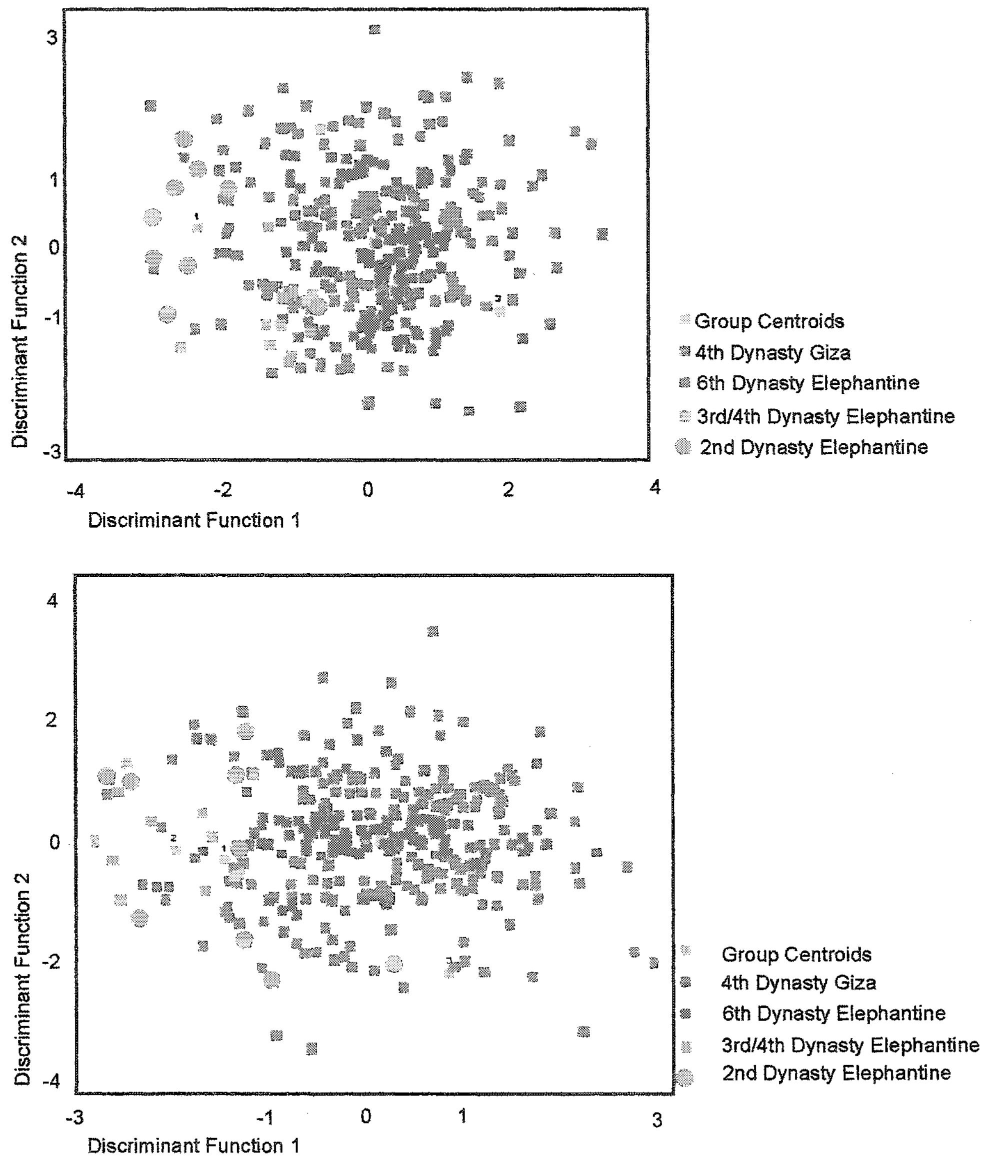


Figure 6-16. DFA plot for Elephantine and Giza assemblages. Comparison using CAZ, BAZ and DIAM, top plot. Comparison using LA:LB and LA+LB, bottom plot.

Table 6-18: DFA of Elephantine, all Dynasties and Giza.

Dyn/Location	**N**	**Eig 1 cumulative var.**	**Eig 2 cumulative var.**	**Corr DF 1**	**Attribute**	**Corr DF 2**	**Attribute**
Ele 2nd	10	81.3	12.4	0.79	Diam	0.943	BAZ
Ele 3rd/4th	20			0.62	CAZ		
Ele 6th	6						
Giza 4th	337						
Ele 2nd	10	78.5	21.5	0.996	ratio LA:LB	0.946	LA+LB
Ele 3rd/4th	20						
Ele 6th	6						
Giza 4th	337						

nonetheless be some structure to this comparison. When added to the Elephantine assemblage, the Giza assemblage has a minimal effect on the structure of the discriminating dimensions of azimuths C, B and diameter. However, dimension 1 accounts for less overall variation.

In contrast, comparisons of length A + length B and ratio arctangent, show a different variation structure than that observed for Elephantine. Ratio is highly correlated with dimension 1, while ratio arctangent is highly correlated with dimension 2.

In other words, Giza is similar to the Elephantine in terms of the more standardized measurements and less so in terms of the less standardized measurements. Accepting the massive sample size issues, it nonetheless appears that the later 4th Dynasty Giza material is closer to the 3rd/ 4th Dynasty Elephantine materials.

Elephantine and Qau and Badari

Material collected from tomb deposits at Qau and Badari are compared to the Elephantine materials. This material also exhibits a similar pattern of variation to the Elephantine material in the same way the Giza material does when compared in terms of azimuth C, azimuth B and diameter. Eigenvalue 1 acounts for 93.9 % of all variation and is highly correlated with diameter and azimuth C. As such, it is virtually indistinguishable from the 6th Dynasty material. See figure 6-17 and table 6-19.

Qau and Badari differs somewhat from Elephantine in terms of length A and length B and their relationship. Dimension 1 accounts for virtually all of the observed variation. Ratio is highly correlated with this dimension, while overall carination size is negatively correlated with this dimension (the opposite of the pattern observed for Elephantine only.) This comparison also suggests substantial overlap with the 6th Dynasty material.

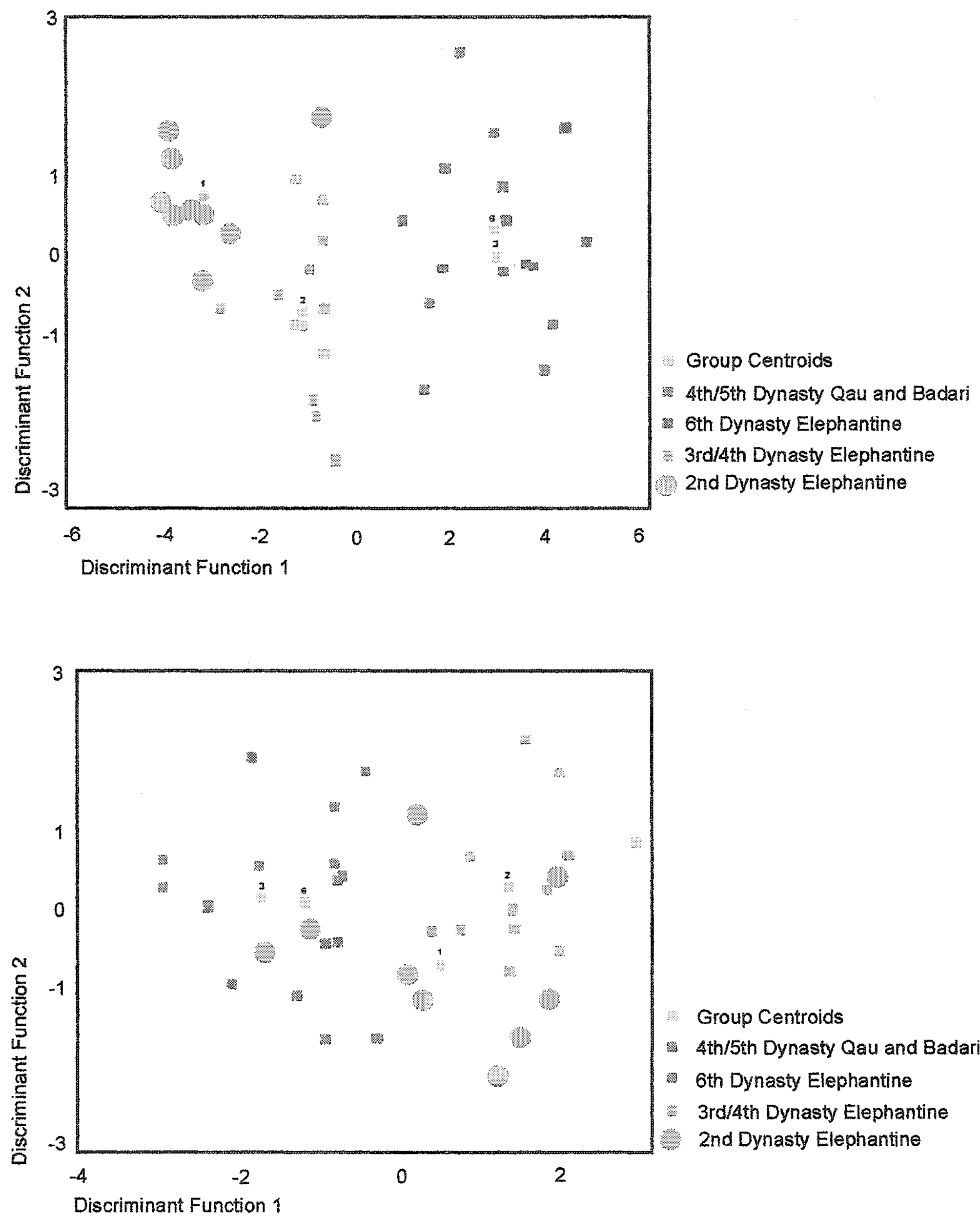


Figure 6-17. DFA plot for Elephantine and Qau and Badari assemblages. Comparison using CAZ, BAZ, and DIAM, top plot. Comparison using LA:LB and LA+LB, bottom plot.

Table 6-19: DFA of Elephantine, all Dynasties and Qau and Badari.

Dyn/Location	N	Eig 1 cumulative var.	Eig 2 cumulative var.	Corr DF 1	Attribute	Corr DF 2	Attribute
Ele 2nd	10	93.9	6.1	0.731	Diam	0.731	BAZ
Ele 3rd/4th	20			0.689	CAZ		
Ele 6th	6						
Q and B 4th/5th	15						
Ele 2nd	10	99.9	na	0.813	ratio LA:LB	na	na
Ele 3rd/4th	20			-0.764	LA+LB		
Ele 6th	6						
Q and B 4th/5th	15						

Like the Meidum material, despite not being associated with the 6th Dynasty, this earlier material is nonetheless quite similar to the 6th Dynasty Elephantine material. Unlike the Meidum material, however, this material does not exhibit significant differences in diameter.

Elephantine and Teti

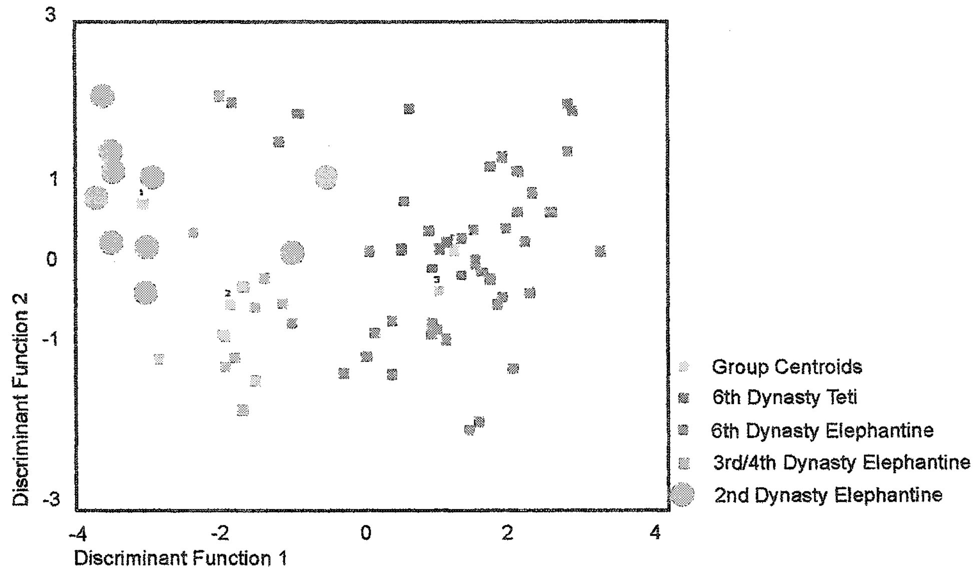
Material collected from environs around the Teti pyramid at Saqqara are compared to the Elephantine materials. This material is chronologically equivalent to the 6th Dynasty material from Elephantine. See figure 6-18 and table 6-20.

This material also exhibits a similar pattern of variation to the Elephantine material in the same way the Giza material does when compared in terms of azimuth C, azimuth B and diameter. Like the Giza material, azimuth B is more highly correlated with dimension 2. There is substantial overlap between this material and the 6th Dynasty Elephantine material.

Across the second set of attributes, Giza also appears similarly structured to Elephantine. Length A + length B is positively correlated with dimension 1 and the ratio arctangent is negatively correlated with dimension 1. The data indicate substantial overlap between the 6th Dynasty material at Elephantine and the Teti material in this comparison as well.

Elephantine 2nd to 6th Dynasty and Kom el Hisn

As discussed in Chapter 8, inscriptional and C14 dates indicate that Kom el-Hisn is a late 5th / early 6th Dynasty site. Unlike the Teti material, however, the addition of this material to the Elephantine material has a substantial impact on the component structure of the calculated dimensions.



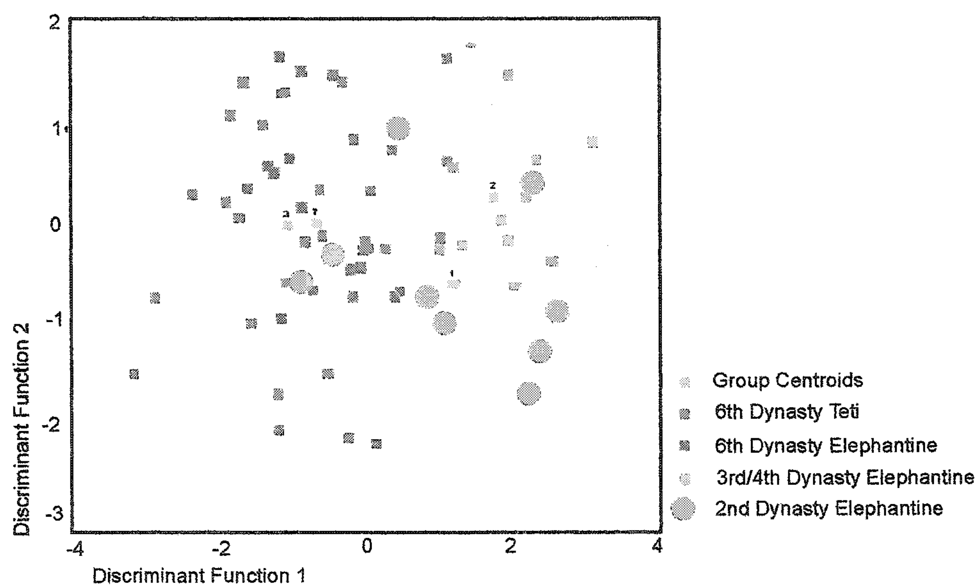


Figure 6-18. DFA plot for Elephantine and Teti assemblages. Comparison using CAZ, BAZ and DIAM top plot. Comparison using LA:LB and LA+LB, bottom plot.

Table 6-20: DFA of Elephantine, all Dynasties and Teti.

Dyn/Location	**N**	**Eig 1 cumulative var.**	**Eig 2 cumulative var.**	**Corr DF 1**	**Attribute**	**Corr DF 2**	**Attribute**
Ele 2nd	10	94	5.1	0.723	CAZ	0.907	BAZ
Ele 3rd/4th	20			0.677	Diam		
Ele 6th	6						
Teti 6th	61						
Ele 2nd	10	98	2	0.813	LA+LB	na	na
Ele 3rd/4th	20			-0.764	ratio LA:LB		
Ele 6th	6						
Teti 6th	61						

When compared in terms of azimuths B and C and diameter, differences are structured in a manner similar to the Giza materials, with Kom el-Hisn somewhat closer to the 6^{th} Dynasty. Variation is structured differently from that of Elephantine only, with dimension 1 accounting for less overall variation and being more highly correlated with azimuth C.

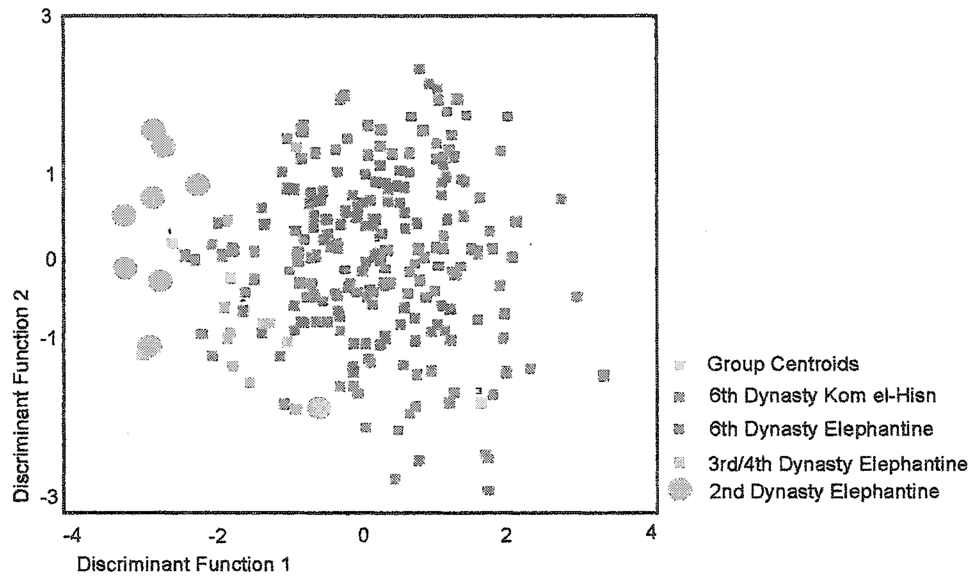
When compared in terms of length A + length B and the ratio of those measurements to each other, variation is structured in a manner similar to that observed for the Elephantine only comparison, but length A and length B work harder in the discrimination (see table 6-21 and figure 6-19).

General

Two general trends are observed. First, the material from the $3^{rd}/4^{th}$ Dynasty at Meidum and the 4^{th} / 5^{th} Dynasty material from Qau and Badari is most similar to the 6^{th} Dynasty material at Kom el-Hisn, Teti and Elephantine. This suggests that the forms that are prevalent during the 6^{th} Dynasty at Kom el-Hisn, Teti and Elephantine are prevalent earlier at Meidum and Qau and Badari.

The behavior of Giza (the largest assemblage used in this study) is different than the behavior of Kom el-Hisn (the second largest assemblage used in this study) and Teti relative to Elephantine. Whereas Giza is farther away from Elephantine than Teti in actual space, it is nonetheless more similar to the Elephantine material than the Teti or Kom el-Hisn assemblages. Kom el-Hisn, the assemblage farthest away from Elephantine is clearly the most different.

Finally, the distribution of Meidum bowl variants indicates two potential lines of development in bowl forms; one with a regional scale sorting regime and the other with a regional scale sorting regime. The nature of these two lineages is discussed below.



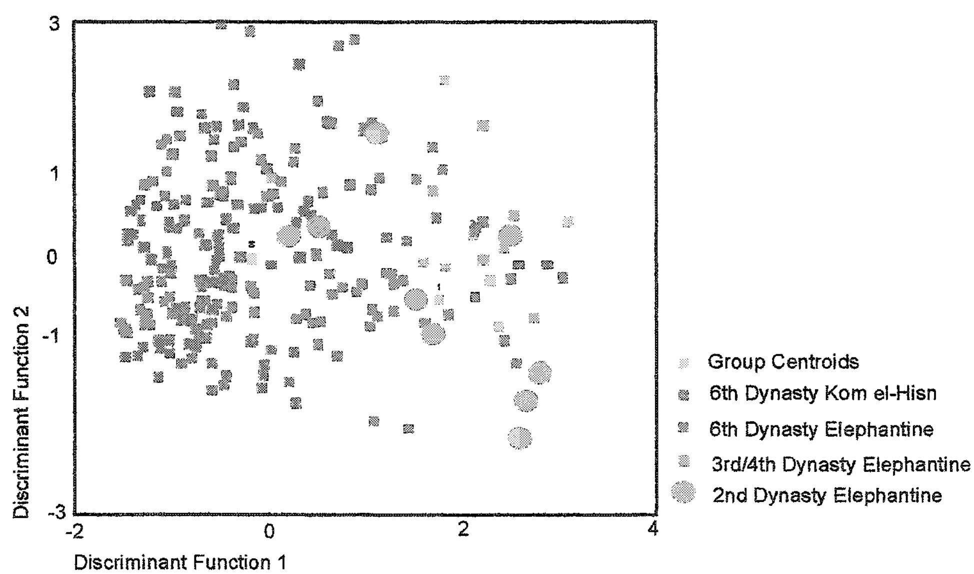


Figure 6-19. DFA plot for Elephantine and Kom el-Hisn assemblages. Comparison using CAZ, BAZ and DIAM, top plot. Comparison using LA:LB and LA+LB, bottom plot.

Table 6-21: DFA of Elephantine, all Dynasties and Kom el-Hisn.

Dyn/Location	**N**	**Eig 1 cumulative var.**	**Eig 2 cumulative var.**	**Corr DF 1**	**Attribute**	**Corr DF 2**	**Attribute**
Ele 2nd	10	80.1	14.9	0.703	CAZ	0.796	BAZ
Ele 3rd/4th	20			0.677	Diam		
Ele 6th	6						
KEH 6th	254						
Ele 2nd	10	99.6	na	0.935	LA+LB	na	na
Ele 3rd/4th	20			-0.555	ratio LA:LB		
Ele 6th	6						
KEH 6th	254						

The "proto bowls": bowls derived from 2nd Dynasty jars

The results presented demonstrate a relationship between the 2nd Dynasty jars at Elephantine and their descendent bowl forms in the 3rd and 4th Dynasty. Hendrickx et al. (2002) discuss the nature of the predecessor jars during the 2nd Dynasty, their hypothesis being primarily based on the stratigraphic relationship between forms, with the bowl forms absent in 2nd Dynasty contexts and the jar forms absent during the 3rd and 4th Dynasty. The quantitative information discussed above supports the relationship between jars and bowls in that other than diameter no attributes distinguish significantly between the 2nd and 3rd/ 4th Dynasty forms.

Along with the vessels Raue describes at Elephantine, versions of the same jars, referred to as "early Maidum (*sic)* bowls" (Hendrickx et al. 2002:282-283) are known from the Nagada IIID (2nd Dynasty) period sites including: Qau, Badari, Abu Roash, Tura, Lahun and Saqqara. Figure 3-3 depicts examples from el-Kab. Therefore, there is little reason to believe that this form necessarily originates at Elephantine.

The relationship between forms at Elephantine over time exhibits changes in overall variation consistent with what that expected of a lineage. The Elephantine assemblage was compared to assemblages from other locations with known dynastic attributions to determine the nature of the "space" sorting variation.

This pattern suggests that the factors sorting variation in these assemblages is regional in scale given the relative uniformity of the vessels from Elephantine and Giza. When added to the overall lineage represented by 2nd, 3rd/4th and 6th Dynasties at Elephantine, the Giza material has minimal effect on the structure of the variance described by particular attributes, with diameter and azimuth C being the strongest discriminators. Therefore, the Giza assemblage can be considered part of a lineage along with Elephantine which appear to be sorted by more regional scale socioeconomic factors.

The Meidum Lineage

There is higher fidelity of transmission between Giza and Elephantine later in the 4th Dynasty than there is between Meidum and Elephantine earlier in the 4th Dynasty. It also appears that derivations of the forms common at Meidum during the early 4th Dynasty seem to be common later at Elephantine, showing up in the 6th Dynasty, the only significant difference being in diameter.

This is consistent with Petrie's observation about the distribution of Meidum bowl forms at Denderah. Of these Petrie observed "...The curves seem identical in the 4th Dynasty at Meidum, in the 5th at Deshaheh and here (Denderah) during the 6th Dynasty," (Petrie 1898:24). Figure 2-1 is a map showing the locations of these sites and the nomes to which they are attached. Meidum is in Nome 21, Deshaheh in Nome 20, and Denderah in Nome 5.

The results produced from this study follow a similar pattern. As discussed above with regard, while both Meidum and materials from Elephantine are chronologically associated with the reign of Senefru, the Meidum material nonetheless is more similar to the 6th Dynasty material from Elephantine than it is to the 3rd/4th Dynasty material from Elephantine. While the Qau and Badari material is contemporary with the Giza material, when plotted against the Elephantine material it occupies the same discriminant space as the 6th Dynasty objects.

If one looks at the distribution of sites between Elephantine (Nome 1) and Meidum (Nome 21), one notices that Deshaheh (Nome 20) is relatively close to Meidum, Denderah (Nome 5) somewhat farther and Elephantine farther still.

The material from Meidum, Qau and Badari, Teti and the 6th Dynasty at Elephantine thus form a second developmental trajectory of Meidum bowls. In contrast to the lineage derived from the 2nd Dynasty jars described above, differences between these assemblages appear to be attributable to both space and time. The distribution of sites in DF space reflects the distribution of sites and assemblages in actual space. Therefore, factors sorting variation in the Meidum lineage are local, as opposed to regional scale.

Relationship between Kom el-Hisn and Elephantine

Kom el-Hisn has a significant effect on the position of assemblages in DF space. Of all the assemblages considered in this analysis, Kom el-Hisn is consistently the most anomalous. When compared to the members of the Meidum lineage, Kom el-Hisn falls outside the relatively well-established line between the other assemblages in the comparison. Therefore, given that overall similarity between assemblages indicates interaction, Kom el-Hisn exhibits a relatively small degree of similarity, suggesting less interaction with other sites discussed here

The presence of these two lineages suggests two different spatial scales of socioeconomic sorting during the Old Kingdom. Larger factors responsible for such sorting are discussed in the following chapter.

CHAPTER 7: CONCLUSIONS

A cornerstone of an evolutionary approach to explaining patterns observed in the archaeological record is the identification of populations of interacting individuals (Neiman 1995; Sober 1980). The geography of complex interaction is part of a larger evolutionary explanation if one is interested in the fitness impacts of participating in a highly integrated economic system. In a functionally differentiated society, degree of interaction reflects more than simple distance; it is a consequence of the functional structure of this larger integrative unit (Dunnell 1995; Lipo 2001). Therefore, long distance economic dependence has fitness implications in that relatively distant ecological or economic perturbations can nonetheless have an effect on local resource availability. The results presented here show patterns of similarity at the local and regional scale simultaneously, suggesting that different members of the population face different selective pressures at any given time. Factors constraining variation appear to be related to socioeconomic factors relating to the construction of pyramids and other large-scale monumental constructions that characterize this period from ca 2700 – 2100 BC.

Communities involved in a complex relationship should exhibit similarities in vessel manufacture that do not track geographic space. Simple interactive space is defined here as one in which similarities between objects can be explained by simple geographic proximity. Complex interactive space can be defined as one in which assemblages of objects that are highly similar regardless of geographic space. As was seen in the previous chapter, the "Meidum" lineage and Kom el-Hisn in particular show patterns of similarity consistent with the transmission of information across simple interactive space, whereas the "proto-bowl" lineage tracks a more complex space incorporating at least Giza and Elephantine. The measured attributes exhibit similar patterns regardless of whether aspects of the lower or upper portion of the body are compared.

The relationship between Giza and Elephantine, while supported somewhat with regard to morphological similarity, is not consistent with the expectations of mass production. The fabrics from both assemblages reflect their individual local geological conditions. Yet measurements on the Giza pots are more similar to those of Elephantine than the measurements for Meidum. These results, along with the similarity in measurement *CV*s, suggest that a relatively small number of potters are making pots at both locations. This raises an intriguing possibility that the artisans are moving and the pots are not. Lehner (personal communication) notes that some modern Egyptian potters travel to different workshops throughout the country. While there is no discussion of this in the literature of the Old Kingdom, the relationship between Elephantine and Giza is what would what be expected if such were the case.

The Egyptian pots discussed here have some attributes that appear to be standardized and some that are not. Furthermore, with the possible exception of Giza and Elephantine, the attempt at standardization appears to exist at the local or nome scale. The small *CV*s for the lower portion of the vessel no doubt reflects the use of a turning device (or perhaps a measurement form), such as the one depicted in the tomb of Ti, which would routinize the shaping of the vessel. The higher *CV*s for the upper portion of the rim by the same token reflects more freehand motion and thus these measurements are more highly variable.

The tomb of Ti also suggests that several people are involved in the production of one pot. Given the possibilities outlined by Eerkens and Bettinger (2001), smaller *CV*s in pottery production probably reflect routinization.

Diameters approach standardization, but not to the degree of azimuth C. Diameter, however, is the only measurement that tracks time unilinearly (i.e. it increases, regardless of location). The early bowls from Meidum and the 6th Dynasty bowls from Elephantine These results indicate that Meidum bowls are made by individuals with skills approaching those of specialized potters working in separate workshops at a variety of locations in Egypt. For any given assemblage, the lower portion of the bowl and the diameter reflects measurement *CV*s approaching the expectations of standardization. As discussed in the previous chapter, measurements tend to have similar *CV*s regardless of location. Yet, the standardization in the form of the *CV* seems to only obtain at the local scale (with the possible exception of Giza and Elephantine, which exhibit remarkably similar *CV*s). Even still, the material at Elephantine and the material at Giza are statistically distinct from each other when compared by fabrics.

By the 6th Dynasty, the form that apparently originates at Meidum characterizes all assemblages. Yet there is no corresponding reduction in *CV*s, such that one could make the argument that apparent attempts at standardization increase over time, such that one might say mass-production emerges later in the Old Kingdom. However, some literature attests to nomarchs (rulers of nomes) during the 5th and 6th Dynasties bragging about the presence of craftsmen in their workshops who were once tied to the Pharaoh (Valbelle 1997:37). If individuals tied to one particular workshop are dispersed to other workshops, this could result in a convergence of forms.

While the idea of itinerant potters is speculative, it is nonetheless a more parsimonious explanation for the patterns of similarity observed during the Old Kingdom than the notion of centralized mass production. If potters are moving, then diffusion or transmission, rather than simple trade or mass production is the factor driving the observed similarities. An habitual interaction, as noted above, appears to exist between Giza and Elephantine, which does not characterize the relationship between the other sites discussed in this text, suggesting two different scales of interaction.

Two different scales of interaction

The notion of differing scales of interaction is not new to the literature of complexity. In fact, the results of this analysis are consistent with Trigger's characterization (1993) of a "territorial state." Typical of this conception is the existence of a two-tiered economy, wherein farmers, such as those individuals living in self-sufficient nomes, participate primarily in a local economy. The primary interaction between the rural areas of the "state" is in the form of tax collection (Trigger 1993:11). Cagle (2001) and Wenke et al. (1988) both discuss Kom el-Hisn as being semi integrated with regard to the larger Egyptian state, however. Given the transmission model presented here, Kom el-Hisn's somewhat anomalous assemblage is not surprising as the site is located in a relatively productive part of Egypt and thus, while apparently connected to the "state" to some degree, observable similarities in pottery manufacture indicating regular interaction are less pronounced.

It is argued here that locations in Egypt particularly involved in pyramid construction and temple maintenance will interact more strongly with each other than with parts of Egypt less involved in the process. Elephantine, as a location with minimal farm land, but the most accessible source of granite in Egypt is more likely to be involved in an exchange network that relates to pyramid construction than other locations.

