Beyond Prestige:
A ritual production model for stone tool specialization in Naqada period Egypt

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Abstract

This dissertation looks at the organization and development of specialized production in 4th millennium BCE Egypt. At the outset of this period northeastern Africa was occupied by small-scale groups of pastoralists and early agriculturalists. By the close of the 4th millennium BC, the Nile Valley was one of the earliest instances of a society with centralized political organization, extensive labor division, and institutionalized inequalities.

This research brings data on stone tools and settlement sites to bear on competing models of specialization. Many models of specialized production have focused either on the production of symbolically meaningful goods for the elite, or the production of utilitarian goods for the masses; they have not considered the production of symbolically meaningful goods for commoners. In Egypt the prevailing theory for the development of specialized production is a prestige-goods model, where elites sponsored the production of items used to display status and which were not available to all. However, this model does not account for all specialized production. A review of the evidence for specialization in Egypt shows that some items made by specialists were quite widely used (e.g., lithic blades, black-topped red ware ceramics), and so do not fit a prestige-goods model. To explore how the production of various stone tools was organized and developed, a model of ritual production outlined by Spielmann (2002) was considered. This model recognizes that people have often increased their economic production in order to make items needed for ritual activities, such as life cycle events (e.g., birth, marriage, death) and community-encompassing rituals. These ritual activities involved many members of society, not a restricted subset. Expectations were developed for archaeological patterns of raw material choice, production locations, and find contexts that should be observed if the ritual production model can account for the development of some aspects of specialized production in

Egypt. These expectations were evaluated based on examination of lithic artifact collections from the settlement sites of el-Mahâsna, Abydos, and Nag el-Qarmila, and comparison to published data from other sites and online museum databases.

This research showed that there were many different ways that stone tool production was organized at the intra-site and regional levels. Some of stone tools—early fishtail knives, axes, large-blade knives, and microendscrapers—fit the ritual production model for the development of specialized production quite well. Preferences for certain raw materials were evident, and these preferences could not be accounted for by functional considerations or access to local resources. Instead, the raw material choices probably related to the symbolic significance of their colors, which can be traced from the Pharaonic back to the Predynastic periods. These tools were produced in conjunction with ritual activity areas, and the tools themselves were found in ritually significant contexts such as early 'temples', offering deposits, and tombs, as well as in more traditionally ordinary contexts such as houses, storage areas, and trash middens. Most importantly, they also had a widespread distribution not limited to the elite class. This study shows that although full-time specialized production was fostered by elites in the latter part of the Predynastic period, this process built on already multivariate and complex systems of production for stone tools, which included the production of stone tools with symbolic uses for a large cross-section of the population.

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Overview of Chapters

Through a review of theoretical approaches to the development of specialized production in archaeological literature in general, and in Egypt, Chapter 1 argues that there has often been an unnecessary divide between explanations that involve the production of symbolic goods for the elite, and those that propose the production of utilitarian goods for the masses. A discussion of existing evidence for specialization in Egypt shows that the production of some items has not been accounted for in current models. Spielmann's (2002) model of ritual production is presented as a possible explanatory framework to address these problems.

The methods for assessing whether a ritual production model helps explain the development of specialization in Egypt are given in Chapter 2. This chapter includes expectations for the ritual production model in terms of raw material use, production locations, and find contexts, and ways those expectations can be assessed archaeologically. Additionally the methods used for artifact analysis in the field and statistical analysis of the collected data are outlined.

Understanding the contexts in which stone tools and their production remains were found is essential for evaluating the ritual production model. After a discussion of chronology and inequality in the period, Chapter 3 takes an in-depth look at Naqada-period Nile Valley settlement contexts and makes the argument that Predynastic settlements were often composed of spatially separated but related localities, some of which were devoted mainly to functionally different activities, such as those pertaining to production, habitation, or ritual. Furthermore this functional differentiation may have increased over time, probably with the development of specialized production.

Chapter 4 presents basic results of the field analysis of materials from the archaeological sites of el-Mahâsna, Abydos, and Nag el-Qarmila, including frequencies of debitage and tool types. Particular emphasis was put on understanding the raw materials and heat treatment, because one of the expectations for evaluating the ritual production model involved raw material use. The raw-materials study showed that the local materials predominating in each site varied considerably. Furthermore, at Nag el-Qarmila much of the raw material was probably imported. The results of a heat treatment experiment provided insights for identifying heat-treated materials in Egyptian archaeological assemblages, and implications for considering how heat-treatment may have factored into specialized production.

Chapters 5 and 6 address the question of which Predynastic Egyptian tools should be considered specialized by comparing the distribution of the production remains to the distribution of the tools for different types of blade and bifacial tools. In Chapter 5, after a discussion of methods for identifying specialized production, the known blade types in Predynastic Egypt and their descriptions are given. An analysis of the attributes of bladelets and medium sized blades indicates that they should be considered separate types. The study of the distribution of production remains and tools, at the intra-site and regional levels, for five blade types showed that there was substantial variation in how blade production was organized. Lithic production cannot be divided simply into two production categories of ad hoc production by everyone vs. specialized production by a small group of sponsored professionals. There was an array of ways the production of blades was organized, ranging from diffuse production in many parts of all sites (which cannot be considered specialized), to highly concentrated production in only one or a few locations throughout the region (which definitely should be considered specialized).

The same methods of assessing the organization of production at inter- and intra- site levels were applied to bifacial tool types in Chapter 6. The production of most, but not all, bifacial tool types examined here should be considered specialized, but, like blades, their production was organized in a variety of ways.

Chapter 7 addresses the expectations for the ritual production model. The archaeological patterns for raw material use, production locations, and find contexts of flaked stone tools made by specialists were compared to those expected for the ritual production model. This research showed that for certain tools—axes, large-blade knives, and microendscrapers—there was a preference for a raw material type or color which could not be explained by functional considerations or access to local raw material sources. Instead the raw material choices may have been related to the symbolic significance of the colors. The cosmological meanings of certain colors are well known for the Pharaonic period—red (desert, chaos), and black (fertile Nile Valley/order)—and the argument that these colors were also symbolically meaningful during the Predynastic was made based on finds of unusual, paired red and black ceramics in Predynastic ritual contexts.

The analysis of stone-tool production contexts shows that for each tool class where data were available, specialized production occurred in conjunction with ritual activity areas some or all of the time. Furthermore, the analysis of stone-tool find contexts showed that fishtail knives, concave-base projectile points, bifacial sickles, axes, large-blade knives, and microendscrapers, were not restricted to a subset of the population. They were found in multiple habitation areas within settlements, at settlements of multiple scales, and in cemeteries dedicated to people of different status. Therefore these tools were not restricted to use by an elite subset of the population, and cannot fit with the prestige-goods model for the development of specialized production. Furthermore the contexts in which these artifacts were found challenge interpretations of the stone tools as purely utilitarian or purely symbolic items, as they were found in both ritually significant contexts such as early 'temples', offering deposits, and tombs, as well as in more ordinary contexts such as habitation, storage, and midden areas.

All together the data for certain tool classes—early fishtails, axes, large-blade knives, and microendscrapers—fit the ritual production model for the development of specialized production. These tools were produced by specialists, and used in ritual (and other) activities by a large sector of the population. The case of fishtails was particularly telling because it was the only tool class that covered the full time span of the Naqada period, and could be stylistically dated to earlier and later types. The differences in the archaeological patterns between the earlier and later types indicated a shift from a ritual production model toward a pattern of production and use that matches a prestige goods system. This study shows that although full-time specialized production was fostered by elites in the latter part of the Predynastic period to produce prestige goods, this process built on already multivariate and complex systems of stone-tool production, which included the production of stone tools with symbolic uses for a large cross-section of the population.

Chapter 1: The Development of Specialized Production

An example of one of the most intriguing items from Predynastic Egypt is shown in Figure 1.1. Known as “fishtail knives” or “fishtails,” the function of these items is not immediately clear, to the extent that they are sometimes shown upside-down in catalogs or displays, and they have generated staunch and disparate interpretations of their use. More fascinating than the fishtails themselves are the people who made and used them. Studies of specialized production are at heart ways to examine the variable connections between people who make things and people who use things. This study aims to explore the organization of production for stone tools in Predynastic Egypt, and in so doing enrich the known repertoire of ways humans interact in the world, in history, and in prehistory.

The following discussion of what constitutes specialized production, and its parameters of variability, sets the stage for a review of theories for the development of specialization. Critiques of models based on efficiency or political economy have led to the possibility of ritual and religion as factors in the development of specialized production. A review of models for the development of specialized production in Egypt shows that they have followed these same broad theoretical trends focusing on explanations of adaptive efficiency and political economy, yet problems remain in applying them to the archaeological record in Egypt. Spielmann’s (2002) ritual production model provides a possible explanation for the development of some specialized production in Egypt. Following that, a short discussion of ritual and religion in archeology clarifies some terms involved in this study. The significant implications of this research are discussed at the close of this chapter.

1.1 What is Specialized Production?

Definitions of what constitutes specialized production have varied widely. Flad and Hruby (2007) reviewed definitions of specialized production, and organized them into two groups: those that use a more broad definition, and those that single out a specific subset. More restrictive definitions only consider production specialized if some or all of the producer's subsistence was provided through exchange of their product (ibid.:3). Examples include Evans (1978), Arnold and Muns (1994), and Longacre (1999). This is often identified archaeologically as full-time production (Costin 1991:16), meaning that the producer spends all of their productive time making their specific product, and none of it on other more direct subsistence pursuits. In focusing on production in exchange for subsistence and full-time production, these kinds of definitions for specialized production emphasize quantity—of products, and of time spent producing—as a primary factor in distinguishing specialized production.

Alternatively, broader definitions of specialized production do not put exchange for subsistence or full-time production as the boundary point of a qualitatively different kind of production. Flad and Hruby (2007:2) define specialization broadly as "simply production that leads to exchange, thereby integrating the society in which it occurs." The focus here is on who is making things relative to the people who use them, not on how much or what kinds of work a producer is doing. Flad and Hruby cite Rodgers (1966), Clark and Parry (1990), and Costin (1991) as examples of this kind of broad definition for specialized production. Other examples include Wattenmaker's (1998:3) definition: "the production of… goods for consumption by social groups other than those that produced them," and that of Costin (2001:275-276, 2015:1) where, above a household level "fewer people make a class of objects than use it." These latter examples show that for scholars using the broader definition, the qualitative difference allowing something to be considered specialized production is in terms of *who* things are exchanged to, not the quantitative level of the exchange. This line is drawn somewhere above the individual and below that of the whole society, such as household or social group as in the examples above.

Ultimately of course the definition of specialized production that one uses depends on the research questions being explored. For example Zeder (1988, 1991) defined specialized economy, rather than specialized production, as when there is differentiation not only between people who make different products, such as pottery or stone tools, but that the production processes themselves are divided among different people, such as raw material acquisition, product finishing, and distribution. This even more particular and restrictive definition was appropriate for her research into the organization of an early urban economy.

For the purposes of this dissertation, specialized production is defined as where, *above a household level, a class of objects is used by people other than those who made them*. The producers themselves may still use the class of items in addition to others. The production and associated exchange is assumed to be a reoccurring pattern not limited to one-time or rare idiosyncratic events. This definition includes tribute relationships where any number of people make goods for the elite few, an example which would have been excluded by Costin's (2001) definition above.

Here, "above a household level" means that items were used by people not in the household of those who made them. It should be noted that a household is understood to be a culturally defined and variable unit, not necessarily following the model of a western nuclear family (Yanagisako 1979). Furthermore, the use of households as a criterion for assessing specialized production is in no way meant to reduce them to homogeneous units. It is recognized than households themselves are made of differentially positioned people (e.g., by gender, age) who may have ties outside the household and may be at odds with each other within it (Hendon 1996; Robin 2003). Here "household" is the boundary for understanding specialization because there is evidence that a household was a meaningful social and economic unit, that is archaeologically identifiable. Based on textual evidence for Pharaonic Egypt (e.g., the Heqanakht Papayri), households were a meaningful conceptual unit that could include a nuclear family, extended family members, servants, or other dependents, and the household was linked to specific domestic structures (Allen 2002; Lehner 2000; Moreno Garcia 2012; Spence 2015). The built structures utilized by households could be individual houses, such as at Wah-sut (Abydos) and Lahun (Petrie 1890, 1891; Spence 2015), or tight clusters of structures such as at Amarna and Tell el-Dab'a (Beitak 2010; Kemp 2006). The association of households with individual or tightly grouped structures also can be identified for the Predynastic period. At Adaïma the house structures were grouped into clusters scattered throughout the settlement, and in the cemetery clusters of graves were found that had different ethnic affiliations. Based on the clustering of graves by ethnic groups, the house clusters were interpreted as household, family, or household groupings (Buchez 2011a, see Ch. 3). At Hierakonpolis there is evidence for an individual house with a fenced-off yard that may have included small outbuildings (Hoffman 1980b). That these structures probably reflected a household is indicated by comparisons to the elite cemetery HK6. There, some graves, such as the Tomb 16 complex, were organized in a way that probably represents an elite household with placement according to social position or job in the household (Friedman et al. 2011c). Dogs (guard dogs?) were at the front of the complex, while women and children were at the back, and the household head was in the center (ibid.). All the burials were connected with above-ground fencing and superstructures that may have been modeled on the actual residences (ibid.). Therefore Predynastic households should correspond to individual house structures, or spatially clustered groups of house structures identified in the archaeological record.

This dissertation specifically involves craft production, rather than production of comestibles. Here, "craft" is pragmatically intended to mean tangible, often durable, portable things (Costin 2007:146). Such items often leave extensive remains. The above definition of specialized production can be operationalized by looking at the number of producers relative to consumers, and the geographic distribution of production locations relative to the products, taking into account disposal practices and taphonomic processes (see Ch. 5.1 for more details on methods for identifying specialized production archaeologically).

While the definition of specialized production is intentionally broad, it is distinct from ad hoc production where people make what they need in an unplanned or unpatterned way, and it differentiates from production that might be planned or patterned but stays within a household and does not circulate widely enough to affect farther reaching social relationships. The above definition of specialized production notably does *not* stipulate that producers were entirely economically dependent on their specialized production for subsistence.

Definitions of specialization that include economic dependence can predetermine an economic motivation for specialized production, whereas this study specifically tests a theory where ritual activities were the motivation for production, although of course ritual and economic activities need not be mutually exclusive. Additionally, a broad definition, by being more inclusive, is better suited to an analysis of intensification or change, rather than presence or absence. Flad and Hruby (2007:6) note that more recent studies do not focus only on defining what is specialized and what is not, but rather focus on understanding the range of factors affecting different configurations of production, and the latter aim is the goal of this dissertation.

Besides these basic definitional issues, which as noted depend on the research questions involved, studies of specialized production have done very well at demonstrating the many ways specialized production can vary. One of the most effective ways of understanding the variability in specialized production was formulated by Costin (1991). She reviewed previous studies of specialized production and defined four parameters for analyzing the organization of production. These were: *Context*, which describes the degree to which the production was sponsored by elites or governments, and varies from independent to attached; *Concentration*, which characterizes the spatial distribution of production locations from dispersed to nucleated; *Scale*, which involves both the size of the production unit and the social composition of its members ranging from small kin-based production to factory level production; and *Intensity* which is a measure of how much time producers worked their trade, varying from part-time to full-time.

Since then Costin herself and others have built on this formulation, pulling apart some aspects and assumptions and adding many more variables. For instance scale can clearly be differentiated to parameters of the amount of output and the 'relationships among workers,' and intensity should also include a consideration of intermittent or seasonal labor (Flad and Hruby 2007:6). Other parameters or aspects of variability for specialized production can include the degree to which the production of different crafts are integrated (Shimada 2007), the degree to which the production process itself was differentiated (Martinon-Torres et al. 2014; Zeder 1988) who the producers and consumers are, e.g. in terms of class (Inomata 2001) or gender (Costin 2015), and understanding the meaning of production (Hruby 2007; Inomata 2001; Wells 2006), among many others. When these parameters are considered against theories of the development of specialized production, they can reveal new avenues for research.

1.2 Theories for the Development of Specialized Production

Archaeological theories for the development of specialized production have been tied up with issues of political formations and class relationships and largely have not considered the symbolic uses of goods by commoners, nor seen ritual and religion as a possible basis for changes in the economy. The following discussion focuses on a number of factors which will help elucidate these issues: what kinds of items were made by specialists (subsistence goods utilitarian goods, prestige or luxury goods); who the goods were for (elites, non-elites, everyone); the relationship of specialized production to political formations and inequalities; and the active locus or motivator for the change.

As with most studies of the economy, models of the development of specialized production have been influenced to different degrees by the writings of Adam Smith and Karl Marx. Smith (1776) and other classical economists saw increasing division of labor (specialization) as a natural process spurred by rational calculating individuals. Division of labor allows more efficient production, therefore rational individuals would naturally want to specialize, thereby producing surplus product of their "particular occupation." This surplus could then be exchanged to further their own interests. While looking out for their own economic interests through exchange and the accumulation of surpluses, individuals created more value in the world, in turn improving society as a whole. In Smith's theory there are no restrictions on the kinds of goods made by specialists or on who the products are for. How much a specialist may produce and accumulate is only limited by individual ambition and ability, and inequalities may arise from these personal differences. If left unchecked, competition between producers will lead to greater efficiency in the production process and for the economy overall. Politics and government policies are seen only as an inhibition to increasing specialization, preventing competition from causing increases in efficiency.

There are manifold critiques of Smith's stance, both within traditional economics and within anthropology (Wilk and Cligget 2007), but just a few chief critiques will be mentioned here. In stating that people should focus on a particular occupation—in other words, that they should specialize—Smith's theory shows that there were already particular occupations to be had, that some specialization already existed. This existing specialization built into Smith's theory gives away that the model was based on the particular economic formation of a certain time, yet it was assumed to apply universally across space and time. Another problem with the model is that it presumes that one has the right to the products one makes, and that the products are completely alienable, able to be exchanged freely, which is not the case in all societies for all goods (Mauss 1954).

Marx (1867) offered a radically different theory for the development of the division of labor, one where politics were central and changes were historically situated. Marx saw differences in the division of labor as tied to the creation and maintenance of different classes. Changes in the division of labor was a method for some groups to gain power over others, therefore making the development of specialization an issue of politics. Marx saw the increasing division of labor as a historical process, with different configurations of producers, consumers, rights, and obligations in different periods. People were limited in their actions by the circumstances of their time. Changes were generated by the conflicting interests of different groups who were defined by their positions in the production process. Changes over time occurred in terms of who had the right to the goods made by producers. By incrementally divesting producers from the rights to their goods, economic dependencies and class divisions were created. Useful summaries of Smith's and Marx's views can be found in Wilk and Cligget (2007:50-54) and Morehart and De Lucia (2015:7-8), among many others.

V. Gordon Childe (1950) popularized questions related to specialized production in archaeology, largely through his idea of the "Urban Revolution." Childe drew on Marxist ideas in that he saw differences between people's production activities as playing a major role in determining the general character of societies. In Childe's model the Neolithic Revolution created the possibility of surplus subsistence. The existence of small surpluses allowed part-time specialists to emerge. In the examples Childe gave, such part-time specialists undertook specialized activities to enhance their own prestige and quality of life (ibid.:8). Childe did not discuss the uses or meanings of the produced goods, whether utility, luxury, prestige, or religious. Also the products of specialists were presumably available to anyone with sufficient surpluses to exchange for them. A combination of technological change and opportunities afforded by certain environmental contexts (namely irrigation and river transport) allowed some societies to develop substantial surpluses and support full-time specialists in multiple capacities. Centralized institutions developed to manage the support of all these specialists, and class divisions were seen as existing between those who produced food and those who did not, as well as between those who managed the surplus and those who were dependent on it (craft specialists). In Childe's model full-time specialization, not part-time specialization, is seen as a critical threshold for larger changes to the structure of society.

Childe's connection of specialized production to centralization and inequality was very influential in subsequent archaeological discussions of complexity, which were chiefly concerned with looking at the relationships between these factors. Childe's model notably lacked the Marxist element of social conflict as the engine of change (Smith 2009:7). Additionally, Childe’s model was inadvertently akin to Smith’s model in that benefits accrued to everyone involved. In Childe’s view the benefits included security and relief from ‘irksome’ intellectual tasks (ibid.:11). In the parallels to both Smith and Marx were the seeds of archaeological models for the development of specialized production to come.

Service (1962) advocated a managerial model for the development of specialized production and hierarchical social organization. In this model specialized production occurred when sedentary agriculture was practiced in areas which had differentially distributed natural resources. He argued that it is much more efficient, and therefore mutually beneficial, for each group to specialize in producing things based on their local resources. A managerial class would arise to manage the redistribution of products. In this model specialized communities mainly produced subsistence and utilitarian items such as food crops, fish, domesticated animals, and associated implements like pottery, basketry, and woven items. Everyone in the society used the specialized products including producers (the lower class in the hierarchy) and the managerial (upper) class. Eventually items and services "of no use to society at all in the economic sense" (such as “more wives, private shamans, … weavers and potters who produce only for his household”) were also supported as the productive level of the society as a whole was raised (Service 1962:139). However the utilitarian goods and services were the primary object of production in the model. This is clearly a model where efficiency and mutual benefit are key elements of the development of specialized production (like Smith), and (like Childe) the full-time specialization of producers is critical to the model because it allows a level of exchange which transforms the nature of society. Subsequent archaeologists critiqued adaptationist approaches like Service’s for taking whole populations in functioning systems as the unit of analysis, and for not considering the agency of the people involved with the changes, changes that can result from conflict and negotiation within populations (Brumfiel 1992).

Other subsequent models looked at how specialization might increase due to gains from efficiency, when there were scheduling conflicts rather than problems with the natural distribution of resources. Blanton et al. (1982) argued that increased demands for agricultural goods as taxes or tribute in already centralized societies led to agricultural intensification, leaving agriculturalists less time to produce the utilitarian craft goods they needed for that work and for life: a scheduling conflict. Since specialists could produce such goods more efficiently, specialized production of utilitarian goods for the large base of agricultural workers was adopted in order to leave more of those people free to focus on meeting the high subsistence demands. Zeder (1988, 1991) similarly saw scheduling conflicts in the production of herd animal products as a motivation for specialization to increase, differentiating stages within individual production processes. Like Service's model, specialization in these cases was adopted due to its increasingly efficient production and the specialized products were mainly subsistence goods.

Models where specialization developed for the mutual benefit of all involved have some inherent problems. Later studies found that it was rarely if ever the case that districts in a polity were organized to focus on specialized production of one item, and moreover, that what goods that did travel to the center were often prestige goods and food that were not distributed among the whole population but just to those in direct support of the court (Earle 1977; Peebles and Kus 1977). These findings contributed to a different kind of theory on the development of complexity and specialized production.

Political models (e.g., Brumfiel and Earle 1987; Brumfiel and Fox 1994; Peregrine 1991) posit that self-interested individuals and factions intervened in the economy in order to create and/or maintain inequalities and political alliances. This could be done by way of developing a prestige-goods economy. Elites would support the livelihood of specialists who could produce high quality goods that other members of society would not be able to acquire. These high-quality, specialist-made goods were symbols of status and power along with other rare or imported materials. Displaying such items was a way for elites to highlight the differences between themselves and commoners. At the same time these prestige goods could be exchanged (through gifting, trade, etc.) to build alliances with followers or between groups in different communities or regions. Explicitly influenced by Marx, this model sees changes to social organization and production arising out of conflict, but the model can include conflict between different horizontal groups, not just class conflict. In reaction to previous models which looked at societies as cohesive units, this model allowed for the agency of individuals, particularly aggrandizers, and brought politics to the forefront of analyses of change. This kind of prestige goods and competition model became a highly productive framework for the analysis of production (Blanton et al. 1996; Clark and Blake 1994; Diehl 2000; Earle 2002, 1997; Feinman et al. 2000; Hayden 1995; Peregrine 1991; Rowlands and Frankenstein 1998), but eventually political economy and aggrandizers became overemphasized as the locus for broad social and economic changes (Pauketat 2007).

Explanations of the development of specialized production due to gains from efficiency or the actions of aspiring elites do not exhaust the possible range of reasons for why specialization might develop. When the models are organized according to whom the specialist goods are for, and the purpose of the goods (Table 1.1), it becomes clear that the symbolic uses of goods by commoners have not often been considered as an explanation for specialization. Although the categories of symbolic vs. utilitarian and elite vs. non-elite are not so clear-cut in reality, the table shows that many formulations of specialized production posit either production of utilitarian goods for the many, or symbolically meaningful goods for the few elite (Table 1.1; Brumfiel and Fox 1994; Costin 1991:11-12; Schortman and Urban 2004:196). A notable exception is Wattenmaker (1998) who argued that *non-elites* in the developing urban contexts of northern Mesopotamia adopted the use of specialized goods for conveying social messages, such as group identity. However her explanation is geared for urban contexts and does not cover the entire range of symbolic reasons non-elites might produce and use specialized goods.

Besides political economy and adaptationist/efficiency/managerial approaches, one of the most potent alternate perspectives on specialization looks at the role of ritual and religion in production. Wells (2006:288) proposed the idea of a "ritual economy" as the process of how world view and belief are materialized. The materialization approach crosscuts different socio-political distinctions, making room for other activities besides political process to be significant for large-scale changes. Most important for this dissertation project is a model offered by Spielmann (2002) who argues that the ritual activities and symbolically laden social transactions that involve many or all members of society can be a significant source of economic intensification. Spielmann's model is discussed in more detail below (Ch. 1.5). A review of work on the development of specialized production in Egypt will highlight why Egypt is an apt case study for the ritual production model.

1.3 Theories for the Development of Specialized Production in Egypt

Theories for the development of specialized production in Egypt broadly mirror the theoretical trends discussed above involving explanations focused on efficiency, management or the pursuit of prestige. All the models focus on the specialized production of prestige goods, though in different circumstances. However none of these models account for the development of specialized production for non-prestige goods. This is probably because most of the discussions of specialization in Egypt have been couched in studies of state formation, and so have focused on political economy. Note that not all authors in this section use explicit definitions of what constitutes specialized production, nor the same definition of specialized production as was described for this study.

Hassan (1988) offered a risk-management adaptationist model for state formation, and discussed specialization as part of that process. In this model specialized production developed out of necessity to provide prestige goods. In this model, sedentism and the adoption of agriculture led to a need to mitigate the risk of local environmental fluctuations. Therefore an elite political stratum arose to act as managers, organizing intra- and inter-community pooling and exchange of staple agricultural resources (subsistence goods). The larger the area controlled, the more efficiently risks might be managed. However, for leaders to manage larger areas effectively, they had to gain support from the other leaders already present in other places. This was done by display of their power and status through the use of prestige items, creating a demand for luxury and exotic goods, and stimulating trade and specialized craft production to make those goods. Thus Hassan's model involved elements of Service's (1962) managerial model, but where risk due to differences in micro-environments was managed rather than differences in the distribution of resources. Unlike Service's model, prestige goods for the elite were the objects of specialized production, not utilitarian and subsistence goods. However prestige goods production was still seen as linked to a process of providing adaptive benefits for all involved, and as such still assumes that everyone works together for mutual benefit and does not account for the possibilities of conflict, competition or differing goals.

A model of state formation offered by Kemp (2006) bears similarity to conflict-based political economy models, and includes considerations for specialization. In Kemp's model, it is assumed that territoriality and an expansionary dynamic were inherent in settled agricultural societies, and that that there were always a few aggrandizers in any population. The combination of these factors led to competition for land and resources. Competition occurred between individuals, lineages, and eventually polities through exchanges and conflict. The results of the competitions were greatly influenced by random variables such as the location of resources or the presence of charismatic leaders. The 'winners' became elites and leaders, and their success was made evident and reinforced through display of prestige items, which fostered the development of specialized production for prestige goods. This model bears some features similar to the political economy models discussed above, including self-interested aggrandizers and the use of prestige goods by elites to re-enforce their status. Besides the problems of assuming that territoriality and expansion are universal, the role and motivation of the producers has not been highlighted because it was not a focus of the model. Despite the attempt to acknowledge potential sources for individual agency and conflict, the model raises the question of why producers would go along with the changes to the economy and become specialized producers.

In a discussion of state formation, Köhler (2010) offered another model for the development of specialized production. In this view specialized production is thought to have developed in regional centers where, through population growth or aggregation, there was sufficient demand to support full-time specialists. In areas with higher population densities, producers had the opportunity to expand their household industries and establish full-time industries which supplied local markets (ibid.:39). The demand was by emerging elites for prestige goods to display their status. This model draws on elements of a commercial model, where increases in specialization are part of spontaneous economic growth, assisted by gains in efficiency from advances in technology, and with little political involvement (like that of Adam Smith, see section 1.2). Köhler's model bears similarity to a commercial model in highlighting population growth and demand as important factors, and assuming that the economic change or growth is spontaneous, needing only opportunity. However in this view elites eventually became interested in sponsoring and controlling the economy and production of prestige goods as well as long-distance trade as a way to maintain their status, so the model also involves elements of the political models.

The above models are primarily concerned with state formation. In contrast, Takamiya (2004), looked specifically at the question of the development of specialized production. She argued for a political model for the development of specialized production based on a review of the evidence in the Nile Valley focusing on three types of goods: stone, beer, and ceramics. While items from each of these classes of goods could be considered specialized, she found that the ones which could be considered luxury or prestige goods were produced by full-time specialists, while more utilitarian items were produced by part-time specialists. Comparing the data to models outlined by Brumfiel and Earle (1987), Takamiya argued that this scenario fit a political model of attached production at the behest of emerging elites for personal advancement, rather than a commercial model of specialized production (see above) or an adaptationist model where political elites intervene in the economy for economic management that is beneficial to all (like that of Service or Hassan).

Dissatisfied with the importance of agriculture in models of the development of complexity, Wengrow (2001, 2006) proposed that the expanding influence of emerging elites and political leaders came not from control over economic resources, but from control over meanings in the symbolic realm, exercised through new forms of ritual interaction with the dead. Here he highlights that in Egypt, pastoralism and mobility were adopted before agriculture, arguing that the advent of extensive burial grounds by mobile groups was the factor that connected people to places, not their agricultural fields. Critically, this focus on burial grounds also allowed emergent elites to develop and disseminate new forms of ritual practice and sumptuary codes. The grave goods involved in these new practices operated along the lines of Rowlands and Frankenstein's (1998:337) notion of a prestige-goods system. In Wengrow's (2006:75-76) view, items obtained through long-distance trade as well as items made locally through sophisticated manufacturing processes lent political advantage to those who could obtain and use such items as funerary gifts. Therefore competing emergent elites sought to gain control over trade and fostered specialized production. Although this model places more emphasis on meaning and symbolism than previous models, it can still be seen as a model where the locus of change is in the activities of ambitious individuals, as with the political models discussed above, and prestige is the goal rather than ritual and religious participation.

These models of specialized production in Egypt harbor the same issues as the models discussed previously for examples outside of Egypt. All of the models of specialized production in Egypt focus on the production of prestige goods for the elite, thus implicitly supporting a dichotomy between symbolically meaningful goods for the elite (to display status creating and maintaining inequalities) and utilitarian goods for others, and do not consider the possibility of symbolically meaningful goods for commoners. Part of the reason for the over-emphasis of prestige goods may be because of the historical focus on cemeteries, where wealthy burials stand out.

Additionally, these models do not account for all of the evidence for specialized production. As discussed by Takamiya (2004), there is evidence for the part-time specialized production of non-prestige goods, yet all the models put the explanatory emphasis on the prestige or luxury goods. The production of non-prestige goods does deserve theorizing, particularly because such items were used by a large portion of the population. If we are to understand specialization we must take into account non-prestige goods because they can be a significant factor in the economy, and as will be shown throughout this study, there is considerable evidence for specialized production of non-prestige goods that these models have not addressed.

1.4 A Brief Review of Evidence for Specialized Production in Egypt

A brief review of the evidence for specialized production shows in more detail which goods have so far been identified as specialized. The main classes of goods discussed are flaked stone tools, ground stone, ceramics, and beer.

Flaked stone

Stone tools constitute some of the best evidence for specialized production. Kelterborn (1984) analyzed Predynastic ripple-flaked knives (Figure 7.1) to understand how they were produced. He analyzed 20 ripple-flaked knives, and through replication experiments created at least 50 knives. Kelterborn concluded that ripple-flaked knives were highly standardized in terms of production technique, showed an extremely high skill-level, took a substantial amount of time to produce (~ 23 hrs per tool), and thus must have been produced by specialists. Furthermore, ripple-flaked knives are a relatively rare class of stone tools, with less than 100 known,[1] and they are sometimes found with elaborately decorated ivory knife handles. The rarity of these items and the motifs on the knife handles indicate that they could be considered prestige goods (Hendrickx 2011d:94; Midant-Reynes 1987; Takamiya 2004:1030). Ripple-flaked knives date mainly to the NIId period.[2] Analyses of specialization based on skill are discussed in Ch. 5.1, and Ripple-flaked knives are discussed in more detail in Ch. 6.1.

Another line of evidence for the specialized production of stone tools is the find of a bifacial tool workshop. Large quantities of debitage, mainly from the production of bifacial tools, were found in association with a ritual structure at Hierakonpolis HK29A (Friedman 2009b; Holmes 1992). There was also evidence for the production of groundstone vessels and beads including the tools used to work these items and fragments of the items themselves. The main phase of this activity was during the NIID2-NIIIA. Holmes (1992a:43) argued that the stone-tool production was full-time, attached specialization, although she did not use the same terminology. She based this assessment on the "industrial scale" (quantity) of the lithic debris relative to other areas of Hierakonpolis, the "carefully chosen" raw material types, and the systematic reduction. More discussion of this workshop is given in Ch. 6.1.

Pre-dating the evidence for the specialized production of some bifacial tools is evidence for the specialized production of blades. Ginter et al. (1996) inferred that specialized blade production was evident at site MA21/83Armant. There the oldest and middle phases date to the

[1] Midant-Reynes (1987) listed 49 RFKs from tombs, based on published excavations. To that can be added a few discovered in excavations since then, plus ones purchased by museums from unknown sites. However, there is possible overlap between ripple-flaked knives in museums with unknown proveniences, and the ones known from excavation reports, since the provenience trail can sometimes be lost over time. Therefore it is difficult to say exactly how many have been found. At least 57 distinct ripple-flaked knives were identified during this study in museum collections and publications.

NI period (Ginter and Kozlowski 1994). During those phases, cores (a byproduct of production) were found throughout the site. In the next phase, which dates slightly later, the frequencies of cores in the settlement drop and blade workshops were identified near the local flint outcrops (ibid.:72-73, Ginter et al. 1996:178). Additionally the frequency of wholly cortical flakes (which are often taken as an indicator of primary in situ production) also drops, and the blades themselves were longer and thicker with more frequent platform preparation than in the previous phases. It is likely that only a portion of the population worked out at the quarries since there is only limited evidence for activities in the desert compared to the evidence for activities along the cultivation. Thus the number of producers relative to the number of consumers was quite different, fitting the definition of specialized production. This is supported by the changes in blade production technology evidenced by the changes in blade attributes, which could indicate an increased level of expertise necessary for production. Since the blades were found throughout the settlement they do not appear to be used by only a subset of society and so cannot really be characterized as prestige goods.

Ground stone

Hendrickx (2011d) argued that the production of ground stone vessels should be considered specialized, because their quality indicates sophisticated workmanship. However, as will be discussed in Ch. 5.1, quality and skill are not considered here sufficient evidence for specialized production. Specialized production is rather a differential relationship between who the producers are and who the consumers are (see Ch. 1.1). However, other evidence supports

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[2] See Chapter 3.1 for details on the chronology of the Naqada period.

the interpretation that groundstone vessels were made by specialists. The distribution of the vessels and the raw materials indicate that there may have been only one production location for basalt vessels, with a much larger range of distribution. The basalt for these vessels comes from a source near Maadi in Lower Egypt, and the quantity of basalt vessels is substantially higher at Maadi than any other site, which Mallory-Greenough (2002:88) takes as an indication of production near or in Maadi. Furthermore the basalt vessel forms mimic the forms of Lower-Egyptian pottery providing additional support for the finding that they were made in lower Egypt (ibid.). The stone vessels are found throughout Egypt, from Buto in the North to Hierakonpolis in the south, during the Predynastic period. Taken together, these lines of evidence indicate that groundstone vessels were produced by specialists.

Basalt ground stone vessels can be considered prestige goods since there are only a limited number of vessels known, ~200-250 dating to the NI-NII period and coming from 77 known graves along with provenienced sources (Mallory-Greenough 2002: Table 4, 86). Furthermore they are found in wealthier graves. Since ground stone vessels are known from the NI, they are certainly the earliest example of a prestige good considered here.

Ceramics

There is also evidence for specialized production of ceramics, some of which could be considered prestige goods, and some of which would not. Hendrickx (1996a:44-47, 2011d:95) discussed marl clay pottery noting that there are fewer types than with other kinds of clay vessels, and a more difficult technical process for production, which together suggest specialization. A large number of these vessels were produced from the middle of the NII onward (Hendrickx 2011d:95, 2006b:79; Needler 1984:202), yet production sites have not been identified for Decorated ware pottery, which may be an indication that they were not numerous. Hendrickx (2011d) makes a distinction between the Decorated Marl Ware (a specific kind of pottery, not just any pottery with decoration) as 'objects of great value', and the non-decorated marl wares for daily use. The uniformity of style in the paintings on Decorated Ware vessels is considered an added indication of specialized production (Aksamit 1992; Needler 1984:2002; Takamiya 2004:1031). Like Hendrickx, many scholars consider the Decorated Marl Ware vessels prestige or luxury goods (Needler 1984:2002; Takamiya 2004:1031,1033). Early types of decoration imitated stone vessels, which as discussed above may also have been prestige goods. Later the decoration involved elaborate motifs including humans, animals, boats, and architecture. Notably the Decorated Marl Wares are mainly found in cemeteries. While much attention is given to the Decorated Marl Wares, it is important to also remember the other kinds of marl wares Hendrickx mentioned: those for daily use which occur in large quantities, and were also likely produced by specialists, but are not considered prestige or luxury goods.

A number of pottery kilns for fine untempered Black-topped and Polished-red Wares were located in the wadi behind Hierakonpolis and date to the NIc-IIa (Friedman 1994:635-648, 883-884; Geller 1984; Hoffman 1982). Friedman (1994:646-648, 2000a) argued that the fine, untempered pottery was made by specialists based on the uniformity in form and technique for these wares across the country, the quantities produced, and the remote location of the production sites at both Hierakonpolis and at Armant. Furthermore, she found that although these pottery types were similar in all sites in the region, there were minor regional differences in shape and slip that indicated that they were not all produced at one centrally organized site. Friedman did not deal with the question of whether the specialization was full or part-time production. Takamiya (2004:1031) argued that they were produced by part-time specialists due to the early date. While the Hierakonpolis workshops were located very near the elite cemetery HK6, the ceramic forms made there were found in both cemetery and settlement contexts (Friedman 1994:646). Furthermore these kinds of pots are found commonly in all settlements of this period, so they should not be considered prestige goods.

A pottery kiln for Coarse Ware ceramics dating to NI-NIIa was found associated with a house at Hierakonpolis HK29 (Friedman 1994:653; Hoffman 1980b). Production was likely part-time because other economic activities, such as animal husbandry, were also evident. Similar kiln structures have been found throughout the settlements at Hierakonpolis (Hoffman 1982). Friedman (1994:662-3) proposed that production was for the local Hierakonpolis area, noting that potmarks found frequently at the kiln were also present in other areas of the settlement. This also indicates a level of production beyond household consumption. It is unlikely that these pots were distributed beyond the region, because Friedman (1994, 2000a) found regional differences in tempers, manufacturing technique, and surface treatment for Coarse Ware pottery. That regional diversity disappeared by NIIc. The ubiquity of Coarse Ware ceramics indicates that they should not be considered prestige goods.

Beer

Large beer-production facilities have been identified at Tel el-Farkha, el-Mahâsna, Abydos, Naqada, Hierakonpolis, and possibly other sites (Baba 2009a; Cichowski 2008; Geller 1992a,b; Kubiak-Martens and Langer 2008; Peet 1914; Peet and Loat 1913; Takamiya and Endo 2009). The earliest, at Hierakonpolis locality HKIIC Op B, dates to NIC-IIB (3762-3537 cal BCE) (Nekhen News 2011b), and most date to the NII or slightly later (Table 1.2).

The sizes of the facilities and amounts produced imply specialized production. The facilities consist of rows of large vats (diameters range from about 50 to 85cm) with various materials used to create a superstructure around the vats. Openings for feeding the fires were left at the bases, and the open space between vats in the interior of the structure indicates that they were likely all used at once. The sizes range from three (Tel el-Farkha) to 35 (Abydos) vats per structure, and most sites have multiple structures. Geller (1992a) estimates that each of the six vats at HK24A could hold about 65 liters, giving a figure of 390 liters of beer at a time for that facility. A site like Abydos, with hundreds of vats, would have produced staggering quantities of beer at a time. The facilities could have been run by a relatively small number of producers, yet the large quantities combined with the fact that ancient beer spoiled quickly (Dietler 2006), indicates that there must have been a small number of producers and large number of consumers, thus meeting the definition of specialized production.

Geller (1992a,b) argued that this beer production should be considered full-time elite-sponsored specialized production because maintaining the appropriate heat in these large facilities requires skill and knowledge, the scale would have required a great deal of co-ordination to collect the raw materials and distribute the products, and a large investment would have been required to produce such quantities. Conversely, Takamiya (2004) argued for part-time use of the facilities because, if they were used full-time and year-round, one would expect to see vessels to contain and distribute the beer on a similar scale, yet distinct ‘beer jars’ were not present until the mid-First Dynasty (NIIIC2) (Hendrickx et al. 2002). So far no one has been able to determine if the facilities were used periodically or year-round. Whether the production of beer was full- or part-time, the quantities produced combined with the spoilage rate of ancient beer indicate that it must have been consumed by a large number of people at once. Therefore it should not be considered a prestige good, which by definition would only be consumed by a select group of people.

In summary, there is evidence for specialized production of both prestige goods and non-prestige goods. The prestige goods include ripple-flaked knives and possibly other bifacial tools, ground stone vessels, and Decorated Ware ceramics. Most of these date to the latter half of the Naqada period, and some are thought to be produced by specialists who were sponsored by elites. The non-prestige goods include lithic blades, Black-topped, Polished-red, and Coarse Ware ceramics, and beer. These all date earlier than most of the prestige goods.

The data on the prestige goods fit well with the models for the development of specialized production discussed above which almost all posit a prestige goods economy as developing at the behest of elites to create and maintain inequalities. Such models are not being questioned here as they work well for some of the data. However the review of the data shows that other goods were also produced by specialists, and those goods cannot be considered prestige goods. Therefore there must have been other factors at work besides the prestige goods economy that also influenced the organization and intensification of production in Predynastic Egypt.

1.5 Hypothesis: Ritual Production model

On the question of the development of specialization in Egypt, an explanation for economic intensification discussed by Spielmann (2002) can account for more of the evidence of specialized production by recognizing that some production may have been geared toward addressing the symbolic needs of the many, not just the elite. Spielmann argued that in small-scale societies, "one of the most salient sources of increased economic production [is] the individual and communal ritual participation and performance of members of entire populations" (ibid.:195), rather than efficiency or the actions of aspiring elites. It is important to point out that this idea includes social transactions such as those for lifecycle events (e.g., birth, marriage, death), as well as community-encompassing rituals. Spielmann termed this model a "ritual mode of production."

Spielmann drew on ethnographic data to illustrate that there are many instances of specialized production in small-scale societies. She defined small-scale societies as "several hundred to several thousand people in size and characterized by relatively uncentralized political systems" (Spielmann 2002:195). One example of specialized activity comes from the Chimbu area of Papua New Guinea where small groups of men worked for five months at a time at a timbered quarry 30 ft deep, for large bridewealth stone axes. Twenty more shafts indicated the scale and sustained practice (Strathern1969; Vial 1940). An archaeological example comes from the Ohio Hopewell, where a relatively mobile population that normally lived in small hamlets, congregated for communal rituals at geometric earthworks and produced thousands of copper ear spools (Ruhl and Seeman 1997). Additionally, Spielmann cites Damon and Wagner (1989) on the mortuary practices in the Papua New Guinea Massim for the time, effort, and resources used for community mortuary rites. These are just a few examples to show that intensified economic production can occur for ritual activities. Although the ritual production model was originally formulated for small-scale societies, ritual activities are found in all societies, so the model could apply to larger-scale societies as well.

There are four main parts of the model that should be highlighted because they are archaeologically actionable. 1) In the ritual production model, goods produced by specialists are used during rituals and certain social interactions. 2) The production of these items is related to their use in those activities. 3) The specialist-produced goods cannot be considered either prestige goods or utilitarian items, but rather straddle both concepts. 4) The items produced by specialists are used by many people, not just a few. These four aspects of the model are all of course interrelated.

Concerning the first point, 1), in the ritual production model the items which are made through specialized production are what Spielmann terms "socially valued goods." Spielmann (2002:95) defined social valuables specifically as "objects that are critical for ritual performance and necessary for a variety of social transactions." This is not to say that any item that has some value is included in this category, only the ones used for ritual performance and symbolically laden social transactions such as those surrounding lifecycle events. Perhaps a better term would be "socio-ritual valuables." An example Spielmann cited which demonstrates that much of the value of such items comes from their use in ceremonial obligations and exchanges was Mary Douglas's (1958) discussion of raffia cloth among the Lele people in the (now) DRC. There the raffia cloth was valued not for its use as cloth, but for its exchange value in gifts and ceremonial payments, gaining greater value the more it was circulated.

A second part of the model, 2), is that the production of these socio-ritual valuables is related to their use in ritual activities. Not only is their production motivated by the need for the items in ritual events and transactions, but in some cases production is directly associated with community wide ritual events, such as the Hopewell example mentioned above. Production during ritual events where people aggregate offers certain advantages, solving the problem of how, "hundreds and sometimes thousands of people in small-scale societies [become] provisioned with large quantities of socially valued goods" (Spielmann 2002:197) without corvée labor or full-time specialists. The aggregation of people during such events may facilitate procurement of raw materials and sharing of knowledge about production methods. Additionally the inverse—widely dispersed production—may not entail the degree of exchange and interaction necessary to make the qualities of the goods (and their associated meanings) a more standardized, society-wide phenomenon. Moreover, production associated with ritual events affords the opportunity for additional symbolic meanings to be associated with the place or time of production which add value to the goods.

Another important point in the ritual production model, 3), is that socio-ritual valuables challenge the dichotomy between prestige and utilitarian goods because, as ethnographic examples show, they have symbolic meaning and utilitarian functions. They are everyday items which have significant symbolic meaning, and as such can be used in both daily life and in critical ceremonial contexts, carrying meaning in both spheres, and existing on a continuum. They are ordinary objects which can be set apart in some way, such as source, elaboration or even quantity. An example is Melanesian axes, where "the very largest axes are unequivocally ceremonial items; their form is unsuitable for subsistence use. Ordinary axes, however, may circulate as bridewealth (Berde 1983; Strathern 1965), or men may wear them in the context of communal ceremony" (Spielmann 2002:202, citing Malinowski 1934). Archaeologists have argued for many years that the distinction between luxury goods and utilitarian goods is problematic. For instance, Wattenmaker (1998) used data from the mid-3rd millennium BCE site of Korban Hoyuk in Turkey to show that even though some goods were ‘utilitarian’ and used in non-elite households they were also valued for their symbolic significance and social messages. Vaughn (2004) discussed a case in an Early Nasca village where seeming luxury goods--highly valued polychrome pottery vessels that had restricted production and were a primary means of presenting Nasca ideology--circulated to the whole community including both high- and low-status households.

A final aspect of the ritual production model, 4), is that many or most members of a community can be involved in the use of socio-ritual valuables, since the use of such items includes lifecycle events such as birth, marriage, and death as well as larger community scale ritual activities. The use of such items is not limited to a certain social group such as emerging elites. Rather, the demand for socio-ritual valuables is widespread and sustained, enough to affect the approach to production.

Spielmann's model can be thought of as an explanation for the development of specialization, where specialist-produced goods are made to meet the symbolic needs of the many. This is substantially different from most existing theories of specialization where symbolic needs (such as display and prestige) are associated with elites, and subsistence needs are associated with commoners. Table 1.1 demonstrates how Spielmann's model significantly differs from others.

In the ritual production model, the ritual cycle motivates and coordinates the production and use of socio-ritual valuables. Their use by many members of society, and the recurring nature of ritual activities, creates a sustained demand requiring economic intensification. The production of such items by specialists allows a sufficient quantity of items with a sufficiently comparable form (and therefore meaning) to be produced to meet the needs for these activities.

One critique if the ritual production model is that many societies produce items for ritual purposes, but it does not always result in economic change. For the case of Egypt, what makes the production of socio-ritual valuables potentially transformative to the ancient economy, are the circumstances in Egypt during the 4th millennium BCE. Spielmann expects the ritual production model to be particularly relevant in situations of increasing social and ritual obligations, and the context of the 4th millennium BCE in the Nile Valley was likely one such circumstance. Beginning around 5300 cal BCE the aridity of the deserts began increasing substantially (Bubenzer and Riemer2007; Kuper and Kröpelin 2006; Nicoll 2001). People responded by expanding their mobile ranges and eventually moving into the Nile Valley. By the early 4th millennium BCE there were settled communities throughout the Nile Valley (Figure 1.2). This influx of people into the Nile Valley along with the adoption of settled agriculture set the stage for new forms of interaction. Among them were certainly trade, warfare, and political maneuvering. Increased ritual interactions and activities are another likely avenue of relationships between groups and individuals.

Furthermore an increase in ritual activity during the Predynastic is not surprising given that Ancient Egypt has such an extremely rich record of ritual activity. Extensive ritual activity is documented in the written and pictographic record of the Pharaonic period, but that ritual activity extends back into the Predynastic. Many Pharaonic-period rituals have their roots in the Predynastic, as many scholars have taken pains to trace (e.g., Baines and Lacovara 2002; Hendrickx et al. 2009; Morris 2016; Patch and Eaton-Krauss 2011). It is exactly this importance of ritual activities to ancient Egyptians that led Wengrow (2006) to argue that a shift in the relations with the dead was significant in Egypt's development, with finite funeral ceremonies replaced by elaborate ones that required more and more symbolically significant items in the grave, and provisioning of the dead continuously after burial. If there is a place in the world where ritual activities might have contributed to change, it would be Egypt. Since the development of specialized production for many goods is not accounted for in current theories, it is necessary to take a closer look at the patterns of production to understand whether the ritual production model does apply in Egypt. Expectations that can be used to evaluate the applicability of the ritual production model for interpreting the data from the Nile Valley during the 4th millennium BCE are given in Ch. 2.2.

1.6 Ritual and Religion in Archaeology

Ritual is rarely considered in studies of lithic artifacts. This is probably because so much research on lithic artifacts is based in the paleolithic past where the point at which humans or their ancestors developed symbolic thought is instead research question, worthy of rigorous interrogation. However, this dissertation focuses on a time period at the brink between prehistory and history, in a place where ritual and religious activity are well documented through text, representation, and archeology. Ritual and religion were central aspects of Ancient Egyptians' lives, and likely had a great deal of effect on what people did and why.

The study of ritual and religion in archeology is an active field of research. Perspectives include: overviews or collected works aiming to focus the theme(s) (Insoll 2004, 2011; Kyriakidis 2007, Rowan 2012; Whitley and Hays-Gilpin 2008), studies of religious change (Graham et al. 2013; Shaw 2013a,b); ritual and religion as a source of power or social strategies (Adams 2004; Grau Mira 2016; Janusek 2006; Kovacevich 2007), material expression of religion (Droogan 2013; Fogelin and Schiffer 2015; Wells 2006), the process of ritualization (Bradley 2005; Humphry and Laidlaw 2007) and of course the intersection of ritual and production (Austin 2015; Hruby 2007; Inomata 2001; Spielmann 2002; Wright and Loveland 2015).

Many of these works wrestle with finding archaeologically actionable definitions of religion and ritual. Discussions of what constitutes 'religion' can get quite complicated, historically particular, linguistic, and are beyond the scope of this work. Suffice it to say that many archaeologists studying religion recognize that the idea of religion is a culturally situated, historically bounded term with specific limits that can be separated from other areas of life and opposed to secular thought and activities (Graham et al. 2013; Insoll 2004:6; Shaw 2013a). Therefore 'religion' is often thought to be an insufficient term for past societies that often did not draw the same boundaries as are implied by the modern western notion of 'religion'. Archaeologists often prefer terms such as 'worldview' (Graham et al. 2013) or 'cosmology' (Plog and Heitman 2010) to religion, since these terms better convey the idea that life was not necessarily divided into secular and religious spheres but that ideas of spirituality or the divine, personhood, how people should interact and in what circumstances, relationships between the living and the dead, decision making, identity, and understandings of cause and effect, could all be intertwined.

Ritual activities are one of the primary ways the above concepts can be made manifest within a worldview. The idea of ritual itself requires definition, since it encompasses a number of features. Based on discussions by a number of authors, especially Kyriakidis (2007) the following elements are here used to characterize 'ritual': *Rituals are repeated, 'set' actions that are transformative and that derive from the worldview of a specific group of people*.

Rituals are first and foremost *actions*, activities, or practices, and as such are quite amenable to archaeological study. These actions can include language and communication. Religion is often considered the realm of belief and thought, and rituals are one aspect of the accompanying action stemming from these thoughts and beliefs. Since rituals are what people actually do, rather than what they think, rituals are quite suitable for archaeological study. While some scholars problematize the association of action with ritual and thought with religion (e.g.

Fogelin 2007; Rowan 2012), it is simply a practical analysis.

Rituals are *repeated*, though the periodicity and the people involved can vary. For instance a person may only get baptized once in their life, but the ritual is repeated with many different people; a harvest festival may be repeated once every year; or an animal mummy may be offered at no prescribed time but as often as deemed necessary.

Furthermore, at least some of the actions which make up rituals are *'set'* (Kyriakidis 2007) or 'invariant' (Bell 1997), or give the impression of being so (e.g. through formal or traditional action, language, and/or material objects). Despite the nature of rituals as actions which are perceived as set, there is room for change and manipulation. Rituals can be 'set' to different degrees, or rather there are elements of varying importance in any ritual activities (Humphry and Laidlaw 2007). The perception of ritual as traditional, precedent-based action is part of what gives the ritual authority (Bell 2007, 1997; Humphrey and Laidlaw 2007). It is this interplay or tension between the perception of rituals as set activities and their variable implementation, which allows people to deploy them strategically (Bell 1992; 2007).

The *transformative* aspect of rituals is what separates them from activities which are simply done over and over again in the same way. Rituals do something. They send people into the afterlife, bestow names, communicate with gods, promote harvests, demonstrate devotion, carry prayers, create alternate states of consciousness etc. In doing something ritual activities are tied with notions of cause and effect. Kyriakidis (2007) discusses the importance of perspective that comes with ideas of cause and effect.

The idea of perspective in cause and effect brings up a central consideration for rituals, which is that they stem from the *worldview***.** The rituals take place in the framework of a worldview, they are actions that stem from and combine with thought or belief (Insoll 2004:10-

12). By considering ritual as part of worldview or cosmology rather than religion, there is less of a need to separate between secular and religious ritual, a separation which seems inappropriate for Ancient Egypt. As mentioned above, worldview relates notions of cause and effect, the divine or sacred, attitudes toward when and how people should act, and many other facets of life. Thus there is clearly room for domestic as well as larger-scale ritual activities.

All of the above aspects combine to make rituals mark themselves as somehow set apart, special, giving them meaning and import. Additionally, besides the overt proximate intentions of a what a ritual does, rituals also embody aspects of solidarity and differentiation. The solidarity building aspect of ritual activities has been theorized since Durkheim (1915), but acknowledgment of the differing positionality of people involved in (and excluded from) rituals has also drawn attention to their divisive aspects (e.g., Hastorf 2007). The many tensions and oppositions inherent in ritual activities—thought and action, stasis and change, special and quotidian, solidarity and differentiation—are what make them so important to understanding past human lifeways and change.

A final clarification needs to be mentioned for this particular study of ritual production. A distinction should be made between production as performance (the process of production being ritualized), and production activities that are motivated by or coordinated by ritual activities. This study is *not* concerned with whether or not the actual sequence of steps to make objects was ritualized (e.g.. Carter 2007; Hruby 2007; Nikolaidou 2007), but rather *is* concerned with looking at whether things were made for their symbolic meanings (related to worldview) and uses in ritual activities.

1.7 Implications

This study of production in the Egyptian Nile Valley during the 4th millennium BCE has important implications for understanding Egypt's past, including the different people or groups involved in large-scale changes, and the significance of ritual activities for such changes. One of the primary implications of this research is the recognition that all people, not just elite, can have uses for symbolically meaningful goods. In so doing this work challenges the dichotomy between prestige goods (symbolic items associated with status), and utilitarian goods (items without significant symbolic meaning beyond their functional uses).

A related implication concerns who is involved in large-scale changes. The ritual production model underlines the involvement of other people besides ambitious aggrandizers in large-scale changes such as the development of specialized production. Similarly, concerning arenas for generating change, the ritual production theory emphasizes that ritual activities can be a significant source of economic change.

Another important aspect of the model being tested is that it does not assume that people only produce items "in excess of biological need" (Morehart and De Lucia 2015) when required to by adaptive necessity (risk aversion) as with managerial models, or when coerced or persuaded into it, as with political models. Nor does this research swing to the opposite end of the spectrum and assume that people will always naturally produce as much as they possibly can whenever not limited by outside factors (classical economic and commercial models). Rather the ritual production model makes room for motivated production activity undertaken for reasons internal to the individuals and groups involved in those activities.

Furthermore, this theory grants that ritual activities have significant cultural content, and are not just venues for the production of "false consciousness that masks reality and operates in the interests of the elite" (Inomata 2001:324). The widespread participation of many people implies that the ritual activities are not infinitely malleable. Despite Egypt's rich and historically deep ritual record, in considerations of state formation or complexity, the ritual realm is often treated as a straightforward venue for legitimization, and little else.

In summary, the central question addressed in this research is to understand how specialized production developed during the Naqada period in Egypt. This question requires examination of craft production activities of a wide range of the population. The hypothesis presented here is that some specialized production developed to make socially valued goods that were used for rituals and social transactions. The following chapter on methods outlines some expectations for how the ritual production model can be evaluated archaeologically. Patterns in raw materials, production locations, and the contexts of specialist-produced goods can be used to evaluate whether or not the ritual production model should be applied in Egypt.

Chapter 2: Methods

2.1 Methods Introduction

To test whether the hypothesis that the ritual mode of production accounts for the development of some specialized production in Naqada period Egypt, I developed a series of expectations based on the preceding discussion of the ritual production model (Ch. 1.5). These expectations concern patterning in raw materials, production locations, and find contexts. This chapter begins with a discussion of why stone tools are an appropriate artifact class for this study, and sets up the first problem for this research: identifying what was produced by specialists. Section 2.2 lays out the expectations for the ritual production model, and addresses how these patterns can be assessed archaeologically. A brief introduction of the sites involved in this study demonstrates that there are known Predynastic Egyptian contexts appropriate for evaluating the model (which are discussed more fully in Ch3). This is followed by an overview of the methods that were used for analyzing lithic artifacts, and the chapter concludes with a discussion of the main statistical methods involved in comparing the data.

Why stone tools?

Chipped stone artifacts are an ideal class of artifacts for addressing the hypothesis of ritual production as a mode of increasing specialized production in Predynastic Egypt. Some of the earliest evidence for specialized production in Egypt concerns stone tools (see Ch. 1.4). Furthermore, stone tool production reaches a particularly excellent level of craftsmanship in the later Naqada period, as was the case for ripple-flaked knives. Chipped stone artifacts were found frequently in both settlements and cemeteries, so there is ample data on this class of artifacts. Most importantly, stone survives extremely well in the archaeological record, including stone tools themselves, and the debitage (production remains) which provide evidence of the process and location of production. All of these factors are critical for understanding the development and organization of production.

What was specialized?

The expectations for evaluating whether the ritual production model may apply to the development of specialization during the Naqada period revolve around an assessment of the patterns of raw material use, production locations, and find contexts of items made by specialists. Therefore the first step is to assess which items were made by specialists. Although certain chipped stone artifacts have uncontroversially been identified as objects of specialized production, such as the ripple-flaked knives, others are less well understood. Therefore Chapters 5 and 6 are devoted to understanding which flaked stone artifacts were produced by specialists. The methodology for this analysis is discussed at the outset of Ch. 5. In short, the method employed was essentially an analysis of the spatial distribution of production remains relative to the spatial distribution of tools, at both intra-site and regional levels. This method was used to assess the production patterns of heat-treated artifacts, six types of blades, and eight types of bifacial tools. The results indicated that there was a surprising array of different ways production of stone tools was organized, many of which could be considered specialized. Once certain tools could be identified as resulting from specialized production, their patterning could be compared to the expectations for the ritual production model.

2.2 Expectations for the Ritual Production Model

Table 2.1 shows the expectations for archaeological patterns that should be observable if specialized production developed according to the ritual production model as outlined in Ch. 1.5. Table 2.2 compares these expectations to other general models of specialized production and their associated archaeological patterns that would contradict the ritual production model.

Raw materials

If the ritual mode of production is applicable then the raw materials of specially produced goods could be significant to their symbolic meaning. For example, the more distant, relatively inaccessible and symbolically charged sites may be chosen because the source sets them apart from other goods (Spielmann 2002:198-99). Procurement of special raw materials takes more investment which can be an indication of the added value. However the raw material needs to be available in sufficient amounts to meet the widespread demand for the goods. Therefore extremely long-distance raw materials, which could only be obtained in small amounts, are not expected to have been chosen for socio-ritual valuables. Another possibility is that if the raw material was procured from a site with important associations, such as a holy place or other symbolically charged site, then those associations could be indexed by the raw material. If the raw material is significant to the meaning of the good, whether for its symbolic associations with place or for other reasons, then there should be an association between the type of raw material and the type of specialist produced good. If there is an association between raw material and tool type, other non-symbolic considerations for raw material choice should be ruled out, such as functional considerations, or local availability relative to production locations.

The most common material for flaked stone tools in Egypt by far is chert (see Ch. 4.1 for a discussion on the terminology chert vs. Flint). However chert is variable, and not evenly distributed across Egypt (see Ch. 4.1). Chert varieties are notoriously difficult to distinguish with any method, whether macroscopic, microscopic, or non-visual, like x-ray diffraction. Nonetheless the variability in Egyptian chert is readily apparent to lithic analysts and laymen alike (Figure 4.1). Most researchers divide their chert assemblages into groups based on macroscopic characteristics (e.g., Ginter et al. 1996; Kabacinski 2012; Kindermann 2010; Midant-Reynes and Prost 2002; Pawlik 2006; Riemer 2011; Rizkana and Seeher 1988). Due to issues with the non-macroscopic methods discussed in Chapter 4 such as reliability, time, and money, macroscopic methods were used to distinguish chert varieties.

Luedtke (1992) described five macroscopic variables for cherts: color, translucency, texture, luster, and inclusions. Additionally, cortex is affected by secondary movement from its natural context (gravity, wind, water, patina development), and can point to whether chert came from a primary or secondary deposit. These characteristics were recorded for a sample of 600 artifacts from el-Mahâsna and Nag el-Qarmila in January and March-April, 2012. A detailed description of how each characteristic was assessed is given in the Appendix. Inclusions such as fossils and banding were documented with a Proscope high resolution digital microscope to facilitate comparison between sites and publication of the raw material groupings.