While granite was doubtless used to some degree at Meidum, this pyramid is singular and unfinished, thus the overall importation of Aswan minerals to this location was probably less intense. (Edwards 1985:70-90; Lehner 1997:98-100). For example, the lower 16 courses of facing on the Menkaure pyramid at Giza are granite, a singular expenditure, not seen on any other pyramid (Lehner 1997: 134-135). Given that, it is expected that interaction between Giza and Elephantine would have been particularly strong during the mid to late Old Kingdom periods. An habitual interaction between Elephantine and the rest of Egypt would have been the movement of Aswan granite from the vicinity of Elephantine to locations where granite was used, particularly the Giza plateau (and in varying amounts throughout other parts of Egypt). The intensive pyramid building activity at Giza, coupled with the known source of granite being Aswan strongly suggests that the simultaneous similarity in Meidum bowl construction into the late 4th Dynasty can be explained by the intensification of that relationship as a result of pyramid construction. No other place in Egypt at that time would have been consuming the volume of granite from Aswan that Giza was consuming.

Such interaction partially explains the pattern of variation observed across bowl variants. It is noted here that there are two distinct lineages of Meidum bowls; one of which (given the data available) originates at Meidum and the other which originates from the 2nd Dynasty jars (the "proto-bowl" lineage). While the chronological distribution of the Meidum lineage can be largely explained by space and time, the Upper Egyptian lineage is a little less clear in terms of explaining the presence of particular variants in particular places. It is argued here that the "proto-bowl" lineage tracks a unique economic relationship between Giza and Elephantine (although the forms seen at both these sites are not exclusive to these sites)

Elephantine is also in a precarious position relative to other places in Egypt because it is located at narrow part of the floodplain that agricultural resources were relatively limited such that the population had to rely on exchange with other parts of Egypt. Therefore, unlike most nomes, which were relatively self-sufficient, Elephantine (nome 1) was less so and thus more prone to becoming incorporated into a complexly organized social entity.

Further evidence of a connection between Giza and Elephantine comes in the form of a sealing fragment found at Giza. As can be seen in figure 7-1, the inscription on this sealing refers to Khnum, the "god of Elephantine" as well as referring to the temple of Khnum which is located at Elephantine. The presence of this object, along with the abundant use of granite for

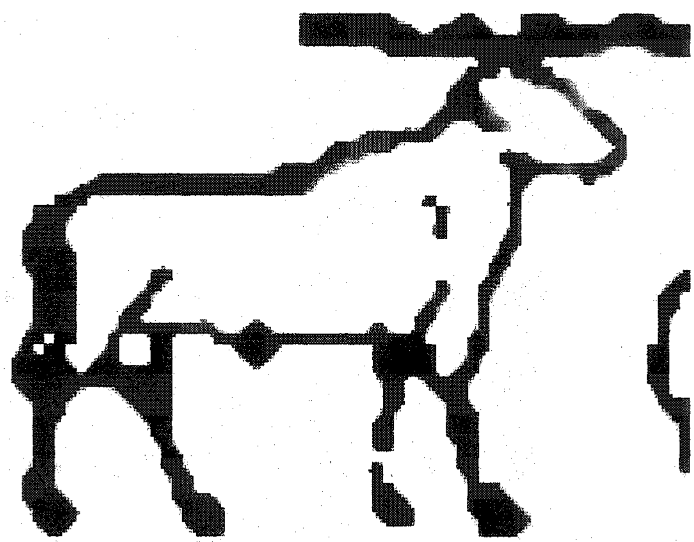


Figure 7-1. Drawing of Khnum sealing recovered from Area A at Giza.
Image courtesy of the Giza Plateau Mapping Project.

Menkaure's pyramid and the similarities in pottery manufacturing styles noted, supports a unique relationship between the two communities driven by the economics of monumental architecture.

Individuals in these communities face different selective pressures than individuals living in more self-sufficient locations. Giza is clearly a planned community established solely for the construction of the Menkaure pyramid, while Elephantine is located in a relatively resource poor and mineral rich area. As such, both locations would be dependent on foodstuffs collected through the institution of taxation.

The Development of Taxation and Monumental construction

The Palermo stone and other Old Kingdom documents provide some information about taxation events and large-scale economic expenditures. The stone itself is only the middle portion of a large slab, estimated to be approximately 2.15 meters long and little over half a meter high, standing on the long edge. Royal annals, recording regnal events through the 5th Dynasty and beginning with sparse records of the reigns of Predynastic (ca 3200 – 2700 BC) kings are written on both sides (Breasted 1906:52). The annals reported in the Palermo Stone record such information as: designations of taxation events (year of the occurrence of the numbering), flood levels and other records of commerce. The designation of Dynasties is somewhat arbitrary, with most attributions imposed by Manetho working literally thousands of years later (Breasted 1906:54). Nonetheless, the dynastic attributions on the Palermo stone provide fairly robust relative chronological information and that information can be presumed to represent something about the socioeconomic factors that characterize the Old Kingdom.

The habit of taxation seems to have taken hold during the 2nd Dynasty. Whereas an "occurrence of the numbering" only took place once during the 1st Dynasty, it becomes an apparently biennial event during the 2nd Dynasty. Flood levels indicate a decline on average, with two registered years showing flood levels of only one cubit (ca 52 cm), an occurrence not common in the 1st Dynasty. It is interesting that this environmental downturn seems to be correlated with the introduction of a more regular taxation system (Wilkinson 1999:83).

During the course of the 3rd and 4th Dynasties, pyramid building becomes a large national activity (although the pharaohs of earlier dynasties did build elaborate and costly tombs). The Palermo stone lacks records from the 3rd Dynasty, but has a wealth of information pertaining to the early 4th Dynasty, particularly the reign of Senefru. The records available suggest that many of the institutions that can be considered components of a complex social system are initiated during his reign.

During Senefru's reign elaborate construction projects and large scale trade with Lebanon are reported in the records of the Palermo stone and three taxation years are indicated (although the record reported is partial and Senefru reigned for 25 years, so there were doubtless other unreported taxation years)(Breasted 1906:65-66). Senefru is also responsible for three pyramids; Meidum (at Meidum), the Bent Pyramid and the Red Pyramid (at Dashur)(see figure 3-1 for location) (Lehner 1997:97). Senefru also initiates a large-scale mining operation in the Sinai (Breasted 1906:75).

Butzer's work suggests that nomes with relatively large amounts of arable land per kilometer of river frontage have lower population densities than areas with smaller amounts of arable land, especially if nomes in the latter category are associated with monumental constructions. If this is the case, then less productive nomes should show a greater amount of similarity to each other, because they are more likely to be supported by centralized granaries. Communities that were supported by granaries would have been more likely to be integrated than those communities that grew more of their own foodstuffs. Therefore, there should be a relationship between arable land to river frontage ratio and mahalonobis distance between assemblages, with less productive nomes nonetheless more similar to each other in spite of spatial differences.

During the later dynasties of the Old Kingdom, the economic picture changes somewhat. The nation of Egypt generally seems to experience a general economic downturn, possibly resulting from some of the enormous expenditures on the earlier pyramids. In addition, while Senefru administered the country directly through members of his immediate family, by the 5th Dynasty, this was no longer the practice. As a result, local rulers become more powerful at the expense of the office of the pharaoh (Aldred 1998:118). One consequence of this would be a reduced ability on the part of the Pharaoh to collect taxes (Aldred 1998:118). Lack of funds meant a decline in the quality of pyramid construction and while this activity continued into the Middle Kingdom, the resulting structures were apparently less durable (Edwards 1985:155). Generally pyramid construction during the 5th and 6th Dynasties consisted of a core of small stones within Tura limestone casing stones (Edwards 1985:155). This fact would change the interaction patterns between Elephantine and other parts of Egypt somewhat toward the end of the Old Kingdom.

Implications

The environment that supports the populations at Giza and Elephantine largely consisted of redistributed resources from the central storehouses. Those populations, therefore would be more likely to be impacted by factors that would affect the king's ability to collect taxes and fill the granaries. Sites such as Qau and Badari and Kom el-Hisn, however (and to a lesser extent Meidum) are more likely to be effected by local factors impacting food production those areas.

As members of a functionally differentiated system, these individuals are under different selective pressures than farmers in the more provincial nomes, whose economic condition was largely a function of local productivity. This is of interest, because the Old Kingdom period is characterized by periods of dramatic fluctuations in Nile flood levels such that from one year to the next, an individual supported by farming would experience normal or dramatically subnormal conditions (Bell 1970; Butzer 1976). This opens the possibility that participating in monumental construction projects might appear to be more stable to individuals dependent on farming in that stored foods, while more limited, would also be more predictably available from one year to the next.

This in turn suggests that "social complexity," is not a monolithic condition. Elephantine, for example, is particularly vulnerable in that it is located at a particularly narrow part of the Nile floodplain and was thus compelled to import at least some of its foodstuffs from other more productive locations. Given the abundance of granite used in monumental constructions during the Old Kingdom, it would appear that Elephantine's relationship with the larger Egyptian polity at least partially involved a unique exchange of granite for subsistence materials.

Elephantine's particular situation, however, is not mirrored by the larger Egyptian polity. Most other nomes in Egypt were relatively self – sufficient, and do not feature accessible granite deposits and are thus less prone to being incorporated into a long-distance economic interaction. It is argued here, therefore, that by focusing on spatial patterns of memetic transmission, rather than searching for archaeological evidence of such vague concepts such as "centralization," the actual interactive structure of an apparently complex polity can be discerned.

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APPENDIX 1: FABRIC DESCRIPTIONS

The following table provides complete fabric descriptions as they were taken in the field. Fabrics were described using the following attributes: particle density (sparse, moderate or dense), inclusions (temper described in detail below), temper particle size (small, medium, large), porosity (sparse, moderate, dense), firing atmosphere (oxidized, reduced, both), and clay type (marl, alluvium or marl/alluvium mix). The use of the categories "sparse, moderate and dense" to characterize aspects of the pottery fabric is a qualitative judgement, however, some quantitative criteria were *approximately* applied. Sparse means that fewer than five pores or inclusions are visible in a 5 square millimeter area. Moderate refers to 10 – 20 pores or inclusions in a five square millimeter area. Dense refers to 20 or more pores or inclusions are visible in a five square millimeter area. The quantitative boundaries noted above are not based on any larger geological parameters, but were instead simply used to keep descriptions as consistent as possible. Complete fabric descriptions were only possible for the three largest assemblages used in this study (Elephantine, Giza and Kom el Hisn).

Table A1 – 1: Particle density and inclusion size.

Site	Sherd Number	Particle density	inclusion size
Elephantine	z2018 21311e	dense	sand+/subsand
Elephantine	z1564 22319a	dense	sand+/subsand
Elephantine	z1512 17344a	dense	sand/subsand
Elephantine	z1565 22316	moderate	sand+/subsand
Elephantine	z199617304dd	dense	sand/subsand
Elephantine	z1996 17304dd	dense	sand/subsand
Elephantine	z2002 24304dd	dense	sand+/subsand
Elephantine	z1284 8936	dense	sand+/subsand
Elephantine	z8737983m	moderate	sand/subsand
Elephantine	z1296 8937m	moderate	sand/subsand
Elephantine	8926f z972	dense	sand/subsand
Elephantine	z870 5914	moderate	subsand

Elephantine	z874 5907	dense	sand+/subsand
Elephantine	z1763 24314c	sparse	sand+/subsand
Elephantine	z2564 16350d	dense	sand+/subsand
Elephantine	z926f z925	sparse	sand/subsand
Elephantine	z2488 5967	dense	sand+/subsand
Elephantine	z974 8926P	dense	sand/subsand
Elephantine	z876 6351 (1966)	dense	sand+/subsand
Elephantine	z875 6351(1925)	moderate	sand/subsand
Elephantine	z20499 22983a	dense	sand+/subsand
Elephantine	10410 c1	dense	sand+/subsand
Elephantine	8926f z958	dense	sand/subsand
Elephantine	5968	moderate	sand/subsand
Elephantine	8926f z929	sparse	subsand
Elephantine	8926f z926	sparse	subsand
Elephantine	8926f z593	sparse	sand/subsand
Elephantine	8926f z951	dense	sand/subsand
Elephantine	8926f z954	dense	subsand
Elephantine	8926f z949	dense	sand/subsand
Elephantine	8926f z941	sparse	sand/subsand
Elephantine	8926f z930	moderate	sand/subsand
Elephantine	8926f z959	moderate	subsand
Elephantine	8926f z982	sparse	sand/subsand
Elephantine	8926f z993	dense	subsand
Elephantine	5925 z2484	sparse	subsand
Elephantine	8403-1 z4616	sparse	subsand
Elephantine	7954a 25226	sparse	sand/subsand
Elephantine	7940b z25230	dense	sand/subsand
Elephantine	za 371	moderate	sand/subsand
Elephantine	18895c 5	dense	sand/subsand
Elephantine	29103 L/H 17	dense	sand+/subsand
Elephantine	29103 p/a 18	moderate	subsand
Elephantine	18895c 4	sparse	sand/subsand
Elephantine	30101 f/g 45	sparse	subsand
Elephantine	29102 b/a 27	dense	sand/subsand
Elephantine	29102 b/a 26	dense	sand+/subsand
Elephantine	29102 b/a 28	moderate	sand/subsand
Elephantine	29103 ss-1	dense	sand+/subsand
Elephantine	29103 ss-2	dense	sand/subsand
Elephantine	29103 ss-3	dense	sand/subsand
Elephantine	30103 k/c ss-4	dense	sand+/subsand

Elephantine	30103 k/c ss-5	dense	sand+/subsand
Elephantine	30101 h/k ss-6	sparse	subsand
Elephantine	30101F/g ss-7	moderate	subsand
Elephantine	30103 L/d ss-8	dense	sand/subsand
Elephantine	30101 H/g ss-9	dense	subsand
Elephantine	29103 G/c ss-10	dense	subsand
Elephantine	29103 G/c ss-11	dense	subsand
Elephantine	29103 G/c ss-12	dense	subsand
Elephantine	29102 B/a ss-13	dense	sand/subsand
Elephantine	29102 B/a ss-14	sparse	subsand
Elephantine	29102 B/a ss-15	moderate	sand/subsand
Elephantine	29102 B/a ss-16	dense	sand/subsand
Elephantine	29102 B/a ss-17	sparse	subsand
Elephantine	30103 B/a ss-18	dense	sand/subsand
Elephantine	29103 G/g ss-19	moderate	subsand
Elephantine	29103 G/d ss-20	dense	subsand
Elephantine	29103 G/d ss-21	moderate	sand/subsand
Elephantine	29103 G/d ss-22	sparse	subsand
Elephantine	29103 G/d ss-23	moderate	subsand
Elephantine	29103 G/d ss-24	moderate	subsand
Elephantine	29103 G/d ss-25	moderate	subsand
Elephantine	30103 L/f ss-26	moderate	sand/subsand
Elephantine	30103 L/f ss-27	moderate	subsand
Elephantine	29102 B/b ss-28	moderate	subsand
Elephantine	30103 L/f ss-29	dense	subsand
Elephantine	30103 L/f ss-32	dense	subsand
Elephantine	30103 L/f ss-31	dense	sand+/subsand
Elephantine	30103 L/f ss-30	dense	sand+/subsand
Elephantine	30103 L/f ss-33	sparse	subsand
Elephantine	30103 L/e ss-34	moderate	sand/subsand
Elephantine	30103 L/e ss-35	moderate	sand/subsand
Elephantine	30103 L/e ss-36	dense	sand/subsand
Elephantine	30103 L/e ss-37	sparse	subsand
Elephantine	30103 L/e ss-38	dense	sand/subsand
Elephantine	30103 L/d ss-39	moderate	sand/subsand
Elephantine	30103 L/d ss-40	dense	sand/subsand
Elephantine	30103 L/g ss-41	sparse	subsand
Elephantine	29102 E/d ss-42	dense	sand/subsand
Elephantine	29102 E/d ss-43	dense	sand/subsand
Elephantine	29102 E/d ss-44	dense	subsand

Elephantine	29102 E/d ss-45	dense	sand+/subsand
Elephantine	29102 E/d ss-46	dense	sand+/subsand
Elephantine	29102 E/d ss-47	sparse	sand/subsand
Elephantine	30101 F/f ss-48	dense	sand+/subsand
Elephantine	30101 F/f ss-49	moderate	subsand
Elephantine	30101 F/f ss-50	moderate	subsand
Elephantine	30101 F/f ss-51	sparse	subsand
Elephantine	30101 F/f ss-52	moderate	subsand
Elephantine	30101 F/f ss-53	moderate	sand/subsand
Elephantine	30101 F/f ss-54	dense	sand/subsand
Elephantine	30101 F/f ss-55	sparse	subsand
Elephantine	30101 F/f ss-56	sparse	subsand
Elephantine	30101 F/f ss-57	sparse	sand/subsand
Elephantine	30101 F/f ss-58	dense	sand/subsand
Elephantine	30101 F/f ss-59	dense	sand/subsand
Elephantine	30101 F/f ss-60	dense	subsand
Elephantine	29102 F/g ss-61	moderate	sand/subsand
Elephantine	29102 F/g ss-62	moderate	sand/subsand
Elephantine	29102 F/g ss-65	dense	sand+/subsand
Elephantine	29102 F/g ss-63	moderate	sand/subsand
Elephantine	29102 F/g ss-66	dense	sand/subsand
Giza	a1/14(1)	sparse	subsand
Giza	a1/14(10)	sparse	sand/subsand
Giza	a1/14(11)	dense	sand+/subsand
Giza	a1/14(13)	very sparse	subsand
Giza	a1/14(14)	sparse	sand/subsand
Giza	a1/14(15)	moderate	sand/subsand
Giza	a1/14(16)	moderate	sand+/subsand
Giza	a1/14(2)	moderate	sand/subsand
Giza	a1/14(3)	moderate	subsand
Giza	a1/14(4)	moderate	sand+/subsand
Giza	a1/14(5)	sparse	subsand
Giza	a1/14(6)	moderate	sand/subsand
Giza	a1/14(7)	moderate	sand/subsand
Giza	a1/14(8)	sparse	subsand
Giza	a1/14(9)	dense	subsand
Giza	a1/15(1)	moderate	subsand
Giza	a1/15(10)	dense	sand/subsand
Giza	a1/15(11)	very sparse	subsand
Giza	a1/15(12)	sparse	subsand

Giza	a1/15(2)	very sparse	subsand
Giza	a1/15(3)	very sparse	sand+/subsand
Giza	a1/15(4)	very sparse	sand+/subsand
Giza	a1/15(5)	very sparse	subsand
Giza	a1/15(8)	moderate	sand/subsand
Giza	a1/15(9)	sparse	subsand
Giza	a1/40	moderate	sand+/subsand
Giza	a1/41	very sparse	subsand
Giza	a1/5	moderate	sand+/subsand
Giza	a10/501(1)	dense	subsand
Giza	a10/501(2)	sparse	sand+/subsand
Giza	a10/501(3)	moderate	sand/subsand
Giza	A2/3 (1)	very sparse	sand+/subsand
Giza	A2/3 (2)	very sparse	subsand
Giza	A2/3 (3)	sparse	sand/subsand
Giza	a2/3 (4)	very sparse	subsand
Giza	a2/38	sparse	sand/subsand
Giza	a2/39	dense	subsand
Giza	a3/1(1)	moderate	sand+/subsand
Giza	a4/1	moderate	sand/subsand
Giza	a4/11	very sparse	subsand
Giza	A4/2	dense	sand+/subsand
Giza	a4/27	sparse	sand/subsand
Giza	a4/8(1)	moderate	sand+/subsand
Giza	a4/8(2)	sparse	sand+/subsand
Giza	a4/8(3)	dense	sand/subsand
Giza	a5/13	sparse	sand+/subsand
Giza	a5/2	dense	sand+/subsand
Giza	a5/7	moderate	sand/subsand
Giza	a6/1022(1)	dense	sand+/subsand
Giza	a6/1022(2)	dense	sand/subsand
Giza	a6/1022(3)	very dense	sand/subsand
Giza	a6/1022(4)	sparse	sand/subsand
Giza	a6/1022(5)	moderate	sand/subsand
Giza	a6/1022(6)	sparse	subsand
Giza	a6/1081(1)	sparse	sand/subsand
Giza	a6/1081(2)	sparse	subsand
Giza	a6/1081(3)	sparse	sand/subsand
Giza	a6/1081(4)	dense	sand/subsand
Giza	a6/1081(5)	moderate	sand+/subsand

Giza	a6/11(1)	sparse	subsand
Giza	a6/11(2)	dense	sand/subsand
Giza	a6/1190(1)	moderate	sand/subsand
Giza	a6/1190(2)	dense	sand/subsand
Giza	a6/1190(3)	moderate	sand/subsand
Giza	a6/1190(4)	sparse	sand/subsand
Giza	a6/23	sparse	sand/subsand
Giza	a61/1089(1)	moderate	sand/subsand
Giza	a61/1089(2)	moderate	sand/subsand
Giza	a7/1003(1)	sparse	sand/subsand
Giza	a7/1003(2)	moderate	sand/subsand
Giza	a7/1050(1)	moderate	subsand
Giza	a7/1050(2)	moderate	subsand
Giza	a7/1063	sparse	sand/subsand
Giza	a7/139(1)	very sparse	sand/subsand
Giza	a7/139(2)	very sparse	sand/subsand
Giza	a7/139(3)	very sparse	subsand
Giza	a7/139(4)	very sparse	sand/subsand
Giza	a7/139(5)	very sparse	subsand
Giza	a7/139(6)	moderate	subsand
Giza	a7/139(7)	sparse	sand+/subsand
Giza	a7/139(8)	sparse	subsand
Giza	a7/139(9)	sparse	subsand
Giza	a7/16(1)	sparse	subsand
Giza	a7/16(2)	moderate	subsand
Giza	a7/16(3)	moderate	sand/subsand
Giza	a7/16(4)	sparse	subsand
Giza	a7/19	sparse	sand/subsand
Giza	a7/20	moderate	sand/subsand
Giza	a7/57(1)	very sparse	subsand
Giza	a7/57(2)	dense	sand/subsand
Giza	a7/57(3)	moderate	sand/subsand
Giza	a7/59	very sparse	subsand
Giza	a7/8(1)	dense	sand+/subsand
Giza	a7/93	sparse	sand/subsand
Giza	a7-6/1000	sparse	sand/subsand
Giza	a8j/18(1)	sparse	subsand
Giza	a8j/18(2)	moderate	sand/subsand
Giza	a8j/19	sparse	sand/subsand
Giza	a8j/19(1)	moderate	subsand

Giza	a8j/19(2)	moderate	sand/subsand
Giza	a7/19	dense	sand+/subsand
Giza	a7/20	sparse	sand/subsand
Giza	a7/57(1)	moderate	sand/subsand
Giza	a7/57(2)	sparse	sand/subsand
Giza	a7/57(3)	sparse	subsand
Giza	a7/59	dense	sand/subsand
Giza	a7/8(1)	dense	sand/subsand
Giza	a7/93	moderate	sand/subsand
Giza	a7-6/1000	sparse	sand/subsand
Giza	a8j/18(1)	sparse	sand/subsand
Giza	a8j/18(2)	moderate	sand/subsand
Giza	a8j/19	sparse	sand/subsand
Giza	a8j/19(1)	sparse	sand/subsand
Giza	a8j/19(2)	dense	sand/subsand
Giza	a8j/23	moderate	subsand
Giza	a8j/30	sparse	sand/subsand
Giza	aa/522(1)	dense	sand/subsand
Giza	aa/522(2)	sparse	subsand
Giza	aa/522(3)	dense	sand+/subsand
Giza	aa/535(1)	moderate	subsand
Giza	aa/535(2)	moderate	sand+/subsand
Giza	aa/535(3)	moderate	sand+/subsand
Giza	aa/535(4)	sparse	sand/subsand
Giza	aa/537(5)	dense	subsand
Giza	aa/537(6)	very sparse	sand/subsand
Giza	aa/537(7)	very sparse	sand/subsand
Giza	aa/578(1)	dense	subsand
Giza	aa/578(2)	sparse	subsand
Giza	aa/579	dense	sand/subsand
Giza	aa10/502(1)	sparse	subsand
Giza	aa10/502(2)	sparse	subsand
Giza	aa10/502(3)	moderate	sand/subsand
Giza	aa10/508	moderate	sand/subsand
Giza	c1/5(1)	moderate	subsand
Giza	c1/5(2)	sparse	subsand
Giza	c11/5(1)	sparse	subsand
Giza	c11/5(2)	moderate	sand/subsand
Giza	c2/1	sparse	subsand
Giza	c5/1	sparse	sand+/subsand

Giza	c9/5(1)	dense	sand/subsand
Giza	c9/5(2)	moderate	sand/subsand
Giza	D17/710 (1)	sparse	sand/subsand
Giza	D17/710 (2)	moderate	subsand
Giza	d17/743(1)	dense	sand/subsand
Giza	d17/743(2)	sparse	sand/subsand
Giza	d17/744(1)	sparse	sand+/subsand
Giza	d17/744(2)	moderate	sand/subsand
Giza	d17/753	moderate	sand/subsand
Giza	d17/758(1)	sparse	sand+/subsand
Giza	d17/758(2)	moderate	sand/subsand
Giza	d17/758(3)	dense	sand/subsand
Giza	d17/758(4)	moderate	sand/subsand
Giza	d17/782(1)	moderate	sand/subsand
Giza	d17/782(2)	moderate	subsand
Giza	d17/782(3)	sparse	sand/subsand
Giza	d17/782(4)	dense	sand/subsand
Giza	d17/782(5)	moderate	sand/subsand
Giza	d17/785	moderate	subsand
Giza	D17x/1118 (8)	sparse	sand/subsand
Giza	d17x/1118(1)	dense	sand+/subsand
Giza	d17x/1118(2)	moderate	sand/subsand
Giza	d17x/1118(3)	dense	sand/subsand
Giza	d17x/1118(4)	sparse	subsand
Giza	d17x/1118(5)	moderate	sand/subsand
Giza	d17x/1118(6)	moderate	sand/subsand
Giza	D17x/1118(7)	dense	sand+/subsand
Giza	d17x/1137(1)	moderate	sand/subsand
Giza	d17x/1137(2)	dense	subsand
Giza	d17x/1138	moderate	subsand
Giza	d17x/1158	moderate	sand/subsand
Giza	d17x/1315	moderate	sand/subsand
Giza	d17x/1316	sparse	subsand
Giza	d17x/1322	sparse	sand/subsand
Giza	d17x/1342	moderate	sand/subsand
Giza	d17x/1344	moderate	subsand
Giza	d17x/1347	sparse	sand/subsand
Giza	d17x/1349(1)	dense	sand/subsand
Giza	d17x/1349(2)	moderate	sand/subsand
Giza	d17x/1353	moderate	subsand

Giza	d17x/1363(1)	sparse	subsand
Giza	d17x/1363(2)	dense	sand/subsand
Giza	d17x/1363(3)	moderate	sand/subsand
Giza	d17x/1383(1)	dense	sand/subsand
Giza	d17x/1383(2)	dense	sand/subsand
Giza	d17x/1408	sparse	sand/subsand
Giza	d17x/1454	moderate	sand/subsand
Giza	d19/798	sparse	sand/subsand
Giza	d8/787(1)	sparse	sand/subsand
Giza	d8/787(2)	moderate	sand/subsand
Giza	d8/787(3)	sparse	subsand
Giza	d8/787(4)	moderate	subsand
Giza	d8/787(5)	dense	sand+/subsand
Giza	d8/787(6)	very sparse	sand+/subsand
Giza	d8/787(7)	moderate	subsand
Giza	d8/787(8)	sparse	sand/subsand
Giza	d8/787(9)	dense	sand+/subsand
Giza	d9/707(10)	sparse	subsand
Giza	d9/751	moderate	subsand
Giza	d9/915	sparse	sand/subsand
Giza	e9/1116	sparse	sand/subsand
Giza	e9/1120	sparse	sand/subsand
Giza	e9/1361	moderate	sand/subsand
Giza	e9/1430	dense	sand/subsand
Kom el-Hisn	30	sparse	sand/subsand
Kom el-Hisn	31	sparse	sand/subsand
Kom el-Hisn	61	moderate	subsand
Kom el-Hisn	242	dense	subsand
Kom el-Hisn	243	moderate	subsand
Kom el-Hisn	719	moderate	sand/subsand
Kom el-Hisn	754	sparse	subsand
Kom el-Hisn	769	moderate	sand/subsand
Kom el-Hisn	780	sparse	sand/subsand
Kom el-Hisn	786	moderate	sand/subsand
Kom el-Hisn	828	dense	sand/subsand
Kom el-Hisn	929	moderate	sand/subsand
Kom el-Hisn	1298	moderate	sand/subsand
Kom el-Hisn	1334	sparse	subsand
Kom el-Hisn	1338	dense	sand+/subsand
Kom el-Hisn	1367	moderate	subsand

Kom el-Hisn		3114	sparse	sand/subsand
Kom el-Hisn	(1174		sparse	sand/subsand
Kom el-Hisn	(1177		dense	sand/subsand
Kom el-Hisn	(1281		dense	sand/subsand
Kom el-Hisn	(1282		moderate	subsand
Kom el-Hisn	(1376		moderate	subsand
Kom el-Hisn	(1394		dense	subsand
Kom el-Hisn	(1473		moderate	sand/subsand
Kom el-Hisn	(1527		sparse	subsand
Kom el-Hisn	(1605		dense	sand/subsand
Kom el-Hisn	(1657		sparse	subsand
Kom el-Hisn	(1712		moderate	sand/subsand
Kom el-Hisn	(182		moderate	sand/subsand
Kom el-Hisn	(1956		sparse	sand/subsand
Kom el-Hisn	(2038		moderate	sand/subsand
Kom el-Hisn	(2079		dense	sand/subsand
Kom el-Hisn	(2092		moderate	sand/subsand
Kom el-Hisn	(2143		moderate	sand/subsand
Kom el-Hisn	(2144		sparse	sand/subsand
Kom el-Hisn	(2219		moderate	sand/subsand
Kom el-Hisn	(2248		moderate	sand/subsand
Kom el-Hisn	(2255		moderate	sand/subsand
Kom el-Hisn	(2317		dense	sand/subsand
Kom el-Hisn	(2385		dense	sand/subsand
Kom el-Hisn	(2394		moderate	subsand
Kom el-Hisn	(2401		sparse	subsand
Kom el-Hisn	(2403		moderate	subsand
Kom el-Hisn	(2424		dense	sand/subsand
Kom el-Hisn	(2500		dense	sand/subsand
Kom el-Hisn	(2512		sparse	subsand
Kom el-Hisn	(2518		dense	sand/subsand
Kom el-Hisn	(2573		moderate	sand/subsand
Kom el-Hisn	(2577		dense	sand/subsand
Kom el-Hisn	(2670		moderate	sand/subsand
Kom el-Hisn	(2672		moderate	sand/subsand
Kom el-Hisn	(2675		sparse	sand/subsand
Kom el-Hisn	(2698		moderate	sand/subsand
Kom el-Hisn	(2734		dense	sand/subsand
Kom el-Hisn	(2777		moderate	sand/subsand
Kom el-Hisn	(2845		dense	subsand