Groupings of chert varieties were created by laying out a sample of the artifacts and grouping them based on observations of the macroscopic variables as defined by Luedtke, and taking into account previous researchers' definitions (Figure 4.2). A type collection consisting of 1-3 examples of each chert grouping was set aside to facilitate comparison and assignment of artifacts to specific chert groups during analysis. Cortex type and inclusions were the most reliable and replicable variables for differentiating cherts. Color, translucency, texture, and luster were all useful, but grade into each other.

Determination of local vs. non-local materials was done by examining the proportions of the chert types at each site, with the expectation that the most common material was local for each area, unless there were indications otherwise. Additionally, I conducted a survey of chert deposits in the high desert area immediately behind Abydos and in the el-Mahâsna area to observe the local materials there (Ch. 4), and considered some other possible sources for certain varieties mentioned in archaeological literature.

In Ch. 7.1 the frequency of each raw material variety was calculated for a sample of artifacts from each specialist produced tool class. If there was an association between tool type and raw material then one raw material variety was expected to be dominant. Some tool classes clearly were made from one or a few raw material varieties only, whereas others were made from many different chert varieties. Additionally, the distribution of raw material types by site relative to known sources of that material was also analyzed, to check whether any of the variability in raw material type could be accounted for by the use of local raw materials.

Production locations

If the ritual model of production applies to specialization in Egypt, then remains from specialized production could be associated with ritual contexts. Production of items may have been organized around ritual events for a few reasons. Production in close association with ritual activities could again add extra meaning or value to the goods. Moreover, if items were produced during events which brought many people together, there would be certain advantages such as the collection or sharing of raw materials and production knowledge. Additionally such production would be part-time rather than full-time due to the periodic nature of ritual activities. Part-time production not associated with ritual contexts does not rule out the possibility of the ritual production model, since socio-ritual valuables may need to be prepared before ritual events, but finds of production remains from specialist produced tools in ritual contexts would certainly support the model.

The locations of production for each tool type can be determined by looking at the specific kinds of debitage associated with each tool type, and the contexts in which it is found. Chapters 5 and 6 give descriptions of each tool type, including the kinds of debitage that might be associated with each. Determining whether tool production was part time or full time is more tricky. Estimates of the amount of time required to produce an artifact, the quantities of finished tools known or the quantities of production remains in a given location, periodicity evident in the production contexts, or even the difficulty of the production technology all factored into an evaluation of whether an artifact was made full-time or part-time.

Context

The context in which specialist-produced goods were found can address a number of aspects of the ritual production model. First, since socio-ritual valuables are necessary to ritual activities, then if the ritual production model applies specialist produced goods should be found in at least some ritual contexts such as temples, ritual activity areas, offering deposits, or burials. Second, since socio-ritual valuables bridge the divide between utilitarian and symbolic goods, being used in daily life and on ceremonial occasions, they should also be found in other contexts which do not have an overtly ritual character, such as domestic contexts, middens, production areas, or storage areas. Luckily examples of all of the contexts mentioned above are now known for Predynastic Egypt due to increased focus on settlement sites. The specific sites and contexts drawn on for this study are briefly mentioned below in section 2.3, and discussed fully in Ch. 3.

Third, since socio-ritual valuables would have been used by many people throughout a society, not just by a select group, then they should be (socially) widespread. A wide social distribution could be indicated in a number of ways. Finds of specialist-produced goods in settlements of all scales, not just paramount or regional centers, would indicate a wide distribution, since settlements of different scales may imply functional or social differences that could affect access to artifacts. In Chapter 3 the sites involved in this study are classified into high level, mid-level, and low level sites according to population size (as indicated by area of the settlement and number of graves in the associated cemeteries), and the diversity of functions evident in the settlements (administration, ritual activities, intensive trade, and large-scale production activities for beer, pottery, stone tools, ground stone, copper, or grain processing).

A widespread distribution of specialist produced goods is also assessed by looking at whether or not such items were found in multiple contexts within individual settlements, not concentrated on one house or structure within a settlement. Additionally the social distribution of specialist produced tools is also assessed by looking at whether they occur in elite vs. non-elite cemeteries or graves of different wealth/status.

As is evident in Table 2.2, which compares the expectations for the ritual production model to equivalent expectations for other models of specialist production, every aspect of each model is not perfectly distinct. However, overall each model has a different set of expectations. Any one of line of evidence is not in itself irrefutable evidence for the ritual production model, but a number of them together would indicate that a ritual mode of production was a major factor in economic intensification during the Naqada period. If the archaeological patterns associated with specialist produced tools match up with those expected for the ritual production model, then a compelling case will exist indicating that specialized production began in Egypt to meet the symbolic needs of the many for objects critical for ritual performance and social transactions.

2.3 Sites Involved in the Study

The expectations for production locations and find contexts both rely on understanding the kinds of contexts in which artifacts were found, and assessing a wide variety of contexts. Historically, much of the data about Ancient and Predynastic Egypt has come from cemetery evidence. This is not only because the finds of gold, jewels, and intact artifacts are more common in cemeteries, but also because settlements are harder to locate. Predynastic settlement sites lack telltale standing architecture because the structures were usually built from wattle and daub. Fortunately, a number of relatively recent excavations have focused on locating and excavating Predynastic settlement sites, providing the opportunity to take into account production sites and living areas. These new contexts provide data on the activities of a larger range of social statuses, not just the ones that have left ample material records in their graves.

Data for this study were collected from three sources: new analysis of archaeological assemblages, published literature on Predynastic assemblages, and online museum databases. Lithic artifacts were analyzed from three recently excavated settlement sites: El-Mahâsna, Abydos, and Nag el-Qarmila (Figure 2.2). These sites are of different scales, from a small farming village to an emerging political center. Furthermore, they include domestic and ritual contexts. The sites are briefly introduced here, and detailed information about each of the sites, including excavation methods, is in Ch. 3.4.

The main body of new material analyzed for this project comes from el-Mahâsna, which is a mid-sized settlement site located ~10 km north of the politically important site of Abydos. El-Mahâsna was briefly excavated by John Garstang (1903), and more recently by David Anderson (2006, 2007, 2011). The architectural, ceramic, and faunal evidence from Anderson's excavations have already been analyzed extensively (Anderson 2006; Rossel 2007). The remains date to NIC-NIID (see Ch. 3.2 for chronology details). El-Mahâsna is integral to the present study because Anderson's excavations revealed the existence of a ritual structure (Anderson 2011), in addition to domestic structures, and middens (Anderson 2006). The associated cemetery was excavated by Ayrton and Loat (1911) and published material is available for reference.

Abydos was a regional political center, as is indicated by the series of Predynastic burials culminating in the tombs of the first kings of Egypt and their associated funerary enclosures which are the earliest examples of monumental architecture in Egypt. However little is known of the associated settlement(s). Stephen Harvey recently uncovered a portion of a Predynastic settlement in the Abydos area while excavating Eighteenth Dynasty remains (Harvey 1998:163-164), and a sample of the lithic materials were analyzed for this study. The site dates to the NI-NIIAB. Materials from Abydos provide an intra-regional comparison of raw materials, tool types, and production techniques to those found at el-Mahâsna.

Artifacts were also analyzed from Nag el-Qarmila, a small, multi-component farming village in the Aswan region. Rescue excavations have been underway since 2007 under the direction of Maria Gatto (Gatto 2014; Gatto et al. 2009a,b), and artifact analysis is ongoing. The site dates to NIC-NIIA/B, and consists of three spatial components: the settlement with identified habitation contexts, a cemetery, and a storage area on a nearby ridge. It is unusual for such a small settlement to be found and thoroughly excavated, and it provides an important window on differences or similarities in production activities and artifact distributions compared to larger sites. The earliest currently known depiction of a pharaoh was recently found just south of Nag el-Qarmila, indicating that the area must have been politically important at least in the later part of the Naqada period (Hendrickx et al. 2012).

The interpretations of different contexts within el-Mahâsna, Abydos, and Nag el-Qarmila were made by the excavators and authors through analysis of architectural remains, stratigraphic relationships, and ceramic and faunal artifacts (Anderson 2006, 2007, 2011; Gatto et al. 2009; Harvey, pers. comm.) (see Ch. 3.4 for more details). These interpretations of context were made independent of the lithic artifact analysis.

In addition to the data from el-Mahâsna, Abydos, and Nag el-Qarmila, this study draws extensively on published lithic artifact assemblages from the following Predynastic sites, listed from north to south: the Naqada Khattara sites (Holmes 1989), Abadiya 2 (Vermeersch et al. 2004), Armant (Ginter and Kozlowski 1994; Ginter et al. 1996), Adaïma (Midant-Reynes and Buchez 2002), and Hierakonpolis (Hikade et al. 2008; Holmes 1989; Takamiya and Endo 2011). Each of these sites has been excavated with modern collection techniques (Ch. 3.1), and has been dated through ceramic relative chronology, in some cases with absolute dating techniques as well. The contexts include habitation areas, production areas, animal pens, middens, and ritual activity areas. Most have associated cemeteries. The sites are described in detail in Ch. 3.5.

Publications are inherently limited in how many photographs, drawings, and measurements of specific tools they can include; therefore I also consulted online museum databases to gather a larger sample of the specific kinds of tools made through specialized production, particularly for looking at the raw material expectation. The total sample includes artifacts from 39 museums and storerooms spread over nine countries and three continents (Table 7.2). More information is given in Ch. 7.1.

This project focuses on the Nile Valley sites for a few reasons. Foremost, it is already well known that there is some regional variation within the valley itself during the Naqada period (Holmes 1989), so other sites beyond the Nile Valley in Egypt were not included, to reduce variability due to regional differences, whether stylistic or environmental. Furthermore, the Nile Valley itself seems to be the prime locus for the development of a suite of characteristics along with specialization, such as writing, social stratification, and kingship. Therefore the main goal of this project was to understand influences on the development of specialized production in the Nile Valley itself, rather than looking at issues between larger regions.

2.4 Artifact Analysis Methods

The artifact assemblages studied included flake, blade, and bifacial tool technologies. Much experimentation has been done by archaeologists to understand how ancient flaked stone tools were produced, and how they and their byproducts can be identified in the archaeological record (e.g., Ahler 1983; Crabtree 1972; Desrosiers 2012; Domanski et al. 2009; Tixier 1984; Whittaker 1994; Wilke and Quintero 1996). Most lithic-reduction experimenters emphasize that there are no smoking gun attributes associated with a given reduction technique. Rather they stress that among a given population of tools and debitage reduced in a particular way, certain attributes will occur frequently. This observation highlights the utility of analyzing attributes, not just types of artifacts. Additionally, typing can mask variability, sometimes forcing continuous factors into artificial groups (Dibble 1995). However, typologies continue to be a time-efficient method of analysis, and when widely used or well defined, they are a good way to communicate much data between researchers.

I used a combined attribute and typology approach for this project. I analyzed each artifact individually, including both debitage and tools. Raw material type, flake type, tool type, and core type were recorded along with more specific attributes such as the amount of cortex, platform faceting, flake scar pattern, and metric measurements. Types were recorded as an attribute category for each artifact, rather than first sorting the artifacts by type, then recording additional attributes. This system allowed type categories to be re-evaluated as necessary (Ch. 5.3), and facilitated analysis of variation within type groups (Ch. 7.1).

No single reference typology exists for Predynastic or Pharaonic Egyptian stone tools, let alone debitage. Over the course of a preliminary research season in 2009 at el-Mahâsna, I developed a coding guide specific to the Predynastic Egyptian material and the questions asked here. The main references used to create the coding guide were: Andrefsky 2005, Debénath and Dibble 1994, Holmes 1989, Inizan et al. 1999, Luedtke 1992, Midant-Reynes and Prost 2002, Rosen 1997, and Tixier 1963. Additionally, a type collection for identifying heat-treated materials was created through experimental heating of chert (Ch. 4). The Appendix gives a detailed description of each characteristic examined and definitions of the choices in each category. The basic classes of observations were: context data, raw material data, production/technology data, tool data, and metric information. Since this study is concerned with identifying production locations as well as distributions of tools, all lithic artifacts (within the selected samples) were analyzed from each site in order to examine the different production technologies present, the products, and their chains of production.

Data collection procedures

The lithic artifacts in this study were analyzed in Egypt over the course of two study seasons: January-May 2012, and January-May 2013. I analyzed the el-Mahâsna and Abydos material at the Abydos American excavation house where the materials are stored. I studied the material from Nag el-Qarmila in the official Kom Ombo storage magazine for the Aswan region. I conducted a preliminary analysis at Abydos on the el-Mahâsna materials in January 2009, however all the data presented here is from the 2012 and 2013 study seasons. Support for the 2013 season came from a fellowship through the American Research Center in Egypt. For information on how the artifacts were collected in the field, see Chapter 3.4.

Artifact analysis proceeded according to the following process. First the artifacts were washed by Egyptian workmen, using soft brushes and water, and laid out to dry. Then pieces below 1.5cm were sorted out, counted, and weighed. At the same time non-cultural material was sorted out and discarded. There had to be recognizable flake scar attributes, (e.g., bulb, ripples point of initiation, erailure scar, etc.) for an item to be classified as an artifact (cultural material).[3] Artifacts equal to and above 1.5cm and tools smaller than 1.5cm were individually labeled with the bag number and a sequential number of the artifact in the bag. The labels were written with a .4mm-tipped Sakura Identi pen, and the ink can be removed with acetone. Flakes were labeled on the ventral side, and tools were labeled on the ventral side if one was discernible, or in the least conspicuous place.

Subsequently, each labeled artifact was individually analyzed for type and attributes (see

[3] Shatter/angular debris is cultural material that does not have the usual recognizable flake scar attributes. Shatter/angular debris was differentiated from natural material based on the raw material types, evidence of heat treatment, and freshness of the surfaces (natural debris was much more rolled and damaged that the man-made artifacts).

the Appendix). The data were entered using E4 software,[4] which brings up one question at a time with associated menu choices and automatically enters the answers into an access database. This software helps to standardize the entries and reduce entry error. Metric measurements were made with metal digital calipers that had a USB attachment to directly feed the measurements into the computer, thus reducing typing error and saving time.

Although the artifacts were analyzed in multiple locations, effort was made to use comparable lighting conditions. Analysis was carried out indoors near windows with natural sunlight. Additionally small desk lamps provided angled light for highlighting certain features. A microscope was also used to examine small details. The advantage of using a microscope instead of a hand loop (10x) magnification is not only in the greater magnification, but in the ability to stabilize or rotate the artifacts as needed.

After analysis all artifacts were photographed in indirect sunlight (shade). Most photographs were taken around midday, but the time of day sometimes varied. Grey background was chosen to minimize contrast, and each photo included a color scale for standardizing the color adjustments on the photographs. The photography surface and the camera were both leveled using a bubble level to minimize distortion from the camera angle. Cores and tools were photographed individually from as many sides or angles as necessary. The dorsal and ventral sides of the debitage were photographed in groups according to type within each bag. Additionally a Proscope high-resolution digital microscope was used to photograph details- particularly raw material inclusions, edge retouch, and usewear. The magnification is 30x unless otherwise noted.

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[4] A free software program designed for data entry by Dibble and McPherron, available on: www.oldstoneage.com.

Representative and unusual examples of debitage, core, and tool types were chosen for illustration. Darcy Hackley and Megan Cook illustrated the selected items following conventions in Addington (1986). Additionally, Darcy Hackley made drawings of intricately flaked tools directly in digital format using photographs as the base and referencing the actual artifact while drawing.

2.5 Statistical Analysis Methods

A number of statistical methods were used to analyze the collected data, including Confidence intervals of proportions, Chi-square, analysis of variance (Anova), and coefficient of variation (CV). All of these statistics are relatively common in archaeological publications. Nonetheless, a discussion of each follows, including what kinds of data they apply to and how they are calculated. The discussions were drawn mainly from Thomas (1986), Diez et al. (2012), and University of Virginia Stats Lab materials. In some cases the discussion of the statistic is re-iterated in the data chapters the first time a method is used, for clarity.

The statistics were calculated using the “R” software (Dalgaard 2008) “Introductory Statistics with R.” Many of the charts and graphs were also built using R software. All of the tables were made in Excel or PowerPoint. Throughout the study the “alpha” significance level used was .05, which, although an arbitrary cut-off level, is standard in archaeological research and makes the results more easily comparable to other studies.

Confidence limits of a proportion

Confidence limits of a proportion were used to answer the question of whether variability in proportions among assemblages is meaningful, a method of hypothesis testing (Diez et al. 2012:173-175). Confidence limits of a proportion can be used to compare nominal/categorical data rather than interval data, by calculating an error range for a proportion. For instance, if the proportions of scrapers in three tool assemblages are 5%, 10 %, and 12%, are these proportions really different, or are they essentially similar? This same question could be answered with T-tests, which give the probability that two proportions are the same. However, it is not a good idea to run many T-tests, as that increases the chance of getting a significant result when there should not be one. The advantage of confidence intervals is that you can compare more than two proportions at a time, and present them in easily interpretable figures.

The confidence limits of a proportion are an error range for that proportion. Archaeological data are essentially samples, rather than entire populations. All of the material under question probably does not enter the archaeological record in the first place, and then post-depositional processes affect preservation, and finally archaeologists rarely collect the entirety of a given site. Therefore a proportion is an estimate or sample of what the real value is. Since archaeological data are samples, there is the possibility of (random) sampling error.

Given a certain sample, the confidence interval indicates the range of values for the actual population, where getting the given sample is a likely result. If the cut-off level for significance is 95% is, then if the sample was repeated 100 times and the confidence intervals calculated for each, 95 times out of 100, the actual population would be in the resulting range. There still remains 5% of the time where the actual population would not be within a given range.

If the confidence intervals of multiple samples do not overlap then it is very likely that the actual underlying populations are different. To put it in standard hypothesis-testing terms:

The null hypothesis is that the proportions are the same. The alternative hypothesis is that the two proportions are really different. If the two confidence intervals do not overlap, then there is sufficient evidence to reject the null hypothesis that the two proportions are essentially similar.

The binomial confidence intervals are calculated based on the binomial probability distribution, using the sample size and an actual estimate to determine the probability distribution. Binomial distribution probabilities were calculated by statisticians running trial and error tests (e.g., for a sample size of 20, there is a very low probability that heads will turn up 19 times, and a very high probability that heads will turn up 10 times). Sample size inversely affects the interval size. So a large sample will result in a small range, and a small sample will result in a large range. The observed proportion affects the location of the peak of the binomial distribution bell curve, and therefore the probability associated with that proportion, given the sample size. In this study, intervals were calculated using R code written by Fraser Neiman for the Clopper-Pearson binomial confidence intervals. The code uses 100,000 tests based on the parameters input for sample size and observed count, and calculates cumulative probabilities. It gives a more conservative error range (in other words, a larger error range) than some other formulas for binomial confidence intervals.

The confidence intervals are very useful for this study because some of the samples sizes are large while others are smaller. Additionally, the confidence intervals are amenable to visual display that can be easily and quickly interpreted.

Chi-square tests

Chi-square tests were used to look for associations among sets of nominal data. Chi-square tests can be used for a kind of hypothesis testing where the null hypothesis is that the two variables are independent of each other. The alternative hypothesis is that the outcome of one variable is dependent on the second variable. A Chi-square test compares whether the observed distribution varies significantly from the null hypothesis distribution, which is the theoretical Chi-square curve for a given number of categories and the counts in each category.

A Chi-square test works by making a contingency table of counts of each possibility of a given variable, which are grouped according to a second set of variables, for instance the bulb types found for each different blade type. Then the expected count in each cell is calculated by taking the sum of the number of observed occurrences in that row, multiplied by the sum of the number of observed occurrences in that column, and dividing by the total number of occurrences in the entire contingency table. The difference between the actual observed counts and the expected counts is figured simply by subtracting the observed from the expected in each cell (they are then squared to remove any negative numbers), and divided by the expected to account for different weights (count sizes) across the groups (cells).

The validity requirements (assumptions) for a Chi-square test are that the two variables are independently measured or defined, and that the expected counts are all above one, and not more than 20% are below five (Thomas 1986:298). If these validity requirements are met, then a probability value can then be calculated. This probability value answers the question of how likely it is that the difference between the observed and expected is due to random chance. This is the ‘p’ value. Sampling distributions for the Chi-square probability curve have been defined by statistics researchers who did many trials with different combinations of the numbers of variables, for instance a 2 x 2 contingency table or a 3 x 5 contingency table (which relates to the degrees of freedom), and different sample sizes (Thomas 1986:286). These experiments helped define the validity requirements for the Chi-square test, and help to define the probability of variation due to random chance. A very low p value indicates that it is very unlikely that the difference is due to random chance. If the probability is below a certain cut off then the null hypothesis can be rejected. The cut-off value for significance, or alpha value, used throughout this study is .05.

Anova

For continuous data, such as metric data, an analysis of variance statistic (Anova) can be useful for comparing the means of multiple groups. Anova is appropriate to use when comparing means across more than two groups, rather than pairing the data in all possible ways and doing multiple T-tests, because there is always a small possibility that a significant result is due to chance. When multiple tests are run the possibility of getting a significant result when one does not really exist is compounded (Diez et al. 2012:236). Anova combats compounding error by checking only whether the means across all groups are equal or not.

The validity requirements (assumptions) of an Anova test are that the observations are independent, that the data approximate a normal distribution, and that the groups have similar variability. QQ plots were used to examine whether the data approximate normal. In a QQ plot the quantiles (the fraction of the material below the n^{th} value) are plotted against the quantiles of a normal distribution. If the data are normal then the resulting plot should be close to a straight line. If the data are not normal then a log transformation can be applied to the data, which usually normalizes the data. Again the log data can be checked for normality using another QQ plot. The variances of the data were calculated in R, and then tested for similarity using Bartlett’s test for homogeneity of variances. With Bartlett’s test the null hypothesis is that the variances are equal, and the null is rejected if the p-value is below .05.

The null hypothesis for most Anova tests is that the means are equal. The alternative hypothesis would then be that at least two of them are different from each other. The null can be rejected if the probability calculated is equal to or below .05. If it is found that the null should be rejected, the question remains as to which are significantly different from each other? A post-hoc test called Tukey's Honestly Significant Difference can be done after an Anova test in order to determine *which* means are different. Tukey's HSD uses data from the Anova (Mean Square Within) to calculate what a significant difference would be (HSD), and then compares each pair of differences in mean to the HSD.[5]

Coefficient of variation

The coefficient of variation (CV) was used to explore the degree of standardization or variability of tools in Chapter 6. The coefficient of variation compares the degree of variability within a sample or population. It is derived by calculating the mean and the standard deviation, then dividing the standard deviation by the mean. The result is multiplied by 100 so that it can be expressed as a percentage.

The standard deviation itself is a measure of dispersion (variability) around a mean, but if the means of two groups being compared are very different, then the standard deviations will accordingly also be different. The magnitude of the standard deviation is related to the magnitude of the mean. Groups with a smaller mean will have a smaller standard deviation, even if the amount of variability is actually the same. For instance, a group of tools with an average

[5] For the exact formula and more information on Tukey's HSD see Tukey (1949) or http://faculty.ucmo.edu/dkreiner/psy2120websitestuff/psy2120oldexams/documents/StatSheet12_TukeysHSD.pdf

length of 4 cm will have a smaller standard deviation than a group of tools with an average length of 40 cm. Dividing by the mean controls for differences in the amplitude of the mean, thereby making the amount of variability comparable across groups with means of any size.

Eerkens and Bettinger (2001) used observations on the degree of variability that humans can perceive in order to set a limit for the degree of standardization that humans could produce. This limit is a CV of 1.7%. They also discussed examples of items produced without aid of measuring devices which are considered quite standardized, and these typically range closer to 2-5% (ibid.:496). Additionally, they generated CVs of random data to set a constant for extreme variability, which worked out to a CV of 57.7%.

Chapter 3: Predynastic Settlements and their Contexts

Specialized production developed over the 4th millennium BCE in Egypt. This chapter provides the background information on Predynastic Egypt including chronology, evidence for inequality, settlement contexts, deposition practices, and settlement patterns. The find contexts of specialist produced tools and their contexts of production are referred to in later chapters to evaluate the expectations for the ritual production model.

The overview of chronology includes differences between relative dating schemes, and their correlated absolute dates. Many of the models for specialized production in Egypt involve different roles for elites and non-elites, therefore a brief overview of the evidence for inequalities during the Predynastic period is given below.

Lithic artifacts were analyzed from three settlements sites to understand the ways production of lithic artifacts was organized, and to evaluate the expectations for the ritual production model. The descriptions of these three settlements and the history of research at each are given here. The information from these three sites was also compared to published information on lithic artifacts from a number of other sites. Therefore brief descriptions of the comparison sites follow. This overview of the settlements includes information about and interpretation of individual contexts, which allows for an analysis of disposal practices and natural taphonomic processes, concluding that the artifacts found in a given context were most likely related to the use of the features therein, rather than from later trash dumping. Finally a discussion of the settlement patterns shows how individual contexts were organized within a site and how sites were distributed across a region.

3.1 Overview of Socio-Economic Changes

Worldwide, Egypt is one of the cases where pastoralism was adopted before agriculture. This is significant because scholars argue that pastoralism affected the development of Egyptian culture even after the adoption of agriculture (Buchez 2011a; Gatto 2014; Wengrow 2006). By the 6th millennium BCE, pastoralism was evident through the presence of domesticated cattle and ovicaprid bones in campsites from the Red Sea to Chad (McDonald 1998). By the beginning of the 5th millennium BCE the climate had begun shifting toward greater aridity (Bubenzer and Riemer2007; Kindermann et al. 2006; Kuper and Kröpelin 2006; Nicoll 2001; Riemer et al. 2013; Wendorf et al. 2001). By 3500 BCE deserts were only suitable for transit and occupation at a few oases. People responded by expanding mobile ranges and moving south or into the Nile Valley. Evidence for agriculture was first identified at sites in the Delta and the Fayoum, dating to the 5th millennium BCE, and from there the evidence for agriculture shifted south over time. This north-south trend along with the appearance of a 'bundle' of agricultural domesticates including emmer wheat, barley, lentils and flax, implies that agriculture was adopted from the Levant (Wetterstrom 1993).

The Badarian is a regional culture in the middle Nile Valley (Abydos area and north) that dates to 4400-3800 BCE with evidence for agriculture and a material culture that directly links to the subsequent Naqada culture (Hendrickx and Vermeersch 2001; Holmes and Friedman 1994). Regional surveys of settlement sites indicate settled agricultural communities existed throughout the Nile Valley by 3800 BCE (Hassan 1988; Patch 1991; for all sites see Hendrickx and van den Brink 2002). Regional differences in ceramic (Friedman 1994) and lithic (Holmes 1989) material culture existed during the early part of the 4th millennium BCE, and became more unified over the course of the millennium. The people of the 4th millennium also made drastic changes to their lifestyles, leading to the rise of Pharaonic Egypt by the beginning of the 3rd millennium BCE. The major changes included: uniform material culture throughout Nile Valley and delta made by specialists; centralized administrative organization evident through the development of writing, bureaucratic titles, and tax collection; and a pervasive system of social stratification centered around the pharaoh, marked most powerfully by monumental architecture in settlements and cemeteries.

3.2 Chronology

A summary of the chronological divisions of the 4th millennium BCE is necessary for an analysis of the development of specialized craft production. Named for the site of Naqada, the Naqada period is a chronological designation for a set of related material culture (known as the Naqada culture). This material culture spanned most of the time period from 4000 BCE into the early 3rd millennium BCE. Geographically, it began in the Nile Valley in Upper Egypt (from Aswan to Asyut), and eventually expanded into Lower Egypt and the oases. The term "Predynastic" is a looser but somewhat interchangeable term for the Naqada period, but can also encompass the Lower Egyptian early 4th millennium cultural sequences (Buto-Maadi culture), and the Badarian period material which is found in middle Egypt in the latter half of the 5th millennium BCE (Hendrickx 2006b:55-57).

The Naqada period is divided into three main parts based on the relative chronology of the ceramics. This was first and famously accomplished by Petrie, who worked with data from the cemeteries of Naqada, Ballas, and Diospolis Parva (a.k.a. Abadiya and Hu), and seriated the grave assemblages to provide Sequence Dates (Petrie 1921; Petrie and Mace 1901; Petrie and Quibell 1896). The three partitions, from earliest to latest, were known as the Amratian, Gerzean, and Semainian, and the divisions were based on the occurrence or absence of different pottery types. Petrie observed that the White Cross-Lined Wares and Decorated Wares never occurred in the same graves, and that the changes in the wavy handles on some pottery could be put into a logical order. Scholars have been continually revising Petrie's chronology (Buchez 2011a,b; Kaiser 1957; Hendrickx 1996a, 2006b, 2011b; Hartmann 2011a,b). Table 3.1 presents the basic correlations between different dating schemes. Based primarily on cemetery data from Armant, Kaiser (1957) revised Petrie's chronology by taking into account horizontal spatial differences within the cemetery. Kaiser observed three spatial clusters of ceramic types: Black-Topped Ware, Rough Ware, and Late ware, and divided the Naqada period into three stages or 'Stufe': I, II, III, with I the earliest and III the latest. Those three main periods were further subdivided and marked by lowercase letters, so that Ia is earlier than Ic and so on. Kaiser's scheme became widely used, but Hendrickx (1996, 2006b) offered further refinements to Kaiser's chronology by using a similar method but basing his analysis on multiple cemeteries. Chronological designations based on Hendrickx's scheme are written with uppercase letters (e.g., IC or IID) rather than lowercase letters to differentiate from Kaiser's chronology.

Kaiser and Hendrickx used the pottery types defined by Petrie, which had some inherent problems (Buchez 2011b; Hendrickx 1996a), but they could not refine the typological categories because they did not have access to the original materials. Buchez developed new typological categories based on material from the site of Adaïma, and used a serration process to examine chronology rather than spatial distribution. Her studies definitively demonstrated that the phase IId1 could not be distinguished from IIc, which means that phase IID2 can just be considered IID. This latter point is an important consideration for understanding ripple-flaked knife production which dates mainly to the NIID period.

Hartmann (2011a,b) refined the dating of the early part of the Naqada period based on finds from the Abydos Umm el-Qa'ab cemetery. Drawing data from 650 graves of the NI/II period, she made a new classification of vessels according to fabric, ware, and shape. She also included some vessels from early excavations in order to correlate the results with Petrie's types and chronology. Hartmann recommends treating the entire period of NIA-NIIB as the Naqada I period, with two main phases, IA and IB, that have additional subdivisions (see Figure 3.1).

These dating schemes were based on cemetery materials, and as more work has focused on settlements it has become clear that settlement ceramic assemblages are made up mainly of vessel fragments, and that the ceramic types are represented in different proportions than in cemeteries. Many authors have worked to correlate the settlement materials to the existing dating schemes (Friedman 1994; Patch 1991). Throughout this dissertation referenced dates follow those given by the original authors, the majority of whom draw on either the Kaiser chronology (lowercase letters) or Hendrickx's Naqada chronology (uppercase letters). Table 3.1 can be used to compare the dates.

There are two important points for understanding Naqada chronology. First, the Naqada III overlaps with the Early Dynastic period, because the latter was often identified through writing and evidence for kings, while the former was based on pottery finds. The second point, is that there are more differences between NIIAB/NIIab and NIIBC/NIIbc than there are between NIC/NIc and NIIA-B/ NIIa (Hendrickx 1996a:39, 2011c). Effectively, these differences divide the Naqada period before Aha into an earlier part (NI-NIIAB), and a later part (NIICD-IIIB).

Absolute dating based on radiocarbon dates for these relative time periods has been beset with problems including the unreliability of calibration curves for the NIII period and the inability to export carbon material out of Egypt for testing after the 1980s. A few projects nonetheless were able to offer some absolute dates (Hassan 1988; Savage 1998), and a C^{14} dating facility is now open in Cairo. The conventional range for the Predynastic period has been from around 3900 BCE to around 3050 BCE. However, due to the above-mentioned problems with dating, Dee et al. (2013) used Bayesian statistical modeling methods to refine the radiocarbon dates from new samples taken from museum collections (focusing on short-lived remains) and measurements available in published material. Notably this revised chronology indicates that the Predynastic period and all its associated socio-economic and political changes took place over a shorter time span than had been previously thought, from around 3700 to 3075 BCE (Table 3.1).

3.3 Inequality in the Naqada Period

Since current theories argue that specialization developed in Egypt in relation to elite demand for prestige goods, it is necessary to briefly present evidence for elites and inequality during this period. In Egypt this issue has mainly been assessed through cemetery evidence. W. Anderson (1992) analyzed Badarian graves and argued that some vertical differentiation was evident. She found statistical differences between and within cemeteries, showing that luxury goods were segregated by area in some cemeteries, that there was a bimodal distribution in the quantity of goods per grave, and that sub-adults could be found with numerous ceramics. Bard (1988, 1994) worked with data at Armant and Naqada, and argued for increasing differentiation from NI to NII, with a two-tiered social hierarchy in the NIICD, and more variability in differentiation during the NIII. Wilkinson (1996) worked with data from a number of cemeteries, and came to similar conclusions using different methods.[6] There were actually fewer differences

[6] However some authors have noted problems with the way Wilkinson grouped Petrie's pottery types.

among graves in some cemeteries in the NIII. Both Bard and Wilkinson attribute this to the suppression of local elites, as more encompassing socio-political structures formed. Savage (1997) provided a detailed analysis of cemetery evidence that considered both horizontal and vertical differentiation at Naga-ed-Dêr. He argued for the presence of descent groups as the best explanation for grave clustering, and showed that each grouping had changing economic fortunes over time. Bard also demonstrated that the social position or wealth of a person was more often expressed by including large quantities of similar objects, rather than through the inclusion of a few rare or exceptional items.

The advent of cemeteries specifically reserved for elites indicates that the developing inequalities became sustained. Hierakonpolis has the earliest cemetery dedicated to elite burials, which dates to the NIC-NIIB. As will be discussed in more detail below (Ch. 3.5), there are tombs with wooden- post superstructures, central tombs surrounded by subsidiary human burials (arguably sacrificed), wild and domestic animals (elephant, hippo, baboons, hartebeest, wild and domestic cattle, goats, dogs, cats), caches of artifacts, and a destroyed human statue in stone (Adams 2000a; Friedman 2011c). Cemetery T at Naqada dates to the NII-III, and has large brick-lined tombs with large quantities of artifacts including rare imported artifacts (Davis 1983; Petrie and Quibell 1896). The Umm el-Qa'ab cemetery at Abydos dates back to before even the NI (Hartmann 2011a). By the NIId it was reserved for elites, and the cemetery eventually became the burial place for the First Dynasty kings (Dreyer 1992).

3.4 Site Descriptions: el-Mahâsna, Abydos, Nag el-Qarmila

The description of the settlements and the history of research at each are given here, along with details about the excavation methods and contexts from which the materials analyzed here derived. Associated settlement sites and cemeteries are also briefly discussed to provide context.

El-Mahâsna

The settlement site of el-Mahâsna (26 15'16" N, 31 50'26" E) is located ~10km north of Abydos, on the west bank of the Nile, in the low desert just on the edge of the modern cultivation (Figure 3.1). The site is situated on a small rise. The Predynastic settlement site itself extends for about 7.6ha[7] (Anderson 2006, 2007, 2011), and probably was originally larger since much of the surrounding area has become farmland. Later cemetery remains intrude on the settlement and extend farther to the north.

El-Mahâsna was originally excavated by John Garstang in 1900-1901 (Garstang 1903). Garstang's work focused on a wide embayment in the high desert cliffs, immediately north of the Abydos embayment. Garstang and company located a number of sites, including the Predynastic settlement of el-Mahâsna, and the Predynastic cemetery of Alawniyah (Beit Allam). Garstang identified the settlement area based on exposed artifacts and darker soils characteristic of decayed mud architecture. He divided the settlement area into two parts, labeled S1 and S2, due to a natural topographic depression which can still be seen today. Garstang (ibid.:5) and Anderson (2006:29) both concluded that the two areas are parts of the same overall settlement, and indeed, a feature of many Predynastic settlements is that they can have somewhat separated localities as part of the whole (Ch. 3.7). Garstang's excavations in the S2 area revealed preserved

[7] Patch (1991:404-408) gave a much smaller size estimate from her survey, only .36 and .3 ha for the site's two parts, but Anderson's excavations have revealed Predynastic remains in a larger and basically contiguous area.

stubs of wattle and daub architecture in situ, post holes with actual wooden posts still in them, and intact ceramics, all of which demonstrate the excellent preservation of the site. However Garstang did note some areas of *sebakh*[8] digging. Other interesting finds from the site included a cache of oddly-shaped natural flint nodules, and a series of kilns which Geller (1992a,b) later argued were beer brewing facilities.

Garstang's work documented that after the settlement was abandoned, the area was re-used as a cemetery, with tombs dating from the Early Dynastic through the Old Kingdom and later. Some of the tombs had been excavated previously, possibly by de Morgan (Garstang 1903:2; J. de Morgan 1896, 1897). The tombs avoided the main settlement area, but it is unknown whether this was due to coincidence, the soil type, the existence of visible remains, or because the site was still remembered.

In 1982-1983 Diana Craig Patch (1991) surveyed the Abydos region for Predynastic-Old kingdom remains, including the el-Mahâsna Predynastic settlement site. Her survey aimed at dating the sites in order to understand the chronological development of urbanism in the area. Patch worked using a combination of pedestrian survey and surface collection of diagnostic sherds in stratified random samples. As with Garstang, the el-Mahâsna Settlement site was again separated into two parts, S83-40 (which included Garstang's S2 and later the Pharaonic cemetery) and S83-41 (Garstang's S1)[9] (ibid.:404-408). Patch noted that the density of surface materials was sparser at S83-41 compared to S83-40. Patch (ibid.:404) dated the site(s) to the Ic-IId2.

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[8] *Sebakh* is the Arabic term for the rich soil that built up in ancient settlements. Farmers in the 19th century would dig up the sebakh to use as fertilizer on their fields, destroying many ancient settlements in the process.

David A. Anderson (2006, 2007, 2011) conducted new excavations at the site over the course of three field seasons from 1995-2000 as part of his dissertation research, and has continued analyzing the material and undertaking new excavations since. Anderson's dissertation focused on comparing the applicability of two models for the development of complexity in Egypt. To do this Anderson's team carried out systematic surface collections, excavations, and analyzed the ceramics, faunal remains, special finds, and evidence for architecture and stratigraphy (Anderson 2006, 2007; Rossel 2007). Like Garstang, Anderson's work uncovered extremely well-preserved habitation remains including preserved posts and matting, basketry, hearths, floor surfaces, and intact pottery. These impressive finds are unfortunately now threatened by modern farmland expansion (Anderson 2006:23). Anderson (2006, 2011:3) dated the Predynastic settlement remains to the NIC-IID. The lithic material analyzed for this dissertation project came from Anderson's excavations.

Anderson's el-Mahâsna excavations

El-Mahâsna is integral to the present study because Anderson's excavations revealed the existence of domestic structures (Anderson 2006) and a ritual structure (Anderson 2011), both of which are contexts that will be used to evaluate the ritual production model. Anderson excavated nine 'Blocks' of units, totaling 405m^2 (Figure 3.2). The Blocks were placed to explore factors identified during the surface survey, and each Block was composed of a number of adjacent 3x3m excavation units. All the Blocks varied in size based on the materials and features present.

Each unit was excavated in arbitrary 10 cm levels within natural or cultural stratigraphic

[9] Patch is not sure if S83-41 corresponds to S1, but Anderson (2006) believes it does based on his

loci. All the material was dry screened through 4mm mesh. The Op-Locus-Lot recording system was used at el-Mahâsna. Each excavation unit was called an operation and given an 'Op' number in the order of their excavation. During excavation individuals features or stratigraphic layers were then assigned sequential 'Locus' numbers. Locus numbers were not repeated in different Ops, instead each locus number is unique across the whole site. Each portion of contiguous soil removed at a time was assigned a 'Lot' number sequentially in each unit. A 'Lot' is a three-dimensionally defined volume of soil and can either consist of an entire locus (such as a small hearth), or an arbitrary division of the locus, (such as the top 10cm of a stratigraphic layer). For example Op5, Locus 44 might be a thick layer of loose sandy soil spreading across the whole unit. The first 10cm removed would be assigned the next available 'Lot' number for the Op, e.g. 4. Materials collected from each individual lot were given unique tracking numbers called "MAP" numbers (tag numbers). 'MAP' stands for Mahâsna Archaeological Project. In this example all the lithic artifacts from Op 3-Locus 15-Lot 4 would be given a MAP number, say MAP#1317, all the ceramics the next MAP number, MAP#1318, and so on. For more details on the Op-Locus-Lot and MAP# system, see Anderson (2006:46-51). After excavation Anderson analyzed the stratigraphy and features and assigned each lot to a habitation phase, and assigned dates to the habitation phases based on the associated diagnostic ceramics.

Figure 3.2 shows the location of each of the excavation blocks, and Table 3.2 presents the basic interpretations of each excavation block. For this study, lithic artifacts were analyzed from two of the domestic contexts (Blocks 1 and 4) and the ritual activity area (Block 3), each described below. Time did not permit analysis of the entire lithic assemblage from each block. Two units were selected per block and fully analyzed: Block 1 Ops 4 and 5; Block 3 Ops 20 and

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observations of the site.

23; Block 4 Ops 25 and 28. Additionally a few other MAP numbers were randomly selected in each block, and special finds were analyzed. Figure 3.3 shows the location of the analyzed Ops in each excavation block.

Evidence for habitation contexts

Anderson identified habitation areas in Blocks 1, 4, and 8. Furthermore Anderson (2006: 242-247) devised an ‘elite index score’ to compare the excavated areas at el-Mahâsna based on expenditure of effort in construction and presence of wealth items. Block 3 clearly stood out from all of the other blocks, while Blocks 1, 4 and 8 had comparable scores. Blocks 1 and 4 were selected for lithic analysis because the faunal material had already been analyzed and contributed to the interpretation of the contexts.

The excavations in Block 1 revealed evidence for a structure (Figure 3.4) made of reeds and wood posts with mats tied onto them (ibid.:77). The structure (or one part of the structure) was defined by walls on at least three sides, had internal divisions and a compact floor surface, and was at least 4m x 2.75m (8.86m^2) in size. One side of this structure was formed by a long (13m) wall which extended further north and south and which may define a larger structure or one side of a fenced area. Another structure just south of the first was identified only by remains of its mud plaster floor surface adjacent to the long wall (ibid.:78).

Other features and artifacts attest to the domestic character of the activities. The presence of a number of hearths, some with faunal remains indicate cooking activities. High proportions of basins and jars in the ceramic assemblage suggest subsistence production and storage activities (ibid.:159). A storage pit which was capped with a piece of limestone and contained a lower grinding stone and two flake cores (MAP#s 1313.1, 1313.2) also complements the ceramic evidence for subsistence production and storage. The lithics analyzed from this op date from the Ic to IIa-b periods.

Identification of Garstang's dig-house allowed Garstang's maps to be rectified with modern maps. Block 4 was located adjacent to an area of Garstang's excavations. Posts and somewhat ephemeral living surfaces were found in Block 4 (Figure 3.6). Although there was no clear patterning to the posts, Anderson (2006:128) thinks they may be associated with a structure described by Garstang, based on proximity. Quite a few ash features were also found in this block including hearths, ash deposits, and middens/areas of trash disposal, which Anderson interpreted as food processing activities in an outdoor area adjacent to a structure (ibid.:132). Finds of faunal remains, particularly large amounts of turtle bone, support this interpretation. The analyzed contexts in this Op date from the Ic-IIa-c periods.

Evidence for the ritual activity area

Analysis of ceramic, faunal, and architectural data distinguished Block 3 from the other excavated contexts at el-Mahâsna. The excavations revealed evidence for a structure (Figure 3.7). The architecture and artifacts associated with this structure date to the NIC-NIIAB, possibly into NIIC (Anderson 2011:12, 14). The Block 3 structure was located prominently on a rise, at the highest part of the site. The Block 3 structure showed a higher investment in architecture compared to other blocks, with significantly larger posts (Anderson 2006:117-119). The size of the structure is unknown, since its limits were not reached during the excavation of the 162m^2 block, which itself indicates that it must have been a rather large structure. A layer of clean sand was found underneath the structure, possibly intentionally placed there, as is seen with later Pharaonic temples (Anderson 2011:14).

The ceramic inventory of Block 3 also stood out from the other excavation blocks, with statically significant higher proportions of imported ceramics (Anderson 2006:170). Higher proportions of White-Cross Lined and Decorated Ware ceramics, the two kinds of ceramics that bear figural decoration, were also more frequent in Block 3, though the statistical significance is only moderately higher due to the overall low frequency of such materials at the site (Anderson 2006:175-179, 260, 2011:19,).

Most notably, 22 human and animal unfired clay figurines and figurine fragments were found in Block 3 (Figure 3.5). Some of the cattle figurines have incision marks on the neck which may represent slaughtering cuts (Anderson 2011:15). Anderson argued that the anthropomorphic (female) figurines were made to be broken. They were constructed from separate individually modeled parts which were not scored to increase adhesion, nor were the parts modeled around sticks to hold them together, like some other known Predynastic figurines. The el-Mahâsna figurines broke along the weak join lines. Furthermore, the (refitting) parts of the figurines were not found adjacent to each other, but scattered around inside the structure, showing that they were not broken after deposition (ibid.:18). Pre-depositional wear on the figurines indicates that they were not production rejects, but artifacts utilized during the life of the structure.

Faunal analysis showed that Block 3 had the highest number of wild animals remains, including gazelle, Barbary sheep, hippo, and antelope, with over 60% of the wild desert animal bones coming from Block 3 (ibid.:20). Remains from wild aquatic animals were also associated with Block 3, and included crocodile, and many turtles (Anderson 2006:208-209). In a study that compared faunal remains from 12 different Predynastic sites Linseele et al. (2009) showed that while hunting was iconographically important, hunted animal remains were actually quite rare in

Predynastic settlements, and could not have constituted a major part of subsistence strategies. Additionally, higher proportions of very large catfish and Nile perch suggest that the best catches were slaughtered or consumed in conjunction with the Block 3 ritual activity area (Anderson 2011:22).

A higher, moderately statistically significant proportion of cattle remains (35% of the domestic mammal assemblage) were found in Block 3. There was also a higher proportion of young cattle remains, and a much higher statistically significant proportion of forelimbs of cattle and other domestic mammals. Young cattle and cattle forelimbs probably constituted preferred beef types for Predynastic Egypt, due to the tenderness of meat form young animals and since the forelimbs of cattle were depicted as a quintessential part of offering ceremonies during the Pharaonic period (Ikram 1995).

Complementing the evidence for the slaughter of wild animals and choice domesticates are the artifacts associated with hunting and/or warfare that were found in Block 3. These include fragments from a ground-stone mace head, bifacial knife fragments, concave-base bifacial projectile points, and an ivory projectile point. Anderson argued that the mace head was more likely a ceremonial or symbolic item than a strictly utilitarian one, since the hole in it would have only supported a very small shaft that would have broken upon any impact. Smiting enemies with a mace is of course one of the most classic and enduring elements of Pharaonic royal imagery dating from before Narmer though the entirety of Pharaonic history.

Other artifacts might be associated with weaving, such as bone awls, copper and bone needles, and spindle whorls. Sixteen of the 28 spindle whorls from el-Mahâsna came from Block 3, and five of the rest came from Block 2 (Anderson 2006:233), which Anderson thinks is an outdoor activity area associated with Block 3. Anderson suggested that the concentration of weaving implements in Block 3 may be evidence of specialized production, although he acknowledges there is no way to determine what sorts of items were produced, which could be anything from fishing nets (which would complement the faunal remains), to fine textiles which might be considered luxury goods. Other notable artifacts found in Block 3 are sealing fragments, which were only found in Block 3 (n=3), and do not have any seal impressions on them.

Anderson argued that the architectural, ceramic, and faunal evidence indicate that the structure should be considered an elite ritual activity area. The findings certainly also fit the definition of ritual activity used here, as repeated, set actions that are transformative and that derive from the worldview of a specific group of people (Ch. 1.6). That the activities which took place in el-Mahâsna Block 3 were to some degree repeated or set can be shown through Block 3's similarity to a Predynastic ceremonial enclosure at Hierakonpolis HK29A. That structure was unusually large compared to other Hierakonpolis domestic structures, the ceramic assemblage included unique forms known only from that site and a nearby cemetery, and the faunal assemblage also includes an unusually high concentration of wild animals, choice domesticates, and large fish. The Hierakonpolis enclosure is discussed in more detail below (Ch. 3.5). The similarities between the two loci indicate that comparable activities were repeated in separate areas of the country. Moreover there is evidence for the same seasonal periodicity in the activities. Four of the seven faunal bones of dorcas gazelle found in el-Mahâsna Block 3 were from very young animals. Consideration of the mating and birth periods indicates that the animals were probably slaughtered in May-June, which is just before the annual Nile flood would have begun (Anderson 2011:20-21). A number of species found at HK29A such as Nile Perch, Nile Oyster, and gazelles would have been easier to obtain when the flood was very low, as would have been the case in June, just before the flood waters arrived (Linseele et al. 2009:134). There are also some differences between the two assemblages, such as the presence of figurines at el-Mahâsna but not Hierakonpolis, and unique ceramic vessel forms found only at Hierakonpolis. The similarities and differences highlight the tension between rituals as ‘set’ or precedented action and the ability of those involved to modify them.

The activities which took place in Block 3 reflect some dominant themes in the Predynastic worldview. In Pharaonic Egypt cattle were shown ubiquitously in scenes of temple offerings, where the left front foreleg was the ‘choice cut’ offered to the gods (Ikram 1995:129). By comparing the distributions of skeletal elements from a Middle Kingdom mortuary temple and associated town at Abydos to those from el-Mahâsna, Rossel (2007) argued that cattle were a preferred high status-food often found in ritual contexts and that cattle were valued and used similarly during both the Predynastic and Middle Kingdom periods. Furthermore a number of authors have argued based on many lines of evidence, that women and cattle (and birds) were particularly salient features of the Predynastic iconographic record, and were often associated with fertility, renewal, strength, and eventually divinities and royalty (Hassan 1988, 1992a, 2004; Hendrickx 2002; Wengrow 2001). The finds of female figurines and cattle figurines support the connection of these features of Predynastic Egyptian worldview to the activities in Block 3. Moreover, markings (tattoos?) on one female figurine consist of shallow incised dots which may represent grain seeds, zigzag wavy lines similar to the later hieroglyphic symbol for water, and an incised and colored pubic triangle (Figure 3.5). Anderson (2011:18) argued that the three together show a focus on female and agricultural fertility. Another significant theme known from the Predynastic iconographic record is that of warfare/hunting (Hendrickx 2011a, 2012). Many artifacts found in Block 3 (mace head, projectile points, bifacial knife fragments) can be associated with warfare/hunting and show the enactment of activities related to this important aspect of the Predynastic worldview in Block 3.

Hendrickx et al. (2009) explicitly related the hunting and slaughter activities associated with HK29A, along with Predynastic evidence for female figurines, to Old Kingdom ‘Acacia house’ ritual activities, which are known from textual references. Known from the beginning of the Old Kingdom onward, the ‘Acacia house’ was a structure associated with a temple. Textual references indicate that butchers were associated with the ‘Acacia house’, as were dancers who performed at funerary ceremonies and occasionally at royal jubilees. Therefore the activities associated with the ‘Acacia house’, and by extension the ritual activities indicated at HK29A and el-Mahâsna Block 3, can be understood as mediating liminal boundaries between life and death.

Alawniyeh / Beit Allam cemetery

Garstang (1903:5, Pl 1) excavated a cemetery near the modern villages of Alawniyeh and Beit Allam during his 1900-1901 season (Figure 3.1). Originally containing an estimated 200-300 graves, the cemetery was already plundered when Garstang reached it, and he only excavated 45 graves, 23 of which were recorded in relative detail. Garstang related the cemetery to the settlement site of el-Mahâsna based on the similarity of pottery types (ibid.:5-6). However the cemetery is ~3 km SE of the el-Mahâsna settlement, and Ayrton and Loat (1911) later excavated a cemetery much closer to el-Mahâsna (see below). Clay models of stone tools and bird-headed humans were striking finds from this cemetery. Little remained of the cemetery when Patch (1991:134,396-397) surveyed it in the early 1980s, designating the site S83-29.[10] She dated the site to the Ib- IIb period based on Garstang's published material.

el-Mahâsna cemetery H

Ayrton and Loat (1911) excavated another cemetery even closer to el-Mahâsna, called Cemetery H, in 1909. The cemetery was also surveyed by Patch (1991:409) during her regional survey, and designated S83-42. The cemetery is located about 1km southwest of the el-Mahâsna settlement site (Anderson 2007:33; Patch 1991:134, Map 4). Extensively looted, Ayrton and Loat (1911:2) estimated that it originally contained approximately 600 graves, and they excavated around 300 of them, although details were only given for 135 tombs (Thomas 2004:1042). Because this cemetery was one of the better recorded for its time, its contents have featured in a number of studies of chronology and/or social inequality (Hendrickx 1996a; Kaiser 1957; Kemp 1982; Wilkinson 1996). Wilkinson's (1996) study of cemetery H showed initial increases in wealth disparity followed by declining differences before the cemetery was moved to a new location in the First Dynasty.[11]

Abydos

The main Predynastic and Early Dynastic sites in the Abydos area include the famous

[10] Note that Hendrickx and van den Brink (2002) list the cemetery twice, once as Mahâsna/Alwaniyeh and referring to page numbers for Patch's Mahâsna settlement site which had later Early Dynastic tombs built over it, and once as Beit Allam with page numbers for Patch's S83-29. This confusion probably stems from Garstang alternately referring to the site as "near Alawniyeh" or "near Beit Allam", and Patch designating the site Beit Allam, while including the Predynastic Mahâsna settlement in an overall entry for the NIII and later cemetery.
[11] See Thomas (2004) for problems with the cemetery data.

Umm el-Qa'ab cemetery near the high desert cliffs (Dreyer et al. 1996, 1998, 2000, 2003), the funerary enclosures of the First and Second Dynasties (Adams and O'Connor 2003; Bestock 2008, 2009; O'Connor 2009:158-181), the Early Dynastic town site in Kom es-Sultan (Petrie 1902,1903) and a number of small settlement sites (Figure 3.8). For the present study, lithic artifacts were analyzed from a Predynastic settlement site found underneath the much later pyramid complex of Ahmose, which will be described in detail. Following that brief descriptions of the other sites in the Abydos area provide context and are important for the discussion of settlement patterns later in this chapter.

The Abydos ATP settlement site is located in the low desert, near the cultivation, on the southern side of the high desert embayment which delineates the Abydos area (26°10'32.2206"N, 31°56'18.4128"E) (Figure 3.8). The settlement is underneath the Ahmose pyramid complex (Figure 3.9). The site was first noticed and partially excavated by Randall-MacIver and Mace (1902:76) in the course of the New Kingdom excavations. They documented 1-3 feet of thickness for the Predynastic layer. Patch (1991:376-377) also recorded the surface material in her survey of the Abydos region. Denoting the site S83-3, she estimated the size of the site at 7800m2 /.78 ha, and based on surface collection of the ceramic material, dated it to the Naqada Ic-IIc. This site is important because it is the earliest known Predynastic settlement in the Abydos area.

Harvey's Abydos excavations

In 1993, Stephen Harvey (1998:146-147) excavated some Predynastic remains in the course of his dissertation research on the New Kingdom Ahmose pyramid complex, and continued excavations from 2002-2006. He surmised that the new kingdom remains were built directly on top of the Predynastic settlement, in some cases with little or no preparation. However the site was not completely disturbed by the New Kingdom activities since Harvey's team found many intact ceramic vessels from different parts of the site, and even more fragile remains such as basketry. Hearths and other features were also found in situ emphasizing that much of the settlement was preserved. Harvey (pers. comm.) also noted many examples of White Cross-lined Ware pottery, which date to the NI-NIIAB, and no pottery clearly indicative of a later NII date. Rita Hartmann (pers. comm.) briefly looked at some of the intact vessels in 2013, and dated them to the NIB to NIC/IIA (Hartmann chronology, see Ch.3.2). These estimates are slightly earlier than Patch's dates for the site, but generally the estimates correspond.

The Predynastic materials were rich in the eastern portion of the Ahmose pyramid temple, particularly near Temple A (Harvey, pers. comm.). The lithic materials analyzed for this study come from that area, and were excavated during Harvey's 1993 season. The excavation methods used was similar to the Op-Locus-Lot system described above for el-Mahâsna (ibid.). However the excavation units (Ops) were each 10m x10m in size, and Lot numbers were only unique to each unit. The tracking numbers given to each tag for artifacts and samples were designated ATP numbers (Ahmose-Tetisheri Project). All of the material was dry sieved through 4mm screens.

A sample of lithic materials were analyzed from two different Ops (Ops 8 and 19, Figure 3.10). The material analyzed here was only a small portion of the total from each Op. Materials from lower lots were chosen to limit any potential mixing with the New Kingdom layers. Bifacial sickles from Op 11 are also mentioned in the analysis. Details given below derive from the field notebooks and communications with Stephen Harvey.

Op 8 was mainly located in an area between the New Kingdom constructions. Some of the Predynastic remains were found directly after removal of the surface layer. The Predynastic stratum consisted of loose yellow sand with a high percentage of charcoal pieces and lithic artifacts. The find of an intact Black-topped jar with many repair holes (Figure 3.15b) indicated that this was a Predynastic layer. In the SW corner of the unit a number of features were found together, including the above mentioned in situ intact jar, a hearth (Locus 4), a possible floor surface, and a mud(?) bin filled with chaff (Locus 6). The three features were all on the same level as the mouth of the intact jar, and in the Predynastic sandy matrix (Figure 3.11). The exact date of the three features is not clear since they were found directly below the surface material, and could have been added later, but the excavator interpreted them as a Predynastic activity area. After removal of these materials, and ~40 cm below the rim of the first Predynastic jar, a stack of two Predynastic jars covered by a large jar fragment was found (ATP 4609), with two zoomorphic figurine fragments (ATP 2515 and 2516, Figure 3.13) and another chaff deposit nearby. Two more vessels were found, one to the north (ATP 3077), and one to the east (ATP 3076) (Figure 3.12). Excavation stopped after this material was removed, but the Predynastic deposits likely continue. At least 50 cm of Predynastic material were removed in total.

The Predynastic remains in Op 19 were found sealed underneath a New Kingdom floor. The matrix of the stratum is exactly like that of Op 8: loose tan sand with a high percentage of charcoal fragments. Fewer features were identified here than in Op 8, but the Predynastic levels were not excavated as deeply. A complete but crushed pot was found in the center of the unit, and a small hearth was located in the SE corner (not excavated) (Figure 3.14). The total thickness of the excavated Predynastic material ranged from about 30cm in the NE to 10cm in the SW. Two zoomorphic figurine were found in the upper layers of this Op (Figure 3.13).

A few other Predynastic finds from the site should also be mentioned. Quite a bit of Predynastic material was found in Op 11. A cache of at least 8 complete vessels placed inside baskets was found just underneath a New Kingdom wall in Op 11 (Figure 3.17a-c), along with a zoomorphic figurine (Figure 3.13). In the same Op three bifacial sickles (Figure 7.8) were found together in a Predynastic strata which was under a New Kingdom floor surface. Unfortunately time did not permit analysis of lithic materials from Op 11. Five additional figurine fragments were found in Ops 4, 11, 27, and 24, including one that may be torso of female. A ceramic vessel fragment with an incised drawing of a bovid came from Op 18. A concave base projectile point was found in the surface layer of Op 1 (Figure 7.7), and a broken rhomboidal slate palette was excavated in Op 13.

The exact nature of the contexts in Ops 8 and 19 are somewhat difficult to determine at this point. Quite a few pieces of pottery with repair holes (Figure 3.15a,b) were noted by Harvey (1998:164), including some from Op 8. Repaired pottery was also mentioned by Randall-MacIver and Mace (1902:76) although they excavated a different part of the site. Pottery without wear, along with special types of pottery, were observed at the HK29A ritual structure (Friedman 2009b:85-88); therefore the presence of the repaired pottery in Op 8 accords better with an interpretation of the area as something other than a ritual activity locus. However it should be noted that at el-Mahâsna vessel fragments with drilled holes were found in Blocks 1-4, including habitation contexts and the ritual activity area, with no statistically meaningful difference in their frequencies, which were quite low (0.1-.26% of the ceramic material) (Anderson, pers. comm.). A number of the vessels found in Op 8 were relatively large open-mouth jars (e.g., Figure 3.16a,b), which could be related to storage and/or cooking. The chaff features in Op 8 may indicate animal feeding or food processing in the later phase of Op 8. The presence of the cattle figurines in Ops 8 and 19 does not necessarily help to interpret the context, since clay figurine fragments were found in domestic contexts at el-Mahâsna,[12] and in the ritual activity area (in a much higher frequency) (Anderson 2006: 216-230). However the presence of at least 5 bull figurines, some with possible cut-marks or blood lines on their necks all within a 30m x 30m area, is somewhat rare, even if those in Op 19 were not in situ. Two figurine fragments were found some distance away, in Op 4. A study of the Abydos ATP faunal remains will certainly help to clarify these contexts. For now they are interpreted as general settlement contexts with activities relating to food processing and storage, habitation, and some ritual activities.

Other Predynastic and Early Dynastic settlement sites in the Abydos area

Two Predynastic settlement sites were found by Peet and Loat (Peet 1914; Peet and Loat 1913), both with facilities interpreted as beer brewing kilns. One of these sites was near the later Seti temple and the other was on the north site of the Abydos embayment near cemetery D (Figure 3.8). The one near the Seti temple was described as roughly circular and ~900m^2/.09 ha in size. Patch (1991:437) designated the site S83-61, and dated it to the IId-IIIa1 period, though it is not clear whether this was based on Peet's publication or her surface surveys, which revealed that the site is now extensively disturbed. In the center of the site 'powdered mud' infused the sand and was thought to derive from wattle and daub constructions, though no architecture nor post holes were found (Peet 1914:2). Over 300 flaked stone microdrills and drills were also found in the center of the site, and along with pieces of agate and carnelian. Together these may indicate bead production. Other evidence for production activities included

[12] These included a cattle figurine fragment and two unidentifiable figurine fragments from Block 4, and

grinding stones, and spindle whorls. Clay models of bread loaves(?) and a clay sealing fragment (ibid.:5), are possibly evidence of administration or tracking of the production activities. On the outskirts of the site were two large hearths containing bone (40cm deep x 5-6m wide). Cattle, sheep/goat, and fish bones were common, and donkey, dog, cat and gazelle were each represented by one or a few bones (ibid.:6-7). Also on the edge of the settlement was a feature originally thought to be a grain parching kiln, but later convincingly interpreted as a beer brewing facility (Geller 1992a,b; Ch. 1.4). This structure incorporated at least 23 vats and certainly indicates beer production on a large scale.