Kom el-Hisn	(2851	sparse	sand/subsand
Kom el-Hisn	(2885	moderate	sand/subsand
Kom el-Hisn	(2946	moderate	sand/subsand
Kom el-Hisn	(2949	dense	sand/subsand
Kom el-Hisn	(2962	sparse	sand/subsand
Kom el-Hisn	(3000	sparse	sand/subsand
Kom el-Hisn	(3041	moderate	sand/subsand
Kom el-Hisn	(3042	moderate	sand/subsand
Kom el-Hisn	(3082	dense	sand/subsand
Kom el-Hisn	(3086	moderate	subsand
Kom el-Hisn	(3090	dense	sand/subsand
Kom el-Hisn	(3099	dense	subsand
Kom el-Hisn	(3129	dense	sand/subsand
Kom el-Hisn	(3131	sparse	sand/subsand
Kom el-Hisn	(3152	sparse	subsand
Kom el-Hisn	(3177	sparse	subsand
Kom el-Hisn	(3181	dense	subsand
Kom el-Hisn	(3190	sparse	sand/subsand
Kom el-Hisn	(3208	moderate	sand/subsand
Kom el-Hisn	(3263	dense	sand/subsand
Kom el-Hisn	(3279	dense	sand/subsand
Kom el-Hisn	(3294	moderate	subsand
Kom el-Hisn	(3297	moderate	subsand
Kom el-Hisn	(3303	moderate	sand/subsand
Kom el-Hisn	(3304	moderate	sand/subsand
Kom el-Hisn	(3331	sparse	sand/subsand
Kom el-Hisn	(3401	moderate	sand/subsand
Kom el-Hisn	(3402	moderate	subsand
Kom el-Hisn	(3403	dense	sand/subsand
Kom el-Hisn	(3426	moderate	sand/subsand
Kom el-Hisn	(3449	moderate	sand/subsand
Kom el-Hisn	(3488	moderate	sand/subsand
Kom el-Hisn	(3536	moderate	sand/subsand
Kom el-Hisn	(3608	dense	sand/subsand
Kom el-Hisn	(3657	dense	sand/subsand
Kom el-Hisn	(3658	moderate	sand/subsand
Kom el-Hisn	(3663	dense	sand/subsand
Kom el-Hisn	(3673	sparse	sand/subsand
Kom el-Hisn	(3676	sparse	sand/subsand
Kom el-Hisn	(3680	sparse	subsand

Kom el-Hisn	(3695	sparse	sand/subsand
Kom el-Hisn	(3698	sparse	subsand
Kom el-Hisn	(3777	moderate	subsand
Kom el-Hisn	(3810	moderate	sand/subsand
Kom el-Hisn	(3864	sparse	subsand
Kom el-Hisn	(3883	moderate	sand/subsand
Kom el-Hisn	(3902	moderate	sand+/subsand
Kom el-Hisn	(3912	moderate	sand/subsand
Kom el-Hisn	(3940	moderate	subsand
Kom el-Hisn	(3948	dense	sand/subsand
Kom el-Hisn	(3982	moderate	sand/subsand
Kom el-Hisn	(4055	dense	sand/subsand
Kom el-Hisn	(4119	dense	sand/subsand
Kom el-Hisn	(4181	sparse	subsand
Kom el-Hisn	(4253	dense	sand/subsand
Kom el-Hisn	(4265	moderate	sand/subsand
Kom el-Hisn	(4286	dense	sand/subsand
Kom el-Hisn	(4311	moderate	sand/subsand
Kom el-Hisn	(4645	moderate	sand/subsand
Kom el-Hisn	(4920	moderate	subsand
Kom el-Hisn	(4941	moderate	sand/subsand
Kom el-Hisn	(4958	sparse	sand/subsand
Kom el-Hisn	(7509	dense	sand+/subsand
Kom el-Hisn	(958	moderate	sand/subsand
Kom el-Hisn	[6007]	moderate	subsand
Kom el-Hisn	[7724]	moderate	subsand
Kom el-Hisn	[888]	moderate	sand/subsand
Kom el-Hisn	x1011	sparse	subsand
Kom el-Hisn	x1082	sparse	sand/subsand
Kom el-Hisn	x1160	dense	sand/subsand
Kom el-Hisn	x1281	dense	sand/subsand
Kom el-Hisn	x1386	moderate	sand/subsand
Kom el-Hisn	x1410	sparse	subsand
Kom el-Hisn	x1476	sparse	sand/subsand
Kom el-Hisn	x1527	moderate	sand/subsand
Kom el-Hisn	x183	moderate	subsand
Kom el-Hisn	x2640	sparse	sand/subsand
Kom el-Hisn	x268	sparse	sand/subsand
Kom el-Hisn	x2780	dense	sand/subsand
Kom el-Hisn	x3791	moderate	subsand

Kom el-Hisn	x382	sparse	subsand
Kom el-Hisn	x3827	dense	sand/subsand
Kom el-Hisn	x3840	moderate	sand/subsand
Kom el-Hisn	x3842	moderate	subsand
Kom el-Hisn	x4001	moderate	subsand
Kom el-Hisn	x4017	moderate	sand/subsand
Kom el-Hisn	x404	sparse	subsand
Kom el-Hisn	x405	sparse	subsand
Kom el-Hisn	x4063	sparse	subsand
Kom el-Hisn	x4132	moderate	subsand
Kom el-Hisn	x4163	moderate	subsand
Kom el-Hisn	x4165	dense	sand/subsand
Kom el-Hisn	x4204	moderate	subsand
Kom el-Hisn	x4206	dense	subsand
Kom el-Hisn	x4229	dense	sand/subsand
Kom el-Hisn	x442	sparse	subsand
Kom el-Hisn	x504	sparse	subsand
Kom el-Hisn	x95	sparse	subsand
Kom el-Hisn	(4272	moderate	sand/subsand
Kom el-Hisn	(4285	moderate	sand/subsand
Kom el-Hisn	(4935	moderate	sand/subsand
Kom el-Hisn	(4126	moderate	sand/subsand
Kom el-Hisn	(4317	moderate	sand/subsand
Kom el-Hisn	(4923	moderate	sand/subsand
Kom el-Hisn	(4295	dense	sand/subsand
Kom el-Hisn	(4030	moderate	sand/subsand
Kom el-Hisn	(4218	sparse	subsand
Kom el-Hisn	(4959	sparse	sand/subsand
Kom el-Hisn	(4312	moderate	sand/subsand
Kom el-Hisn	(4932	dense	sand/subsand
Kom el-Hisn	(4862	sparse	sand/subsand
Kom el-Hisn	(4647	sparse	sand/subsand
Kom el-Hisn	(5987	moderate	sand/subsand
Kom el-Hisn	(5017	dense	sand/subsand
Kom el-Hisn	(5988	moderate	sand/subsand
Kom el-Hisn	(5255	dense	sand/subsand
Kom el-Hisn	(5990	sparse	sand/subsand
Kom el-Hisn	(5359	moderate	sand/subsand
Kom el-Hisn	(5992	sparse	subsand
Kom el-Hisn	(5338	moderate	sand/subsand

Kom el-Hisn	(5167	dense	sand/subsand
Kom el-Hisn	(5676	dense	sand/subsand
Kom el-Hisn	(5156	moderate	sand/subsand
Kom el-Hisn	(5673	dense	sand/subsand
Kom el-Hisn	(5523	dense	sand/subsand
Kom el-Hisn	(5245	sparse	subsand
Kom el-Hisn	(5014	moderate	sand/subsand
Kom el-Hisn	(5811	moderate	sand/subsand
Kom el-Hisn	(5001	sparse	subsand
Kom el-Hisn	(5579	dense	sand/subsand
Kom el-Hisn	(5003	dense	sand/subsand
Kom el-Hisn	(5329	dense	sand/subsand
Kom el-Hisn	(5397	dense	subsand
Kom el-Hisn	(5581	moderate	subsand
Kom el-Hisn	(5834	dense	sand/subsand
Kom el-Hisn	(5782	moderate	subsand
Kom el-Hisn	(5205	sparse	subsand
Kom el-Hisn	(6585	moderate	sand/subsand
Kom el-Hisn	(6586	sparse	sand/subsand
Kom el-Hisn	(6001	moderate	sand/subsand
Kom el-Hisn	(6005	sparse	sand/subsand
Kom el-Hisn	(6686	dense	sand/subsand
Kom el-Hisn	(6003	sparse	sand/subsand
Kom el-Hisn	(6070	moderate	sand/subsand
Kom el-Hisn	(6405	moderate	sand/subsand
Kom el-Hisn	(6397	moderate	sand/subsand
Kom el-Hisn	(6755	sparse	subsand
Kom el-Hisn	(6413	dense	sand/subsand
Kom el-Hisn	(6391	moderate	sand/subsand
Kom el-Hisn	(6006	sparse	subsand
Kom el-Hisn	(6910	sparse	subsand
Kom el-Hisn	(6424	sparse	sand/subsand
Kom el-Hisn	(6749	sparse	subsand
Kom el-Hisn	(6412	sparse	sand/subsand
Kom el-Hisn	(6381	sparse	sand/subsand
Kom el-Hisn	(6645	dense	sand/subsand
Kom el-Hisn	(6583	moderate	sand/subsand
Kom el-Hisn	(6911	dense	sand/subsand
Kom el-Hisn	(6423	moderate	sand/subsand
Kom el-Hisn	(6347	moderate	sand/subsand

Kom el-Hisn	(6856		dense	subsand
Kom el-Hisn	(6422		sparse	subsand
Kom el-Hisn	(6598		dense	subsand
Kom el-Hisn	(6978		moderate	subsand
Kom el-Hisn	(6552		dense	sand/subsand
Kom el-Hisn	(6543		dense	sand/subsand
Kom el-Hisn	(6608		dense	sand/subsand
Kom el-Hisn	(6387		moderate	subsand
Kom el-Hisn	(6806		moderate	sand/subsand
Kom el-Hisn	(6302		moderate	sand/subsand
Kom el-Hisn	(6375		moderate	sand/subsand
Kom el-Hisn	(6399		sparse	sand/subsand
Kom el-Hisn	(6428		moderate	sand/subsand
Kom el-Hisn	(6938		moderate	sand/subsand
Kom el-Hisn	(6400		moderate	sand/subsand
Kom el-Hisn	(6547		moderate	sand/subsand
Kom el-Hisn	(6982		sparse	sand/subsand
Kom el-Hisn	(6211		moderate	sand/subsand
Kom el-Hisn		5835	sparse	sand/subsand
Kom el-Hisn		2727	moderate	sand/subsand
Kom el-Hisn	x1918		sparse	subsand
Kom el-Hisn		270	dense	sand/subsand
Kom el-Hisn		179	dense	sand/subsand
Kom el-Hisn		2656	moderate	sand/subsand
Kom el-Hisn		2616	sparse	sand/subsand
Kom el-Hisn		115	sparse	subsand
Kom el-Hisn		1878	moderate	sand/subsand
Kom el-Hisn		1249	sparse	subsand
Kom el-Hisn		3862	moderate	sand/subsand
Kom el-Hisn		451	moderate	sand/subsand
Kom el-Hisn	(5689		sparse	sand/subsand
Kom el-Hisn		2370	dense	sand/subsand
Kom el-Hisn		3013	sparse	subsand
Kom el-Hisn		1468	sparse	subsand
Kom el-Hisn	x2518		moderate	sand/subsand
Kom el-Hisn		1293	moderate	subsand
Kom el-Hisn		1412	sparse	subsand
Kom el-Hisn	(1134		sparse	subsand
Kom el-Hisn	(2104		sparse	subsand
Kom el-Hisn		1339	sparse	sand/subsand

Kom el-Hisn		7268	moderate	sand/subsand
Kom el-Hisn		2503	dense	sand/subsand
Kom el-Hisn		1360	moderate	sand/subsand
Kom el-Hisn		2726	sparse	sand/subsand
Kom el-Hisn		397	moderate	sand/subsand
Kom el-Hisn		1340	dense	sand/subsand
Kom el-Hisn		3135	sparse	sand/subsand
Kom el-Hisn		2520	dense	sand/subsand
Kom el-Hisn	x2013		sparse	sand/subsand
Kom el-Hisn	x2138		moderate	sand/subsand
Kom el-Hisn		1327	dense	sand/subsand
Kom el-Hisn	(2222		dense	sand/subsand
Kom el-Hisn		1424	moderate	subsand
Kom el-Hisn		2447	moderate	sand/subsand
Kom el-Hisn		900	dense	sand/subsand
Kom el-Hisn	(1625		dense	sand/subsand
Kom el-Hisn		176	moderate	subsand
Kom el-Hisn	x1697		dense	sand/subsand
Kom el-Hisn	x1783		moderate	sand/subsand
Kom el-Hisn	x1782		moderate	sand/subsand
Kom el-Hisn		219	dense	sand/subsand
Kom el-Hisn		2254	moderate	sand/subsand
Kom el-Hisn		1309	moderate	sand/subsand
Kom el-Hisn		444	dense	sand/subsand
Kom el-Hisn		1410	dense	sand/subsand
Kom el-Hisn		2514	dense	sand/subsand
Kom el-Hisn	(938		sparse	subsand
Kom el-Hisn		1341	dense	sand/subsand
Kom el-Hisn		512	sparse	sand/subsand
Kom el-Hisn	(2266		dense	sand/subsand
Kom el-Hisn	(1856		moderate	sand/subsand
Kom el-Hisn		1414	dense	sand/subsand
Kom el-Hisn	x3412		sparse	sand/subsand
Kom el-Hisn	x3082		dense	sand/subsand
Kom el-Hisn	(2589		dense	sand/subsand
Kom el-Hisn		384	dense	sand/subsand
Kom el-Hisn		1301	dense	sand/subsand
Kom el-Hisn		1509	moderate	sand/subsand
Kom el-Hisn	(2791		sparse	subsand
Kom el-Hisn	x1775		sparse	sand/subsand

Kom el-Hisn	(1487		dense	sand/subsand
Kom el-Hisn	x441		dense	sand/subsand
Kom el-Hisn	x3355		moderate	sand/subsand
Kom el-Hisn	x2150		moderate	sand/subsand
Kom el-Hisn		2070	moderate	subsand
Kom el-Hisn		810	dense	sand/subsand
Kom el-Hisn	x1643		dense	sand/subsand
Kom el-Hisn		3414	moderate	sand/subsand
Kom el-Hisn	x1553		dense	sand/subsand
Kom el-Hisn	x355		moderate	sand/subsand
Kom el-Hisn	x1791		dense	sand/subsand
Kom el-Hisn		1328	dense	sand/subsand
Kom el-Hisn	(1971		moderate	sand/subsand
Kom el-Hisn	(792		moderate	sand+/subsand
Kom el-Hisn	(976		moderate	sand+/subsand
Kom el-Hisn	(250		moderate	sand/subsand
Kom el-Hisn	(987		moderate	subsand
Kom el-Hisn	(323		moderate	sand/subsand
Kom el-Hisn	(645		dense	sand+/subsand
Kom el-Hisn	(793		dense	sand/subsand
Kom el-Hisn	(693		dense	sand/subsand
Kom el-Hisn	(683		moderate	sand/subsand
Kom el-Hisn	(180		dense	sand+/subsand
Kom el-Hisn	(342		sparse	sand/subsand
Kom el-Hisn	(188		dense	sand/subsand
Kom el-Hisn	(231		dense	sand/subsand
Kom el-Hisn	(510		dense	sand/subsand
Kom el-Hisn	(523		sparse	subsand
Kom el-Hisn	(580		dense	sand/subsand
Kom el-Hisn	(33		moderate	sand/subsand
Kom el-Hisn	(103		moderate	sand/subsand
Kom el-Hisn	(7328		dense	sand/subsand
Kom el-Hisn	(7651		sparse	sand/subsand
Kom el-Hisn	(7511		moderate	sand/subsand
Kom el-Hisn	(7391		sparse	sand/subsand
Kom el-Hisn	(7133		sparse	subsand
Kom el-Hisn	(7574		moderate	sand/subsand
Kom el-Hisn	(7517		dense	sand/subsand
Kom el-Hisn	(7435		dense	sand/subsand
Kom el-Hisn	(7040		dense	sand+/subsand

Kom el-Hisn	(7714	moderate	sand/subsand
Kom el-Hisn	(7117	moderate	sand/subsand
Kom el-Hisn	(7454	dense	sand/subsand
Kom el-Hisn	(7653	sparse	subsand
Kom el-Hisn	(7519	dense	sand/subsand
Kom el-Hisn	(7493	moderate	sand/subsand
Kom el-Hisn	(7152	moderate	sand/subsand
Kom el-Hisn	(7485	sparse	sand/subsand
Kom el-Hisn	(7443	moderate	sand/subsand
Kom el-Hisn	(7073	moderate	sand/subsand
Kom el-Hisn	(7713	sparse	sand/subsand
Kom el-Hisn	(7712	sparse	sand/subsand
Kom el-Hisn	(7488	sparse	subsand
Kom el-Hisn	(7442	moderate	sand/subsand
Kom el-Hisn	(7290	sparse	sand/subsand
Kom el-Hisn	(7560	moderate	subsand
Kom el-Hisn	(7160	moderate	sand/subsand
Kom el-Hisn	(7437	moderate	sand/subsand
Kom el-Hisn	(7618	dense	sand/subsand
Kom el-Hisn	(7356	sparse	subsand
Kom el-Hisn	(7435	sparse	sand/subsand
Kom el-Hisn	(7553	sparse	sand/subsand
Kom el-Hisn	(7719	sparse	subsand
Kom el-Hisn	(7617	moderate	sand/subsand
Kom el-Hisn	(7034	sparse	sand/subsand

Table A1-2: Porosity and firing atmosphere.

Site	**Sherd Number**	**porosity**	**firing atmosphere**
Elephantine	z2018 21311e	flat and round, moderate	oxidized
Elephantine	z1564 22319a	sparse, round	reduce
Elephantine	z1512 17344a	flat and round, moderate	reduced and oxidized
Elephantine	z1565 22316	flat and round, moderate	oxidized
Elephantine	z199617304dd	flat,moderate	oxidized
Elephantine	z1996 17304dd	flat,moderate	oxidized
Elephantine	z2002 24304dd	flat and round, moderate	oxidized
Elephantine	z1284 8936	round and irregular,moderate	oxidized
Elephantine	z8737983m	Round and irregular,sparse	oxidized
Elephantine	z1296 8937m	round and dense	?
Elephantine	8926f z972	round and dense	oxidized

Elephantine	z870 5914	flat and round, moderate	oxidized
Elephantine	z874 5907	flat and round, dense	reduced
Elephantine	z1763 24314c	round and sparse	oxidized
Elephantine	z2564 16350d	round and sparse	oxidized
Elephantine	z926f z925	flat and round, moderate	reduced
Elephantine	z2488 5967	?	
Elephantine	z974 8926P	round and sparse	oxidized
Elephantine	z876 6351 (1966)	round, moderate	oxidized
Elephantine	z875 6351(1925)	round, moderate	oxidized
Elephantine	z20499 22983a	na	na
Elephantine	10410 c1	round, moderate	oxidized and reduced
Elephantine	8926f z958	round and irregular, sparse	oxidized
Elephantine	5968	round, sparse	na
Elephantine	8926f z929	flat,moderate	oxidized
Elephantine	8926f z926	flat,moderate	oxidized
Elephantine	8926f z593	flat and round, moderate	oxidized
Elephantine	8926f z951	flat,dense	oxidized and reduced
Elephantine	8926f z954	flat,moderate	oxidized
Elephantine	8926f z949	flat,moderate	oxidized
Elephantine	8926f z941	round and flat, moderate	na
Elephantine	8926f z930	round and irregular,dense	oxidized
Elephantine	8926f z959	flat,moderate	oxidized
Elephantine	8926f z982	round and sparse	oxidized and reduced
Elephantine	8926f z993	round and dense	oxidized
Elephantine	5925 z2484	round and moderate	reduced
Elephantine	8403-1 z4616	round and moderate	na
Elephantine	7954a 25226	round and sparse	oxidized
Elephantine	7940b z25230	flat and round, dense	oxidized
Elephantine	za 371	flat,round,irregular,dense	oxidized
Elephantine	18895c 5	flat,round,irregular,dense	oxidized
Elephantine	29103 L/H 17	flat and round, moderate	oxidized
Elephantine	29103 p/a 18	flat, sparse	oxidized
Elephantine	18895c 4	round,moderate	oxidized and reduced
Elephantine	30101 f/g 45	flat, sparse	oxidized
Elephantine	29102 b/a 27	flat and round, dense	oxidized and reduced
Elephantine	29102 b/a 26	flat, moderate	oxidized
Elephantine	29102 b/a 28	na, very sparse	oxidized
Elephantine	29103 ss-1	round and irregular, dense	oxidized
Elephantine	29103 ss-2	round,sparse	oxidized
Elephantine	29103 ss-3	oxidized	oxidized

Elephantine	30103 k/c ss-4	flat, dense	oxidized
Elephantine	30103 k/c ss-5	round, moderate	reduced and oxidized
Elephantine	30101 h/k ss-6	round and sparse	oxidized
Elephantine	30101F/g ss-7	flat and sparse	oxidized
Elephantine	30103 L/d ss-8	round and moderate	oxidized
Elephantine	30101 H/g ss-9	round and sparse	oxidized
Elephantine	29103 G/c ss-10	round and sparse	oxidized
Elephantine	29103 G/c ss-11	round and sparse	oxidized
Elephantine	29103 G/c ss-12	round and sparse	oxidized
Elephantine	29102 B/a ss-13	round and flat, moderate	oxidized
Elephantine	29102 B/a ss-14	round and sparse	NA
Elephantine	29102 B/a ss-15	round, irregular, sparse	oxidized
Elephantine	29102 B/a ss-16	round and irregular, dense	oxidized
Elephantine	29102 B/a ss-17	round and irregular, dense	NA
Elephantine	30103 B/a ss-18	round and sparse	oxidized
Elephantine	29103 G/g ss-19	round and moderate	oxidized and reduced
Elephantine	29103 G/d ss-20	round and moderate	oxidized
Elephantine	29103 G/d ss-21	round and moderate	oxidized and reduced
Elephantine	29103 G/d ss-22	round and sparse	oxidized
Elephantine	29103 G/d ss-23	round and moderate	oxidized
Elephantine	29103 G/d ss-24	round and moderate	oxidized
Elephantine	29103 G/d ss-25	round and moderate	oxidized
Elephantine	30103 L/f ss-26	irregular,round,moderate	oxidized
Elephantine	30103 L/f ss-27	oval,moderate	oxidized
Elephantine	29102 B/b ss-28	round and moderate	oxidized
Elephantine	30103 L/f ss-29	na,sparse	na
Elephantine	30103 L/f ss-32	round and sparse	oxidized
Elephantine	30103 L/f ss-31	round and dense	oxidized
Elephantine	30103 L/f ss-30	irregular,round,sparse	oxidized
Elephantine	30103 L/f ss-33	round and flat,sparse	oxidized
Elephantine	30103 L/e ss-34	round and moderate	oxidized
Elephantine	30103 L/e ss-35	irregular, sparse	oxidized and reduced
Elephantine	30103 L/e ss-36	round and dense	oxidized
Elephantine	30103 L/e ss-37	round and sparse	oxidized
Elephantine	30103 L/e ss-38	irregular,round,dense	oxidized
Elephantine	30103 L/d ss-39	round and dense	oxidized
Elephantine	30103 L/d ss-40	irregular, round,moderate	oxidized
Elephantine	30103 L/g ss-41	na	oxidized
Elephantine	29102 E/d ss-42	irregular,flat,dense	oxidized
Elephantine	29102 E/d ss-43	irregular,round,dense	oxidized

Elephantine	29102 E/d ss-44	irregular,round,dense	oxidized
Elephantine	29102 E/d ss-45	irregular,round,flat,dense	oxidized
Elephantine	29102 E/d ss-46	irregular,round,flat,dense	reduced
Elephantine	29102 E/d ss-47	irregular,round,flat,dense	oxidized and reduced
Elephantine	30101 F/f ss-48	flat and round, dense	reduced
Elephantine	30101 F/f ss-49	na	reduced
Elephantine	30101 F/f ss-50	round and irregular,dense	oxidized and reduced
Elephantine	30101 F/f ss-51	round, dense	oxidized
Elephantine	30101 F/f ss-52	flat and irregular,moderate	oxidized
Elephantine	30101 F/f ss-53	irregular,sparse	oxidized
Elephantine	30101 F/f ss-54	na,sparse	oxidized
Elephantine	30101 F/f ss-55	round and sparse	oxidized
Elephantine	30101 F/f ss-56	round and dense	reduced
Elephantine	30101 F/f ss-57	round,irregular,moderate	oxidized
Elephantine	30101 F/f ss-58	flat and sparse	oxidized
Elephantine	30101 F/f ss-59	irregular,round,flat,dense	oxidized
Elephantine	30101 F/f ss-60	na	oxidized
Elephantine	29102 F/g ss-61	irregular,round,flat,dense	oxidized and reduced
Elephantine	29102 F/g ss-62	round,irregular,sparse	oxidized
Elephantine	29102 F/g ss-65	irregular,round,flat,dense	na
Elephantine	29102 F/g ss-63	irregular,round,flat,dense	oxidized and reduced
Elephantine	29102 F/g ss-66	round,irregular,dense	oxidized
Giza	a1/14(1)	flat pores, sparse	oxidized
Giza	a1/14(10)	round, sparse	reduced
Giza	a1/14(11)	round and flat, moderate	reduced
Giza	a1/14(13)	round pores, very sparse	reduced
Giza	a1/14(14)	flat pores, moderate	oxidized
Giza	a1/14(15)	flat pores, moderate	reduced
Giza	a1/14(16)	round pores, moderate	oxidized
Giza	a1/14(2)	flat pores, sparse	oxidized
Giza	a1/14(3)	flat pores, moderate	oxidized
Giza	a1/14(4)	round and flat, sparse	reduced
Giza	a1/14(5)	round and flat, sparse	oxidized
Giza	a1/14(6)	na	oxidized
Giza	a1/14(7)	round, sparse	reduced
Giza	a1/14(8)	round and flat, moderate	oxidized
Giza	a1/14(9)	round, sparse	oxidized
Giza	a1/15(1)	round, sparse	oxidized
Giza	a1/15(10)	round, moderate	reduced
Giza	a1/15(11)	round and flat, moderate	oxidized

Giza	a1/15(12)	round and flat, moderate	oxidized
Giza	a1/15(2)	round, sparse	oxidized
Giza	a1/15(3)	round, moderate	oxidized and reduced
Giza	a1/15(4)	round, sparse	reduced
Giza	a1/15(5)	round, moderate	oxidized
Giza	a1/15(8)	round and flat, moderate	oxidized
Giza	a1/15(9)	round and flat, moderate	oxidized
Giza	a1/40	round and flat, moderate	oxidized
Giza	a1/41	round pores, sparse	oxidized
Giza	a1/5	round and flat, dense	reduced
Giza	a10/501(1)	flat,dense	oxidized
Giza	a10/501(2)	round,moderate	oxidized
Giza	a10/501(3)	flat pores, sparse	oxidized
Giza	A2/3 (1)	round pores, sparse	oxidized
Giza	A2/3 (2)	na	oxidized
Giza	A2/3 (3)	flat pores, very sparse	oxidized
Giza	a2/3 (4)	round pores, sparse	oxidized
Giza	a2/38	flat,moderate	reduced and oxidized
Giza	a2/39	flat,dense	oxidized
Giza	a3/1(1)	flat pores, moderate	oxidized
Giza	a4/1	flat pores, moderate	reduced
Giza	a4/11	flat pores, moderate	oxidized
Giza	A4/2	round and flat pores, dense	reduced
Giza	a4/27	round pores, sparse	reduced
Giza	a4/8(1)	round pores, sparse	reduced
Giza	a4/8(2)	round pores, dense	oxidized and reduced
Giza	a4/8(3)	round and flat, moderate	oxidized and reduced
Giza	a5/13	round and flat, moderate	oxidized and reduced
Giza	a5/2	round pores, dense	oxidized
Giza	a5/7	round and flat, sparse	oxidized
Giza	a6/1022(1)	round, dense	oxidized
Giza	a6/1022(2)	round,dense	oxidized
Giza	a6/1022(3)	round, sparse	oxidized
Giza	a6/1022(4)	round and flat, moderate	reduced and oxidized
Giza	a6/1022(5)	round and flat,moderate	reduced
Giza	a6/1022(6)	round and flat, moderate	reduced and oxidized
Giza	a6/1081(1)	flat, moderate	reduced
Giza	a6/1081(2)	round and flat, sparse	reduced and oxidized
Giza	a6/1081(3)	flat and round, moderate	reduced
Giza	a6/1081(4)	flat and round,moderate	oxidized

Giza	a6/1081(5)	round and flat, moderate	oxidized
Giza	a6/11(1)	round and flat, moderate	oxidized
Giza	a6/11(2)	round and flat, dense	oxidized
Giza	a6/1190(1)	flat,dense	reduced and oxidized
Giza	a6/1190(2)	round, sparse	reduced and oxidized
Giza	a6/1190(3)	flat,sparse	reduced and oxidized
Giza	a6/1190(4)	flat,dense	reduced and oxidized
Giza	a6/23	flat and round, sparse	oxidized
Giza	a61/1089(1)	flat, moderate	oxidized
Giza	a61/1089(2)	flat and round,moderate	oxidized
Giza	a7/1003(1)	round and flat,moderate	reduced and oxidized
Giza	a7/1003(2)	flat and round, moderate	oxidized and reduced
Giza	a7/1050(1)	round and flat, moderate	oxidized and reduced
Giza	a7/1050(2)	flat and round, dense	reduced
Giza	a7/1063	flat and round, dense	reduced
Giza	a7/139(1)	round pores, moderate	reduced
Giza	a7/139(2)	round pores, dense	oxidized
Giza	a7/139(3)	round pores, moderate	oxidized
Giza	a7/139(4)	round pores, sparse	reduced and oxidized
Giza	a7/139(5)	round pores, moderate	reduced and oxidized
Giza	a7/139(6)	round pores, moderate	oxidized
Giza	a7/139(7)	round pores, dense	oxidized
Giza	a7/139(8)	round pores, sparse	oxidized
Giza	a7/139(9)	flat and round, sparse	reduced and oxidized
Giza	a7/16(1)	round, sparse	reduced and oxidized
Giza	a7/16(2)	round, moderate	reduced and oxidized
Giza	a7/16(3)	round, moderate	reduced
Giza	a7/16(4)	round and flat, moderate	oxidized
Giza	a7/19	round pores, moderate	oxidized
Giza	a7/20	round pores, moderate	burned
Giza	a7/57(1)	flat pores, moderate	reduced
Giza	a7/57(2)	round pores, sparse	oxidized
Giza	a7/57(3)	round and flat, moderate	oxidized
Giza	a7/59	round and flat, moderate	oxidized
Giza	a7/8(1)	round and flat, moderate	oxidized
Giza	a7/93	flat and round, moderate	reduced and oxidized
Giza	a7-6/1000	flat,moderate	oxidized and reduced
Giza	a8j/18(1)	round,dense	oxidized and reduced
Giza	a8j/18(2)	round and flat,sparse	oxidized
Giza	a8j/19	flat,dense	oxidized and reduced

Giza	a8j/19(1)	round and flat,moderate	oxidized
Giza	a8j/19(2)	round,sparse	oxidized
Giza	a7/19	round,flat,irregular,moderate	oxidized and reduced
Giza	a7/20	flat,dense	oxidized
Giza	a7/57(1)	round and flat,moderate	reduced and oxidized
Giza	a7/57(2)	round,sparse	
Giza	a7/57(3)	round and flat,moderate	reduced and oxidized
Giza	a7/59	flat and round,dense	oxidized
Giza	a7/8(1)	round,dense	oxidized
Giza	a7/93	round,moderate	oxidized
Giza	a7-6/1000	round and irregular,moderate	reduced
Giza	a8j/18(1)	round and irregular, moderate	reduced
Giza	a8j/18(2)	round and irregular,moderate	oxidized
Giza	a8j/19	round,sparse	na
Giza	a8j/19(1)	round and irregular,sparse	reduced and oxidized
Giza	a8j/19(2)	round,dense	oxidized
Giza	a8j/23	round,dense	oxidized
Giza	a8j/30	round,moderate	reduced
Giza	aa/522(1)	round and flat,dense	reduced and oxidized
Giza	aa/522(2)	round,dense	oxidized
Giza	aa/522(3)	round pores, dense	oxidized
Giza	aa/535(1)	round and flat, sparse	oxidized
Giza	aa/535(2)	round pores, sparse	oxidized
Giza	aa/535(3)	flat and round pores, sparse	oxidized
Giza	aa/535(4)	round pores, dense	reduced
Giza	aa/537(5)	round pores, moderate	reduced
Giza	aa/537(6)	round pores, moderate	reduced
Giza	aa/537(7)	round and flat, moderate	oxidized
Giza	aa/578(1)	flat,sparse	oxidized
Giza	aa/578(2)	round and irregular,sparse	reduced
Giza	aa/579	round and flat,moderate	oxidized
Giza	aa10/502(1)	round and flat,moderate	oxidized
Giza	aa10/502(2)	flat,dense	oxidized
Giza	aa10/502(3)	round,moderate	oxidized
Giza	aa10/508	round and flat,moderate	oxidized
Giza	c1/5(1)	round and flat,moderate	oxidized
Giza	c1/5(2)	round and flat,moderate	oxidized
Giza	c11/5(1)	flat and round,moderate	oxidized and reduced
Giza	c11/5(2)	flat,dense	oxidized
Giza	c2/1	round, dense	oxidized

Giza	c5/1	round, dense	oxidized
Giza	c9/5(1)	flat,dense	oxidized
Giza	c9/5(2)	round, dense	reduced
Giza	D17/710 (1)	round,dense	oxidized and reduced
Giza	D17/710 (2)	flat and round, dense	oxidized
Giza	d17/743(1)	flat and round, dense	oxidized
Giza	d17/743(2)	flat and round,moderate	oxidized
Giza	d17/744(1)	round and irregular, dense	oxidized and reduced
Giza	d17/744(2)	round, moderate	reduced
Giza	d17/753	round, moderate	oxidized
Giza	d17/758(1)	flat and round,dense	reduced and oxidized
Giza	d17/758(2)	flat and round,dense	oxidized
Giza	d17/758(3)	irregular,flat,round,dense	oxidized
Giza	d17/758(4)	flat and round,moderate	oxidized
Giza	d17/782(1)	round,flat,irregular,moderate	oxidized
Giza	d17/782(2)	round and flat,moderate	reduced
Giza	d17/782(3)	round,flat,irregular,moderate	oxidized
Giza	d17/782(4)	round and irregular, moderate	oxidized
Giza	d17/782(5)	round,flat,irregular,dense	oxidized
Giza	d17/785	flat and round, moderate	oxidized
Giza	D17x/1118 (8)	round and flat, dense	reduced
Giza	d17x/1118(1)	flat and round,dense	oxidized
Giza	d17x/1118(2)	round, dense	reduced
Giza	d17x/1118(3)	round and irregular, moderate	reduced and oxidized
Giza	d17x/1118(4)	round and flat, moderate	reduced and oxidized
Giza	d17x/1118(5)	flat,dense	reduced
Giza	d17x/1118(6)	flat and round, dense	reduced and oxidized
Giza	D17x/1118(7)	flat,dense	oxidized
Giza	d17x/1137(1)	flat and round, moderate	oxidized and reduced
Giza	d17x/1137(2)	flat and round, dense	oxidized
Giza	d17x/1138	round and flat,moderate	oxidized and reduced
Giza	d17x/1158	flat and round, dense	reduced and oxidized
Giza	d17x/1315	flat and round, dense	oxidized
Giza	d17x/1316	round, sparse	oxidized
Giza	d17x/1322	round,moderate	oxidized
Giza	d17x/1342	round,sparse	oxidized
Giza	d17x/1344	round,dense	oxidized
Giza	d17x/1347	round,moderate	oxidized and reduced
Giza	d17x/1349(1)	round,dense	oxidized
Giza	d17x/1349(2)	round and flat,dense	oxidized

Giza	d17x/1353	round,dense	oxidized
Giza	d17x/1363(1)	round,dense	oxidized and reduced
Giza	d17x/1363(2)	round and flat,moderate	oxidized
Giza	d17x/1363(3)	round and flat,dense	oxidized
Giza	d17x/1383(1)	round,moderate	oxidized
Giza	d17x/1383(2)	round and flat, moderate	oxidized
Giza	d17x/1408	round, moderate	oxidized
Giza	d17x/1454	flat and round pores, dense	oxidized
Giza	d19/798	round and flat, moderate	oxidized
Giza	d8/787(1)	round and flat, moderate	reduced and oxidized
Giza	d8/787(2)	round pores, sparse	reduced
Giza	d8/787(3)	flat and round pores, sparse	oxidized
Giza	d8/787(4)	round pores, moderate	reduced and oxidized
Giza	d8/787(5)	round and flat, moderate	reduced
Giza	d8/787(6)	round pores, moderate	oxidized
Giza	d8/787(7)	round and flat, moderate	reduced
Giza	d8/787(8)	round,moderate	oxidized
Giza	d8/787(9)	round and flat,sparse	oxidized
Giza	d9/707(10)	round and flat, moderate	oxidized
Giza	d9/751	round,moderate	reduced and oxidized
Giza	d9/915	irregular,moderate	oxidized
Giza	e9/1116	flat and irregular,moderate	reduced and oxidized
Giza	e9/1120	round and irregular,moderate	oxidized
Giza	e9/1361	round and flat, dense	oxidized
Giza	e9/1430	flat and round, dense	oxidized
Kom el-Hisn	30	round,irregular,moderate	oxidized
Kom el-Hisn	31	irregular,flat,moderate	reduced and oxidized
Kom el-Hisn	61	round, irregular, sparse	reduced
Kom el-Hisn	242	round,irregular,moderate	reduced
Kom el-Hisn	243	round, sparse	oxidized
Kom el-Hisn	719	round, irregular, dense	reduced and oxidized
Kom el-Hisn	754	round,irregular,moderate	oxidized
Kom el-Hisn	769	irregular,dense	reduced and oxidized
Kom el-Hisn	780	irregular,moderate	reduced and oxidized
Kom el-Hisn	786	round,irregular,moderate	reduced and oxidized
Kom el-Hisn	828	round,flat,irregular,dense	reduced
Kom el-Hisn	929	round, dense	reduced
Kom el-Hisn	1298	round, irregular, moderate	reduced and oxidized
Kom el-Hisn	1334	round,moderate	oxidized
Kom el-Hisn	1338	flat and round, moderate	reduced and oxidized

Kom el-Hisn		1367	irregular,dense	reduced
Kom el-Hisn		3114	irregular,moderate	reduced and oxidized
Kom el-Hisn	(1174		round,dense	oxidized
Kom el-Hisn	(1177		round,irregular,moderate	oxidized
Kom el-Hisn	(1281		round,irregular,dense	oxidized
Kom el-Hisn	(1282		round and flat,moderate	reduced and oxidized
Kom el-Hisn	(1376		irregular,round,dense	reduced and oxidized
Kom el-Hisn	(1394		round,irregular,dense	oxidized
Kom el-Hisn	(1473		round,irregular,dense	reduced and oxidized
Kom el-Hisn	(1527		round,sparse	oxidized
Kom el-Hisn	(1605		round,irregular,dense	oxidized
Kom el-Hisn	(1657		round,irregular,moderate	oxidized
Kom el-Hisn	(1712		round,moderate	oxidized
Kom el-Hisn	(182		round,irregular,moderate	oxidized
Kom el-Hisn	(1956		round,moderate	oxidized
Kom el-Hisn	(2038		round,moderate	oxidized
Kom el-Hisn	(2079		round,irregular,moderate	reduced and oxidized
Kom el-Hisn	(2092		round,moderate	oxidized
Kom el-Hisn	(2143		round,moderate	reduced and oxidized
Kom el-Hisn	(2144		irregular,sparse	oxidized
Kom el-Hisn	(2219		irregular,round,moderate	reduced and oxidized
Kom el-Hisn	(2248		round,moderate	oxidized
Kom el-Hisn	(2255		round,irregular,dense	oxidized
Kom el-Hisn	(2317		irregular,dense	reduced and oxidized
Kom el-Hisn	(2385		round,moderate	oxidized
Kom el-Hisn	(2394		round,irregular,moderate	oxidized
Kom el-Hisn	(2401		irregular,moderate	reduced and oxidized
Kom el-Hisn	(2403		irregular,sparse	oxidized
Kom el-Hisn	(2424		round,irregular,dense	oxidized
Kom el-Hisn	(2500		round,irregular,dense	oxidized
Kom el-Hisn	(2512		round,moderate	oxidized
Kom el-Hisn	(2518		irregular,round,moderate	oxidized
Kom el-Hisn	(2573		round,moderate	oxidized
Kom el-Hisn	(2577		irregular,moderate	reduced and oxidized
Kom el-Hisn	(2670		round,irregular,dense	oxidized
Kom el-Hisn	(2672		round,sparse	oxidized
Kom el-Hisn	(2675		round,irregular,dense	oxidized
Kom el-Hisn	(2698		round,irregular,moderate	oxidized
Kom el-Hisn	(2734		round,flat,dense	oxidized
Kom el-Hisn	(2777		round,irregular,dense	oxidized

Kom el-Hisn	(2845	round,sparse	oxidized
Kom el-Hisn	(2851	round,moderate	oxidized
Kom el-Hisn	(2885	round,moderate	oxidized
Kom el-Hisn	(2946	round,irregular,moderate	reduced and oxidized
Kom el-Hisn	(2949	irregular,round,moderate	reduced and oxidized
Kom el-Hisn	(2962	irregular,round,moderate	reduced and oxidized
Kom el-Hisn	(3000	round,irregular,moderate	reduced and oxidized
Kom el-Hisn	(3041	round,moderate	reduced and oxidized
Kom el-Hisn	(3042	round,flat,moderate	oxidized
Kom el-Hisn	(3082	round,sparse	reduced
Kom el-Hisn	(3086	round,moderate	reduced
Kom el-Hisn	(3090	round,irregular,moderate	oxidized
Kom el-Hisn	(3099	round,sparse	oxidized
Kom el-Hisn	(3129	round,irregular,dense	oxidized
Kom el-Hisn	(3131	irregular,moderate	reduced and oxidized
Kom el-Hisn	(3152	round,dense	oxidized
Kom el-Hisn	(3177	round,irregular,moderate	reduced
Kom el-Hisn	(3181	irregular,round,moderate	reduced
Kom el-Hisn	(3190	round,irregular,dense	oxidized
Kom el-Hisn	(3208	round,irregular,moderate	reduced and oxidized
Kom el-Hisn	(3263	round,irregular,moderate	oxidized
Kom el-Hisn	(3279	round,moderate	reduced
Kom el-Hisn	(3294	round,moderate	reduced and oxidized
Kom el-Hisn	(3297	round,sparse	reduced and oxidized
Kom el-Hisn	(3303	round,irregular,moderate	oxidized
Kom el-Hisn	(3304	round,moderate	oxidized
Kom el-Hisn	(3331	flat,round,moderate	reduced and oxidized
Kom el-Hisn	(3401	irregular,moderate	oxidized
Kom el-Hisn	(3402	round,irregular,moderate	oxidized
Kom el-Hisn	(3403	round,dense	oxidized
Kom el-Hisn	(3426	irregular,dense	reduced and oxidized
Kom el-Hisn	(3449	round,irregular,moderate	oxidized
Kom el-Hisn	(3488	irregular,round,moderate	oxidized
Kom el-Hisn	(3536	irregular,round,moderate	oxidized
Kom el-Hisn	(3608	round,flat,moderate	oxidized
Kom el-Hisn	(3657	round,irregular,moderate	reduced
Kom el-Hisn	(3658	round,flat,dense	reduced and oxidized
Kom el-Hisn	(3663	round,irregular,moderate	oxidized
Kom el-Hisn	(3673	irregular,round,moderate	reduced
Kom el-Hisn	(3676	irregular,flat,moderate	oxidized

Kom el-Hisn	(3680	round,moderate	reduced
Kom el-Hisn	(3695	round,irregular,moderate	oxidized
Kom el-Hisn	(3698	round,irregular,moderate	oxidized
Kom el-Hisn	(3777	round,dense	oxidized
Kom el-Hisn	(3810	round,flat,irregular,dense	oxidized
Kom el-Hisn	(3864	round,irregular,moderate	oxidized
Kom el-Hisn	(3883	round,moderate	oxidized
Kom el-Hisn	(3902	round,irregular,moderate	reduced and oxidized
Kom el-Hisn	(3912	round,irregular,sparse	oxidized
Kom el-Hisn	(3940	irregular,dense	reduced and oxidized
Kom el-Hisn	(3948	round,irregular,moderate	oxidized
Kom el-Hisn	(3982	round,flat,moderate	reduced and oxidized
Kom el-Hisn	(4055	round,irregular,moderate	oxidized
Kom el-Hisn	(4119	flat,moderate	oxidized
Kom el-Hisn	(4181	flat,moderate	reduced and oxidized
Kom el-Hisn	(4253	round,flat,dense	reduced
Kom el-Hisn	(4265	flat,round,dense	oxidized
Kom el-Hisn	(4286	round,irregular,dense	oxidized
Kom el-Hisn	(4311	flat,round,moderate	reduced and oxidized
Kom el-Hisn	(4645	round,flat,moderate	reduced
Kom el-Hisn	(4920	irregular,moderate	oxidized
Kom el-Hisn	(4941	round,moderate	reduced and oxidized
Kom el-Hisn	(4958	round,moderate	oxidized
Kom el-Hisn	(7509	irregular,moderate	reduced and oxidized
Kom el-Hisn	(958	irregular,moderate	oxidized
Kom el-Hisn	[6007]	flat and round, moderate	reduced
Kom el-Hisn	[7724]	round, moderate	reduced and oxidized
Kom el-Hisn	[888]	round, irregular, moderate	reduced
Kom el-Hisn	x1011	round,flat,moderate	reduced
Kom el-Hisn	x1082	round,irregular,moderate	reduced
Kom el-Hisn	x1160	round,irregular,moderate	oxidized
Kom el-Hisn	x1281	irregular,round,moderate	reduced and oxidized
Kom el-Hisn	x1386	round,irregular,moderate	oxidized
Kom el-Hisn	x1410	round, dense	reduced
Kom el-Hisn	x1476	irregular,round,moderate	oxidized
Kom el-Hisn	x1527	irregular,round,moderate	oxidized
Kom el-Hisn	x183	round,moderate	oxidized
Kom el-Hisn	x2640	round,moderate	oxidized
Kom el-Hisn	x268	flat and round, moderate	oxidized
Kom el-Hisn	x2780	round,flat,sparse	oxidized

Kom el-Hisn	x3791	flat and round, moderate	oxidized
Kom el-Hisn	x382	round,irregular,moderate	oxidized
Kom el-Hisn	x3827	round,irregular,dense	oxidized
Kom el-Hisn	x3840	irregular,flat,round,dense	oxidized
Kom el-Hisn	x3842	round,irregular,moderate	oxidized
Kom el-Hisn	x4001	round,irregular,dense	reduced and oxidized
Kom el-Hisn	x4017	round,sparse	reduced
Kom el-Hisn	x404	round,sparse	oxidized
Kom el-Hisn	x405	round,sparse	reduced
Kom el-Hisn	x4063	round,sparse	oxidized
Kom el-Hisn	x4132	irregular,round,moderate	reduced
Kom el-Hisn	x4163	round,irregular,dense	reduced
Kom el-Hisn	x4165	round,dense	reduced and oxidized
Kom el-Hisn	x4204	round,moderate	oxidized
Kom el-Hisn	x4206	irregular,dense	reduced
Kom el-Hisn	x4229	flat,moderate	oxidized
Kom el-Hisn	x442	round,irregular,dense	reduced
Kom el-Hisn	x504	round,irregular,moderate	reduced and oxidized
Kom el-Hisn	x95	round,irregular,moderate	reduced
Kom el-Hisn	(4272	round,moderate	oxidized
Kom el-Hisn	(4285	irregular,round,dense	oxidized
Kom el-Hisn	(4935	round,moderate	oxidized
Kom el-Hisn	(4126	irregular,round,dense	oxidized
Kom el-Hisn	(4317	irregular,round,dense	oxidized
Kom el-Hisn	(4923	irregular,moderate	oxidized
Kom el-Hisn	(4295	irregular,moderate	reduced
Kom el-Hisn	(4030	irregular,moderate	oxidized
Kom el-Hisn	(4218	irregular,moderate	oxidized
Kom el-Hisn	(4959	irregular,moderate	reduced and oxidized
Kom el-Hisn	(4312	irregular,moderate	reduced and oxidized
Kom el-Hisn	(4932	irregular,moderate	oxidized
Kom el-Hisn	(4862	irregular,moderate	oxidized
Kom el-Hisn	(4647	irregular,moderate	oxidized
Kom el-Hisn	(5987	irregular,round,moderate	reduced
Kom el-Hisn	(5017	irregular,moderate	reduced and oxidized
Kom el-Hisn	(5988	irregular,sparse	oxidized
Kom el-Hisn	(5255	round,moderate	oxidized
Kom el-Hisn	(5990	round,irregular,moderate	reduced and oxidized
Kom el-Hisn	(5359	flat,round,sparse	reduced and oxidized
Kom el-Hisn	(5992	irregular,moderate	oxidized

Kom el-Hisn	(5338	irregular,moderate	oxidized
Kom el-Hisn	(5167	irregular,dense	oxidized
Kom el-Hisn	(5676	irregular,flat,moderate	reduced and oxidized
Kom el-Hisn	(5156	irregular,round,moderate	reduced and oxidized
Kom el-Hisn	(5673	irregular,moderate	reduced and oxidized
Kom el-Hisn	(5523	round,irregular,moderate	oxidized
Kom el-Hisn	(5245	irregular,round,moderate	oxidized
Kom el-Hisn	(5014	irregular,round,dense	reduced and oxidized
Kom el-Hisn	(5811	irregular,moderate	reduced and oxidized
Kom el-Hisn	(5001	flat,sparse	oxidized
Kom el-Hisn	(5579	irregular,round,moderate	oxidized
Kom el-Hisn	(5003	irregular,sparse	reduced and oxidized
Kom el-Hisn	(5329	irregular,round,moderate	oxidized
Kom el-Hisn	(5397	round,irregular,moderate	oxidized
Kom el-Hisn	(5581	irregular,round,moderate	reduced and oxidized
Kom el-Hisn	(5834	irregular,moderate	reduced and oxidized
Kom el-Hisn	(5782	irregular,moderate	oxidized
Kom el-Hisn	(5205	irregular,moderate	oxidized
Kom el-Hisn	(6585	irregular,dense	oxidized
Kom el-Hisn	(6586	irregular,moderate	oxidized
Kom el-Hisn	(6001	irregular,moderate	reduced and oxidized
Kom el-Hisn	(6005	irregular,round,moderate	oxidized
Kom el-Hisn	(6686	irregular,round,dense	reduced and oxidized
Kom el-Hisn	(6003	irregular,round,moderate	reduced and oxidized
Kom el-Hisn	(6070	round,irregular,moderate	reduced and oxidized
Kom el-Hisn	(6405	irregular,round,dense	oxidized
Kom el-Hisn	(6397	round,moderate	reduced and oxidized
Kom el-Hisn	(6755	round,sparse	reduced and oxidized
Kom el-Hisn	(6413	flat,irregular,moderate	reduced and oxidized
Kom el-Hisn	(6391	flat,moderate	reduced and oxidized
Kom el-Hisn	(6006	round,irregular,moderate	oxidized
Kom el-Hisn	(6910	irregular,sparse	oxidized
Kom el-Hisn	(6424	round,irregular,sparse	reduced and oxidized
Kom el-Hisn	(6749	flat,irregular,moderate	oxidized
Kom el-Hisn	(6412	flat,round,moderate	oxidized
Kom el-Hisn	(6381	irregular,round,dense	oxidized
Kom el-Hisn	(6645	irregular,round,dense	reduced and oxidized
Kom el-Hisn	(6583	round,flat,moderate	oxidized
Kom el-Hisn	(6911	flat,irregular,moderate	reduced
Kom el-Hisn	(6423	irregular,moderate	oxidized

Kom el-Hisn	(6347		flat,round,sparse	oxidized
Kom el-Hisn	(6856		irregular,round,moderate	reduced and oxidized
Kom el-Hisn	(6422		round,dense	oxidized
Kom el-Hisn	(6598		irregular,sparse	reduced and oxidized
Kom el-Hisn	(6978		round,moderate	oxidized
Kom el-Hisn	(6552		flat,round,dense	oxidized
Kom el-Hisn	(6543		round,irregular,moderate	oxidized
Kom el-Hisn	(6608		round,flat,moderate	oxidized
Kom el-Hisn	(6387		round,irregular,moderate	reduced
Kom el-Hisn	(6806		flat,irregular,moderate	oxidized
Kom el-Hisn	(6302		irregular,round,moderate	oxidized
Kom el-Hisn	(6375		irregular,dense	oxidized
Kom el-Hisn	(6399		round,irregular,dense	reduced and oxidized
Kom el-Hisn	(6428		flat,irregular,moderate	reduced and oxidized
Kom el-Hisn	(6938		irregular,sparse	oxidized
Kom el-Hisn	(6400		flat,round,moderate	oxidized
Kom el-Hisn	(6547		round,irregular,moderate	reduced
Kom el-Hisn	(6982		round,irregular,moderate	oxidized
Kom el-Hisn	(6211		irregular,dense	oxidized
Kom el-Hisn		5835	irregular,moderate	reduced and oxidized
Kom el-Hisn		2727	irregular,moderate	oxidized
Kom el-Hisn	x1918		irregular,round,moderate	reduced and oxidized
Kom el-Hisn		270	round,moderate	oxidized
Kom el-Hisn		179	flat,round,moderate	oxidized
Kom el-Hisn		2656	flat,irregular,moderate	reduced and oxidized
Kom el-Hisn		2616	round,irregular,moderate	reduced and oxidized
Kom el-Hisn		115	sparse	oxidized
Kom el-Hisn		1878	irregular,moderate	oxidized
Kom el-Hisn		1249	irregular,moderate	reduced and oxidized
Kom el-Hisn		3862	irregular,sparse	oxidized
Kom el-Hisn		451	irregular,sparse	reduced and oxidized
Kom el-Hisn	(5689		irregular,moderate	oxidized
Kom el-Hisn		2370	flat,irregular,moderate	reduced and oxidized
Kom el-Hisn		3013	round,moderate	oxidized
Kom el-Hisn		1468	irregular,moderate	reduced and oxidized
Kom el-Hisn	x2518		irregular,round,moderate	reduced and oxidized
Kom el-Hisn		1293	flat,round,moderate	reduced and oxidized
Kom el-Hisn		1412	sparse	reduced and oxidized
Kom el-Hisn	(1134		round,moderate	oxidized
Kom el-Hisn	(2104		sparse	reduced

Kom el-Hisn		1339	irregular,moderate	reduced and oxidized
Kom el-Hisn		7268	irregular,round,moderate	oxidized
Kom el-Hisn		2503	round,irregular,moderate	oxidized
Kom el-Hisn		1360	irregular,moderate	reduced and oxidized
Kom el-Hisn		2726	irregular,moderate	oxidized
Kom el-Hisn		397	irregular,sparse	reduced and oxidized
Kom el-Hisn		1340	irregular,moderate	oxidized
Kom el-Hisn		3135	irregular,moderate	oxidized
Kom el-Hisn		2520	irregular,moderate	oxidized
Kom el-Hisn	x2013		flat,irregular,sparse	reduced and oxidized
Kom el-Hisn	x2138		irregular,moderate	oxidized
Kom el-Hisn		1327	round,moderate	na
Kom el-Hisn	(2222		round,irregular,moderate	oxidized
Kom el-Hisn		1424	round,moderate	oxidized
Kom el-Hisn		2447	sparse	reduced
Kom el-Hisn		900	flat,irregular,dense	na
Kom el-Hisn	(1625		round,irregular,dense	reduced and oxidized
Kom el-Hisn		176	flat,irregular,moderate	oxidized
Kom el-Hisn	x1697		irregular,round,dense	oxidized
Kom el-Hisn	x1783		round,irregular,moderate	oxidized
Kom el-Hisn	x1782		round,irregular,moderate	oxidized
Kom el-Hisn		219	irregular,round,dense	reduced
Kom el-Hisn		2254	irregular,moderate	oxidized
Kom el-Hisn		1309	irregular,round,moderate	oxidized
Kom el-Hisn		444	irregular,round,dense	oxidized
Kom el-Hisn		1410	round,moderate	oxidized
Kom el-Hisn		2514	round,irregular,dense	oxidized
Kom el-Hisn	(938		round,irregular,moderate	oxidized
Kom el-Hisn		1341	irregular,round,moderate	oxidized
Kom el-Hisn		512	irregular,round,moderate	oxidized
Kom el-Hisn	(2266		round,irregular,moderate	reduced
Kom el-Hisn	(1856		round,moderate	oxidized
Kom el-Hisn		1414	round,irregular,moderate	oxidized
Kom el-Hisn	x3412		irregular,moderate	reduced and oxidized
Kom el-Hisn	x3082		irregular,dense	oxidized
Kom el-Hisn	(2589		irregular,moderate	reduced and oxidized
Kom el-Hisn		384	irregular,moderate	oxidized
Kom el-Hisn		1301	irregular,moderate	reduced and oxidized
Kom el-Hisn		1509	irregular,round,dense	reduced and oxidized
Kom el-Hisn	(2791		flat,round,moderate	reduced and oxidized

Kom el-Hisn	x1775		irregular,moderate	reduced and oxidized
Kom el-Hisn	(1487		irregular,moderate	oxidized
Kom el-Hisn	x441		irregular,flat,moderate	reduced and oxidized
Kom el-Hisn	x3355		irregular,moderate	oxidized
Kom el-Hisn	x2150		round,irregular,moderate	oxidized
Kom el-Hisn		2070	irregular,sparse	reduced and oxidized
Kom el-Hisn		810	flat,round,sparse	na
Kom el-Hisn	x1643		flat,round,sparse	oxidized
Kom el-Hisn		3414	round,irregular,moderate	oxidized
Kom el-Hisn	x1553		irregular,dense	reduced and oxidized
Kom el-Hisn	x355		irregular,dense	reduced and oxidized
Kom el-Hisn	x1791		irregular,moderate	oxidized
Kom el-Hisn		1328	irregular,round,dense	oxidized
Kom el-Hisn	(1971		irregular,dense	na
Kom el-Hisn	(792		irregular,round,moderate	oxidized
Kom el-Hisn	(976		irregular,round,moderate	oxidized
Kom el-Hisn	(250		irregular,flat,moderate	oxidized
Kom el-Hisn	(987		irregular,flat,moderate	oxidized
Kom el-Hisn	(323		round,irregular,dense	na
Kom el-Hisn	(645		round,irregular,dense	oxidized
Kom el-Hisn	(793		irregular,round,dense	oxidized
Kom el-Hisn	(693		irregular,flat,dense	oxidized
Kom el-Hisn	(683		round,irregular,moderate	oxidized
Kom el-Hisn	(180		irregular,round,moderate	oxidized
Kom el-Hisn	(342		irregular,round,dense	oxidized
Kom el-Hisn	(188		irregular,moderate	oxidized
Kom el-Hisn	(231		irregular,moderate	oxidized
Kom el-Hisn	(510		irregular,moderate	oxidized
Kom el-Hisn	(523		irregular,moderate	oxidized
Kom el-Hisn	(580		irregular,round,moderate	na
Kom el-Hisn	(33		irregular,moderate	na
Kom el-Hisn	(103		irregular,round,moderate	oxidized
Kom el-Hisn	(7328		irregular,dense	reduced
Kom el-Hisn	(7651		irregular,flat,moderate	reduced and oxidized
Kom el-Hisn	(7511		round,dense	oxidized
Kom el-Hisn	(7391		irregular,round,moderate	reduced and oxidized
Kom el-Hisn	(7133		irregular,round,dense	reduced and oxidized
Kom el-Hisn	(7574		irregular,dense	reduced and oxidized
Kom el-Hisn	(7517		irregular,dense	oxidized
Kom el-Hisn	(7435		irregular,flat,dense	oxidized

Kom el-Hisn	(7040	irregular,flat,dense	oxidized
Kom el-Hisn	(7714	irregular,sparse	oxidized
Kom el-Hisn	(7117	irregular,flat,moderate	oxidized
Kom el-Hisn	(7454	irregular,round,dense	oxidized
Kom el-Hisn	(7653	irregular,sparse	reduced and oxidized
Kom el-Hisn	(7519	irregular,moderate	oxidized
Kom el-Hisn	(7493	irregular,sparse	oxidized
Kom el-Hisn	(7152	irregular,flat,moderate	oxidized
Kom el-Hisn	(7485	irregular,moderate	reduced and oxidized
Kom el-Hisn	(7443	irregular,flat,moderate	oxidized
Kom el-Hisn	(7073	irregular,moderate	reduced and oxidized
Kom el-Hisn	(7713	irregular,sparse	oxidized
Kom el-Hisn	(7712	irregular,sparse	oxidized
Kom el-Hisn	(7488	irregular,sparse	oxidized
Kom el-Hisn	(7442	irregular,round,moderate	oxidized
Kom el-Hisn	(7290	irregular,round,moderate	oxidized
Kom el-Hisn	(7560	irregular,round,moderate	oxidized
Kom el-Hisn	(7160	irregular,round,moderate	oxidized
Kom el-Hisn	(7437	irregular,round,dense	oxidized
Kom el-Hisn	(7618	irregular,round,dense	oxidized
Kom el-Hisn	(7356	irregular,flat,moderate	oxidized
Kom el-Hisn	(7435	irregular,round,moderate	oxidized
Kom el-Hisn	(7553	irregular,moderate	oxidized
Kom el-Hisn	(7719	irregular,round,moderate	oxidized
Kom el-Hisn	(7617	irregular,round,moderate	oxidized
Kom el-Hisn	(7034	irregular,moderate	oxidized

Table A1-3: Clay types and additional descriptive comments.