Even more extensive brewing facilities were found in the area of cemetery D (Peet and Loat 1913:1-7). Here 8 different sets of vats were found below the remains of later Pharaonic tombs and mastabas. The best preserved set contained at least 35 vats. Peet and Loat (ibid.:6-7) dated the cemetery D kilns to the Predynastic period generally. By the Old Kingdom period beer consumption had increased to the point that it was a staple food, as is indicated by its prevalence in offering scenes and the equal prevalence of 'beer jars' in settlement sites. Therefore, the cemetery D facilities may be contemporary with or slightly later than the Seti temple ones, since they are much more extensive and the increase in size may relate to increasing beer consumption. It is not known whether other settlement remains or evidence of other activities existed adjacent to the brewing structures, but it seems likely since brewing facilities have never been found isolated from a settlement (Table 1.2).

Nearby in an area known as Kom es-Sultan Petrie (1902, 1903) excavated a town site which dates from the NIII/Dynasty 0- the Second Dynasty (Adams 1999:108; Petrie 1902:10). This early settlement was underneath successive layers of later habitation remains which formed

one unidentifiable fragment from Block 1 (Anderson 2006:230).

a tell[13] (mound). In the early town Petrie excavated a 'temple zone' of enigmatic mud brick structures under or near the later Osiris temples. Outside of the temple area Petrie also found a living site consisting of small mud brick houses. Hearths and abundant ceramic and lithic artifacts were associated with these houses, which were extensively affected by the water table and years of flooding. Petrie excavated a small portion of the and noted that it continued underneath the later town remains. Petrie observed changes in town development over the period. First the excavated are contained habitation remains, then it became a cemetery for a time, then it was again an area for housing.

Patch (1991:426) identified another possible Predynastic-Early Dynastic settlement site called S83-54 near the modern town of Salmani. It was located on the northernmost end of the Abydos embayment, north of the breweries excavated by Peet (1914) in cemetery D (Figure 3.8). The site is underneath an abandoned Islamic period town. Patch was only able to note the presence of Predynastic ceramics. Since a Predynastic cemetery was located nearby (el-Sayed 1979), Patch thought that this site might be the related settlement.

Egyptian excavations south of the Seti temple have revealed a settlement and Early Dynastic cemetery (el-Aref 2016; Habachi 1939; Hossein 2011; Patch 1991:414, 448). Additionally Patch (1991:423, S83-52) located a possible raw material collection and tool processing location on the edge of the high desert with extensive lithic debitage and a some non-diagnostic Predynastic(?) sherds. However the lithic reduction activities and in this area near and on the high desert cliffs have a very long time span dating back to the Middle Paleolithic (Olszewski et al. 2005, 2010), so the relationship between the lithic reduction activities and Predynastic ceramics remain to be understood.

[13] The tell had been eaten away by *sebakh* digging, leaving the earlier layers accessible in many areas.

The Abydos funerary enclosures

At the edge of the low desert just behind the Kom es-Sultan settlement are a series of Early Dynastic mud brick funerary enclosures (Adams and O'Connor 2003; Bestock 2008, 2009; O'Connor 2009:158-181). These structures are the temple component of the royal tombs which were located further back in the desert. Each consists of a large, high wall enclosing an open space and a smaller temple building. Some also had a smaller perimeter wall. The pyramid complex around the Third Dynasty step pyramid of Djoser incorporates many of these features, but with an added pyramid, showing that the Abydos enclosures were the direct precursors to later royal funerary monuments. Enclosures have been identified for most of the First Dynasty kings, and the last two kings of the Second Dynasty. Only the last enclosure, that belonging to Khasekhemwy remains standing. The rest were intentionally destroyed (sent into the afterlife?) probably in association with funerary ceremonies. The structures were very large. Khasekhemwy's funerary enclosure was the largest: 10,395m^2 in area with walls 11m high and 5m thick (O'Connor 1999:102). These structures are the earliest examples of monumental architecture in Egypt. The First Dynasty enclosures were surrounded by human sacrificial subsidiary burials ('cemetery S'/ S83-59: Patch 1991:434-435; Peet 1914:30-34; Petrie 1925). Funeral processions probably linked the town, enclosures and the royal cemetery.

Abydos cemeteries

There are many cemeteries and tombs in the Abydos area, the most important of which is Umm el-Qa'ab. Due to its time span, excavation history, and spectacular finds, the cemetery has factored into many studies of chronology, social inequality, the development of the state, and the development of writing. Umm el-Qa’ab is located about 1.5km into the low desert from the edge of the cultivation, at the mouth of a wadi leading out of the high desert (Figure 3.8). The cemetery actually consists of three parts: cemetery U with the earliest graves, cemetery B with graves of Dynasty 0 rulers, and the royal cemetery with tombs of all the First Dynasty rulers and the last two of the Second Dynasty. The cemeteries were excavated a number of times around the beginning of the 20th century (Amelineau 1899; Naville 1914; Peet 1914; Petrie 1900, 1901, 1902), and most recently by the German Institute since the 1970s (e.g., Dreyer 1992, 2008, 2009, 2010; Dreyer et al. 1996, 1998, 2000, 2003, 2006, 2011). The cemetery is large, with over 600 tombs in cemetery U, another 5 large tombs with 34 subsidiary graves in cemetery B, and nine royal tombs accompanied by over 800 subsidiary burials. Umm el-Qa’ab shows a long duration with basically continuous development from the beginning of the NI into the First and Second Dynasties (Hartmann 2011a). In the very earliest period (NIA-C[14]) graves clustered around a few of the oldest burials which were each located some distance apart from each other. During the NIC-IIA just a few of these groups remained in use, and eventually all burials clustered around one of them (ibid.:931-932). By the late NIIC period cemetery U was reserved for large elite burials (ibid.:934; Dreyer 1999:121).

One of the most important discoveries was the partially intact tomb U-J, which bore evidence for foreign trade and the early development of writing (Dreyer 1992, 2011). Small bone or ivory labels were found in the tomb, each with a few very early hieroglyphs, likely recording the amounts and sources of the goods in the tomb. One chamber of the tomb was filled with jars made in the style of Levantine pottery. Items from other parts of Umm el-Qa’ab are particularly

[14] Here Hartmann’s phases were converted to Hendrickx’s Naqada chronology to facilitate comparison with other dates given throughout this study.

significant for this dissertation, including spectacular flaked-stone swords, ripple-flaked knives, and fishtail knives (Dreyer 1999, 2010; Hikade 1997). The Umm el-Qa'ab cemetery remained important to Egyptians during the Pharaonic periods, eventually being considered the burial place of Osiris. Its status as a pilgrimage site is attested to by numerous inscriptions and the mounds of Pharaonic offering pottery which give the site its name in Arabic: Mother of Pots.

A number of other cemeteries have been found in the Abydos area (Figure 3.8). They cover all the periods from NIA-NIII. Most are only known from turn of the century publications, and accordingly less detailed information is known about these cemeteries. Lithic artifacts from some of these cemeteries are mentioned in this study, including one concave base projectile point which was found by the Abydos Middle Cemetery project (AMC, University of Michigan, directed by Janet Richards). This area corresponds to cemeteries E/G which extend under the Old Kingdom remains currently being excavated by the AMC project.

Nag el-Qarmila

Nag el-Qarmila (24° 14' 9.5856"N, 32° 51' 40.2258"E) is located on the west bank of the Nile, ~17km north of the modern town of Aswan (Figure 3.18). It is situated in the mouth of a small wadi that branches off of the north side of the larger Wadi Kubbaniya. The Predynastic remains are in the low desert adjacent to the cultivation (Figure 3.19) (Gatto et al. 2009c). The overall site has three components: the habitation area (WK15), a storage area on a nearby terrace (WK22), and the cemetery (WK14) (Figure 3.20). A road cuts through the site to the east, and its construction likely impacted the remains. Additionally Predynastic pottery has been found in surface survey of the nearby cultivated land, so the cultural materials probably extended farther east toward the Nile. The sites date to the NIC-IIB (Dee et al. 2013 chronology) and the cemetery was re-used during the NIICD (Gatto 2014:100, pers. comm.). Radiocarbon dates corroborate these relative dates (Gatto et al. 2009a).

Nag el-Qarmila is an important site for many reasons. It is the only settlement site dating to the NIC-IIA ever studied south of Hierakonpolis (Gatto 2011:866). The settlement and cemetery are also undeniably related to each other. Additionally, Nag el-Qarmila is a rare example of a small farming village. Such villages are often assumed to have existed, but are less rarely located and studied. This site also gives insight into cultural interaction on a border region. Nubian ceramics make up just under 10% of the pottery from the settlement showing local Nubian influence in a Naqada culture settlement (Gatto 2014). Nubian character is also detectable in the use of quartz/chalcedony, and small pebbles for flaked stone tools, and in features of the later burials at the cemetery. The spread of Naqada culture into this region and the diachronic interaction between Nubian and Naqada culture took place in conjunction with the emergence of social stratification and centralization and resulted in complex 'cultural entanglement' for this area that was materialized in a number of ways (Gatto 2014). Nubian identity was materialized most explicitly in tombs assemblages, while hybridization of domestic objects, combining Naqadian and Nubian elements, occasionally occurred among the settlements artifacts. Additionally aspects of material culture which are purely local and unique to this area, different form either Naqadian or Nubian examples, have also been identified.

Nag el-Qarmila was found during a 2005-2006 survey of the area by the Aswan-Kom Ombo Archaeological Project (AKAP), directed by Maria Carmela Gatto (Gatto and Giuliani 200). Rescue excavations began in 2007 because the site was in danger of destruction due to the expansion of modern villages and farmland, and continued through 2012. The site has now been substantially built over. The Nag el-Qarmila localities were excavated in 'areas', which could range from 5m x 5m to any size deemed appropriate for the terrain. Each 'area' was divided into 1x1m 'squares' and given an alphanumeric code (e.g., C1, C2, etc) in order to provide relatively tight horizontal control of proveniences. Feature and level numbers were assigned consecutively within each area, but the materials from each square were bagged separately. The levels consisted of natural or cultural strata which were excavated in arbitrary 10cm levels *within* the natural/cultural layers, although most strata in the settlement were not thick enough to merit the arbitrary vertical divisions. Each bag of collected material within a square was assigned an unique tracking number (AKAP#) according to material (e.g., AKAP 1042 lithics, AKAP 1043 ceramics, etc). All of the excavated material was screened through 4mm or smaller mesh. Analysis of the ceramics, lithics, osteological remains, and other artifacts is ongoing.

Nag el-Qarmila settlement WK15 (Wadi Kubbaniya 15)

The settlement WK15 is located on the north side of the wadi, and is ~5000m^2/.5ha size (Gatto et al. 2009a:193). Four 'areas' have been excavated within WK15 to date (Figure 3.20). These excavations reveled many intact features including hearths, post holes, in situ pottery, plastered pits, a child burial, and more. The features indicate that there was little post-depositional disturbance of the site. However some parts of the settlement were impacted by (ancient?) silt extraction, and construction of modern facilitations including the road, houses, boundary walls, and gardens.

Lithic artifacts were analyzed from Area A (here) and Area B (Gatto et al. 2009a; Usai 2012). Area B (Gatto et al. 2009a) is in a the central portion of the settlement. Three levels of activity were identified in this area. The uppermost consisted only of two hearths. In the middle layer a living surface of compact sand and ash was in the NW corner of the Area. Resting on top was a shell bracelet fragment and portion of a ceramic model boat covered in ocher (Figure 3.21). Two meters to the SE an intact vessel with repair holes was set into the ground (Figure 3.22). The earliest layer in Area B (Figure 3.23) contained a stratified sequence of four hearths, with a fragment of a pot in situ next to them. Just to the east were two mud-lined pits, which may have been large post holes or storage pits. Adjacent to these features, and to the south was a floor surface of compact silty soil, and at least four post holes. It was not possible to define a precise architectural pattern outlining the structure. The remains indicate the presence of a structure with an associated cooking and storage area. Additional artifacts from area B are another boat model fragment, a copper ring or earring, upper and lower grinding stones, ceramic fragments, lithic tools and debitage, and faunal remains. Boats in Predynastic iconography are related to the solar cycle (D. Darnell 2007, 2009; Huyge 2002; Lippiello 2012), and these figurines can be considered indications of ritual activities. However on the whole Area B can be interpreted as a habitation area with evidence for food preparation and storage, and possibly some domestic ritual activities.

Area A is situated in what was probably on the outer edge of the settlement, to the south (Figure 3.20). The surface may have been affected by erosion or deflation. There were two main levels of activity evident in area A. The features in uppermost level (Figure 3.24), consisted of multiple hearths, a large in situ stone mortar (Figure 3.25), and a small pit filled with stones. Notable associated artifacts included an upper grinder, a hammerstone (pestle?), a spindle whorl, a fragment of a sherd with a repair hole, and a sherd with post-firing incisions. The lower layer (Figure 3.26) of actives consisted of a few artifact concentrations and a child burial (Figure 3.27) on the south side of the unit. The burial was underneath a burnt surface (feature 2) but not directly associated with it because the two features were separated by sand layers. A raptor talon was found nearby, and a transverse arrowhead was found in the hard concreted soil that around the body, but it is not clear whether the projectile was a grave good or incidental. This child was about 1 year old +/- 4 months, and has the earliest identified case of scurvy in Egypt (Pitre et al. 2016). The practice of burying infants in settlements is known from other Predynastic habitation sites (e.g., Adaïma, Midant-Reynes and Buchez 2002; Badari sites, Brunton and Caton-Thompson 1928; Maadi, Caneva et al 1989:288; Naqada, Petrie and Quibell 1896:2).

The frequency of lithic cores was much higher in area A (see Ch. 4.3), as was the frequency of *piece esquilles* which are either cores or wedging tools (Bradbury 2010; LeBlanc 1992; Shott 1999). Either way, the lithic remains, along with the hearths, grinding stones, spindle whorl, and the lack of any clear structural features or midden deposits indicate that this area which was likely used for production activities, at least in the later phase.

Nag el-Qarmila WK22 (Wadi Kubbaniya 22)

WK22 is located on the rocky natural sandstone terrace south of WK15 (Figure 3.20). It was at first thought to be a cemetery (Gatto et al. 2009), but excavations in 2012 revealed that the area is better interpreted as a storage area, later re-used for a few burials, including children. The ceramics found at the site date it to NIC-IIAB, contemporary with the settlement and the early phase of the cemetery. Covering at least $225m^2$, the main features identified at WK22 were a number of pits that varied in size and depth (Figure 3.28). Some were quite small and shallow. Some pits cut through earlier ones, showing that the area was used over time. Only three of the 14 pit features contained human remains. Some of the bones were from young individuals, and the bodies were highly disturbed and only found in the upper layers of the pits. No bones were found at the bottom of the pits as is usual for small bones disturbed primary burials. Two of the pits were filled with very clean loose sand, almost entirely devoid of artifacts. This sand is likely intentional fill and not wind accumulation. Charred grains of emmer wheat, barley, and weed seeds (Gatto 2014:100) were found near the bottom of one of the deepest pits in this clean sand layer. Very few ceramics or lithics were found at all compared to the settlement WK15, and cemetery WK14. The finds of grains, grinding stones, the general paucity of artifacts, and the variability in size and depth of the pits led to an interpretation of WK15 as a storage area. All of the lithic artifacts from WK22 (numbering only 50 in total) were studied as part of this dissertation. The analysis (Ch. 4.3) showed that there was a very high percentage of tools, and a low frequency of cores and debitage.

Nag el-Qarmila cemetery WK14 (Wadi Kubbaniya 14)

The cemetery WK14 is located just north of the WK15 settlement area, in the slopes of a sandy river terrace (Figure 3.20). As of 2012, excavations indicate that the cemetery covered at least 3250m^2 / .33ha. At least 30 burial pits have been excavated, 22 more were identified, and the cemetery must have contained more. Erosion and ancient plundering have affected the burials. Two phases of use were detectable in the cemetery. The first phase corresponds in date to the settlement at WK15, and consists of small pit burials. This first phase is present in the northwestern part of the cemetery, on the sandy river terrace slopes (Area A and Trench 9). The second phase dates slightly later (NIICD-NIIIA1), and in this phase there is a much higher frequency of Nubian ceramics, along with Nubian tomb characteristics such as slab coverings and lateral niches. These later tombs extend from the northeast to the southwest of the cemetery, and almost encroach on the early settlement, which was most likely abandoned by that time. The earlier phase of the cemetery must be associated directly with the inhabitants of the settlement because of the very close proximity and the contemporaneous time periods (Gatto et al. 2009a:195-201). Ceramics and other artifacts such as palettes and items of personal adornment were found in the cemetery, some in situ, again emphasizing the difference between the cemetery and WK22. A few lithic artifacts were recovered from general stratigraphic layers in the cemetery and occasionally from the fill of the tombs. Unfortunately time did not permit analysis of these materials. No striking lithic artifacts, such as the bifacial knives, were noted during excavation of the cemetery.

Other Predynastic sites in the Aswan area

A few more sites should be mentioned to put Nag el-Qarmila in its regional context. The site of Elephantine was located on an island in the first cataract of the Nile, about 17km south of Nag el-Qarmila (Figure 3.18). This cataract formed a natural border that was also a political border during Pharaonic Egypt. The position of Elephantine in the middle of the Nile made it a strategic site for observing and controlling river traffic. As such, during the Pharaonic period Elephantine was an important border town, involved in trade and administration, with a fortress built there by the middle of the First Dynasty that lasted at least through the Old Kingdom (Kaiser 1999). Elephantine was also an important religious site. A regional temple of unusual design focused on a cleft in the rocks on Elephantine, and probably related to the arrival of the Nile flood. Subsequent temples dedicated to Satet and eventually to Khnum were built over this same spot, into the Greco-Roman Period.

The island was inhabited during the Predynastic period beginning by the IId/IIIa (Kopp 2006:90), which is slightly later than the Nag el-Qarmila settlement site. A limestone baboon figurine and the earliest examples of faience figurines were found at the rock niche that was the focus of later temples, indicating that this area was already a site of ritual activities by the NIIIA2/b (early Dynasty 0). Production remains were located in the area in front of rock cleft (~10m away), with indications of ceramic and possibly copper production (ibid.: 90, Figure 10). Contemporary burials are also known on the island. Few lithic artifacts were recovered from the settlement area (N=193), and these cover four stratigraphic periods from NIIIA2-NIIIC1 (Kopp 2006:16, 80). Due to the paucity of material plus the relatively late date of the site, it is not included in the overall comparison of lithic assemblages from settlement sites.

Nag el-Hamdulab is a rock art site located on the west bank of the Nile, 6km North of Elephantine and 11km south of Nag el-Qarmila (Figure 3.18). The rock art at this site dates to late Dynasty 0 and shows how politically important the area was by that time (Hendrickx et al. 2012:1073). The rock art consists of a series of tableaux spread around the mouth of a wadi. The content and technical style indicate that they were all made at the same time and should be read together (ibid.:1073). These tableaux contain the earliest known images of a pharaoh, along with scenes of cattle hunting/herding, boats processions (at least one of which carries a shrine), animal sacrifice, female dancers alongside bulls, and beer production (ibid.: 1073-1080). Additionally, there is a short early hieroglyphic inscription referring to the 'Following of Horus' (Darnell 2015) which, in the Early Dynastic period, was the biennial procession of the King throughout the country to collect taxes and dole out judgment. The iconography includes many motifs known from Dynastic jubilee scenes (Williams and Logan 1987) , blended with equivalent ones known for the Predynastic (such as Hierakonpolis Tomb 100), and other late Predynastic iconographic elements. The composition is an early representation of tax collection and the economic power of the pharaoh, and it is by no coincidence located in this natural and cultural borderland. Finds of charcoal, lithic artifacts, and Predynastic sherds among the modern village remains directly in front of Nag el-Hamdulab indicate that a settlement was located there (Gatto 2014:111,112).

A number of other settlement, cemetery, and rock art locales are known in the Aswan region, as identified in survey by the Aswan Kom-Ombo archaeological project, along with a few known from earlier archaeological work (Gatto 2014:110-114) (Figure 3.18). Gatto notes that there is a trend toward nucleation over the course of the Predynastic period in this area.

3.5 Site Descriptions: Comparative Sites

Due to an increasing interest in settlement studies, primarily over the last few decades, there is now published data on lithic artifacts from a number of Predynastic settlement sites. Brief descriptions of the sites, their contexts, collection strategies, and any associated cemeteries provide the necessary information for comparing the sites to each other and to the analyzed material from el-Mahâsna, Abydos, and Nag el-Qarmila. The specific contexts will be referenced for comparing the contexts of finds to expectations for the ritual production model. The main sites drawn on for comparative analysis were: Naqada sites (South Town, North town, KH3, KH4, KH7), Abadiya 2, Armant (MA21/83 and MA21a/83), Adaïma, and Hierakonpolis (localities 11C, 14, 24A, 25, 25D, 29, 29A, 29B). All of the sites are in the Nile Valley, were excavated relatively recently with thorough collection strategies, and have published material on the lithic artifacts. The sites will be discussed below, in order from north to south. Figure 2.2 shows their locations.

Naqada Area Settlement Sites

The Naqada settlement sites are located 20km north of Luxor, on the west bank of the Nile (Figure 2.2). These sites are each located approximately 2km apart, and are known as the Naqada-Khattara sites. The sites were excavated by Hassan and Hays as part of the Predynastic of Egypt project (Hassan 1981a; Hays 1976; Holmes 1989). Deposits were up to 1m thick (Hays 1976:552). All of the excavated material was screened (Holmes 1989:33). North Town and KH4 were surface collections only, so little is known about the contexts and therefore they are not included in the main comparative analysis, but reference was occasionally made to pertinent examples of artifacts from these sites. The lithic artifacts from the Naqada sites were analyzed by Holmes (1989).

North town is a large site (4ha) excavated by Petrie and Quibell (1896:2) and surveyed by Hassan and Hays (Holmes 1989:197). It dates to the late Naqada period, likely NIIcd into the NIII (Holmes 1989:197; Hendrickx and van den Brink 2002:378). No indications of mud brick architecture were found at the site, but small trenches were probably from reed walls or fences. Hearths, grinding stones, spindle whorls, and storage pits were identified at the site (Petrie and Quibell 1896:2). Finds of fire-bars supporting a large ceramic vat indicate that beer production took place here (Geller 1992). Holmes' (1989:34) analyzed materials come from four 5m x 5m surface collection units.

South Town (Aka. Zawaydah) is a large settlement site (3ha) that dates mainly to the later Naqada period, NIIcd-NIII (Barocas et al. 1989:298-300; Hassan 1999:670; Hendrickx and van Den Brink 2002:378; Holmes 1989:195). Petrie and Quibell (1896:54,Pl85) found a very large mud brick wall or structure at the site, which unfortunately has not be re-located by subsequent excavations, but was probably in the northern part of the site. Remains of small trenches and post holes from wattle and daub constructions were identified. Administrative and ritual artifacts including seals, tokens, and over 100 human and animal figurine fragments were found in the southeastern part of the site (Barocas et al. 1989; Di Pietro 2011; Fattovich et al. 2007). The large mud-brick wall and the administrative artifacts, along with the site's association with an elite cemetery and a very large regular cemetery has led many scholars to consider it a politically important site, the paramount site in the Naqada region. Holmes analyzed lithic materials from 10 randomly selected 1m x 1m units from six larger test trenches spread across the site, and re-analyzed artifacts from Petrie's excavations which were housed in the Petrie Museum, University College London.

KH4 is the next settlement south of South Town, and it covers ~2ha. It dates to the early Naqada period, I-IIab (Hassan and Matson 1989). Two 10m x 10m units were surface collected and the top few cm screened, but the site was not excavated (Holmes 1989:33, 194) so little is known about the contexts of the finds.

KH3 is about 3ha in size and dates to the early Naqada period, I-IIab, with an absolute date around 3830+/-75 B.C.E[15] (Hassan and Matson 1989:309). Excavations revealed a number of 'household complexes' each consisting of a habitation area and an animal pen (Holmes 1989:192). Features found in the habitation portions consisted of hearths, complete ceramic vessels, and posts from structures. Part of one such complex excavated in Area B had a hearth (with dung (fuel), seeds, and bone), and two lithic processing concentrations, all spread over a $12m^2$ area. In Area X/XI hearths, grinding stones, a cache of complete pots, and a child burial

[15] Note that this does not take into account the different methods used by Dee et al. 2013, so the dating or relative chronology may be slightly different.

were found in the habitation portion, and dark sediments rich in dung characterized the animal pen area. The lithic artifacts analyzed by Holmes in Area B came from three 2m x 2m squares, G54, G56, and I54, which include both the habitation and animal pen areas (Holmes 1989:33, 193-194). The analyzed materials from Area X/XI came from forty 2m x 2m squares excavated down 10cm (ibid.:33).

Site KH7 is smaller than the other sites, only around .21ha, and it also dates to the early Naqada period I-IIab, but may be slightly older within that sequence than KH3 or KH4. Investigations included four 5m x5m surface collections and one 3m x 2m test unit that revealed a large pit filled with ashy charcoal rich material (Holmes 1989:33, 194). Holmes analyzed the lithic materials from the test pit and the surface collections. She noted that there was a lower density of lithic material at this site compared to the others (ibid.:195).

Naqada Area Cemeteries

Petrie and Quibell (1896) excavated three cemeteries near South Town: Cemeteries B, T, and the “great new race cemetery” which hereafter is referred to as the main cemetery. Cemetery T was a spatially separated cemetery reserved for a small number of elite burials, and included a later First Dynasty mastaba tomb known as the ‘royal’ tomb, which may have been the tomb of someone from the royal family. The tombs in this elite cemetery were large and some had mud-brick lining. The cemetery dates to NIIB-IIIB (Hendrickx and van den Brink 2002:360). In contrast, the main cemetery contained around 2000 graves, and is the largest known cemetery in Predynastic Egypt. Bard (1994) demonstrated that cemetery T, B, and the western and eastern portions of the main cemetery were differentiated based on types and quantities of grave goods. Cemetery T was the richest and most exclusive of all, but the main-west cluster was richer and more exclusive than the main-east cluster, and B was somewhat similar to main-west. The main cemetery covers a long time span, from NIA-IIIC1 (Hendrickx and van Den Brink 2002:360). Through a lifelong effort, Baumgartel (1970) reconstructed the grave assemblages based on Petrie's notes and visits to museum collections. Combined with the work of Payne (1987) who edited and updated this information, much is known about the grave assemblages from these Naqada cemeteries.

Abadiya 2

Abadiya 2 is a small site (at least .12ha) located a few kilometers south of KH7 in the Naqada region. Vermeersch et al. (2004) carried out rescue operations at the site before it was destroyed by the expansion of farmland. Two test units were excavated, each $12m^2$, one in the north part of the site and one in the south. The units were excavated in arbitrary 10cm levels, with the material was screened through 4mm mesh. The deposits were about 50cm thick consisting of loose yellow silty sand with charcoal, lithics, ceramics, and bone throughout, along with occasional patches of dung. Few features were identified and the deposits were interpreted as general settlement midden, affected by bioturbation. The site was dated to the NI-IIA/B. No cemetery is specifically associated with this site.

Armant Settlements

The settlement site of Armant is located on the west bank of the Nile, about 10 km south of modern Luxor, at the edge of the low desert. The site consists of two separate localities, MA21/83 and MA21a/83, on either side of a small wadi that may have held a seasonal pond. Ginter and Kozlowski (1994:41) considered the two localities part of one overall settlement site.

This is supported by the find of a long fence or palisade wall (Area 300) ~90m north of the two localities. It may have encircled the site or delineated a portion of it. Hendrickx and van den Brink (2002:379) give a combined size of .25ha for the Armant localities, but if the area with palisade wall is also factored in the site may have been over .5ha in area, based on Ginter and Kozlowski's maps. Both localities date to the early part of the Naqada period, with absolute dates ranging from 4100-3600 BCE[16] about NI-IIAB. MA21/83 and MA21a/83 were among a series of at least 15 Predynastic sites identified in an area of about 8km by Ginter et al. (1985).

MA21/83 was divided into northern and southern portions for their analyzes, and MA21a/83 was excavated in three separate trenches. Ginter and Kozlowski (1994:38-45) detailed the features and interpreted the activities which took place in each of the excavated areas. The northern sector of MA21/83 was a subsistence activity and storage area consisting of hearths and storage pits, with light structures that may have been dwellings or windbreaks. The southern sector of MA21/83 contained multiple habitation structures with stone foundations and associated features including storage pits, hearths, a basket, and other pit features. Bifacial tool production was also concentrated in this area (Ginter et al. 1996). MA21a/83 Trench I was a subsistence activity area with storage pits, storage containers, and hearths. Trench II was also a subsistence activity area with flat hearths and pit hearths, and two huts made from posts that may have been dwellings. Trench III was midden zone, including refuse pits.

[16] Not calibrated to the shorter Naqada period dates given by Dee et al. 2013.

Armant Cemetery

Mond and Meyers (1937) excavated the Armant cemetery, which is about 300 meters away from MA21/83, across a small wadi (Ginter et al. 1985: Fig 1). It should be noted that Ginter and colleagues also identified other Predynastic settlement localities nearby this cemetery, just 200 meters away, MA18/83 and MA19/83 (ibid.). The cemetery consists of three different parts: two large Dynasty 0 tombs, a few Predynastic tombs in area 1300, and the main cemetery in area 1400-1500, which contained 169 burials.

The location of the burials shifted over time, from south to north. This spatial difference allowed Kaiser (1957) to make his revisions of Petrie's chronology. The graves in the main cemetery 1400-1500 date from Ic to IIIa2 (Bard 1994:54), showing that the cemetery continued to be used after MA21/83 and MA21a/83 were abandoned.

Bard (1994) analyzed the graves in the Armant cemetery as part of a study of the development of inequality. She found that the quantity of grave goods and the size of grave pits increased over time (ibid.:61-68). She also found that burials could only be differentiated into two basic hierarchical groups, a richer one and a poorer one, based on grave size and quantity of pottery. Bard (1994:72) considered Armant a small farming village lacking more than a two-tiered internal hierarchy.

Adaïma Settlement

Adaïma is located on the west bank of the Nile, about 60 km upriver from Luxor and (~25 km north of Hierakonpolis). The whole spread of archaeological remains including settlement and cemeteries is over 35 ha in size. However the habitation areas occupy only a portion of the total archaeological zone. The settlement was occupied from NI-III, but the main time period was NI-NIIC, after which the settlement dwindled (Buchez 2011a).

The northern portion of the settlement is an area devoted to grain processing and storage. A series of perpendicular wall trenches for wattle and daub fencing surrounded 73 shallow wide pits that ranged in size from 13-145 cm, averaging 45cm wide, and only around 8cm deep (Midant-Reynes 1999:128). Seeds of wheat and barley were recovered from pit fillings.

The southern area contained the main habitation zone. Excavation of one portion of this habitation zone reveled structures made from wattle and daub as was evident from the arrangement of post holes in elongated oval shapes. The best preserved of the structural footprints measured 4.3m x1.2m (Midant-Reynes and Buchez 2002:37, 129). Associated features, generally outside the structures, included hearths, storage jars, pot emplacements, grinding stones, and trash pits. Four infant burials were found in this habitation area. Not only in this excavated area, but throughout the whole southern portion of the site distinct habitation or household areas with sets of structures or dwellings could be identified, with different ‘units’ located 100-400m apart, and each rebuilt in place over time (Buchez 2011a:33, 36). These were interpreted as family groupings. This interpretation is supported by evidence of grave grouping in the cemeteries (see below).

Lithic artifacts were analyzed from the southern habitation area, excavation block 1001 and extensions, which consisted of 39 5m x 5m excavation units, totaling 975m^2 (Midant-Reynes and Prost 2002). The deposit was up to 90 cm deep (Midant-Reynes and Buchez 2002:141-148). The materials were dry screened through 5mm mesh (ibid.:12).

Adaïma Cemetery

Two cemeteries were associated with the site of Adaïma, known as the West cemetery and the East cemetery (Crubézy et al. 2002; Debono 1971; Garstang 1907; de Morgan 1912; Needler 1984; Sauneron 1974). They are located only a few hundred meters away from the settlement. Badly plundered and excavated by archaeologists numerous times, the cemeteries may have originally contained around 1500 burials (Midant-Reynes 1999:128). The West cemetery was used from the NI through the Third Dynasty (Buchez 2011a:32). The East cemetery was used only for child burials from the NIIC on. The graves were organized into clusters that probably represent family groupings based on the distribution of Nubian pottery (ibid.). There was also some segregation of the cemeteries by class, with the wealthiest graves in a distinct area of the West cemetery. After the NIID, wealthy graves were not apparent, and the overall number of burials began to decline. This is interpreted as movement of the population, especially the wealthiest people, out of the area entirely (Buchez 2011a:35,38).

Hierakonpolis

Hierakonpolis is located on the west bank of the Nile, approximately half way between the modern cities of Luxor and Aswan (Figure 2.2). The overall site of Hierakonpolis consists of many different components spread for about 1.5km along the edge of the cultivation and extending at least 2km back into the mouth of Wadi Abu Suffian (Figure 3.29). The main large settlement area lies in the low desert along the edge of the cultivation, and there is another settlement 2km back in into wadi near the elite cemetery. An Early Dynastic and later settlement was located in an area now within the cultivation. This later settlement is called Kom el-Ahmar or Nekhen, and is known for the temple there where deposits of votive offerings (the 'main deposit') were found, many of which date to the late Predynastic period, including the famous Narmer Palette. Hierakonpolis has been proposed to be an early urban center and the seat of one of the earliest forms of kingship in the Nile Valley. Here the discussion is confined to the main localities with substantial published information on Predynastic lithic artifacts (localities 11C, 14, 24A, 25, 25D, 29, 29A, 29B).

Hierakonpolis HK29

HK29 is the designation for a large area of Predynastic habitation remains along the edge of the cultivation (Figure 3.29). This should not be confused with the ritual center at HK29A (see below). Hoffman (1980a) excavated a habitation area in HK29, with a dwelling, a fenced yard, and a pottery production kiln. Hoffman dated the site to the Ib-Ic period (ibid.:129), and radiocarbon dates yielded an average estimated date around 3500BCE (Hassan 1984), which should be somewhere around the NIC-IIAB considering the revised chronology of Dee et al. (2013). The dwelling was semi-subterranean and composed of wattle and daub with 8 wooden posts. Features in the house include an oven, a large storage pot, and an upright pottery slab that might have functioned as a heat shield for the oven (Hoffman 1980:131-132). A few small wattle and daub outbuildings were also present in the enclosed fenced area, along with the kiln, which was about 5x6m in size (Holmes 1989:287). Faunal remains associated with these habitation remains include cattle, sheep/goat, and pig (ibid.). The lithic artifacts discussed in the comparative analysis here come from the kiln area square 10L10 (Holmes 1989) and the house area square 17L13 (Holmes 1996). All of the material was collected by screening through 6mm mesh (Hoffman 1980:124).

Hierakonpolis HK29A

HK29A is located in the central area of the Hierakonpolis settlement in the low desert along the alluvium (Figure 3.29). It is a large enclosure which has been interpreted as a ritual or ceremonial site (Friedman 1996, 2009b). Many of the aspects are similar to those from el-Mahâsna Block 3 (Ch. 3.4). Because this is a critical context for this dissertation, the argument that it is a ritual activity area is discussed in some detail here.

The two main phases of use at HK29A date to the NII(A)B-C, and NIID2-[17]NIIIA (Friedman 2009b:79). The structure consists of an unusually large oblong courtyard (13m x 45m) (ibid.:81). Other known structures from this period rarely exceed six meters, often smaller (Tristant 2004:123-125). The walls and floors show a series of renewals. At least four episodes of floor plastering indicate the long use-life and care of the structure (Friedman 2009b:91). The walls were originally constructed of posts, some extremely large with post holes 1.5m in diameter (Friedman 1996:24), and later the walls were replaced with mud brick (Friedman 2009b:95). The large size of the posts and the structure itself indicate a substantial labor investment. At one end of the courtyard a mud brick platform evokes the scenes of a king on a platform as shown on the Narmer mace head, and a tag of Den. At the other end of the courtyard a single post hole in the center of the floor brings to mind contemporary depictions of temples with flag/standard pole(s) at one end. The HK29A structure is surrounded or flanked by a large palisade wall, HK29B (Hikade 2011; Hikade et al. 2008). This wall may have enclosed HK29A and a nearby columned hall HK29B, perhaps forming a ceremonial precinct.

The ceramic assemblage associated with the structure was quite substantial but only

[17] Since the sub-phase IId1 is no longer thought to be valid (Buchez 2011b; see Ch 3.2), the date of the second phase should be considered NIID-IIIA.

incorporated a limited range of forms. These include unique vessel types with distinctive shape and surface treatment that are only found at this ceremonial precinct and the elite HK6 cemetery: polished black egg-shaped vessels and matte red flaring collared rim jars (Friedman 2009b:85-88; Hendrickx and Friedman 2003). Friedman also noted a lack of wear in the ceramic assemblage. The contexts and lack of wear support the idea that the vessels had a ritual function (Friedman 2009b:88). Additionally, like at el-Mahâsna, fragments of Decorated Ware pottery and imported pottery were also more frequent in HK29A than other areas of the settlement (ibid.).

In a study comparing faunal remains from HK29A to those from other Hierakonpolis localities and other Predynastic settlement sites, Linseele et al. (2009) demonstrated that the assemblage at HK29A was quite unusual for a Predynastic site. HK29A had a high frequency of hunted/wild animals compared to other sites. Those wild animals include Barbary sheep, cat, crocodile, gazelle, hare, hartebeest, hippopotamus, and turtle. There was a higher proportion of crocodile remains than at any other Predynastic site (ibid.:118). HK29A also had higher proportions of deep water fish than other sites, many of which are very large and required concerted coordinated efforts to obtain (ibid.:115-116). The diversity of so many wild animals in once place is also unique compared to other Predynastic sites besides HK6 elite cemetery and el-Mahâsna Block 3. Linseele et al. emphasize that many of these animals were iconographically significant in Predynastic Egypt and that they derive from both the Nile Valley and the deserts.

Other well represented iconographically important animals were domesticated dog and cattle. Dog bones were unusually frequent here, and some bore cut marks indicating that they were skinned or eaten. Dogs were directly correlated to elites in Predynastic iconography, such as on the Hunter’s Palette where hunters (elites) wore dog tails (Baines 1993; Hendrickx

2006a).The cattle remains were not only quite prevalent at HK29A, but were on the whole younger than elsewhere at Hierakonpolis, and on average larger (Linseele et al. 2009:127). There is evidence that the HK29A structure may have been used for activities related to the arrival of the annual flood, since a number of species such as Nile Perch, Nile Oyster, and gazelles would have been easier to obtain when the Nile flood was very low, as would have been the case in June, just before the flood arrived (Linseele et al. 2009:134). On the other hand, the few aquatic bird species identified such as heron and egret would have been available in the fall, during the decline of the flood (ibid.:120). These potentially seasonal species were found in both the earlier and later phases of use at HK29A (ibid.: Table 2). These data do not definitively solve the question of seasonal use, but they do point to repeated periodic use.

Other notable artifacts are flat or slightly concave slabs of clay thought to be model bread loves, possibly tokens or symbolic offerings (Friedman 2009b:96). Incised sherds are examples of early ostraca. A number of ceramic spindle whorls were also found at HK29A, like at el-Mahâsna Block 3.

There was also ample evidence at HK29A for the large-scale production of bifacial tools (including knives and projectile points), along with beads, and ground stone (Holmes 1992a). The evidence is discussed in detail in Ch. 6.1. The lithic production must have made up an integral activity associated with the enclosure. 143kg of lithic material were collected from the 1985-1986 excavations of a 600m^2 area in HK29A (Holmes 1992a:39). Holmes analyzed 46% of this material by weight, about 54,000 pieces (ibid.).

Hierakonpolis HK29B

About 40m north of HK29A, in an area designated HK29B, the remains of a palisade wall were found (Hikade 2011; Hikade et al 2008). About 50m of the wall have been uncovered. There were two construction phases, and earlier one with very large post holes (70-110cm) and a later one consisting of a narrower trench (Hikade 2011). The remains mainly date to the NIID, with some earlier and later material (ibid.), so it is largely contemporary with the HK29A structure. The orientation of the palisade wall is the same as that of the HK29A enclosure and the columned hall in HK25 (see below), both of which are structures for ritual activities. Therefore it is possible that this palisade enclosed a ceremonial complex within the greater Hierakonpolis settlement (Hikade 2011:105). Hikade's analyzed lithic material comes from five 5m x 5m squares excavated during the 2005/2006 seasons (Hikade et al. 2008:155). The deposits were sometimes shallow, only 5-10 cm thick, but the post holes were much deeper, cut into the sterile soil (ibid.).

Hierakonpolis HK25

A columned hall was found in HK25 (Hikade 2011, 2008; Hikade et al. 2008), located about 80 meters northwest of HK29B. The hall measures at least 20m x 8m and was built of at least 50 'columns' or posts arranged in a grid and set into a thick mud floor (Hikade 2011:93-96). Some post holes contained the remains of wooden posts up to 40cm thick. A thick layer of clean sand was laid underneath the floor surface, and similar practices have been identified in other temple sites such as el-Mahâsna Block 3, and later Pharaonic temples. Remains of roofing materials were found above the floor. The structure has the same orientation as HK29A and HK29B, and a similar date, mainly in the NIID and NIIB-C (ibid.). The only other known

Predynastic columned halls in Egypt are at H6, the Hierakonpolis elite cemetery. The large size and investment in the structure, its use of columns (which is known from later temples and contemporary funerary structures), and the layer of clean white sand below the floor all indicate that this should be considered a ritual structure.

Analysis of the associated artifacts gives some idea of the ritual activities that took place at this structure. At least 776 fragments bifacial tools, along with over 200 small natural ring-shaped flint nodules, and fragments from 10 mace heads were found in this area, and all were burnt (Friedman and Nagaya 2013). The bifacial tools represented included at least 24 fishtail knives, 17 bifacial knives, 3 rhomboid lances, and 15 concave-base arrowheads (ibid.). Stylistically, these tools date to the NI-IIA, earlier than the rest of the remains associate with the structure, so they could be heirlooms (Hikade et al. 2008). Finely flaked bifacial tools such as these are actually quite rare in settlements, so to find so many, all treated in the same way indicates that they were all likely deposited as part of a distinctive activity. Distribution analysis shows that each type was centered in a slightly different part of the structure, indicating that each type was probably burned separately (Friedman and Nagaya 2013). The floor of the structure and the sand directly above it contained very few finds (Hikade 2011:105). The burnt deposits were presumably above the relatively clean material. It is hard to believe that such a unique burnt artifact assemblage is completely unconnected to such a unique building. Perhaps the burnt assemblage relates to activities associated with the ‘closing’ of the structure.

The ceramic assemblage parallels the dates and the ritual nature of the activities in HK25. The ceramics mainly date to the NIID and NIIB-C. The vessels include the distinct ceramic forms only otherwise found at HK29A and the elite cemetery HK6 (Hikade 2011:102): polished black egg-shaped vessels and matte red flaring collared rim jars (Friedman 2009b:85-88;

Hendrickx and Friedman 2003). Ceramics in the NE part of the excavated area, where all the burnt bifacial tools were found, included White Cross-Lined wares and date to the NI-IIA. Also found were sherds incised with images of plants and in one case a bird. The incisions were definitely made after the vessels was broken, so they are early ostraca.

The lithic material analyzed by Hikade comes from ten 5m x 5m units, which had deposits over 50cm thick (Hikade et al. 2008). Hikade reported the burnt bifacial tool fragments separately from the rest of the assemblage.

Hierakonpolis 24A and 25D

HK24A and 25D are located in the low desert along the edge of the cultivation, on the north side of the depression formed by the final extent of Wadi Abu Suffian (Figure 3.29). Just across this depression to the south are the settlement remains containing HK29, HK29A, and HK25. HK24A is a beer production facility, consisting of at least six vats arranged in two rows with evidence for heating (Geller 1992a,b). Black residue from the interior of the vats contained emmer wheat grains, and residue analysis revealed compounds identified with “all phases of the biosynthetic fermentation system” (Geller 1992a:21). Geller (1992b:118-119) gave a relative date of Ib-IIa for the structure. However the C14 absolute date was calibrated to 3500-3400 BCE, which according to Dee et al. 2013’s scheme is closer to NIIA-B (Table 3.1). The lithic artifacts analyzed by Holmes (1996) come from a 5m x 5m unit that included most of the beer-making structure, square 360L420, unit 2.

HK25D is only 100 meters away (separate from the above described Hk25), and consisted of a silty platform with six shallow depressions of fire-reddened silt (Geller 1992b:95-98). Mud-crusted sherds were dense on top of the platform and may be related to the ephemeral superstructure(s). Emmer wheat grains and charred wood were found in the depression features. Geller interpreted the area as a bread baking facility due to the light heat indicated and the proximity to the beer production area, which may have used bread in the beer recipe. Geller (1992b:102) dated the remains to the IIa period. The lithic artifacts come from the 5m x 5m square (502.5L387.5) in which this baking platform was found (Geller 1992b:95; Holmes 1996). All the excavated materials from both HK24A and HK25D were screened through 6mm mesh (Geller 1992b:95)

A circular mud brick structure lined with mud, likely a storage facility, was found at HK24B (Takamiya 2011b; Takamiya and Shirai 2010). Outside this structure was a layer of chaff and straw from barley and emmer wheat. Another beer production facility, even larger than the HK24A structure, was found adjacent to the circular silo. The facilities date to the mid Naqada II period (ibid.). These finds confirm that the activities in the HK24A-24B-25D area focused on grain based food production.

Hierakonpolis HK 14 and HK11C

HK14 and HK11C are a settlement area about 2km from the edge of the cultivation, in Wadi Abu Suffian, on the southeast side of the wadi (Figure 3.29). The settlement is across from and just east of the elite cemetery HK6. HK14 is an extension of HK11 into the wadi (Fairservice 1971-1972:Fig 1; Harlan 1982). The presence of White Cross-Lined Ware sherds dates the locality to the I-IIa. In 1969 Hoffman (1971-2) excavated a test pit in the area. He did not encounter any features, and interpreted the area as a midden accumulation. Artifacts include ceramics, lithics, well preserved faunal remains, coprolites, and a wooden arrowhead. The material was hand collected, not screened, but effort was made to collect as many artifacts as possible (Hoffman 1971-72:49). Holmes (1996) analyzed the lithic material from this area.

HK11C was a settlement site with living areas, animal pens, and zones of large-scale production activities. The lithic artifacts from HK11C discussed in this study come from Operation A (a beer production kiln) and excavations by Harlan in an animal pen area. However each of the main excavated areas in HK11C are discussed below to show the complex array of activities which took place in this settlement.

Harlan (1982; 1985; Khalifa 2012) excavated a mound in HK11C and identified a 2m-deep midden (Mound A/Test A). Thin lenses of material resulting from repeated dumping episodes were visible in the profile. The material consisted of general domestic refuse dating to the early Naqada period. Harlan identified four similar mounds throughout HK11C, which based on surface inspection also appeared to be middens. Square 0N6E was a 5m x 5m unit excavated by Harlan (1982) with a mud brick feature interpreted as a trough for watering and feeding animals, and a nearby fence. Reeds, branches, and barley were found on the trough, and a concentration of wheat and chaff was also found in the unit. The material was collected by screening through 6mm mesh and flotation (Harlan 1982:15). Holmes (1996) analyzed lithic material from sq 0N6E. Harlan also excavated a 'kiln' which was later investigated more thoroughly by Takamiya (see below).

Excavations by Watrall (2000, 2001) farther to the northeast (area G) identified multiple phases of habitation in a house structure and fenced yard or animal pen area, dating from NIC-IIB (Watrall 2001). The two primary phases of occupation each contained a floor surface with wattle and daub structural elements, a fence, and a stone lined hearth outside the floor surface. Pot emplacements and in situ upper and lower grinding stones were also associated with some phases. A small trash deposit in a pit separated these two phases. After the later phase, part of the area was re-paved, and finds of dung indicate that the area was used as an animal pen. In the latest phase, NIIC, a large pit was dug through all the layers and used as a refuse dump.

Other areas of HK11C do not have a domestic character but instead were focused on large scale production activities. Some of the more unusual remains are from squares C3-4 and C10-11 (Baba 2010, 2011, 2012, 2013). In both of these locations large areas (11.5 x were walled off by low mud brick walls—the earliest known use of mud brick in a Predynastic settlement. The interiors were filled with ash. The interior of structure in C3-4 was excavated revealing a number of hearths below the ash. Finds of numerous fish bones and cattle bones suggest cooking. What's more, the skeletal elements represented were opposite of those found in HK29A (Baba 2013:13), head and small extremities, not the bones associated with the meaty parts. This area may have been a large-scale food preparation area for feasting done elsewhere. Outside of one of these walls over 1000 small 'potato sized' worked pieces of sandstone were found, and the excavators suggest that they may have been used as counters, keeping track of all the food being processed in this area. The remains date to the NIIC-D.

Other evidence for large-scale production in HK11C area comes from squares A6-A7 (operation A), and squares B4-B5 (Operation B). The activities in Operation B (Baba 2006, 2007, 2008a,b; Friedman 2004c) were mainly devoted to pottery production. In the earliest phase of this area there was a combined pottery and beer production kiln (Baba 2007:26-27) that dates to the NIC-IIB (Nekhen News 2011b:24). During a second phase of use a platform of burnt mud and potsherds was built over the earlier kiln, and used for firing pottery. Adjacent to the kiln were wattle and daub structures or fences, and 5+ caches of pottery tools containing over 1000 worked sherds for making pottery (Baba 2007, 2008b). This second phase dates to the latter half of the NII period, NIIC-D.

Another beer production kiln was located in Operation A (Takamiya and Baba 2004; Takamiya and Aoki 2005; Takamiya and Endo 2007, 2011a). Part of the kiln was first excavated by Harlan in 1979 and was thought to be a shallow pit-updraft kiln, but later was determined to be part of the larger structure in squares A6-A7 (Takamiya and Baba 2004:19; Takamiya and Aoki 2005:18-19). The kiln consisted of at least 8 vats supported by firebars and a superstructure composed of fragmentary ceramic plates and mud. It dates to the NIIB-NIIC (Takamiya and Endo 2011a:729). Many phases of use were evident in the layers adjacent to the kiln, with wattle and daub structures, floor surfaces, and layers of sheep dung found underneath the layer of soot that marked the brewery surface level (Takamiya and Endo 2007:19, 2011a:728). The lithic artifacts from Operation A area were studied by Takamiya and Endo (2011a), with only 450 of the over 3000 pieces coming from the layers below the brewery surface.

Hierakonpolis HK59 and others

A series of pottery production sites were found in Wadi Abu Suffian on the low cliffs to the northwest above the elite cemetery HK6 (Friedman 1994:635-649; Geller 1984). These were localities 67, 59, 59A, 40, and 30. Although no lithic artifacts from these sites are discussed in this study, these sites are important for understanding settlement organization and specialized production. The sites date to the NIc-IIa (Friedman 1994:883-884), and consisted of ceramic sherd concentrations which were overwhelmingly dominated by untempered Black-Topped and Red-Polished wares. Many ceramic wasters were found among the sherds. Geller (1992:87) found a water-smoothed pit in a test excavation and Friedman (1994:636) suggests it may have been used for shaping pottery or preparing clay. Friedman (1994:646-648) argued that these kinds of ceramics were made by specialists based on the uniformity in form and technique for these ceramic wares across the country, and the remote location of the production sites at both Hierakonpolis and at Armant.

Hierakonpolis cemeteries HK6 and HK43

A number of cemeteries existed at Hierakonpolis (Figure 3.29), including HK6, the elite cemetery, and HK43, a non-elite cemetery. HK6 (Friedman 2008a,b, 2010, 2011; Friedman et al. 2011a,b) is located about 2 km from the edge of the cultivation, in Wadi Abu Suffian, distinctly separated from the rest of the cemeteries at the site. The main phase of use dates to the NIC-IIB with tomb complexes and substantial above ground architecture; and the cemetery was re-used again in the NIII period. An animated timeline available at the Hierakonpolis-online website very clearly demonstrates the different construction phases. Over 72 tombs have been identified so far, many of which were not for humans (see Table 6.9 for full references).

During the main phase of use at the cemetery central tombs were surrounded by satellite graves of family members and/or courtiers, who may even have been sacrificed, prefiguring the subsidiary burials around the Abydos royal tombs (Friedman 2011c:39). The tombs were also surrounded by wild and domestic animals, and the graves were situated within complexes of above-ground architecture. In one part of the cemetery a number of columned halls were built with no associated substructures— possibly the forerunners to the First Dynasty mud brick funerary enclosures at Abydos. A large wattle-and-daub plastered and painted enclosure wall surrounded the cemetery.

Offering deposits and artifacts have been found associated with the above-ground architecture, including the earliest known life size statue, which was later crushed into small fragments. Two offering caches in one of the columned hall structures each contained a fishtail knife, ground stone and flaked stone animal figurines, trapezoidal and bifacial projectile points, and unusual forms of ceramic vessels (Friedman 2006:7-8). Other spectacular finds include the earliest funerary masks, made of ceramic. Tomb 16 included hundreds of ceramic vessels (Friedman 2011c).

Of the over 100 animals found at HK6, the wild animals included hippopotamus, elephant, baboon, wild donkey, aurochs (wild bull), hartebeest, and wild cat. The domestic animals included cattle, sheep, goat and dog (Linseele et al. 2009:110-111). Friedman (2011c:40) interprets the wild animals as part of a display of power perhaps related to control over chaos, and also possibly related to a ruler's capacity to take on the abilities of the animals, as is paralleled in late Predynastic iconography that shows the king alternately depicted as human, as a bull, or as a falcon.

In contrast, the non-elite cemetery at HK43 had many more graves, but fewer grave goods and architectural investment. The cemetery is located in the low desert at the edge of the cultivation at the southern most end of the Predynastic remains (Figure 3.29), in a non-secluded location compared to HK6. There were at least 452 graves of NIIAB date in this cemetery (Friedman 2008a:20), and probably many more (thousands?) but the cemetery was heavily disturbed by modern activities. Rescue operations indicate that less than half of the tombs still retained grave goods, but some of the goods might be missing due to plundering. The burials that did contain grave goods usually had only 1-3 ceramic pots (ibid.). The tombs were very small, only large enough to fit a flexed body, and no indications of superstructures have been found. A few of the better preserved tombs contained lithic artifacts such as a fishtail knife with a reed handle (Friedman 2004b). Despite the relative dearth of material goods associated with these graves, they were certainly not without indications of lively funerary practices. The earliest evidence for mummification in Egypt comes from this cemetery, where some bodies had padding and wrapping around the hands and neck (Maish and Friedman 1999). Some burials were found with cut marks to the neck and the heads placed elsewhere in the burial (ibid.). Five cases of scalping have been identified through skulls with up to hundreds of cut marks (Dougherty 2004). More generally, the graves in the cemetery were placed in dense rings situated around blank central areas that contained concentrations of pottery, perhaps related to funerary feasts and rituals (Friedman 2008a).

Additional Sites

Besides the above sites which are comparable because of their overall cultural milieu and collection strategies, two more sites were pertinent to this study because of the availability of information on the lithic artifacts: the Badari sites, which are mainly known from museum collections, not modern excavations, and Maadi, which is in the lower Egyptian cultural sphere.

Badari-region sites

The Predynastic Badari sites are a series of settlements on the east bank of the Nile, over 300km south of Cairo, and about 100km downriver from Abydos. These settlements were excavated by Brunton in the 1920s and 1930s (Brunton and Caton-Thompson 1928). Brunton did not leave detailed information about the size of the settlements, but they do seem to vary, including many small sites and a few larger ones (Hendrickx and van den Brink 2002:375-376). Nor are there many plans of the settlement remains, but Brunton did mention floor surfaces, low mud walls, posts, post holes, stacks of pottery, and hearths. Firebars were found at site 3000/6, indicating that there may have been a beer brewery there.

Brunton also excavated many sites dating to the earlier Badarian period in the same area, some of which were occupied continuously from the Badarian through the later Naqada period. By the Naqada III period, the sites were abandoned and re-used as cemeteries. One of the sites with continuous occupation was Hemmamiya (North Spur), which was excavated in detail by Caton-Thompson (Brunton and Caton-Thompson 1928). She found a series of small circular mud structures ranging mainly from .9-2.75m in size. Caton-Thompson thought that some might be houses, but others have interpreted them as storage facilities or animal pens (Holmes 1999:186; Holmes and Friedman 1994:124). Wattle and daub fences were also found in the upper layers of the site. Holmes analyzed materials from Brunton's and Caton-Thompson's excavations which are now housed in the University College London Petrie Museum. These artifact collections cannot be considered complete or representative samples due to selective collection and the vagaries of what actually ends up in a museum. However the presence certain lithic items is useful information.

Maadi

Maadi is a large settlement site (4ha) located at the apex of the Nile Delta, on the eastern side of the Nile (Seeher 1999b). Culturally it is a type site for the lower Egyptian culture, and the site dates to the equivalent of the Naqada NI- NIIb. Maadi is noted for the abundant evidence trade with the Levant, including imported pottery, stone tools (tabular scrapers), copper, and houses built in a style similar to that of the Chalcolithic Beersheba culture (Braun 2011*;* Hartung et al. 2003; Rizkana and Seeher 1989). Ironically, the site is now threatened and affected by expansion of a modern suburb which is a current enclave for foreigners. The ancient contexts identified in the Maadi settlement certainly included habitation contexts evidenced by the structural remains, including post holes, wattle-and-daub architecture, and subterranean dwellings. However no specific activity zones were identified due to the spread of the settlement over time (ibid.:547). One cemetery was found 150m from the settlement, and another larger one was located 1km to the south. Rizkana and Seeher (1988) published much of the lithic material from the settlement site.

3.6 Depositional practices

The method for evaluating the ritual production model involves looking at the archaeological contexts of artifacts. Such a method raises the question of whether the artifacts found in a given context are actually related to the features in that context. Evidence for disposal practices and taphonomic processes indicates that on the whole, artifacts do relate to the contexts in which they were found.

There is evidence that 'trash' was often disposed of very near to the structures it derived from, particularly for ritually significant 'trash'. At HK29A much of the material associated with this structure comes from a series of pits immediately adjacent to and outside (river side) of the North wall. The unusual nature of the assemblages in the pits with their high frequencies of wild animals and distinct ceramics complements the unusual shape and size of the HK29A structure. More importantly, the assemblages in the pits are comparable to the assemblages excavated in the structure itself indicating that they are all related (Friedman 2009b). The consistency of the assemblages indicates that they derived from clean-up episodes that took place on a regular basis (ibid.:85). The relative chronology of the pottery in the pits shows that they were filled from the east to the west (ibid.:88).

This practice of disposing items used in ritual activities near to their associated 'temple' was not limited to Hierakonpolis. A similar practice can be observed at el-Mahâsna. Block 2 was located just east (river side) of the ritual activity area in Block 3. Block 2 is on the very edge of the low desert escarpment as it begins to slope down to the cultivated fields below. The main stratum was made of inter-fingered lenses of material with more or less ash and charcoal that probably resulted from small deposition events over time (Anderson 2006:90). The only substantial feature associated with these layers was a large hearth located in the north part of Block 2. Below this layer was a collapsed fence. Artifacts had accumulated next to the fence before it collapsed, and Anderson interpreted it as a division of outdoor space (fence). Block 2 had the highest density of ceramics of any block, many of which were small and possibly trampled. Furthermore, the artifact assemblages of Blocks 2 and 3 bear some important similarities, with each area having relatively high frequencies of (beer?) drinking cups, the forelimbs of mammals (the 'choice cut'), *Synodontis* catfish (coordinated deep-water fishing), and spindle whorls (Anderson 2006:163, 191-194, 200, 233). Anderson (2006:162, 246) interpreted Block 2 as an outdoor activity area with trash disposal, associated with Block 3. This evidence shows that at el-Mahâsna, as at Hierakonpolis HK29A, the refuse from a ritual activity area was deposited near the structure.

Special disposal of ritually charged items is also known from later Pharaonic contexts. At the temple in the Hierakonpolis dynastic town site of Nekhen, numerous caches of objects were found associated with the temple. They were deposited singly and in groups, and while it is not clear whether they were votive offerings dating to the original use of the temple, or heirloom temple furniture collected over the years, they were certainly groups of artifacts which could not be deposited just anywhere (Whitehouse 2002). The main deposit included elaborately decorated palettes like the Narmer Palette, ivory figurines and handles, mace heads, faience objects, and more (Adams 1974; Quibell and Green 1902). Similarly at Abydos, Petrie (1903) found a cache of ivory and glazed figurines near the temple remains dating to the early First Dynasty. Examples of temple caching are known from other sites including Elephantine (Dreyer 1986) Tel Ibrahim Awad (van Haarlem 2001), and Tel el-Farkha (Chłodnicki et al. 2012).

Special disposal was not limited only to the rather distinct and obviously symbolic objects like figurines and decorated palettes. During the Pharaonic period, the leftover materials from mummification, known as embalming caches, which included bandages, natron, resins, and even ceramic vessel fragments, were often buried in or near the tomb of the deceased (Eaton-Krauss 2008).

In domestic contexts, trash pits, trash dumps, and midden accumulations were located in houseyards, between structures, or in open portions of the settlement more often than in abandoned structures. In the habitation section of the Adaïma settlement numerous trash deposits were identified, including ashy concentrations, deposits of organic material, and concentrations of mixed material, often in wide shallow pits (Midant-Reynes and Buchez 2002:66-69). These were mainly around and outside of the remains of structures as outlined by post holes (ibid.:126, 130). At KH7 a trash pit filled with ashy material was identified (Holmes 1989:194). Its exact relationship to other structures is not known, since no other features were identified, but the lack of features indicates that the pit was not *in* a house structure. At Armant MA21/83 pits of unknown function nearby house structures in the southern sector of the site may have been trash pits.

Other evidence indicates that trash was also dumped nearby houses, in addition to being dumped in pits. Hassan (1978, 1981a; Hays 1976) carried out microarchaeological analysis of archaeological remains and soil from the Naqada Khattara sites, particularly at KH3. This involved taking soil samples and characterizing all artifacts larger than 1mm, and sorting and characterizing the soil and artifacts in the 1-.01mm range (Hassan 1978:208-209). Hassan deduced that trash deposits were interspersed with dwellings in the Naqada sites (Hassan 1999:670). At Armant MA21a/83, trench II contained dwellings, and the trash midden deposits in the nearby Trench III were interpreted as deriving from the dwelling area in II (Ginter and Kozlowski 1994:41). At HK11C multiple deep midden accumulations were found in areas without structural remains, and were likely designated dumping areas that were used over a long period of time (Harlan 1982).

In the settlement contexts surveyed here there was only one case of trash dumping in an abandoned structure. At area G of HK11C Watrall (2001) recorded a large pit dug through two earlier house floor surfaces associated with wattle-and-daub architecture. However this pit was well defined and clearly differentiable from the earlier materials.

The environment and materials of Predynastic houses differ substantially from the tell accumulations that many archaeologists are familiar with. Rather than mud brick structures which could stand open when abandoned and were often built close together, in Predynastic Egypt the houses were most often built out of light materials on sandy surfaces (e.g. Maadi, Mahâsna, Naqada-Khattara sites, Armant, Adaïma, Nag el-Qarmila).[18] Collapsed houses would have formed layers or piles rather than convenient pits.