Site	Sherd Number	clay	comments
Elephantine	z2018 21311e	marl/alluvial	
Elephantine	z1564 22319a	marl/alluvial	base burned
Elephantine	z1512 17344a	marl/alluvial	
Elephantine	z1565 22316	marl/alluvial	large calcite exterior
Elephantine	z199617304dd	alluvial	large temper variety
Elephantine	z1996 17304dd	alluvial	large temper variety
Elephantine	z2002 24304dd	marl/alluvial	large temper variety
Elephantine	z1284 8936	alluvial	
Elephantine	z8737983m	alluvial	
Elephantine	z1296 8937m	alluvial	

Elephantine	8926f z972	marl/alluvial	red slip int rim?
Elephantine	z870 5914	alluvial	
Elephantine	z874 5907	marl/alluvial	
Elephantine	z1763 24314c	marl/alluvial	
Elephantine	z2564 16350d	marl/alluvial	
Elephantine	z926f z925	marl	
Elephantine	z2488 5967	marl	burned
Elephantine	z974 8926P	marl	
Elephantine	z876 6351 (1966)	marl/alluvial	burned
Elephantine	z875 6351(1925)	marl	
Elephantine	z20499 22983a	marl/alluvial	no complete cross section
Elephantine	10410 c1	marl/alluvial	
Elephantine	8926f z958	marl	
Elephantine	5968	marl	burned
Elephantine	8926f z929	marl	pure, white, marl
Elephantine	8926f z926	marl	pure, pinkish marl
Elephantine	8926f z593	marl	
Elephantine	8926f z951	marl	
Elephantine	8926f z954	marl	
Elephantine	8926f z949	marl	
Elephantine	8926f z941	marl/alluvial	burned
Elephantine	8926f z930	marl/alluvial	
Elephantine	8926f z959	marl	
Elephantine	8926f z982	marl/alluvial	burned
Elephantine	8926f z993	marl	
Elephantine	5925 z2484	marl	very fine
Elephantine	8403-1 z4616	marl/alluvial	complete, no cross section
Elephantine	7954a 25226	marl/alluvial	groove around rim
Elephantine	7940b z25230	alluvial	
Elephantine	za 371	alluvial	
Elephantine	18895c 5	marl	probably not MB
Elephantine	29103 L/H 17	marl	
Elephantine	29103 p/a 18	marl	
Elephantine	18895c 4	marl/alluvial	organic? Temper
Elephantine	30101 f/g 45	marl	
Elephantine	29102 b/a 27	marl	
Elephantine	29102 b/a 26	marl/alluvial	
Elephantine	29102 b/a 28	marl/alluvial	odd manufacture
Elephantine	29103 ss-1	marl	
Elephantine	29103 ss-2	alluvial	groove around rim

Elephantine	29103 ss-3	alluvial	
Elephantine	30103 k/c ss-4	marl	
Elephantine	30103 k/c ss-5	marl	
Elephantine	30101 h/k ss-6	marl/alluvial	burned
Elephantine	30101F/g ss-7	marl	
Elephantine	30103 L/d ss-8	marl	
Elephantine	30101 H/g ss-9	marl	
Elephantine	29103 G/c ss-10	marl	
Elephantine	29103 G/c ss-11	marl	burned
Elephantine	29103 G/c ss-12	marl	
Elephantine	29102 B/a ss-13	marl/alluvial	
Elephantine	29102 B/a ss-14	marl	burned
Elephantine	29102 B/a ss-15	marl	slightly burned
Elephantine	29102 B/a ss-16	marl/alluvial	slightly burned
Elephantine	29102 B/a ss-17	marl/alluvial	burned
Elephantine	30103 B/a ss-18	marl	
Elephantine	29103 G/g ss-19	marl/alluvial	
Elephantine	29103 G/d ss-20	marl	
Elephantine	29103 G/d ss-21	marl	
Elephantine	29103 G/d ss-22	marl/alluvial	
Elephantine	29103 G/d ss-23	marl	
Elephantine	29103 G/d ss-24	marl/alluvial	
Elephantine	29103 G/d ss-25	marl	
Elephantine	30103 L/f ss-26	marl	
Elephantine	30103 L/f ss-27	marl	
Elephantine	29102 B/b ss-28	marl/alluvial	
Elephantine	30103 L/f ss-29	marl	
Elephantine	30103 L/f ss-32	marl	
Elephantine	30103 L/f ss-31	marl	
Elephantine	30103 L/f ss-30	marl	
Elephantine	30103 L/f ss-33	marl	
Elephantine	30103 L/e ss-34	marl/alluvial	
Elephantine	30103 L/e ss-35	marl	looks deep
Elephantine	30103 L/e ss-36	marl	pores are subsand sized
Elephantine	30103 L/e ss-37	marl	
Elephantine	30103 L/e ss-38	marl	round pores are subsand
Elephantine	30103 L/d ss-39	marl/alluvial	round pores are subsand
Elephantine	30103 L/d ss-40	marl	interior impression
Elephantine	30103 L/g ss-41	marl	
Elephantine	29102 E/d ss-42	alluvial	straw impression?

Elephantine	29102 E/d ss-43	alluvial	straw impression?
Elephantine	29102 E/d ss-44	marl/alluvial	
Elephantine	29102 E/d ss-45	alluvial	large pores
Elephantine	29102 E/d ss-46	alluvial	
Elephantine	29102 E/d ss-47	alluvial	
Elephantine	30101 F/f ss-48	alluvial	large,flat,fibre pores
Elephantine	30101 F/f ss-49	alluvial	machine made,very fine
Elephantine	30101 F/f ss-50	alluvial	very burned
Elephantine	30101 F/f ss-51	marl/alluvial	round pores are subsand
Elephantine	30101 F/f ss-52	alluvial	
Elephantine	30101 F/f ss-53	marl/alluvial	
Elephantine	30101 F/f ss-54	marl	
Elephantine	30101 F/f ss-55	marl/alluvial	round pores are subsand
Elephantine	30101 F/f ss-56	marl/alluvial	round pores are subsand
Elephantine	30101 F/f ss-57	marl	
Elephantine	30101 F/f ss-58	marl	
Elephantine	30101 F/f ss-59	alluvial	straw impression?
Elephantine	30101 F/f ss-60	marl	
Elephantine	29102 F/g ss-61	alluvial	straw impression?
Elephantine	29102 F/g ss-62	alluvial	straw impression?
Elephantine	29102 F/g ss-65	marl/alluvial	some temp burned
Elephantine	29102 F/g ss-63	alluvial	
Elephantine	29102 F/g ss-66	alluvial	
Giza	a1/14(1)	alluvium	
Giza	a1/14(10)	marl/alluvium	
Giza	a1/14(11)	alluvium	
Giza	a1/14(13)	marl/alluvium	
Giza	a1/14(14)	marl/alluvium	
Giza	a1/14(15)	alluvium	
Giza	a1/14(16)	alluvium	
Giza	a1/14(2)	marl/alluvium	
Giza	a1/14(3)	alluvium	
Giza	a1/14(4)	alluvium	
Giza	a1/14(5)	alluvium	
Giza	a1/14(6)	alluvium	
Giza	a1/14(7)	alluvium	
Giza	a1/14(8)	alluvium	
Giza	a1/14(9)	alluvium	
Giza	a1/15(1)	alluvium	
Giza	a1/15(10)	alluvium	

Giza	a1/15(11)	marl
Giza	a1/15(12)	alluvium
Giza	a1/15(2)	alluvium
Giza	a1/15(3)	alluvium
Giza	a1/15(4)	alluvium
Giza	a1/15(5)	alluvium
Giza	a1/15(8)	alluvium
Giza	a1/15(9)	alluvium
Giza	a1/40	marl/alluvium
Giza	a1/41	marl
Giza	a1/5	alluvium
Giza	a10/501(1)	marl
Giza	a10/501(2)	marl
Giza	a10/501(3)	alluvium
Giza	A2/3 (1)	marl
Giza	A2/3 (2)	marl
Giza	A2/3 (3)	alluvium
Giza	a2/3 (4)	marl
Giza	a2/38	alluvium
Giza	a2/39	marl
Giza	a3/1(1)	marl/alluvium
Giza	a4/1	alluvium
Giza	a4/11	marl
Giza	A4/2	alluvium
Giza	a4/27	marl/alluvium
Giza	a4/8(1)	marl/alluvium
Giza	a4/8(2)	alluvium
Giza	a4/8(3)	marl/alluvium
Giza	a5/13	alluvium
Giza	a5/2	marl/alluvium
Giza	a5/7	alluvium
Giza	a6/1022(1)	alluvium
Giza	a6/1022(2)	alluvium
Giza	a6/1022(3)	marl/alluvium
Giza	a6/1022(4)	alluvium
Giza	a6/1022(5)	alluvium
Giza	a6/1022(6)	alluvium
Giza	a6/1081(1)	alluvium
Giza	a6/1081(2)	marl/alluvium
Giza	a6/1081(3)	marl/alluvium

Giza	a6/1081(4)	alluvium	
Giza	a6/1081(5)	marl/alluvium	
Giza	a6/11(1)	marl	
Giza	a6/11(2)	alluvium	
Giza	a6/1190(1)	alluvium	
Giza	a6/1190(2)	alluvium	
Giza	a6/1190(3)	marl/alluvium	
Giza	a6/1190(4)	marl/alluvium	
Giza	a6/23	alluvium	
Giza	a61/1089(1)	alluvium	
Giza	a61/1089(2)	marl/alluvium	
Giza	a7/1003(1)	marl/alluvium	
Giza	a7/1003(2)	alluvium	
Giza	a7/1050(1)	alluvium	
Giza	a7/1050(2)	alluvium	
Giza	a7/1063	alluvium	
Giza	a7/139(1)	alluvium	
Giza	a7/139(2)	alluvium	
Giza	a7/139(3)	alluvium	
Giza	a7/139(4)	alluvium	
Giza	a7/139(5)	alluvium	
Giza	a7/139(6)	alluvium	
Giza	a7/139(7)	alluvium	
Giza	a7/139(8)	na	
Giza	a7/139(9)	alluvium	
Giza	a7/16(1)	alluvium	
Giza	a7/16(2)	alluvium	
Giza	a7/16(3)	alluvium	
Giza	a7/16(4)	alluvium	
Giza	a7/19	marl/alluvium	
Giza	a7/20	na	
Giza	a7/57(1)	marl	
Giza	a7/57(2)	alluvium	
Giza	a7/57(3)	alluvium	
Giza	a7/59	marl	
Giza	a7/8(1)	alluvium	
Giza	a7/93	alluvium	burned
Giza	a7-6/1000	marl/alluvium	
Giza	a8j/18(1)	marl/alluvium	pores are subsand sized
Giza	a8j/18(2)	alluvium	

Giza	a8j/19	marl/alluvium	
Giza	a8j/19(1)	marl/alluvium	burned
Giza	a8j/19(2)	marl/alluvium	
Giza	a7/19	marl/alluvium	fabric is very course
Giza	a7/20	alluvium	
Giza	a7/57(1)	marl/alluvium	
Giza	a7/57(2)		
Giza	a7/57(3)	marl/alluvium	
Giza	a7/59	alluvium	
Giza	a7/8(1)	alluvium	
Giza	a7/93	alluvium	
Giza	a7-6/1000	alluvium	
Giza	a8j/18(1)	alluvium	
Giza	a8j/18(2)	alluvium	some large circular pores
Giza	a8j/19	marl/alluvium	burned
Giza	a8j/19(1)	alluvium	
Giza	a8j/19(2)	alluvium	
Giza	a8j/23	marl	pores are subsand sized
Giza	a8j/30	marl/alluvium	
Giza	aa/522(1)	marl/alluvium	burned
Giza	aa/522(2)	marl	pores are subsand sized
Giza	aa/522(3)	alluvium	
Giza	aa/535(1)	marl/alluvium	
Giza	aa/535(2)	alluvium	
Giza	aa/535(3)	alluvium	
Giza	aa/535(4)	alluvium	
Giza	aa/537(5)	alluvium	
Giza	aa/537(6)	alluvium	
Giza	aa/537(7)	marl/alluvium	
Giza	aa/578(1)	marl	
Giza	aa/578(2)	marl/alluvium	weathered
Giza	aa/579	alluvium	
Giza	aa10/502(1)	marl/alluvium	
Giza	aa10/502(2)	alluvium	
Giza	aa10/502(3)	alluvium	
Giza	aa10/508	alluvium	
Giza	c1/5(1)	alluvium	
Giza	c1/5(2)	marl	
Giza	c11/5(1)	alluvium	
Giza	c11/5(2)	alluvium	

Giza	c2/1	alluvium	
Giza	c5/1	alluvium	
Giza	c9/5(1)	alluvium	
Giza	c9/5(2)	marl/alluvium	
Giza	D17/710 (1)	marl/alluvium	
Giza	D17/710 (2)	alluvium	
Giza	d17/743(1)	alluvium	
Giza	d17/743(2)	marl/alluvium	
Giza	d17/744(1)	alluvium	weathered
Giza	d17/744(2)	alluvium	weathered
Giza	d17/753	marl/alluvium	
Giza	d17/758(1)	alluvium	weathered
Giza	d17/758(2)	marl/alluvium	
Giza	d17/758(3)	marl/alluvium	
Giza	d17/758(4)	alluvium	
Giza	d17/782(1)	alluvium	
Giza	d17/782(2)	alluvium	
Giza	d17/782(3)	alluvium	
Giza	d17/782(4)	alluvium	
Giza	d17/782(5)	alluvium	
Giza	d17/785	alluvium	
Giza	D17x/1118 (8)	alluvium	
Giza	d17x/1118(1)	alluvium	
Giza	d17x/1118(2)	alluvium	
Giza	d17x/1118(3)	marl/alluvium	
Giza	d17x/1118(4)	alluvium	
Giza	d17x/1118(5)	alluvium	
Giza	d17x/1118(6)	alluvium	
Giza	D17x/1118(7)	marl/alluvium	
Giza	d17x/1137(1)	marl/alluvium	
Giza	d17x/1137(2)	alluvium	
Giza	d17x/1138	alluvium	
Giza	d17x/1158	alluvium	
Giza	d17x/1315	alluvium	
Giza	d17x/1316	alluvium	
Giza	d17x/1322	alluvium	
Giza	d17x/1342	alluvium	
Giza	d17x/1344	marl/alluvium	
Giza	d17x/1347	alluvium	
Giza	d17x/1349(1)	alluvium	

Giza	d17x/1349(2)	marl/alluvium	
Giza	d17x/1353	alluvium	
Giza	d17x/1363(1)	marl/alluvium	
Giza	d17x/1363(2)	alluvium	
Giza	d17x/1363(3)	alluvium	
Giza	d17x/1383(1)	marl/alluvium	
Giza	d17x/1383(2)	marl/alluvium	
Giza	d17x/1408	alluvium	
Giza	d17x/1454	alluvium	
Giza	d19/798	alluvium	
Giza	d8/787(1)	alluvium	
Giza	d8/787(2)	marl/alluvium	
Giza	d8/787(3)	marl	
Giza	d8/787(4)	alluvium	
Giza	d8/787(5)	alluvium	
Giza	d8/787(6)	alluvium	
Giza	d8/787(7)	alluvium	
Giza	d8/787(8)	alluvium	
Giza	d8/787(9)	marl/alluvium	most temper particles subsand
Giza	d9/707(10)	marl/alluvium	
Giza	d9/751	marl/alluvium	
Giza	d9/915	marl/alluvium	
Giza	e9/1116	alluvium	
Giza	e9/1120	alluvium	
Giza	e9/1361	alluvium	
Giza	e9/1430	alluvium	
Kom el-Hisn	30	marl/alluvium	burned
Kom el-Hisn	31	alluvium	
Kom el-Hisn	61	marl	similar to x 1410
Kom el-Hisn	242	alluvium	burned
Kom el-Hisn	243	alluvium	
Kom el-Hisn	719	marl/alluvium	organic temper?
Kom el-Hisn	754	alluvium	
Kom el-Hisn	769	marl	
Kom el-Hisn	780	marl/alluvium	burned exterior,interior
Kom el-Hisn	786	marl/alluvium	burned exterior,interior
Kom el-Hisn	828	alluvium	burned exterior,interior
Kom el-Hisn	929	marl/alluvium	burned and eroded surface
Kom el-Hisn	1298	marl/alluvium	burned and eroded surface
Kom el-Hisn	1334	alluvium	burned exterior

Kom el-Hisn		1338	marl/alluvium	organic temper?
Kom el-Hisn		1367	alluvium	burned exterior,interior
Kom el-Hisn		3114	marl/alluvium	burned
Kom el-Hisn	(1174		marl/alluvium	
Kom el-Hisn	(1177		alluvium	
Kom el-Hisn	(1281		alluvium	
Kom el-Hisn	(1282		marl/alluvium	
Kom el-Hisn	(1376		marl/alluvium	some sand+ pores
Kom el-Hisn	(1394		alluvium	
Kom el-Hisn	(1473		marl/alluvium	
Kom el-Hisn	(1527		marl/alluvium	
Kom el-Hisn	(1605		marl/alluvium	similar to (182
Kom el-Hisn	(1657		alluvium	
Kom el-Hisn	(1712		alluvium	
Kom el-Hisn	(182		marl/alluvium	
Kom el-Hisn	(1956		alluvium	
Kom el-Hisn	(2038		alluvium	burned
Kom el-Hisn	(2079		alluvium	similar to (2845
Kom el-Hisn	(2092		alluvium	
Kom el-Hisn	(2143		alluvium	fabric like (2424
Kom el-Hisn	(2144		marl/alluvium	
Kom el-Hisn	(2219		marl/alluvium	burned
Kom el-Hisn	(2248		alluvium	burned
Kom el-Hisn	(2255		alluvium	
Kom el-Hisn	(2317		marl/alluvium	
Kom el-Hisn	(2385		marl/alluvium	burned
Kom el-Hisn	(2394		marl	classic marl bowl
Kom el-Hisn	(2401		marl/alluvium	
Kom el-Hisn	(2403		marl	classic marl bowl
Kom el-Hisn	(2424		alluvium	like cd7, pinkish slip
Kom el-Hisn	(2500		marl/alluvium	
Kom el-Hisn	(2512		marl/alluvium	whitish slip
Kom el-Hisn	(2518		marl/alluvium	
Kom el-Hisn	(2573		alluvium	
Kom el-Hisn	(2577		marl/alluvium	
Kom el-Hisn	(2670		alluvium	burned
Kom el-Hisn	(2672		marl/alluvium	
Kom el-Hisn	(2675		alluvium	
Kom el-Hisn	(2698		marl/alluvium	burned
Kom el-Hisn	(2734		marl/alluvium	burned

Kom el-Hisn	(2777	alluvium	
Kom el-Hisn	(2845	alluvium	
Kom el-Hisn	(2851	marl/alluvium	
Kom el-Hisn	(2885	marl/alluvium	
Kom el-Hisn	(2946	marl/alluvium	burned
Kom el-Hisn	(2949	marl/alluvium	
Kom el-Hisn	(2962	marl/alluvium	
Kom el-Hisn	(3000	marl/alluvium	
Kom el-Hisn	(3041	alluvium	burned exterior,interior
Kom el-Hisn	(3042	alluvium	burned interior
Kom el-Hisn	(3082	alluvium	burned
Kom el-Hisn	(3086	alluvium	burned
Kom el-Hisn	(3090	alluvium	
Kom el-Hisn	(3099	alluvium	
Kom el-Hisn	(3129	alluvium	
Kom el-Hisn	(3131	marl/alluvium	
Kom el-Hisn	(3152	alluvium	
Kom el-Hisn	(3177	marl	classic marl bowl
Kom el-Hisn	(3181	marl/alluvium	burned exterior,interior
Kom el-Hisn	(3190	marl/alluvium	
Kom el-Hisn	(3208	alluvium	burned exterior,interior
Kom el-Hisn	(3263	alluvium	
Kom el-Hisn	(3279	alluvium	burned interior
Kom el-Hisn	(3294	marl/alluvium	burned exterior,interior
Kom el-Hisn	(3297	marl/alluvium	burned exterior,interior
Kom el-Hisn	(3303	alluvium	
Kom el-Hisn	(3304	alluvium	
Kom el-Hisn	(3331	marl/alluvium	burned interior
Kom el-Hisn	(3401	alluvium	
Kom el-Hisn	(3402	alluvium	burned interior
Kom el-Hisn	(3403	alluvium	
Kom el-Hisn	(3426	alluvium	burned exterior,interior
Kom el-Hisn	(3449	marl/alluvium	
Kom el-Hisn	(3488	alluvium	
Kom el-Hisn	(3536	alluvium	
Kom el-Hisn	(3608	marl/alluvium	
Kom el-Hisn	(3657	marl/alluvium	similar to x 1410
Kom el-Hisn	(3658	alluvium	
Kom el-Hisn	(3663	alluvium	burned exterior,interior
Kom el-Hisn	(3673	marl/alluvium	

Kom el-Hisn	(3676	alluvium	
Kom el-Hisn	(3680	alluvium	
Kom el-Hisn	(3695	alluvium	
Kom el-Hisn	(3698	alluvium	classic fourth dyn shape
Kom el-Hisn	(3777	alluvium	
Kom el-Hisn	(3810	marl/alluvium	fibre?
Kom el-Hisn	(3864	alluvium	
Kom el-Hisn	(3883	alluvium	
Kom el-Hisn	(3902	alluvium	burned interior
Kom el-Hisn	(3912	alluvium	
Kom el-Hisn	(3940	marl/alluvium	
Kom el-Hisn	(3948	marl/alluvium	
Kom el-Hisn	(3982	marl/alluvium	
Kom el-Hisn	(4055	marl/alluvium	
Kom el-Hisn	(4119	marl/alluvium	
Kom el-Hisn	(4181	marl/alluvium	similar to x 1410
Kom el-Hisn	(4253	alluvium	
Kom el-Hisn	(4265	marl	
Kom el-Hisn	(4286	marl/alluvium	
Kom el-Hisn	(4311	marl/alluvium	
Kom el-Hisn	(4645	alluvium	
Kom el-Hisn	(4920	alluvium	
Kom el-Hisn	(4941	marl/alluvium	burned exterior,interior
Kom el-Hisn	(4958	marl/alluvium	
Kom el-Hisn	(7509	marl/alluvium	
Kom el-Hisn	(958	alluvium	
Kom el-Hisn	[6007]	marl/alluvium	organic temper?
Kom el-Hisn	[7724]	alluvium	groove around neck
Kom el-Hisn	[888]	alluvium	matte slip
Kom el-Hisn	x1011	alluvium	burned
Kom el-Hisn	x1082	marl/alluvium	
Kom el-Hisn	x1160	alluvium	
Kom el-Hisn	x1281	marl/alluvium	
Kom el-Hisn	x1386	alluvium	
Kom el-Hisn	x1410	marl	high fired
Kom el-Hisn	x1476	alluvium	
Kom el-Hisn	x1527	alluvium	
Kom el-Hisn	x183	alluvium	
Kom el-Hisn	x2640	marl	
Kom el-Hisn	x268	alluvium	

Kom el-Hisn	x2780	alluvium	burned exterior,interior
Kom el-Hisn	x3791	marl/alluvium	burned
Kom el-Hisn	x382	alluvium	burned
Kom el-Hisn	x3827	alluvium	
Kom el-Hisn	x3840	marl/alluvium	burned
Kom el-Hisn	x3842	alluvium	burned
Kom el-Hisn	x4001	alluvium	
Kom el-Hisn	x4017	alluvium	
Kom el-Hisn	x404	alluvium	
Kom el-Hisn	x405	marl/alluvium	similar to x 1410
Kom el-Hisn	x4063	marl/alluvium	
Kom el-Hisn	x4132	alluvium	burned
Kom el-Hisn	x4163	marl/alluvium	
Kom el-Hisn	x4165	marl/alluvium	
Kom el-Hisn	x4204	alluvium	
Kom el-Hisn	x4206	alluvium	
Kom el-Hisn	x4229	alluvium	
Kom el-Hisn	x442	marl/alluvium	similar to x 1410
Kom el-Hisn	x504	marl/alluvium	similar to x 1410
Kom el-Hisn	x95	marl/alluvium	similar to x 1410,org? temper
Kom el-Hisn	(4272	marl/alluvium	burned exterior
Kom el-Hisn	(4285	alluvium	
Kom el-Hisn	(4935	alluvium	
Kom el-Hisn	(4126	marl/alluvium	burned exterior
Kom el-Hisn	(4317	marl/alluvium	
Kom el-Hisn	(4923	alluvium	
Kom el-Hisn	(4295	marl/alluvium	burned exterior
Kom el-Hisn	(4030	alluvium	
Kom el-Hisn	(4218	alluvium	
Kom el-Hisn	(4959	marl/alluvium	
Kom el-Hisn	(4312	marl	burned exterior,interior
Kom el-Hisn	(4932	marl/alluvium	
Kom el-Hisn	(4862	alluvium	
Kom el-Hisn	(4647	alluvium	
Kom el-Hisn	(5987	marl	similar to x 1410
Kom el-Hisn	(5017	marl/alluvium	burned exterior,interior
Kom el-Hisn	(5988	marl	classic marl bowl
Kom el-Hisn	(5255	alluvium	
Kom el-Hisn	(5990	marl/alluvium	burned interior
Kom el-Hisn	(5359	marl/alluvium	

Kom el-Hisn	(5992	marl/alluvium	burned exterior,interior
Kom el-Hisn	(5338	alluvium	
Kom el-Hisn	(5167	alluvium	
Kom el-Hisn	(5676	marl/alluvium	
Kom el-Hisn	(5156	marl/alluvium	
Kom el-Hisn	(5673	marl/alluvium	
Kom el-Hisn	(5523	alluvium	
Kom el-Hisn	(5245	alluvium	
Kom el-Hisn	(5014	alluvium	burned exterior,interior
Kom el-Hisn	(5811	marl/alluvium	
Kom el-Hisn	(5001	alluvium	
Kom el-Hisn	(5579	alluvium	
Kom el-Hisn	(5003	marl/alluvium	
Kom el-Hisn	(5329	alluvium	burned interior
Kom el-Hisn	(5397	alluvium	
Kom el-Hisn	(5581	marl/alluvium	
Kom el-Hisn	(5834	marl/alluvium	burned interior,exterior
Kom el-Hisn	(5782	alluvium	burned,interior,exterior
Kom el-Hisn	(5205	alluvium	
Kom el-Hisn	(6585	alluvium	
Kom el-Hisn	(6586	alluvium	
Kom el-Hisn	(6001	marl/alluvium	burned,interior,exterior
Kom el-Hisn	(6005	alluvium	burned exterior
Kom el-Hisn	(6686	marl/alluvium	burned,interior,exterior, fibre?
Kom el-Hisn	(6003	marl/alluvium	burned interior
Kom el-Hisn	(6070	marl/alluvium	burned exterior
Kom el-Hisn	(6405	marl/alluvium	
Kom el-Hisn	(6397	alluvium	burned,interior,exterior
Kom el-Hisn	(6755	marl/alluvium	similar to x 1410
Kom el-Hisn	(6413	marl/alluvium	
Kom el-Hisn	(6391	marl/alluvium	
Kom el-Hisn	(6006	marl	classic marl bowl
Kom el-Hisn	(6910	marl	classic marl bowl
Kom el-Hisn	(6424	alluvium	
Kom el-Hisn	(6749	alluvium	burned,interior,exterior
Kom el-Hisn	(6412	alluvium	burned,interior,exterior
Kom el-Hisn	(6381	alluvium	
Kom el-Hisn	(6645	alluvium	burned,interior,exterior
Kom el-Hisn	(6583	marl/alluvium	
Kom el-Hisn	(6911	marl/alluvium	burned,interior,exterior

Kom el-Hisn	(6423		marl/alluvium	
Kom el-Hisn	(6347		alluvium	
Kom el-Hisn	(6856		alluvium	
Kom el-Hisn	(6422		alluvium	
Kom el-Hisn	(6598		marl/alluvium	
Kom el-Hisn	(6978		alluvium	burned,exterior,interior
Kom el-Hisn	(6552		alluvium	
Kom el-Hisn	(6543		alluvium	
Kom el-Hisn	(6608		alluvium	
Kom el-Hisn	(6387		alluvium	burned all the way through
Kom el-Hisn	(6806		alluvium	
Kom el-Hisn	(6302		alluvium	
Kom el-Hisn	(6375		alluvium	
Kom el-Hisn	(6399		alluvium	burned,interior,exterior
Kom el-Hisn	(6428		marl/alluvium	
Kom el-Hisn	(6938		alluvium	
Kom el-Hisn	(6400		alluvium	
Kom el-Hisn	(6547		alluvium	burned,interior,exterior
Kom el-Hisn	(6982		marl/alluvium	burned,interior,exterior
Kom el-Hisn	(6211		alluvium	
Kom el-Hisn		5835	alluvium	
Kom el-Hisn		2727	alluvium	burned all the way through
Kom el-Hisn	x1918		marl/alluvium	
Kom el-Hisn		270	alluvium	burned exterior
Kom el-Hisn		179	alluvium	
Kom el-Hisn		2656	marl/alluvium	
Kom el-Hisn		2616	marl/alluvium	
Kom el-Hisn		115	marl	thin walled, pores subsand
Kom el-Hisn		1878	alluvium	burned exterior
Kom el-Hisn		1249	marl/alluvium	burned,interior,exterior
Kom el-Hisn		3862	marl/alluvium	
Kom el-Hisn		451	marl/alluvium	fibre impressions?
Kom el-Hisn	(5689		alluvium	wavy profile
Kom el-Hisn		2370	marl/alluvium	
Kom el-Hisn		3013	alluvium	
Kom el-Hisn		1468	marl/alluvium	burned exterior
Kom el-Hisn	x2518		alluvium	
Kom el-Hisn		1293	alluvium	burned interior,exterior
Kom el-Hisn		1412	alluvium	burned interior,exterior
Kom el-Hisn	(1134		alluvium	

Kom el-Hisn	(2104		alluvium	
Kom el-Hisn		1339	marl/alluvium	
Kom el-Hisn		7268	alluvium	
Kom el-Hisn		2503	alluvium	
Kom el-Hisn		1360	alluvium	
Kom el-Hisn		2726	marl/alluvium	burned exterior
Kom el-Hisn		397	marl/alluvium	burned interior,exterior
Kom el-Hisn		1340	alluvium	
Kom el-Hisn		3135	alluvium	burned interior,exterior
Kom el-Hisn		2520	marl/alluvium	fibre impressions, interior
Kom el-Hisn	x2013		marl/alluvium	
Kom el-Hisn	x2138		alluvium	
Kom el-Hisn		1327	alluvium	very burned all the way through
Kom el-Hisn	(2222		alluvium	
Kom el-Hisn		1424	alluvium	
Kom el-Hisn		2447	marl/alluvium	white wash exterior
Kom el-Hisn		900	alluvium	burned all the way through
Kom el-Hisn	(1625		alluvium	
Kom el-Hisn		176	marl	fine
Kom el-Hisn	x1697		alluvium	fibre impressions, interior
Kom el-Hisn	x1783		alluvium	burned exterior
Kom el-Hisn	x1782		alluvium	
Kom el-Hisn		219	marl/alluvium	
Kom el-Hisn		2254	alluvium	
Kom el-Hisn		1309	marl/alluvium	
Kom el-Hisn		444	alluvium	
Kom el-Hisn		1410	alluvium	
Kom el-Hisn		2514	alluvium	
Kom el-Hisn	(938		marl/alluvium	
Kom el-Hisn		1341	marl/alluvium	
Kom el-Hisn		512	alluvium	
Kom el-Hisn	(2266		alluvium	burned all the way through
Kom el-Hisn	(1856		alluvium	
Kom el-Hisn		1414	alluvium	fibre impressions?
Kom el-Hisn	x3412		marl/alluvium	
Kom el-Hisn	x3082		marl/alluvium	
Kom el-Hisn	(2589		alluvium	
Kom el-Hisn		384	alluvium	fibre impressions?
Kom el-Hisn		1301	alluvium	
Kom el-Hisn		1509	alluvium	

Kom el-Hisn	(2791		marl/alluvium	burned interior, some exterior
Kom el-Hisn	x1775		marl/alluvium	
Kom el-Hisn	(1487		marl/alluvium	
Kom el-Hisn	x441		marl/alluvium	
Kom el-Hisn	x3355		alluvium	
Kom el-Hisn	x2150		alluvium	
Kom el-Hisn		2070	alluvium	burned exterior
Kom el-Hisn		810	alluvium	burned all the way through
Kom el-Hisn	x1643		alluvium	similar to 810
Kom el-Hisn		3414	alluvium	
Kom el-Hisn	x1553		marl/alluvium	
Kom el-Hisn	x355		marl/alluvium	burned interior,exterior
Kom el-Hisn	x1791		alluvium	fibre impressions?
Kom el-Hisn		1328	alluvium	
Kom el-Hisn	(1971		alluvium	burned interior
Kom el-Hisn	(792		alluvium	
Kom el-Hisn	(976		marl/alluvium	
Kom el-Hisn	(250		alluvium	
Kom el-Hisn	(987		alluvium	
Kom el-Hisn	(323		alluvium	burned interior, core
Kom el-Hisn	(645		alluvium	
Kom el-Hisn	(793		alluvium	
Kom el-Hisn	(693		alluvium	burned interior,exterior
Kom el-Hisn	(683		alluvium	
Kom el-Hisn	(180		alluvium	
Kom el-Hisn	(342		alluvium	burned exterior
Kom el-Hisn	(188		alluvium	
Kom el-Hisn	(231		alluvium	burned all the way through
Kom el-Hisn	(510		alluvium	
Kom el-Hisn	(523		alluvium	
Kom el-Hisn	(580		alluvium	burned interior
Kom el-Hisn	(33		alluvium	burned all the way through
Kom el-Hisn	(103		alluvium	
Kom el-Hisn	(7328		marl/alluvium	similar to x1410
Kom el-Hisn	(7651		marl/alluvium	burned interior,exterior
Kom el-Hisn	(7511		alluvium	
Kom el-Hisn	(7391		marl/alluvium	similar to x1410
Kom el-Hisn	(7133		marl/alluvium	similar to x1410
Kom el-Hisn	(7574		alluvium	
Kom el-Hisn	(7517		alluvium	

Kom el-Hisn	(7435	alluvium	
Kom el-Hisn	(7040	alluvium	
Kom el-Hisn	(7714	alluvium	slightly burned interior,exterior
Kom el-Hisn	(7117	alluvium	
Kom el-Hisn	(7454	alluvium	
Kom el-Hisn	(7653	alluvium	burned interior,exterior
Kom el-Hisn	(7519	alluvium	
Kom el-Hisn	(7493	alluvium	
Kom el-Hisn	(7152	alluvium	
Kom el-Hisn	(7485	alluvium	burned all the way through
Kom el-Hisn	(7443	alluvium	burned interior,exterior
Kom el-Hisn	(7073	marl/alluvium	burned exterior
Kom el-Hisn	(7713	alluvium	
Kom el-Hisn	(7712	alluvium	
Kom el-Hisn	(7488	alluvium	
Kom el-Hisn	(7442	alluvium	
Kom el-Hisn	(7290	marl/alluvium	burned interior,exterior
Kom el-Hisn	(7560	alluvium	burned all the way through
Kom el-Hisn	(7160	alluvium	
Kom el-Hisn	(7437	alluvium	
Kom el-Hisn	(7618	alluvium	
Kom el-Hisn	(7356	alluvium	burned interior,exterior
Kom el-Hisn	(7435	alluvium	
Kom el-Hisn	(7553	alluvium	
Kom el-Hisn	(7719	alluvium	
Kom el-Hisn	(7617	alluvium	burned interior,exterior
Kom el-Hisn	(7034	marl/alluvium	

APPENDIX 2: DEPOSIT DESCRIPTIONS

The objects used in this study were collected from a variety of settings, some surface contexts and some subsurface contexts. Detailed descriptions of the deposits which produced the objects used in this study are described below.