Moreover there would have been ample room for disposal around the houses and around the habitation areas. Outdoor spaces (yards?) were often associated with the houses, such as the animal pen areas found at Naqada KH3, the fenced area adjacent to HK29, the outdoor space in el-Mahâsna Block 4 found by Anderson and associated with a structure excavated by Garstang, the structures and large fence in Block 1 at el-Mahâsna, and the structure with adjacent cooking area at Nag el Qarmila WK15. Similarly at each of the Armant localities habitation and subsistence production zones were identified. These data show that the houses were not packed in on each other, which would have limited the options for refuse disposal. At HK 11C multiple areas specifically reserved for trash dumping were identified, which must have accumulated over many years (Harlan 1982). All of this indicates that the artifacts found associated with domestic structures probably did not derive from the refuse of other houses.

More to the point, post-and-mat architecture and sandy surfaces make it quite likely that artifacts could easily be lost among the sands and reeds where they were used. In fact there is direct evidence for accumulations of artifacts against the reed fencing. Anderson (2006:95) found examples of this at el-Mahâsna, as did Watrall (2001) in HK11C.

Furthermore most sites were only minimally disturbed by natural taphonomic processes that could have resulted in substantial horizontal and vertical movement of artifacts. The existence of fragile features such as hearths, floor surfaces of compact sand, and even light fencing with the knots of the matting still in place, indicates that the sites were well preserved. The exception that proves the rule is Abadiya II where there was clear evidence of extensive bioturbation, seen in the contact between sterile soil and cultural layers, as well as in the return of aberrant C^{14} dates (Vermeersch et al. 2004). However there was also little evidence for in situ features such as hearths or floor surfaces at this site.

[18] The HK29 house (Hoffman 1980) was characterized as semi-subterranean and is somewhat unique, probably related to the presence of a silt layer at Hierakonpolis. The Hemmamiya mud circles have been

There was certainly surface deflation at many sites, such as at Nag el-Qarmila (Gatto et al. 2009) but once past the surface levels other layers were intact. In the dry desert environment rain events were rare, and strong rain events that would lead to alluvial transportation of artifacts even rarer. When present, finds such as the refitting of figurine fragments from Block 3 indicate that any horizontal movement must have been minimal.

In sum depositional practices and natural taphonomic processes do not inhibit an association between artifacts and features from the same contexts. The Predynastic Egyptian contexts are well suited to a methodology that involves understanding artifacts based on comparisons of their find contexts.

3.7 Settlement Patterns

Organization within settlements

The above site descriptions indicate that many Predynastic settlements consisted of a number of distinct localities spread across the landscape. Some of these localities were for functionally different activities. For example, at Nag el-Qarmila there was a habitation area (WK15), and a separate storage area (WK22) ~150m away. At Adaïma there was a habitation area in the southern portion of the site, and an area devoted to grain processing and storage in the northern portion of the site. Hierakonpolis is the best and most complicated example of functionally differentiated areas spread across a larger landscape. In the earliest phase, NI-NIIA(B) there were habitation areas at HK11C square G and HK29 (the latter included a pottery kiln), and by the end of this period there were dedicated production facilities at HK11C

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interpreted as storage features or animal pens, rather than houses (Holmes and Friedman 1994).

Operation B (beer and ceramics), at HK 24/HK25D (beer and bread), and at HK59/59A (ceramics). In the Naqada IIBC period many of these production areas continued, another beer production facility was added in HK11C (operation A), and a ritual precinct was founded at HK29A and HK25. By the Naqada IID period there was also large scale food production (meat and fish) occurring at HK11C squares C3-4 and C10-11, and the ritual precinct was bordered by a large palisade wall. In sum, Hierakonpolis always consisted of multiple localities spread across a large area, and these became more functionally distinct over time. The existence of an elite cemetery and a non-elite cemetery at two of the furthest points of the overall settlement along with the functional interdependence of the parts (e.g. only one ritual area) indicate that these localities should be considered one overall settlement, and not a number of independent sites that happen to be near each other.

Similarly, the Abydos Predynastic settlement sites should also be understood as a series of separate but interrelated localities. Certainly by Dynasty 0/Dynasty 1 there is a habitation area (possibly with a temple) close to the alluvium (Kom es-sultan), one or two beer production facilities slightly farther back in the low desert, an elite cemetery far back toward the entrance to the high desert, and a ritual activity area (funerary enclosures) between the settlement and cemetery (Figure 3.8).

On the other hand there is evidence that localities with the same functional activities could be repeated in one overall settlement. Examples include the above mentioned HK29 and HK11C square G, both with habitation areas, approximately 1.5-2km apart. Armant MA21/83 and 21a/83 constitute two domestic habitation areas separated by ~25m and a natural dip in the topography, yet they were both surrounded by a palisade wall. A similar situation was apparent at el-Mahâsna where two localities, Garstang's S1 and S2, were separated by a small natural depression. Both of the el-Mahâsna localities contained habitation remains. The multiple, basically contemporary beer production facilities at Hierakonpolis and Abydos are another example of repeated but separate areas devoted to the same activities.

The site of Maadi does not fit this pattern, as no specific activity zones were identified at the site, and it seemed to spread and shift over time (Seeher 1999b:547). However it is not surprising that Maadi exhibits a different pattern of internal settlement organization since it is in a different environmental region (Lower Egypt) and belongs to a different cultural milieu (Buto-Maadi culture). The Naqada-Khattara sites are the only Nile Valley sites so far known without documented separate localities. However this kind of settlement patterning for Predynastic upper Egyptian sites was not known at the time when the sites were surveyed, and so any outlying localities may not have been identified. An understanding of Predynastic settlement sites as composed of related but spatially separated localities can also explain the density of 'sites' identified by Ginter et al. (1985) in the Armant region. They located 15 Predynastic sites in a span of 8 km. That would be a site every 500 m if they were distributed evenly. Actually the sites can be grouped into at least three stretches, with each group spreading over 1-2km, and with a space of 1-3km between each group.[19] It seems quite likely that each of these 'sites' might actually have been one of a series of related localities.

This kind of 'internal' settlement organization makes it very hard to estimate and compare site size. For some sites the area of an individual locality is given, which can be very small, only tenths of a hectare. For others the overall spread including much relatively blank space is included. And in many cases expansion of modern villages and farmland have made it

[19] Group 1: 21,20,19,18,18A,17, and Mond and Myers' site 1000 (following Buchez 2011); Group 2:16,15,14,14A; Group 3:8, 7(A,B,C), 6, 5, 4.

impossible to understand whether there were originally more ‘parts’ to a site. Therefore caution should be used whenever comparing Predynastic site sizes.

The locations and distance of the different parts of a settlement are likely related to the features of the landscape to some degree. The sites were often arranged around wadi mouths or embayments. At Nag el-Qarmila and Armant the habitation areas were just above the lowest point in a wadi mouth, perhaps facilitating access to water, at least during the flood season. At Nag el-Qarmila the storage area was placed on a sandstone shelf which allowed for more durable storage structures than the edge of the sand dune where the main habitation was located. Similarly at Adaïma the grain processing area was on the firmer silt and gravel terrace, while the habitation remains were located in a sandy area. At Abydos and Hierakonpolis the elite cemeteries were set back from the settlement by 1-2km, in or near to the wadi itself. The sizes of wadi mouths vary considerably across Egypt, thus affecting the space available for a related series of localities. Hierakonpolis and Abydos may be examples of wadi mouths or embayments which were just the right size: quite large with room for plenty of population in comparison to places like Nag el-Qarmila, but small enough to be delineated. Patch (1991) noted that the Abydos embayment was actually the smallest in the Abydos area. El-Mahâsna, just north of Abydos, was not set within one of these naturally delimited areas. Instead it was at the edge of the cultivation in an extremely large desert embayment, with the high desert ~6km behind the site. It is unknown how this more open environmental context would have affected the organization of the settlement, since so much of the surrounding area has been turned into farmland. Buchez (2011a) noted that Adaïma was a more spatially distinct unit than the Armant settlements, and thought that this was because Adaïma was situated in a large sandy plain—a kind of inverse relationship to available space so that localities clustered closer together in areas where the landscape did not delineate the settlement area. The Armant sites constitute a third environmental landscape. There each 'site' or locality was situated on the hillocks or promontories between wadi mouths, rather than in the wadi mouths. However the wadi mouths are small and very close together in this area, being only 100-250m wide according to Ginter et al.'s (1985) maps. They also do not appear to cut back into embayments, but to end rather linearly which hinders the identification of potentially related clusters. A similar scenario occurs at Badari where Predynastic sites were found rather linearly on spurs that were only 50-100m apart (Brunton and Caton-Thompson 1928; Holmes and Friedman 1994).

Distribution of settlements across the landscape

Whether individual sites or clusters of localities, Predynastic settlements tended to space out across the landscape about 2km apart in the early part of the period. Later in the Naqada period there was nucleation of sites into larger settlements, as is now well documented in multiple regions of the country.

Patch (1991) conducted a large-scale regional survey charting the location and date of settlements and cemeteries in the Abydos region. She found that in the early part of the period (Ic-IIc) settlements were located evenly across the landscape, except immediately around Abydos where there was greater spacing between the Abydos settlement group and the sites to the north and south. This spacing may have been related to the preeminence of the site, or may even have been intentionally maintained. After the Naqada IIc period there was a reduction in the number of sites, which, based on growth of certain cemeteries, Patch argued was due to the population nucleating into fewer sites (Abydos, Mahâsna, and Nag ed-Deir), rather than from people moving onto the alluvium. Similar patterns were observed in the Naqada region, where the Naqada I-II period sites were found spaced approximately every 2km throughout the area, but the later sites were fewer and larger (South Town and North Town) (Hassan 1981a; Holmes 1989). Buchez (2011a) also argued for population nucleation based on evidence of the depopulation of farming villages at Adaïma and Armant. She observed that at Armant the number of settlement localities decreased over time, and at Adaïma the number of domestic units in the site also decreased over time. Meanwhile a gradual decease in population occurred in the cemeteries after the NIIC, with a precipitous drop in population after the NIIIA1. Since the presence of large wealthy graves also dropped, she argued that the changes were a result of people, especially wealthy people, moving to the more preeminent sites. Gatto (2014) also documented settlement nucleation in the Aswan region, with a reduction in both the number of settlements and the number of cemeteries over time.

Settlement hierarchy?

The nucleation of settlements begs the question of whether there was a settlement hierarchy in the Predynastic period. This gets into issues of state-level organization and/or urbanism, which depend on an analysis of the interrelatedness of the sites, and such an analysis is outside the scope of the present project. However the above analysis of settlement contexts and settlement patterns do indicate that there were differences in population size and in the kinds of activities that occurred at sites. These differences are important to the present study because of the need to evaluate whether artifacts made by specialists were used by large portions of the population, or only by certain subsets. It is conceivable that access to artifacts might be related to the kind of site, such as whether that site was a large center or a small farming village. Therefore I divided the sites into a three-part scale: highest-order sites which are large sites in terms of area/population and have indications of many different kinds of activities (habitation, designated ritual activity areas, administration, trade, production of ceramics, beer, or other items), and in some cases the known, continuing historical importance of the site; mid-level sites which are not quite as large and have indications of a smaller range of activities; and low-order sites, which are small and devoted mainly to habitation and subsistence.

This scheme is not meant to imply any specific relationships between the sites, such as urban-hinterland relationships, but is simply a way to look at whether there were differences in access to goods based on where people lived. Table 3.3 shows how the sites were assigned based on the information provided in sections 3.4 and 3.5, and the above parameters.

Chapter 4: Results of fieldwork

4.1 Raw Materials

Special focus was put on the analysis of raw materials to understand patterns of raw material use and to evaluate the expectation for the ritual production model of an association between raw material type and tool type. The most common material for chipped stone tools in Egypt was chert (Harrell 2012). Quartzite, agate, rock crystal, carnelian, silicified limestone, and obsidian are other raw materials sometimes used for chipped stone tools, but by far the majority of lithic artifacts were made from chert.

Chert vs. flint

A note on terminology. In English, 'chert' and 'flint' are both terms that have been used to refer to microcrystalline quartz. The distinctions between the two terms for microcrystalline quartz can be based on color, quality, geological source, or geographical source (Whittaker 1994:70). However there is no standard definition of the difference between the two, resulting in discrepancies between researchers. The same problem applies to raw material definitions in Egypt. As Harrell (2012:3) stated, both terms have been "variously and inconsistently defined" in Egypt. Hikade (2013:22) also observed that the distinction is arbitrary in studies of Egyptian materials, with the implicit distinction being that chert is coarser and greyer, while flint is finer and brown. Complicating the matter are terms from other languages, which may not map onto English terms in the same ways. French uses the term *silex* which translates to flint, but there is no translation for the term chert, while German has hornstein and feuerstein.

Luedtke (1992:6) describes the distinction between chert and flint as originating from Britain and specific to geological formations there. She stresses that the definitions do not translate well to the rest of the world. During the study undertaken here, it was apparent that there is so much variety in the macroscopic properties microcrystalline quartz rocks in Egypt (Figure 4.1), that it would be difficult to formulate and apply a dichotomy between chert and flint consistently. Therefore, this study will use only the term chert, following Harrell (2012) who treats the terms chert and flint as synonymous in Egypt, and Luedtke (1992) who uses the term chert to refer to all microcrystalline quartz rocks.

Chert varieties

There are three main geological contexts in which chert can be found in Egypt: in its primary context in the high desert limestone plateaus and cliff faces as tabular veins or nodules; in secondary context as nodules or chunks which have eroded out into gravitation screes or on desert plateau surfaces; or in secondary context as surface or buried material which has been washed down from the wadis through gravitational and/or alluvial action. Limestone cliffs with primary deposits of cherts are present in Egypt north of Esna, but chert is available throughout the country in secondary deposits, such as gravel terraces (Harrell 2012; Said 1990).

Many varieties of chert are present in Egypt (Figure 4.1). Attempts to classify chert varieties or types have increased in recent years (Briois 2002; Ginter et al. 1996; Hikade 2013; Kabacinski 2012; Kindermann 2010; Midant-Reynes and Prost 2002; Nagaya 2011; Pawlik 2006; Rizkana and Seeher 1988). Researchers divide their chert assemblages into groups based on visual characteristics. However every researcher defines the groups differently, ranging from 3 to 36 defined varieties of chert per study.

Without actual physical examples, it is difficult to replicate chert groupings between researchers for a number of reasons. For one, it is probable that the chert varieties present in any given site differ, and second, the level of detail given in chert descriptions varies widely. Color photographs are helpful when possible (e.g. Hikade 2013; Kindermann 2010; Nagaya 2011). During a recent workshop at the IFAO on lithic industries in Egypt (Midant-Reynes et al. 2014) interest was expressed in forming a type collection of chert varieties to be housed at the IFAO, which would be very useful for standardizing raw material studies.

In the meantime, for this study 14 chert varieties were defined based on the macroscopic properties of color, luster, texture, translucency, structures, and cortex, observed in the materials from el-Mahâsna and Nag el-Qarmila (Ch. 2.2). To be as explicit and replicable as possible, systematic descriptions using those six characteristics are given in the Appendix, along with color photos. The groupings were formed in a multi-step process. First previous definitions of chert varieties were consulted. Then while in the field, during study seasons in 2009 and 2012, hundreds of labeled artifacts were laid out and grouped according to the above mentioned properties (Figure 4.2). This process was done for the materials from el-Mahâsna and Nag el-Qarmila to account for differences in assemblages across Egypt. Then a type collection with representative samples was set aside at each site for reference when analyzing individual artifacts. Structures and cortex were the most helpful features for differentiating materials because they were the most discretely defined, identifiable, and replicable characteristics. Color, luster, texture, and translucency were also helpful, but are all relative characteristics which grade into each other.

Although 14 separate groups were defined, some relationships between the groups should be noted. The first four groups are all beige, mostly opaque cherts separated for differences in texture and structures. Groups 5, 6, and 7 are all medium to dark browns, mostly opaque, with very fine texture, separated for their structures. Groups 8-11 are all semi-transparent and with small white (probably calcareous) mottles throughout, separated for differences in color, and in some cases structures or cortex. Types 12 and 13 are both rare and distinctive, and 14 is an 'other' category.

Among the research described here and in the above mentioned publications on raw materials, certain chert types or varieties are readily identifiable, and have been singled out by many researchers. These are the groups called here type '4.Beige with pink bands', type '7.Dark gray and brown', and type '13.Caramel.' The fact that a number of researchers have recognized and defined these same varieties is significant because it underlines the validity of the groupings, and efforts at sourcing would probably be most productive if focused on these materials. This brings up the question of how well these chert varieties correspond to actual raw material sources.

Chert sources

Remains of cortex on lithic artifacts indicate that chert was obtained from both primary and secondary contexts (including surface material, gravel terraces, and gravitational screes) during the Predynastic period in Egypt (e.g. Ginter et al. 1996; Rizkana and Seeher 1988). Only a few specific chert quarries have been identified in Egypt (Briois 2002; Briois and Midant-Reynes 2015; Friedman and Youngblood 1999; Ginter et al. 1996; Harrell 2012). Large-scale chert quarrying occurred by the Early Dynastic period (Köhler et al. 2017). However smaller-scale quarrying could have taken place anywhere in the high desert limestone formations north of Esna, and collection of surface materials probably took place throughout the Nile Valley. There is only one documented source of chert dating to the Predynastic period, although many more likely existed. Surprisingly it is near Hierakonpolis, south of the main chert-bearing limestone formations, and consists of chert cobbles in a gravel matrix (Friedman and Youngblood 1999; Harrell 2012, pers. comm.). Ginter et al. (1996) also matched samples of cherts found in primary and secondary context near Armant to archaeological materials in the settlements.

The problems associated with linking specific artifacts to specific quarries complicate the possibilities for sourcing raw materials. Luedtke's (1992) discussion of chert formation showed that chert is an extremely variable material, and highlights some of the difficulties for sourcing. Unlike obsidian which forms all at once from the cooling of a relatively homogenous lava flow, each individual chert nodule is formed separately through chemical precipitation. The first step in chert formation is the precipitation of silica out of a silica solution in water. Silica can also be derived from silica-secreting organisms. Precipitation is affected by temperature, pressure, pH, impurities, the concentration of silica, and the presence of nuclei for formation. Microcrystalline quartz is likely to form when silica concentrations are low and impurities are abundant. The actual formation of chert takes place in many steps that can involve compaction, cementation, chemical alternation, replacement, and recrystalization. There is not a single overall process, but multiple paths through which chert can form. All of the above factors can affect color, opacity, grain size, inclusions such as minerals and carbonates, final water content, and porosity. Thus there is great variability in chert across the world, within a region, and even within a single chert source.

Furthermore, chert in Egypt is often found in horizontal beds in the limestone, layered one on top of another, each of which formed in vastly different time periods (e.g. Ginter et al. 1996). The result is that multiple 'kinds' of chert are all located in a single geographic area, that might be considered a single ‘source’. Conversely, natural alluvial and gravitational transportation can carry eroded chert far from its primary source, so a nodule may have been obtained by people at one place, even though it originated at a primary source farther away. Such secondary deposits could contain multiple varieties of chert from different original sources. An additional complication is that many artifacts do not retain cortex making it difficult to determine if the material came from a primary or secondary source.

Nonetheless, personal observations made while visiting sites across Egypt indicated that the chert at one archaeological site often seemed predominantly different from chert at another archaeological site. Therefore a three pronged approach was taken to understanding raw material sources: desert survey for primary sources, comparison of the chert varieties found in the assemblages from multiple sites, and comparison of the cortex types associated with each raw material type. Additionally, a small proof-of-concept study of XRF for chert artifacts was carried out (see below).

Desert survey

A pedestrian survey for raw material sources near Abydos was undertaken on February 11, 2013. Figure 4.3 shows the relationship of the main Abydos survey area to Abydos and el-Mahâsna. I examined exposed materials and collected information on geological context, nodule shape, cortex description, Munsell color, inclusions, chert variety, metric measurements, and volume. Chert nodules, pieces, and artifacts were abundant throughout the studied area. Time and permissions were not available for survey in the high desert behind el-Mahâsna, however some raw material examples were observed on the desert surface around Beit Khallaf, which is just north of el-Mahâsna. The Beit Khallaf desert surface provides a likely comparison for the desert surface around el-Mahâsna, which cannot be studied now since it is completely covered in farming fields. No primary sources of chert exist around Nag el-Qarmila, however a few examples of secondary chert gravels from Wadi Kubbaniya were studied. The 42 total entries are given in Table 4.1.

Figures 4.4- 4.10 show the geological context of the survey area around Abydos. The Umm el-Qa'ab cemetery is located in an embayment formed by the high desert, and near the mouth of a wadi that cuts into the high desert plateaus (Figure 3.8, 4.4, 4.5). The archaeological settlement areas are 1 - 2 kilometers from the high desert. Chert was observed on the surface of the high desert (Figures 4.9-4.10), on the erosional slopes in front of the cliff faces in the wadi (Figures 4.6, 4.8), and in primary context in exposed sections of the cliff faces (Figures 4.11-4.12).

Three raw material varieties—'1.Indistinct beige', '3.Beige less-fine', and '8. Translucent brown'—were observed in primary context (Figure 4.13). No quarries were observed in the surveyed area, but the materials could have been easily removed from exposed outcrops. Furthermore the presence of the raw materials indicates at least that they were locally available, even if the exact source was not located during this survey. The types '1.Indistinct beige', '8.Translucent brown', and '4.Beige with pink bands' were also found commonly in secondary context on the high desert surface, in slopes coming down from the high desert cliff faces, and washed down from the wadi onto the low desert surface (Figure 4.14). Additionally examples of '2.Beige-fine', '10.Pink-gray', and silicified limestone were also found in secondary contexts. Figure 4.15 shows examples of each of the raw material types found in this survey.

In sum, two chert varieties were commonly available and local to Abydos: '1. Indistinct beige', and '8.Translucent brown'. Type '4.Beige with pink bands' was also a commonly available local material, at least in secondary context, and its abundance indicates that it is highly likely that primary chert outcrops of this variety are probably nearby, but just were not found in this survey.

Beit Khallaf is just 7km north of el-Mahâsna, and provides a good example of the geology of the area in lieu of el-Mahâsna, because both are ~4-6 km from the chert-bearing high desert cliffs and both are located in the flat low desert plain. Figure 4.16 shows the desert surface around Beit Khallaf, and Table 4.1 includes examples of raw materials from Beit Khallaf. Abundant material of the type ‘8.Translucent brown’ was noted all across the desert surface in the form of gravel nodules, fist sized and slightly larger. The type ‘9.Translucent brown with pink gravel cortex’ was also found there (Figure 4.17), and is likely a subtype of 8. Type 9 was originally separated from type 8 in case the dark pink color of the cortex was related to heat treatment. However finds of nodules with dark pink cortex on the desert surface at Beit Khallaf indicates that this dark pink color can be due to natural processes. Furthermore, it was noted that on some nodules only the upper exposed portion was dark pink, while the cortex of the side face down was tan (Figure 4.18, upper right), which verifies that the color change occurred naturally. Such two-colored nodules also show that the surface around Beit Khallaf has been stable for quite some time.

Additionally, nodules of type ‘1.Indistinct beige’ and some gravels of a coarser material, probably silicified limestone, were identified (Figure 4.18). However types 8 and 9 seemed to be the most abundant. Therefore, by extension it is possible to surmise that surface nodules of gravel chert, particularly type ‘8.Translucent brown’ would have been an easily accessible local chert source at el-Mahâsna.

No systematic survey took place around Nag el-Qarmila because that far south in Egypt the main stone type in the area is sandstone rather than limestone, so there should not be any primary sources of chert in the area. However a few small nodules were noted in Wadi Kubbaniya (Table 4.1, Figure 4.19). These were quite small, much smaller than fist-sized, and the cortex indicates extensive transportation from their original source including alluvial transportation. The types were '1.Indistinct beige' and '8.Translucent brown'. These finds indicate that some small nodules would have been locally available to the inhabitants of Nag el-Qarmila. However the presence of artifacts larger than these nodules in the artifact assemblages shows that material must have also been obtained from farther afield.

To summarize, there was plenty of local chert available at Abydos and el-Mahâsna. Types 1, 2, 3, 4, 8, and 10 were probably all locally accessible for the people of Abydos, and possibly also el-Mahâsna since it is not very far away. Types 8 and 9 surely were locally available chert types at el-Mahâsna. Conversely, at Nag el-Qarmila some small nodules of types 1 and 8 were available, but at least some of the chert used there must have been imported.

Raw materials in archaeological assemblages

Raw material types were recorded according to the groups defined in the Appendix. Table 4.2 shows the frequencies of raw material types at el-Mahâsna, Abydos, and Nag el-Qarmila. At each site a different chert variety is more prevalent than any other. At el-Mahâsna type '8.Translucent brown' is the most common chert variety, with over 37% of the material belonging to that group. Notably that is a type of gravel chert. At Abydos the type '4.Beige with

Pink Bands' had the highest frequency, at over 25% of the material. And at Nag el-Qarmila, type '6.Brown fossil',[20] stood out as the most common (10.4%) of the identifiable chert varieties. Moreover, the 95% binomial confidence limits for each of these cases (Figures 4.21-4.22) indicate that the differences can be considered reliable. Another difference between the sites is in the use of non-chert materials. Table 4.3 shows the comparison of the frequencies of chert materials to non-chert materials. A significantly higher percentage of non-chert materials was present at Nag el-Qarmila (Figure 4.23).

These data show that the most common raw material type varies by site, and that the overall composition of the raw materials varies by site. Therefore, the sources of raw material were likely different for each site. This information can then be combined with the observations from the desert survey for raw materials. The desert survey indicated that chert types 8 and 9 were probably locally available at el-Mahâsna, and indeed type 8 was the most common material used in the archaeological assemblage at el-Mahâsna. At Abydos type 4 was the most common raw material in the archaeological assemblage, and type 4 was also found to be present in the desert just behind Abydos. The clear conclusion is that much of the material used at el-Mahâsna and Abydos came from local sources. This cannot be said for Nag el-Qarmila. There, type 6 was the most abundant identifiable raw material, and it was not observed among the local material, underlining the inference that at least some raw materials were imported into Nag el-Qarmila. These conclusions on the sourcing of raw materials at the three sites are supported by the analysis of the cortex, below.

[20] Note that the name "Brown fossil" is given only because the structures look like small fossils, but the actual mineral content of the structures has not yet been identified. They are probably foraminifera.

Comparison of cortex type by raw material type

Analysis of the cortex associated with each raw material type can help identify the source of the materials based on the kinds of weathering present. If the material came from a primary source it would have unmodified chalky cortex. If the material came from a lag deposit (moved by gravity, wind, etc. and often exposed to the sun), it might show light weathering such as light pitting, abrasion, and discoloration. Materials that have been transported by extensive alluvial action have extremely smooth and shiny cortical surfaces. There are also examples of cortex that result from a combination of these forces, such as the gravels on the low desert surface which have washed down from the wadis through a combination of gravity, wind, and occasional water transportation. Additionally some pieces simply have patina which is essentially a process of chemical weathering.

Table 4.4 shows the proportion of cortex types in the overall assemblages of el-Mahâsna, Abydos and Nag el-Qarmila. The numbers were calculated from all pieces above 1.5cm, including tools, cores, and complete and fragmentary debitage, where the cortex type was recorded. The most interesting finding is that there is a high proportion of unmodified material at Nag el-Qarmila. The 95% binomial confidence intervals for the proportion of unmodified cortex at each site are given in Figure 4.24, showing that there is a significantly higher amount of unmodified cortex at Nag el-Qarmila than at el-Mahâsna or Nag el-Qarmila. Unmodified cortex most likely comes from a primary source, possibly even quarried, since there was little evidence of weathering on the cortex. This finding corresponds well with the idea that much of the material at Nag el-Qarmila was imported, implying that the material was imported from a primary context, such as a chert quarry.

The fact that Nag el-Qarmila was obtaining chert from a primary context is significant because Nag el-Qarmila is just a small farming village, compared to el-Mahâsna and Abydos which were larger sites with more diverse activities, in the case of Abydos possibly an emerging political center, and both el-Mahâsna and Abydos were associated with extensive cemeteries that had indications of emerging social stratification. Nonetheless, the inhabitants of Nag el-Qarmila were well connected or well-traveled enough to obtain a fair amount of chert from somewhere north of Esna, where the primary deposits of chert are located. By extension the inhabitants of Nag el-Qarmila may also have been able to connect into wider exchange networks for other items besides chert, such as specialist produced goods.

An examination of the cortex types of individual raw material categories indicates the probable sources for some chert varieties. Tables 4.5-4.15 show the frequencies of cortex types for each raw material, at each of the three sites studied here. For types '2. Beige Fine', and '4-Beige with Pink Bands' the most common cortex types were the lightly weathered cortex from lag deposits, and the unmodified chalky cortex from primary contexts. Possibly this material was collected from near outcrops of the primary sources which would have a mix of unmodified and more weathered pieces. This scenario accords well with the results of the desert survey where both types were found in lag deposits scattered around the desert. Although the primary sources were not located, they may be nearby. Type '5.Medium brown' also fits the pattern of material collected from near a primary outcrop, because both unmodified and lightly weathered cortex types are the most common for type 5. However this material was not identified during the Abydos desert survey, so it probably comes from elsewhere.

On the other hand, Types '6.Brown fossil' and '7.Dark gray and brown' were likely quarried. Where the cortex was present it was predominantly the chalky unweathered cortex of primary deposits. Furthermore, over 50% of the material for both of these types did not retain any cortex, which fits well with the scenario of some initial processing outside of the settlement site, perhaps decortication at the quarries.

A third source of chert is evident for types ‘8.Translucent brown’, ‘9.Translucent brown with pink gravel cortex’, and ‘12.Pink-purple-red family.’ For these groups the gravel and lag cortex types were the most common. Of course type ‘9.Translucent brown with pink gravel cortex’ was defined by the gravel cortex, but it seems to be a subset of 8, which also predominantly had gravel cortex. The combination of gravel and lag cortex types indicates collection from desert surfaces—either near the sites, or farther away—or from gravel deposits. Given the observations at Beit Khallaf, desert surface collection in the vicinity of the site seems the most likely option, especially at el-Mahâsna. One caveat is that for type 8 at Nag el-Qarmila the most common cortex type was unmodified chalky cortex, (although some gravel and lag cortex was also present). However this fits with the overall pattern of high amounts of unmodified cortex from Nag el-Qarmila, which is likely due to the fact that there simply were not as many surface or secondary deposits available in the area.

Type ‘10.Pink-gray’ deserves a special mention. It would seem to fit with the last group of material collected from the desert surface, since the most common cortex types are gravel and lag cortex at el-Mahâsna and Abydos, and unmodified cortex at Nag el-Qarmila. Furthermore, this fit with the last group is underscored because type 10 has properties similar to the types 8, 9 , and 12, such as translucency and white calcareous(?) mottles. However, at all three sites type 10 has an extremely high percentage of non-cortical pieces, ranging from 65% to almost 80% of the type 10 material. This factor alone indicates a different pattern of initial processing, which must have taken place outside of the site. Since types 8, 9 and 12 do not have high percentages of non-cortical material, it is hard to imagine them being collected at the same places but treated so differently.

Types ‘1.Indistinct beige’ and ‘3.Beige less-fine’ showed no clear pattern in the frequencies of cortex types. The sample sizes for types ‘11.White translucent’, and ‘13.Caramel’ were too small for any patterns to be discerned.

XRF Research

All the above raw material groupings were made based on the macroscopically observable properties. Such designations are to some degree subjective, although every effort was made to make the groups standardized and replicable. Therefore, an X-ray Fluorescence (XRF) element analysis was tested this season to determine whether XRF has potential to aid in raw material grouping and possibly, sourcing for Egyptian cherts.

Three artifacts were tested by Gregory Dale Smith of the Indianapolis Museum of Art using a Bruker Tracer III-V Portable XRF. Each artifact was analyzed for 180 seconds, with no filter, and no vacuum, at 40 keV voltage with an Rh anode. Two of the artifacts were of the same type of raw material, to look at whether or not they gave similar results, and the third was a different raw material variety, to see whether the pieces returned differentiable results. The two similar artifacts were both characterized as type ‘7.Dark gray and brown’ but came from different locations in the Abydos region: MAP 2528 from el-Mahâsna and AMC 12.48 from the Abydos Middle cemetery, and the third piece was: MAP 2021.14 type ‘8.Translucent brown’ (Figure 4.25).

The results for two comparisons are shown in Figures 4.26-4.27. The two pieces of type ‘7.Dark gray and brown’ returned basically similar results with peaks in the same places, but to differing degrees. On the other hand, the comparison between the type '8.Translucent brown' and one of the type '7.Dark gray and brown' showed peaks in different places. Thus the XRF does have some potential to help identify or separate chert groups. However it must be cautioned that other surface modification such as desert varnish or patina can affect the results and must be taken into account before any conclusions are drawn on tests of actual artifacts. Samples of raw materials with fresh surface breaks might provide better results for characterizing the material itself.

Raw material conclusions

It is difficult to look at a single artifact and determine whether the raw material was found locally or was brought in from elsewhere. However the study of large collections of artifacts allowed some inferences to be made on which materials were obtained locally and which were not. Knowledge of the raw material provenience forms a basis for understanding patterns of production and exchange.

The desert survey combined with the analysis for the most common chert materials in each settlement assemblage indicates that at el-Mahâsna type '8.Translucent brown' was likely a local material. Investigation of the cortex types indicated that this material was probably collected from the desert surface or lag deposits. At Abydos these same analyses showed that type '4.Beige with pink bands' was the local material which was likely collected from around outcrops of the primary sources. An additional important point is that although el-Mahâsna and Abydos were relatively near to each other (~10km), they each mainly drew on different chert sources.

Such sourcing of local materials was not the case at Nag el-Qarmila. There the most common identifiable chert variety was type ‘6.Brown fossil’, which was likely an imported material that came from a primary source, and was possibly quarried. Indeed much of the chert at Nag el-Qarmila probably was imported, as indicated by the high frequency of unmodified chalky cortex coming from primary deposits but the lack of primary sources south of Esna, which is ~170km to the north. The importing of chert into Nag el-Qarmila indicates that the inhabitants must have had been able to obtain resources from a relatively wide geographical area.

There is evidence that el-Mahâsna and Abydos also imported some chert. The raw material type ‘7.Dark gray and brown’ was probably imported to all three sites, as indicated by its high frequency of chalky cortex, and high frequency of non-cortical pieces. Furthermore this type was only present in relatively low frequencies at el-Mahâsna and Abydos. Other types that occur only in low frequencies, such as type ‘11.White translucent’ and type ‘13.Caramel’ may also have been imported.

4.2 Heat Treatment

Heat treatment is the process of heating stones, usually cherts, up to high temperatures. This process effects the mechanical properties of the chert, making the stones easier to flake (Domanski and Webb 2007; Luedtke 1992). It is a particularly useful preparation for pressure flaking because not as much pressure or force is necessary to drive off the flakes after they have been heat-treated (Crabtree and Butler 1964; Patterson 1981). Additionally, sharper edges and fewer step and hinge terminations are reported by flintknappers (Whittaker 1994:73). Heat treatment also tends to change the visual properties of the material, which may have been a desired effect (Kennoyer et al. 1991:55). Humans have been heating chert for a very long time, some researchers suggest as far back as 100,000 years ago, but it is found commonly after the Paleolithic in many parts of the world (Domanski and Webb 2007).

The process of heating chert involves slow heating, sometimes to specific temperatures, and care to avoid thermal shock. It certainly required some level of expertise (see heat treatment experiment below). Ethnographic accounts of heat-treatment in western Australia (Akerman 1979: 146-147) give some idea of how chert might have been heated anciently. Thin, shaped preforms were prepared, then a fire built in a large sandy pit, and one the ground around the pit. The resulting coals were removed, and the preforms embedded in fresh sand in the pit, and then topped with the coals from the fire. After up to two days, when the coals had completely cooled, the preforms were removed and final flaking ensued.

It can be difficult to identify heat-treated chert in archaeological assemblages because chert is such a variable material. Since most assemblages contain multiple varieties of chert, it can be difficult to know whether an individual piece was heat altered or is just a different variety of chert. The differences in minerals, carbonates, water content, and porosity can result in diverse macroscopic changes during heat treatment, including color, translucency, luster, and texture (Luedtke 1992). Reddening is the most widely known change in heated chert. However, reddening depends on the presence of certain trace minerals, and does not consistently manifest with heat treatment (Domanski and Webb 2007). Because cherts are not all similar, the effects that heat treatment causes also vary. Chert can also become heated naturally, if geological strata were exposed to heat, changing these same properties.

A few aspects of what happens to chert on the microscopic level during heating are clear, but the overall process is debated. Water is driven off during heating, but the amount depends on crystal size and porosity. Non-silica minerals can undergo oxidation causing color changes depending on the trace minerals present. Unfortunately the specifics of what happens to affect the mechanical properties of chert remain unresolved. Domanski and Webb (1992; 2009) argue that the chert re-crystallizes during heating, changing the shape, size, and interlocking of the crystals. They argue that fractures propagate along the boundaries between crystals, so there would be different possible paths for fracture propagation in heated chert, potentially offering more direct paths for the force and fracture to travel along. Their findings however, were not supported by a study by McCutcheon and Kuener (1997; *c.f.* Domanski et al.2009). Others argue that heating increases cracks or microflaws *within* grains in the material, allowing fractures to occur more easily (Luedtke 1992:104). Until this issue is sorted out it cannot directly aid our understanding and identification of heat-treated material in archaeological assemblages.

Besides macroscopic visual identification, a number of other methods have been attempted for identifying heat-treated chert in archaeological assemblages. Borradaile et al. (1993) tested samples from a chert source in northern Ontario and found changes in magnetic susceptibility and saturation were measurable before and after heating, and could be used to identify heat-treated chert in archaeological assemblages. This method is only appropriate for cherts containing iron oxides. DeForest (2006) developed an experimental method for differentiating heated and non-heat-treated chert based on striking the piece of stone and using computer software to measure the sound waves. Heat-treated rocks did have differences in sound intensity than unheated specimens. However these experiments were done comparing the sound generated from pieces of exact same size and weight dimensions and no outline was offered for how to apply this method to an actual archaeological assemblage with many different sizes and shapes of artifacts and multiple varieties of chert. Domanski et al. (2009) could see clear textural differences in scanning electron microscope images of their experimentally heated and raw

Polish flint. However they used this method to understand the fracture mechanics, and were not recommending it as a method to differentiate heated cherts in archaeological assemblages. Dunnell et al. (1994) and Griffiths et al. (1986) have used electron spin resonance to detect heat treatment, and Godfrey-Smith et al. (2005) tried thermoluminescence as another method for assessing whether stones were heated. However, all these non-visual methods for assessing heat treatment have many drawbacks. They require specialized equipment, so artifacts need to be brought to the equipment or the equipment needs to be brought to the artifacts. In Egypt artifacts are not allowed to be transported out of the country at this time, and it is difficult, expensive, restricted or sometimes impossible to bring the appropriate equipment into Egypt. Moreover, these methods can also be time consuming, which is not ideal if the goal is to evaluate each artifact in an assemblage of thousands.

Given these issues with non-visual methods, the most practical way to identify heat-treatment in archaeological assemblages still seems to be through macroscopic visual identification. To overcome the problem of chert variability the main recommendation is to test the local varieties of chert and determine what they look like when heated (Luedtke 1992).

In Egypt, heat treatment has not been reported in many assemblages until just recently, mainly because few people were looking for it. With good quality chert available heat treatment does not seem necessary. As discussed above in section 4.1 there was a range of coarser and finer grained cherts and other flakeable stone materials in Egypt, and it is not likely that these different qualities and kinds of cherts were evenly distributed across Egypt. For instance, south of Esna the desert is composed of sandstone rather than limestone containing chert. Moreover, availability of high quality chert could have been affected by social factors, such claims to specific resources, or prioritizing of other activities, like agriculture, over travel to distant resources. Therefore Ancient Egyptians may have had reasons to heat treat more easily accessible cherts, or even change the properties of cherts that might otherwise be considered high quality.

Indeed, Ancient Egyptians *did* heat treat their chert. Diana Holmes (1989) was the first to argue for the presence of heat-treated material in Predynastic assemblages. In her dissertation research she examined lithic material from Badari, Naqada, and Hierakonpolis, and identified material she thought was heat-treated. She also reported on a heat treatment experiment she carried out on cherts from Luxor, which supported her argument that there were heated materials present in Predynastic assemblages. Subsequently, she examined some of the lithic artifacts from Maadi and confirmed that heat-treated material was also present in the collection there, although the authors did not recognize it as such at the time of publication (Holmes 1992b).

Other researchers have only recently begun to build on Holmes' finding. In an article on lithics from Hierakonpolis HK11C, Takamiya and Endo (2011) specifically researched and reported the presence of heat treatment at the site. They analyzed materials from the same sites as Holmes and were certainly aware of her work. Additionally, in the publication on Adaïma, Midant-Reynes and Prost (2002) mention heat-treated materials. Kabacinski also described some heat-treated materials from the Lower Egyptian site of Tel el-Farkha.

Holmes described heat-treated chert as reddish, glossy, and with a light speckling. Takamiya and Endo (2011) and Midant-Reynes and Prost (2002) used this same basic definition. However, preliminary research into raw materials for this study revealed naturally occurring pinkish toned chert with white inclusions (Figure 4.28). This observation raised the question of whether this is the only variety of chert that turns really red during heat treatment. An indication that there is indeed some variability in the macroscopic changes to Egyptian chert during heating comes from Holmes. She heated a few nodules from near Maadi and noted that the results were somewhat different from the Luxor samples (Holmes 1992b). Considering Luedtke's conclusions on the variability in chert, and the observations made here, heat-treatment experiments were conducted to make a type collection that would facilitate identification of heat-treated material in archaeological assemblages.

Heat treatment experiment

Six varieties of visually different cherts were tested. To ensure variability in the nodules tested, chert was obtained from two different sources, Abydos and Elkab. These different regions are separated by about 300 km and are on different sides of the Nile. The nodules vary in color and texture, and most come from lag deposits while a few show signs of alluvial transportation. Nine nodules were partially reduced. Each nodule was given an alphanumeric code, and each flake from each nodule was labeled with a subscript, e.g. A1.1, K2.1, K1.2 etc. Flakes from each rock were kept aside as control samples, and photographs were taken before and after heating. The following attributes were recorded for heated samples before and after firing, and for control samples: ease of flaking, volume, Munsell color, cortex Munsell color, luster, texture, and inclusions. Phil Geib[21] did all the flaking and rated the ease of flaking for each based on his personal assessment.

Thirty one pieces were heated, consisting of flakes and cores or core fragments. The specimens were heated in a portable kiln. Some were embedded in sand and others were placed directly in the kiln. Five different tests were run (Table 4.16, 4.17). In each test, the pieces were

[21] University of Nebraska

heated slowly, between 10 to 40°C per hour. The temperature was raised to a maximum temperature of 300, 350, or 400°C. The maximum temperature was held for 6-7 hours. Then the pieces were allowed to cool slowly, to avoid breakage from thermal shock. After the tests were finished additional flakes were removed from each heated piece in order to examine differential visual properties.

Results of heat treatment experiment

There are a few important results from these tests. First, while all cherts got somewhat darker with heating, some cherts did *not* redden. Figure 4.30 presents some pieces before and after heat treatment, showing the variety of color change. Second, the surface that was exposed during heating became more matte or dull, but the scars of subsequent removals were glossier. This result was expected, as increased luster of surfaces flaked after heating is the most frequently reported change (Domanski and Webb 2007; Luedtke 1992). Luster difference is a bit difficult to capture with photography, but Figure 4.29 shows a few good examples. Surprisingly, the glossiness was sometimes subtle.

And finally, an important finding was that the cherts had different optimal maximum temperatures (Table 4.18, Figure 4.31). Optimal maximum temperature was measured by how easy the piece was to pressure flake after being heated to a certain temperature without burning. Some pieces reached optimal ease of flaking at 300°C while others burnt at the same temperature. The same goes for 350°C and 400°C. A difference of 50 degrees could make or break a chert.

These findings have implications for the identification of heat treatment in the field, and for understandings of how heat treatment might fit into the development of specialized production. This experiment indicates that *differential luster is a better indicator for heat treatment than a reddish color*. According to these experiments, researchers that want to definitively identify heat-treated artifacts should look for an earlier flake scar or surface that is matte with a later cross-cutting scar that is glossier. Figure 4.29 shows examples of the differential luster of flake scars before and after heating from these experiments, and Figure 4.32 shows an archaeological example of two refitting artifacts where the oldest flake surface is matte and the more recently flaked surface is glossier. It should be noted that artifacts can also become glossy from wear due to exposure to wind and sand, often referred to as desert gloss. However, the patterns of glossy and matte flake scars is inverted for desert gloss pieces compared to heat-treated pieces: on artifacts with desert gloss the more recent scars will be matte while the older scars will be glossier. Additionally glossiness resulting from heat treatment is differentiable from desert gloss because pieces with desert gloss often have slightly worn ridges, causing them to look waxy. It is also important to note that with heat-treatment reddening did occur on a number of the samples, so red color can help identify heat treatment in some pieces.

Regarding the speckling mentioned by Holmes, it is likely part of the raw material, not an effect of heat treatment. Raw materials with small white inclusions were observed naturally occurring in Egypt, like that seen in Figure 4.33. There may be an association between speckled raw materials and heat treatment because such materials may have been chosen for heat treatment to improve the flaking results of the non-homogeneous material.

The results of these experiments also indicate that heat treatment would be a good candidate for specialized production because the process is not just a matter of throwing rocks into a campfire. People heat treating chert in Ancient Egypt would have needed a fine control of temperature- within 50 degrees Celsius, and a good knowledge of the varieties of cherts, and to match them to the right temperatures. Similar arguments of skill with temperature control, and access to resources for fires have been used as part of the argument for specialized beer production (Geller 1992).

4.3 Assemblage Composition: Debitage and Tools

Table 4.20 gives the frequencies of tools, cores, debitage categories, and debris from el-Mahâsna, Abydos, and Nag el-Qarmila compared to other Predynastic settlement sites/localities in the Nile Valley. Note that the percentages of flakes vary depending on how many debitage categories were differentiated. Debris is included in the overall counts for comparability to existing publications. Figures 4.35-4.36 show examples of cores and debitage.

On the whole, the assemblages are all basically comparable except for the sites from the ceremonial area of Hierakonpolis, and Nag el-Qarmila WK22. Hierakonpolis HK29A, 29B, and 25 stand out for having extremely low proportions of flakes, high proportions of debris, and relatively low proportions of tools. At HK29A and HK29B the bifacial thinning flake proportions are high, and at HK29A the cores are few. Notably HK29A, HK29B, and HK25 are all together part of a ritual precinct in Hierakonpolis (Friedman 1996, 2009b; Hikade 2008; 2011). As discussed above, Holmes (1992a) argued that specialized production of finely flaked bifacial tools occurred in the HK29A structure, and she used such evidence as the extremely high proportions of chips and thinning flakes in her argument.

The storage area at Nag el-Qarmila WK22 also has a somewhat different profile of reduction categories. WK22's tool and debitage profile clearly shows that it was not a place where much lithic reduction occurred. WK22 has the highest percentage of tools by far and the second lowest percent of debris. The debris at WK22 consisted of only seven pieces that were all flake fragments- none of the debris consisted of piece below 1.5cm or angular debris, both of which can usually be considered indicators of on-site production. WK22 also had an overall low number of lithics. The WK22 and the Hierakonpolis ceremonial precinct assemblages highlight the general comparability of the other settlement sites in terms of lithic reduction. Chapter 5 looks at comparisons of blade types between assemblages in more detail, and Chapter 6 looks at bifacial tool production in depth.

Comparison of cortical flake frequency

Another way to look at production is via the cortex. Cortex can be removed early in the production sequence, and an area with a high proportion of cortical flakes may very well be a locus of primary production. For instance, at Armant there was a very high proportion of wholly cortical flakes in the early phase of the southern sector of MA21/83, which aided in identifying the area as a location where at least some stages of lithic production took place. Problems with this method are known (see cortex ratio, below), but many publications give this information, so it is presented here for comparison.

Information was available on the proportions of cortical flakes from 15 sites, including el-Mahâsna, Abydos, and Nag el-Qarmila. Definitions of cortex categories varied slightly from publication to publication, so the data could only be divided into two groups: "primary flakes" defined as those with more than 50% cortex, and "secondary flakes" defined as those with less than 50% cortex, including flakes with no cortex.[22] Table 4.19 and Figure 4.34 show that, of the fifteen comparable sites, the percentage of primary (mostly cortical) flakes ranges mainly between 7-16%. Only el-Mahâsna stands out with 25% primary flakes. The 95% confidence limits of the proportions indicate that the high proportion at el-Mahâsna is indeed a real difference, and not likely due to sampling error. This finding may indicate higher levels of primary production took place at el-Mahâsna, and may be related to the use of surface gravel materials available directly around the site as argued in Ch. 4.1.

Cortex Ratio

Another way to look at cortex and production is with the "Cortex Ratio." Most strategies for examining cortex in an assemblage use a three-stage typology for recording cortex: primary (mostly cortical), secondary (partially cortical), and tertiary (non-cortical) (Andrefsky 2006:115). One problem with the three-stage typology method is that it quantifies the *numbers* of pieces with and without cortex. However, different methods or intensities of reduction can create higher or lower counts of cortical flakes (and different sizes of flakes) (Andrefsky 2006:104). These counts result in percentages of cortical vs. non-cortical pieces that would vary due to the *technologies* employed, not just due to the stage or amount of reduction done on site, even if the entire reduction processes were present, or even if the same quantities and sizes of nodules were used. This insight is significant for understanding lithic processing in Predynastic Egypt because flake, blade, and biface technologies were all utilized, each of which may produce different numbers of cortical detachments. These considerations make it difficult to determine whether assemblages are really comparable since it is not clear what the *expected* frequencies of cortex are, and whether the data collected deviates from what is expected.

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[22] Adaïma could not be added to the comparison because they used different categories: wholly cortical,

Dibble et al. (2005) developed a method for determining an expected amount of cortex for an assemblage and for evaluating whether the assemblage has less or more cortex than expected. This method compares the expected amount of cortical material that should be found in a given area if all processing was carried out at therein, to the actual observed amount. The resulting ratio will show if the expected amount is present (a ratio close to 1), if there is more cortex than expected (>1), or if there is less cortex than expected (<1). This method also takes into account the sizes of cores and flakes, which are not accounted for in considerations based only on raw frequencies. So far, Dibble et al.'s method has been applied mainly to Paleolithic sites and/or considerations of mobility (Douglass and Holdaway 2011; Douglass et al. 2008; Lin et al. 2009; Marwick 2008; Phillipps 2006). A high Cortex Ratio (more cortex than expected) means that products have been moved away from the production area, and a low Cortex Ratio might mean that present items were moved from an initial processing area. Since the question of specialized production also involves determining where items were found relative to where they were produced, data necessary for calculating the Cortex Ratio were collected from the three sites examined here. This data includes weight, length, width, and percentage of cortex for individual artifacts.

Cortex Ratios for el-Mahâsna and Nag el-Qarmila were calculated, since el-Mahâsna stood out from all other sites as having more cortex based on the raw percentages, and Nag el-Qarmila was comparable to all the other sites in terms of the percentages of cortical material. The Abydos site sample was substantially smaller than these two sites, so its Cortex Ratio was not calculated. Nor could Cortex Ratios be determined for other published sites since the cortex

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partially cortical, and no cortex (Midant-Reynes and Prost 2002:301-318).

was not recorded in fine enough intervals to give good estimates of observed cortical surface area.

Tables 4.21-4.24 show the calculations used for determining the Cortex Ratio at el-Mahâsna, and Nag el-Qarmila. The expected quantity of cortex was determined by first calculating the volume of lithic material present. The volume of material was determined from the weight of all the lithic pieces, divided by density. Density was calculated by measuring the weight and volume of displaced water for 89 raw material samples of chert from Egypt. Next, the surface area expected for that volume was estimated based on the average size and shape of nodules of that raw material. The estimated average nodule *volume* and *surface area* were calculated based on the average nodule size and shape, using geometric formulas appropriate to the shape. Estimated nodule shape was based on observations of partially reduced cores in the assemblage as well as visits to local raw material sources. The volume of the total assemblage was divided by that average nodule volume, resulting in an estimated number of original nodules. The estimated number of nodules was then multiplied by the estimated surface area for an average nodule resulting in the expected amount of cortical surface area in the assemblage, since cortex is effectively surface area. Dibble et al.'s (2005:549) experiments with the reduction of different nodule shapes and sizes found the method to be robust enough to be applicable even if there is some variation in the nodule shapes and sizes.

The observed amount of cortex in the assemblage was determined by multiplying the length and width of each lithic artifact that was larger than 1.5cm, to obtain the individual surface area. The percentage of surface area covered by cortex was recorded in intervals: 0%, 1-10%, 10<-40%, 40<-60%, 60<-90%, 90<-99%, 100%. The surface area for each artifact was multiplied by the mid-point of its cortex interval, then all of the members of a assemblage were added together to find the observed surface area of a given assemblage. Finally, the observed amount of cortex was divided by the expected amount to arrive at the Cortex Ratio.

Since the estimated nodule size and shape greatly affect the outcome of the Cortex Ratio, each Cortex Ratio was calculated four times, using two different shapes of nodules (cubic/rectilinear, and right cylinder), and two different methods for determining the average nodule size and quantity. In the first method, average nodule size was determined from looking at the largest tested cores found on the site, and the largest dimensions of length, width, and thickness found in the assemblage. All of the tested nodules at el-Mahâsna were smaller than the dimensions of the largest artifacts. The largest dimensions of all artifacts were used as average nodule size since overestimating the nodule size affects the expected amount of cortex less than underestimating the average nodules size (Dibble et al. 2005). There is an exponential relationship between the volume and surface area of a geometric shape as the shape gets smaller. For the second method, Dibble et al. recommended basing the estimated number of nodules in the assemblage on the number of cores found in the assemblage, and calculating the average nodule size from that and the total volume.

The cortex ratio was higher at el-Mahâsna than at Nag el-Qarmila (Tables 4.21-4.24). However both were above 1, meaning that there was more cortex than expected at both sites. This was surprising for Nag el-Qarmila since the general impression after analysis was that there was not a lot of cortex there. At both el-Mahâsna and Nag el-Qarmila, varying the presumed nodule shape did not alter the results greatly. On the other hand, the two different methods for estimating average nodule size did produce substantially different results. Nonetheless, in all cases, the Cortex Ratios remained above 1, greater than expected, and in all cases the cortex ratio of el-Mahâsna was farther above 1 than that of Nag el-Qarmila.

These results confirm that el-Mahâsna is substantially different from other sites in terms of cortex, and indicate that there is more cortex than should be expected for the volume of chert material found there. This could be interpreted in two ways: 1) nodules were reduced on-site at el-Mahâsna and much of the non-cortical products left the site by some means, or 2) cortical material was brought in from elsewhere. Option 1 is the more likely explanation, because it is not clear why cortical material would be brought to the site.

Tools

Table 4.25 gives the tool types found at el-Mahâsna, Abydos and Nag el-Qarmila compared to other Nile Valley settlement sites. Retouched pieces and burins are the most common tool types. From their lack of patterning, ubiquity, and simple production technique both should be considered ad hoc tools. Bifacial tools are very rare. More specifics on bifacial tool types in settlements are given in Chapter 6.

The Mahâsna and Abydos assemblages are very comparable to other Nile Valley tool assemblages. The presence of axes at el-Mahâsna is notable since it is the only site with axes outside of the Naqada region in this survey. As will be discussed in Chapter 6, Garstang (1903) found many more axes in his excavations at el-Mahâsna.

The Nag el-Qarmila tool assemblage had a few features different from the other tool assemblages. There was a very high percentage of piece esquilles (Figure 4.52). Usai (Gatto et al. 2009:201; Usai 2012) also noted a high percentage of these tools in Nag el-Qarmila Area B. Piece esquilles are produced through bipolar reduction, and it is debated whether they should be considered wedging tools or cores for very small flakes (Bradbury 2010; LeBlanc 1992; Shott 1999). Considering that the raw material study (Ch. 4.1) indicated that much of the raw material for lithic artifacts had to be imported to Nag el-Qarmila, the piece esquilles may have been a way to maximize the output of the raw materials present, however this suggestion should be studied in more detail in the future. The frequency of transverse arrowheads was also high at Nag el-Qarmila, and may relate to hunting. One of the tools in the ‘other’ category was a lunate, also probably used for a similar purpose. Lunates were also found in Area B (Gatto et al. 2009a:201; Usai 2012), and their presence probably relates to the Nubian influence at the site (Gatto 2014).

Other pieces found at el-Mahâsna but not included in Table 4.25 (such as surface finds, special finds from other blocks besides 1,3, or 4, or items from disturbed contexts from Blocks 1 and 3) include a fishtail knife fragment, a bifacial knife fragment, a bifacial sickle, a bifacial tool preform, a burnt concave base projectile point fragment, a circular scraper, six sickle blades, five denticulates, four fragments of blade knives, and an unidentifiable unifacial tool fragment. Drawings and photographs of a sample of tools from all three sites are given in Figures 4.37-4.52.

Chapter 5: Blade tool Specialization

Chapters 5 and 6 address the question of which Predynastic Egyptian tools should be considered specialized by comparing the distribution of the production remains to the distribution of the tools for certain types of tools. Section 5.1 is a review of methods for assessing specialized production, and this is followed by on overview of the known blade types in Predynastic Egypt (5.2-5.3). The distribution of production remains and tools for the different blade types at an inter-site level is given in section 5.4 shows that there were a variety of ways blade production was organized. A look at the distribution data within sites in section 5.5 shows that there was also variability in the distribution of production elements within sites for some blade types.

5.1 Identifying the Organization of Production Archaeologically

Direct method

The first step in understanding *how* craft specialization developed in Predynastic Egypt is to determine which items were produced by specialists. The identification of specialized goods depends on the definition of specialized production. As discussed in Ch. 1.1, here specialized production is defined as where, above a household level, a class of objects is used by people other than those that made them. Accordingly, a primary way specialized production can be identified is through the distributions of the production remains compared to the distributions of the products (Costin 1991:3, 2001:276; Tosi 1984; Wattenmaker 1994). The products of specialists should be found beyond the production areas, either within a community, or at a regional level. For instance, if bifacial knives were made by specialists within a given community the production remains might be located in one household only, but the knives themselves would be found in multiple households. Or if there was regional specialization, all the production remains of bifacial knives might be located in one settlement, but the knives would be found in multiple settlements within the larger region. Evidence of a differential distribution of tools compared to the distribution of production remains would be direct evidence for specialized production. This method of assessing the organization of production works very well for stone artifacts which have durable, plentiful, and easily identifiable production remains (e.g. Charlton et al. 1993; Hartenberger and Runnels 2001; Hogberg 2009; Schafer and Hester 1991; Wright and Loveland 2015).

Indirect methods

One problem with the distribution method for assessing the organization of production is that if production areas were highly concentrated or very few, they may be difficult to locate archaeologically. Therefore it is useful to have other strategies for determining whether a class of objects was produced by specialists. Indirect methods have been used to identify specialized production by looking at skill, and standardization. These characteristics only indicate specialized production because of the implied relationship between producers and consumers.

A high degree of skill required to make an item can be indication of specialization (e.g. Charlton et al. 1991:103; Costin and Hagstrum 1995:623; Geller 1992; Kelterborn 1984; Sheets 1978). An advanced skill-level evident in an object’s production implies that only a small number of people had the expertise and ability required to make the object. If such goods were distributed widely, then there must have been few producers relative to the number of consumers, and the item could be considered specialized according to the definition used here. However it should be noted that a lack of production skill required for an object does not rule out specialized production, nor does a high degree of skill (or even more vaguely 'quality') always equate to specialized production. Increases in specialization can sometimes result in objects which require only simple skills in their production, or result in less elaborate or high-quality products, such as when efficiency or quantity was the production goal. This was the case for ceramic bread molds in Old Kingdom Egypt and Uruk period Mesopotamia (Chazan and Lehner 1990). These bread molds were mass produced (by specialists) and were not technically difficult to make, and were notably somewhat crude rather than high-quality. Conversely, there are cases where items with elaborate decorations, which may be interpreted as requiring more skill, have been made in ways that should not be considered specialized. For instance pottery decoration in 6th millennium BCE Mesopotamia, could be quite elaborate. However the designs were all slightly different, made by many people and may reflect each producer's individual creativity, social positioning, ways of combining meanings related to motifs and functions (Wengrow 200l). In this example, with increasingly specialized production decorations actually became less elaborate over time.

Skill, quality, or time investment, are not sufficient characteristics for considering an item specialized. More time and even skill may be invested to make elaborate, high-quality but unique products in less concentrated forms of production, where time and efficiency were not as important. On the other hand mass production can result in quite simple items. Costin (2001:282) notes that the idea that high skill levels are a characteristic of specialists has not been tested. It is certainly possible to imagine situations where jobs were inherited and the people who execute those jobs have varying levels of skill. Skill necessary for production or overall 'quality' can only be considered indicators of specialization when accompanied with an argument that those who used an item were different from or more numerous than those that produced it. A high degree of skill can be considered an indicator of specialization if it seems likely that few people had the time or talent to master the technologies involved. Replication experiments have the potential to demonstrate skill levels. In this study skill level was assessed by reference to literature on experimental recreation of technologies.

Standardization as an indirect indicator of specialization comes from the idea that specialized items would have been made by a smaller number of people, therefore there would be fewer chances for variability stemming from idiosyncratic differences, training differences, personal preference, degree of ability etc (Costin and Hagstrum 1995:622) and from the idea that specialists make their wares over and over again, and this repetition (high rate of production or routinization) would also lead to decreases in variability (Longacre 1999). Archaeological and ethnoarchaeological studies specifically aimed at understanding whether standardization is a correlate of specialized production have verified that standardization does often result from specialized production, with the caveats that the analysis of standardization stays within boundaries of quite specific typologies and time periods (Blackman et al. 1993; Longacre et al. 1988; Roux 2003).

A few additional factors are pertinent for assessing specialization through standardization. Standardization can be affected by how important standardization is to the people making and using the item. If it is very important that a product be standardized, (for whatever reason such as function, preference etc.), then people may try harder to reach that goal, resulting in overall higher level of standardization (Longacre 1999). An example of a functional reason an item might need to be standardized might be sickle inserts which have to be of a specific size to fit into sickle hafts. Social reasons items might need to be standardized is that similarity of products might be a matter of pride or status for the producers, or items of similar style might be necessary to convey social messages such as affiliation or status. In the latter case standardization may even be a reason why specialized production was pursued (Wattenmaker 1994). Additionally, the degree of variability that can be tolerated for something to still be considered standardized can vary culturally (Roux 2003:778-779). However, Eerkens and Bettinger (2001) have outlined the physical parameters for what humans can perceive as the same in terms of size or magnitude.

Another consideration is the degree to which the technical production process affects standardization rather than the number or producers or their experience. Quintero and Wilke (1995) argue that the blade production technology in the PPNB facilitated the ability to make large numbers of generally standardized blades in terms of shape and size. Some techniques of ceramic production might result in more standardized items, such as wheel made compared to mold made (Arnold and Nieves 1992), although some authors have found that similar degrees of standardization in pottery production can be reached using different production techniques (Roux 2003).

Therefore, to use standardization as an method for assessing whether or the degree to which an item was specialized there are two points which must be considered: what was standardized (the process, the raw material choice, the form, or the metric measurements); and where that standardization was coming from (the technology, the requirements of the product, or the number of producers and their training and ability).

A difference or change in technology can also potentially indicate that a class of items was made by specialists. A contrast in the technology used to produce a class of tools over time, or a contrast in the technology used to make different types of tools could indicate specialization if there are major differences in the skill levels and knowledge required. For instance, the presence of both ad hoc tools, clearly reflecting low skill levels, and another tool type reflecting high skill levels, would offers indirect support for specialized production. Such an assertion a could be bolstered by experimental data.

Application

In this study, the primary method used for assessing and describing the organization of production was analysis of the spatial distribution of production remains and tools (products), looking at inter- and intra-site distributions of artifacts in the Nile Valley—the direct method. Reference to issues such as standardization and skill were only relied upon when primary data from production locations was not available.

The spatial distribution method has the potential to show different degrees or configurations of production. Just a few examples include: Production which should not be considered specialized according to the definition used here Ch. 1.1, such as where the distribution of tools and their production remains overlap entirely- either within a site or on a larger scale; Diffuse production where a product is made in every community but only by certain people within that community; Very concentrated production where an item is made in only one or a very few locations but distributed widely; Tribute like production where an item is made in one or multiple places but only used in one or other places.

The rest of Chapter 5 and Chapter 6 deal with assessing these spatial distribution patterns for a number of different classes of stone tools. Although some researchers have argued that certain stone tools were produced by specialists during the Predynastic period (Ginter et al. 1996;

Holmes 1992; Kelterborn 1984) these studies have only focused on a few tool types. This study expands the existing discussions of specialized production of stone tools in Predynastic Egypt by looking at the organization of production for heat-treatment, and multiple kinds of blade types and bifacial tool types.

As discussed in Ch. 1.1 there are many other factors or parameters besides spatial distribution that can contribute to understanding past systems of production. Throughout Chapter 7 a number of other parameters of specialized production are layered onto the basic understanding of the spatial patterns for the organization of production. These include the relative quantities of items produced, understandings of the contexts in which the items were produced and used, and who was using the items, and whether production was full-time, part-time, or periodic.

5.2 Predynastic Blades

In the following sections a number of specific blade types are described and the organization of production is evaluated for each. Section 5.2 provides the definitions of blades types known from existing literature on Predynastic Egypt. Section 5.3 deals with the question of whether blades and bladelets should really be considered separate types by evaluating attribute data collected from el-Mahâsna, Abydos, and Nag el-Qarmila, and includes that indeed, they should. Having (re-)established the blade type categories, section 5.4 assesses the degree of specialization for each blade type by looking at the distributions of production remains and tools, drawing on data from the three sites studied here along with data available in the literature on Predynastic Egypt. This analysis shows that there were many different ways blade production was organized, and that a simple dichotomy between items made by sponsored specialists and ad hoc production does not capture the diversity of Predynastic stone tool organization.

Blades result from a reduction strategy whereby flaking follows scar ridges that are roughly parallel to the flaking axis. The detached pieces produced (blades) generally have relatively parallel margins, although some may converge at the distal end. They have one or two dorsal ridges forming a triangular or trapezoidal cross section. Blades are usually relatively thin, and generally have a uniform thickness (Andrefsky 2005:165). Because identifying these characteristics can be somewhat arbitrary in practice, Tixier (1963:36) defined a blade as any detached piece where the length along the striking axis is equal to or more than twice the width. Most publications on Predynastic lithic artifacts follow this rule of thumb (e.g. Ginter and Kozlowski 1994:48; Holmes 1989:445). Blades can be produced through a variety of technologies, including different kinds of percussion flaking, or pressure flaking (Dessrosiers 2012; Pelegrin 2012; Whittaker 1994; Wilke and Quintero 1996).

A number of different blade subtypes exist in the literature on Predynastic Egypt. Bladelets, medium-sized blades, and large blades are differentiated based on metric measurements. These can then be further separated into even more subtypes based on characteristics such as raw material, heat-treatment, and twist. In this section the signature characteristics of Predynastic Egyptian bladelets, medium blades, and large blades are described, along with their associated cores, and any details known about how they were produced. Additionally, descriptions are also given for twisted blades and trapezoidal blades. The characteristics for all the blade subtypes are summarized in Table 5.1.

Bladelets

There is some variability in how bladelets are defined. For instance, at Adaïma bladelets were defined as blades below 1.5cm in width and 3cm in length (Midant-Reynes and Prost 2002:305), while at Maadi Rizkana and Seeher (1988:21) mention that "the usual separation between blades and bladelets at 5cm length is not realistic" for their assemblage. Others follow Tixier's (1963) definition of bladelets as small blades with a maximum width of 1.2 cm (Ginter and Kozlowski 1994:48; Holmes 1989:445), and Tixier's definition is also followed here to facilitate comparison because it is the most commonly used definition for bladelets. Figure 5.1 shows examples of bladelets from el-Mahâsna. Observation of bladelets in the assemblages analyzed for this dissertation showed that they tend to be thinner than regular blades, and have very small platforms. Table 5.2 shows the average dimensions for bladelets from the sites analyzed here. The average bladelet from these sites is just over 3cm long, 1-1.12 cm wide, and .33-.45 cm thick.

Bladelet cores have a length similar to bladelet dimensions. The removals are parallel (part of the process of creating ridges for subsequent removals), and a few authors have noted that the bladelet core scars tend to have rather regular scars (Holmes 1989:111, 293; Rizkana and Seeher 1988:17). Analysis of the materials presented here left the impression that bladelet cores tend to be single platform with regular scars and a conical shape (Figures 4.35-36). The tendency for bladelet cores to be single platform has been observed at other sites (e.g. Holmes 1989:111, 293; Hikade et al. 2008:179, 181; Midant-Reynes and Prost 2002:317; Rizkana and Seeher 1988:17, Pl2) and the conical shape is often depicted in the associated drawings.

The category "bladelet" can encompass multiple production trajectories. At Hierakonpolis three different trajectories of bladelet production have been defined (Holmes

1992a; Takamiya and Endo 2011). One trajectory is specifically for making micro-drills. The raw material chosen for microdrill production is a course gray chert. In this case the choice of raw material is definitely functional as the coarse material would have stronger edges and be more abrasive, properties which aid the drilling process. The microdrills were found abundantly at HK29A. A second specific kind of blade production identified at Hierakonpolis is heat-treated bladelet production, where bladelets were produced from heat-treated cores. The final kind of bladelet production defined at Hierakonpolis is where bladelets were made from non-heat-treated cores of regular (non-coarse) chert raw materials. Additionally, bladelets with a longitudinal twist are also known from Predynastic sites. These will be discussed in the twisted blades section below.

Rizkana and Seeher (1988:16-17) offered a reduction sequence for bladelet and small blade production from gravel chert at Maadi. First, small roundish gravel nodules "rarely larger than a fist" were selected. Then one end was removed with a "heavy blow", resulting in an oblique break and creating the platform. As a result of this oblique break, one side of the core had an obtuse angle, the other an acute angle, the latter of which was used for removing the blades. The core was worked from the acute platform angle end only, and no further preparation was necessary. Hikade (1996:35) measured the platform angles on 24 bladelets and bladelet tools form Abydos cemetery U and found them to be 60-70 degrees. Holmes (1989:290-291, 1992:42) and Rizkana and Seeher (1988:19) suggested that small blades and bladelets may have been produced from soft hammer percussion, indirect percussion, or pressure flaking. Hikade (1996:35) offered indirect percussion as a possible removal technique based on the diffuse bulbs in some of the examples from Abydos cemetery U. Midant-Reynes and Prost (2002:317) proposed that soft hammer percussion may have been used because punctiform platforms are most common among the bladelets compared to other flake groups. No refitting or replication experiments have been reported out for any kind of bladelet production.

Bladelets spanned most of the Naqada period. In Lower Egypt they disappeared around NIId (Hikade 1996:35; Schmidt 1992a:34). There may have been some regional variation in the frequency of bladelets. They were quite common in Maadi and at Lower Egyptian sites, their frequency defining the Buto-Maadi lithic industry (Rizkana and Seeher 1988; Schmidt 1992a, 1999). Although not as frequent, they were also present in Upper Egyptian assemblages (e.g. Mostagedda: Holmes 1989; Hierakonpolis: Holmes 1989, 1992).

Medium blades

Here the term "medium blades" is used to designate the blades which fall in neither the bladelet nor large blade metric categories. These were the most common Predynastic Egyptian blades. Holmes (1992a:41) and others noted that medium blades were not particularly regular (e.g. Holmes 1992a:41; Rizkana and Seeher 1988:19; Takamiya and Endo 2011:733; Vermeersch et al. 2004:229). Figure 5.2 shows some examples of medium blades. Unfortunately, little dimensional data just for these blades was available, since the metric data for medium blades and bladelets are sometimes combined. Table 5.3 shows the metric data for medium blades from el-Mahâsna, Abydos, and Nag el-Qarmila. The average size tends to be 3.6-4.4cm long, 1.5-1.8 cm wide, and .5-.7cm thick.

Some idea of how medium blades were produced has been gathered from the cores and the blades themselves. Predynastic medium blade cores tend to have a single platform and removals in a single direction, but some cores also have 90 degree platforms, or opposite platforms. Single platform blade cores are the most common kind of core at Armant and Maadi

(Ginter and Kozlowski 1994:72; Rizkana and Seeher 1988:16-17). From HK29 Holmes (1989:293) reports that the medium blade cores are all single platform, exhausted, and with steep platform angles. At Adaïma there are many mixed flake and blade cores that are multiplatform and globular, but they also have a consistent proportion of single platform blade and bladelet cores (Midant-Reynes and Prost 2002:317). Holmes (1989:111) proposed that medium blades from the Badari area may have been produced through indirect or soft hammer percussion.

Large blades

Some blades are so much larger than medium blades that they must have been made with a distinctive production technology. Large blades were the blanks for the tools known as 'Gerzean blade knives' (Baumgartel 1960:40, 41), 'Hemamieh knives' (Schmidt 1992a:32-33), or 'Blade knives' (Holmes 1989:402), and 'Endscraper knives' (Baumgartel 1960:37) which were found quite often in cemeteries, but also in some settlements (Brunton and Caton-Thompson 1928: 45-47; Holmes 1989:118; Payne 1993:156-158; Takamiya and Endo 2011:739). Table 5.4 gives the dimensions of some examples of large blades from settlements and Figure 7.7 shows examples of large blade tools. Lengths ranged from 10-17+cm, widths 2.5-4.4cm, and thicknesses 1.5-3+cm. These dimensions are noticeably larger than the medium blades from the sites analyzed here (Table 5.3), which rarely reached more than 8cm in length, and average closer to 4 or 5cm in length. Additionally, Holmes (1989: 402) gave dimensions for 'blade knives' as 8.2-15cm in length. Therefore large blades are here defined as wide and thick blades whose length is over 8cm, usually 10cm+.

Baumgartel described large-blade knives as the typological markers for the Naqada II period. Looking at patterns of retouch, Schmidt (1992a:32-33) found that the retouch pattern typical of Baumgartel's Gerzean blade knives was present in Tel Iswid from the NIIc period on, but that less-standardized versions were present in earlier periods at Tel Iswid and in upper Egyptian sites. However Schmidt's observations were not correlated to blade size. The settlements with the above examples of large blades fit with a Naqada II date for the knives.

No description of cores specifically for these large blades was found in the literature, but presumably the dimensions of the cores should approximate the dimensions of the blades in terms of length. However, a possible problem with finding large blade cores is that such cores may have been re-purposed and further exploited to make smaller blades (or even flakes) after they were reduced to a size too small for large blades. Alternatively such blade cores may have been reduced in the desert near raw material sources and not transported to settlements.

No production process has been proposed for large blades. The size of the large blades indicates that these were unlikely to have been produced through pressure (see Pelegrin (2012) for pressure flaking techniques and associated maximum widths), leaving direct or indirect percussion as possibilities.

The question of twist

Blades of each of the above defined dimensions (bladelets, medium blades, and large blades) may have the added attribute of a longitudinal twist. That is, when looking down the length of the blade from the platform, the distal end is rotated. Rizkana and Seeher (1988:19) found that twist was a common feature of the longer blades (up to 20cm in length) and note that a twist is "typical of large blades of Predynastic date." Indeed Baumgartel (1960:34,40) considered large twisting blades to be the hallmark of the Naqada II period. However twisted versions of smaller blades are also known. Schmidt (1996) described the lithics of the Buto-

Maadi culture as a twisted blade and bladelet industry, and gave data on the twist direction of bladelets, (medium) blades, and large blades at Tell Ibrahim Awad (Schmidt 1992a:81). In the field analyses conducted for this study, twisted versions of both medium blades and bladelets were identified.

A question remains as to the relationships between twisted and non-twisted versions of blades of all dimensions, and how different or similar their production processes were. Rizkana and Seeher (1988:19) conjectured that twisted blade cores would be pyramidal shaped with corresponding scars that ran obliquely from the upper left to the lower right of the core face. However they identified no such cores at Maadi, even though most of the blades there had this distinct twist. Thus the question of how twisted blades and bladelets were produced remains open.

Outside of Egypt, Pelegrin (2012) noted from his experimental reproductions that pressure blades produced by holding the core in the hand, rather than stabilizing it on the ground or with a device, often had a slight twist. Pelegrin also noted that with increased stability of the core, the blades were more regular. Accordingly, it is conceivable that the Egyptian twisted blades might have been made using a method where the core was not particularly stable.

Data on twists indicate that there may be some differences in production. Rizkana and Seeher (1988:19) reported that at Maadi blades and bladelets blades were invariably twisted anti-clockwise. Schmidt (1992b:81) found the same consistently counter-clockwise twist at Tell Ibrahim Awad in the layers transitional between the Predynastic and Early Dynastic periods. However study of the direction of twist for a sample of medium blades and bladelets from el-Mahâsna indicated both clockwise (20.2%) and counter-clockwise twist (17.24%), with 51.23% showing no twist, and 11.33% indeterminate. Furthermore, the degree of twist can vary. Rizkana and Seeher (1988:19) reported that “a difference of 20-40° between the plane of the distal and the proximal end is common,” but that some twist as much as 70-80°. They also noted that many blades curved to the right in plan view.

Other differences in production may relate to heat-treatment. Schmidt (1996:280) argued that nearly all of the twisted bladelets of Buto and Tell el-Iswid were glossy, and therefore likely heat-treated. Heat treatment was often done to make pressure flaking easier (Domanski and Webb 2007; Luedtke 1992), so it is possible that the heat-treated bladelets were detached using a pressure technique. However, as discussed above, larger blades could also be twisted. Detaching very long blades with a pressure technique is much more complicated (Clark 2012; Pelegrin 2012). Therefore it is likely that there were differences between the production processes for twisted large blades and twisted bladelets, and possibly even for twisted medium blades.

Twisted blades of all kinds cover a range of time in the Predynastic period. Maadi, and its twisted blades and bladelets, date to the NI-NIIb (Seeher 1999b), while at Buto the end of the twisted bladelet industry is in Buto layer III (Schmidt 1996), which is equivalent to the Late Predynastic/ Naqada III (von der Way 1999:210). The large twisted blades and blade knives are characteristic of the Naqada II period (Baumgartel 1960:40).

Prismatic blades

Prismatic or trapezoidal blades with very straight parallel margins and ridges were made in Egypt during the Pharaonic period. Barket and Yohe (2011:31) studied trapezoidal percussion blade production from Wadi el-Sheikh. On the few complete trapezoidal blades that they were able to observe the blades ranged from around 8-12cm in length, and mainly had punctiform platforms. Recent research at Wadi el-Sheikh shows that the blades were very narrow ranging from .6cm to 2.4 cm, and averaging around 1.2cm (Hart et al. *In prep.*). The cores for producing these blades are very distinctive, with an acute platform angle of around 40°. They are also thin, often with cortex remaining on both sides, likely as a result of using the tabular material found in Wadi el-Sheikh. The core sizes found by Barket and Yohe (2011:35) were 17 to 19cm in length, 4 to 8cm in width, and 3 to 5cm in thickness.

Barket and Yohe reconstructed a reduction sequence for trapezoidal blades. A bifacial crest was prepared and then removed to create a long flat platform. Another crest was prepared on the flaking face to facilitate the blade removals that would follow. The blades were detached unidirectionally, from one face of the core only. In cases where the raw material was already in a suitable shape for removing blades, the crests were not prepared.

Recent finds at a particular locality in Wadi el-Sheikh (L20) where trapezoidal blades and cores have been found date the site to the Early Dynastic through Old Kingdom periods (Köhler et al. 2017), and similar material has been found in a nearby Early Dynastic-Old Kingdom settlement site (Pawlik 2006). During the Naqada II period more regular blades become common throughout the Nile Valley and delta (Ginter et al. 1996; Hikade 2010:8; Holmes 1989:392). Often these were used for sickle elements (e.g. Kindermann 2008). By the early Dynastic period prismatic blades were produced in large quantities at workshops adjacent to desert quarry sites (Köhler et al. 2017).

5.3 Re-evaluation of Blade Categories

Despite the seeming distinctness of the blade types described above, some authors have questioned whether Predynastic blades and bladelets should really be treated as separate types

(Holmes 1989; Takamiya and Endo 2011). After all, the division between blades and bladelets was originally organized by Tixier (1963) who was looking at assemblages from the Epipaleolithic of the Maghreb, a different cultural context. Were Predynastic medium blades and bladelets made through separate production processes, or was there essentially one process that resulted in both smaller and larger blanks? In other words, are medium blades and bladelets actually different types? Holmes (1989:290,297) and Takamiya and Endo (2011:733) state that blades and bladelets from Hierakonpolis grade into each other in terms of size, and they therefore suggest that they are one reduction technology. However it is not clear how they came to these conclusions as no statistical data were presented. Conversely, preliminary observations of the el-Mahâsna material left the impression that medium blades and bladelets had different bulb and platform characteristics, which could indicate that they were made in distinctive ways.

Furthermore, typological questions also surround the division of blades/bladelets into twisted and non-twisted forms. Do twisted blades and bladelets really result from production strategies distinct from those of non-twisted blades and bladelets? Or are these perceived differences in form merely byproducts of their production process, perhaps unintentional on the part of the producers?

Since these typological/technological questions exist, before analyzing whether their production processes can be considered specialized, it is critical to first assess whether each of these blade subtypes is really different from the others, or whether they should be combined into fewer groups. In order to test the blade categories, the blades analyzed from el-Mahâsna, Abydos, and Nag el-Qarmila were separated into the above blade types according to certain relevant attributes during the primary data collection analysis, then later other attributes—attributes thought to vary depending on the production process—were used to analyze whether the members of each group were essentially similar or different. The attributes used to classify the blades into types during the data collection analysis were: width, presence of twist, and the presence of straight parallel margins and ridges. Then the similarities or differences among these groups were assessed using statistical evaluations of platform types, platform areas, and bulb types. The premise is that items resulting from distinct production processes would have different attributes in terms of the platforms and bulbs.

Results of data collection

Some information regarding the results of the initial classification of blade types from the three analyzed sites is necessary before moving on to the re-evaluation of blade types. Table 4.20 gives the overall frequency of blade debitage (of all types combined) at each of the three sites in this study. Nag el-Qarmila (AKAP WK15), has a much smaller percentage of blades than el-Mahâsna or Abydos. Table 5.5 shows the frequency of the blade types identified among the debitage across the three sites analyzed here. Table 5.6 shows the frequencies of blade types identifiable as tool blanks. Both medium blade and bladelet debitage were present at all three sites (Table 5.5). Medium blades were the most common type of blade debitage in all cases, with percentages ranging from 44-52% of the blade debitage. Tools made on medium blanks were found at all three sites, and comprised the most common type of blank for blade tools (Table 5.6). Tools made on bladelets were found at el-Mahâsna and Nag el-Qarmila, but not at Abydos.

Tools made on twisted medium blades were found at el-Mahâsna, and Nag el-Qarmila, but not at Abydos (Table 5.6). Tools made on twisted bladelets were only found at el-Mahâsna. However, twisted blades and twisted bladelets were present among the debitage at all three sites, counting for roughly 5-15% of the blade types (Table 5.5). The relative degree of twist was recorded for a sample of 91 twisted blades from el-Mahâsna (Table 5.7). Approximately 12% were only slightly twisted, and only 3 (3.3%) were very twisted.

Tools made on large blades were identified at el-Mahâsna and Abydos (Table 5.6). However no debitage from any of the three sites could be reliably identified as large blades (Table 5.5). The only cores that could have produced detachments of large blade dimensions were found at el-Mahâsna, but they had only flake removals without any signs of blade removals. This evidence suggests that while the large blades tools were used at el-Mahâsna and Abydos, they were not manufactured in any of the excavated areas. Because there are few examples of large blades, the following evaluation of the distinctness of blade subtypes will focus only on the medium blade, bladelet, twisted blade, and twisted bladelet types.

Re-evaluation of blade subtypes based on platforms and bulbs

The analysis of how distinct the blade type categories are is first carried out using data from one site only, in order to control for any differences in production by site. The analyzed material comes from el-Mahâsna, because it had the largest sample size, and largest range of blade types present. Below, platform types, platform area, and bulb types are each evaluated across blade type categories for comparability. Each attribute is described, along with the statistical method for evaluating the attribute in question, and the results given. A summary of the results showing that medium blades and bladelets should be considered separate types is given after presenting all the results of the attribute assessments. Following that, data from Abydos and Nag el-Qarmila are analyzed showing that the conclusions drawn regarding blade types at el-Mahâsna can be extended to the other sites.

Platform type

A platform on a blade is the area of the core surface where force was applied, that still remains on the detached piece (Figure 5.4). The different types of platforms mainly refer to the number of facets on the platform (for complete descriptions see the Appendix). The platform type categories used here are commonly found in, and comparable to, other publications dealing with Egyptian lithic artifacts (Close 1980; Ginter and Kozlowski 1994; Holmes 1989; Midant-Reynes and Prost 2002). Often platform faceting correlates with different kinds of reduction strategies (Debénath and Dibble 1994:13-14; Tomka 1989:146-147). Therefore differences in platform faceting among blade types may indicate different reduction strategies.

Table 5.8 shows that there is some variability in platform type frequencies across blade types. A chi-square test was used to assess whether there was a relationship between platform type and blade type. The null hypothesis was that the platform type is independent of blade type (no relationship between the variables). The alternative hypothesis was that platform type was related to the blade type. The null hypothesis would be rejected if the probability calculated from the chi-square statistic was equal to or below .05. The validity requirements for a chi-square test are as follows: The variables should be independently measured and defined, and the generated expected counts should all be above one, with fewer than 20% below five (Thomas 1986:298).

A chi-square test of eight platform types (cortical, flat, dihedral, multifaceted, linear, broken, other, indeterminate) by the four blade types (medium blade, bladelet, twisted medium blade, twisted bladelet) was determined not to be valid because the sample sizes were too small: many of the expected counts were below one and over 50% were below five. However, a valid chi-square test was performed on a contingency table looking at the platform types of only the medium blade and bladelet categories. The results were a Pearson's chi-square statistic of

18.5122, with 7 degrees of freedom, and a probability of .009861. This probability is well below .05, so the null hypothesis that platform type is independent of blade type should be rejected. In other words there is a better than 99% probability that the variation in platform frequencies noted on medium blades and bladelets is not just due to chance. Therefore platform type does vary by blade type, which is what would be expected if medium blades and bladelets resulted from different production processes.

However, there is some indication that this variation in platform type may be related to platform size. In this case the linear and the multifaceted bladelet platform chi-square values were furthest from zero, thus causing the most influence, as might be guessed by looking at the frequencies. There is a high frequency of linear platforms among bladelets, and a low frequency of multifaceted platforms among bladelets (Table 5.8). These frequencies are probably related to platform size, since a smaller platform is less likely to pick up any faceting (resulting in a low occurrence of multifaceted platforms), and linear platforms are by definition minute, so the platform area may be affecting the variability of platform type.

The question still remains regarding how the platform types of the twisted medium blades and twisted bladelets compare to each other and to the medium blades and bladelets. Although the significance of the variation in platform type frequencies could not be evaluated via a chi-square test for the twisted blades and twisted bladelets, it was still possible to assess whether the variation in frequencies of platform type was significant by comparing the binomial confidence intervals[23] of select platform types. The binomial confidence intervals were calculated for the flat platforms since the flat platforms showed the most variation across blade types. Despite this variation, the binomial confidence intervals mostly overlap (Figure 5.6), showing that the frequencies of flat platforms cannot be statistically differentiated at the 95% confidence level for medium blades, bladelets, and twisted medium blades. While flat platforms are significantly more common among the twisted medium blades than among the medium blades, the frequency of flat platforms for twisted medium blades cannot be completely differentiated from bladelets and twisted bladelets.

In sum, the chi-square test indicates that blades and bladelets may very well have a different spectrum of platform types. Additionally, the confidence intervals of the frequencies of flat platform types indicate that flat platforms are more common among twisted medium blades than among regular medium blades, giving some indication that these two types may come from distinct production methods, however, as is shown below the overall relationship between medium blades and medium twisted blades is somewhat ambiguous.

Platform area

Since the differences in platform type are likely related to platform area, platform area was also analyzed. Platform area was obtained by multiplying the measurement of platform width by the measurement for platform thickness (Figure 5.4). A box plot of the platform areas by blade type shows variation in median platform areas between blade types (Figure 5.8). The means also show variation, with the mean thickness of medium blades much larger than the other blade types (Table 5.9).

A one-way analysis of variance (ANOVA) test was used to compare the means of the platform areas of the different blade types. ANOVA is an appropriate test to use when comparing

[23] See Chapter 2: Methods.

means across more than two groups. The requirements of an Anova test are that the observations are independent, that the data approximate a normal distribution, and that the groups have similar variability. To examine whether the data approximate normal, the quantiles were plotted against the quantiles of a normal distribution (a qq plot). If the data are normal then the resulting plot should be close to a straight line, but these did not. Therefore the log of the data was computed in order to transform them to a normal distribution. QQ plots of the resulting data show that they approximate a normal distribution (Figure 5.7). The variances of the transformed data are given in Table 5.9, and show that the variances are (basically) similar. Nonetheless, a Bartlett's test for homogeneity of variances was run on the log transformed platform areas. With Bartlett's test the null hypothesis is that the variances are equal, and the null is rejected if the p-value is below .05. The Bartlett's test of the log platform areas returned a p-value of 0.1114, so the null hypothesis that the variances are homogeneous holds, and the assumptions for the ANOVA are met.

The null hypothesis for the ANOVA was that the means of platform area for all blade types were equal. The alternative hypothesis was that at least two of them were different from each other. The null would be rejected if the probability calculated was equal to or below .05. Table 5.10 gives the ANOVA results. The p-value, or the probability that the null hypothesis is true, is far smaller than .05, therefore the null should be rejected—not all of the means are essentially the same, at least two of them are significantly different.

The goal here is to understand which, if any of the blade subtypes have statistically different attributes, which could indicate that they likely come from different production processes. Therefore knowing that some of the means are significantly different from each other is not enough, but an understanding of which means are significantly different is necessary. A glance at the means (Table 5.9) shows that the average platform area of medium blades is double that of any other blade subtype. A post-hoc test called Tukey's Honestly Significant Difference was done in order to verify which means are different. Tukey's HSD uses data (Mean Square Within) from the Anova to calculate what a significant difference would be (HSD), and then compares each pair of differences in mean to the HSD.[24] Table 5.11 shows the results of the Tukey's HSD including the pairwise differences and the corresponding probabilities. A probability below .05 would indicate a significant difference in the means. According to this, the medium blades and bladelets have significantly different mean platform areas.

Since these tests indicate that the platform areas of medium blades and bladelets are significantly different, then it is reasonable to conclude that blades and bladelets were made through different production processes that resulted in different platform areas. Again, as with platform types, none of the other blade subtypes could be differentiated from each other based on the platform areas.

Bulb type

A bulb of force (also known as a bulb of percussion) is a protrusion on the ventral side of a flake just below the platform, reflecting the Hertzian cone resulting from conchoidal fracture (Figure 5.5). Bulbs types were defined according to the size and prominence of a bulb relative to the rest of the flake. There were four main categories: diffuse (no bulb), moderate, prominent, and small prominent, along with other and indeterminate (for specific definitions see the Appendix). The formation and size of a bulb of force is thought to relate to the technique of flake

[24] For the exact formula and more information on Tukey's HSD see: Tukey 1949, Or http://faculty.ucmo.edu/dkreiner/psy2120websitestuff/psy2120oldexams/documents/StatSheet12_TukeysHSD.pdf

detachment including hammer type, force, and application of force (Andrefsky 2005:20). For example, pressure flakes tend to have short fairly pronounced bulbs (Inizan et al. 1999:63). Direct percussion with a soft hammer (such as an antler) rather than a hard hammer (such as stone) produced flakes with relatively thinner bulbs of percussion in an experimental setting (Pelcin 1997a).

Table 5.12 shows that there is variation in bulb types when blades were grouped according to blade subtype. A chi-square test was run to assess whether there was a relationship between bulb type and blade type. The chi-square test of the six bulb types (prominent, moderate, diffuse, small prominent, other, indeterminate) by the four blade types was determined not to be valid because the sample sizes were too small- many of the expected counts were below one and over 50% were below five. However, a valid chi-square test was run on a contingency table looking at the bulb types of the medium blade and bladelet categories only. The results were a Pearson's chi-square statistic of 21.3332, with 5 degrees of freedom, and a probability of .0007006. This probability is well below .05, so the null hypothesis that platform type is independent of blade type is rejected. In other words there is an over 99% probability that the variation in bulb type frequencies is not just due to chance. This suggests that bulb type is related to blade type, or to put it in other words, the blade types have statistically different bulb types. By extension, this variation in bulb type likely means that the blades were made in distinctive ways, and so should be considered different types.

Since the chi-square test could not be run with the data from twisted blades and twisted bladelets, the significance of the variability in bulb types for twisted blades and twisted bladelets was tested using binomial confidence limits. Moderate bulbs showed the most variability between categories, so the confidence limits of the frequency of moderate bulbs for each blade type was analyzed. The binomial confidence intervals of the proportions of moderate bulbs (Figure 5.9) shows clearly that the proportions of moderate bulbs on medium blades and twisted medium blades are similar, and the proportions of moderate bulbs on bladelets and twisted bladelets are similar, and that the two groups (medium blades/twisted medium blades versus bladelets/twisted bladelets) are different from each other. The twisted bladelet category is a very small sample so it has a much larger confidence interval that overlaps slightly with the twisted medium blades, but otherwise the pattern is clear. These confidence intervals provide some indication that in terms of bulbs, bladelets and twisted bladelets are similar, while medium blades and twisted medium blades are similar.

These data support the findings from the above platform analyses that blades and bladelets have statistically distinct attributes and so likely result from different methods of production, and should therefore be considered distinct types. However this bulb analysis additionally indicates that twisted medium blades may be differentiable from twisted bladelets.

Summary of blade type assessment

Table 5.13 summarizes the outcomes of the above tests. It is very clear is that in almost every case the medium blades and bladelets have significantly different attributes, and should be considered different types.[25] The relationship between bladelets and twisted bladelets is also quite clear, but in contrast the results reveal that their characteristics consistently overlapped, so they should be grouped together. The logical extension of these two conclusions, that medium blades should be differentiated from twisted bladelets, was reasonably well supported by these tests.

However, the relationship of twisted medium blades to each of the other blade subtypes was not as clear cut. The platform areas of the twisted medium blades were smaller than those of the medium blades, and quite similar to those of the twisted bladelets, but the bulb types of twisted medium blades were more similar to medium blades than to either bladelets or twisted bladelets. Therefore, in the following section examining which items were specialized, bladelets and twisted bladelets will form one group, medium blades will be treated as a second, separate group, and twisted medium blades will be omitted from the assessment.

Do these conclusions hold true across sites?

Having completed the analysis of data from el-Mahâsna, the next issue to consider is whether these conclusions about blade types are generalizable to other sites. This is done by comparing these same attributes across sites. The analyses below show that the attributes of medium blades do not differ significantly across sites. The sample sizes of the other three blade subtypes were too small for meaningful statistical comparisons, but since the medium blades compare favorably across sites, then it is assumed that the other blade types probably also are similar.

The proportions of platform types and bulb types among medium blades from el-Mahâsna were compared to those of Abydos and Nag el-Qarmila. The 95% confidence intervals

[25] The fact that the frequencies of flat platforms cannot be differentiated between the medium blades and bladelets does not negate this conclusion for two reasons. First, the chi-square is a better measure because it compares all of the platform type categories, rather than just one. Second, it is entirely

were used to assess whether any differences might be due to random chance, or whether the variations reflect real differences in the populations. For platform types, cortical platforms showed the widest range of variation (Table 5.14), and so the confidence limits were compared. Despite this variation, the 95% confidence limits for the frequency of cortical platforms from each of the sites overlap (Figure 5.10), indicating that the differences are not meaningfully different. Since all of the other platform types show less variation, and have the same sample sizes, their confidence intervals will all overlap as well.

The metric platform areas were also compared between the sites. Box plots of the platform areas of medium blades (Figure 5.12) shows that while the mean and median are slightly higher at el-Mahâsna the data are similar in terms of median, spread and skew. An ANOVA was run to test the null hypothesis that the means of the platform areas from all three sites are essentially similar. The platform areas were adjusted through a log transformation so that the data are normally distributed and variances are homogeneous (Figure 5.13). The Anova of the log transformed platform areas returned a p value of 0.573, well over .05, so we cannot reject the null hypothesis that all three means are equal. Therefore, in terms of platform sizes medium blades cannot be distinguished across the three sites.

Similarly, the proportions of bulb types (Table 5.15) for medium blades is notably similar at all three sites. Moderate bulbs showed the most variability, however the confidence intervals (Figure 5.11) indicated that this variability is not necessarily significant. Therefore, medium blades cannot be differentiated across sites in terms of bulb types.

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possibly that two different production methods may produce *some* attributes in similar frequencies. That is why multiple attributes were analyzed.

Given that the data were comparable for platform type, platform area, and bulb type, the conclusions regarding blade subtype groupings can be extended to other Predynastic sites besides el-Mahâsna. To re-cap, medium blades and bladelets are clearly distinct groups, and twisted bladelets can be considered part of the bladelet group. Twisted medium blades are somewhat ambiguous, and so will not be included in the following analyses. All in all that leaves two main blade groups, medium blades and bladelets, along with large blades, to be considered in the rest of this chapter.

5.4 Blade Specialization at an Inter-Community Level

Specialized production of blade subtypes is assessed here through an examination of the distribution of production remains and tools across settlement sites, then, in section 5.6 within sites, for the blade types: large blades, medium blades, and bladelets. The category of bladelets can be further subdivided into heat-treated bladelets, non-heat-treated bladelets, and microdrill bladelets because the differences in the raw material choice or preparation of the raw material.

Comparing sites is somewhat challenging because data were reported or collected with different degrees of specificity or different foci. Therefore presence/absence tables were generated to compare the settlement site data, which enabled a more extensive comparison than a frequency/proportion comparison would have. While the focus is on the settlement data, information on lithic artifacts in the associated cemeteries was also consulted when available. A few terms should be explained. The word “blanks” refers to un-retouched blades or bladelets which could have been discarded production debris, unfinished tools, or pieces that could have been used as tools without further modification. Along with cores, “core rejuvenation pieces” (e.g. core tablets), “crested blades,” and “plunging blanks”[26] are all specific kinds of production remains.[27] It should be pointed out that empty spaces in the presence/absence tables do not necessarily indicate that the item was definitely not present, but rather, only that it was not reported. There are multiple reasons why such information might be omitted. For example, during the original research a given item type may not have been differentiated from other items such as when bladelets are not differentiated form blades, or the data may not have been pertinent to the original publication topic, such as the presence of blades with plunging terminations for a publication focusing on tool use. In the presence/absence tables, a solid black circle indicates that the specified item was definitely identified at the given site. A red “X” indicates that the item was looked for, but specifically reported as not present. Some of the presence/absence information was determined from the published drawings of the artifacts in addition to the text and tables, or from reference to museum collections (in the case of certain items from cemeteries). Finally a few notes worth bearing in mind: Systematic data on debitage and tools from North Town was not given in Holmes (1989), but the presence of a few items mentioned may be significant, and so North Town was included here.

Medium blades

Table 5.16 shows that for medium blades, most types of production remains and tools were present at almost all sites. Congruously, medium blade blanks and blade tools were also found in all of the corresponding cemeteries where data were available (Abydos cemetery U (Hikade 2000); Naqada cemeteries (Holmes 1989); Armant cemeteries (Mond and Meyers

[26] Plunging blanks having a thick and often curving termination that removed part of the end of a core.

1937); Adaïma cemeteries (Crubézy et al. 2002); Hierakonpolis HK6 (Adams 2000a; Friedman et al. 2011a,c). A closer look at the settlement sites where some production elements are missing indicates that despite these missing elements it is still likely that blade production occurred at those sites. At el-Mahâsna, Abydos, and Nag el-Qarmila no core rejuvenation pieces for medium blades were reported, but that is because all core rejuvenation pieces were treated as a single category and not separated into blade core rejuvenation pieces and flake core rejuvenation pieces. This means that it is not known whether blade-core rejuvenation pieces were present at those sites—they very well may have been. At Hierakonpolis, locality HK 11C did not have any blade cores, but other remains from medium blade production were found there, such as crested blades. Similarly, at HK29 there were no crested blades but there were blade cores. Since at this point the aim is to compare findings among sites and across regions, the Hierakonpolis localities can be grouped together, in which case certainly all the elements of medium blade production were well represented at Hierakonpolis. In the Naqada region, North Town materials were not fully reported in the publication, so the absences there cannot be considered reliable. South Town did have cores in addition to blanks, a strong indicator that blade production occurred there. KH3B did not have any production remains besides blanks (which can be used as tools), so, at best, the jury is still out on whether or not there was blade production at KH3B, and it is perhaps the exception that proves the rule. In all, the data indicate that blade production was found at most sites and cannot be considered specialized at an inter-community level.

The presence/absence data has two drawbacks. This kind of information does not allow for a closer comparison of frequencies and proportions, so the quantity or frequency of production may vary among the sites. For instance the medium blade production at Naqada

[27] See the Appendix for definitions.

KH3B may have been of a low intensity compared to other sites, which would account for why few production remains have been located in the archaeological record. The second problem is that there may be variability in the kinds of medium blades produced at each site. For instance at Maadi a difference was discerned between larger medium blades produced from quarried nodules and other medium blades produced from gravels at the site (Rizkana and Seeher 1988:16-17). Conversely, at Hierakonpolis the medium blades produced were described as small (Holmes 1996:95). This variability in the medium blades from different sites indicates that there were probably producers in each community, producing slightly different blades, thereby providing more support for the conclusion that medium blade production was not specialized at an inter-site level.

Furthermore, the data on tool types (Tables 5.17- 5.18) also suggest that medium blade tool production was not specialized at an inter-community level for two reasons. First, many of the tools produced on these blades are ad hoc, such as burins, retouched pieces, notches and perforators. Burins are often made on broken tools, a form of re-use, and also exist in such a large variety of "types" that they seem to be an as-needed tool rather than systematically produced.[28] Tools classified as "retouched pieces" by definition exhibit non-standardized retouch that does not fit into another type category. Burins and retouched pieces are the most consistently represented pieces made on medium blade blanks both in the presence/absence data and in frequency data. The only sites where the presence of burins on blades is unknown are those where the medium blade blanks were not reported. Furthermore, in the sites where frequency data were available for tools made on blades, burins and retouched pieces are almost always the first and second most frequent tool types (in either order). Notches and perforators are tools that also rather variable and unstandardized in the Predynastic period.

Second, the range and frequency of tools produced on medium blades are basically comparable (Tables 5.17- 5.18). If a site or sites were producing tools for the other sites, we might expect the frequency of those tools to vary by site, depending on access. However, among tools made on blades the range of tool types present is basically similar at all sites.[29] The only sites that are missing a number of the tool types are those where the blanks were not specifically reported for some of the tools classes (North Town, Armant, HK29A, HK29B, HK25). On the whole, the data on medium blade debitage and tools indicate that medium blade production was not specialized at an inter-community level.

Heat-treated bladelets

Table 5.19 shows the presence/absence distribution of heat-treated bladelet tools and production remains across sites. It is immediately clear that this distribution is quite different from that of medium blades. Heat-treated bladelet tools and the production remains for making those tools were present at only a few sites (Badari, el-Mahâsna, Adaïma, and Hierakonpolis). At el-Mahâsna every stage of production for making heat-treated bladelet tools was found (Figure 5.3), including angular debris, debitage, a core of bladelet dimensions with a prepared crest

[28] For example, the following “types” of burins were found at HK29 (Holmes 1989:3): Single burin on a: break, oblique straight truncation, straight truncation, other truncation, retouched edge, unretouched edge, backed blade, other; Double burin on:1 break, 2 breaks, 1 burin on a break, burins not on breaks, other; Dihedral burins; Angle dihedral burins; Multiple dihedral burins; Multiple burins on: 1 break, on 2 breaks; Burins not on breaks.

(Figure 4.37), reduced bladelet cores, core trimming elements, heat-treated bladelet blanks, and bladelets tools. At other sites, heat-treated bladelet tools were present, but the production remains were glaringly absent from those sites (Abydos, Naqada sites, Nag el-Qarmila). Therefore, it is likely that heat-treated bladelet tools were not produced at all sites, but rather that some sites obtained heat-treated bladelet tools from elsewhere.

At the Naqada sites, although no heat-treated bladelet tools or production remains were found in the settlements, the tools themselves were reported from the cemeteries[30] (Holmes 1989:276-282). At Nag el-Qarmila, besides having no remains related to the production of heat-treated bladelet cores, the overall proportion of heat-treated material was quite low (1.6%) compared to el-Mahâsna (12.4%) and Abydos (8.5%). Abydos is an interesting case because there was no evidence for heat-treated bladelet production nor heat-treated bladelet tool use even though it is very near el-Mahâsna where there was extensive evidence for heat-treatment, including the production of heat-treated bladelet tools.[31] Therefore at the Naqada sites and at Nag el-Qarmila (AKAP- WK15) the tools were present where the production materials were not. A relatively small sample size may be a factor for Abydos, but since no categories of heat-treated bladelet production or use were present at all, it seems likely that something different was going on there compared to el-Mahâsna.

The range of tools produced on heat-treated bladelets (Table 5.20) was also strikingly different from those made on medium blades. For heat-treated bladelets, the tool production was

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[29] Blade knives are essentially a specific kind of backed blade so those categories can be considered together.

[30] The overall number of heat-treated tools in cemeteries is likely underrepresented in the literature because heat-treatment has not been assessed for stone tool assemblages until recently. Many bladelets and bladelet tools are known from cemeteries which have not been assessed for heat treatment.

geared toward one specific kind of tool—microendscrapers—a finding that aligns with expectations for specialized production. Microendscrapers (Gilead 1984; Holmes 1989) were the most commonly found tool type made on heat-treated bladelets. Along with those were some ad hoc tools such as retouched pieces, and occasionally other tools such as sickle blades or truncations. All in all, production of heat-treated bladelet tools, specifically microendscrapers, was clearly specialized at the inter-community level.

Microdrills

Microdrills present a third system of production (Table 5.21). Microdrills were made on coarse-grained bladelets, and few other tools were made on these coarse bladelets except for microdrills (Hikade et al. 2008; Holmes 1989, 1992a:41), indicating a production process geared toward a single tool type. In this case the microdrill production was concentrated in one area: Hierakonpolis. The use of the tools was also limited to Hierakonpolis. Note that no mention of microdrills was found in the assessment of cemetery lithics for this study. By the definition of specialized production used here, microdrills cannot be considered specialized. They were not used beyond the areas where they were made. However, microdrills may have been employed in the production of other specialized items.

Microdrill production was connected to bead drilling. Unfinished stone beads and carnelian debris were found at HK29A, where many microdrills were found. Experiments using flaked stone microdrills on carnelian pieces produced wear patterns that matched those found on the HK29A microdrills, indicating that they were indeed used to drill beads (Nagaya 2014). In

[31] Other heat-treated material was present at Abydos, but it was not related to bladelet production.

Nekhen (Kom el-Ahmar), the Early Dynastic to Old Kingdom town site on the floodplain in Hierakonpolis, Quibell and Green (1902:11-12) found a deposit with “an enormous number of exceedingly small pointed flint implements…and with them were many broken carnelian pebbles, some chipped into the form of rough beads, one or two of which showed signs of the commencement of the boring operation.” This description matches the descriptions of microdrills and bead remains from HK29A. These microdrills from Nekhen were found adjacent to an outer wall of the temple enclosure and Quibell and Green date them to the Old Kingdom. Additionally, microdrills were reported from a site at Abydos dating to the late Naqada period (Peet 1914:3-6), where they were also found with unworked carnelian and agate, and carnelian beads. The Abydos microdrills were probably produced on the spot, since much flaking debris was found associated with them, and cores were present. Concentrations of microdrills have been found in the Early Dynastic layers at Tel el-Farkha in the Nile Delta, where they were also produced and used in the same spot as evidenced by their production remains and heavy wear on the drills (Kabacinski 2012:339-344). However these later examples differed in some details of their production (raw material choice and treatment) from those discussed here. Jordeczka and Mrozek-Wysocka (2012:289) suggest the drills were used to make beads, but note that can’t be confirmed until trace analysis is done.

The Abydos example (and possibly the Tel-el-Farkha example) not only shows that microdrills were consistently used for bead production, but it also shows that the microdrills should not be considered only a regional phenomenon. The microdrills have been found in multiple regions, but in each case they were made and used in the same area. Perhaps a distinction between ‘specialized’ and ‘specific’ is useful here: Microdrills were not a subject of specialized production (which involves exchange), although they were made and used for specific purposes by a specific set of producers (who were probably making other items which would be considered specialized).

Large blades

Large blades show a distribution which indicates that they were made through specialized production since the products, but not the production remains, were present in most of the settlement sites studied here (Table 5.22). The one exception is Badari where there were two refitting unretouched blanks of large blade dimensions, and a single platform blade core of a quite similar raw material (Holmes 1989: 111, 118; Figure 7.7). The blade core dimensions were on the small side for large blades (L=10.7cm), but it could have been very reduced or used to produce smaller blades. Unretouched large blades were also found in South Town, but these had wear showing that the blanks were used as tools (Payne 1993:156-158). These findings indicate that for most sites the large-blade knives must have been produced outside of the settlement. This interpretation is supported by a study at Adaïma, where raw material analysis indicated that a number of 'backed blade knives' were imported into the settlement, not made there (Briois and Midant-Reynes 2008:25).

While the quantities of large-blade knives found in settlements was usually very few, large blades knives were found quite commonly in cemeteries, including cemeteries associated with each of the settlements studied here except for Nag el-Qarmila: el-Mahâsna Cemetery H (Ayrton and Loat 1911); Abydos cemetery U (Hikade 2000); Naqada cemeteries (Holmes 1989); Armant cemeteries (Mond and Meyers 1937), Hierakonpolis cemeteries (Quibell and Green 1902: 48-49 Pl61) and others (Table 5.22; Table7.18). Their presence in numerous cemeteries emphasizes the spatial disparity between their production in few sites, and use in many sites.

The range of tools made on these large blade blanks was limited to a few kinds of knives. The knives have been classified as 'Hemamija A' knives (more standardized retouch pattern), 'Hemamija B' knives/other blade knives (less standardized retouch pattern), or end-scraper knives (based on the shape of the retouch at one end) (Baumgartel 1960:37, 40-41; Holmes 1989:402-403; Schmidt 1992a: 32-33). The width of the knife may also be taken into account (Kabacinski 2012). It is very clear that the large blades were primarily used to make knives, and this restriction of tool types made on the large blades is in line with specialized production.

The distribution of the large blades extends well beyond the areas where they were made. Production of these large blades did not take place at most of the sites where they were used. Therefore it is possible to conclude that they were produced by specialists. However some question remains as to precisely how the specialization was organized. The large blades could have been made in some communities, such as Badari, and exchanged to other communities throughout the region or even to other regions. However it is not possible to say at this point how many communities produced large blades, only that it was likely very few. Additionally, large blades may have been made out at desert quarry sites since there were certainly raw material size requirements for these tools, and special raw materials may have been selected.

Non-heat-treated bladelets

Nothing conclusive can be said about the patterns of production for non-heat-treated bladelets at the inter-community level (Table 5.23). Heat-treated bladelets were not differentiated from non-heat-treated ones at the Armant, HK29B, and HK25 settlements. The same goes for the cemetery data. Bladelet blanks were present in Abydos cemetery U (Hikade 1998, 2000) and in Hierakonpolis HK6 (Droux and Friedman 2014), and microendscrapers have been identified at

Abydos cemetery U (Hikade 1998, 2000) and Armant (Mond and Meyers 1937) but it was not indicated whether any of these examples were heat-treated or not. From the settlement evidence it is clear that there was production of non-heat-treated bladelets at el-Mahâsna and at the Hierakonpolis localities, both of which also have evidence for heat-treated bladelet production. At Maadi, a site in Lower Egypt, there was a substantial amount of bladelet production; however it is not known how much of it was non-heat-treated since Holmes identified some heat-treated material from Maadi (Holmes 1992b). Most likely, only some of the material was heat-treated since at other sites where heat-treated bladelets were present there were also non-heat-treated bladelet remains.

There was no clear focus on the production of a certain tool type from non-heat-treated bladelets (Table 5.25). Retouched pieces (unpatterned tools) were the most commonly reported tool type, but other tool types have been reported sporadically. The represented tool types were somewhat similar to those reported for heat-treated bladelet tools, with some microendscrapers, denticulates, and truncations. On the whole there is not enough data to support any conclusions on the organization of production for non-heat-treated bladelets.

Summary of blade distribution at an inter-community level

In summary, the distribution of blade tools and production remains across sites shows that the organization of blade production was actually quite complex—there were multiple diverse ways tools were produced by different groups of people across the Nile Valley—not just simple homogeneous production. There were many different types of blade production, and they were all organized differently in terms of the sites of production and use.

Medium blades cannot be considered specialized at the inter-community level since they were made and used in all settlements studied. On the other hand, the production of large blades was specialized at the inter-community level. The large blade production was geared toward producing blade knives, only a few of these large-blade knives were recovered in each settlement, their production did not take place in most communities where they have been identified, and the number of production locations was likely quite few, possibly even at desert quarry sites. The heat-treated bladelet production constitutes a third kind of organization, where these items were produced in a number of settlements, but not all of them, yet the products reached all areas. There was not enough information on non-heat-treated bladelets to really discern their production pattern. They were at least made in the same sites that made heat-treated bladelets, possibly in others as well. And finally, microdrills showed another entirely different pattern of tool production, one which cannot be considered specialized according to the definition used here, because they were not exchanged. Microdrills were made in the same places where they were used, although what people made with the microdrills may have been specialized. All in all, the variety of blade production systems shows that Predynastic lithic production was anything but a homogeneous or simplistic affair.

5.5 Blade Specialization at an Intra-Site Level

There is sufficient data from el-Mahâsna and Hierakonpolis to look for differences in specialization within sites. Specialization was assessed through differences in the distribution of tools and debitage for different reduction sequences: medium blades, heat-treated bladelets, and non-heat-treated bladelets. As per the data in the preceding section 5.4, these blade types had evidence of production remains in settlements, and were either not specialized at the inter community level or could be even more finely specialized within the sites where they were produced.

Medium blades at el-Mahâsna

Table 5.24 shows the frequency of medium blade production remains and tools across three blocks at el-Mahâsna. The percentages do not vary greatly. There is sufficient data to calculate the confidence intervals (Figures 5.14- 5.15), which show that no real difference can be distinguished in the distribution of blade tools and production remains in el-Mahâsna. This information indicates that blade production should not be considered specialized within el-Mahâsna.

Non-heat-treated bladelets at el-Mahâsna

The non-heat-treated bladelet production was concentrated in Block 3. All the non-heat-treated bladelet cores and crested blades were found in Block 3 (Table 5.26). However, the sample size is rather small (all under 30), and the confidence limits for the percentages from different blocks overlap (Figure 5.16), indicating that the differences may not be meaningful. Therefore the concentration of production remains in Block 3 is not conclusive, and for now it is not possible to determine whether non-heat-treated bladelet production was specialized within el-Mahâsna. However at the 80% confidence limits the proportion of non-heat-treated bladelet cores in block 3 is statistically different from the other blocks. While not conclusive, this evidence is certainly intriguing.

Heat-treated bladelets at el-Mahâsna

Table 5.27 shows the counts of identifiable heat-treated bladelet debitage and tools at el-Mahâsna. Heat-treated bladelet production remains were present in Blocks 1 and 3, but not in Block 4. Block 3 had more cores, and the core in Block 1 is a prepared core with no actual bladelet removals (Figure 4.37). The sample size is small, and the 95% confidence limits for the percentages of cores all overlap, indicating that the differences could simply be due to sampling error. However, at the 85% confidence level the percentages are basically distinct (Figure 5.17) which means that the patterns are suggestive. While it is not possible to conclude that heat-treated bladelet production was definitely specialized within el-Mahâsna, there is some variability in the distribution of production remains which may be important, and, together with the data from Hierakonpolis (see below) may indicate a slightly more intricate way of organizing the production.

Given that the sample sizes were so small for the non-heat-treated bladelet and heat-treated bladelet data they were also analyzed as a combined group since the only difference in production may be in the raw material treatment. When the heat-treated and non-heat-treated bladelet data from el-Mahâsna were combined, production was clearly concentrated in Block 3 (Table 5.28). Six of the seven bladelet cores were found in Block 3, and only one (the prepared core) was from Block 1, while no bladelet cores of any kind were found in Block 4. The confidence intervals show that these percentages can be differentiated at the 90% confidence level (Figure 5.18), which, although slightly lower than the usual 95% significance cut off, indicates that it is quite likely that there was significantly more bladelet production in Block 3, whether heat-treated or not.

Hierakonpolis

Hierakonpolis provides the opportunity to compare across localities. Each locality is a kind of “site” in and of itself, with sample sizes the same order of magnitude as the el-Mahâsna sample was before being divided into blocks. The Hierakonpolis localities are all within 2km of each other, and some are even closer. They were likely all integrated into a larger settlement complex composed of diverse parts (Friedman 2011c; also see Ch. 3.7). Analyzing the distribution of materials across localities at Hierakonpolis is a way of looking at production within a large multi-component site. The following figures are more specified versions of the presence/absence tables reported in Tables 5.19-5.25. When possible actual counts are also given.

Medium blades at Hierakonpolis

As with el-Mahâsna, medium blade production at Hierakonpolis does not appear to be specialized at the intra-site level (Table 5.29). All of the localities had elements from many stages of medium blade production, and many kinds of tools were made on medium blades. The comparison of the counts and percentages from HK11C and HK29 show that they were practically identical (Tables 5.30 -5.31).

Non-heat-treated bladelets at Hierakonpolis

Cores, blanks, and (likely) tools from non-heat-treated bladelet production were present in all three localities (Table 5.32). Thus it seems there is no discernible difference in production. Unfortunately, there were not enough specific quantities available for statistical comparison.

Heat-treated bladelets at Hierakonpolis

Cores, blanks, and tools associated with heat-treated bladelet production were present at three Hierakonpolis localities[32] (Table 5.33). It should also be noted that Holmes (1992) clearly demonstrates that the main focus of production at HK29A was finely flaked bifacial tools, along with bead production. There was some heat-treated bladelet tool production there, but not necessarily more than at HK11C or HK29.

Before concluding that heat-treated bladelet production was the same across these three localities at Hierakonpolis, some additional data regarding heat-treated chunks (angular debris) should be considered. "Chunks" are lithic debitage that result from random shattering of a rock- either through force during flaking or through heat shattering. They could be considered the 'slag' of lithic reduction. Chunks were not included in the tables on heat-treated bladelets because heat-treated chunks could result from the production of any kind of heat-treated tool, not just bladelets. On the other hand, heat-treated chunks certainly would be a part of the early production of heat-treated bladelets. HK11C had a high percentage of heat-treated chunks, 10.9% of all heat treated material (calculated from Takamiya and Endo 2011:Table 1), compared to el-Mahâsna (7.9%) and Abydos (2.2%). Unfortunately the percentages of heat-treated chunks from the other Hierakonpolis localities was not available for comparison. Despite this high percentage of heat-treated chunks, there was only a low percentage of heat-treated cores at HK11C (1.2%). For comparison, at el-Mahâsna, heat-treated cores accounted for 7.45% of all of

[32] Specific counts of heat treated material for all tool and debitage types were not available, so statistical comparison was not possible. But where present, the reported frequencies from HK11C and HK29 were commensurate, since the sample sizes were similar.

the heat-treated material.[33] Considering the high ratio of chunks to cores at HK11C, it seems likely that some cores are missing from HK11C. It is possible that the cores were prepared there (heated, and then possibly flaked to produce an initial crest) and then distributed to other localities or sites, where they could have been reduced as needed. It is important to remember that HK11C was a workshop area where other crafts involving heating took place, including beer production, ceramic production, and food production (Ch. 3.5). This situation of preparing cores for others to then reduce could be considered a form of within-site specialization. Furthermore, a similar case can be made for el-Mahâsna.

At el-Mahâsna there was variability in the distribution of bladelet cores across the site, which may indicate that not only was the heat treating segment of production specialized, but perhaps also core preparation. At el-Mahâsna a prepared but unreduced core was found in Block 1, whereas in Block 3 there were a number of (reduced) heat-treated bladelet cores. While these data are qualitative and not based on a large sample, variability in the distribution of key early production elements (chunks and cores) may indicate that indicated that the entire production process may not simply have been carried out in each area, but organized in a more complex way across the site at both el-Mahâsna and Hierakonpolis.

Summary of distribution within sites

Medium blade production certainly was not specialized within the sites studied here. Conversely, heat-treated bladelet production did show some variability in the distributions of cores and chunks within sites, which indicates that specialization in the production process may

[33] This includes other core types besides bladelet cores.

have been developing at el-Mahâsna and Hierakonpolis, although whether such hypothesized specialists produced only prepared cores for exchange, or the final bladelets tools as well is indeterminate. An additional pattern worth pointing out is that the distributions of the non-heat treated bladelet production elements and the heat-treated bladelet production elements tend to overlap.

5.6 Chapter 5 Conclusions

From the above analysis two tool types can be considered specialized: large-blade knives, and microendscrapers. Large-blade knives appear to be specialized at the inter-site level since the knives themselves are found in many sites, but few if any of the associated production remains have been found in any Predynastic settlement sites. Presumably they were made in only very few areas and/or near the raw material sources in the desert.

The production of heat-treated microendscrapers was definitely specialized at the inter-community level: production remains from these tools were only present in some settlements, but the microendscrapers reached all areas. Furthermore at the within-site level the preparation of the cores, in terms of heating them and possibly preparing the crests, may also have been done by specialists. Additionally it should be mentioned that microendscrapers were made on both heat-treated and non-heat-treated bladelets, and, in the cases where sufficient data are available, non-heat-treated bladelet tool production overlapped spatially with the heat-treated bladelet tool production. However the distribution of the production remains for non-heat-treated microendscrapers was not as clearly specialized as with the heat-treated microendscrapers, which would make sense if it was only the core preparation that was specialized within sites. The best interpretation that can be offered at this point is the probably both were made together, or in the same basic reduction stages, with certain nodules being heat-treated as deemed necessary by the ancient knappers.

Neither medium blade production nor the production of microdrills could be considered specialized according to the definition here: as where*, above a household level, a class of objects is used by people other than those who made them*. In both cases the tools were produced where they were used (the distribution of production remains overlapped with the distribution of tools) so as far as we can tell archaeologically they were made by the same people that used them, without wider exchange. However the details of their production nonetheless differed in terms of concentration, quantity, and tool type: Medium blades were relatively common item made in multiple areas in many communities, and used for many different kinds of tools. On the other hand the bladelets for microdrills were much rarer, only made in certain communities and only microdrills were made on these coarse bladelets.

These patterns are visually summarized in Table 6.35. These findings are significant because they show that Predynastic blade production was quite diverse, not limited only to as-needed household production nor even limited to a simple division between ad hoc production and specialized production. Rather the distribution of blade tools and production remains across and within sites shows that lithic production was organized in an array of ways including multiple forms of production that can be considered specialized and multiple forms of production that is not considered specialized here. Evaluation of the ritual production model depends on analyzing patterns of specialist produced tools. Therefore, only the data concerning large-blade knives and microendscrapers will be used to evaluate the ritual production model, since those are the most clearly specialized blade tools.

Ch 6: Bifacial Tool Specialization

Investigations into specialized production of Predynastic stone tools have so far mainly focused on bifacial tools. It has already been argued, quite convincingly, that ripple-flaked knives were produced by specialists (Kelterborn 1984; see below). Additionally, Holmes (1992a) argued that at HK29A the large quantities of lithic remains indicated that bifacial tools were produced there by specialists. However, many different kinds of bifacial tools were made and used during the Naqada period in Egypt, and no clear case has been made about the organization of production for many other kinds of bifacial tools.

In section 6.1, descriptions are given for the HK29A bifacial tool production area, and eight different bifacial tool types (RFKs, rhomboid tools, fishtails, concave-base projectile points, figural eccentrics, bifacial knives, bifacial sickles, and axes). Each discussion includes a description of the tool type, date, production methods, and use (including symbolic meaning, use-wear, discard). Sections 6.2 and 6.3 contain discussions assessing the degree of specialization for each tool type. Specialization was evaluated by looking at the distribution of production remains and tools first on an inter-site level (Ch. 6.2), and then on an intra-site level (Ch. 6.3). The results of this evaluation indicate that, as with the blades, Predynastic Egyptians had many approaches to organizing the production of their tools.

6.1 Predynastic Bifacial Tools

Bifacial tool production at HK29A

Large scale production of bifacial tools and beads was identified at HK29A (Holmes

1992a). The evidence that HK29A was a ceremonial enclosure was laid out in Chapter 3.5, based on its unusual size and shape, investment in materials and repair over time, its unusual and unique ceramic assemblage, and the unusual faunal assemblage with a focus on rare wild animals. Large amounts of lithic material were associated with this enclosure. Here the evidence for this production and the argument that it represents attached specialized production is discussed in more detail.

Bifacial tool production evidence

143kg of lithic artifacts were recovered from approximately 600sq m of HK29A during excavations in 1985-86 (Holmes 1992a:37,39). Holmes sorted and classified just under half of that, about 54000 pieces.[34] 68.6% of the material is “debris-like debitage, largely consisting of chips” (ibid.:39). Chips are flakes and flake fragments less than 1.5cm in dimension. Holmes’ interpretation was that most of the debris came from bifacial tool reduction.

Of the remaining 31.4% of the material, almost half of it consisted of biface thinning debitage[35]—15.4% of the total assemblage (ibid.:39, 1996:196). Probably even more of the material actually resulted from the biface reduction process, but did not have all of the specific markers of a thinning flake, and so were classified as plain flakes (Holmes 1992a:39).

The main raw material among the bifacial tool debitage was a fine-grained beige chert, but 13% of the biface thinning debitage was of an unusual cream or orange chert (ibid.:39). The

[34] It is not clear whether the number 54,000 applies to the analyzed material or is an estimate of the number of pieces in the total weight of the material. Following Takamiya and Endo (2011:740) 54,000 seems to refer to the analyzed material, and the total estimate must have been over 100,000.

cream and orange material was also found among the chips, but not among the blades, flakes, or cores. Holmes argued that this shows careful selection of raw material for bifacial tool production. One raw material source has been located near Hierakonpolis (Friedman and Youngblood 1999; Harrell 2012). However this material is not described and it is unknown whether the chert is the beige described for these bifacial tools.