Elephantine

Deposits are described based on descriptions provided in Kaiser et al. 1999, unless otherwise noted.

5907

This level is an early level excavated from the Eastern Settlement, located in the eastern portion of the settlement. Dating for this level comes from the presence of sealing material attributed to Horus Khasekhemwy, a 2^{nd} Dynasty pharaoh. This level is assigned building phase VI.

Level 5907 produced one complete vessel. It should be noted that this vessel is not a Meidum bowl in the traditional sense, but rather a round-bottomed, wide-mouthed jar that may be ancestral to the Meidum bowl (Raue in Kaiser et al. 1999:181).

5914

This unit is also an early level excavated from the Eastern Settlement, located in the eastern portion of the town. This level is also assigned to building phase VI, for reasons discussed above. Level 5914 produced one complete round-bottomed, wide-mouthed jar.

5967

This level was excavated from a test trench located east of the steps between the later temple of Chnum and the Satet temple. Kaiser et al (1999:181) date the earliest construction of these steps to the late second dynasty. The basis for this date is a similarity between beer jar forms at Elephantine and those found in the grave of Khasekhemwy at Abydos.

This material is largely attributed to the 4^{th} Dynasty, based on the presence of sealing inscriptions. This level is assigned building phase VIII , mid 4^{th} Dynasty, based on stratigraphic position. One complete vessel was recovered from this material.

5968

This level is located just east of the granite boulder forming part of the Satet temple proper. This level was assigned late 5^{th} to early 6^{th} Dynasty based on its stratigraphic position (Dreyer et al. 1986:24). Level 5968 produced one complete vessel.

6351

This level is also associated with the trench east of the south Satet steps. This material is assigned to building phase VIII based on stratigraphic position and like 5967 is assigned to the mid 4^{th} Dynasty. This level produced two complete vessels.

7983

This unit is also an early level excavated from the Eastern Settlement, located in the eastern portion of the town. This level is also assigned to building phase VI, due to the presence of 2^{nd} Dynasty inscriptions. Level 7983 produced one complete, round-bottomed wide-mouthed jar.

8420

This level is attributed to the 6th Dynasty due to its association with courtyard I constructed during the late 5th and early 6th Dynasties. This level produced three complete vessels.

8926

Also associated with the Eastern Settlement is a larger deposit excavated during an earlier season identified as 8926. Level 8926 also bounds the South Satet temple step, so this level is located in the southeast portion of the settlement west of the fortification. Generally this material is associated with building phase VIII, Dynasty 4, based on stratigraphic position, however, some 2nd Dynasty material is present as well. Eleven complete vessels / measureable rim sherds were recovered from level 8926.

8936

This is a 2nd Dynasty level located in the eastern portion of the Eastern Settlement, assigned to building phase VI. Level 8936 produced one complete vessel.

9934

Level 9934 is also a 2nd Dynasty level located in the Eastern Settlement, assigned to building phase VI. This level produced one complete vessel.

10410

This level was excavated in the Eastern Settlement and is assigned to the 4th Dynasty, building phase VIII. Level 10410 produced one complete vessel.

16350

Level 16350 was excavated from the Eastern Settlement and is associated with a sealing attributed to Djoser (3^{rd} / 4^{th} Dynasty), building phase VI. This excavation unit produced one complete vessel.

17304

This level was also excavated from the Eastern Settlement and is associated with a sealing attributed to Djoser (3^{rd} / 4^{th} Dynasty). Therefore, level 17304 is assigned to building phase VI. This unit produced one complete vessel.

17344

Level 17344 is also associated with the Djoser sealing inscription (3^{rd}/4^{th} Dynasty) in the Eastern Settlement, thus this level is assigned to building phase VI. This unit produced one complete vessel.

21311

This level is also from the same general area as the levels discussed above associated with the Djoser sealing in the Eastern Settlement. This level is also assigned to building phase VII. It produced one complete vessel.

22316

Unit 22316 was also excavated in the Eastern Settlement and is dated to the 3^{rd}/4^{th} Dynasties, building phase VII. This level produced one complete vessel.

25226

This level is attributed to the 6^{th} Dynasty due its association with courtyard II constructed during the late 5^{th} and early 6^{th} Dynasties. This level produced one complete vessel.

29102

Level 29102 is described in the excavation notes as representing a mix of materials into the fifth dynasty and is located in the eastern city. To date, this level has not been assigned a building phase. Unit 29102 produced 18 identifiable rim sherds.

29103

29103 is associated with courtyard I dating to the 6^{th} Dynasty, but contains a mix of earlier materials. Level 29103 produced 16 identifiable rim sherds.

30103

Level 30103 is associated with the eastern city. Excavation notes indicate this small deposit is associated with a sealing associated with Senefru. Sixteen identifiable rim sherds were recovered from this deposit.

30101

30101 contains no 6^{th} Dynasty material, but does contain material from a mix of dynasties up to Dynasty 5. This level is located in the Eastern Settlement. This material just overlies 30103 (discussed above). As such this material incorporates and post-dates that earlier stratum. Excavation notes indicate this material contains a mix of dates running into the 5^{th} Dynasty. Level 30101 produced 12 identifiable rim sherds.

Giza

Mark Lehner of the Giza Plateau Mapping Project (GPMP) kindly provided access to field notes generated for the GPMP field seasons 1991 - 2000. Deposit descriptions are summarized from those notes.

Area AA

Early 1988 excavations in the bakery area were simply designated "a." There are no forms for these features, they are described briefly in a feature log. Following the 1988 season, a 5 x 5m grid is superimposed on the area, defining squares A1 – A6 and later A7 (distinct from operation A7, noted above and described below) through A14 (also identified as AA7-AA14).

A114, 115, 140, 141

Feature 114 is an ash lens below a fill layer. Feature 114 produced 11 identifiable rim sherds. Feature 115 is the southern extension of a wall. Feature 115 produced 11 identifiable rim sherds. Feature 140 is described as an ash lens below a wall. Feature 140 produced one identifiable rim sherd. Feature 141 is an ash lens south of a yellow marl layer (perhaps a floor?) below Feature 114 (described above). This unit produced one identifiable rim sherd.

Square A2

Feature 3

This material is a mixed deposit containing silt, sand, charcoal, limestone fragments and tefla. Feature 3 underlies Features 1 (described as the top five surface centimeters covering the expanse of the square consisting of loose yellow sand) and 2 (which underlies Feature one and consists of brownish yellow sand with abundant ceramic inclusions). Feature 3 consists of dark brown, friable sediments. Excavator speculates that it is rubble from adjacent walls. This feature produced four identifiable rim sherds.

Feature 38

This feature is rubble fill over a floor, equivalent to Feature 26 (described as an ashy layer to the west, associated with dense pottery concentration to the east) and Feature 25 (described as mudbrick tumble with pottery and bone inclusions). This feature produced one identifiable rim sherd.

Feature 39

This feature underlies 25 (described above) and overlies 42 (described as a marl plaster floor). This feature is an ashy sandy loam mixed with silty mudbrick, with pottery and a small number of limestone inclusions. Feature 39 produced one identifiable rim sherd.

Square A4

Feature 1

This feature is surface sand covering the expanse of the square. This feature overlies Feature 2 (described below). This feature produced one identifiable rim sherd.

Feature 2

This material is silty sand underlying Feature 1, distinguished from feature one by a larger amount of silt. This feature produced one identifiable rim sherd.

Feature 8

This feature underlies Feature 2 (described above) and Feature 7 (described as scraping without screening consisting of wall collapse and midden). Feature 8 is described as dark gray midden material with pottery and ash inclusions, covering an area of 1.5 x 1.5 meters. Excavated material extends to the west side of a central wall. This feature produced three identifiable rim sherds.

Feature 11

This deposit is described as a test pit in the SW corner of A4, measuring 0.65 x 1.5 m and underlying feature two described above. The feature produced one identifiable rim sherd.

Feature 27

This feature underlies 55 (described as a thin deposit of marl plaster at the north end of the corridor), and Feature 13 (described as a floor deposit, the 10cm of material overlying a marl floor). Feature 27 overlies 56 (described as the fill under 27) and 57 (described as a layer of limestone cobbles forming the eastern edge of an enclosure). Feature 27 itself is described as a marl plaster floor with limestone chip inclusions. Feature 27 produced one identifiable rim sherd.

Square A6

Feature 11

Feature 11 consists of brown sandy clay, fine textured with charcoal inclusions. This feature produced two identifiable rim sherds.

Feature 23

This feature underlies 20 (described as a limestone wall with sand and mudbrick ca 115 cm x 100 cm, ca 15 cm thick). Feature 23 overlies 24 (described as a layer of header bricks, possibly the lower course of a robbed out wall), 22 (an E/W trending stone wall, south of "domed chamber") and 27 (a N/S trending wall intersecting with 21 and 22). Feature 23 is dense bricky debris with ash, pottery and charcoal inclusions, approximately 1.1 x 1.1m in extent, and approximately 15 cm deep. This feature produced one identifiable rim sherd.

Feature 1081

This feature underlies 1082 (a limestone tumble feature related to walls 1023 and 1017). Feature overlies 1191 which is a pit cut containing 1081. Feature 1081 is 2.10 m E/W by 2.1 m N/S. The cut containing this material consists of a steep almost vertical cut at the NE corner of the square. This feature is described by the excavator as "a deliberate sherd dump." This feature produced five identifiable rim sherds.

Feature 1022

Described as an ash deposit underlying 1191 (pit cut described above). Feature is described as grey, ashy sand equivalent to 1003 (an ash spread extending into and over squares a7 and a6 which post dates the structural collapse of 1006, structural remnants in the SW corner of square A7) and 1031 (an ash spread in A6). Feature 1022 is contained by 1023 (a limestone alignment trending NNW by SSE). This feature produced six identifiable rim sherds.

Feature 1089

This feature underlies feature 1000 (described as modern sand covering the expanse of the excavation square). Feature 1089 is described as brown sandy fill, equivalent to 1003 (described above, covering approximately the same area). Feature 1089 produced two identifiable rim sherds.

Square A7

Feature 1190

This is collapse of the upper courses of 1017 (described as an E/W trending stone wall). Feature 1190 is concentrated against 1017 and 1016 (described as an EW trending limestone wall). The feature is compacted mud brick tumble. Feature 1190 underlies 1022 and 1089 (described above). This feature produced four identifiable rim sherds.

Feature 1003

This feature underlies 1024 (a surface sand layer covering the extent of the square). Feature is a large ash lens. Feature 1003 produced two identifiable rim sherds.

Feature 1050

This feature underlies feature 1025 (described as a lower layer of surface sand covering the expanse of the square). This feature is described as stone tumble mixed with pottery. Feature 1050 is in the NE portion of the square . The feature overlies 1105 (described as yellow sand) and produced two identifiable rim sherds.

Square A10 (also aa10)

Features 501, 502, 508

Feature 501 is "sand under surface sand," covering the extent of the square. Feature 501 produced three identifiable rim sherds. Features 502 and 508 are melted brick tumble also covering the extent of the square; the contents of these features are combined. Features 502 and 508 produced five identifiable rim sherds.

Operation AA (1991 season)

During the 1991 season, this area was distinguished from the larger grid (discussed below) as "AA"

Feature 516

Feature 516 is mudbrick tumble. This feature overlies 522 (described below) and 514 (greyish yellow surface sand). Feature 516 underlies 512 (also described as surface sand). This feature is 3 x 2m in extent and approximately 55cm deep. This feature produced one identifiable rim sherd.

Feature 522

This feature is mud and sand with sherd and limestone inclusions. Feature 522 overlies tumble features 535, 536 and 537. The feature covers the northern extension and is 5 x 2.5m in extent and 70 cm thick. Feature 522 produced three identifiable rim sherds.

Feature 527

Feature 527 is mud tumble similar to 522, with limestone and sherd inclusions. Feature underlies 515 (primarily surface sand overlying the expanse of the excavation area). Feature 527 overlies 528 (described as an E/W trending wall, forming the southern portion of building 532), 577 (described below) and 578 (described below). This feature is described as covering the entire southern extension of the square and is 5 x 2.5m in extent and 5cm deep. Feature 527 produced one identifiable rim sherd.

Feature 533

Feature 533 is loose, ashy pit fill with intrusive modern sand. Feature 533 underlies 512 (surface sand). Feature 533 overlies 534, which is simply the cut of the pit containing 533. Pit cut intrudes into some of wall 539 (described as a marl plastered N/S trending wall running parallel to 525. This fact suggests that the pit contents in 533 postdate the construction of these walls. Feature 533 is 1.1 x 1.2m in extent and approximately 31 cm deep. Feature 533 produced one identifiable rim sherd.

Feature 535

This feature is marl and mudbrick tumble with sand, ash and plaster inclusions. Feature 535 underlies 522 (described above). The feature only covers the northern extent of the excavation unit. This feature is 5 x 2.5m in extent and approximately 40cm deep. Feature 535 produced a large number and variety of artifacts including; mudseals, beads, charcoal and yellow pigment as well as six identifiable rim sherds.

Feature 537

This feature is mud and marl brick tumble underlying 522 (described above). Feature 537 overlies 568 (described as a loose ashy deposit) and walls 547 (an E/W trending mudbrick wall) and 542 (a N/S trending mudbrick wall) and is approximately 1 cm deep. Feature 537 produced 99 mud seals as well as one identifiable rim sherd.

Feature 540 and 569

Features 540 and 569 are ashy, sandy silt deposits underlying 522 (described above). These features, along with 619, are pit fill overlying 541 (a pit cut) and are approximately 40cm deep. Features 540 and 569 are described as consisting of ash and sand in a pit between walls 524 (a limestone and mudbrick wall, N/S trending forming the eastern wall of a marl building) and 542 (a N/S trending mudbrick wall). Combined, 540 and 569 produced three identifiable rim sherds.

Feature 577

Feature 577 is fill with abundant fish bone, charcoal and sealing mud underlying feature 522 (described above) and 527 (described above). Sediments are described as loose ashy sand at the east end of the southern extent of the excavation unit, approximately 2.5 x 2.5m in extent and approximately 40cm deep. Feature overlies 578 (described below) and 593 (described as a sand and mudbrick). Feature 577 produced one identifiable rim sherd.

Feature 578

This feature is mudbrick tumble and sand at the west end of the southern extension of the excavation unit underlying 527 (described above). Feature is equivalent (or at least difficult to distinguish from) 593 (described above as matrix, probably later than 578, containing large numbers of bread molds). This feature is approximately 2.5 x 2.5m in extent (depth unknown). Feature 578 produced two identifiable rim sherds.

Feature 579

This feature consists of ashy, sandy silt deposits. Feature 579 is similar to 577 (described above) in that it contains abundant sherds, bone, charcoal, mud sealings and brick fragments. Feature 579 underlies 537 (described above) and is 1.1 x 70cm in extent, approximately 30cm deep. Feature 579 produced two identifiable rim sherds.

Operation A7

As discussed above, operation A7 (distinct from square A7 in operation AA) overlies what was subsequently revealed to be a bakery (based on the large number of breadmold sherds and amount of ash present) in the larger grid system. Initially, this square covered the area gouged by the back hoe (described above). Square A7, therefore covers an approximately 15 x 20m area.

Features 8, 16, 19 and 20

These features compose a sherd dump covering much of the excavation square (approximately 15 x 20m). Features underlie Feature 6 (described as a mud tumble deposit with pottery inclusions also covering much of the excavation square). Feature 8 consists of ashy sediments. Feature 16 consists of yellow sandy silt underlying surface sand. Feature 19 also underlies surface sand and is a level area contained by walls 25 (an E/W trending mudbrick wall excavators speculate represents an earlier architectural period in A7), 26 (a limestone foundation abutting and thus possibly later than 25) and 27 (along limestone wall or foundation that might represent a later architectural phase of A7). Feature 20 underlies Feature 2 (described above) and Feature 13 (described as including the material at the interface of the compact sand of feature two and the underlying cultural debris). Feature 20 is alluvial mud with abundant pottery inclusions. The feature is adjacent to walls 25 and 26 (described above) and 55 (described as being inside the room defined by walls 25, 26 and 37 (described as an E/W trending shallow stone wall). Feature 20 is described as a surface within this area. Altogether, these features are between 10-20 cm deep. Combined, these features produced eight identifiable rim sherds.

Feature 57

This is a limestone wall or foundation from the second main architectural phase in the square. Feature 57 underlies 2 and 13 (described above). Feature 57 is approximately 3.0m x 0.6m in extent and of unknown depth. Feature produced three identifiable rim sherds.

Feature 59

This feature also underlies Features 2 and 13 (described above). Feature 59 is described as alluvial mud with abundant pottery inclusions. Feature is described as a "floor or midden that is patched over with limestone rubble. Feature 59 is contained by 30 (described as a narrow E/W trending limestone wall or foundation) and 58 (described as a N/S trending limestone wall or foundations). This feature extends over an area of approximately 2 x 4m and is of unknown depth. Feature 59 produced one identifiable rim sherd.

Feature 93

This feature underlies feature 38 (described as pottery, mud sealing fragments and brick tumble possibly used as packing for remodelling, abutting wall 25). Feature 93 is described as mudbrick tumble with little pottery and some limestone blocks. Feature is ca 1.86 x 1.6 m in extent. Feature 93 produced one identifiable rim sherd.

Feature 139

This feature also underlies feature six (described as a thick layer of broken pottery underneath a rubble wall foundation) and 15 (described as a floor constructed from sandy alluvial mud in the corner of wall 28 and Feature 5 (described as a shallow E/W trending limestone wall). Feature 15 is described as being 2 x 2m in extent, so 139 might have the same dimensions (though these were not reported). Feature 139 is a pottery layer that the excavator speculates is probably older than the overlying features. Feature 139 produced nine identifiable rim sherds.

Feature 579

This is a fill feature in the north end of the square. Feature 579 overlies 569 (also described as fill between walls 524 and 542). This feature is 1.1 x 0.7 x 13cm in extent. Feature 579 produced one identifiable rim sherd.

Operation A8

This operation represents efforts to uncover structures on the southern side at the base of what is now known as the Wall of the Crow.

Feature 1

This feature is yellow, coarse surface sand with pottery, granite, alabaster and diorite, as well as modern materials. Feature one covers the expanse of square A8 and is about 60cm deep. This feature produced two identifiable rim sherds.

Feature 18

This feature underlies Feature 1 and is rubble mixed with fine dry silt sand and ash. This feature overlies 19 (described below), 21 (sand and ash with various inclusions) and 25 (thick dense ash overlying some sort of bread mold infrastructure, ca 40 cm deep.) The feature covers an area of approximately 7 x 4.6m and is approximately 30cm deep. This feature produced two identifiable rim sherds.

Feature 19

This feature is similar to 25 (described above). Feature 19 consists of dark gray fine ash, covering an area 2.6 x 4.3m (approximately 30cm deep) and underlying feature 18. Feature features abundant mud sealing material. Feature overlies a series of depressions designed to hold breadmolds in place. Feature 19 produced four identifiable rim sherds.

Feature 23

This is fill covering an area of 3 x 2.2m . Trash and debris related to room use contained between walls 20 (described as an E/W trending limestone wall) and 24 (described as a NS trending limestone rubble wall forming the eastern boundary of "room" 21/23 and the SW boundary of "kiln oven room" 36). Feature 23 is ten cm deep. The feature produced one identifiable rim sherd.

Feature 30

This feature underlies 29 (a hard layer of yellow soil and crushed limestone, possibly a ramp of some kind). Feature 30 is yellow sand and gravel covering an area extending 1.3 x 1.0m and reaching a depth of 10cm. This feature produced one identifiable rim sherd.

Copper Workshop –D17x

This portion of Area A is located in both square D17 and D17x in the southeast corner of the excavation grid as it was exposed in 1999-2000. D17x was designated as a result of excavators noting part of an apparent industrial installation emerging south and west of square D17 proper. Features within this general area containing identifiable Meidum bowls are described below.

Feature 1118

This is a "mud and pottery rich" feature, dark, hard and crumbly, particles primarily sand sized, this is a mudmass feature. This feature underlies 1108 (also mudmass, distinguished from 1118 because of a slightly sandier character). Feature 1118 covered the expanse of the area designated D17x and is approximately 25 cm deep. Nine identifiable rims were recovered from this feature.

Feature 1137

Described as a "charcoal rich layer with some mudbricks and pottery" underlying 1118 (described above). This is also fill of approximately the same area with apparently ashier contents than the fill feature overlying it and is approximately 30 cm deep. Two identifiable rims were recovered.

Feature 1138

This feature is mudbrick tumble, apparently associated with feature 1124, (a small N/S running mudbrick wall approximately two meters east of 1205, a main gallery wall). Feature 1138 underlies both 1137 and 1118 and covers approximately the same area and is approximately 30 cm deep. This feature produced one identifiable rim sherd.

Feature 1315

This feature is a combination of ash and mud, containing large pieces of dark charcoal. This feature underlies 1138 and 1155, described as floor (usually marked by a uniform layer of marl plaster). This feature produced one identifiable rim sherd.

Feature 1316

Feature is medium brown compact surface sediments separated from 1108 and 1118 by walls 1124 (described above). Feature 1316 may be the same as 1155 (large sherds in mud matrix), but is west of wall 1124. Vessels from this feature are described as being semi-complete. This suggested to the excavator that this feature is a floor. One identifiable rim sherd recovered.

Feature 1322

This is a "compact surface," consisting of hard-packed silt and associated with 1317, a distinctive feature consisting of a conical jar embedded in the floor of the installation, and 1320; a "large bread mold embedded at an angle in baked bricks." These two features are associated with large amounts of black fine ash and copper slag. Features 1317 and 1320 are the attributes used to identify this general area of the excavation exposure as a copper workshop. Several sherds from this feature show evidence of vitrification.

Feature 1322 is therefore a floor of the identified copper working installation, covering approximately 4 meters N/S by 2 meters E/W. The original excavator noted that this is the *latest* floor associated with this area. A variety of similar floors throughout Area A suggest that when the ash from whatever activity that took place in various structures throughout the area reached a certain thickness, it was packed down by a rough layer of plaster. This creates a feature consisting of any number of alternating layers of ash and plaster (Lehner personal communication). This floor feature produced 1-2 identifiable rim sherds.

Feature 1342

This is a light brown compact mud surface underlying 1155 (described above as a floor like surface). The excavator suggests that this feature is really part of 1316, but divided by feature 1160 (described as "a possible wing wall running E/W off 1124"), and that this feature might form a doorway between 1124 and 1157 (described as "abutting 1205 (a gallery wall), and evident only in 20 – 30 cm strip along the N. baulk). This small feature produced one identifiable rim.

Feature 1347

Excavator identifies this feature as being the same as 1345, the conical jar embedded in the floor discussed above. The aforementioned jar had large numbers of sherds packed around it (possibly for insulation). The one identifiable Meidum bowl rim recovered from this feature was associated with this packing.

Feature 1349

This is an ashy feature covering the southern half of the room identified as the copper workshop. As with 1315 and 1137 discussed above, this feature appears to be an ashy layer overlying a floor surface. This feature is also described as being "sherd rich." The feature was probably ashy buildup from firing in the oven at the south end of the room. This material produced one identifiable rim.

Feature 1353

This is a stone and mudbrick tumble fill between 1124 (a wall discussed above) and 1259 (an E/W running continuation of 1205, a gallery wall). The fact that this feature fills a gap between 1124 and 1259 suggests it formed after the construction of these walls. This feature produced one identifiable rim.

Feature 1363

This feature is sherd rich fill associated with "bread molds" and another pottery vessel "oven" (feature 1279, similar in character to 1320, described above). Feature contained objects that look like molds, possibly associated with the casting of copper. The feature itself is described as being light brown sandy mud, with abundant pottery. This feature also overlies what are described as large baking pits (shallow depressions), east of 1124. Feature 1363 produced one identifiable rim sherd.

Feature 1383

This feature is described as being a plaster surface with depressions, probably associated with 1320 (the possible bread mold oven discussed above), in the northern portion of the room. This feature produced two identifiable rim sherds.

Feature 1408

This material directly underlies 1383 and is primarily black ash. This feature overlies 1418 (a marl floor covering the entire room). This material also fills the depressions in the floor to the east (1460). This material produced two identifiable rim sherds.

Feature 1454

This feature is sherd-rich fill under 1408 and filling 1445 (large depressions east of 1418). Feature 1454 produced one identifiable rim sherd.

Square D17

This is the 5 x 5 m grid square just east of D17x (the "copper workshop"). These units are separated by a gallery or 3 cubit wall (described above), identified as feature 1205.

Feature 710

This is mudmass feature typical of much of the fill throughout the excavation area. The feature covers the expanse of the 5 x 5 m unit and is approximately 10cm deep. This feature produced two identifiable rim sherds.

Feature 743

This is another fill feature underlying 710, consisting of compacted dark brown mud with abundant pottery. The feature is bounded on the west by 742 (described as a wall "badly robbed in a(n) … irregular pattern) and is approximately 20 cm deep. Tumble from wall 742 is also contained in this feature. This feature produced two identifiable rim sherds.

Feature 744

This feature is fill south of 741 (a rubble wall running along the north baulk of the square and running under the east baulk of the square) and east of 742 (a north south trending wall abutting a stone rubble wall on the west end of the square) approximately 30 cm deep. The excavator noted abundant pottery representing a variety of Old Kingdom types. Feature 744 consists of sherd rich compact mud. Other artifact types recovered include lithics, bones, charcoal and "objects" (a term used to describe all manner of obviously shaped yet functionally enigmatic items). This feature produced two identifiable rim sherds.

Feature 753

This is a limestone rubble concentration associated with 794 (an EW trending wall on the north end of the square), approximately 25cm deep. Several large pieces of pottery were mixed in with this limestone rubble, including one identifiable rim sherd.

Feature 758

This is a soft brown/black mud fill feature containing abundant pottery and charcoal, underlying 756 (a mubrick concentration with limestone block inclusions in the south half of the square). Removal of 756 revealed feature 758 covering most of the south half of the square and approximately 65 cm deep. Feature 758 has a higher ash content than the overlying features, but like the overlying features is filled with brick tumble and large sherds. This feature produced four identifiable rim sherds.

Feature 782

This feature consists of ashy sediments with abundant pottery and bone inclusions. The excavator noted that pottery density is so high that pottery debris makes up the bulk of the sediments in the sample. This feature underlies: 741, (a stone rubble wall along the northern and eastern baulk of the square); 744, a fill feature south of 741 and east of 742 (remains of a rubble wall and associated tumble in the western portion of the square, which is also characterized by a high sherd content) and 781 which is described as "probably tumble off 741." Feature 782 is approximately 50cm deep. The excavator suggests that this feature, which produced six identifiable rim sherds, is earlier than the bulk of the Old Kingdom exposure in area A.

Feature 785

Feature 785 is described as a "mudbrick structure" underlying feature 782. The structure trends E/W and is likely a wall, given that it is 1.7 m thick and thus a width consistent with the wall widths seen through the rest of the site. The one identifiable rim sherd from this feature is more likely associated with 782.

Square D14

This square encompasses the south end of one of the galleries in the central portion of the site, west of D17x.

Feature 705

This is a fill feature, medium hard, dark brown with abundant pottery and limestone inclusions and mudbrick tumble. This feature underlies 704 (described as an artifact free, clean sand feature, covering the expanse of the square) and several mudmass features. Feature 705 underlies 704 only in the area north of wall 714. One identifiable rim sherd was recovered.

Feature 715

Described as a "sherd scatter" underlying 704 (the clean sand feature described above) and overlying 717 (a feature of deteriorated mudbrick, south of wall 714). This feature is south of wall 714. Pottery is described as being particularly eroded, suggesting that it was exposed on the surface for a time before being buried, sherds more deeply buried in the same feature are less eroded. Sherds in this feature are particularly dense, averaging one per 10cm2. Tumble possibly related to wall 714 is intermixed with the feature. One identifiable rim sherd recovered.

Feature 746

This is a patch of mudbrick tumble up against 745 (a “curtain wall,” [an interior partition, rather than a load bearing wall] on the south face of 714). This feature is bounded on the north by the south faces of walls 745 and 716 (an EW trending mudbrick and stone rubble wall). The eastern, southern and western boundaries are formed by the baulks. This feature produced two identifiable rim sherds.

Feature 795

This is an “ashy black surface” underlying feature 746. Feature contains large amounts of carbon along with small bone, shell, pottery and sealings. Also described as being comprised of many small localized features of piled material. The pottery in this feature seems to be associated with fish bones, the excavator describes finding fish bones within some vessels. Although there was little pottery in this feature relative to flint and sealing mud, two identifiable rim sherds were recovered.

Square D8

This square is west of D14 and also overlies the south end of a “gallery." Only one feature (787) in this square produced identifiable rim sherds.

Feature 787

This feature is typical mudmass underlying three surface features; 724, 725 and 726. Feature 724 is described as stone rubble wall in the southern half of the square. Feature 725 consists of a dark, ashy fill NE of wall 724. Feature 726 consists of brick tumble, sherds, bone and charcoal equivalent to 725, but NW of wall 724 and approximately 50 cm deep. Feature

787 is a relatively large feature which produced a large variety of artifacts including; a figurine, red ochre and sealings. Feature 787 also produced seven identifiable rim sherds.

Square D9

This square is directly east of square D8, also overlying the southern end of a gallery set. One feature (707) in this square produced identifiable rim sherds.

Feature 707

This feature is typical mudmass at the south end of Area A exposure. Feature 707 underlies 706, a relatively recently deposited clean sand feature. The feature produced a great variety of artifacts including; bone, charcoal, sealings and pottery. This feature is approximately 90cm deep. The pottery produced six identifiable rim sherds.