Takamiya and Endo (2008, 2011) examined more of the lithic artifacts from the original excavation of the HK29A enclosure, plus newly excavated material. They confirmed Holmes' findings of an assemblage predominated by biface thinning debitage, and also found a number of tabular flint nodules with initial flake removals that were likely the blanks for bifacial tools.

Date

Newer excavations at the HK29A ceremonial structure in 2002 and 2008 helped clarify the dating of the material and the trends in lithic tool production over time (Friedman 2009b). Materials from the refuse pits along the NE side of the courtyard (from the 1980s excavations) were dated to NIIB-C based on the ceramics (ibid.*:85*). The 2002 excavations of square 150L40SW (a little farther to the south, along the same wall) uncovered more refuse pits, and 1350 lithic artifacts were collected from that 25 sq meter unit (ibid.:89). This gives a density of 54 lithic artifacts per square meter. Additionally there was some indication that this unit contained material dating slightly earlier, to NIIAB. Sixty-five percent of the lithic material recovered from the 2002 excavation unit was biface debitage (ibid.:89), showing that biface production was already the main focus of lithic reduction at that time. However the quantity and

[35] Holmes called this biface thinning flakes and blades- meaning that some of the biface thinning debitage were of blade like proportions (twice as long as wide) but she classified them as from biface

density was substantially lower than in the following period. No microdrills were found, indicating that bead production also came later.

In the next phase NIID2-[36]NIIIA, lithic production increased in both quantity and diversity. Square 140L50 (presumably also a 5x5m unit), excavated in 1986 and dated to NIId contained over 9,000 lithics (Takamiya and Endo 2008:8) which works out to over 360 pieces per square meter. In addition to the increase in bifacial tool production there was evidence of bead production. In this later phase 34% of the tools were microdrills for bead production. Beads and unfinished beads were also found. Crescent drills and partial stone vessels indicate that stone vessel manufacture that took place there or nearby (Friedman 2009b:98).

Tool types produced

The production remains were from what Holmes (1992a:39) termed "finely-flaked" bifacial tools. No complete bifacial tools were found, but broken projectile points and other bifacial tool fragments, possibly knives, were recovered. Holmes (1992:41, 43, Fig. 5) illustrated an item which she called a bifacial knife, however Friedman (2009b:89, footnote 36) argued it may be part of a rhomboid lance. Holmes (1992a:41) thought some of the projectile points may be production rejects, making it extremely likely that they were produced in the enclosure. All I all, the "finely-flaked" bifacial tools produced at HK29A likely consist of projectile points, and possibly also ripple-flaked knives, fishtails (which can have ripple-flaking and whose hafts,

thinning, not from blade production.

[36] Since the sub-phase IId1 is no longer thought to be valid (Buchez 2011b; see Ch 3.2), the date of the second phase should be considered NIID-IIIA.

when broken look like bifacial knives), rhomboid tools, and other bifacial knives. Other bifacial tools cannot be ruled out.

Specialization

Holmes (1992a) argued that the evidence suggested a temple workshop of full-time specialists, in other words, full-time attached specialization (Takamiya 2004). This assessment was based first and foremost on the large quantity of lithic debitage and debris relative to other areas of Hierakonpolis. Secondly, Holmes (1992a:43) argued that the special selection of certain chert varieties for certain tools indicates a level of standardization in production. Furthermore, if the tools produced were the ripple-flaked knives, fishtails, rhomboid knives, concave-base arrows, etc, then there was a degree of standardization in the products, since these are the most stylistically standardized lithic tools from the period. The quantity of remains also led Holmes to conclude that the specialists worked full-time, and the location of the remains in a ceremonial enclosure was taken to indicate that elites supported the specialists.

The most compelling evidence that the HK29A lithic production activities should be considered specialized production according to the definition used here (Ch. 1.1), is that the quantity of debris relative to the paucity of broken or finished tools. Much of what was made there "was destined for use elsewhere" (Holmes 1992a:44). Holmes, Friedman (2009b), and Takamiya and Endo (2011) all reasonably concluded that many of the tools went to the elite cemetery at HK6 and likely beyond.

Ripple-flaked knives

Description

Ripple-flaked knives (RFKs) are bifacially worked tools where one face was completely ground, and the other face was covered by very precise systematic ripple-flaking (Figures 6.1-6.6, 7.1). Ripple-flaking is a kind of retouch with "large, flat, parallel, lamellar" removals (Holmes 1989:408), where the spacing of the flakes is very regular, leaving even, parallel scars that look like ripples. Ripple-flaked knives have tiny microserrations along the knife edge, and the ground side usually has marginal edge retouch. These knives are elongated with a straight to slightly concave back and a slightly convex cutting edge. The haft end is usually rounded, but some have short tangs. A few RFKs have been found with elaborately decorated handles of ivory or gold. Midant-Reynes and Tixier (1981:380) gave average dimensions of the ripple-flaked knives as about 20-30cm long, 4.5-6.5 cm wide, and .7-1cm thick. These match closely to dimensions of 22 RFKs studied here (Table 6.18), that had lengths between 14.9-30cm, widths of 4.6-8.3cm, and thicknesses of .5-.9cm (see Ch. 6.2). Other Predynastic bifacial tools are known which have ripple-flaking (Figure 6.7), but only knives of this shape, with one ground face, are considered ripple-flaked knives.

Date

RFKs existed only for a short period of time, dating mainly to the NIId (Dreyer 1999:213; Midant-Reynes 1987:212). From a technical point of view their appearance is a culmination of foregoing technologies (ibid.), so they can be considered to have had a long slow development. Conversely, RFKs disappeared rather suddenly, around about the same time as the D-ware pottery, both largely absent in the NIII. However a few RFKs have been found in later graves, such as the Abu Zaidan knife with ornate handle found in a grave which possibly dates to the Naqada IIIB, or the RFK fragments found in the tomb of Djer (First Dynasty) (Petrie 1902:Pl 14; Pitt Rivers Museum object 1901.40.23). Such pieces may have been heirlooms, buried well after they were originally produced (Huyge 2004:823). Additionally the use of elaborate decorated knife handles may date toward the later end of the time span for RFKs, perhaps late NIId-NIII, given the stylistic dating of the handles and the provenienced examples (Midant-Reynes 1987:220; Needler 1984:270; Whitehouse 2002:432).

Production

RFKs have the best understood, and most elaborate, production process of any Predynastic Egyptian lithic tools, largely thanks to the replication experiments done by Kelterborn (1984) and the research by Midant-Reynes (1987; Midant-Reynes and Tixier 1981). These scholars and others (Bradley 1972), all agree on the major aspects of production.

Kelterborn examined twelve complete and eight incomplete RFKs from European museum collections, and based on these observations, carried out more than 50 full replication experiments, in order to understand the production process. He concluded that RFK production likely employed many different reduction techniques, including percussion, grinding, pressure flaking, and microflaking. The six basic production stages that Kelterborn outlined are as follows (from Kelterborn 1984:439):

1- *“Obtaining the blank”: quarrying, testing, and selection of raw materials.* The archaeological knives Kelterborn studied had very high quality raw materials without visible grains, and were often glossy and pinkish (ibid.:441). He emphasized that the chert must have been carefully selected and tested for quality. Kelterborn’s description suggests heat treatment:

glossiness and pinkish tones. However, Kelterborn said that heat-treatment of the specimens he studied could not be determined one way or the other (ibid.:439), and after examining a few specimens from the University of Cambridge, Bradley (1972:3) did not find any evidence for heat treatment. On the other hand, the grinding (see below step 3) may have removed any possibility for observing differential luster. Kelterborn himself made the replications on heat-treated material and on window glass.

Kelterborn did not guess whether tabular nodules or flakes were used as blanks, although others (Bradley 1972:3, Midant-Reynes and Tixier 1981:381) supposed tabular slabs were used for blanks. Kelterborn estimated that the size parameters for the blanks should have been approximately 20-30cm long, 10-20cm wide, 5-10cm thick. (Estimated time: 3 hrs)

2-*Making the preform*: Hard and soft hammer percussion and possibly some pressure flaking were used to create the shape of the preform from the blank. Percussion flake scars often remain on the back (ground) face, and sometimes on the front faces, particularly in the region where the haft would have been. This stage and the next have to strike a balance: percussion reduction is faster but more likely to break the piece, grinding is safer but far more time consuming. The percussion preform size should end up about 1.5-2cm thick. (Estimated time: 2 hrs)

3-*Grinding the preform*: On all observed archaeological knives the back faces were fully ground and the front faces of over 90% of the examples Kelterborn examined had small traces of grinding, showing that the preforms had been fully ground on both sides. Experimental ground preforms ended up 19-27cm long, 5-6.5cm wide, and .6-.9cm thick. The edges were also ground to a 75° angle to create the right platform for pressure flake removals. (Estimated time: 12 hrs)

4- F*ront surface ripple-flaking*: Precision pressure flaking was carried out to remove relatively large ellipsoid flakes, starting at the hafted end and moving counter clockwise. The apparent "perfection" (regularity) can only be reached on a ground preform. Kelterborn (1984:443) says the secret to this flaking is getting "the right combination of depth and spacing of the pressure point, and the suitable amount of inclination (about 10˚) of the flake detachment force, resulting in just the right amount of flake overlapping." These experiments show that the flakes were not long and thin as the remaining scars would suggest, but rather C-shaped, with one rounded side and one straighter side. The maximum size of replicated flakes was 4.5cm long x 1.1cm wide. (Estimated time: about 2 hours)

5- "*Marginal retouching*": Extremely fine pressure flaking was used to remove the high areas remaining between the bulbar portions of each ripple-flake scar. (Estimated time: about 2hrs)

6-*Serration of the cutting edge*: Extremely fine grinding and pressure flaking with a very fine tip was done to form the microserrations. These were bifacially flaked from both the front and back faces, creating about 10-13 teeth per cm (ibid.:449). Bradley (1972:4) found a maximum of 16 and an average of 11 serration flakes removed per cm. (Estimated time: around 4hrs)

The tools used for the experimental replications were few and simple: a pressure flaker with a copper point, a wooden block with a cleft for holding the knife, and a small grinding stone for preparing the platforms. Presumably during the earlier stages hard and soft percussors would have been used, along with a larger stone for grinding the faces of the stones.

The techniques used with these simple tools to carry out the ripple-flaking required great skill. Kelterborn pointed out the difficult aspects of making these knives: keeping the line where the flakes from opposing sides met centered, and keeping a steady even rhythm and spacing to the flake removals. Kelterborn (1984:449-451) also described a few different recovery techniques he was able to observe when problems or mistakes occurred during ripple flaking. The ability to recover from the (relatively few) mistakes made underlines rather than takes away from the skill and repertoire of the knappers.

Moreover, the knives took quite some time to produce. The total time for the replicated knives took 17-25 hours. Midant-Reynes and Tixier (1981) reproduced a knife in only 10 hours, citing just 5 hours for grinding instead of Kelterborn's 12, and not including raw material procurement time. Either way it was clearly a time consuming process and much of the time can be spent in the grinding stage.

As the above production outline shows, many different techniques, each with a different skill level, were involved in the production of RFKs: hard hammer percussion, soft hammer percussion, grinding, pressure flaking, ripple flaking, and microserration. Hence Kelterborn proposed that production of RFKs was probably spread across a number of people—a kind of segmented production. Another important point regarding the multiplicity of techniques that were combined to make RFKs is that each of these techniques was known previously and used to produce other tools (Midant-Reynes 1987). Ripple flaking itself was the only new technology, however it was also done on some fishtails (Figure 6.11(2)), and a few other tools (Figure 6.7).

The RFKs' combined suite of flaking techniques (grinding- ripple flaking-microserration) fell out of use by the First Dynasty (ibid.). However, grinding remained in use for technically impressive, prestigious knives at least through the First Dynasty, since it is evident on the large sword-like knife from the tomb of Khasekhemwy (Hikade 1997:88). The production of elaborate stone vessels took off at the same time that RFK production decreased (Hendrickx 2011:95-96; Midant-Reynes 1987:214), and also used at least similar principles of grinding and polishing. So in a way, RFKs left a legacy of ground stone (prestige?) items.

Use

Almost all provenienced RFKs have been found in cemeteries (see Ch. 7.3), and the primarily funerary context of the knives could mean that they were made specifically to be included in burials. However Whitehouse (2002) finds that unlikely due to the high quality of workmanship and the content of the decorated handles, which seems intended for display (during life). Supporting this interpretation is the fact that most knives were not buried intact (see below)- they were either broken or had their handles removed before burial, an unlikely scenario if they were intended as purely funerary objects.

One of the best ways to understand the use or purpose of RFKs is to look at the depictions on the knife handles (Figures 6.3-6.6). There are seven known decorated handles associated with RFKs , and up to ten other decorated handles (Ciałowicz 1992; Delange 2000, 2009; Dreyer 1999; Midant-Reynes 1987; Needler 1984; Whitehouse 2002; Williams and Logan 1987). Most are of carved ivory and one RFK handle is embossed gold. Much has been written about the symbolism, art, composition, and interpretation of these pieces (Asselberghs 1961; Ciałowicz 1992; Davis 1992; Delange 2000, 2009; Dreyer 1999; Hendrickx 2006a; Huyge 2004; Kelley 1983; Midant-Reynes 1987; Needler 1984; Whitehouse 2002; Williams and Logan 1987). The main themes depicted relate to control over chaos, dominance, and royalty.

Rows of animals were a primary theme depicted on these knives, and they relate to control over chaos and domination. The animals include elephants, storks, giraffe, dogs, bovines, sheep, donkeys, oryx(?), badgers, fish, ibises(?), lions, jackals, and others along with fantastical creatures.[37] The order of the first few rows, and certain combinations of animals, was repeated on many handles and other media showing that particular constructed meanings were intended, not simple depictions of the natural world. At the end of many rows is a contrasting image, such as a dog, feline, rosette, or even fish. There is a connection between dogs and elite hunters (Baines 1993; Hendrickx 2006a), so dogs found at ends of the rows of animals represented the elites in terms of a controlling force, as did the other controlling motifs capping the rows. Rosettes, a vegetal motif, were shown on many knife handles (Figure 6.6), where they appeared either between curved serpents or at the end of rows of animals. The symbol of the rosette was borrowed from Mesopotamia where it was associated with dominant figures (Smith 1992: 241-242), and in Egypt came to be associated with Egyptian royalty. Other scenes depicted domination and control over chaos more explicitly, such as the Gebel Arak knife handle which has the 'master of animals' motif and scenes of humans fighting (Figure 6.3). The royal themes on the Metropolitan Museum knife handle are even clearer, showing a person in a boat wearing the white crown with a rosette in front of his face, and what are likely kneeling prisoners on the other side. These themes all relate to the main job of Ancient Egyptian kings: to maintain order over chaos, and this idea persisted as a part of Pharaonic kingship ideology (Kemp 2006:92-99).

Dualities apparent in the knives constitute additional evidence of the symbolic nature of the knives. Duality was an important aspect of Ancient Egyptian iconography. The knife handles display elements of duality in their composition, including pairing and mirror imaging, such as

[37] Some identifications are disputed.

the coiled snakes on the Gebel Tarif knife. However, the symbolism and meanings incorporated into ripple-flaked knives did not stop at the end of the haft. Duality was embodied in the chert knives themselves with the different treatment of the two faces: one flaked and one ground. When the production process is taken into account, these faces can be related to desert vs. Nile symbolism, another theme apparent in Predynastic and Ancient Egyptian iconography. Stone grinding did not just involve rubbing one stone against another, but sand was often added to help speed the process along and to create a finer grain (Stocks 2003: 109-111). Sand is indexically related to the desert, associating the ground side of the knives with the desert. In turn the shiny "ripple-" flaked side could reference the water of the Nile. If such is the case then the boats of the Gebel Arak knife handle literally ride on the water, while the wild animals on the opposite face stand in the desert. Given the common association of the desert with chaos in Predynastic Egypt and later, then the theme of control over chaos would be built into the knives themselves, not just the handles, and underlines the highly symbolic nature of these items.

These high-brow ideological themes show that the knives were undeniably laden with symbolic meaning. However the rows of animals literally marching toward the blade of some knives suggests that they may have been used in animal slaughter, in addition to symbolic uses for display, raising the question of whether the knives were also used for cutting.

Cutting?

Although RFKs had clear symbolic meanings and value, were they nonetheless also used for cutting? Scholars disagree. Usewear analysis of RFKs was conducted by M. Christensen, with conflicting results. In a 1993 publication Christensen et al. concluded that RFKs were used for cutting plant materials based on the identification of silica on the knives. This work was based on a model of usewear analysis where trace elements of the worked material build up on the tool creating a polish. However, many now agree that abrasion is a more likely cause of usewear polish (Odell 2001:51-53; Rosen et al. 2014). In a later publication Christensen concluded that RFKs were not used (Delange 2009:9).

Other opinions on the usewear of RFKs were based on the microserrations. Midant-Reynes (1987:186) considered the microserrations (not to mention the ripple-flaking and grinding) to be aesthetic rather than functional. Conversely, Kelterborn (1984:449) opined that the tiny microserrations are “visually ineffective” and therefore must be functional. In Bradley’s (1972:5) opinion, the thinness and serration of the knives would be good for light cutting. He did not find any macroscopically visible wear or breakage on the pieces he examined in Cambridge, but he noted that does not rule out microwear. Similarly, Stevenson (2009:113) examined the serrated edges of the RFKs from Gerzeh under 10x magnification and found no evidence of wear. At this point, there is no consensus for whether or not the knives were used for cutting.

Discard

Many RFKs are broken rather than complete. Many examples displayed in museums have been discreetly repaired by conservators. In Midant-Reynes’ (1987:200) survey of RFKs the condition of the knife was reported in 35 cases: 24 were broken or fragmentary (69%) and 11 were complete (31%). The question is whether the pieces were broken post-depositionally, broken during their use in life and then buried in a tomb, or whether they were intentionally broken for cosmological reasons before burial.

Post-depositional breakage is the least likely explanation. Bradley (1972:5) noted that many of the RFKs have similar kinds of breaks (e.g. Figure 6.2). Similarly, of the 15 RFKs recovered from the Abusir-el Meleq cemetery, all were “broken in the same manner” (Seeher 1999a:100). Such similar breaks would have to be the result of being used in the same way or intentionally broken in the same way, rather than random post-depositional breakage. Furthermore, Graves-Brown (2011:209) and Stevenson (2011:72) both point out that plundering is an unlikely explanation for the breakage because broken knives have been found in graves where the other artifacts remained intact. Similarly, at Tel el-Farkha a sword-like bifacial knife and a RFK were found together in a deposit with two gold covered statues (Ciałowicz 2007). The bifacial knife was intact while the RFK was broken in several places (illustrations in Kabacinski 2012). If the knives were broken while being used in life, then associated wear would be expected, along with worn but unbroken knives. However, as discussed above the knives show few unambiguous signs of use, even though many are broken. Thus intentional breakage is left as the most likely explanation.

Intentional breakage of burial items was practiced during the Pharaonic era to render dangerous representations harmless. Similarly RFKs may have been broken before being put into a tomb in order to protect the deceased. Additionally, most knives were found without their handles. Whitehouse (2002:432) suggested that handle removal may have been part of “decommissioning” the knives, rendering them practically and symbolically unusable, i.e. another form of breakage. Either way, intentional breakage and inclusion in burials, or the inclusion of these items in burials despite being broken underlines the symbolic significance of the objects.

Rhomboid tools

Description

Elongated bifacial tools that widen in middle and taper to the ends are known as rhomboid knives or lances or daggers (Figure 6.8, 7.2). Because these terms are used interchangeably and imply functions that are not securely known for this case, these items will be referred to as rhomboid tools. Some of the rhomboid tools are more pointed in the middle while others are more curved, and the tips can be rounded, ogival or pointed (Holmes 1989:408). The flaking of one end is usually less well executed, indicating where the haft would be. They are symmetrical in shape along the longitudinal and sometimes latitudinal axes. Rhomboid tools are very thin and they often have microserrations along the edges, except along the haft area. Baumgartel gave sizes between 27-41cm length, by 4-5cm width, and a maximum thickness of ~.6cm, and the 18 rhomboids studied here had dimensions ranging between 18-41cm in length, 3.5-6.4cm in width, and .3-.9cm in thickness (see section 6.2, Table 6.19). So far no systematic study has been specifically devoted to the rhomboid tools.

Date

Baumgartel (1960) classed rhomboid tools with the Naqada I period tools. However it is likely that their use may have extended slightly later. Petrie dated rhomboid tools from SD 32-45 based on his excavations at Diospolis Parva (Petrie 1901:23, PL 4), which corresponds to NIA-IIB (Table 3.1). A rhomboid tool was found recently in a partially preserved tomb at Hierakonpolis HK6, which dates to the NIIA-B (Droux and Friedman 2014). The early date of rhomboid knives makes them much earlier than RFKs and contemporary with the earlier fishtails.

Production

The production of rhomboid tools involved many of the same suite of techniques as RFKs, fishtails, and CBPPs, including: hard and soft hammer percussion, grinding, pressure flaking, and microserration. Rhomboids are very thin, and the signs of grinding (Midant-Reynes 1987:189), indicate that their preforms were likely ground down to size. They may have followed a very similar production process as RFKs, except without ripple-flaking.

Use

Like RFKs, rhomboid tools have been found mainly in cemeteries (Baumgartel 1960:32; Ch. 7.3). And as with RFKs there is some question as to whether these tools were used primarily for display or whether they were also used for cutting, spearing, or stabbing. There is little clear evidence for use-wear. Baumgartel (1960:32) deemed them too thin to withstand much pressure or any form of hard usage. Spurrell (1896:57) considered the tools "all for show" due to the microdenticulation. However, no study of use-wear has been conducted. Some wooden model rhomboid tools exist, with red or black painted designs on them (Petrie 1920:25) possibly indicating blood, although the wavy and striped patterns could have other interpretations.

Rhomboid tools found in cemeteries were usually broken. For instance Brunton (1937:72, 90, PL40) found a broken rhomboid tool laying in pieces in front of the face of the tomb occupant. The pieces were widely scattered and some small pieces were missing, showing it was not broken in place. The burial was covered by matting and undisturbed. This intentional breakage points to the existence of some symbolic meaning beyond a practical use for cutting.

Fishtails

Description

"Fishtails" are bifacial tools shaped like an elongated triangle where the pointed end is the handle and the wide end is the working end (Figures 1.1, 6.9-6.11, 7.3). The wide has an indentation, either a softly concave 'u shape' or sharply indented 'V shape', creating the fishtail look. There is often a very fine microserration inside the indent and extending around the sides down to where the haft or handle portion would begin (Figure 6.9). The flaking of the haft end is usually not as well executed as that of the forked end. Van Walsem (1978) documented over 150 examples known, and since then more have been found in excavations. A sample of 63 complete fishtails yielded lengths ranging from 7.7-20cm, widths of 3.2-10cm, and thicknesses of .32-.9cm (see Ch. 6.2, Table 6.20).

A few fishtails have been found with the hafts intact. One fishtail in the Cairo museum was hafted with a gold handle[38] (Currelley 1913: 272, Pl 47). A probably more typical example comes from the HK43 non-elite cemetery at Hierakonpolis and was hafted in a reed handle with a leather band holding it on (Friedman 2004). Additionally there was a leather sheath covering the forked blade, and another fishtail, now housed in the Metropolitan Museum (MMA20.5), also preserves a sheath on the forked end. Model fishtail knives often depicted the haft (Figure 6.13).

[38] J. P. Corteggiani, The Egypt of the Pharaohs at the Cairo Museum (Paris, 1986), 21 -2, has argued that this knife (purchased at Gebelein in I 906) is probably genuine (Roth 1992).

Date

Fishtails mainly date from the Naqada I to late Naqada IId or NIII (Hikade 2003:139). They were most common in the late NI- early NII (Hikade et al. 2008:185-186). Some later examples exist, such as the Early Dynastic fishtail found at Abydos by Petrie[39] (1902:Pl 51), but they are certainly rare by that point. It is also worth noting that fishtails were produced before RFKs, and then they were both produced simultaneously during the late NII (Hikade 2003:149).

Fishtails changed stylistically over time, and can serve as chronological markers. The earlier fishtails have the softer and wider 'U' shaped fork, and date from NI to NIIc or d, while the later fishtails have the sharper 'V' shaped fork (Figures 6.10-6.11) and date from NIIa or b to NIId, possibly into NIII (Hikade 2003:139-140; van Walsem 1978:242). The later specimens with the V shaped fork also tend to have more parallel sides rather than the converging sides of the earlier fishtails. Additionally, there is a style of fishtails with a more pronounced haft. Van Walsem dated these to ~NIIc-d, but Hikade placed these a bit earlier, transitional between the other two types (see Ch. 7.1). After the Predynastic period fishtails likely evolved into the *psš-kf*, an implement used for the opening of the mouth (rebirth/mummification) ceremony (Roth 1992; van Walsem 1978; *cf*. Hikade 2003).

Production

Fishtails were made in many varieties of chert, along with other raw materials, and there may have been some change over time in raw material choice (see Ch. 7.1). Bradley (1972) did not see any sign of heat-treatment on the few fishtail knives he examined in the Cambridge museum. However, it is not outside the realm of possibility considering that heat-treatment facilitates the use of fine bifacial pressure flaking such as is observed on the fishtails. Most fishtails were probably made from tabular cores, as was suggested by Bradley (1972) and Hikade (2003). This idea is supported by an assessment of cortex on fishtails. Out of the 101 fishtails inventoried in Table 7.8), three had cortex on at least one face and another 21 had cortex remaining on the very bottom of the haft (e.g. Figure 6.11(1)).[40] The placement of the cortex seems more in line with thin tabular nodules than of flakes.

Bradley (1972) examined a few fishtail knives from the Cambridge Museum of Archeology and Ethnography and constructed the following production sequence. First the core margins were prepared via alternate flaking. Then the piece was bifacially thinned with direct percussion, probably using a soft hammer. Next came surface grinding limited to the distal (fishtail) half of the piece. Then the distal (fishtail) half of the piece was pressure flaked continuously around the edge (not back and forth alternating edges). Last the microserrations were all done on one face, then the piece was turned over and all the serrations done on the second face. There was an average of 13 serrations per centimeter.

However it is quite possible that the production process for fishtail knives had a degree of variability. Van Walsem (1978:243) noted that the quality of workmanship for fishtails varied widely, as did their size. Some fishtails of the later style were ripple-flaked (Figure 6.11 (2)). Unlike the RFKs, when ripple-flaking was used on fishtails both sides were ripple-flaked rather than just one. Another indicator of production variability is a fishtail from Maadi that was made on a blade, ground on one side, and only bifacially edged, not fully bifacially thinned (Rizkana

[39] Hikade (2003) questions whether this object should be in the same category as the Predynastic fishtails.

and Seeher 1985: 243,247). Roth (1992:128) suggested it was a locally made imitation of the Upper Egypt fishtails.

Use

The exact use of fishtails is a topic of debate. Many authors (Brunton 1935:216-217; Massoulard 1936; Petrie 1914; and others, see Roth 1992; van Walsem 1978:197) have made a connection based on similarity of form between Predynastic fishtail tools and the later *psš-kf* implement which was a central part of model tool sets used for ritual purposes (Figure 6.12). Dating mainly from the Old Kingdom, examples are known into the New Kingdom (Roth 1992). They were used in the opening of the mouth ritual which "served to give power to the mummy, or a statue of the deceased, so that it might continue to live in the hereafter" (van Walsem 1978:194). This ritual is documented textually from the Old Kingdom period through the Roman period (ibid.:193). The *psš-kf* tools were made from limestone, alabaster, and polished chert (Roth 1992). The connection between Predynastic fishtails and the *psš-kf* is additionally supported by the translation of the word "*psš-kf*" itself, which means either stone that divides or divided stone (van Walsem 1978:202-203), a description that fits the chert fishtails well. Therefore the use of the fishtails might be similar to, or a precursor of, the use of the *psš-kf*.

Based on the use of the *psš-kf*, van Walsem (1978) interpreted the earlier Predynastic fishtails as wedges used to hold a corpse's jaw closed during the Protodynastic period. Noting the impracticality of these carefully sharpened tools for such a task, Roth (1992) offered a different explanation. She interpreted the opening of the mouth ceremony as recounted in the

[40] For many, only one face is visible in published documents, so more may retain cortex.

pyramid texts as a ritual of rebirth, and from this she surmised that the fishtail knives were used during births to cut the umbilical cord. Conversely, Hikade (2003) rejected the connection of fishtails to *psš-kf* sets and the opening of the mouth ceremony due to the problems of projecting meanings backward in time. Instead he interpreted fishtails as status symbols for men in outstanding community positions, because fishtails have been found in some graves that also have implements of hunting and warfare. Unfortunately Hikade's interpretation is not compelling because it is based on a small selective sample of tombs, with no statistical verification. The main theme running through all these interpretations, and what all authors could probably agree on, is that fishtails were symbolically significant items.

Hester (1976) carried out a usewear analysis of six fishtail knives from the Naga ed-Deir cemetery. She found heavy intentional dulling on the haft ends. One specimen from tomb N7120[41], had a re-worked edge where one of the tangs had broken off, and the micro-serrations on the rest of the knife had been worn away (ibid.:349), indicating that it was probably used in some way that caused wear. Additionally, a number of model fishtails were painted red on the forked end, which may represent blood (Petrie 1920:25) (Figure 6.13).

It is possible that many were intentionally broken. The tip or one tang of many specimens is missing. While such breaks may have happened accidentally during use, or even occurred during production, one fishtail found in Abydos cemetery U tomb 178 (Hikade 2003) had two notches carefully worked on the outer edge of one tang that must have been intentionally put there (Figure 6.9). Hester (1972) noted from her review of Quibell (1905) that many fishtails were found broken through the middle. Similar breakage patterns might result either from use in a similar way or intentional breakage. Additionally, just as Whitehouse (2002) suggested for the

RFKs, the handles missing from most fishtails could have been intentionally removed as a means of breaking or immobilizing them to minimize the danger to the deceased tomb occupants (Friedman 2004:9).

Concave-Base Projectile points

Description

Concave-base projectile points (CBPPs)[42] are triangular shaped tools with two long barbs that form a hollow or concave notch for hafting in the middle (Figure 4.48, 6.14, 7.4). There is some variability to their shape in terms of how elongated the point is, whether the sides are straight or curved, the depth of the notch, the curvature of the barbs, and the shape of the bottom of the barbs (Baumgartel 1960:28). There have been attempts to divide the CBPPs into subtypes, (Caton-Thompson and Gardner 1934:27-28; Ciałowicz 1990), and there was certainly some variation over time. Hikade (2001:119-120) described earlier points, such as “Merimde points” and “Fayoum points” as less elongated and with shorter barbs/ shallower notches compared to the Naqada period examples. The Naqada examples also sometimes had fine lammellar retouch (ibid.) from pressure flaking. Rizkana and Seeher (1988:33) pointed out that at many sites CBPPs with notches of different depths existed alongside each other. The sizes of concave-base projectile points examined during this study (Ch. 6.2, Tables 6.22-6.23), ranged from 3.4cm - 10cm in length, 1.7-3.1cm in width, and .4-.8cm in thickness.

The method of hafting is known because there is an extant example of a CBPP mounted on a foreshaft in the Ashmolean Museum (Clark et al. 1974:361). Unfortunately the provenance

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[41] Lowie Museum accession # 6-3102.

and date are unknown. Clark et al. think it is likely that the example is from a much later period than the Predynastic, and likely from Nubia. Seen in X-ray, the chert point is 3.4cm long (ibid.), so it is smaller than many Predynastic examples. Regardless, it is the only known example of a hafted CBPP. The tool was set onto a slotted shaft and completely covered by mastic leaving only the tip and lateral edges uncovered.

Date

CBPPs can date early as the 5th millennium BCE in Merimde (Eiwanger 1999), and continued to be used well after the Naqada period, into the 1st millennium AD in areas outside Egypt, particularly Nubia (Clark et al. 1974). However, as mentioned above, the style during the Naqada period was distinctive, and in Egypt proper CBPPs were most common in the late NI-early NII (Hikade et al. 2008:185-186), and fell out of use by the Early Dynastic period (Clark et al. 1974:358; Hikade 2001:123). Possible explanations for the decline of CBPPs include changes in hunting practices, the increasing use of metals, and changes in lithic reduction techniques.

Production

A number of chert varieties were selected for making CBPPs (see Ch. 7.1). Based on study of materials from HK29A, Takamiya and Endo (2008) reconstructed a process whereby concave-base projectile points and other bifacial tools were made from tabular pieces of chert. Hikade (2001: 121) also implied that CBPPs were made from tabular nodules. Holmes (1989:274) noted one example from Petrie's South Town collection which was made on a thin

[42] Also referred to as hollow-base projectile points.

patinated piece of raw material, and was likely unfinished. However some CBPPs were also made on flake or blade blanks, such as a possibly unfinished one from Maadi (Rizkana and Seeher 1988:32, Pl 68). Examples from the Naqada area include some CBPPs made on flakes and one made on a thin nodule (Holmes 1989:247-249).

In Takamiya and Endo’s (2008) model, raw material selection was followed by edge trimming the nodule using hard hammer percussion, then the blank was shaped and thinned by soft hammer percussion, and final stylization applied with pressure retouch. A few CBPPs have been found with signs of grinding (Midant-Reynes 1987:189), although most examples are usually entirely flaked on both sides leaving no place to see grinding marks, so it is difficult to determine if this was a regular practice. As Nagaya (2011) pointed out, the same technology and skills used in making these concave-base projectile points was also applied to the production of flaked figural eccentrics (see below).

Use

CBPPs have also been found in both cemeteries and settlements (Table 7.12). Some CBPPs were definitely used as projectiles. Classic impact scars are visible on some Merimde points, and debitage from resharpening or re-shaping was found in the settlement (Hikade 2001:119). For the Naqada period, a triangular projectile point with a slightly concave base from South Town also had wear indicative of use (Holmes 1989:275).

There is some question as to whether CBPPs were used as arrowheads or lance heads, because they are rather large (Hikade 2001:111). Clark et al. (1974) classified the preserved specimen in the Ashmolean Museum as an arrowhead. Additionally, due to the size and weight, Rizkana and Seeher (1988:32) suggested that they were arrowheads for close distance hunting, not designed to fly very far, and Hikade (2001:123) also added that a special kind of bow could have been used.

It is possible that the projectile points were used in conjunction with poison. Poison has been identified on Egyptian bone arrowheads (Clark et al. 1974:342), so it may have been used on other projectiles. A test for similar poison on the mastic from the Ashmolean hafted concave-base projectile was negative, however Clark et al. pointed out that it was a very small sample tested with a limited array of methods, so it does not rule out the possibility of poison. Small indentations in the mastic indicate that the projectile point was possibly wrapped, which is a known method for keeping poison moist (ibid.:366).

CBPPs were also used in a symbolic way. At a columned hall (structure 07) in HK6 a number of concave-base projectile points were recovered from the NE corner of the structure, along with a number of other objects, including ostrich eggshells, ivory objects (clappers?), a hippopotamus figurine, and a fragmented falcon statuette (Droux and Friedman 2007:8,16; Friedman 2010:69-70). Some of the CBPPs were unusually large, almost 10 cm in length. Friedman suggested that the large size and context indicates that these CBPPs were over-sized votive offerings not intended for use. Along similar lines, clay models of CBPPs have been found in cemeteries (Garstang 1903:7, Pl3).

Though no systematic study of CBPP breakage patterns has been made, the impression from research here is that they were often found broken, usually with a tang or tip missing. However complete ones are also known. A study of the breakage patterns of CBPPs to determine the variability in location of the break and whether the break was from use, production, incidental occurrences, or was intentional, would help to identify production areas and specify how they might have been used, whether for hunting/warfare, as ritual items, or both.

Eccentrics

Description

Among Predynastic Egyptian lithic artifacts, the eccentrics constitute one of the best examples of creativity, skill, and blatantly symbolic use. Naqada period knappers produced an array of figures in chipped stone. These included an antelope(s), arrows, Barbary sheep, birds, bovine heads, crocodiles, dogs, a donkey, a giraffe, hippos, a hartebeest, a human(s), ibex, a scorpion, serpents, and other figures which are more difficult to identify (Figures 6.17-6.24). The figure depicted, size, and production techniques all varied widely. Of 20 figures for which metric data were available, the sizes ranged from 3.3cm-23cm in length.

A study by Hendrickx et al. (2003) gave an in-depth look into Egyptian figural eccentrics. However a number of new figures have since been found, particularly at Hierakonpolis. Therefore, a new inventory was compiled adding on to Hendrickx et al.'s list and focusing on production attributes. Table 6.1 lists 53 figural eccentrics,[43] and Table 6.2 lists additional ones which are probably not authentic.[44] Given that an attempt was made to be exhaustive, the low quantity of these items shows that figural eccentrics were rarer than any other class of bifacial tools, particularly since they covered a comparatively long time span.

[43] In addition to the items listed in Table 6.1, a number of fragments which probably come from eccentrics have been found at HK6 (Friedman 2013:7; Friedman et al. 2017). Additionally five lithic items dubbed "bow-ties" have been found at the HK6 cemetery could be considered eccentrics (Droux 2011:17; Friedman et al. 2017; Nagaya 2011). Alternatively, the very slightly asymmetrical objects could also be a type of transverse arrowhead, with the notches used for hafting. Arrowheads and eccentrics alike have been found as offerings in HK6.

Date

The figural eccentrics have been found in contexts dating from the early NII into the Early Dynastic period. Some of the ones found in later contexts may have been produced earlier and retained as heirlooms. The earliest eccentrics mainly come from Hierakonpolis. At HK 6 a chipped stone figure of a human (dwarf) was found in a tomb complex containing dating to the NIC-IIA, and the human figurine was likely an offering relating to a dwarf burial in that tomb complex (Friedman 2011:4-6). Similarly, tomb 24 is dated to NIIAB (Friedman 2009b:7), and contained not only an elephant burial but also a chipped stone figure of an elephant head, likely related and so of the same date (Friedman 2006:7-8).

Many other animal eccentrics were found at Abydos, and came from later contexts. Petrie recovered a bovine head from the tomb of Djer (First Dynasty) (Petrie 1902: pl XIV), and a crocodile from the Osiris temple at Abydos, which Petrie dated to the Second Dynasty (Hendrickx et al. 2003:10). A number of additional crocodiles and a serpent were found in the settlement under/around the Osiris temple at Abydos, one of which Petrie dates it to the reign of Djer (ibid.:22) with the rest found at earlier levels below that piece, but all within the Naqada III (Petrie 1902, 1903). Hendrickx et al. (2003:10) suggested that a long thin piece from Umm el-Qa'ab Tomb U-178 which dates (to phase Ia2 which corresponds roughly to NIB (Hartmann 2011a:932-933, 935) may be a figural eccentric because of its slight curvature. However, the piece is more likely from a CBPP, which accords better with the date. Another piece from a First Dynasty context is a bull head from the royal mastaba tomb of Neithhotep at Naqada, which

[44] Scharff (1929: 68, figure 47) reported that flaked-stone (bird) figures bought in Luxor in the 1920's were locally made fakes.

Hendrix et al. (2003:10) feel should be considered an heirloom based on the style and association with other early Predynastic artifacts.

Recently, an undulating bifacial object was found at Kom al-Ahmar/Sharuna, near Wadi el-Sheikh, in middle Egypt (Pawlik 2006:557). While the date of the object was not given, the site has contexts dating at least as early as the Second Dynasty, and into the Old Kingdom and later. The object is similar to the serpents, however production of chipped stone bracelets is known from Wadi el-Sheikh and one was found at the Kom al-Ahmar/Sharuna (ibid.), so the undulating piece could be related to jeweler production instead of figural eccentrics. Petrie also reported a chipped stone figure in the shape of a hippopotamus from Kahun, a Twelfth Dynasty site (Petrie et al. 1890:30 Pl VIII). However, since there is a vast temporal gulf between that hippopotamus and the eccentrics which have secure proveniences, it seems likely that the Kahun hippopotamus is not in its original context, but either was a Predynastic item mixed into a later context, or was unrelated to the Predynastic-Early Dynastic eccentric production.

Production

Egyptian figural eccentrics were executed in a variety of production techniques with variable quality ranging from rather simple unifacially edged silhouettes of animals, to quite finely thinned and pressure-flaked fully bifacial pieces. At least four were made on flakes.[45] It is not possible to determine if any were made on thin nodules or tabular slabs because cortex rarely remains. Of the 53 (authentic) figures inventoried here, 25 are bifacial, and 13 are edge retouched (including unifacial and/or bifacial edge retouching). The production technique of 15

[45] BM.EA.30411; BrM.09.889.291; HK.6.2005.1; OIM.10534; See Table 6.1 for descriptions.

eccentrics was indeterminate because images of one or both sides were not available. These details show that there was variability in how the eccentrics were produced.

Indeed, variability characterizes the eccentrics. Many different animals or figures were depicted, with the same one rarely represented more than a few times. Among figures of the same animal, individual examples were not always made the same way in terms of both production technique and/or style/shape of the figure. This variability is an important consideration for the present study because it indicates that there were probably multiple producers, which is significant for understanding the organization of their production (Ch. 6.2). A few of the different kinds of animals or figures are discussed below to illustrate the degrees of variability or similarity.

The three or four bovine heads were all made differently (Figure 6.20). One was made through very fine bifacial reduction and is perfectly symmetrical (RMAH.E.6185A). The other two specimens were less well worked and are noticeably asymmetrical (BM.EA.32124, FMcGC.1). All three have horns with different shapes, sizes and angles, along with different head shapes. The fourth is only known from a cursory description and its current whereabouts are unknown (Capart 1905:153; Hendrickx et al. 2003).

There are five probable crocodiles (Figures 6.15-6.17) among the collection of figures, and all show a great range of style, making the identification somewhat dubious for the most abstract ones. The unifying feature seems to be an open mouth. Additionally, some have a ridged back, though these could be executed differently. There is also variability in how they were made, two are bifacial, and two are only edge-retouched. The production techniques of the last are difficult to determine from available materials.

The two scorpions are different in both reduction technique and shape. One is bifacial

(MrM.98.88) and the other (Unknown.10) was only edge-retouched. The pincers are depicted differently and the bifacial piece has a smooth body while the other scorpion has distinct ridges on the sides.

Much more uniform are the ibex, which were made with similar production techniques but show some minor differences in style (Figure 6.23). All were bifacially worked. The ibexes from HK6 are extremely similar, in shape and reduction quality. However, the legs of the ibex in the Berlin museum are quite different in style, with a thick back leg and a protuberance on the foreleg.

Like the ibex, the five hippos show similarities in production, but still many differences in style (Figure 6.21).[46] All were bifacially worked, but the one from Kahun is of slightly lower quality. Noticeably, they are all of rather dark raw materials, and the raw materials of the two in the Hearst museum are so similar that they seem to be a set. Four have rounded bellies and a slight protrusion marking the tail. The Kahun and HK6 hippos have rounded snouts, the hippo from a private collection has a square snout with rounded corners, and one of the Hearst museum pieces has a square snout. The other from the Hearst Museum has an additional appendage or is shown with its mouth open. The square snouted Hearst Museum one has clear bumps on top of the snout indicating wrinkles above its nose- a feature of many Predynastic hippos (Hendrickx and Depraetere 2004). Though the PAHMA catalog cards note them as possible fakes, the detail above the nose, the raw material type, and general reduction style argue for authenticity.

There are at least three dogs (Table 6.1, Figure 6.24), and they show similarities in style but differences in production. They were all depicted in a similar position with their front paws out, leaning back with butt up and bellies down, although the exact shapes vary. A quadruped from HK 6 (HK6.2006.3) has similar features and may also be a dog.[47] Unlike the ibex and hippos, the dogs vary in production technique from fully bifacial to only worked along the edges.

The five serpents (Table 6.1, Figure 6.22) form a rather cohesive group in that they are all squiggly and of not particularly high quality. It is difficult to determine from such thin pieces whether they are worked only along the edge or across the whole face. None of them stand out as being particularly well made. They are all likely all fragmentary.

Use

These items clearly had symbolic uses. However it is difficult to understand the selection of figures chosen, and to derive insight on how they were used from that selection, because the eccentrics do not fit into a clear category from a modern point of view. The figures include both wild and domesticated animals; both Nile and desert animals; both edible animals and animals which show no signs of having been eaten during the Predynastic. Furthermore, both humans and animals were represented (although the human dwarf might still fit into an "other" category); and all manner of taxa are present including mammals, reptiles, fish, insects, and birds.

All the animals represented among the eccentrics were important iconographic elements of the period (Hardtke (2012); Hendrickx 2002, 2006a; Hendrickx and Depraetere 2004; Hendrickx et al. 2009; Huyge 1998). Underlining their ritual and religious significance is the fact that many of the animals identified among the chipped stone figures were also present among the

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[46] One from the Hearst museum is identified there as an elephant, but given its similarity to the other hippopotami, and dissimilarity to the more convincingly elephantine piece from Hierakonpolis, it is here classified as a hippopotamus.

faunal remains identified at ritually significant sites, as shown in Table 6.3. The overlap between the animal figures and the faunal remains from ritually significant sites is not just coincidence because, except for the domesticates, wild hunted animals are all very rare at Predynastic sites (Linseele et al. 2009:120) yet they show up in disproportionately large quantities in these ritually significant areas (Anderson 2011; Friedman 2009b; Linseele et al. 2009; Rossel 2007).

Hendrickx et al. (2003:14) proposed that the meaning or use of the flint figures may not be uniform. They broke down the potential meanings as follows: Those coming from elite cemeteries could be symbols of politico-religious power; some figures may have had an apotropaic and eventually religious significance (crocodiles, scorpions, serpents); while others may represent models of (victual?) offerings (birds, fish). Victual offerings, should probably be ruled out since most of the birds were probably fakes, and both birds and fish could be iconographically important animals (e.g. Horus, or Narmer [catfish]).

Recent excavations at the elite Hierakonpolis HK6 cemetery indicate that the figural eccentrics there were used as some sort of offerings (which does not rule out that the nature of the offerings may relate to religious/political power). All of the eccentrics there were found near the surface rather than inside graves (Adams 2001:6; Friedman 2010:70). Many have been found in the corners of above-ground structures or groups of structures, often with specific caches of artifacts. The locations of these items in the corners may relate to delineation and protection (Friedman et al. 2017). A good example of eccentrics in an offering deposit comes from structure E8. There, in the NW corner, a cache of artifacts was found in a shallow depression sealed in place by plaster melt from the reed walls (Friedman 2006:7, 2010:71). The cache consisted of an animal eccentric shaped like a dog or gazelle, a full-size model steatite fishtail knife, 20

[47] The excavators propose that it could be a gazelle.

transverse arrowheads, 2 tanged projectile points, a large piece of obsidian, and an unusual ceramic vessel. In the NE corner of the same structure parallel artifacts were found consisting of a fragment(?) of an elephant shaped eccentric, a fishtail knife, 60 transverse arrowheads, 2 concave-base projectile points, and the same kind of unusually shaped ceramic vessel (ibid.:8). An actual elephant was buried in the center of the tomb complex, so the choice of an elephant as one of the animal eccentrics does not seem coincidental. Other figural eccentrics at HK6 were also found in the corners of tomb complexes or structures (Droux and Friedman 2007:8; Friedman 2005:4-6; Friedman et al. 2017), including a human figure that is likely a dwarf found in the NW corner of a complex that contained a dwarf burial (Friedman 2011). At Hierakonpolis, over the course of the Predynastic there is evidence for a shift toward representations replacing the actual item (Friedman 2009b:95-96). The figural eccentrics might be seen as part of this shift toward representation in addition to, or eventually in place of, the real thing.

The use of eccentrics was not limited to cemetery offerings. Chipped stone figural eccentrics were also found in settlements. Of the 23 excavated pieces, nine were from settlements. The settlement pieces showed less variability in figure type than cemetery eccentrics with four (probable) crocodiles, two dogs, two serpents, and a fragment of an unidentifiable quadruped. It is also important to note that only one of the settlement eccentrics came from a temple, and the rest from a domestic settlement context.

Although the samples were small, there is a discernible difference between the settlements and cemeteries in terms of preservation. Among the pieces with secure proveniences from cemeteries, six are complete, six broken, and two indeterminate. From the settlements, two are complete, five are broken or fragmentary, and two are indeterminate but look fragmentary. The difference in breakage rates may indicate that they were used in different ways in settlements and cemeteries. Unlike the RFKs, fishtails, and rhomboid tools discussed above a case cannot be made for intentional breakage, since of the 42 where the preservation could be determined, 66.7% (N=28) were complete.

All in all, the figural eccentrics were primarily religious/ideological objects. Proposed meanings/uses include offerings in cemeteries, symbols of politico-religious power, and apotropaic elements, none of which need be mutually exclusive. Their uses may have varied depending on who was using them, when, and where. Many of the types of animals represented became associated with gods in the Pharaonic period.

Bifacial Sickles

Description

Bifacial sickles are fully bifacially thinned tools that have denticulations along one edge (Figures 4.49, 7.5). These elongated tools were made in a few main shapes: bi-pointed, pointed on one end and squared on the other, or squared on both ends. The degree of convexity of the sides can vary, and some are symmetrical along the longitudinal axis while others have a straighter back and convex working edge. Bifacial sickles can be relatively large tools, the bipointed ones sometimes reaching over 20 cm in length. The widths of bifacial sickles studied here (Table 6.25) ranged from 1.3-4.2cm, and thicknesses from .5-1.3cm. They are one of the main kinds of bifacial tool types found in settlements.

Date

Bifacial sickles date from the Neolithic period at least through the Naqada III. Bifacial sickles were quite common at Merimde, Badarian sites, and Fayoum Neolithic sites (Baumgartel 1960:25,29; Brunton and Caton-Thompson 1928:36-37; Caton-Thompson and Gardner 1934:21). Stylistically the Badarian sickles are quite different, shorter and more convex in the middle with larger sickle teeth (Homes and Friedman 1994:132). Bifacial sickles continued to be used in the Naqada I-II (e.g. Rizkana and Seeher 1988:34-35), and have been found in the uppermost level at Adaïma (Midant-Reynes and Prost 2002:353-354) which dates to early NIII (ibid.:20). Bifacial sickles decreased in frequency over time, which likely related to the increase of sickles made on blades with only edge retouch from the NII onward (Rizkana and Seeher 1985:249). Bifacial sickles were certainly gone by the Old Kingdom (Graves-Brown 2011:425). Occasionally, denticulated bifacial tools have been found in the Dynastic periods, such as a First Intermediate Period "knife sickle" from Ayn Asil (Midant-Reynes 1998). However they were not common.

Production

Bifacial sickles were made in a wide variety of raw materials (Ch. 7.1). Some of them may have been heat-treated. Midant-Reynes and Prost (2002:354) noted one "bifacial piece with regular denticulations" from Adaïma that was heat-treated. Holmes and Friedman (1994:132) suggested that a bifacial sickle from Badarian-Amratian transition level was heat treated. Others observed in this study were not heat-treated or were indeterminate. They could be made on flakes or nodules. Holmes (1989:163) noted one bifacial sickle that was probably made on a blade blank. Given that some bifacial sickles have very large dimensions, around 20 cm, it is likely that some were also made on nodules, rather than flakes. However, bifacial sickles were fully flaked leaving little cortex remaining that would indicate a nodule blank.

Bifacial sickles were probably made using soft-hammer percussion, or a combination of hard- and soft-hammer percussion, along with pressure flaking. Holmes (1989:162-163) noted some variation in the technique for forming the denticulations of the six examples she studied from Predynastic sites in the Badari region, although most denticulations were made through some kind of pressure retouch.

Use

Bifacial sickles have sickle gloss clearly indicating that they were used to cut plant material. Some tools with the same morphological features as bifacial sickles have been found without sickle gloss. They simply may not have been used long enough to develop the gloss, or the tools could have been used for multiple purposes. Many, even the ones without sickle gloss, also often have broken serrations.

There is no indication of intentional breakage. Some broken examples are extant such as examples from Predynastic sites in the Badari area (Holmes 1989:162) but many more have been found complete except for minor wear, such as examples from Maadi (Rizkana and Seeher 1988: Pl 73).

Bifacial knives

Description

A bifacial knife is a tool that has been bifacially thinned across most of both faces, has a single cutting edge, and an asymmetric shape (Holmes 1989:405; Midant-Reynes and Prost 2002:374) (Figures 4.50; 6.25). Predynastic bifacial knives had a wide range of morphologies that varied in terms of the degree of curvature of the back, the tip shape, the width, and the presence or shape of a handle or haft. Some knives have a more standardized shape and some researchers have defined subclasses such as 'comma shaped knives' and 'standard Gerzean knives' (Holmes 1989:405-406). The sizes can be quite variable, ranging from knives as small as 7cm long (Holmes 1989:161), to swords over 51cm long by the NIIIB (Kabacinski 2012:332).

Date

Bifacial knives existed well before the Naqada period (e.g. Kindermann 2003), and continued to be made after. While the morphology of knives was quite variable in all the periods (Hikade 2013; Holmes 1989; Kabacinski 2012), some trends are characteristic for different time periods. The subclasses defined by Holmes (1989) are distinctive for the Predynastic period. Pronounced handles become more common in the Early Dynastic and later (Kabacinski 2012; Petrie 1902; Schmidt 1992a,b), though hafting areas are often discernible on Predynastic knives by the less controlled retouching (Holmes 1989: 265, 405; Midant-Reynes and Prost 2002:374). Bifacial knives became more prevalent in lithic tool assemblages in the Early Dynastic and continued to become increasingly pervasive throughout the 3rd millennium BCE (Graves-Brown 2011; Hikade 2013:115). Bifacial knives of gigantic proportions (40cm+) mainly date to the Early Dynastic (Graves-Brown 2011:109, 452-453; Hikade 1997, 2010:9).

Production

A wide range of raw materials were used for bifacial knives (Holmes 1992a; Kabacinski 2012; Takamiya and Endo 2008, 2011). Holmes (1992:41) did not find indications of heat-treatment among bifacial thinning flakes and bifacial tool fragments from HK29A. Those from the el-Mahâsna materials analyzed here were not heat-treated. One bifacial knife fragment from

Adaïma was classed as a type of raw material thought to be heat-treated (Midant-Reynes and Prost 2002:360). The most evidence for heat-treatment of bifacial knives so far comes from Tel el-Farkha, where there is limited and declining indication of heat treatment of knives[48] (Kabacinski 2012:324,339).

Often the blank for bifacial tools is difficult to discern if the piece was fully flaked, however there is evidence that bifacial knives could be made on tabular nodules or on large flakes. Naqada period knives made on large flakes or blades have been identified at Tell el Farkha (Kabacinski 2012:328, Fig 5), Hemmamiya (Holmes 1989:79) and Adaïma (Midant-Reynes and Prost 2002:320). Knives made on nodules or thin tabular pieces come at least from Badari, Hemmamiya, and South Town (Holmes 1989). Furthermore, Takamiya and Endo (2008, 2011) identified tabular flint nodules with a few preliminary flake removals among the material from HK29A, which they argued were the blanks for the bifacial tools produced at the site.

The quality of flaking for bifacial knives can vary from "irregularly flaked and shaped to extremely finely retouched and precisely shaped" (Holmes 1992:405), and this variation likely indicates that, at least to some extent, multiple flaking techniques were used, although skill in execution of the techniques could factor into the variation as well. Probably a range and/or combination of techniques were used including hard and soft hammer percussion and pressure flaking. Holmes (1989:265) identified one non-ripple flaked knife with signs of grinding, from South Town (UC.5331). Additionally, Kabacinski (2012:331) found two knife fragments with signs of polishing from Tel el-Farkha, so grinding was part of the production process for some bifacial knives.

[48] Some of the knives were not fully bifacial but made on blades.

Use

There is much evidence for usewear on bifacial knives. Some bifacial knives have been found with sickle gloss (e.g. Midant-Reynes and Prost 2002:354), though it is possible that the gloss may be from woodworking rather than reaping (Graves-Brown 2011:179). Furthermore knives are often found broken, especially in settlements (Holmes 1989, 1992; Kabacinksi 2012:329-333; Midant-Reynes and Prost 2002:353-354). It is not uncommon for broken knives to be reworked, such as examples from el-Mahâsna studied by the author in University of Pennsylvania Museum. Other times bifacial knives were simply reworked into knives of a different form (e.g. Schmidt 1992b:86, Fig 9.53), which may contribute to the diversity of forms in this class of tools.

However the fact that the knives were used for practical purposes does not mean that they lacked symbolic significance. From the Old Kingdom and into the New Kingdom bifacial knives were often depicted in cattle slaughter scenes (Eggbrecht 1973; Graves-Brown 2011:173-179; Hikade 2010:9). Cattle slaughter has been associated with temple activities in the Pharaonic Period through archaeological and representational evidence (Graves-Brown 2011:177; Rossel 2007), and this same association likely extends back to the Predynastic. The faunal assemblages in the ritual activity areas of HK29A (Linseele et al. 2009:127) and el-Mahâsna Block 3 (Anderson 2006:186-195; Rossel 2007:206-207) had higher quality cattle remains (in terms of age, size, and cuts of meat) and/or higher proportions of cattle compared with surrounding contexts. Graves-Brown (2011:173-179) argued that the knives used in cattle slaughter were important elements of the ritual, and there is evidence that bifacial knives were used for the cattle slaughter at least into the Middle Kingdom.

Axes

Description

Predynastic axes are bifacial flaked stone tools with an oval or expanding form, and a distal rather than lateral working edge (Figures 6.26, 7.6). The cross-section of axes is convex on both faces. Some but not all Predynastic axes often have the scar from a transverse blow across the end that created a sharp edge. This blow forms a distinctive type of debitage known as a "tranchet" or "axe-preparation" flake (Figure 4.40) (Holmes 1990:9). Predynastic axes can range from approximately 4 to 15cm in size (e.g. Holmes 1989:247, 1990), however on average they tend to be rather small, only around 6-7cm long (Table 6.29). Fifty-eight axes studied here had lengths ranging from 4.2-10.5cm, width of 3.3-8cm, and thicknesses of 1.5-3cm (see Ch. 6.2).

Holmes (1990) has conducted the most detailed study of axes, on examples from settlement sites in the Naqada region. Predynastic axes were a major factor in identifying regional variation among Nile Valley lithic assemblages dating to the early Predynastic period (Holmes 1989a,b). A distinctive characteristic of the Naqada region was that axes were much more common there than in the others. The prevalence of axes in collections from that area has been borne out by subsequent studies (e.g. Ginter and Kozlowski 1994; Vermeersch et al. 2004).

Date

Axes appeared in conjunction with Neolithic activities in many parts of the world (Barkai 2011:445). In Egypt, early forms of these axes have been found in Tarifian and Badarian sites, as well as in the Kharga oasis (Holmes 1990). Many examples are known from Naqada I and II sites, and the latest Naqada-type axes may come from Adaïma (ibid.). Axes certainly continued to be made in the Dynastic period in different forms, but perhaps less frequently, in conjunction with the increasing prevalence of copper axes (Graves-Brown 2011:473-475). However the Dynastic axes lack the distinctive tranchet scar, are longer, and tend to have a higher width to thickness ratio (ibid.). In the Middle Kingdom, some chipped stone axes were more proportional in their width and length ratios and had pronounced spurs or lugs for hafting, which imitates the metal axes of the time (ibid.).

Production

Axes were often made on small and/or thin nodules, and occasionally on large flakes (Holmes 1989:240, 274; 1990:5). The axes tend to be fully bifacial, but sometimes patches of cortex remain. Holmes (1990:7) did some experimental replication of axes using chert from the Naqada area and concluded they were likely made with hard hammer percussion, although she also noted that some may have been finished with soft hammer percussion. Very few axes show traces of grinding. Holmes (1989:273) only noted one axe (UC5351 from South Town) which had indications of grinding, but this grinding occurred after the flaking as a finishing modification rather than as a preparation for flaking.

Sixty-seven percent of the axes studies by Holmes had a tranchet scar. Based on signs of wear such as microchipping, Holmes (1990:9-10) concluded that the tranchet blow was a form of preparation, not re-sharpening. This was based on analysis of the order of flake removals and measurements of the axe preparation flakes relative to the size of the axes themselves, which showed that the tranchet flakes were larger than the average width of the axes.

Use

Axes are commonly found in settlements, and so are thought to relate to daily-life activities. Based on early excavations, axes seemed to be one of the most common tool types found in settlements (e.g. Baumgartel 1960:35). However comparison of modern Predynastic settlement excavations to museum collections shows that this was simply a matter of collection bias- preference for bifacial tools (Holmes 1990:3). For instance, Garstang (1903:7-8; Pl 3,5) specifically reported on and pictured axes and hoes from the el-Mahâsna settlement, but only three axes were counted among the artifacts studied here from Anderson's el-Mahâsna excavations.[49]

Use-wear studies of axes with tranchet blows from other parts of the world have concluded that such tools likely were used for light woodworking (Barkai 2011:445; Yerkes et al. 2003). This interpretation seems reasonable for at least some Naqada axes. The average edge angle for axes is around 65° (Holmes 1990:10), which is thick enough to stand up to some strong work but sharp enough to still be a cutting edge. Holmes (1987) conducted a use-wear study of a few Predynastic artifacts, and for two axes she initially proposed a woodworking use. Holmes also observed edge rounding and sheen on two additional axes (ibid.). However she also noted problems due to the presence of patina and desert varnish, and in the end concluded that the function of Naqada axes remains unknown (Holmes 1990:10).

Phil Geib and I examined 12 axes housed in the University of Pennsylvania museum in June 2011. John Garstang collected these artifacts from the El- Mahâsna settlement site in 1900-1901. Figure 7.6 shows the variability in size and shape of these objects. The average dimensions of the axes were comparable to those published by Holmes (1990) (Tables 6.26-6.28). Two of

[49] The size of the area excavated by Garstang is unknown, but was likely larger than the volume of material excavated by Anderson and analyzed here.

the axes had a macroscopically visible wear pattern which can be identified as soil polish[50] (E9681, E9682). Soil polish is described as "distinctive, flat, fluted polish with numerous comet-shaped pits" (Yerkes et al. 2003:1054) (Figures 6.26-6.27): therefore, the two artifacts (E9681, E9682) were likely used as hoes. Additional support for hoeing is that micro-fractures were also observed near the edge, on the side of the artifact opposite the soil polish. Chopping the artifact into the soil and pulling it would likely result in microfracturing to the far side and soil polish on the near side. Additionally, another example with an even more developed soil polish was found by and mentioned in Garstang (1903:7 PL V).

The category 'axe' is based on morphology and production characteristics, and is not meant to specify function. Therefore the category 'axe' may actually include tools used for chopping and tools that may have been used for hoeing.

All of the 49 Naqada axes in Holmes' (1990) sample were complete. Of the 15 axes from el-Mahâsna three were broken or fragmentary. Five of the 49 axes studied by Holmes showed evidence of re-working (ibid.:10). Re-working or re-sharpening may account for some of the range of dimensions and small average size of Predynastic axes.

6.2 Evaluation of Specialized Production at an Inter-Community Level

Below, specialized production of bifacial tool types is evaluated on the inter-site level (Ch. 6.2) and at the intra-site level (Ch. 6.3) by comparing the distributions of tools and production remains. Tables of the tool types and production remains were constructed for this

[50] The identification of this wear pattern as resulting from soil was made by Phil Geib, based on similarity to such patterns on Mayan agricultural tools

analysis. Additionally the relative degree of standardization was assessed through a look at the coefficient of variation (CV) for metric attributes[51] (see Ch. 2.5 for an explanation of the CV).

Tables 6.6-6.7 show the bifacial tool types from the Naqada period Nile Valley settlement sites focused on in this study: el-Mahâsna, Abydos, Naqada sites, Armant, Adaïma, Hierakonpolis, and Nag el-Qarmila. These sites all have sufficient published data on lithic artifacts to calculate percentages, and thus compare between the sites.

Many of the studies represented in Tables 6.6-6.7 were not the first or the largest collections from a given site, so Table 6.8 shows the counts of bifacial tools from other publications relating to each site. However in many cases the total counts of lithic artifacts collected are unknown, so percentages could not be calculated. Furthermore many are from much older excavations, where collection was not as comprehensive as it is these days. Therefore this information is best seen as presence/ absence data.

Since some of the bifacial tool types studied here were mainly found in cemeteries, Table 6.9 shows the counts of bifacial tools in cemeteries associated with the settlement sites studied here. Again, collection strategies varied, and total counts of lithic artifacts found were not always available, so percentages were not calculated. The total number of graves gives some idea of the sample sizes.

Table 6.5 shows that bifacial thinning flakes were found in all settlements, but the frequencies differ. Axe preparation flakes, also shown in Table 6.5, are the only debitage type assessed here that relates to a specific tool type. Summary tables were made for each individual

[51] The variability of tools described here does not come near the limits and typical ranges discussed by Eerkens and Bettinger (2001) for considering something standardized, which is a COV around 2-5%. The least variable tools here range instead around 12-15%. However here the question is not whether or not the tools were standardized, but rather which were the most standardized for their time.

bifacial tool type, showing the presence/absence of the tools and the production remains together (Tables 6.10-6.17).

Ripple-flaked knives

Ripple-flaked knives were definitely made by specialists. Previous studies dealing with RFKs agree on this point (Bradley 1972:4; Hikade 2010:7, Holmes 1989: 338; Kelterborn 1984:452; Midant-Reynes 1987:222, 1992:200; Takamiya 2004:1030). However, reasoning and details can vary. Most scholars base their assessment on the obvious degree of skill involved. After replicating 50 RFKs, Kelterborn's (1984:452) conclusion was that: "Such a degree of conceptual sophistication and manual perfection can only be reached by highly specialized master craftsmen who must be ranged among the world's best." Kelterborn's (1984:452) only reference to standardization was his conclusion that there must have been formalized education and training in order to account for the uniform quality of the knives. Holmes (1989:338) based her assessment of specialization on the standardization of the style and manufacturing techniques. The flakes were always removed in a counter-clockwise direction (ibid.:442; Midant-Reynes 1987:190), which is a kind of standardization of the production process.

Because of the high levels of knowledge, skill, and aesthetic achievement Takamiya (2004:1034) classed the producers of RFKs as full-time specialists. Furthermore, Takamiya posited attached specialization for the producers of the RFK knives, figuring that the royal and elite symbolism evident on the RFK knife handles can be considered evidence that the specialists were supported by emerging leaders (ibid.:1035).

In the present study, the definition of specialization (Ch. 1.1) is where items were used by other people beyond those who made them (above a household level), which is here assessed by looking at distributions. Kelterborn's assessment of skill does fit with this definition because it hard to believe that the kind and degree of skill evident in the knives' production would be found among more than a very small subset of the population, while the knives themselves were found spread throughout the country (Tables 6.9-6.10). RFKs reached as far north in Egypt as Minshat abu Omar and Tel el Farkha (in the Delta) and even as far as Azor in the Levant (Braun 2014:39). To the south, RFKs were found at Hierakonpolis in Egypt and Qushtamna in Nubia (Midant-Reynes 1987). In contrast to this broad distribution, there were probably only one or a few production locations for RFKs. Because of the standardization of the knives, Holmes (1989: 338) posited that there may have been only one workshop for RFKs in the Egypt. From his examination of the raw materials used for RFKs, Kelterborn (1984:441) thought that more than one source of material was used for the knives, which may indicate that different materials were brought to one workshop or that there were multiple workshops. Only one candidate for an actual RFK production area has been found, the above described locality HK29A at Hierakonpolis. Kelterborn detailed what kinds of production remains should be expected from every stage of RFK production. So far none have been specifically identified and correlated with Kelterborn's analysis, but finding them would help identify RFK production locations with greater certainty. Overall, the distribution is much wider than the possible production areas, and the knives were certainly specialized.

Metric data on ripple flaked knives (Table 6.18) shows that besides being made with standardized production techniques, they were also among the most standardized bifacial tools in terms of size. Twenty-two complete RFKs surveyed here had an average length of 23.75cm, with a standard deviation of 3.75 and a coefficient of variation of 15.79%. The average thickness for 18 RFKs was 5.87cm, with a standard deviation of .832 and a CV of 14.17%. Thickness were available for 10 knives, which averaged .66cm, with a standard deviation of .106, and a CV of 16.06%. Only the concave-base projectile points (see below) were more standardized in width and thickness, but this probably relates to their smaller size and functional requirements rather than to the skill and number of the producers.

Tables 6.6-6.10 show that the RFKs were found in cemeteries, and while they were present in many cemeteries they were not found in all cemeteries. Some of the cemeteries without RFKs in Table 6.9 do not date to the right period, but others do (el-Mahâsna cemetery H) showing that despite having wide distribution, RFKs, have not been found in all cemeteries. The quantities of RFKs are small compared to the number of graves in each cemetery, which points to their restricted distribution. All in all, RFKS had concentrated production and wide geographical distribution (to only a limited number of people), and were used/discarded in a select venue (cemetery). They clearly should be considered specialized at an inter-site level.

Rhomboid tools

Tables 6.8, 6.9, and 6.11 show the distribution of rhomboid tools and production remains among the sites in this study. The distribution pattern for rhomboids is notably similar to that of RFKs. Rhomboids were also primarily found in cemeteries. The geographic distribution was not concentrated, and in fact was wider than is reflected in Table 6.11 because rhomboid tools have also been recovered from other sites in the regions covered here, such as Mesaid[52]. There is no clear evidence of where rhomboid tools were produced. Again a likely production place for rhomboids is HK29A where one tool fragment may be from a rhomboid tool (Friedman

[52] Examples in the Boston Museum of Fine Arts: 13.3766, 11.256, 11.253, 11.23

2009b:89, footnote 36; Holmes 1992:41,43, Fig. 5). However the earliest phase of the HK29A remains dates to NIIB-C, which would be on the late side for rhomboid tools.

Rhomboids were quite variable in terms of their metric attributes (Table 6.19). The average thickness was .65cm (standard deviation .189, coefficient of variation 29.08%) for seven examples where thickness data were available. The average length for 15 rhomboids was 26.68cm (standard deviation 8.16, CV 30.58%). Width was the least variable characteristic. Fifteen rhomboids had an average width of 4.74cm, with a standard deviation of .916, and a CV of 19.32%. The variability in length may relate to the availability of raw materials of sufficient size to make the really large rhomboids.

The metric data show that on average, rhomboid tools are extremely thin, just as thin as RFKs, especially considering their length, which speaks to the skill of their producers. This thinness indicates a degree of flintknapping skill not likely had by many people. Furthermore rhomboid tools involved many of the same production techniques as RFKs, except for the ripple flaking. Since RFKs must have been produced by specialists at the inter-site level, and rhomboid tools bear many similarities to fishtails and RFKs in production techniques and thinness, and were similar to RFKs in terms of distribution (being mainly found in cemeteries), it is likely that rhomboid tool production was specialized, probably at an inter-site level.

Fishtails

Tables 6.8, 6.9, and 6.12 show that fishtails, although much more common in cemeteries, were also found in settlements, so their use/discard was not as restricted as RFKs. Neither the settlement nor the cemetery distribution of the tools was concentrated in any particular region. Even though Naqada has the highest number of fishtails, it also has a much higher number of graves. In cemeteries, the fishtails were actually the most common bifacial tool type, being found in almost all of the cemeteries represented in Table 6.9, and at many of those cemeteries' fishtails are the most numerous of any bifacial tool type.

No production sites for fishtails have been specifically identified, except that HK29A is a likely production area. No debitage has been specifically associated with fishtails, nor have any preforms been securely identified. Since fishtails were made in many different raw material types (see Ch. 7.1), it is quite possible that there were multiple production locals for them. The example from Maadi which was possibly locally made (Roth 1992:128) supports this idea, as does the variability in quality of the fishtails (Van Walsem 1978:243).

Metric data were collected on 63 examples that were complete enough for accurate dimensions (Table 6.20). When these data were analyzed according to the shape type (Table 6.21), it confirmed van Walsem's (1978:243) assessment that fishtail lengths increased over time with the average length of Type 1 fishtails at 12.23cm, and the average length of Type 2 fishtails at 16.16cm. But more importantly for this study, the data showed that the variability in lengths, as measured by the coefficient of variation, decreased over time from 19.94% to 13.63%. This means that the lengths became more standardized over time, as would be expected for increasing specialization. Additionally this trend confirms that style 3 should be placed between styles 1 and 2 chronologically. There was not enough thickness data to look at the variability of thickness over time, and the widths relate more to the style of the object than to factors affecting standardization.

Since the production techniques for making fishtails was very similar to the production of RFKs, particularly for those fishtails with grinding and/or actual ripple-flaking, and there is very good evidence for inter-site specialization for RFK production, it is very likely that at least the later fishtails with ripple-flaking were produced by specialists at the inter-site level. By extension, the production of the earlier fishtails was probably either specialized or developing into specialized production. The decreasing variability in length supports this conclusion indicating that fishtails were probably made by fewer and fewer specialists over time, despite their wide geographic distribution. In sum, fishtails had a wide geographical distribution, but involved production techniques that were not likely practiced by all, and became more standardized over time. Therefore it is likely that fishtails were produced by specialists at an inter-site level.

Concave-base projectile points (CBPPs)

Tables 6.6-6.9, 6.12 show that CBPPs were more common in settlements, but also could also be found in cemeteries, including model CBPPs. The distribution of the tools was geographically widespread, not concentrated. In this case it is clear that there were multiple production areas. Unfinished CBPPs have been identified at Naqada KH4 (Holmes 1989:248-249), South Town (Holmes 1989:274) and at HK29A (Holmes 1992:41). Whether they were produced at other sites besides these is unknown.

It is difficult to judge from this data alone whether or not they were made by specialists. Again, the production techniques used—pressure flaking, microserration, and possibly grinding to prepare and thin the blank—were also features of RFKS, fishtails, and rhomboid tools, all types that are likely produced by specialists. Microserration was not here identified on other tool types besides these. Furthermore this suite of techniques is significant, because the Naqada period CBPPs were different in style and technology compared to those produced during earlier periods. Naqada period CBPPs have deeper notches, finer barbs, and more lammellar retouch

(Hikade 2001:119-120). This change could related to increasing specialization in the organization of production.

The metric data for CBPPs (Tables 6.22-6.23) show that they were actually the thinnest tools, having an average thickness of about .6cm, but this probably relates to their smaller size. CBPPs were also the most standardized bifacial tools in terms of thickness (CV=15.41%) and width (CV=12.65%), but the lengths were quite variable. The standardization of the thickness and width might have to do with the hafting requirements rather than (or in addition to) the number and skill of the producers.

All in all, CBPPs had a wide geographical distribution, with use focused on but not limited to settlements, production at least in multiple sites but it is indeterminate if production occurred in all sites, and there was a technological change toward a suite of production techniques which were also used on other tools types that were made by specialists. Additionally there was a very high degree of standardization in metric characteristics which was comparable to other tools made by specialists. Altogether, it is likely that specialists produced CBPPs. Whether that production was on an inter-regional, inter-site, or intra-site level cannot be conclusively stated at the moment.

Figural eccentrics

As was mentioned in section 6.1, the distribution of figural eccentrics was uneven, focused mainly on Hierakonpolis and Abydos. Finds of figural eccentrics from other sites are significantly later in date, have had their authenticity called into question, have insecure proveniences, or were likely heirlooms.

Although no unfinished figural eccentrics have been identified to indicate production locations, a number of lines of evidence indicate that there were probably multiple production locations, specifically Hierakonpolis and Abydos. The variability in figures depicted, and the variability in production style[53] and quality within the same figure type (Ch. 6.1), indicate that there were multiple producers and possibly more than one production locality. One of those is certainly Hierakonpolis, where so many of the figural eccentrics come from, and where there is a known location for the production of bifacial tools at HK29A. Note that the Hierakonpolis figural eccentrics date mainly to the NIC-IIAB period, and the earliest phase of bifacial tool production at HK29A dates to NIIB-C, or possibly slightly earlier (Friedman 2009b:85-97), with the main phase of industrial-scale production even later, NIID-IIIA (ibid.:93).

A second location of production was likely at Abydos, where the most figural eccentrics were found after Hierakonpolis. However, the Abydos figures, dating to the NIII and First Dynasty, were later than the majority of the Hierakonpolis figures. Given the temporal and spatial differences, with many of the provenienced early figures coming from Hierakonpolis and the later ones coming from Abydos, the main location of production and/or use shifted over time. In this case the animals seem to mainly be used, and probably made, in one site at a time, which does not fit the definition of specialized production at the inter-site level. See section 6.3 below for a discussion of specialization at the intra-site level.

Bifacial knives

Bifacial knives have been found at many Naqada period settlements and cemeteries (Tables 6.6-6.9, 6.15). Production of bifacial knives has been identified at both el-Mahâsna and

[53] It would not be appropriate to compare the variability in metric characteristics since the eccentrics

HK29A, through the presence of unfinished knives and thinning flakes.

Figure 6.28 shows an unfinished bifacial tool in the University of Pennsylvania's collection that Garstang found during his excavations at el-Mahâsna. Based on the size and shape, it is most likely a preform or roughout for a bifacial knife or dagger. The el-Mahâsna preform is made from a type of chert (type '1.Indistinct beige') that was quite common at the site, and about 10 % of the thinning flakes from the analyzed material of Anderson's excavations were the same variety of chert. Therefore at el-Mahâsna there is a case of local production for local use. Whether knives such as the one made at el-Mahâsna were also exchanged farther is unknown.

At HK29A, Takamiya and Endo (2008:9) identified a bifacial knife that was broken during the production process, confirming that bifacial knives were made at Hk29A. Bifacial knives were also found in other parts of the site localities (localities 11, 29, and 25D), so some of the bifacial knife production at HK29A could have been for use in Hierakonpolis. In both the el-Mahâsna and Hierakonpolis cases, there was production of knives for use within the same community where they were produced, which would not be considered specialized at an inter-site level.

However there was evidence from other sites that bifacial knives were obtained from outside communities and not produced locally. At Adaïma, Briois and Midant-Reynes (2008:27) argued based largely on raw materials that bifacial knives were brought into Adaïma from elsewhere and not made on site.[54] At Tel el-Farkha Kabacinski (2012:339) divided the Naqada

had such diverse form.

[54] However the article is somewhat confusing, because the charts imply that there were no bifacial knives on the site besides the sickles and fishtails, but other publications from Adaïma show that bifacial knives were found there.

period and Early Dynastic knives into two distinct groups. The first group consisted of small, poor quality, poorly standardized, locally made knives, and the second group was composed of large wide knives with distinct handles, imported from outside the site. The locally made knives were more numerous than the imported ones. By definition the imported knives must have been made by specialists, and Kabacinski implied that the locally made knives were not made by specialists, although the possibility for variation in the production remains within the site was not addressed.

It is also important to point out that the category of bifacial knives can be quite variable in terms of morphology, quality of flaking, and production technique (Holmes 1989:405; Ch. 6.1). Due to this morphological variability, no attempt at a comparison of metric characteristics was made. In sum, at least some bifacial knife production was specialized at the inter-site level, but not all. Since this category combines both specialized and non-specialized tools, it will not be used to evaluate the expectations for a ritual production model of specialization in Chapter 7.

Bifacial sickles

Tables 6.6-6.9, and 6.16 show that bifacial sickles were present in many sites, including both settlements and cemeteries. At most settlements only a few bifacial sickles have been recovered (n=1-3). There is no direct evidence for where bifacial sickles were produced. No unfinished pieces have been identified, and there are no specific forms of debitage associated with these tools besides bifacial thinning flakes, which were present in low amounts at all sites.

Information on the raw materials constitutes the best evidence for production locations. Looking at raw materials of bifacial thinning flakes present at Adaïma compared to various tool classes, Briois and Midant-Reynes (2008:27) indicated that bifacial sickles and other bifacial knives were imported into the site, which implies some sort of specialization. A similar situation was evident at Abydos (ATP). There one bifacial sickle was made of type ‘1.Indistinct beige’ raw material and only 1 thinning flake of that raw material was found at the site (3% of the thinning flakes). Two bifacial sickles were made from type ‘7.Dark gray and brown’ material, and only two thinning flakes were found of the equivalent material.

Conversely at el-Mahâsna there was one bifacial sickle made of raw material type ‘10.Pink-gray’ material, and 26% of the thinning flakes were of this same material indicating that the sickle could have been made in el-Mahâsna. In a comparable situation, the bifacial sickle from Nag el-Qarmila (AKAP) was made of raw material type ‘7.Dark gray and brown’, an 22% of the thinning flakes were also of that material.

The metric data indicate the bifacial sickles were relatively variable in terms of their widths and thicknesses (Tables 6.24-6.25), with CVs of 24.84%, and 29.74%, respectively. Only width and thickness were examined because bifacial sickles come in bi-pointed and single point varieties, and many had breaks at one end. This relative variability could indicate multiple producers. All in all, bifacial sickles had a wide geographical distribution, and were probably produced at multiple sites, but not at every site, indicating that there was some intra-site specialization in the production of bifacial sickles.

Axes

Axes were a major factor in defining regional differences among lithic artifact assemblages in the Nile Valley (Holmes 1989). Holmes’ analysis showed that axe production was much more prevalent in the Naqada region. Tables 6.6-6.9, 6.17 show a very different pattern of production than any of the previous bifacial tool classes. Axe production is very obvious in the Naqada-Armant region, where all kinds of production remains and as axes were present in the settlements and cemeteries. However the presence of axe and preparation flakes in a few other sites indicates that some axe production also went on in other sites. The lack of identifiable axe roughouts or preforms probably indicates that axe production was much less frequent outside of the Naqada area, which fits well with Holmes' interpretation of regional variation.

The metric data on axes (Tables 6.26-6.29) indicate that they were relatively variable tools in all dimensions, with CVs ranging around 20-25%. The axe data also show that the average dimensions were slightly different between sites, although this could relate to collection bias for the samples that come from museum collections, as excavators might have been more inclined to both recognize and keep the larger axes. Width was the least variable characteristic and length the most variable, which makes sense if axes were resharpened by adjusting the working end. The range of variability was comparable at all sites, which could indicate that there were not substantial differences in the organization of production between the Naqada-Armant region and other areas. The major difference seems to be in the quantity of axe production in the Naqada-Armant region, not in the characteristics of the axes or how they were produced. All in all, there is evidence for production of axes in almost every site where they were used, so axes cannot be considered specialized at an inter-site level, but see below for specialization at the intra-site level.

6.3 Bifacial Tool Specialization at an Intra-Site Level

There were sufficient data from three sites (el-Mahâsna, Armant, and Hierakonpolis) to analyze intra-site differences in bifacial tool production. For the most part, bifacial tool production could only be analyzed as a whole, rather than as individual tool classes, because of the similarity of the production remains, and because some of the tools described above were only rarely found in settlements. The distribution of bifacial production remains and tools was used to assess whether there were any differences in the organization of bifacial tool production at each site, by looking at differences in frequencies. The significance of the differences were checked using confidence limits (see Ch. 2.5 for an explanation of confidence limits).

el-Mahâsna

There was a slight but defined concentration of bifacial tool production remains in Block 3 at el-Mahâsna. Bifacial thinning flakes were present in low percentages in each of the three blocks (Table 6.30), however the frequency was higher in Block 3. The 95% confidence limits of the percentage of bifacial thinning flakes for Block 3 does not overlap with those from Blocks 1 and 4 Figure 6.29). Therefore the differences are not simply due to chance or sample size but probably reflect a real difference in the underlying population. Additionally, the only axe preparation flake (Table 6.30), and a bifacial tool preform (CBPP) (Table 6.33), were also found in Block 3.

There was some variability in the distribution of bifacial tools with a higher amount in Block 3 (Table 6.33). Each block had non-standardized miscellaneous bifacial tools, but almost all of the more standardized identifiable types, such as CBPPs, axes, and a knife, were found in Block 3. However this variability in the frequencies of bifacial tools could not be differentiated to the 95%, or even 85% confidence levels (Tables 6.31-6.32). Therefore, even though there was a higher percentage of bifacial tools in Block 3, this difference is not statistically meaningful, and the concentration of bifacial tools in Block 3 cannot be confirmed.

The definition of specialization used here is that items were used by others than just those that make them. Since there were more bifacial tool production remains in Block 3, but no statistical difference in the distribution of bifacial tools, then it is likely that there was production of bifacial tools in Block 3 for use in other areas. This more intensive bifacial tool production in Block 3 means that there was a degree of intra-site specialization in the production of bifacial tools. Since a preform for a concave base projectile point (Figure 4.47) and an axe preparation flake were found in Block 3, then some of the specialized bifacial tool production in Block 3 was likely to make axes and CBPPs.

Armant

Additional evidence for intra-site specialization of axe production comes from site of Armant MA 21/83. There, Ginter et al. (1996:177-178) found that the production of axes, and possibly other bifacial tools, was concentrated in the southern sector of the site in all phases. The flakes from bifacial tool production were distinctly concentrated in that area, and the full sequence of bifacial tool production took place in the “specialized sector.” Additionally, many preforms were found at the site (Ginter and Kozlowski 1994). This spatial concentration of bifacial tool production did not change over the different phases of the site even though blade production shifted from being carried out in the settlement, to workshops in the desert (Ginter et al. 1996). They identified the differential distribution of flakes from the production of bifacial tools by simply plotting the quantities of such flakes on a map of 1x1m units. This method however did not take into account differences in sample size. For consistency, the data provided in Ginter and Kozlowski (1994) were analyzed in the same manner as was done for el-Mahâsna (above) and Hierakonpolis (below). Table 6.34 shows the percentages of bifacial thinning flakes from the two sectors at Armant MA21/83, and Figure 6.30 gives the upper and lower 95% confidence limits. The data support Ginter et al.'s findings, showing that there was a statistically higher portion of thinning flakes in the southern sector of Armant.

Table 6.35 gives the data for the frequencies of different tool types (including preforms) in the two areas of Armant MA21/83. Figure 6.31 gives the percentages and upper and lower 95% confidence intervals for the preform data, confirming that there were significantly more preforms in the southern sector.[55] The percentage of bifacial tools (Table 6.36), however, was the same in both areas.

These data clearly show that bifacial production was concentrated in the southern sector of the site, as indicated by bifacial thinning flakes and bifacial preforms, while the bifacial tools themselves were found relatively evenly beyond that area. Ginter and Kozlowski classified most of the preforms as axe preforms, showing that this bifacial tool production focused on axes. This constitutes evidence of within-site specialization in the production of axes.

Hierakonpolis

While it is already very clear that specialized bifacial tool production was taking place at HK29A (Holmes 1992), Hierakonpolis still provides an opportunity to see how that production area compares to other localities at the site. In this case the comparison is between more widely disbursed localities, rather than different parts of a single, well defined site.

Unsurprisingly, clear differences in the frequencies of bifacial thinning flakes are apparent among localities at Hierakonpolis (Table 6.5)[56], and the 95% confidence intervals bear out these differences (Figure 6.32). HK29A has the highest frequencies by far, and there are moderate amounts at HK29B, HK25, and parts of HK11C, while the lowest amounts occur at HK25D, HK14, HK24, and other parts of HK11C. These data also show that adjacent localities could have very dissimilar frequencies of thinning flakes. Parts of HK11C were quite different,[57] and HK25 and 25D can be statistically distinguished, even with a small sample size at 25D. All this points to quite a bit of intra-site differentiation in bifacial tool production. Like at el-Mahâsna, the only axe-preparation flakes were found in the ritual precinct, in HK29Bv(Table 6.5).

On the other hand, the distribution of bifacial tools across Hierakonpolis localities (Table 6.7) showed some variation, but could not be separated statistically. The 95% confidence intervals overlapped in all cases (Figure 6.34), meaning that they could come from similar underlying populations and the differences could be due to chance, sample size, or other factors.

A few points are interesting to note for individual tools classes. Like at el-Mahâsna Block 3, a greater variety of bifacial tool types were present at Hk29A compared to surrounding areas, and CBPPs were found only at those ritually significant locations within each site. It should also be noted that HK29 10L10 had a higher percentage of drills than in other areas, which may be evidence of some other kind of production (stone vessels?).

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[55] One caveat is that nothing was classified as 'unidentifiable bifacial tools', so it is likely some of what would have been classified at other sites a miscellaneous or unidentifiable bifacial tool, here was put in the general bifacial preform category. However there is no way to know how these compare, and many of the preforms were identified specifically as axe preforms, which was not possible at other sites, so the conclusion still should be tenable.

[56] No data on bifacial thinning flakes was available from HK29 10L10, so the data from Hk29 17L13 was used instead (Holmes 1996). The rest of this dissertation uses the HK10L10 data.

[57] Although they were also analyzed by different researchers, which cause some differences.

The case for intra-site specialization of bifacial tool production is very clear at Hierakonpolis. There was unmistakable variability in the production remains across Hierakonpolis, with bifacial tool production of course concentrated on HK29A. Localities 29B and 25 also had relatively high frequencies of production remains, which I find significant because these sites potentially make up a precinct of ritual activities along with HK29A. The high frequencies of thinning flakes at HK11C indicate that more intensive bifacial tool production may have occurred there as well, which makes perfect sense since the area was also the site for production of ceramics, beer, and food (Baba 2013; Friedman et al. 2009, 2011).

One last consideration for Hierakonpolis is whether there was intra-site variability in the production of the figural eccentrics. Some of the fine bifacial eccentrics from Hierakonpolis were certainly made by the same people who produced other specialized items. Nagaya (2011) analyzed eccentrics and tools from Hierakonpolis and related the production of certain animal figures to certain tools and raw material types. For instance, the Hierakonpolis ibex can be seen as a variation on the concave base projectile points, using many of the same production techniques and a similar base form (Figure 7.4). To that could be added the crocodile (Figure 6.17) which seems to have the base shape of a dagger or rhomboid with additional adjustments.

However the eccentrics had a much more limited distribution than other similar items made by specialists, since there are no reliably provenienced eccentrics of the same date outside Hierakonpolis. Within Hierakonpolis the eccentrics were found in only two contexts, which are very different from each other: the elite cemetery HK6 where they were clearly used as offerings (Friedman 2010:70-71; Friedman et al. 2017:236), and the settlement area of HK11 (Watrall 2000).

It is not possible to determine the exact production location for the eccentrics; they could have been made at Hk29A, but many of the figural eccentrics date earlier than HK29A. However the presence of the eccentrics of similar quality in two very different contexts within Hierakonpolis shows that they were likely used by people other than those who made them (even if it is not possible to confirm who made them), thus fitting the definition of specialization at an intra-site level.

Complicating the picture is the fact that some of the figural eccentrics could have been made by people who were not specialists at all. Many of the more simple edge retouched pieces were made with the same techniques as were used to make non-specialized tools, such as scrapers, and some bifacial and edge retouched pieces do not show the same degree of control over form as the finest examples (e.g. Figures 6.15, 6.16, 6.22, 6.24 top left). Although in some cases the provenience of these simpler eccentrics is unknown, a number of the Abydos ones have these characteristics, and are notably later in date.

Due to the very limited quantity of the figural eccentrics, and to the fact that it is not possible to confirm that they were all made by specialists, they are not considered further in Ch7 for the comparison of the specialized tool to the expectation for the ritual production model. However the eccentrics certainly constitute production for religious/ritual purposes, since they are clearly of a symbolic nature and have been found in offering contexts associated with a cemetery (HK6) and a temple or ritual area (Abydos). They are discussed further in the conclusion (Ch. 8).

6.4 Conclusion: Production of Bifacial Tools

Like with blades, Predynastic knappers produced bifacial tools in a spectrum of ways. These results are summarized in Table 6.37 and Figure 6.35. RFKs and rhomboid tools were made by specialists at an inter-site level, meaning that they were not produced in all communities. These tools were principally for cemetery use. Chronologically they did not overlap, and the earlier rhomboids were more variable which may relate to the size of the tools and the availability of raw materials, but could also indicate a larger number of producers than RFKs. Fishtails were also produced by specialists and the decreasing variability in fishtails, along with changes in the production techniques indicate that the later fishtails were certainly specialized at an inter-site level.

In contrast, CBPPs were made at many sites as was indicated by the presence of preforms and unfinished CBPPs. Distribution data from el-Mahâsna and Hierakonpolis indicate that CBPPs were specialized within sites, meaning that only some people at a given site produced CBPPs. Their production drew on many of the same techniques as RFKS, rhomboids, and fishtails (such as pressure flaking, microserration and possibly grinding), and CBPPs were the least variable tools in terms of width and thickness.

Figural eccentrics were also specialized at an intra-site level, but the production and distribution of figural eccentrics was highly localized and the overall quantities produced were quite low. Some eccentrics may not have been made by specialists at all. Bifacial knives were another variable category, with the production of some knives specialized at an inter-site level, while others were not made by specialists at all.

Bifacial sickles were specialized at an inter-site level since they were clearly not produced in certain communities. However there may have been more locations for the production of these tools compared to RFKs, fishtails, or rhomboids, as was indicated by raw material data and the variability in metric attributes. Axes were produced in almost all (if not all) sites, but by specialists within each site. Furthermore there were regional differences in the frequencies of axe production.

On the other hand there was also non-specialized production of unstandardized bifacial tools at all sites, as indicated by the low but prevalent presence of bifacial thinning flakes and unstandardized miscellaneous bifacial tools at all sites, and in multiple areas within sites. Moreover, these unstandardized bifacial tools were often more common within settlements than the more standardized identifiable bifacial tools.

The important conclusion here is that bifacial tool production cannot be described as a simple dichotomy of specialist produced luxury goods and utilitarian tools made and used by the masses. Moreover, as will be discussed in Chapter 7, the organization of production for bifacial tools was even more varied than is reflected above, when patterns in raw material use, contexts of production, and contexts of finished tools are taken into account.

Chapter 7: Evaluation of Expectations

Chapter 7 compares the archaeological patterns of raw material choice, production contexts, and find contexts of specialist produced tools to expectations derived from Spielmann's (2002) discussion of a ritual production model for the development of specialization (Ch. 2.2). The specialist produced tools identified in Chapters 5 and 6 were ripple-flaked knives, rhomboid tools, fishtail tools, concave-base projectile points, bifacial sickles, axes, large-blade knives, and heat-treated microendscrapers. Table 7.22 gives a summary of the findings for these expectations by tool class.

7.1 Raw Materials Expectation

If specialized production of some tools developed in Egypt to make symbolically meaningful goods for a large portion of the population, then the raw materials for those tools may have been chosen based on symbolic considerations. The raw material could add significance to the meaning or symbolic value of the item. For instance the difficulty of obtaining the raw material, or specific associations with the place of raw material procurement (e.g. holy place, or any sort of symbolically charged site) could be indexed by the raw material. Additionally, a review of the Pharaonic evidence for the symbolic significance of chert showed that color may have been important to the symbolic meaning of the tools, influencing raw material choice (see below).

Method

This expectation was evaluated by looking for an association between tool type and raw material type, and by ruling out other factors that could govern raw material choice such as functional considerations or local (easy) access to the raw material sources. Raw material and provenience data were collected for a sample of artifacts from each of the tool classes that were identified as specialized in Chapters 5 and 6 (RFKs, rhomboids, fishtails, CBPPs, bifacial sickles, axes, large-blade knives, and heat-treated microendscrapers). The goal was to have a sample of at least 30 artifacts in each category. Since the data from el-Mahâsna, Abydos, and Nag el-Qarmila did not constitute a sufficiently large sample of any of the individual tool types, additional data were also gathered from online museum data bases, or observed in person in a few cases. Museum databases were chosen as a primary source rather than publications because many more photographs—essential for examining raw materials—were available via online museum databases than in publications which normally show artifacts in black and white line drawings. Publications were also consulted when color photographs were available and the artifacts could definitively be differentiated from those already studied in the museum databases, in order to avoid counting the same artifacts twice. For certain tool types—CBPPs and bifacial sickles—only those with provenience information were included in the sample so that the artifacts could be securely dated to the Naqada period rather than the Badarian. This resulted in a small sample size for the bifacial sickles. The rhomboids included only relatively complete examples so that they could be differentiated from other kinds of lances/daggers, also resulting in a relatively small sample.

The total sample of all tool types includes artifacts from 39 museums and storerooms spread over nine countries and three continents (Table 7.1). Thus it was not feasible to travel and observe them all in person given the time frame and financial scope of this research. However the same principles were used for assigning raw material types as described in Chapter 4: The primary focus was on the structures such as banding and mottles, along with the degree of translucency. Color was used only broadly and secondarily to assign artifacts to groups. Translucence could generally be deduced from photographs due to familiarity with the cherts from Egypt. Any descriptions of the raw material given with the artifact were also consulted.

A few new raw material categories had to be defined because the materials appeared quite distinctive,[58] and simply did not correspond to any of the groups identified during fieldwork. This is not surprising since the examples in this chapter include more sites and a longer time span than what was studied in the field. Sometimes a specific raw material type could not be identified since many of the determinations were made from photographs, but only a general group was assigned, for instance '1,2,4', which are all light opaque cherts with differences in texture and/or structures. Unfortunately this made statistical comparisons of the diversity of chert varieties relative to the sample size impossible, since the number of raw material types represented was not exact. However, the data are sufficient enough to determine whether one type was dominant, and to compare qualitatively between tool categories. When grouped more broadly, according to light/dark color categories the data were sufficient to do a chi-square test for association between tool type and raw material color. Additionally, the

[58] One was 'Other: variable translucent-opaque,' which is light in color ranging from beiges to light or medium yellowish browns, with opaque and translucent patches that occurred in swirls or large bands. Remnants of a chalky (?) white cortex were visible on four of the RFKs (BrM.09.889.120; ManM.38160; ManM.5305a-e; Pr.1900.42.2) indicating that the material likely came from a primary source. The second was 'Other: chocolate,' which is homogeneous dark brown, fine grained, and with chalky white cortex. It corresponds to a raw material described by Hikade (2013:23, Pl 2c-d) as looking like chocolate.

distribution of raw material types by site was analyzed, to check whether any of the variability in raw material type could be accounted for by the use of local raw materials.

Since many of the artifacts come from excavations that occurred before the 1960's, the artifacts can only be associated with general dates (e.g. Naqada period rather than NIC or NIIIA). Therefore it was not possible to look at differences in raw material choice over time for most of the tools classes. The exceptions are the RFKs and the fishtails, since both can be dated stylistically to some degree. In cases where there does appear to be a clear association between tool type and raw material, functional parameters were also considered.

Pharaonic evidence for the symbolic significance of chert

There is evidence that chert itself had symbolic significance during the Pharaonic period. Aufrere (1983) looked at the relationship between minerals and divinity. Not only were the images of gods, and the gods themselves, said to be made of gold and lapis lazuli, these stones were thought to both originate from the gods and to protected them. Even in an unworked form minerals had symbolic properties. Certain minerals were crushed and mixed with water to act as purifying agents, showing that the minerals themselves had efficacy, not just their final forms as amulets, jewelry, statues, (or even perhaps, as tools). Aufrere also argued that the variety of types and colors of stones allowed them to form a symbolic array that could invoke different aspects of gods or reference myths well known to Egyptians. Although Aufrere's research mainly focused on the Greco-Roman period texts, he also drew on the Pyramid texts which date much farther back, to the Old Kingdom. Thus the divine significance of minerals can conceivably date back to earlier periods.

Representational and textual evidence indicate that chert in particular had symbolic significance. The ancient Egyptian word for chert (or flint) was *ds* (Graves-Brown 2011:61; Harris 1961; Midant-Reynes 1981). *Ds* could also mean knife, which is understandable since most Predynastic-Old Kingdom knives were made from chert. Graves-Brown (2011:176-277) showed that chert knives were used for cattle sacrifice—an important ritual act—through the Middle Kingdom, even though metal knives were commonly available by the late Old Kingdom. Her evidence was based on the sharpening scenes depicted with cattle slaughter and the archaeological distribution of flint knives. Furthermore, all of the textual references to chert during the Pharaonic period are in religious contexts, not secular ones (ibid.:223). Midant-Reynes (1981) discussed examples of chert in texts about the afterlife (including the pyramid texts, coffin texts, and the book of the dead), showing that chert knives were used to defeat enemies. Additionally she showed that chert could constitute the eyes of Horus, which recalls Aufrere's arguments for the significance of minerals that made up the bodies of gods. Considering the evidence for cattle slaughter connected with ritual areas at HK29A and el-Mahâsna Block 3, it is conceivable that these symbolic/religious connotations associated with chert could have begun earlier, during the Predynastic period, and moreover that these considerations may have affected raw material choice for specialist produced tools.

Furthermore, the color of the chert may have been important to the symbolic meaning. Ancient Egyptians used four basic color terms: *ḥḏ* (white), *km* (black), *dšr* (red), and *w3ḏ* (green) (Baines 1985). *ds (chert)* could be described as *km*, or *ḥḏ*.[59] A look at ancient Egyptian color terms, color pairings, and color dualities shows not only that colors often carried symbolic religious meanings, but also indicates how the chert artifacts studied here could be divided into groups that roughly correspond the Ancient Egyptian categories *ds km* and *ds ḥd̠*.

Egyptian color terms do not align with western colors, nor do they necessarily even correspond to the idea of hue (Baines 1985; Quirke 2001). Quirke 2001 notes that even among the basic color terms the words do not refer exclusively to a color, noting that 'black' and 'white' are also the words for dark and bright, and that that 'green' also means fresh and can be applied even to things that might otherwise be considered red, such as meat. The colors black and green were both associated with plant fertility and Osiris' rebirth into the afterlife (Baines 1985:284; Pinch 2001:183). The association of green with plants is pretty straightforward, and most scholars point to the fertile black soil of the Nile for the connection between the color black and fertility. Osiris's face can be painted either black or green. The connection between black, green, fertility, and Osiris is made most plain with the New Kingdom 'Osiris corn beds', which were planters in the shape of Osiris, filled with dirt (black) and germinating grain (green), and included in tombs (Ikram and Dodson 1998:120). However the idea for these planters was probably derived from a section in the pyramid texts, showing that the connection dates back much earlier.

The most famous color dualism from Ancient Egypt is in the name of Ancient Egypt itself: *Kmt*, black land, named for the fertile black soil from which the Egyptian livelihood sprung. *Kmt* was the land of the living. This black land was opposed to *dšrt*, red land, the dry desert that surrounds the Nile Valley, and home to the 'other'— dangerous wild creatures, even

[59] *Ds* could also be described as *t̠ḥn*, yellow, but the translation of yellow for *t̠ḥn* is not always accepted and may refer instead to other properties rather than hue, such as shininess or brightness (Graves-Brown 2010:142-145; Harris 1961:138-139; Midant-Reynes 1981:41-42; Quirke 2001). Additionally, the

the beings of the afterlife. Given the close association between black and green, the opposition of red to black is less surprising.

The word *dšr* (red) could best be defined as warm colors focusing on red, and has clear associations with the desert (Baines 1985:284-286). Yellows were also a part of this category, including the light yellows and tans that westerners might more readily associate with the desert. Red and yellow-gold were used interchangeably for representations of the sun disk (Pinch 2001:184). Some browns could also fall into the category of *dšr*, such as in reference to cows on a late Middle Kingdom onomasticon (Harris 1961:228 228).

There is some evidence that the opposition of black and red probably extends back into the Predynastic period. The juxtaposition of red and black during the Predynastic period is clearly seen in the black-topped pottery with red bases. This of course may simply be related to how they were produced (Baba 2005, 2008b, 2009a, 2011). However there is evidence that the pairing of red and black was ritually significant. Two types of ceramic vessels with distinctive shape and surface treatment were found at Hierakonpolis: polished black egg-shaped vessels and matte red flaring collared-rim jars (Friedman 2009b:85-88; Hendrickx and Friedman 2003). These forms, intentionally made all in dull red or all in shiny black and occurring together in the same contexts, are found only in ritually significant areas of Hierakonpolis, the HK29A ceremonial enclosure, and the pillared halls in the elite cemetery HK6[60] (Friedman 2009b:97). This intentional play on the red and black colors of the vessels in ritual contexts indicates that the

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use of *ṯḥn* as yellow seems to have come into ancient Egyptian textual references later in its history, so is not salient for the current study.

[60] They were even specifically found paired together in one context: Two red collared jars and two black egg-shaped jars were found with foot bones of a sheep/goat in a basket or mat-lined pit at the entrance to the chapel of tomb 23 (Friedman 2009: 87). Fragments of the earliest life size statue were also found in that chapel.

red-black opposition was likely significant during the Predynastic period.

Based on the above discussion of Egyptian color categories the raw material groups as defined here were divided into *ds km* (black chert) and *ds ḥd̠* (light chert). Given that *km (*black) was opposed to *ḥd̠* (white), but also to *dšr* (red), and that the opposition of red and black probably extends back into the Predynastic period, the light yellowish and reddish toned chert categories were combined. Thus all the beige, pinkish toned, and lighter-medium brown categories such as types 1, 2, 3, 4, 8, and 13 might reasonably be supposed to correspond to *ds ḥd̠*. Correspondingly, the raw material categories '7.Dark gray and brown', obsidian, and any other very dark or greenish materials could easily be considered *ds km*. The artful manipulation of natural color variation within a piece of raw material to depict clothing for the dwarf/human eccentric (Nagaya 2011) (Figure 6.28) shows that the Predynastic Egyptian flintknappers did pay attention to the colors and patterns in the material, and did not always treat it all as interchangeable. Therefore, in addition to looking for associations between tool type and raw material type (as defined in the Appendix), associations between tool type and light (*ds ḥd̠*) or dark (*ds km*) raw material color categories were also analyzed.

Results

Light/dark color categories

A chi-square test[61] was used to look for an association between tool type and light/dark color categories (Table 7.4). The test returned a chi-square statistic of 91.6993 with 8 degrees of freedom, and a probability of 2.2e-16. All of the expecteds were above five, so the test was valid.

[61] See Ch. 2.5 for more information on chi-square tests.

The probability is well below the .05 significance level, so the null hypothesis that there is no relationship between tool type and light/dark raw material color categories can be rejected. Therefore there was an association between tool type and color category for at least some of the tools. The individual tool types are each discussed below, with the analysis of particular raw material varieties.

Ripple-Flaked Knives

Sufficient data were available to make raw material determinations for 44 RFKs (Table 7.2, Figure 7.1), which could be assigned to six different raw material groups (Table 7.3). The most frequent raw material type was type '4. Beige with pink bands' (31.82%). The type group '1,2,4' was almost equally as abundant (27.27%), and many of the pieces in that group are probably also type 4, because type 4 is a high quality material. Therefore there was an overwhelming preference for raw material type 4 for RFKs.

However the fact that most of the RFKs were made from type 4 material may be related to the production location rather than symbolic considerations. The type 4 RFKs were concentrated at Abydos (Table 7.5). Of the six type 4 RFKs with provenience information, half came from Abydos. Dreyer (1999:213) argued that a fourth, the Gebel Arak knife, actually came from Abydos as well.[62] Two additional pieces that could only be identified as type '1,2, or 4' also came from Abydos. All the rest of the RFKs made from type 4 or type '1,2,4' were found only singly at sites which stretch from Fayoum in the north to Qushtamna in the south (see Figure 2.2 for site locations). Since there was a source of the type 4 raw material near Abydos

[62] This knife is not included in Table 7.5 since its provenience is not secure.

(Ch. 4.1; Hikade 2013), and there was a high concentration of RFKs made from that material at the site, then it is possible that the RFKs were produced near there, and that the raw material choice was a matter of proximity. However, it should be noted that Holmes (1989:459) also found type 4 material in secondary deposits on the west bank of Luxor, and that it has been identified among artifacts at other sites such as Hierakonpolis and Elephantine, so Abydos may not have been the only source for type 4 raw material.

Grouping the raw materials according to the light/dark color categories (*ds km* or *ds ḥḏ*), showed that the overwhelming majority were of light chert (84.09%) (Table 7.4). Furthermore, these light materials only consisted of 2-3 raw material types: 4, ‘1,2,4’, and ‘Other: variable translucent-opaque’. However, the choice of the type 4 light raw material could have been due to local availability of materials, so it is not possible to conclude that the preference for light materials was due to symbolic considerations. Additionally, the raw material choice may have been limited by the availability of nodules or tabular pieces of the required size. Lengths were available for 25 RFKs, and these ranged from 14.9cm - 30.4cm, averaging 23.78cm showing that these tools were rather long.

It should also be noted that the raw material choice for RFKs may have changed over time, shifting towards use of darker materials. Two RFKs of type ‘Other: chocolate’ have ivory handles (MMA.26.241.1, the “Carter knife” (Figure 7.1); UC.16294, the “University College knife”). The use of elaborate decorated knife handles is thought to happen toward the later end of the time span for RFKs, perhaps late NIId-NIII, given the stylistic dating of the handles and the provenienced examples (Midant-Reynes 1987:220; Needler 1984:270; Whitehouse 2002:432). The third RFK of raw material type ‘Other: chocolate’ (UC.35723), is a small proximal fragment[63] that was found in the tomb of Djer, also late. Additionally a dark RFK from Tel el-Farkha (here designated raw material type 5) was found in a context that dates to the NIIIB (Chłodnicki et al. 2012; Ciałowicz 2007). The possibility that the piece was an heirloom cannot be ruled out, but the lesser quality of that particular piece (the ripple-flakes did not carry all the way across the face and join in the middle), combined with the unusual dark raw material could be an indication that it was a later example made after the knowledge and skill of such production was not in regular practice. If all of these dark RFKs are later, then they indicate that there was a change in raw material choice over time. It is tempting to relate this possible shift in raw material choice to the shift in Egypt's political center. The political capitol of Egypt moved from Abydos up to Memphis at about the same time. Sponsored workers could have moved in tandem, changing their access to raw material sources. However much more work would need to be done to verify this proposal, such as identifying the source of the 'chocolate' raw material, and definitively identifying production locations for the RFKs.

In summary, was some preference for lighter colored raw materials, and type 4 raw material in particular, it is not possible to conclude that RFKs meet the expectation that raw materials were chosen for symbolic reasons, because the because the raw material choice might have stemmed from simple use of raw materials available near the place of production, rather than symbolic concerns.

[63] It is possible that UC.35723 was burnt, which could make the raw material designation questionable. There is a small divot on the flaked side of the knife which could either be the scar of a heat spall or the remnants of a deep flaking scar from original shaping that was not fully removed with subsequent ripple-flaking. There are no signs of crazing or other heat spalls, and the material looks very much like the "other: Chocolate" pieces, so it was classed accordingly.

Rhomboids

The 20 tools that could definitively be classed as rhomboids (Table 7.6, Figure 7.2) were made from only four chert raw material types[64] (Table 7.3). Raw material type '7.Dark gray and brown' was by far the most common, accounting for 55% of the pieces. Just over half of the rhomboids were made from dark cherts (*ds km,* 60%), and 40% were made from light materials (*ds ḥḏ*), so there is no clear preference for one color over another (Table 7.4).

The sample available for assessing the distribution of rhomboids by raw material type was small because many came from unknown proveniences (Table 7.7). There was some clustering of type 7 rhomboids at Naqada, however no source of that material is so far known near Naqada. Ginter et al. (1996) characterized raw materials on the west bank of the Luxor area, just south of Naqada. They described a gray flint, but did not describe it as including brown portions. Holmes (1989:459-460) described material from the same Luxor area as grayish-beige to yellowish beige (Munsell 10YR 7/3). Type '7.Dark gray and brown' has a Munsell color range of 7.5YR 4/1 - 10YR5/2 so the material described by Holmes is not the same as type 7. Therefore the clustering of type 7 rhomboids at Naqada cannot be explained as local production using local raw material sources, given current knowledge of the raw materials in the area.

Functional considerations must have limited the raw material choices. Coarse or difficult to flake materials would not have been appropriate for rhomboids which are often very finely flaked and would have required fine-grained materials. Moreover, rhomboids are quite large tools, up to 41 cm long (e.g. Brunton 1937:90). A sample of 18 complete rhomboids yielded lengths ranging from 17.5cm to 41 cm, with an average of 25.88cm. Thus rhomboids would have required very large nodules or tabular pieces which must have occurred only among certain raw materials.

Rhomboids do not meet the raw material expectation for the Ritual Production Model. There is no clear preference for one color over another, and size requirements probably greatly influenced the raw material choice, more so than symbolic considerations.

Fishtails

Fishtails were made from a comparatively wide variety of raw materials[65] (Table 7.3). Of the 101 fishtails with identifiable raw material types (Table 7.8, Figure 7.3), the most common type was '7.Dark gray and brown' (34.65%), but fishtails were made from at least ten other raw material types as well, including non-chert materials (obsidian,[66] rock crystal), so there was no clear association with one raw material type.

However fishtails were in use over a long span of time, and when broken down by time period, there was a trend for dark raw materials (*ds km* 66%) in the earliest phase, and light raw materials (*ds ḥd̠*, 88%) in the latest phase (Table 7.4). Three main shape types have been defined for fishtails (Figure 6.23) (Massoulard 1936; van Walsem 1978), and the shape type changed over time. Stylistic types 1 and 1a with wide U-shaped forks were the earliest (NI - NIIc or d), and stylistic type 2, with sharper V-shaped forks, the latest (NIIa or b - NIId). Hikade (2003:140-141, 148) had the impression that early fishtails were made on a dark gray-brown flint (type 7),

[64] Note the small sample size.
[65] However, note that the sample of fishtails was larger than any other group, which increases the likelihood of finding more raw material types if they existed.

and the later fishtails were made on a "brown (honey or caramel colored) variety of flint often with light red or pinkish discoloration as concentric bands" which is equivalent to this study's type 4. (Table 7.9) shows the frequencies of raw materials by fishtail shape and confirms Hikade's impression. The 95% confidence limits for the proportions shows that type 7 is significantly more frequent for the earlier fishtails than for the later fishtails (Figure 7.11). Furthermore, van Walsem placed shape 3 fishtails coeval with the shape 2 fishtails (~NIIc-d). However, Hikade (2003:138-140) posited that shape 3 should actually be assigned a bit earlier, dating to the transition between shapes 1 and 2. The frequencies of raw material types corroborate Hikade's proposal. When placed in that order, shape 3 fishtails fit perfectly with the trend for increasing use over time of raw material type 4, and decreasing use of raw material type 7 (Table 7.9).

Provenience information was examined to see whether any of the variability in raw materials could be accounted for by use of local resources, with the idea that if fishtails were made using a local materials, examples of that material would be more frequent near where they were produced. Tables 7.10-7.11 show the provenience information for 58 fishtails, separated into earlier and later types. The distributions for the type 4 and type 7 raw materials echo what was seen for the RFKs and rhomboids. Raw material type 4 and '1,2,4' fishtails clustered slightly around Abydos, where there is a known source of type 4 material (Ch. 4; Hikade 2013:2), so the slightly higher frequency there could be related to production in the area. Fishtails of raw material type 7 clustered somewhat at Naqada, however the source(s) of the type 7 material is

[66] A few other obsidian fishtails exist besides those listed in table 7.8, (two in the Berlin Museum and two in the Egyptian Museum in Cairo), but they are probably intermediary between the Predynastic

not known. The diversity of raw materials for fishtails suggests that there could have been multiple production locations for fishtails.

The variety of materials used to make fishtails indicates that functional constraints were not restrictive, and that the preference for type 4 material in the later fishtails could not have been due to functional considerations. A sample of 63 fishtails of all shape types yielded an average of 13.49cm. This relatively small average length means there was less restriction on the required nodule size, and that more raw material types would have fit the requirements.

It is unlikely that symbolic considerations affected the raw material choice for fishtails since so many different raw materials types were used. Additionally many fishtail models have been found, and these were made out of diverse raw materials, such as copper (Ayrton and Loat 1911:Pl22), steatite (Friedman 2010:71; Friedman et al. 2008:90), alabaster (Petrie 1920:Pl9), serpentine (Petrie 1912:24,Pl 6), sandstone (Seton-Karr 1904); clay (Quibell and Green 1902:26,51,PL67; Petrie 1920:PL28), and possibly one of black paste[67] (Hartung 2011:476). Moreover the predominant variety of chert used to make fishtails changed over time, which implies either that the raw material was not integral to the meaning of the tool, since it could change, or that the meaning changed over time. The later shape 2 fishtails sometimes were made with ripple flaking, showing that with the change in raw material there was also a change in production technique. These later fishtails may have been made in workshops alongside ripple flaked knives since they used the same production techniques, and had the same predominance of type 4 or type '1,2,4' raw materials. It is also important to point out that these later fishtails also include examples made from obsidian. Obsidian had to have been imported from quite

fishtails and old kingdom psš-kfs (van Walsem 1978:242), so they were not included here.

distant sources (Ethiopia or South Arabia; Bavay et al. 2000), so it was a very difficult material to obtain which was only available in small quantities. In sum the raw material choice for fishtails does not meet the expectations for the ritual production model. The raw materials were originally quite variable, perhaps indicating multiple production locations, but it changed over time to a more restricted raw material choice centering on type 4, and including the use of very difficult to get raw materials, combined with production involving more difficult flaking techniques. Despite the fact that symbolic factors cannot be deduced for the raw material choice, the existence of models, which by definition are not utilitarian items, means that tools themselves must have had some symbolic significance.

Concave-Base Projectile Points

The 31 concave-base projectile points that can be dated to the Naqada period (Table 7.12, Figure 7.4) were made from eight different varieties of chert (Table 7.3). The most common raw material was type '7.Dark gray and brown' (45.16%), with the rest distributed across eight other raw material types, showing that while type 7 is prevalent, CBPPs were made from many raw material types. Nor was there any preference for a certain color, with half of the CBPPs made from dark cherts (*ds km*, 51.61%), and the other half from light cherts (*ds ḥd̠*, 48.39%) (Table 7.4). The variability in raw materials was facilitated by the relatively small size of CBPPs, which do not require as strict size parameters for the raw materials compared to rhomboids or RFKs. A sample of lengths for 11 CBPPs with at least one full tang preserved ranged from 3.4cm - 10 cm, and averaged 6.46cm.

[67] Hartung interprets this piece as a model gutted fish because one end is hollow. However the piece has

The distribution of the raw material types by site shows that type 7 CBPPs were quite prevalent at Hierakonpolis (Table 7.13). Eight of the 14 pieces which were made from type 7 material came from Hierakonpolis. A source of raw material was found near Hierakonpolis which consists of chert cobbles in a gravel deposit (Friedman and Youngblood 1999; Harrell 2012, pers. comm.) however the material was not described in detail. Without knowing what kinds of materials were available or commonly used at Hierakonpolis it is not possible to determine whether some of the variability in raw material choice may be accounted for by proximity to raw material sources. There was also some clustering of the type '13.Caramel' CBPPs in the Badari sites, but the local raw materials in that area are also unknown.

In sum, like fishtails, CBPPs were made from many different raw materials, so based on the method used here, it is not possible to conclude that symbolic factors affected raw material choice. Additionally, like fishtails, model CBPPs existed, made out of clay (Garstang 1903:5, PL3-4). Again the existence of models implies that the tools had some symbolic significance beyond their utilitarian functions.

Bifacial Sickles

Only 20 Bifacial sickles were found that can be dated to the Naqada period and that have identifiable raw materials (Table 7.14, Figure 7.5). Despite the small sample size, the sickles were made from seven different raw material types (Table 7.3). Type '7.Dark gray and brown' was the most common (35.3%). The bifacial sickles were basically evenly divided between light and dark raw materials (*ds km* or *ds ḥḏ*) (Table 7.4), so there was no preference for either color.

a different coloring on the forked end, which corresponds quite easily to a handle and a knife.

Of six complete examples, the sizes ranged from 11.7cm to 22cm long, averaging 16.9cm, and no functional explanations for raw material choice were obvious.

The was no clear association between any site and any particular raw material type (Table 7.15). The find of a cache of three bifacial sickles made from two different raw material types at the Abydos settlement site (Ch. 3.4) indicates that the tools made from different raw materials were in use at the same time at the site, so the variation in raw material type cannot be only a function of time. Overall, in the case of bifacial sickles, there was no clear association between tool type and raw material type that would indicate symbolic factors contributing to raw material choice.

Axes

A sample of 82 axes with provenience information (Table 7.16, Figure 7.6) yielded 11 different raw material types[68] (Table 7.3). The majority were assigned to the '1,2,4' chert type group (41.46%). Despite the use of many different raw material types, axes were overwhelmingly made from light raw materials (*ds ḥḏ*, 89.02%) (Table 7.4).

Moreover, this preference for light colored raw materials cannot be explained by a simple preference for local resources. The raw material studies in Chapter 4.1 showed that the local materials which were preferentially used could vary between sites, even if the sites were close together. Therefore, if raw material choice for axes was governed by the availability of local materials then variation in raw material choice by site should be observable. However this was

[68] Note that many of the axes were actually studied in person by the author, whereas for many other tool types the raw material designations were made from photographs. This may account for some of the reason why more detailed and thus *more* raw material distinctions could be made.

not the case for axes (Table 7.17). Axes identified as type group ‘1,2,4’ were common at two sites (Naqada and Armant), and type 1 axes were common at both el-Mahâsna and Armant. Additionally, each site had light axes made from quite a few different raw materials. This is significant because at el-Mahâsna (the only site where such data were available), most of the axes were made of raw material 1, 2, or 4, *even though* the most commonly used local material was type ‘8.Translucent Brown.’ Therefore the choice to use light materials for axes, particularly types 1, 2, and 4 does seem to be intentional.

Furthermore there were few functional constraints that would have limited axe production to lighter materials rather than darker ones. In fact the occasional production of axes from darker materials shows that darker materials could be suitable. The axes are rather small in size, a sample of 48 complete axes ranged from 4.96cm to 15.9cm long and averaged 7.6cm. Holmes (1990) reported an average length of 6.5 cm for 49 axes from the Naqada region. Gravel nodules were observed at Beit Khallaf (near el-Mahâsna) over 10cm in size, so even small gravel nodules would have been sizable enough for axes, and indeed some were occasionally made from such materials.

Therefore the choice of light raw materials for axes cannot be explained by functional considerations nor local availability of materials. Nonetheless there was an association between tool type and raw material choice, so the expectation was met. Symbolic considerations related to color very well may have affected raw material choice for axes.

Large-blade knives

The 60 examples of large-blade knives (Table 7.18, Figure 7.7) were made from nine different raw material varieties (Table 7.3). Most of the large-blade knives were made from type group ‘1,2,4’ (40.85%). As with the axes, the majority of the large-blade knives (84.52%) were a light material (*ds ḥd*) (Table 7.4).

Table 7.19 gives the distribution of raw materials by site, and shows that all of the knives classed as type ‘1.Indistinct beige’ were from Naqada. However type 1 knives may have been included in the type ‘1,2,4’ category at other sites. At Badari and at Naqada there was a lot of diversity in the materials used for large-blade knives, not a focus on one type which would be more in line with simple use of local raw materials. The raw material sources available near Naqada and Badari are unknown. On the whole the raw material choices for large-blade knives cannot be accounted for by access to local materials at this time, although more information about raw material sources would be helpful on this point.

A sample of 54 complete pieces ranged from 8.12cm to 23.4cm in length,[69] averaging 13.5cm. Many artifacts of darker material types in that size range and larger existed (e.g. fishtails, rhomboids) so the choice for lighter raw materials could not have been restricted by the size of available materials. Certainly darker materials were sufficiently sharp and strong for use as knives since other kinds of knives or daggers were made from those materials.

Large-blade knives meet the expectation evaluated here since there is an association between raw material color and tool type. This association cannot be explained by functional considerations, or use of local materials nearby where they were made, given current information.

[69] These blades were defined as pieces larger than 8cm.

Microendscrapers

Only 14 heat-treated microendscrapers[70] were identified, coming mainly from the el-Mahâsna and Nag el-Qarmila assemblages, along with a few pieces from Naqada which were studied by Holmes (1989). However there are likely many more in archaeological assemblages, but images and raw material descriptions of such small and inconspicuous items rarely get published. The non-heat treated and heat-treated microendscraper production processes were likely quite closely related (Ch. 5), so the sample was expanded to include 11 additional non-heat-treated microendscrapers (Table 7.20, Figure 7.8). Table 7.3 shows that the types of raw materials used to make microendscrapers was very limited. Type '8.Translucent Brown' was by far the most common raw material type (44%). The pieces in the 'other light cherts' category (24%) were made from raw materials that could not be differentiated between type 8 or 10, so likely even more of them were made of type 8 material.

All of the microendscrapers are light to reddish in color, and so should all be considered *ds ḥḏ* (light chert). Only three raw material types were present, all of which are quite similar. All of these types have small white mottles, are semi-translucent, and are light brown to pink in color. The type 11 pieces are quite possibly a heat-treated version of types 8 and 10, which would mean that only two basic raw material types were used to make microendscrapers (types 8, and 10). In terms of the source for these raw materials, types 8 and 11 are definitely nodular gravel chert, and the source of type 10 is not known (Ch. 4.1). Therefore, the microendscrapers were made mainly from raw material type 8, and a few pieces were also made from another type that is visually strikingly similar. This shows a high degree of association between raw material type and tool type, the most of any of the specialist produced tools seen here.

Table 7.21 shows the distribution of the raw materials by site. All the type 11 pieces come from el-Mahâsna. This is not surprising since type 11 may just be a heat-treated version of type 8, and there is evidence that people at el-Mahâsna heat-treated raw materials there (Ch. 5.5). The use of these pink-brown mottled semi-translucent materials cannot be explained solely by the use of local materials. While the raw material was certainly local to el-Mahâsna, this was not the case at other sites. Heat-treatment and microendscraper production also occurred at Hierakonpolis (Holmes 1989; Takamiya and Endo 2011). Some bladelets found in HK6 tomb 72, and HK43 Burial 333 can be identified as raw material types 8 or 10[71] (Figure 7.9) (Droux and Friedman 2014:4, lower photo, center, 18-19; Friedman 2003:17-19). These items were described as bladelets in this short publication, but the rounded retouched ends are visible in the photographs, so they include microendscrapers. However the main locally available material at Hierakonpolis must have been quite different from that of el-Mahâsna. A chert source composed of chert-bearing fossilized coral was discovered near Hierakonpolis and thought to be the main source of chert (Friedman and Youngblood 1999), whereas the el-Mahâsna chert probably ultimately originated in the extensive limestone deposits surrounding el-Mahâsna and found everywhere north of Esna. These two very different contexts must have yielded quite different examples of a raw material which is already noted for its variability, yet both sites used the same

[70] In some cases a number of microendscrapers of identical raw materials were found in the same tomb, and likely came from the same core. There were only listed as a group to not unduly weight the sample towards one raw material or another.

[71] Some of the lithics from tomb 72 are also clearly type 4. Sizes and descriptions of the bulb and platform characteristics have not yet been published for this recently found tomb, so it is not yet known which should be considered bladelets according to the definitions used in this study.

materials for microendsrapers. Therefore, the choice to use light brown-pinkish semi-translucent mottled raw materials was a trend over multiple sites, from Hemmamiya and Badari in the north, to Hierakonpolis in the south, and not due to simple availability of local resources.