Contents of this feature are combined with 787 in square D8.

Square E9

Two features (1120 and 1430) from the excavation of this square just north of D8 and D9 produced identifiable rim sherds.

Feature 1120

This feature is fill/ mudbrick tumble. The feature is west of 1057 (a NS trending "central wall" running through the center of E9), and distinguished from 1035 (a similar tumble feature "filling the rest of E9," meaning the area east of wall 1057) and is approximately 45cm deep. Feature 1120 underlies 1069, described as an "ephemeral layer of ash and burning, marking the interface between 1120 and 1035." Feature 1120 produced one identifiable rim sherd.

Feature 1430

Feature 1430 is described as a "floor feature" of the "western room" in E9, directly underlying 1120. This floor underlies 1392 (fill of doorway 1390 in between N/S trending walls 1033 and 1391, the northern continuation of 1033) and produced one identifiable rim sherd.

Squares F19, E18, and G20

These squares cover the connection between the identified "hypostyle hall" and the modular buildings that approximately bisect the Area A exposure along ranges 18 and 19.

Feature F19/260

Feature 260 is typical mudmass covering the entire expanse of the square and producing the typical large volume and variety of artifacts. This feature can be combined with 261, 263 and 279 (described below). The combined area of all these features is approximately 10 x 10m. Altogether these features produced six identifiable rim sherds.

Feature E18/312

Feature 312 is ashy, compact dsediments in the southeast corner of the square. This feature underlies 281, a patch of limestone and mudbrick material which might represent the remnants of a wall. This small feature produced one identifiable rim sherd.

Square G20

This square is associated with an area identified in previous seasons as "bakeries" (Lehner 1992:4). Three features in this square produced identifiable rim sherds. The contents of these features are combined, along with the contents of F19/260.

Features 261, 263 and 279

All of these features are mudmass. Feature 261 is equivalent to 260 in square F19 (produced one rim sherd). Feature 263 is mudmass underlying 256 (not described, but probably mudmass)(also produced one rim sherd). Feature 279 is described as an arbitrary subdivision of 261 (based on the presence of a marl line, which usually represents a plaster face on an underlying wall), and between benches three and four from the west baulk. Feature 279 is another mudmass feature which produced one identifiable rim sherd. All these features are combined with each other and with 260 in F19. As is mentioned above, six total identifiable rim sherds were recovered from the 10 x 10m area covered by features 260, 261, 263 and 279.

Square I17

This square is in the area identified as "workers' houses" (Lehner 2002). Five features in this square produced 10 identifiable rim sherds; 808, 829, 901, 902 and 903.

Feature 808

Feature 808 is a clean modern sand layer covering the expanse of the square. This feature produced some charcoal and pottery, including one identifiable rim sherd.

Feature 829

This is an ash rich, dark brown fill feature, underlying 808, 827 and 828. Feature 827 is described as the interface between 808 (described above) and feature 829, with feature 829 being greyer and sandier than 829. Feature 828 is a pit cut into 829. Feature 829 is contained in a southern room of the square described by walls 826, 825, 839, 848, 849 and is approximately 10 cm deep. This feature produced six identifiable rim sherds.

Feature 901

This feature underlies 829 and is described as a "pottery rich, ashy mound," (also under 849, described as a concentration of limestone rubble associated with walls 825 and 848). The feature is approximately 25 cm deep. Feature 901, like 849, also contains quite a bit of limestone rubble. This feature produced one identifiable rim sherd.

Feature 902

This feature also underlies 829 and is distinguished from 901 due to a relative paucity of pottery and an abundance of fine charcoal and generally loose fine sediments. Feature 902 is approximately 10 – 12 cm deep. This feature produced one identifiable rim sherd.

Feature 903

This feature underlies 849 (limestone rubble concentration described above). It is sandier than 902 and contains relatively more pottery. The excavator suggests that this feature is equivalent to 829. This deposit produced one identifiable rim sherd.

Square L9

This square is at the southern end of the NE gallery set. The contents of the three features described below could be combined into one unit. All three of these features underlie 1099, which is described as consisting of clean, recently deposited sand covering the expanse of the square.

Features 1115, 1116, 1117

Feature 1115 is a brick tumble feature in the southern strip of L9 south of 1113 (an EW trending mudbrick wall). Feature 1116 is tumble feature in the NW corner of L9, consisting primarily of mud and marl bricks. This feature is adjacent to 1117 (see below) and 1115. Feature 1116 is west of 1114 (a N/S trending mudbrick wall). Feature 1117 is a brick tumble feature in the NE corner of the square east of 1113. Six rim sherds were recovered from these deposits.

L10/1332

Square L10 is located in an area identified as a "bakery." Feature 1332 is a typical mudmass feature concentrated south of 1331 (an EW trending mudbrick wall). This feature produced three identifiable rim sherds.

Square L11

This is the square immediately to the east of L10. Three features within this square produced identifiable rim sherds; 1249, 1261, and 1289.

Feature 1249

Feature 1249 is mudmass fill, underlying 1201 (which is also mudmass distinguished from 1249 because 1249 has a larger concentration of sherds). Feature 1249 produced three identifiable rim sherds.

Feature 1261

This feature is described as a "marl floor," underlying 1260 (described as "baking emplacements in a plaster floor," consisting of ashy ground tefla). The ground tefla comprising 1260 appears to have been applied directly over 1261. Features 1302-1310 are small pits dug into 1260 and 1261. Feature 1261 produced one identifiable rim sherd.

Feature 1289

This feature underlies 1196 (described as compact gray mud fill) and is distinguished from 1196 in that the sediments are ashier and dark brown/black. Feature 1289 is described as "mounding to the east." This feature produced one identifiable rim sherd.

Square L12/1139

Square L12 is directly east of square L11. Feature 1139 is consists of surface sand and sherds covering the extent of the square. This feature produced one identifiable rim sherd.

Square M10

Square M10 is directly north of L10 and is also within the area considered a bakery. Five features in this square produced identifiable rim sherds; 1127, 1130, 1133, 1375, and 1410.

Feature 1127

This is a mudmass feature underlying 1100 (described as surface sand and sherds covering the expanse of the square) and adjacent to 1133 and 1130 and overlying 1375 and 1410 (all discussed in turn). Feature 1127 is in the southern half of the square, west of wall 1126 (a N/S trending limestone wall running through the middle of the southern half of the square), and south of 1129 (an E/W trending limestone wall in the middle of the western half of M10) and 1132 (an E/W trending limestone wall in the NE corner of M10). This feature also apparently appears east of 1126, surrounding 1128 (a dark feature in the middle of the eastern half of M10 south of 1132). This feature produced seven identifiable rim sherds.

Features 1130 and 1133

Both features are mudmass tumble on the eastern and western sides of wall 1131 (a N/S trending stone wall that may be and probably is part of 1126). Feature 1130 is in the NW corner of M10, north of wall 1129 and west of 1131. Similar to 1127, this feature directly underlies 1100. Feature 1133 also underlies 1100, but in the NE corner of the square, east of wall 1131. Because these features are mudmass, they are combined. Together, these features produced six identifiable rim sherds.

Features 1375 and 1410

These features are both described as ashy surfaces underlying 1127. Feature 1375 is located in the SW corner of M10, south of 1129 and west of 1126. Feature 1410 is located in the SE corner of M10 and east of wall 1126. Because these are both ashy surface features, they are combined into one feature. Together these features produced two identifiable rim sherds.

Square M12

This square is also within the area identified as a bakery. Three features in this square produced identifiable rim sherds; 1192, 1193 and 1214. All of these features underlie 1161, described as a typical mudmass feature trending EW in the center of the square. Feature 1192 is a sherd, grain and charcoal concentration in the SE corner of the square, producing one identifiable rim sherd. Feature 1193 is a sherd and limestone concentration in the NW corner of the square, also producing one identifiable rim sherd. Feature 1214 is a sherd and mud concentration underlying 1161 in the west half of the square. This last feature produced eight identifiable rim sherds.

Square N11

This square is also located in the area identified as bakeries. Four features produced identifiable rim sherds; 1101, 1212, 1330 and 1372.

Feature 1101

A clean sand feature covering the expanse of the square, overlying 1212. This feature produced one identifiable rim sherd.

Feature 1212

This is a fill feature; pottery rich with some ash lenses and lumps of mudbrick rubble as well as some large pieces of pottery. Feature located between walls 1156 (a N/S trending mudbrick wall underlying 1101) and 1145 (a N/S trending limestone and mudbrick wall that is probably related to 1156, but disjunction exists). The feature is described as being equivalent to 1167 (a concentration of ash, pottery and fill in the doorway between 1156 and 1207). Both features are associated with gaps in these walls. Feature 1212 produced three identifiable rim sherds.

Feature 1330

This feature is fill east of wall 1146, underlying 1101. This feature produced one identifiable rim sherd.

Feature 1372

This feature is simply described as room fill and it produced one identifiable rim sherd.

Square N12/1136

This is described as a surface sand feature covering the expanse of the square. This feature produced three identifiable rim sherds.

Square N20

Seven features in this square produced eight identifiable rim sherds; 727, 739, 740, 771, 793, 810 and 823.

Features 727 and 739

Both features are primarily modern sand with some artifacts. Feature 727 is described as modern yellow sand feature, compacted and relatively artifact free. This feature is dated by the presence of British army postholes dug into the surface. Feature 727 overlays the expanse of the square. This feature produced one identifiable rim. Feature 739 directly underlies 727 and also consists primarily of clean sand. Feature 739 is distinguished from 727 primarily due to its being browner and somehwhat more compact. Both features are approximately 15 cm deep. Features are combined and together produced two identifiable rim sherds.

Feature 740

This is a layer of clay and sand containing lots of sherds, some of which are clearly whole vessels broken in place. The feature is also described as being between clearly defined walls and the presence of broken whole vessels suggests a floor surface. Feature underlies 739 (described above) and is approximately 20cm deep. Feature 740 produced one identifiable rim sherd.

Feature 771

This feature consists of reddish sandy soil with small pottery inclusions which covers an area simply described as the East Hallway. This feature is north of 761 (a N/S trending limestone wall on the east side of the square underlying 739). This feature produced one identifiable rim sherd.

Feature 793

This feature is room fill, bounded by 760 (an EW trending limestone wall in the SE corner of the square), 759 (which is an continuation of 760 on the eastern end, the two walls are separated by a gap) and 792 (a N/S trending mudbrick wall forming the west side of the 'hallway' mentioned above.) The excavator notes that this wall connects features 760 and 759. This feature produced one identifiable rim sherd.

Feature 810

This feature is also room fill. Feature 810 underlies 740 (described above). Sediments are blackish brown ashy sand and approximately 25 cm deep. This feature produced two identifiable rim sherds.

Feature 823

This is a pottery concentration in the NE corner of the room (discussed above) approximately 50cm deep. Feature 823 produced one identifiable rim sherd.

Square N9

This square is just to the NW of the area identified as a bakery. Three features produced identifiable rim sherds; 1243, 1404 and 1406.

Feature 1243

This feature surface sand and sherds covering the entire expanse of the square. Feature produced one identifiable rim sherd.

Feature 1404

This is pit fill with mud and large jars. Feature produced two identifiable rim sherds.

Feature 1406

This is compact mud fill in the SE quadrant of the square approximately 2.5 x 2.5m in extent. This feature produced three identifiable rim sherds.

O10/1637

Square o10 is directly north of the area identified as bakery in the NW quadrant of area A. Feature 1637 is a typical mudmass deposit covering the expanse of the square. Only one feature in this square, 1637, produced identifiable rim sherds (two total).

Square O11

Square O11 is just northeast of the area identified as a bakery. Two features; 1140 and 1642 produced identifiable rims.

Feature 1140

This is surface sand and sherds, covering the entire expanse of the square. Feature 1140 produced four identifiable rim sherds.

Feature 1642

This is a mudmass feature covering the east half of square (ca 5 x 2.5m in extent). This feature produced one identifiable rim sherd.

Square O12

This square is in the NE portion of the NW gallery quadrant, generally north of the bakery area. Five features produced 19 identifiable rim sherds; 1122, 1464, 1468, 1469, and 1541.

Feature 1122

This is surface sand covering the expanse of the square and it produced 10 identifiable rim sherds.

Feature 1464

This is a N/S trending wall, on the north side of 1461. Feature 1461 is described as a cut pit for a burial on the north central portion of the square. Feature 1464 produced one identifiable rim sherd.

Feature 1468

This is a possible floor, west of wall 1463 (described as wall defined by marl line, on the east side of the square). This floor surface is located approximately in the center of the square. Feature 1468 produced one identifiable rim sherd.

Feature 1469

Feature 1469 is another possible floor located in the center of the square and west of wall 1464 (described above). This deposit produced one identifiable rim sherd.

Feature 1541

Described as "rubbly compact fill," underlying 1468 and 1469 (described above). This feature produced six identifiable rim sherds.

Square C1, Feature 5

This excavation unit is located at the entrance of E/W trending gallery 68. It is a gray alluvial deposit enclosed by features two and three (limestone and plaster walls). Feature 5 is one of two features identified in this square. The gallery was divided in two halves; east and west. Of these, Feature 5 is the westernmost and is described as "a patch of gray deposit" (Conard and Lehner 2001:33). There are small pits in the limestone threshold in C1 (and C10, described below) (Conard and Lehner 2001:33). Also found in this feature were several fragments of white gypsum plaster. These fragments suggest the fronts of the galleries were covered with gypsum plaster (Conard and Lehner 2001:34). This feature produced two identifiable rim sherds.

Square C2, Feature 1

This unit is located in the middle section of E/W gallery 36. This feature is poorly sorted sand with abundant fossil inclusions (a general feature of the Mokkatam or Maadi formation, which forms much of the Giza Plateau.) This fill deposit is defined by walls 4 and 5. This feature produced one identifiable rim sherd.

Square C5, Feature 1

This square contains a gray deposit similar to that noted in C11 (described below). Also found within this square are carbonized plant remains. Feature 1 produced one identifiable rim sherd.

Square C9, Feature 5

C9 is the middle section of N/S gallery 83 (Conard and Lehner 2001:26). Feature 5 is not described. Square C9 in general is noteworthy because it produced a sandstone abrader and a piece of worked granite. Feature 5 also produced four identifiable rim sherds.

Square C11, Feature 5

Unit C11 is also a gallery similar to C1. The excavation of this gallery was not completed due to time constraints on the season. This unit featured a "gray deposit," approximately 40cm thick above the floor. Marl patches suggest that this feature "was a higher floor laid down after the material of Features 4 and 5 had accumulated," (Conard and Lehner 2001:39).

Feature 5 is described as "a more concentrated alluvial mud layer about 10 cm thick just upon the original floor of the gallery," (Conard and Lehner 2001:39). This ashy colored feature produced pottery and bone as well as roofing material (eight large fragments in all). Feature 5 in this square produced three identifiable rim sherds.

Kom el-Hisn

Both Buck (1990) and Cagle (2001) classify the Kom el-Hisn deposits with slightly different research goals. Because Buck's research pertained to site formation processes, he used five dimensions; structure, texture, dominant largest clast, presence or absence of mudbricks and evidence of burning. Therefore, he emphasizes depositional characteristics. Understanding the depositional context of various sediments does contribute to reasonable interpretations of past use.

Structure refers to the overall patterning in particular deposits (Buck 1990:74). Three modes are assigned to this dimension; massive, horizontal and vertical. Massive refers to homogeneous deposits, such as a sand stratum with no internal structure. Horizontal refers to a deposit with stratified or laminated lenses. Vertical refers to a pattern of rectangular features separated by voids or other sediment distinguishable from the matrix of the deposit (essentially the presence of mudbricks)(Buck 1990:76). Cagle's use of structure is essentially the same (Cagle 2001:66).

Texture is the dominant particle size represented in the SUs (Buck 1990:77). These are simply subdivided into coarse and fine. Coarse refers to primarily gravel sized clasts (4mm +). Fine refers to clasts smaller than 4mm. This dimension distinguishes deposits based on the energy of the transport medium. High energy transport mechanisms have the potential to transport larger clast sizes. In the case of Kom el-Hisn, large clasts may be attributable to gravity (mass wasting) or human transport or deposition (Buck 1990:78). Cagle uses texture in approximately the same way (Cagle 2001:66-67).

Large clast type refers to the composition of the larger clasts in the deposit. Buck (1990:78) identifies mudbricks, mottles (spotty or blotchy patches), sherds and other as potential clast kinds. This dimension allows the identification of potential sources of large clasts. Cagle (2001:68) uses more cultural modes in his approach, identifying the modes of larger clasts in the deposit as: absent; bricks, brick fragments and mottles; ceramics and other.

Color is simply "black" and "not black." "Black" was assigned to deposits of any Munsell hue, but with lowest readings for both value and chroma (Buck 1990:78). This mode was chosen to distinguish deposits exhibiting evidence of burning from those that showed no evidence of burning. Cagle (2001:68) substitutes an observation of burned sediments for the Munsell reading advocated by Buck.

Because Cagle classified more deposits containing Meidum bowls than Buck, in most instances Cagle's deposit classification will be employed. Cagle notes that strict paradigmatic classification was often inadequate for distinguishing between observable deposit types. Thus his classification is really a heuristic device used in combination with the actual excavation notes to finally interpret deposits as; wall collapse, dump, floor, decomposed wall collapse, UPL, pit, redeposited dump, redeposited wall collapse, fluvial, intact wall, burial, and column base.

Deposits containing identifiable Meidum bowl rim sherds are described below. Where possible, Cagle's paradigmatic class is provided, along with Cagle's interpretation and depositional level. Additional information was taken from excavation field notes, however, in most cases, deposit information is taken from Cagle 2001.

Because excavation unit boundaries were in some cases determined by the walls of surface structures, while in other cases determined by grid square boundaries, the grid square boundary is used as the index for describing SUs in a general area. Deposits described below are listed by grid square coordinate. If relevant, room number is also provided. Despite the fact that Cagle has combined several SUs into larger DU units, it was deemed wiser here to retain the original provenience information.

Contents of Excavation Squares and Rooms

1202/1070 (Room 1)

This room was partially excavated in 1984 and 1986 as a 2 x 2 meter unit. Room 1 itself was not defined until the 1988 season. The room boundaries are defined by brick walls on the west and south and a less well-defined wall on the east (Cagle 2001:138). Upper deposits (SUs 1 and 2 described below) are associated with the walls making up the room boundaries and are assumed to be contemporary with the block area architecture to the south of the room (Cagle 2001:138). Beneath SU 2 (floor surface described above, pertaining to SUs 8, 9 and 10), is a dump positioned stratigraphically beneath the walls composing room 1 and thus not associated with it. Five depositional units in this room produced identifiable rim sherds.

SU 1 is the uppermost deposit in the room. This deposit is brick rubble fill with mottled gray orange brick fragments, occasionally burned. Bone is the most abundant inclusion in this deposit, whereas ceramic density is relatively light. This deposit is classified by Cagle as wall collapse, class 12111, level 3. This deposit produced six identifiable rim sherds.

SU 2 underlies and is identified as an occupation surface marked by a horizontally bedded dark gray compact sediments. Horizontal bedding results in a series of discontinuous lenses, some with ash pockets. Ceramics from this unit are burned as are the interior faces of the southernmost and easternmost walls of the room. Original excavation notes suggest this deposit marks a break between features contemporary with room 1 as a structure and the materials that underlie it. This deposit is classified by Cagle as floor, class 22201, level 3. This unit produced three identifiable rim sherds.

SU 8, 9 and 10 underlie SU 2 and predate the construction of room 1. SU 10 represents material collected in 1988 that underlies the water table. Material collected from the water table does not come from a deposit with any kind of structure. These deposits were therefore not classified. The assumed level for this material is level 4 as these dump deposits underlie SUs 4 and 5 which Cagle has assigned level 4. Combined these deposits produced seven identifiable rim sherds.

1202/1072 (room N1)

At the time of excavation, two structures were assigned room number 1. Therefore this room was designated N1. SUs 1, 2, 3, 4, 5 and 6 produced measureable rim sherds. This unit is 4m x 4m in extent with deposits bounded on all sides by mudbrick walls. Because this deposit is not described in either **Buck (1990)** and Cagle (2001), excavation notes were used to outline the depositional history of this unit.

SU 1 is described as "a black layer containing eroded red pottery." This material is probably Cagle's UPL. This SU is 1m x 75cm in area and approximately 65 cm thick and overlies several architectural features. The estimated classification is 11211, interpretation is UPL, level is 1. SU 1 produced 15 identifiable rim sherds.

SU 2 is distinguished from SU 1 by the presence of brick fragments. This deposit is approximately 13 cm thick. This deposit consists of yellowish mudbricks with some black lines interspersed. A mudbrick wall emerges on the eastern side of the square in the course of excavating this SU. Some of these bricks are burned. The estimated classification is 31121, interpretation is decomposed wall collapse, level 1. Among the artifactual material recovered from this unit were seven identifiable rim sherds.

SU 3 underlies SU 2 and is distinguished from SU 2 by the presence of abundant black ash. Deposit depth is not clear. This deposit is apparently very small and is probably a lower less eroded portion of the wall collapse described above. The estimated classification is 31121, wall collapse level 1. SU 3 produced one identifiable rim sherd.

SU 4 is brickier than SU 3. The deposit is described as burnt yellowish bricks ca 20m deep. At the bottom of this deposit are found several large thick walled vessel fragments. The base of this deposit therefore, could represent an occupation surface (*sensu* Cagle 2001). The estimated classification is 31120, wall collapse, level 1. This deposit produced four identifiable rim sherds.

SU 5 is distinguished from SU 4 by being black and ashy. SU 5 is approximately 15 cm deep. Given that large sherds broken in place seem to rest on this surface, this is potentially an occupation surface. The estimated classification is 11301, floor level 1. This deposit produced two identifiable rim sherds.

SU 6 underlies SU 5 and is distinguished from SU 5 by the presence of yellow bricky material. Within this deposit is one bone from an infant which might represent the beginning of level 2 (the burial level), as the SU below this one produced most of an infant burial. The estimated classification is therefore 12300, burial level 2. SU 6 produced three identifiable rim sherds.

1208/1074, 1207/1074 (Room 2)

Grid square corners are used to identify the location of particular rooms, however, it is often the case that rooms overlap multiple excavation units. Room 2 is defined by three walls on the northern, western and southern sides, all associated with level 3 occupations. Two SUs in this general range of grid squares room produced identifiable rim sherds.

SU 1 is UPL and consists of brick fragments with a small number of ceramics in a dark matrix. The grid coordinates for SU 1 are 1208s/1074e. All artifact categories are moderate, relative to all other units in general and UPL in particular (Cagle 2001:139). The classification of this deposit is 11200, level 0. This deposit produced two identifiable rim sherds.

SU 3 is similar to SU1 (which directly overlies it in roughly the same configuration.) Sediments in this unit consist of dark brown clayey material. Grid coordinates for this SU are 1209s/1074e. Ceramic density is moderate. Also noteworthy is the presence of a grinding stone at the bottom of this unit, however, it is not clear whether this deposit is a floor or not. Layers in this deposit are laminated and extend below the base of the south wall defining Room 1 (hence the Level 3 assignment). A hard, burned and clayey surface occupies the lower portion of the SU, next to a circular feature, SU 3 is then sandy farther away from the circular feature. This deposit is at the same elevation as the base of the walls that define room 2. The classification is 11111, wall collapse Level 3. This unit produced four identifiable rim sherds.

1216/1072 (Room 4)

The upper layers of this room represent two episodes of wall collapse; SU 3 and SU 7. Sometime after the walls collapsed and material was dumped on top of them, an infant burial was cut into the north wall through the sediments of SUs 3 and 7 (Cagle 2001:148). .

SU 3 is wall collapse, with a black to brown mottled matrix sloping, to the southeast. This SU contains more brick relative to the deposit that underlies it (SU 7). Cagle combined SUs 7 and 3 into one deposit (Cagle DU 2), however, only SU 3 produced identifiable rim sherds. SU 7 is a continuation of the wall collapse represented by SU 3. There is some evidence of burning in the lower courses of SU 3, suggesting that the bulk of the sedimentary unit was built after a hiatus in the construction of SU 7. Further evidence of a hiatus in the construction of the walls represented by SUs 3 and 7 comes in the form of several large ceramics lying on the surface of SU 7. The Cagle classification is 12111, level 3, wall collapse. SU 3 produced two identifiable rim sherds.

SU 4 is an intact wall containing a moderate amount of bone and ceramic. Part of this wall was robbed out for the interment of an infant, indicating that the wall construction predated the infant burial. The Cagle classification is 32120, level 3, intact wall. This deposit produced two identifiable rim sherds.

SU 12 is interpreted as a floor surface, but does not appear to be associated with the walls defining Room 4. This material consists of a dark gray and tan mottled matrix containing black lenses of bone concentrations. This deposit is noteworthy due to the large number of rim sherds present, relative to body sherds. The Cagle classification is 22201, Level 4, floor. Among these rim sherds are two identifiable Meidum bowl rims.

SU 23 underlies the material discussed above. This deposit produced one identifiable rim sherd. In general, throughout Kom el-Hisn, SU 23 refers to deposits below Level 4 that are associated with the water table and thus have little solid integrity.

1211/1072 and 1213/1072 (Room 5)

This room was excavated during the 1986 and 1988 seasons. This room contains two sets of occupation surfaces associated with the room structure. SUs 7, 8 and 9 (discussed below) probably represent the foundation deposit of the room (Cagle 2001:154). SUs 3 and 4 are pit fill used to level pits underlying the foundation deposit represented by SUs 7,8 and 9.

SU 1 is a pottery dump layer with some brick fragments (Cagle 2001:149). This deposit in general consists primarily of pot sherds. This SU crosses into both grid squares. The Cagle classification is 11200, level 0, UPL. Of these abundant pot sherds, five were identifiable rim sherds.

SU 3 is a dump deposit with distinctive lenses (variously described as "gravelly sediment," "gray clay," "loose sand," and "loose clay.") The relationship between this deposit and SU 5 (wall collapse, discussed below) is unclear, as they are separated by a burial (SU 4, described below) (Cagle 2001:149). Ceramic and bone density in this deposit are moderate in comparison to other dumps. The Cagle classification is 11201, Level 1, dump deposit. This deposit produced one identifiable rim sherd.

SU 4 was initially differentiated from SU 3 because it consists of a lighter colored hard clay 'plastered layer' in the NW corner of the room (Cagle 2001:152). As with SU 3, ceramic and bone densities are moderate. SU 4 is a floor associated with a grave. This grave intrudes into the occupation surfaces of the room. The unit boundaries crossed the grave outline during the 1986 excavation seasons, with the head and torso in 1211s/1072e and the legs and pelvis in 1213s/ 1072e. This burial is associated with an infant burial found in 1213s/1072e west of the adult burial and west of the pit structure. The relationship between these burials is unclear, however (Cagle 2001:151). The Cagle classification is 12200, Level 3, floor. SU 4 produced three identifiable rim sherds which are more likely associated with the time of room construction as opposed to the burial.

SU 5 is wall collapse associated with SU 3, but the nature of the relationship is unclear due to its being interrupted by the burial. This deposit contains a moderate amount of ceramics as compared to a relatively high density of bone. This is also a brick lined pit structure that is cut to the NE by the burial associated with SU 4. Contents suggest the use of this pit as a small dump (Cagle 2001:153). SU 5 is classified as 12200 level 3 pit. Of the ceramics, one was an identifiable rim sherd.

SU 7, 8, 9 have been combined together in as representing one depositional event, Cagle's DU 10. The deposit is the second of two sets of floors associated with the room structure and consists of three SUs (7, 8 and 9) representing a series of laminated layers (Cagle 2001: 154). Cagle combined these deposits because they are all associated with the bottom of the enclosing walls and thus could represent continuous floor remodeling, similar to that noted at Giza (wherein floors sometimes consisted of alternating layers of ash and plaster caps, apparently installed to keep the ash down). The layers are loosely compacted brown sediment with approximately 1cm thick laminated layers in between. Also noted are small blackened areas filled with charcoal and ceramics which Cagle (2001:154) suggests might represent small hearthsArtifact densities are moderate compared to other deposits. Also noted are several lithics and bits of lithic debris. This material was classified as 2120, level 3, floor. Combined, these deposits produced eleven identifiable rim sherds.

1212/1068 (Room 6)

Two occupations are associated with this room. The more recent occupation is indicated by a floor surface strictly associated with room 6 (SU 5, not described, as it contained no identifiable rim sherds). The earlier occupation is represented by a floor surface underlying SU 5 and an intervening dumping event, that connects to the floor surface in the adjacent room 8 (Cagle 2001:159). Several SUs in this room produced identifiable rim sherds.

SU 1 is wall collapse material in a brown matrix. The deposit itself is thicker in the center of the room than it is toward the edges (Cagle 2001:156). Bricks are more patterned toward the center of the room, suggesting whatever structure they represent was centered there. Field notes indicate these bricks are arranged in five rows of three to four bricks each in curving lines that don't look like a wall but rather a collapsed wall. Ceramic density is moderate relative to other excavation units. The Cagle classification is 12210 level 3, wall collapse. This deposit produced three identifiable rim sherds.

SU 2 is the same material as SU 1. However, it is distinguished from SU 1 as well, in that SU 1 was terminated when blackish and brown sandy material started to emerge from under the wall collapse. This deposit covers the area defined by the four walls of the room. Excavation notes describe this material as black and brown sandy material with brick fall in brown sandy sediments, the notes also indicate this material can be properly combined with SU 1. At the bottom of this unit the excavator notes the presence of a grinding stone, and large sherds lying on a surface that turns out to be SU 3. The Cagle classification is12210, level 3 wall collapse. This deposit produced one identifiable rim sherd.

SU 3 is a black unit following the contours of SU 1, humped in the middle and tapering out to the sides. Excavation notes suggest the deposit is full of ash, charcoal and burned bone that appears to be a secondary deposit simply because the material is blackened, but does not appear to have been burned *in situ*. Ceramic density is moderate, relative to bone. This deposit appears to have been formed after a wall collapse episode. This deposit, unlike those described above does not cover the expanse of the room, but is rather centered only on the black humped material described in the middle of the room. The excavator notes the presence of grinding stones and large sherds. Classification is 12201 level 1 dump. SU 3 produced three identifiable rim sherds.

SU 4 is brown sandy sediment with no visible brick fragments, underlying SUs 1 and 6. This deposit is interpreted it as brick collapse, nonetheless, because of its appearance and position underlying similarly colored brick fragments (Cagle 2001:158). Ceramic density is moderate relative to lithic density, which is relatively high. This deposit also covers the extent of the room. This deposit extends to the base of brick walls defining the room. In general this deposit appears to extend below the bases of the walls defining room 4. The Cagle classification is 12000, level 3, decomposed wall collapse. This deposit produced one identifiable rim sherd.

Cagle (2001:158) suggests that SU 1 can be combined with SU 6, which is the same as SU 1 with the exception of its being interrupted by SU 3 (a black ashy deposit, described below). However, since there is an intervening lens between these deposits their contents are kept separate for the purposes of this study. The Cagle classification is 12210 level 3, wall collapse. This deposit produced one identifiable rim sherd.

SU 8 is a thin occupation surface underlying SUs 1 and 6, 3 and 4. Sediments are dark brown to black and ceramic frequency is high. The Cagle classification is 12210 level 3, wall collapse. This deposit produced one identifiable rim sherd.

SU 10 was analyzed as part of Room 8. This deposit is a floor composed of burned sediment with bone inclusions. The deposit connects under the south wall to SUs 4, 5, 7 and 9 in room 8. The excavation notes also indicate that SU 10 is associated with the walls of room 8 (discussed below). The lowest of these room 8 walls extends below the north wall of the excavation unit and connects to this SU (room 6, SU 10). The deposit itself is mottled dark black sediment with abundant burned bone and ceramics (Cagle 2001:169). This material is classified as 22201, level 3 floor. Of these burned ceramics, six are identifiable rim sherds.

1218/1072 (Room 7)

This excavation unit contains an irregular semicircular structure adjacent to the room in unit 1220/1072 (described below). The relationship between this room and the adjacent rooms to the north and south is unclear, due to Room 7's irregular shape. Only one SU in this structure (SU 2) produced an identifiable rim sherd.

SU 2 follows the outline of surface bricks toward the center of the structure. Excavation notes indicate that ceramics occur in clusters suggesting that whole pots were broken in place. Ceramic density is moderate (Cagle 2001:160). The Cagle classification is 12201, level 3 floor. SU 2 produced one identifiable rim sherd.

1216/1068 (Room 8)

The uppermost of room 8's deposits potentially represent three different wall collapse events. The upper most (SU 2) exhibits evidence of burning (discussed below). SUs 2, 4, and 6 produced identifiable rim sherds.

SU 2 is the lower portion of a burned wall (SU 1 is the upper portion of the wall). This deposit may also contain some dumped material as indicated by a relatively high concentration of ceramics relative to other wall deposits (Cagle 2001:168). The Cagle classification is 12211 level 3, wall collapse. This deposit produced two identifiable rim sherds.

SU 4 is also wall collapse with heavier brick fall relative to the overlying SU 1 and 2 complex. Cagle (2001:168) speculates the wall was burned and then collapsed, in that many of the intact bricks are burned. Ceramic content is lower than in the overlying deposits (discussed above). The classification is 1211, level 3, wall collapse. This deposit produced five identifiable rim sherds.

SU 6 links to SU 10 in Room 6. As is noted above, SU 10, room 6 consists of mottled dark black sediment with abundant burned bone and ceramic (Cagle 2001:169). The Cagle classification is 22201 level 3 floor. SU 6 produced two identifiable rim sherds.

1216/1076 (Room 9)

The upper strata in unit 1216/1076 consist of dumps deposited later than the occupation of the room, thus providing evidence of an occupational hiatus. The floor of the room is exceptional in comparison to other room floors. This is due to the presence of pits in the floor that may have held column bases supporting a roof (Cagle 2001:175). Four SUs in this room produced identifiable rim sherds; 1, 4, 5, and 7.

SU 1 is a dump deposit with some mudbrick tumble, black in color, with a high concentration of ceramics relative to other dump deposits. Ceramic density is comparable to that of bone density (Cagle 2001:170). The Cagle classification is 12211 level 1, dump. This deposit produced one identifiable rim sherd.

SU 4 is a fill deposit of mottled brown sandy sediment sitting on top of black sediment with patches of gray clay (SU 5). The mottles themselves are probably decomposed mudbricks (Cagle 2001:173). This deposit was combined with SU 5, which is blacker than and underlies SU 4, however, excavation notes indicate that both SU 4 and 5 are part of the same dumping event. The Cagle classification is 12211 level 1, dump. Combined, SUs 4 and 5 produced six identifiable rim sherds.

SU 7 is sandy brown sediment with abundant lithics and few other artifactual remains. Despite the paucity of pottery, this deposit produced one identifiable rim sherd. Classification is 12010 level 3, decomposed wall collapse.

1212/1064 (Room 10)

This excavation area is the west end of Room 10. The entire area defined by the walls is cut into by a mudbrick tomb (Room 15 described below) and the extent of this room actually goes beyond the boundaries of the grid unit listed above. Excavators cut an east facing section along the 1064 grid line to determine the chronological relationship between rooms 10 and 15. Room 15 (the tomb), therefore, is earlier than this room in that room 10 cuts into it. Therefore, the deposits in this room were all assigned level 1. Only three deposits were identified in this room, two of which, SUs 2 and 3 produced identifiable rim sherds.

The upper deposit (SU 1) contained wall collapse and fluvial materials. Artifact contents result from objects washed in from other locations around the site.

SUs 2 and 3 are more laminated than SU 1 (which overlies these deposits) and contain more lenses of charred material. This suggests that SUs 2 and 3 are primary deposits as opposed to the redeposited dumped material in SU 1. The classification of SUs 2 and 3 (which Cagle has combined into DU 2), is 22001 level 1 redeposited dump. SUs 2 and 3 together produced six identifiable rim sherds.

1214/1062 (Room 12)

This excavation unit contains room 12, which is defined by four intact walls. The southern wall is the northern wall of room 13 (discussed below). The east wall is the western wall of the large structure containing room 10 (discussed above) and room 15 (discussed below). Room 12 is connected to this large structure by a doorway (Cagle 2001:183).

SU 1 could either be a dump or an intact floor assemblage and is combined with SU 3 by Cagle (2001:179). Sediments overlie SUs 2 and 4 (combined into one DU 2 by Cagle and identified as a floor feature, described below), but it is not clear whether objects contained in these sediments were left in their use context or deposited later (Cagle 2001:179). Ceramic content is high relative to other deposits. Also noteworthy in this feature is the presence of complete grinding stones, which tend to indicate a floor surface, rather than fill material. This is because, in general, complete grinding stones due to their weight are less likely to be incorporated into fill deposits. These units combined are classified as 11200 level 3, dump. The combined contents of SUs 1 and 3 produced three identifiable rim sherds.

SUs 2 and 4 were combined by Cagle into one unit (DU 2) representing the floor of room 12. The deposit is a layer of thin laminated clay and silt sediments that could either be prepared floors or naturally formed through fluvial activity. The top of this deposit is dark black and contains a large amount of charcoal and small burned bones (Cagle 2001:182). The

Cagle classification is 22201 level 3 floor. Combined, these SUs produced five identifiable rim sherds.

SU 5 (along with SU 7, which produced no identifiable rim sherds) is decomposed wall tumble possibly representing several collapse episodes (Cagle 2001:182). The bulk of SU 5 is clean brown sand underlain by greenish gray material mostly devoid of artifactual material. Within SU 5 is a thin layer of black sediment which may represent a brief occupation surface (speculation in Cagle 2001:182). The Cagle classification is 22000, level 4, decomposed wall collapse. SU 5 produced two identifiable rim sherds

1220/1064 (Room 13)

Four SUs in this room produced identifiable rim sherds; 1, 2, 3, 6 and 7. The excavated portion of this room represents two occupations. The more recent (upper occupation) is associated with the room walls. Below this relatively clear occupation is a more ambiguous occupation represented by wall collapse from undetected structures. The room was sectioned, so that only the southern portion was excavated. Therefore, the relationship between the deposits described below and those noted in room 12 are unclear.

SU 1 is a combination of UPL and wall collapse. This material is black sandy matrix with tan mottles and thin lenses of tan sand, the latter suggesting to Cagle (2001:184-187) the possibility of fluvial activity. This deposit is also associated with an infant burial. Ceramic density is relatively high compared to other deposits. The Cagle classification is 11211, level 3 wall collapse. This unit produced five identifiable rim sherds.

SU 2 is combined with SU 1 by Cagle (2001:184) into one unit, DU 1. SU 2 is identified as the lower portion of DU 1, and is darker than SU 1 (discussed above), with reddish mottles and charcoal indicating a possible burning and dumping event. The Cagle classification is 11211 level 3,wall collapse. This deposit produced five identifiable rim sherds.

SU 3 is a large unit (covering approximately four square meters) and is differentiated from DU 1 (SUs 1 and 2) by a lighter tan color, more bricks and fewer artifacts. The Cagle classification is 12110, level 3, wall collapse. This deposit produced five identifiable rim sherds.

SU 6 is wall collapse under the wall that defines room 13 and is thus associated with an earlier structure, not associated with the overlying deposits. These sediments consist of gray-brown mottled matrix with some brick fragments and therefore probably represent decomposed wall collapse. The Cagle classification is 12110, level 4 wall collapse. This deposit produced four identifiable rim sherds.

SU 7 is heavy brick fall. There are also lenses of clay flecked with charcoal that may have been fluvially deposited. Ceramic density is low relative to all deposits, but moderate compared to other wall collapse deposits. The Cagle classification is 11111, level 4, wall collapse. This deposit produced two identifiable rim sherds.

1214/1066 (Room 15)

This room was a tomb built into a preexisting structure that contains room 10 (which is directly north of room 15). Both layers of wall collapse contained within room 15 are presumed to be from the tomb structure (Cagle 2001:194). The tomb was probably constructed after the main occupation of the larger structure (containing rooms 10 and 15). After a period of decomposition the walls of the tomb began to collapse, creating SU 4 (discussed below). Following the creation of SU 4, SU 3 was deposited on top (Cagle 2001:194). Therefore all the deposits described below are associated with the burial (a female of unknown Dynastic attribution is buried in an extended position with a bronze copper mirror).

SU 2 is dark brown to tan wall collapse containing small brick fragments and some ceramics. The deposit is slightly higher at the south end of the unit. Artifact densities are high relative to other deposits. Brick material is presumed to be from the mastaba structure. The Cagle classification is 11210, level 2, wall collapse. SU 2 produced two identifiable rim sherds.

SU 3 is a dump deposit consisting of blackened, charcoal rich sediments. Noteworthy is the abundance of burned bone. Cagle (2001:193) suggests the material was dumped over the wall of the room , as this deposit in general was humped up along the eastern wall. The Cagle classification is 11211, level 1, dump. This deposit produced six identifiable rim sherds.

SU 4 is decomposed wall collapse (Cagle 2001:194). The basal portion of this deposit overlies plaster coffin material. Ceramic density is moderate in comparison to other wall collapse deposits, while bone and lithic densities are high. The Cagle classification is level 2, 12000 decomposed wall collapse. This SU produced three identifiable rim sherds.

1212/1058 and 1214/1058 (Room 16)

This "room" is really an ambiguous structure with an unclear deposit sequence. Materials from this excavation unit, therefore, were removed in two SUs; 3 and 4. Boundaries used for the removal of this material were determined from the excavation of two 2 x 2m units which is why these deposits are associated with two different grid squares.

SUs 3 and 4 are both gray and brown mottled matrix with burned brick pieces throughout. Therefore, the contents of these two deposits are combined into one unit. It should be noted that the grid coordinates for SU 3 are 1212/1058, while those for SU 4 are 1214/1058.

The Cagle classification is 12211, level 3 wall collapse. Together, SUs 3 and 4 produced seven identifiable rim sherds.

1156/1004 (Room 17)

This unit consists of a single structure, subdivided by a wall into two separate occupation areas. The portion of the room north of the dividing wall contains a hearth and evidence of two wall collapse episodes (Cagle 2001:200-201). The material deposited in the upper levels of the southern half of the room is probably contemporary with material in the northern half of the room, but deposits in the southern half of the room extend below those in the northern half. Seven deposits from this room produced identifiable rim sherds; 2, 3, 4, 5, 7, 10 and 11. In addition, several sherds were recovered from surface clearing prior to excavation.

Surface clearing can be assumed to be Cagle's level 0. Sediments removed during the course of surface cleaning were not described. From the surface cleaning of the room 17, six identifiable rim sherds were recovered.

SU 2 lies in the southern half of the room (the room being bisected by a small wall) and is the upper deposit discussed above (Cagle 2001:199). Sediments are brown with a relatively high frequency of pottery and bone. SU 3 consists of similar sediments and is thus combined with SU 2 (Cagle 2001:199). The Cagle classification is 11200 level 3, dump. Together, these deposits produced six identifiable rim sherds.

SU 4 is wall collapse, occupying the northwest and eastern portion of the structure. Ceramic density is low to moderate relative to wall deposits and all deposits in general. The Cagle classification is 12110, level 3, wall collapse. Among these sparse ceramics lurked one identifiable rim sherd.

SUs 5 and 10 are also interpreted as wall collapse and floor surface (Cagle 2001:198). These deposits underlie SU 4 in the northwest and eastern portion of the structure (described above). These deposits are distinct from SU 4 because they generally consist of darker sediments. Sherd density in these deposits is lower than that of the deposits overlying them. The Cagle classification is 12211 level 3, wall collapse. Combined, these deposits produced four identifiable rim sherds.

SU 7 is decomposed wall collapse underlying SUs 5 and 10. Cagle (2001:199) suggests that since this material underlies a possible floor surface, it probably represents an earlier occupation. Sherds in this deposit are highly weathered, suggesting they were exposed on the surface for some time before later occupations were constructed. The Cagle classification is 11200, level 4, decomposed wall collapse. SU 7 produced one identifiable rim sherd.

SU 11 is a clear circular pit with burned clay walls, interpreted as a hearth structure (Cagle 2001:200). The Cagle classification is 12202, level 4 pit. Sherd density is relatively low, yet this deposit produced one identifiable rim sherd.

1208/1068 (Room 18)

This room contains evidence of three to four episodes of wall collapse (Cagle 2001:209). The uppermost deposits, SUs 3 and 4, produced identifiable rim sherds. While SUs 3 and 4 are associated with the structure, several deposits underlie this structure and are thus simply provenienced by the grid square coordinate. SU 7 is a middle wall collapse episode sealing the lower layers from the upper layers (Cagle 2001:206). SU 13 is part of a wall collapse deposit to the west of the SU 10 wall.

Within 1208/1068 are deposits underlying the structural elements that outline "room 18" and are thus not related to it as a room. Therefore excavators shifted over to the use of grid coordinate numbers to identify the location from which these deposits were removed. Three additional deposits in this location produced identifiable rim sherds; 7, 13 and 14.

Cagle (2001:205) combines SUs 3 and 4 into one unit (DU 2). DU 2 is associated with the upper walls. DU 2, itself covers the floor deposit and is wall collapse with small charcoal deposits throughout. DU 2 also incorporates a thin lens of darker black material found in the northern third of the room. The classification of DU 2 is 12111, level 3 wall collapse. The combined contents of SUs 3 and 4 (DU 2) produced eleven identifiable rim sherds.

SU 7 is mottled yellowish brown brick tumble containing a light tan colored lens (Cagle 2001:206). The Cagle classification is 12110 level 3, wall collapse. SU 7 produced one identifiable rim sherd.

SU 13 is lowest portion of a brick collapse deposit that Cagle (2001:207) combines into one unit (DU 6). This deposit occurs to the west of the wall identified as SU 10. SU 13 is mottled sand with coarse sand pockets containing relatively few ceramics. The Cagle classification is 12210 level 4 wall collapse. SU 13 produced one identifiable rim sherd.

SU 14 is associated with the lower most episodes of wall collapse in this room. This deposit contains a greater abundance of brick fragments relative to ceramics relative to the overlying deposits (SUs 9, 12 and 13). The Cagle classification is 12110, level 4, wall collapse. This deposit is wall collapse (Cagle 2001:207). SU 14 produced two identifiable rim sherds.

Room 19

The notes collected by the ceramicists working at Kom el-Hisn indicate the existence of room 19, however, there is no available documentation describing the contents or location of this room. Two SUs in this room (2 and 4) produced two identifiable rim sherds. Three identifiable rim sherds were recovered from surface cleaning. Because no provenience is provided, all rim sherds recovered from room 19 will be considered equivalent to the UPL in level 0.

1160/1002 (Room 20)

This room is brick tomb within room 17 (described above). As with the tomb in room 15 (described above), this tombs cuts into and thus post-dates the construction of room 17. Half the body has been removed by modern farming activity in the area, but the individual appears to have been a male enclosed in a plaster coffin (Cagle 2001:209).

This room contained only one deposit, SU 1. This deposit is a sherd dump, apparently heavily disturbed and thus excavated in one unit (Cagle 2001:209). Therefore, there is no necessary connection between the contents of this deposit and the burial underlying it. The Cagle classification is 12210, level 2, upper pottery layer. This deposit produced two identifiable rim sherds.

1210/788 (Room 22)

This room is bounded at the south end by a wall which it shares with room 23 (described below). The bulk of the fill material in this room was not excavated, but it is speculated that this material might contain more than one floor surface (Cagle 2001:213). Two excavated deposits produced identifiable rim sherds; 1 and 2.

SU 1 consists of dark brown compacted sediments with some brick inclusions, particularly where it is closest to the wall shared by rooms 22 and 23. This wall collapse debris appears in the upper layers of this room. Ceramic density is high, relative to other wall collapse deposits. The Cagle classification is 12210, level 3, wall collapse. SU 1 produced three identifiable rim sherds.

SU 2 underlies SU 1 and was not completely excavated. The Cagle classification is 12201, level 3 floor. The upper portions of this SU produced one identifiable rim sherd.

1214/788 (Room 23)

As was discussed previously, rooms 22 and 23 share an E/W trending wall. There are two sets of deposits in this room, the uppermost of which are associated with the room walls. Three SUs in this room produced identifiable rim sherds; 1, 2 and 3. Of these, SUs 1 and 2 comprise the upper most deposits, while SU 3 represents a different occupation level (Cagle 2001:214).

SU 1 consists of brown compacted sediments with abundant ceramics. This SU is distinctive due to the large variety of artifacts found within it including; bone, blade fragments, limestone and sandstone debris and a possible sandstone pounder. The Cagle classification is 12201, level 3, dump. SU 1 produced one identifiable rim sherd.

SU 2 is located at the base of the E/W trending wall that marks the northern boundary of this room. Sediments are dark brown to black with laminations visible and are thus interpreted as a floor surface (Cagle 2001:214). Ceramic density is moderate relative to bone density, which is high. The Cagle classification is 22201, level 3, floor. This deposit produced one identifiable rim sherd.

SU 3 underlies the walls defining this room and thus is not directly associated with the room. Sediments are dark brown with some brick pieces and black lenses, possibly representing several dumping episodes. Faint laminations throughout the deposits suggest some material was redeposited. Ceramic density is moderate relative to other deposits. The Cagle classification is 22011, level 4, decomposed wall collapse. This SU produced one identifiable rim sherd.

Unit 1156/1060

No SUs were excavated from this unit. Identifiable rim sherds were recovered from surface cleaning and thus can be assumed to be part of Cagle's UPL and equivalent to Cagle's level 0. This room lies just outside the block area within which most of the rooms were found. Three measureable rim sherds were recovered.

Unit 1160/1000

No SUs were excavated from this unit. Identifiable rim sherds were recovered from surface cleaning and thus can be assumed part of the UPL and equivalent to level 0. This area lies just south of room 20. Seven measureable rim sherds were recovered.

Unit 1192/1035

From this unit, one SU (originally 23, but combined with other deposits to be identified as Cagle's DU8) , in the lower levels of the square produced a large number of identifiable rim sherds. No rooms were identified in this area, and there are no identifiable rim sherds until the lower levels of the excavation unit.

Buck (1990:275) describes the profile in this unit as being composed of "dense concentrations of large and small sherds in a tan or white sand matrix." The sherds appear "jumbled" without a preferred orientation, representing an episode of rapid dumping with little charcoal or ash in it. Cagle (2001:102) argues that material from this general depositional context represents a dumping event separated from overlying dumping events after a period of disuse. This interpretation is based on the fact that the lower levels of the excavation unit contain more massive (*sensu* Buck 1990 and Cagle 2001) structures and little evidence of discrete dumping events.

This excavation square consists of a series of thick sloping black or dark brown deposits with high sherd density and no recognizable mud bricks (Buck 1990:277). In general the surroundings are an area of sloping debris without walls, collapse or occupation surfaces. Most of the deposits are black with large numbers of big sherds, bone and charcoal, with occasional dumps of sherds in jumbles (Buck 1990:277).

Buck originally subdivided the deposits in this unit into levels. These levels were assigned roman numerals. This subdivision anticipates Cagle's overall assignment of deposits to general levels across the site. Of interest for this research it Buck's unit VIII which overlies SU 23. Unit VIII is described as a layer of massive sherd concentration, with a sandy matrix, abundant large and small sherds. Also present were burned bones. This unit was not concluded, presumably due to the rising water table. The sand also indicated to Buck (reported in field notes) that the bottom of this large dump overlies the gezira (presumed to be sterile). Presumably, therefore, ceramics taken from this massive dump should be earlier than the bulk of those removed from the overlying overburden from other parts of the site.

Cagle (2001:99) attributes the lowest deposits in this square to level 3. Since SU 23 underlies all other deposits in the excavation unit, SU 23 is assigned level 3 as well. Cagle's decision to assign the bulk of the material found here to level 3 is based on the fact that this unit is close to habitation structures in the main architectural block and thus it was assumed that this was a topographic depression, outside the structures that was used as a general dumping ground. He argues further that evidence for this comes primarily from the fact that all the sherds in the lower levels are stylistically similar to those found within the nearby structure of room 17.

SU 23 underlies SU 21, described as a wall. SU 23 is a number assigned to many deposits across the site that consist primarily of material removed from sump puddles. SU 23 produced eleven identifiable rim sherds.

Unit 1220/1072

The excavation of this unit was a 2 x 2m test pit excavated to determine the presence of structures to the east of a wall along the western boundary of the square that was cleared earlier (Cagle 2001:162). SUs 2 and 5 produced identifiable rim sherds.

SU 2 is interpreted as redeposited wall collapse (Cagle 2001:162). This evaluation is based on high ceramic and bone densities, partial mud bricks and melted mud bricks. Fine laminations within the deposit suggest occasional fluvial activity saturating the deposit. The Cagle classification is 22010 level 3, redeposited wall collapse. This deposit produced two identifiable rim sherds.

SU 5 underlies SU 2. This deposit consists of several alternating layers of mottled brown and tan sand with few sherds. No brick fragments were visible, but otherwise the fluvial sediments in the deposit are consistent with the expectations of wall collapse. Cagle (2001:164) notes also that artifact densities are high relative to other fluvial deposits, perhaps due to the inclusion of wall collapse material. The Cagle classification is 22000, level 3, fluvial. SU 5 produced one identifiable rim sherd.

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PRESENTATIONS, SYMPOSIA AND PUBLICATIONS

2004 "Quantifying the Scale of Pottery Production in the Egyptian Old Kingdom," Lecture presented at Portland State University. Presented final results of dissertation research at the invitation of the Anthropology Department, February 5.

"The scale of pottery manufacture during the Old Kingdom," in *Aegyptos*, vol. 2(4), in press.

"Cultural Elaborations in Ancient Egypt: An Alternative Model," In, *Explanations of change: Case studies in evolutionary archaeology*. Edited by Robert Dunnell and Robert Leonard. University of Utah Press. In review.

2003 "Digital Imagery in the Assessment of Standardization in Pottery Assemblages: An Example from Old Kingdom Egypt," Paper presented at the 51st International Congress of Americanists, Santiago, Chile.

"Digital Imagery in the Assessment of Standardization in Pottery Assemblages," Paper

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2002 "Applying Evolutionary Theory to Archaeological Problems: Data from Ancient Egypt," Lecture presented to a graduate seminar on anthropological theory at Portland State University, at the invitation of the Anthropology department, November 21.

"Digital Photography and Artifact Analysis: An Example from Old Kingdom Egypt," Poster exhibited at the 2002 Society for American Archaeology meetings, Denver, CO.

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2001 "Pyramids in Old Kingdom Egypt," Lecture presented at the Seattle Art Museum, November 24. Sponsored by the Ancient Egypt Study Association of Seattle.

"How complex was Ancient Egypt?" Lecture presented at Portland State University. Presented preliminary results of dissertation research at the invitation of the Anthropology Department, May 31.

"Social Complexity in Ancient Egypt: Functional Differentiation as Reflected in the Distribution of Standardized Ceramics." In, *Posing Questions for a Scientific Archaeology*, Edited by Terry Hunt, Carl Lipo and Sarah Sterling, pp. 145 - 175. Greenwood Press, Westport.

"Posing Questions for a Scientific Archaeology," In, *Posing Questions for a Scientific Archaeology* pp. 1 - 23. Third author with Terry Hunt and Carl Lipo.

Editor, *Posing Questions for a Scientific Archaeology*. Third editor with Terry Hunt and Carl Lipo.

2000 Book review: *An Archaeological Investigation of the Central Sinai, Egypt*. Edited by Frank Eddy, Fred Wendorf and Associates, the American Research Center in Egypt, Inc. and the University of Colorado, 1999. Reviewed for the *Society of Archaeological Sciences Bulletin*, vol. 23(1).

"Degree of functional differentiation as reflected in the distribution of standardized ceramics," Paper presented at the 2000 Society for American Archaeology meetings, Philadelphia, PA.

1999 "Mortality profiles as indicators of slowed reproductive rates: Evidence from ancient Egypt," *Journal of Anthropological Archaeology* 18(3):319-343.

1998 "Evolutionary implications of increased environmental unpredictability and cultural elaborations in Old Kingdom Egypt," Paper presented at the 1998 Society for American Archaeology meetings, Seattle, WA.

Organizer and Co - Chair "Archaeological consequences of evolution in temporally variable environments," Symposium presented at the 1998 Society for American Archaeology meetings, Seattle, WA.

1997 Attribute scale seriation of Old Kingdom ceramics," with Robert J. Wenke. Paper presented at the 1997 Society for American Archaeology meetings, Nashville, TN.

1995 "Cultural elaborations in Old Kingdom Egypt: An alternative model," Paper presented at the 1995 Society for American Archaeology meetings, Minneapolis, MN.

FELLOWSHIPS AND HONORS

2004 University of Washington Yeager Award for Scholarly Excellence in Archaeology. Monetary award for the publication "The scale of pottery manufacture during the Old Kingdom," *Aegyptos*, vol. 2(4), in press.

Listed, 2004-2005 Edition of *Marquis Who's Who of American Women.*

Board Member, American Research Center in Egypt, Seattle Chapter.

1998-1999 Niles Fellow, Department of Anthropology, University of Washington.

TEACHING POSITIONS

2004 Portland State University
Lecturer, "North American Archaeology," This class is a survey of pre-contact cultures north of Mexico, from the first prehistoric migrant populations and early hunter-gatherers to the complex agricultural societies encountered by 15th and 16th century European explorers. The nature of archaeological record and the kinds of explanations possible constituted the major focus of the course. Spring quarter.

2003 Portland State University
Lecturer, "Egyptian Archaeology," Topics covered: the archaeological record of Egypt from 300,000 years ago with an emphasis on the period from 6000-2000 BC. Discussion focuses on changing subsistence strategies and the development of monumental architecture and other cultural elaborations, culminating with the archaeological record of the Old Kingdom (ca 2500 BC). Spring and Summer quarters.

Lecturer, "Archaeological Method and Theory," Class focuses on how archaeologists interpret and explain archaeological data; the history of archaeological investigation and explanation; relative and absolute dating techniques; survey, remote sensing and excavation; artifact, osteological, faunal and botanical analysis and, ethics and laws. Summer quarter

Lecturer, "Introduction to Archaeology," Old and New World archaeological studies are used to demonstrate the impact of human technology on the fitness of the human species. Topics range from the question of Neanderthal extinction, the influence of DNA studies, peopling the New World, significance of cultural elaborations in Ancient Egypt, Eastern North America and Mesoamerica, and fitness consequences of social complexity. Spring quarter.

2002 Portland State University
Lecturer, "Egyptian Archaeology," See 2003 entry. Summer quarter.

University of Washington
Instructor, "Old World Prehistory," Topics covered: Neanderthals and anatomically modern humans, post-Pleistocene adaptations, origins of agriculture, social complexity in Egypt and Europe. Spring quarter.

2001 Portland State University
Lecturer, "Egyptian Archaeology," See 2003 entry. Summer quarter.

Lecturer, "Introduction to Archaeology," See 2003 entry. Summer quarter.

Instructor, "Introduction to Physical Anthropology," Topics covered: The biological side of anthropology: primate paleontology, human evolution and modern human variation. Spring quarter.

2000 Portland State University
Instructor, "Egyptian Archaeology," see 2003 entry. Summer quarter.

Instructor, "North American Archaeology," See 2004 entry. Summer quarter.

1999 University of Washington
Instructor, "Old World Prehistory," See 2002 entry. Summer quarter.

1998 University of Washington
Instructor, "New World Prehistory," Topics covered: Peopling of the New World, post-Pleistocene adaptations, origins of agriculture, social complexity in the North American East, Mesoamerica and Peru. Summer Quarter.

Teaching Assistant, "Principles of Biological Anthropology," Topics covered: Hominid Origins, the emergence of anatomically modern humans, principles of genetics. Spring quarter.

1997 University of Washington
Instructor, "Old World Prehistory," See 2002 entry. Summer quarter.

1996 University of Washington
Instructor, "Old World Prehistory," See 2002 entry. Summer quarter.

1994 University of Washington
Teaching Assistant, "Principles of Geoarchaeology," Topics covered: Sediment transport, grain size analysis, point counting, basic principles of geomorphology. Fall quarter.

Teaching Assistant, "Introduction to World Prehistory," Topics covered: Hominid origins, peopling of the New World, origins of agriculture, social complexity, writing systems, faunal analysis, stratigraphy. Winter quarter.

1993 University of Washington
Teaching Assistant, "Principles of Archaeology," Topics covered: The nature of the archaeological record, archaeological method and theory, artifact analysis, mapping, site recording, classification, statistical sampling. Fall quarter.

1987 – 1989 American Indian Archaeological Institute
Educator; Introduced students of varying ages to the prehistoric lifestyles of Eastern Woodland Indians, also introduced basic archaeological methods and theories.

FIELD WORK

2001 Archaeologist, Howard Giza Cemetery Project, Giza, Egypt. Supervised osteological inventory and mapping at the Western Cemetery of the Giza Plateau.

Ceramic Analyst, Giza Plateau Mapping Project, Giza, Egypt. Quantified excavation generated Old Kingdom pottery and developing a problem-oriented classification system to better understand the scale of craft specialization. In conjunction with dissertation research.

2000 Archaeologist, Giza Plateau Mapping Project, Giza, Egypt. Supervised part of a large-scale excavation, also served as interim surveyor.

Ceramic Analyst, Giza Plateau Mapping Project, Giza, Egypt. See 2001 entry.

1999 Ceramic Analyst, Institute for the Study of Aegean Prehistory, East Crete, Chrysokamino Excavation. Quantified excavation generated Late Minoan I-III pottery assemblage. Provided written report of results.

1997 Site Supervisor, American Research Center in Egypt Field School at Memphis, Egypt. Instructed members of Egyptian Antiquities Organization in American archaeological excavation and basic mapping techniques. Also served as project surveyor.

1996 Field Instructor, Central Washington University Field School, Department of Anthropology, Ellensburg, Washington. Instructed field archaeology class on archaeological survey principles.

Site Supervisor, American Research Center in Egypt Field School at Memphis, Egypt. See 1997 entry.

1993, 1994 Field Supervisor, Central Washington University Field School, Department of Anthropology. Supervised and instructed field crews in aspects of archaeological survey.

1992 Project Member, Mule Canyon cultural resource mitigation conducted by

Intermountain Research, Silver City, Nevada. Conducted field survey and excavation of several sites in north central Nevada.

1992 Project Member, Mendes project, Mendes, Egypt. Assisted in excavation and mapping of occupation/temple complex on the Nile Delta. Collected samples and mapped walls for master's paper on variability and change in Lower Egyptian brickwork.

1990 Archaeologist, U. S. Forest Service, Milford Ranger District, Milford, California. Conducted field inventory, identified and record cultural findings. Prepared detailed reports of all field work and made recommendations regarding the impact of timber harvesting on cultural resources.

1987 Archaeologist, Bureau of Land Management, Phoenix, Arizona. Conducted field inventory, identified and recorded cultural findings.

LABORATORY

1995 Collection management, prepared field-collected artifacts for curation. Intermountain Research, Silver City, NV.

1993-1995 Thermoluminescence Analyst, University of Washington TL lab. Dated material using both optical and thermoluminescence.

1991 Laboratory Supervisor, San Juan Island Archaeological Field School of the University of Washington. Supervised staff of eight in the documenting and processing of materials removed during the excavation of a prehistoric shell midden. Created protocols for excavated materials as needed.

OTHER EMPLOYMENT

1995-1998 Library Manager, Roy Webb Library. Managed private library within the anthropology department at the University of Washington. Duties included: book-keeping, database management, book purchasing and supervision of desk staff.