Nor was the choice of raw materials due to functional considerations. They are very small tools, (2.8-5.5cm long, averaging 3.8cm), so large nodules were not required. The texture of the microendscrapers is not discernibly different from many of the other chert varieties (e.g. types 2,4,5,6,7, or 13), so any of these other materials would have sufficed for the production of small sharp thin microendscrapers. It is possible that the small size of the tools made them suited to the fist-sized gravel nodules, thus saving larger materials for other tools. However raw material economy is not a persuasive argument considering the abundance of chert available at most sites throughout Egypt, if the particular variety is not important. If anything, the small white calcareous mottles found in the microendscraper raw materials could have been an impediment to predictable thin flaking. Indeed type 8 material was more difficult to flake than some other materials heated to the same temperature during the heat-treatment experiment described in Ch. 4.2. Therefore no functional reason was identified for the choice to make microendscrapers out of the types 8 and 10 raw materials.

In conclusion, there is an association between tool type and raw material for microendscrapers. It is quite possible that the raw materials for microendscrapers were chosen for symbolic reasons, since functional explanations can be ruled out. A possible symbolic reason for choosing this kind of raw material could have been the distinctive reddish-brown coloration. Heat-treatment would have enhanced the reddish color and/or the luster of the pieces.

Summary and Discussion

The expectation of an association between raw material type and tool type was met for three classes of tools: Microendscrapers, axes, and large-blade knives. Microendscrapers had the least variability in raw material choice, made from only two main types which were visually quite similar. Axes and large-blade knives were made from many different types as defined here, but they each showed a clear preference for light raw materials (*ds ḥd*), which cannot be explained through functional considerations nor preference for local materials.

As for the other tool classes, RFKs and rhomboids both only had a moderate amount of variability in raw material choice. The production of RFKs focused on one raw material type in particular, but this focus may have been related to the raw materials available near the production locations, and/or the size requirements for the knives. Rhomboid raw material selection was also probably governed by the size requirements for these large tools, and there was no preference for light or dark materials for rhomboids, so symbolic considerations were probably not a factor in raw material choice.

Fishtails, CBPPs, and bifacial sickles were all made from many different raw materials, and there was no clear preference for a certain color. Therefore it is not likely that one raw material type or one color was significant to the symbolic meaning of the tools. The use of so many different raw materials may indicate that there were multiple production locations for these tools. Fishtails however showed a change in raw material choice over time, toward fewer raw material types focusing on the same raw material that was preferred for RFKs. Both the later fishtails and RFKs used the ripple-flaking technique. This change in the production of fishtails may indicate a shift toward fewer production locations.

At the beginning of this chapter a case was made that the color of the chert varieties may have been important to the symbolic meaning of tools made from them. And the finds of color preference for axes, large-blade knives, and microendscrapers corresponds nicely to the Pharaonic category of chert *ds ḥḏ* meaning light or bright chert. Furthermore, the heat-treating of microendscrapers may have been done to increase the pinkish color and/or the luster of the pieces. The heat treatment does not seem to have been functional since microendscrapers were made of both heat-treated and non-heat-treated pieces of the same raw material, although more experimental work may clarify this point.

These findings suggest a new avenue for future research. One way to further substantiate the suggestion that the color of the raw materials was a significant part of the meanings of the tools is to look at patterns in how raw materials were deposited. The practice of depositing materials in specific patterns for symbolic reasons is known from other archaeological contexts worldwide. In Mesoamerica each of the four cardinal directions was associated with a color and specific attributes (Marcus 2007:61-63). This principle was not only depicted in motifs painted on celts and pottery, but also three-dimensionally replicated in deposits such as colored basins distributed around a dooryard (San Jose Mogote), offering caches deposited in the four corners of a structural platform (Zapotec), or even in the layout of a Tenochtitalan which was divided into four quadrants and associated with the appropriate colors (Aztec). An example of topographic locations indexed by raw materials comes from Chaco Canyon where non-structural wood corner posts in a burial chamber referenced the sacred mountain regions from which they came (Plog and Heitman 2010:7). These are but a few examples to illustrate the idea. There is some evidence for color pairings of tools in intentionally deposited Predynastic Egyptian contexts.

Tomb 72 at HK6 was a basically intact grave which contained one dark and one light bifacial sickle among many other fabulous objects (Droux and Friedman 2014). Similarly, a cache of three bifacial sickles was found at Abydos containing two dark and one light sickle (Ch. 3.4, Figure 7.5). That these sickles were deposited together indicates that the differences in chert color were not due to changes in the raw material source over time. Additionally, a number of offering deposits (some sealed, some disturbed) have been found in the corners of the columned structures in HK6. In the NE corner of Structure 7 a number of CBPPs were found. Most of these CBPPs were made from dark cherts and at least one was made from a light chert (Figure 7.4). Similarly, in the Block 3 ritual activity area in el-Mahâsna, two CBPPs were found, one dark and one light (Figure 7.4). The pairing of light and dark stone tools could echo the color pairing of red and black pottery in ritual locations at Hierakonpolis (Friedman 2009b:85-88; Hendrickx and Friedman 2003). This suggestion that light and dark (red and black) materials might have been intentionally paired should be researched further, through collection of more detailed information on the raw materials of items in intact contexts.

Besides raising new questions for study, this analysis of the raw materials of specialized tools has demonstrated the utility of studying raw materials. Such studies can provide information about production and distribution patterns, change over time, and even the symbolic uses of tools.

7.2 Production Expectation

If specialized production of some tools developed in Egypt to make symbolically meaningful goods, then it is likely that the production of those tools would have been associated with ritual activities. The production may have been organized around ritual events, when people aggregated together, which would have offered advantages such as facilitating the procurement of raw materials, or sharing of knowledge. Additionally production associated with ritual activities or ritually important locations could have added meanings to the tools indexing the place or time of production. This expectation was evaluated by looking for production remains in ritual contexts[72]. Such contexts include the HK29A, HK29B, and HK25 ritual precinct at Hierakonpolis, the ritual activity area in Block 3 at el-Mahâsna, and the numerous cemeteries throughout Egypt. See Chapter 3.4 and 3.5 for more details on these contexts. Chapters 5 and 6 looked at the spatial distribution of production remains relative to products at inter- and intra-site levels to understand the organization of production. This chapter is concerned with looking at production remains relative to the interpretations of their contexts.

It should be noted that production associated with ritual activity areas has often been interpreted as indications of sponsored production (e.g. Holmes1992; Takamiya 2004). One way that production associated with ritual aggregation may be differentiated from such sponsored production is that the former is by definition part-time, seasonal or periodic. Therefore the intensity of the activities (*sensu* Costin 1991, 2001) will also be considered below.

[72] Ritual contexts judged as such from other lines of evidence such as the ceramics, faunal remains, and architecture.

Ripple-Flaked Knives

No production locations for RFKs have been definitively identified. However there was indirect evidence that pertains to RFK production locations and intensity. The standardization of the production process has led researchers to conclude that production was limited to one or very few locations (Holmes 1989:338; Kelterborn 1984:452). Although the exact dimensions of the knives varied, the consistency of the direction of flake removals (ibid.:442; Midant-Reynes 1987:190) points to a standard production process.

The analysis of RFK raw materials in the previous section (Ch. 7.1), indicated that RFKs were possibly produced near Abydos. The most commonly used RFK raw material type was available and used near Abydos, and the RFKs made from that raw material type clustered around Abydos. Abydos' political importance is clear from the exceptional graves, such as the burials of Egypt's first Kings, or the earlier tomb UJ, which had evidence of far distant trade connections and early writing. If RFKs were produced near Abydos their production could have had political overtones in addition, to or instead of religious ones, especially considering that many of the knife handles had motifs of warfare and domination (Ciałowicz 1992; Delange 2000, 2009; Dreyer 1999; Midant-Reynes 1987; Needler 1984; Williams and Logan 1987). Accordingly, production of RFKs at Abydos could easily fit a model of sponsored production.

An additional or alternative production location for RFKs was the HK29A ritual enclosure at Hierakonpolis. As discussed in Ch. 6.1, large quantities of remains from bifacial tool production were associated with this enclosure. The enclosure was used during two periods, NIIAB-C and NIID2-[73]NIIIA (Friedman 2009b). RFKs date to the NIId (Dreyer 1999:213;

[73] Since the sub-phase IId1 is no longer thought to be valid (Buchez 2011b; see Ch 3.2), the date of the second phase does correspond to the dates of the RFKs.

Midant-Reynes 1987:212), so they could have been made there during the early part of the second stage of that workshop. The technique of ripple flaking has been identified among HK29A remains (e.g. Takamiya and Endo 2008:8), but no actual RFK fragments with one ground side and one flaked side have been reported.

The issue of seasonal vs. continuous use of the HK29A structure is somewhat unresolved. There is some faunal evidence that suggests the HK29A ritual structure was used during multiple seasons throughout the year (Linseele et al. 2009, see Ch. 3.5). More importantly, the quantities of lithic remains from the later phase of the workshop, when RFKs would have been made, indicate a full-time production level (Holmes 1992), rather than seasonal or periodic production that would be more in line with production associated with ritual aggregation.

Therefore, while the production location(s) for RFKs is not definitively known, neither of the two possible production sites discussed here fit well with the expectations for the ritual production model. Instead they indicate sponsored production, possibly in a full time capacity, not one related to ritual cycles.

Rhomboids

At least some rhomboid tools were almost certainly made at the HK29A ritual enclosure. A fragment of a probable rhomboid tool was found there (Friedman 2009b:89; *c.f.* Holmes 1992:41), along with large amounts of bifacial thinning flakes. Rhomboid tools primarily date to NI-IIAB (Ch. 6.1), the tail end which overlaps with the beginning of the earlier phase of the HK29A ritual structure (NIIAB-C) (Friedman 2009b). Moreover, Hierakonpolis was the only site where rhomboids have been found in a settlement (Friedman and Nagaya 2013:22; Needler 1984:114-115, 265-266). More rhomboids (n=8) come from the Hierakonpolis settlement and cemeteries than any other site, more even than were found at Naqada with its very large cemetery (Table 6.3, 6.4, 7.6). However it should be noted that since the HK29A structure was only in use at the end of the period in which rhomboids were made, it cannot be the only production area for rhomboid tools.

In the previous section, Ch. 7.1, the analysis of rhomboid raw materials and their distribution showed some clustering of the most common raw material type around Naqada. However note that this was a rather small sample and no source of that material has been identified near Naqada. The dates of South Town are slightly later than the dates of the rhomboid tools, but many other earlier settlements existed in the Naqada area.

The rhomboids do meet the expectation of production associated with a ritual location, since some of their production likely comes from the early phase of HK29A ritual enclosure. In the earlier phase of the structure the lithic artifact density was not as high as in the later phase (Friedman 2009b, see also Ch. 6), so the production was not necessarily full-time, but very well could have been periodic or associated mainly with ritual events.

Fishtails

Fishtails were likely made at multiple sites. The variability in quality and size of the fishtails (Van Walsem 1978:243; Ch. 7.1) and in the raw materials used (Ch. 7.1, Table 7.4)) indicate that fishtail production probably occurred in multiple locations. Some of this variability comes from changes in raw material choice over time. Type ‘4.Beige with pink bands’ was quite common for later fishtails, and might be associated with a shift in the place(s) of production.

One probable fishtail production location was the HK29A ritual enclosure. The fishtails date from the NI to late NIId or NIII (Hikade 2003:139), and most scholars agree that they continue as the *psš-kf* instrument, in a slightly altered form. Therefore fishtails were certainly coeval with both phases of lithic reduction at the HK29A ritual enclosure: NII(A)B-C and NIID2-NIIIA (Friedman 2009b). Although no broken fishtails or fishtail preforms have been found associated with the site, there was a high frequency of bifacial thinning flakes, unidentifiable fragments from bifacial tools, and as mentioned above, a fragment of a tool that shows some ripple-flaking. Later fishtails (shape type 2) had similar ripple-flaking (e.g. Figure 7.6 MMA.24.2.13).

As discussed with RFKs, HK29A was a ritual activity area, which would seem to fit the production expectation. However, in the later period, coeval with the *later* fishtails, the scale of production was quite high, indicating full-time production, which does not fit the expectation for production in the context of ritual aggregation, at least. On the other hand, the earlier HK29A context did not have the same density of remains, indicating that stone tool production did not occur as intensively in there in the NII(A)B-C. Since there was also some evidence for seasonal use of the structure (Linseele et al. 2009; Ch. 3.5), then it is likely that production in the earlier phase may have been more periodic, and that the production context for *earlier* fishtails does fit the expectation.

Overall the production context of fishtails may have been variable and/or changed over time. Fishtails were probably made in multiple locations, as was indicated by the variability in their style, size, quality, and raw material types. At least some early fishtails were probably produced at the HK29A ritual structure in its early phase, which does conform to the expectation for the ritual production model. However they were also likely produced there during the second phase, which does not fit well with the model since the high level of production has been interpreted as sponsored full-time production. This shows change over time over time in the production of fishtails.

Concave-base projectile points

Evidence for the production of CBPPs came from HK29A, South Town, and Naqada Khattara site KH4, all in the form of unfinished CBPPS. These included both ritual and non-ritual contexts. At the HK29A ritual enclosure Holmes (1992:41) found a number of bifacial tool fragments which she thought were projectile points broken during manufacture, along with more complete fragmentary specimens that may have broken during manufacture, or may have been finished pieces that broke later. Takamiya and Endo (2008:8) indicated that CBPPs were probably among the tools manufactured at HK29A. The finds of CBPP fragments have not been correlated to the different phases of activity at HK29A, but because CBPPs themselves date to the late NI-early NII (Hikade et al. 2008:185-186), they were likely produced during the earlier phase of bifacial tool production at HK29A (NIIAB-C). As mentioned above, production of tools in the early phase of HK29A corresponds well to the expectation of part-time or periodic production associated with ritual activities in the ritual production model, because of the lower density of artifacts during that phase.

Additionally, the distribution of CBPP raw material types by site shows that eight of the 13 examples which were made from type “7. Dark gray and brown” material came from Hierakonpolis (Table 7.13). However it is not known whether there was a source for this material near Hierakonpolis. Additionally it should be noted that while Holmes (1992) and Takamiya and Endo (2008, 2011) emphasized the preferential use of orange and cream colored raw materials for bifacial tool production at HK29A, those materials made up only 13% of the bifacial tool manufacture debitage in HK29A (Holmes 1992:8). Holmes (ibid.) also noted that beige and dark brown materials were used for bifacial tools, thus supporting the notion that raw material type 7 CBPPs were made at HK29A. Furthermore, besides the 13 CBPPs with identifiable raw materials known from Hierakonpolis, at least 15 more burnt CBPPs were found at HK25, which was an extremely high concentration of CBPPs in one site (Tables 6.1-6.4, 7.12).

Petrie found an unfinished CBPP in his excavations at South Town (Naqada) (Holmes 1989:274; Petrie and Quibell 1896:Pl 55). Petrie's work revealed extensive mud brick architecture, but there was no other information about the context of the find. Subsequent excavations at the site by Barocas and others (Barocas et al. 1989; Di Pietro 2011; Fattovich et al. 2007) found evidence for administrative and ritual artifacts including seals, tokens, and figurine fragments. However the Italian excavations took place in the Southeast part of the settlement, and Petrie's excavations took place in the North and Northwest part of the site, so the CBPP production cannot be directly associated with the ritual and administrative activities in the area. Nonetheless, the existence of CBPP production, ritual activities and administration at such a prominent site, especially considering the evidence from Hierakonpolis where CBPPs were very likely manufactured in association with ritual activities, suggests a possible relationship.

Three unfinished CBPPs came from Naqada KH4 (Holmes 1989:, Holmes (1989:247) along with an additional finished but broken specimen. The site was only surface collected, so little is known about the kinds of contexts that existed at the site. KH4 was a relatively substantial size for a Predynastic site, at 2 ha, but was smaller than other nearby sites including KH3, South Town and North town. There was no evidence for overt or concentrated administrative or ritual activities. The botanical and faunal remains, and other finds, indicate that KH4 was an agricultural village. Therefore the production of CBPPs cannot be connected to ritual activities there, given current data. A possibly unfinished CBPP was also found at Maadi, another site with no clear evidence of concentrated ritual activities (Rizkana and Seeher 1988:32 Pl 68).

Thus it is likely that CBPPs were produced in a number of contexts. These contexts included a ritual context (HK29A), a possible a context of sponsored production which may have included ritual activities (Naqada South Town), a settlement not securely connected with either ritual or political activities (KH4), and a town known for its trading activities (Maadi). For the early phase of HK29A and especially for KH4 part time production of CBPPs seems reasonable based on the lower density of lithic remains compared to the later phase of HK29A. Therefore the evidence accords well with the expectations from the ritual production model.

The connection between lithic tool production and the ritual activities at HK29A was very clear for CBPPs. Both relate to hunting and animal slaughter, which had highly symbolic ritual connotations and status building effects (Hendrickx 2013). So in this case it is very clear how the production of CBPPs would have been structured by these ritual activities, although production occurred in other places as well, so it was either not limited to these activities or could have been associated with smaller-scale hunting and ritual activities that did not leave as many traces.

Bifacial sickles

There is no data for the precise production context of bifacial sickles. There was a moderate amount of variability in the raw material choices compared to the other specialized tool types (Table 7.3). Additionally there was fair amount of variability in size and shape, but this was difficult to quantify since some have clear indications of being re-worked. All in all, there was nothing to rule out their production at ritual sites like HK29A or el-Mahâsna Block 3, since thinning flakes of the appropriate raw materials were found in both locations. But there was nothing to confirm that these tools were made there, so for now this expectation cannot be evaluated.

Axes

Axe production was associated with both ritual and non-ritual contexts. Axes were produced in sites throughout the Naqada region including Armant 21/83, Armant 21a/83, the Naqada Khattara sites, and Abadiya (Tables 4.20, 6.1, 6.3). The evidence for axe production included thinning flakes, axe preparation flakes, and axe preforms. At Armant MA21/83 axe production remains were more prevalent in the southern part of the site (Ginter et al. 1996:177-178) which was primarily a habitation context (Ginter and Kozlowski 1994:38-45; Ch. 3.5).

However, there was also evidence for axe production in association with ritual contexts at HK29A and el-Mahâsna Block 3. The only reported axe preparation flakes from any of the Hierakonpolis localities studied here came from HK29B in the ritual precinct, Table 4.20). HK29B and HK29A also had significantly higher amounts of bifacial thinning flakes than other areas of Hierakonpolis (Table 6.22), although no axe preforms were specifically identified. Axes themselves were found in the settlement and cemetery (Ch. 7.3). HK29B dates to the second half of the Naqada II period (Friedman et al. 2011b:115), which bridges the end of the first phase of use at HK29A and the beginning of the second phase of use there so it is not clear whether axe production should be associated with part-time or full time bifacial tool production.

At el-Mahâsna, only one axe preparation flake was recovered, and it was found in Block 3 the ritual activity area. Block 3 also had a higher percentage of bifacial thinning flakes than the other blocks (Tables 6.17-6.18), and there was a preform for an unidentified tool which could be an axe. Finished axes were found in Block 3 and in other areas of the settlement. The densities and quantities of lithic tools production remains were only slightly higher than other parts of the site, so the production should not be considered full-time.

On the whole, axe production is best characterized as part-time production in conjunction with ritual and non-ritual activity areas, but at Hierakonpolis may have been associated with more intensive bifacial tool production during the later part of the Naqada period.

Large-blade knives

The only possible production place so far identified for large-blade knives was at Badari 3000/6, where two refitting large blades matched the raw material of a blade core (Figure 7.7). However, little is known about the context of these production remains. Brunton left very few notes about the contexts he excavated except to say that they “showed remains of settlements” (Brunton and Caton-Thompson 1928:45). At settlement 3000/6 he did recover a few intact jars full of interesting items such as ivory tags, a disk mace head, pendants, a rhomboid slate palette, resin, malachite, ochre, horns, shells, pebbles and a tusk shaped like a human head that has a loop on top, which some have likened to an early version of the white crown (ibid.: Pl 53; Hendrickx et al. 2015). Additionally there may have been a beer production facility at Badari 3000/6 since some of the distinctive fire bars associated with such structures were found there (Geller 1992a). The only other sites with beer production facilities so far identified were Abydos, el-Mahâsna, Hierakonpolis, and Tel-el Farkha, each associated with substantial evidence for ritual activities and/or elite political activities. In the end though it is not possible to say one way or another whether any production of large-blade knives at Badari 3000/6 was associated with a ritual activity area or not.

Heat-treated microendscrapers

The production remains for heat-treated bladelet tools were associated with both ritual and non-ritual contexts at the sites where context information was available. Production of heat-treated microendscrapers occurred in a number of communities including Badari, el-Mahâsna, Adaïma, and Hierakonpolis, but not at others, such as Naqada region sites or Nag el-Qarmila (Table 5.24). At both el-Mahâsna and Hierakonpolis, where intra-site data were available, production remains from the process of making heat-treated bladelets were found in multiple areas of the sites, including, but not limited to, the ritual contexts. There was variability in the distribution of the specific kinds of production remains (chunks, cores, prepared cores) which indicated that the entire production process may not simply have been carried out in each area, but organized in a more complex way across the site (see Ch. 5.6). These data show that heat-treated microendscraper production was sometimes associated with ritual contexts, and in other cases not.

More evidence of microendscraper production in association with ritual activities came from the cemetery finds. There were indications that some stages of the production of heat-treated bladelets were carried out in relation to burials or funerals (ritual activities). Bladelets that refit together were found in tombs in the Hierakonpolis and Abydos cemeteries (Droux and Friedman 2014:4-5; Hikade 1996) (Figures 7.9, 7.10). These bladelets were made from the kinds of raw materials preferred for microendscrapers (see Ch. 7.1). The fact that the bladelets refit shows that they all came from the same core, and that they were all likely made at once for the burial, otherwise time and life would have scattered the pieces into different depositional contexts. According to Hikade (1998, 2000) a third of the bladelets from Abydos cemetery U were made into microendscrapers. The exact location where the bladelet production and/or microendscraper finishing retouch took place, whether at the burial site or elsewhere, is not pertinent for this discussion. What matters is that the bladelet production was motivated by a ritual event—a burial or funeral. Furthermore this practice of producing bladelets and/or microendscrapers probably occurred at other places besides Hierakonpolis and Abydos, as will be discussed in section 7.3.

The production of microendscrapers was probably part-time, perhaps eventually becoming full-time. At el-Mahâsna (which dates to the NIc-IIc) the microendscraper production remains, and the lithic production remains in general, were not numerous enough to be considered full time, and the same probably goes for other sites like Badari or Adaïma where no dense concentrations of lithic remains have been noted. The later phase of lithic production at HK29A probably derived from full-time production (Holmes 1992; Friedman 2009b; Ch. 6.1), but it is not clear whether the heat-treated microendscrapers there were associated with the early and/or late phase of use. However microendscraper production likely also occurred at HK11C, Operation A, which by the later NII period was a dedicated production area for many items including beer and ceramics, and may very well have constituted full-time production.

Microendscrapers certainly meet the expectation for the ritual production model. Their production was often associated with ritual activities in settlements and cemeteries, and part-time production in the earlier phase of the Naqada period.

Production expectation conclusion

In conclusion, for every case where sufficient data were available, specialized production of lithic tools took place in association with ritual contexts at least some of the time. Rhomboids, fishtails, CBPPs, axes, and microendscrapers all fit the expectation for production associated with ritual activities, on a part-time basis. Moreover the association between the production of specialized tools and ritual contexts was not limited to one site, but occurred over multiple sites, including Hierakonpolis, el-Mahâsna, and possibly Naqada and Badari, showing that this was a real pattern in production practices.

However in some cases (fishtails, CBPPs, axes, and microendscrapers) the tools were also made in other contexts which cannot be associated with ritual activities. Upon reflection, the fact that a number of these specialist produced tools were made in both ritual and non-ritual contexts sits quite well with the ritual production model. As discussed in Ch. 1.5 the ritual production model concerns production of items which have both utilitarian uses *and* symbolic value. Therefore it makes sense that they could be produced in multiple kinds of contexts.

Over time, production levels increased from part-time production to full-time production (Takamiya 2004), here this trend is evident from the increase in the density of lithic debitage with the later phase of the HK29A ritual enclosure. This trend can be seen clearly for fishtails, which were made over the longest time span of any of the tool classes, and have their own independent stylistic measure of dating. The variability in raw material types used for fishtails decreased over time, probably indicating fewer production locations. Additionally there was a change in technology with the adoption of ripple flaking, which also probably indicates a reduction in the number of producers/production locations since it was such a difficult technique. Microendscrapers may eventually have been made by full-time specialists since their production remains occurred in areas with high levels of production activities at Hierakonpolis (HK11C and HK29A).

7.3 Find Context

In the ritual production model outlined by Spielmann (2002), the ethnographic examples she drew on showed that the socio-ritual valuables made by specialists were often used in both ritual contexts and more ordinary contexts. These items blur the boundary between symbolic goods and utilitarian goods, often being used for both purposes. Therefore the goods made by specialists should be found in both ritual and non-ritual contexts.

Ch. 3.4 and 3.5 gave evidence for the interpretation of many Predynastic contexts which can be used to evaluate this expectation. Examples of ritual contexts include the HK29A ceremonial enclosure, the HK25 columned hall, el-Mahâsna Block 3, the temple area of Kom es-Sultan, and cemeteries. Examples of contexts which were not primarily or overtly used for ritual purposes include habitation areas (el-Mahâsna Blocks 1 and 4, Abydos ATP, Naqada KH3B, Armant MA 21/83, Adaïma 1001, Hierakonpolis HK29, HK11C area G, Nag el Qarmila WK15), middens (HK14, HK11C mound A, Armant MA21a/83 trench 3), storage areas (Nag el-Qarmila WK22), animal pens (Hemmamiya North Spur, HK11C ON6E), or production areas (Adaïma 1000, HK24A, HK25D, HK11C Op A).

Additionally, in the ritual production model specialist goods are used by many people, not just by a subset designated according to emerging class, wealth, or other factor. So the second expectation examined here was whether specialist produced tools are found in widespread rather than more restricted contexts. One way this was evaluated was by looking at whether the tools were found in settlements of all scales. It is conceivable that access to artifacts might be related to the kind of site people lived in, such as whether that site was a large center or a small farming village. In Ch. 3.7 the settlements were divided into a three-part scale based on the area/populations and the diversity of activities apparent at that site (Table 3.4). The cemeteries were assumed to correspond to the scale of their associated settlement. The expectation for widespread distribution was also evaluated by looking at whether the tools were found in multiple household contexts within a settlement, rather than concentrated in only one (a more restricted distribution of the tools). The presence of specialist tools in burials or cemeteries of different status at a given site was also taken as an indicator of a widespread rather than more restricted distribution of the artifacts. It is important to point out that while the determinations of which tool types were produced by specialists involved looking at the spatial or geographic distribution of the tools vs. their production remains (Ch. 5 and 6), this expectation looks at what those contexts were, i.e. the *social* distribution, of the tools themselves.

Ripple-Flaked Knives

RFKs were overwhelmingly found in ritual contexts. Those ritual contexts included burials, where they were primarily found, and a cache of goods at the Tel el-Farkha settlement, which also included two golden statues and an over-sized bifacial knife (Ciałowicz 2012; Kabacinski 2012). One possible RFK was also found in a domestic context.[74] An RFK re-worked into a scraper was found in the Hemmamiya settlement (Brunton and Caton-Thompson

[74] A fragment of a RFK was reported from a trash pit dug through domestic layers in HK11C area G (Watrall 2000). However it was later deemed to not be a true RFK with one flaked side and one ground side (R. Friedman, pers. comm.)

1928:77, Pl81). However, the Hemmamiya piece is a bit too wide to be from an actual RFK,[75] and may have originally derived from another kind of knife with ripple flaking.[76] Alternatively it may be from an unfinished example that broke during production, never having become an RFK. Overall, true RFKs were found only in ritual contexts.

RFKs were found in cemeteries of all scales, but were most common in highest-order sites like Abydos (see Tables 6.4, 7.4, and 7.5). They were present in the highest-order cemeteries of Abydos and Naqada, and in some but not all mid-level cemeteries, like Adaïma, but not at el-Mahâsna. Occasionally RFKs have been found in some small cemeteries. For instance, an RFK comes from Armant, but the cemetery was in use after the settlement discussed here was abandoned, so it was not clear whether it should be considered a low-level site or a mid-level site. An RFK was found at Harageh cemetery G, which was a small cemetery, and so it may represent a lower order site (Engelbach and Gunn 1923:7; Hendrickx and van den Brink 2002:352).

RFKs have also been found in graves which exhibit different degrees of wealth. RFK fragments were found in the royal tomb of Djer. At Gerzeh an RFK[77] comes from the largest tomb in the cemetery (Stevenson 2009:113). At Abu Zaidan tomb 32 contained three RFKS and could certainly be considered among the wealthiest if not the wealthiest grave in the cemetery in terms of size and quantity and variety of objects (Needler 1984:124-125, 392). However, looking at overall data on tombs with RFKs Midant-Reynes (1987:202) concluded that many graves with

[75] The Hemmamiya piece is 4cm wide, and shows ripple flaking from one direction only. If it was from a true RFK, with ripple flaking from both lateral edges, the original knife would have been at least 8cm wide. A sample of 25 complete RFKs with width measurements showed that only one example was 8cm wide, the rest ranged from 2.4-cm, averaging 5.5cm wide.
[76] E.g. Boston Museum of Fine Arts 03.1388, or University of Pennsylvania Museum E.1114.
[77] Pitt Rivers Museum Knife 1911.33.1. Also see notes there by Stevens.

RFKs could not be classified as elite, based on dimensions, architecture, and offerings, nor would she place them in a lower strata of society according to those same criteria. At Naqada, RFKs were found in the main (non-elite) cemetery. However Bard (1994) demonstrated that the western cluster of graves in the Naqada main cemetery was wealthier and more exclusive than the eastern cluster based on types and quantities of grave goods. RFKs were only found in the wealthier western cluster. Thus the overall cemetery data indicates that RFKs were restricted to tombs of upper and middle status/wealth.

All in all, while the RFKs were found in cemeteries of all scales, the RFKs do not meet the expectation for find contexts well because they were only found only in ritual contexts, and they were mainly found in graves with middle or high degrees of status or wealth.

Rhomboid tools

Rhomboids have only been found in ritual contexts. These contexts were: the cluster of burnt bifacial tools at the HK25 columned hall (Hikade et al. 2008; Nagaya and Friedman 2013), the HK29A ceremonial enclosure (Friedman 2009b:89), and burials. Two rhomboid tools were collected by H. de Morgan from somewhere in the Hierakonpolis the settlement (Needler 1984:114-115, 265-266) but these probably also came from HK25 considering that they were burnt and broken, just like the bifacial tools from HK25.

Rhomboid tools were found most commonly in the highest order and mid-level sites, but also in some lower order sites (Tables 6.3, 6.4, 7.6, 7.7). The Abydos, Hierakonpolis, and especially Naqada cemeteries represent the highest-order sites. Additionally rhomboids were found at the Mesaeed cemetery (Table 7.6), Abadiya Cemetery B (Petrie and Mace 1901:Pl 5), and Hiw Cemetery U (Hikade 2010; Petrie and Mace 1901), which were all medium- large cemeteries of 400-700+ graves each. A number of rhomboids came from Mostagedda cemetery 1800 (Brunton 1937:90, Pl40, tombs 1803, 1847, 1854), which was a small to medium-sized cemetery of around 170+ graves. One was found at Armant cemetery 1400-1500 (Mond and Meyers 1937:Pl20), which is here considered a lower order site.

Whether or not rhomboid tools occurred graves of different status was more difficult to determine. They definitely have been found in very high status graves, such as Tomb 72 at Hierakonpolis, which may have belonged to an early ruler (Droux and Friedman 2014:7). Additionally, two rhomboids were also found as heirlooms in the 'royal' tomb at Naqada (Hendrickx 1994:52-55, 2002:283). On the other hand they were also found in regular non-elite cemeteries, in both the western and eastern clusters of the main cemetery at Naqada (1241, 1437, 1676), where they were found with other stone tools, pottery, and sometimes stone vessels or pallets.

Overall the contexts or social distribution of rhomboid tools was similar to that of the RFKs. They occurred mostly in the highest order sites and definitely in elite graves, and sometimes in medium level cemeteries and graves which may not be the most elite, but rarely in the lowest order cemeteries and not at all in poorer graves.

Fishtails

Fishtails have been found in both ritual and non-ritual contexts. Fishtails were certainly prevalent in cemeteries, where they occur as grave goods (Table 6.9). Additionally they have been found in offering caches associated with a columned hall (Structure E8) in Hierakonpolis cemetery HK6 (Friedman 2006:7-8). In terms of ritual contexts in settlements, fishtails have been found among the group of burnt bifacial tools at the HK25 columned hall (Hikade et al.

2008; Nagaya and Friedman 2013). Additionally, at least one fishtail was found associated with the late Predynastic votive offerings of the Hierakonpolis Nekhen temple 'main deposit' (Quibell 1900: Pl24).

Fishtails have also been found in a number of other contexts which were primarily domestic in character. Two fishtails were excavated from habitation contexts at the site of Hemmamiya, which has evidence for storage, animal pens, and debatably, houses (Caton-Thompson 1928:77,96,107 Pl.71-72, 79-80). Two fishtails also come from the settlement site of el-Mahâsna. One (PR.1901.42.107) was from Garstang's "Settlement 2" area, and Anderson (2006:30, Fig 3.10) thinks Garstang's excavations there were located west of the ritual activity area (Figure 3.2) and contained wattle and daub structural remains. Another fishtail fragment, found by Anderson (MAP.301.1), was on the surface at the southern end of the site, which was the opposite end of the settlement as the Block 3 ritual activity area, in an area that corresponds to Garstang's "Settlement 1" (Anderson, pers. comm.). Another fishtail fragment was located on the surface at Adaïma, where only habitation and grain production contexts have been identified (Midant-Reynes and Prost 2002:367, no 431, Pl 27.1). Hoffman found a fishtail fragment on the surface of HK29, an area with a dwelling, fenced yard, and pottery production remains (Holmes 1989:318).

The examples above show that the fishtails came from settlements of all scales including Hierakonpolis for the highest order sites, el-Mahâsna and Adaïma for mid-level sites, and Hemmamiya for the low order sites. Correspondingly, fishtails are known from cemeteries of all scales (Tables 6.4 and 7.8), including the Abydos, Naqada, and Hierakonpolis cemeteries (high-order sites), el-Mahâsna, Mesaeed, Abadiya, and Hu cemeteries (mid-level sites), and Armant cemetery and Harageh Cemetery H (Engelbach and Gunn 1923:7, Pl 7) (low-order sites).

Fishtails were quite numerous and these examples do not cover all cemeteries where fishtails have been found, but are just examples to show that they were found in cemeteries of all scales.

Furthermore, the two fishtails from Hemmamiya were from different parts of the site, and the two fishtails from el-Mahâsna were from widely separated areas of the site, showing that their distribution within a settlement was not confined to a single context or household. Additionally fishtails were included in graves of different status. At Hierakonpolis multiple fishtails were uncovered in the elite cemetery HK6, and one was associated with painted Tomb 100 (Quibell and Green 1902:21) also an elite grave. At least one fishtail was included in a grave of the non-elite 'working class' cemetery (HK43) (Friedman 2004b). At Naqada two fishtails were found in cemetery T (tomb 22), the elite cemetery, while many also came from the non-elite main cemetery. Even in the Naqada main cemetery, the fishtails were found from graves of diverse wealth. They ranged from graves with only a few pots, to tombs with all sorts of items, such as tomb 271 which in addition to a fishtail had ivory figures, a clay figure, 16 ceramic pots, 3 stone vases, tags, resin, a slate amulet, malachite, coral, and cloth with stucco and paint (Baumgartel 1970; Payne 1987; Petrie 1896). Bard's analysis showed that the western cluster of graves in the main Naqada cemetery was slightly wealthier and more exclusive than the Eastern cluster, but fishtails were found in both clusters.[78] These data indicate that people with a range of wealth or social affiliation used fishtail tools, not only a restricted set of people.

In sum fishtails meet the expectations derived from the ritual production model for context. The contexts show that fishtails were associated with ritual activities but could also be a part of other contexts which were not primarily ritual in nature, and they were used by many people, not just a subset, at least as far as status and settlement scales are concerned.

Concave-base projectile points

Finished CBPPs have been found in both ritual and non-ritual contexts (Table 6.1-4, 6.19, 7.12-13). The ritual contexts of CBPPs include the Block 3 ritual activity area at el-Mahâsna, the HK29A ceremonial enclosure (Holmes 1992; Takamiya and Endo 2008), the nearby HK25 columned hall where they were among the group of burnt and broken bifacial tools (Hikade et al. 2008; Nagaya and Friedman 2013), and the temple area of Hierakonpolis Kom el-Ahmar/Nekhen town site (Adams 1974:xv, 39, Pl27). CBPPs have also been found in different capacities in cemeteries, such as the offering deposits associated with structures 7 and 8 in the Hierakonpolis HK6 cemetery (Friedman 2012:69-71), and as grave goods in tombs, e.g. HK6 tomb 72 (Droux 2014:4-7, 18-19), or tomb 178 in Abydos cemetery U (Hikade 2000).

In addition, CBPPs come from contexts which were not predominantly associated with ritual activities. Examples include ones found among the habitation structures in Adaïma Block 1001 (Midant-Reynes and Prost 2002:366, Pl 25) and Naqada KH3 (Holmes 1989:247). Two were found in Predynastic levels of the living/storage/animal pen remains at Hemmamiya (Caton-Thompson 1928:98, Pl 71,79; Holmes 1989:83), and one comes from a general settlement context at Elkab (Claes et al. 2014:85). A CBPP from Armant MA21a/83 was found in Trench I which was a subsistence activity area with storage pits and hearths (Ginter and Kozlowski 1994:43).

[78] The grave inventories are given in Baumgartel (1970) and Payne (1987). Bard gave the grave numbers

How widespread the CBBPs were in terms of social distribution was gauged by looking at their presence in settlements and cemeteries of different scales, multiple non-ritual contexts in settlements, and/or graves of different status. Finished CBPPs have been found in sites of all scales. The highest order sites include the settlements of Naqada South Town (Baumgartel 1960:28, Pl 1; Petrie and Quibell 1896:Pl 72) and Hierakonpolis (above), and the cemeteries of Abydos and Hierakonpolis (Table 7.12). Mid-level sites with finished CBPPs include the settlements of Badari 3000/6, el-Mahâsna, Adaïma, and Maadi (Tables 6.1, 6.3, 7.12; Rizkana and Seeher 1988:32, Pl 68). Examples of CBPPs from Naqada Khattara sites, Armant, and some Badari sites (Holmes 1989) show that they were also present in the low-order settlements. Examples from Hemmamiya cemetery 1700, and Badari cemetery 3900 show that their distribution extended to these lower-order cemeteries as well.[79]

Within settlements there was conflicting evidence for whether CBPPS were concentrated within contexts associated with certain groups, or more widespread. At Hierakonpolis the CBPPs were concentrated in ritual contexts (HK25, and HK29A) and were not found in other kinds of contexts,[80] let alone in multiple non-ritual contexts. However at el-Mahâsna there was some evidence that the CBPPs were not quite as concentrated. Two of the three el-Mahâsna CBPPs

for the cemeteries as: Western cluster tombs 56-499 & 1200-1299; Eastern cluster 500-1195 & 1301-1953.

[79] Brunton thought these dated to the Badarian, but he assigned the date based on the presence of the CBPPs, which we now know extend into the Predynastic. These cemeteries are otherwise Predynastic (Holmes 1989:171).

[80] Two CBPPs found by de Morgan in the Hierakonpolis settlement (Needler 1984:262-263) probably came from the HK25 columned hall since they were burnt and broken, like all the bifacial tools from that locality. Friedman and Nagaya (2013) similarly argued that burnt and broken bifacial tools collected by Petrie probably came from HK25.

from Anderson's excavations[81] were found in Block 3, the ritual activity area (Table 6.19). However, Anderson (pers. comm.) also located a third one (MAP 395) on the surface adjacent to Block 4, and Garstang (1903:7, Pl3) found a few CBPPs in the "settlement 2" portion of el-Mahâsna which is likely adjacent to Block 4 (Anderson 2006:30, Fig 3.10). Finds of CBPPs from other settlement sites either occurred singly, or were not associated with the level of data that would enable comparison between contexts.

Additionally, there were examples of CBPPs from very elite wealthy tombs and from less exceptional tombs. The examples from Abydos Cemetery U tomb 178 (Hikade 2000) and Hierakonpolis HK6 tomb 72 (Droux 2014:4-7, 18-19) were certainly from elite burials. On the other hand the example from Badari tomb 3920[82] was from an intact grave of a male whose only other graves goods were two rough bowls of type R3f(6) (Brunton and Caton-Thompson 1928:52).

On the whole the CBPPs meet the expectation for a widespread social distribution since they were found in settlements of all scales, in graves of different status, and in multiple contexts at some settlements. However their concentration in ritual contexts at Hierakonpolis may indicate that their use varied either by location or over time.

[81] This includes all the blocks excavated by Anderson, not just blocks 1,3, and 4, because any CBPP would have been tagged separately as a special find (Anderson pers. comm.).

[82] Brunton originally dated the tomb to the Badarian based on the shape of the CBPP, but Brunton himself questioned the date, and Holmes (1989:171) pointed out that all of the rest of the graves in that cemetery were Naqada period. Hendrickx and van den Brink (2002:355) dated the cemetery to NIIC-NIID2.

Bifacial sickles

Bifacial sickles came from both ritual and non-ritual contexts. Burials were the only ritual contexts with bifacial sickles. Examples come from Naqada Tomb 1906 (Holmes 1989:278), Armant Tomb 1413 (Mond and Meyers 1937:26, Pl8), Adaïma Tomb 326 (Midant-Reynes and Prost 2002:354, 379, Pl 16), Hemmamiya cemetery 1700 (Brunton and Caton-Thompson 1928:Pl 57), and Hierakonpolis HK 6 (Tomb 72, Droux 2014:4-7, 18-19).

In settlements bifacial sickles were found in non-ritual contexts. At el-Mahâsna a bifacial sickle was found in Block 5, an outdoor activity and trash disposal area (Anderson 2006:133-137). Three bifacial sickles were excavated at Armant 21/83 (Ginter and Kozlowski 1994:152-153). Two came from the southern area, which included habitation structures and a concentration of remains from bifacial tool production. The third came from an unspecified feature. Three bifacial sickles were found in a cache in ATP Op 11. At least five bifacial sickles were found in the domestic habitation section of Adaïma, the 1001 Block plus extensions (Midant-Reynes and Prost 2002: 344-354), and more have been found on the surface (ibid.) and in the settlement excavations by H. De Morgan (Needler 1984:83-87). A bifacial sickle was found in test pit 2 at Elkab which was in a domestic area with floor surfaces, hearths, and a nearby workshop using many burins (Claes et al. 2014:85; Kindermann pers. comm.). A bifacial sickle came from Nag el-Qarmila WK 15 Area A, a domestic and/or production area (Table 6.1, Figure 4.49). Two bifacial sickles were found at Hemmamiya near the circular mud structures, one stylistically dates to the Naqada period, and the other came from a Badarian/Amratian transition level but is more Badarian in style (Holmes and Friedman 1994:132).

Bifacial sickles were used in sites of all scales, showing a wide distribution. Highest-order sites with bifacial sickles include the Abydos and Naqada South Town settlement sites

(Table 6.3), and the Hierakonpolis HK6 and Naqada cemeteries (Table 7.14). The examples from the el-Mahâsna, and Adaïma settlement sites, paralleled by an example in the Adaïma cemetery, constitute evidence for the presence of bifacial sickles in mid-level sites. The Nag el-Qarmila bifacial sickle, two examples from the small site of Abadiya 2 (Vermeersch et al. 2004:236-237, Table 6.1), and the examples from the Armant settlement and cemetery show that they were also used in low-order sites.

At sites where multiple bifacial sickles were found they were not concentrated in a specific house or area. At el-Mahâsna one bifacial sickle was found by Anderson in Block 5, and at least one by Garstang (1903:Pl. 5), so they must have come from different areas. The bifacial sickles from the habitation area in block 1001 at Adaïma came from different areas of the excavation block, not focused on one of the structures. Additionally, more bifacial sickles were collected during earlier excavations, and while their proveniences are unknown, they likely represent an even larger spread of the bifacial sickles. At Armant bifacial sickles were found at both locality MA21/83 (above) and at MA21a/83 Trench 3, a refuse zone associated with habitation structures in MA21a/83 Trench 2 (Ginter and Kozlowski 1994:160-163). The presence of bifacial sickles in multiple contexts at these sites shows they were not restricted to one group but were used by many. This is not surprising since the presence of sickle gloss indicates that bifacial sickles were used for harvesting grain, which was one of the staple foods for Naqada period society, and was carried out by many people.

Despite this seemingly humble use for bifacial sickles, two were nonetheless included in Tomb 72 in the elite Hierakonpolis HK6 cemetery (Droux and Friedman 2014:4-7, 18-19). Bifacial sickles have also been found in other tombs which do not stand out as particularly elite, such as Tomb 1906 from Naqada main cemetery (Holmes 1989:278), Armant tomb 1413 (Mond and Meyers 1937), and Adaïma Tomb 326 (Midant-Reynes and Prost 2002: 354, 379, Pl 16). The inclusion of bifacial sickles in a variety of tombs shows that they had a widespread social distribution.

The bifacial sickles meet the context expectations for the ritual production model for the most part. However they were not as strongly associated with ritual activities as some of the other specialists produced tools, since they were found as burial goods but not in other overtly ritual contexts.

Axes

Axes have been found in ritual contexts, and more often in habitation contexts. Three axes were found in the Block 3 ritual activity area at el-Mahâsna (Table 6.19). Axe preparation flakes were found at HK29B, and some bifacial tools were also found there, unfortunately their types were not given (Hikade et al. 2008). Additionally axes were included as grave goods in burials (Table 6.9, 7.16). At the Naqada main cemetery tombs 178 and 350 contained axes, another axe was found in a pot in an unspecified burial, and one was found on the surface of Cemetery B (Baumgartel 1970; Holmes 1989:274; Spurrel 1896:56). Mond and Meyers (1937:48) reported axes from cemeteries 700 and 1300 at Armant. Axes were also part of grave assemblages outside the Naqada region. At Hierakonpolis, in the same cemetery as the Painted tomb 100, Quibell and Green found an axe inside a jar in a burial (Quibell and Green 1902:48, Pl60, 17). An axe comes from a grave in Badari cemetery 25/5500,[83] but the dating is somewhat dubious.

[83] Provenience given in the Petrie museum online catalog, UC.9839.

Axes were found commonly in household contexts, production areas, and middens. Examples include those from Naqada KH3B a domestic area with evidence for cooking storage, and flint working (Holmes 1989:192-193), and KH3X/XI, another domestic area interpreted as a household unit including an occupation area with hearths and grinding stones, and an animal pen area (ibid.:194). Other examples of axes from habitation contexts include ones from Armant (Ginter and Kozlowski 1994, see below), Adaïma (Midant-Reynes and Prost 2002:38, 130, 369), and midden deposits at Abadiya (Vermeersch et al. 2004:218, 236, 272).

The finds of axes in settlements of all scales show that the distribution of axes was widespread, not restricted to certain groups (Tables 6.1-6.4, 7.16). Highest-order settlement sites with axes include Naqada South Town and Hierakonpolis, and their corresponding cemeteries. El-Mahâsna, Adaïma and Badari 3000/6 are examples of mid-level sites with axes. Lower-order sites with axes include the Naqada Khattara sites, Armant, and Abadiya.

There was ample evidence showing that axes were a part of multiple contexts within settlements, not concentrated in specific areas. Axes were found in all of the excavated areas at Armant MA21/83 and MA 21a/83, and these contexts included habitation areas, subsidence and storage areas, and middens (Ginter and Kozlowski 1994:38-45, 152-153, 162-163). Similarly, axes were also found in both of the excavated areas at Abadiya, which were interpreted as habitation middens located over 20m apart (Vermeersch et al. 2004:218). As mentioned above, axes came from at least two different household units at Naqada KH3: area B and area X/XI (Holmes 1989:192-193,201). At el-Mahâsna Anderson's excavations located axes in the ritual activity area in Block 3, but Garstang (1903) collected quite a few axes from other areas of the settlement. At Adaïma one axe was reported from the excavations of Block 1001, and another was found elsewhere in the settlement, on the surface (Midant-Reynes and Prost 2002:369).

Finally, it should also be noted that while no axes were reported from Holmes' (1989, 1992, 1996) or Takamiya and Endo's (2008, 2011) analysis at Hierakonpolis, H. De Morgan collected a number of axes from the main Hierakonpolis settlement area (Needler 1984:114-117), although the contexts of these finds are not known. While axes have been found in cemeteries, there was not sufficient information about the particular burials to determine whether they show a distribution across emerging class boundaries or social groups.

In general axes were found in both ritual and domestic contexts, and were used by a large range of people, being found in settlements of all scales and in multiple domestic contexts within settlements. Thus they meet the expectations for context derived from the ritual production model.

Large-blade knives

While large-blade knives were found most commonly in burials, which were of course ritual contexts, they were also found in habitation contexts (Table 7.18). Examples of burials include the many from tombs at Naqada, (Holmes 1989:278, Petrie and Quibell 1896: Pl 73), along with examples from el-Mahâsna, Mesaeed, Badari, and Gerzeh. The examples given in Table 7.18 are only a sample of the whole, not an exhaustive list since these tools were relatively common grave goods. Large-blade knives have been found in many other cemetery sites, such as Abydos (Hikade 2000), Hierakonpolis (Quibell and Green 1902:48-49, Pl61), Armant (Mond and Meyers 1937:Pl 15, 20), Mostagedda (Brunton 1937: Pl 40-41), Abadiya cemetery B and Hiw cemetery U (Petrie 1901: Pl8) and more.

However some large-blade knives also came from settlements contexts. One was found at Hierakonpolis HK11C, squares A6-A7, a beer production area (Takamiya and Endo 2011:739).

Fragments of large-blade knives were found in the habitation sector of Adaïma (Midant-Reynes and Prost 2002:344-346, 391, 419). A fragment (ATP.1990.36) was found in the Abydos ATP settlement site in Op 8, which had features generally relating to food processing, storage, and habitation. Others were found in settlements but in less clear or unknown contexts, including an example found in a disturbed surface area at el-Mahâsna (MAP#2176; Anderson, pers. comm.), and numerous examples from Petrie's South Town excavations (Baumgartel 1960:40; Holmes 1989:265; Payne 1993:176-177). At Badari 3000/6 some large-blade knives were found among caches of objects in three pots (3165, 3167, 3284, Brunton and Caton-Thompson 1928: 45-47). The pots contained remarkably similar inventories. Each had large-blade knives, other flakes or blades, ivory tags, a slate pallet, animal bones/horns, shells, pebbles, hair, minerals or natural stones, and in some cases other items such as a copper needle or pieces of wood. It is unknown whether these were ritual offering deposits such as those found in the corners of the HK6 cemetery structures, or whether they were collections of standard household goods.

Besides demonstrating that large-blade knives occur in both overtly ritual contexts and in other contexts, the above examples also show that they were found in settlements and cemeteries of all scales, rather than only in the highest- or lowest-order sites. Their occurrence at many scales indicates that they must have had a widespread social distribution. Large blades knives were found in both the settlements and cemeteries at the highest order sites of Abydos, Naqada South Town, and Hierakonpolis, and at the mid-level settlements and cemeteries of Mahâsna, Adaïma and Badari 3000/6. The examples from the cemetery of Armant, and examples from small cemeteries such as cemetery 3800, constitute lower-order sites.

Furthermore, there was some evidence that within settlements blade knives were found in multiple contexts, supporting a widespread rather than restricted social distribution. A large blade knife was found at Hierakonpolis HK11C (above), while other large-blade knives found by H. de Morgan came from the main settlement area close to the cultivation (Needler 1984:115-117). Therefore large-blade knives certainly came from multiple contexts in Hierakonpolis. The examples from recent work at Adaïma were found in the habitation area, Block 1001 and extensions (Midant-Reynes and Prost 2002:344-346, 391, 419), and H. de Morgan recovered large-blade knives from other parts of the Adaïma settlement (Needler 1984:84-86, 277).

The blade knives from cemeteries also show a widespread social distribution. Bard demonstrated that four different cemetery clusters at Naqada were differentiated based on types and quantities of grave goods (Bard 1994). These four cemeteries or grave clusters were: T, B, main West, and main East. Bard found that the main-west cluster was richer and more exclusive than the main-east cluster, but that cemetery T was the richest and most exclusive of all, with B somewhere in the middle, somewhat similar to main-west. A look at the distribution of large-blade knives across these cemeteries using data from Baumgartel (1970) and Payne (1987), showed that large-blade knives were found in Cemeteries B, main-west and main-east[84]. Although not recorded in the most elite cemetery large blade knife use did cross cut finer social distinctions.

In summary the large-blade knives meet the expectations for context. They occurred in both ritual and habitation contexts, and were used by many people throughout society.

[84] Bard gave the grave numbers for the cemeteries as: Western cluster tombs 56-499 & 1200-1299; Eastern cluster 500-1195 & 1301-1953.

Microendscrapers

Microendscrapers have been found in both ritual contexts and in other contexts that did not have an overt ritual character. The ritual contexts included burials and ritual areas in settlements. Numerous microendscrapers were identified in Abydos cemetery U and the Naqada main cemetery (Hikade 1998, 2000; Holmes 1989:278; Table 7.20). As will be discussed below, items identified as small bladelets at the Hierakonpolis, Adaïma, and Maadi cemeteries probably also included microendscrapers. Outside of cemeteries, microendscrapers were also identified in ritual contexts in settlements. Three were found in the ritual activity area in el-Mahâsna Block 3, consisting of <2% of the tools. At the Hierakonpolis ceremonial precinct microendscrapers were identified in each of the excavated areas HK29A (4.5%, Holmes 1992:42, 1996:197), HK29B (2.5%, Hikade et al. 2008:180), and HK25 (1.77%, ibid.:182).

However, as is expected for the ritual production model, microendscrapers were also used in other settlement contexts as well. At el-Mahâsna they were present in the habitation contexts of Block 1 (n=4, ~2% of tools) and Block 4 (n=2, ~1% of tools). Holmes (1996) identified one microendscraper at Hk11C 0N6E, an animal pen area (.76% of tools), and from the house structure at HK29 square 17L13 she identified 14 microendscrapers, (5.83% of tools). An example from Hemmamiya was found among general settlement layers in area H (Brunton and Caton-Thompson 1927:114, pl 80, no 83), and at least one microendscraper was found at Adaïma in the area of the house structures, Block 1001 (Midant-Reynes and Prost 2002:323, 356, 398). Three microendscrapers (1.5% of tools) were identified in the analysis of materials from Nag el-Qarmila WK15 Area A, which was an area used for food production, lithic reduction, and a child burial. Although a Lower Egyptian site, it should also be mentioned that many microendscrapers came from the Maadi settlement (Rizkana and Seeher 1988).

Besides occurring in both ritual and non-ritual contexts, the microendscrapers showed a widespread distribution, as was expected for the ritual production model. They were present in settlements of all scales. The Hierakonpolis town site along with the Abydos and Naqada cemeteries represent highest order sites. The above el-Mahâsna and Adaïma examples, along with those from Badari 3000/6 (n= 19, 5.8% Holmes 1989:10) show that microendscrapers were used in mid-level sites. The microendscrapers from Hemmamiya and Nag el-Qarmila represent examples from low-order sites. There is little evidence for microendscrapers in mid and low level cemeteries, but, as is discussed below, this may relate to early collection strategies than actual under representation.

The widespread rather than concentrated social distribution of bladelets was also underlined by their occurrence in multiple domestic contexts, and in cemeteries of different status. The above described examples from el-Mahâsna Blocks 1 and 4, along with the examples form HK11C and Hk29 show that microendscrapers were not restricted to single households within settlements. As discussed below, the finds of (probable) microendscrapers in the HK6 elite cemetery, in tomb 72 which was thought to belong to an early ruler (Droux and Friedman 2014:7), and in HK43 the non-elite cemetery shows that status was not the only guiding factor in the use of microendscrapers. It is also worth noting that the HK6 tomb 72 owner is probably male, while the HK43 tomb 333 owner was female, showing microendscrapers were used by males and females.

In sum, microendscrapers fit the expectations for context quite well since they were found in ritual and non-ritual contexts, and were widely used throughout society by people of different status and gender, and in settlements of all scales.

The use of microendscrapers in cemeteries deserves more attention, to show that they were probably more common than has so far been noted, and to better understand patterning that might relate to their use and ritual nature. The frequency and importance of the small and less-imposing microendscrapers has been overshadowed by more striking lithic tools like RFKS, rhomboids, fishtails and large-blade knives. However microendscrapers can actually be one the most prevalent kinds of lithic grave goods. Such was the case at Abydos cemetery U where Hikade (1998, 2000) found that microendscrapers were the most common tool type, accounting for almost a third of all tools. They were also found in a number of tombs at Naqada (Table 7.20). Additionally, bladelets were found in tombs at Hierakonpolis HK6 (Tomb 72) and HK43 (Tomb 333) (Droux and Friedman 2014:4, 18-19; Friedman 2003:17-19). The rounded retouch on the ends is visible in the photographs showing that they were microendscrapers. At Adaïma a fragment of a lustrous bladelet was found in tomb 116 of the West cemetery (Crubézy et al. 2002:268-273). However it could very well be from a microendscraper since the retouch is limited to small areas on these tools. All of the above examples are from recent excavations, and in some cases relatively intact graves. Therefore it seems likely that these small tools were overlooked in early excavations or thought to be 'waste,' debitage or debris not worth mentioning. Detailed excavation, recording, and publication of all chert materials associated with burials will probably show that microendscrapers were more common than has hitherto been recognized.

Identifying these materials among grave goods is important because they may reveal some aspects of funerary practice and provisioning. Multiple examples of these items were often found together in tombs along with unretouched bladelets, and a number of them either refit or were made of identical raw materials, showing they were struck from the same core. Examples include those from Abydos cemetery U (Figure 7.10; Hikade 1996), Naqada tombs 144, 471, 1786, and 1233, HK6 tomb 72, and probably HK43 tomb 333. The close association of items from the same core indicates that there was little time between production and deposition, and that they were made specifically for the burial. Were some of them used before the burial, creating the small fine “retouch”? Only finds of additional examples can help clarify the funerary practices surrounding these microendscrapers and bladelets.

Furthermore, these microendscrapers and bladelets were associated with grinders, pigments, ivory combs, and other items in a number of graves. Tomb 72 at the elite HK6 Hierakonpolis cemetery was partially disturbed in antiquity, with some of the body missing, but most of the grave goods were left in place. Twenty-nine flint bladelets and small blades (including microendscrapers) were found “arranged around the corner of the tomb” and in close association with 3-4 hippopotamus tusks (Droux and Friedman 2014: 4-5). The hollowed out and perforated tusks had traces of yellow ochre inside showing that they were pigment containers. Very nearby were two stone palettes, a number of pebble grinders, malachite, and a number of ivory combs, one with a donkey-shaped top. Many other objects were also found in the tomb, in the center and in the North corner, including an ivory figurine of a bearded man. Friedman et al. (2017) suggested that the placement of the bladelets in the corner of the tomb parallels the placement of eccentrics in the corners of structures and tomb complexes at HK6 which they think was related to rituals of protection.

The inventory of objects found in a basket in Tomb 333 at Hierakonpolis HK49 the non-elite cemetery, was strikingly similar. There a slate palette was found propped against a basket. Inside the basket were three matching bladelets (probably microendscrapers), two pebble grinders, the pigments galena and red ochre, an ivory comb, and a pendant with the face of a bearded man (Friedman 2003:17-19), all of which parallel finds from Tomb 72. Other items also found in the basket were stone pendants, animal bone pointed tools, gaming pieces (?), shell, plant remains (dill, tamarix leaflets, tubers of tiger nuts and nut grass, herb fruits, herbs, carbonized wood, juniper, cedar/fir/cyprus, and bread), and a leather bag with clay cones. The excavator suggested that the basket was a magical or medical kit, based on ethnographic parallels of the uses of some of the plant remains for medicinal purposes and incense (Fahmy 2003:20). Additionally the unusual number of children interred around the tomb may have indicated that the occupant was considered a "protective presence" (Friedman 2003:19).

Similar sets of finds in other tombs show that the pattern or 'set' was not confined to Hierakonpolis. Naqada Tomb 144 included microendscrapers bladelets, many of identical raw materials, along with malachite, ochre, galena, a pebble grinder, bone 'pins' (one with a bird head), small natural pebbles, a siltstone pendant, and a few other items (Baumgartel 1970; Payne 1987; Petrie Museum online database). Naqada tomb 1233 had a similar inventory. At Abydos cemetery U, 20 microendscrapers of identical raw material and four bladelets of another raw material (Figure 7.10) were found together on the floor of Tomb 127, in a decayed organic container (Hikade 1996:35, 2003:146). Also found were tokens or gaming pieces, which may be equivalent to the gaming pieces (?) or clay cones found in HK43 tomb 333, a fishtail knife, a ripple-flaked knife, decorated and plain ivory handle fragments (Dreyer 1999), dice sticks ("*wurfel-stabe*"), and pieces of gold thread (Hikade 2003:145-146). While no pigments, grinders or palettes were reported, the tomb was heavily disturbed and the grave inventory is probably not complete. Considering the vagaries of time, looting, early excavation and recording practices, and the inconspicuous nature of the microendscrapers, the set of items occurring with microendscrapers was probably more prevalent than just these examples. The similar use of these tools in at least three cemeteries separated by geography and status indicates that this ‘set’ was well defined, repeatedly used, and significant for the afterlife.

Context expectation conclusion

In summary, all of the tool types fit the context expectations, except for RFKs and rhomboid tools, which were only found in ritual contexts, and showed a distribution focusing on tombs of upper status or wealth. The remaining tool types, fishtails, CBPPs, bifacial sickles, axes, large-blade knives and microendscrapers were all found in ritual contexts and in more ordinary contexts. Additionally all were used by a large portion of society since they were found in sites of all scales, multiple habitation contexts within settlements, and in graves of different status or wealth. The only exception was the CBPPs which at Hierakonpolis were concentrated on the ritual structures. All of the expectations for each tool type are summarized in Table 7.22. Chapter 8.1 provides a discussion of expectations for raw material use, production locations, and context in tandem for each tool type relative to the models for the development of specialized production.

Chapter 8: Conclusion

8.1 Summary of Raw Material, Production, and Find Context Patterns by Tool Class

This study compared archaeological patterns for raw material use, production locations, and find contexts of flaked stone tools made by specialists to the patterns expected for the ritual production model (summarized in Table 7.22). For the raw material expectation, this research showed that for certain tools—axes, large-blade knives, and microendscrapers—a certain raw material type or color was preferentially chosen for these tools. Furthermore, these raw material choices could not be explained solely by functional considerations, or by simple access to local raw material sources. Instead the raw material choices may have been related to the symbolic significance of the colors. The cosmological meanings of certain colors are well known for the Pharaonic period-- red (desert, chaos), and black (fertile Nile Valley/order)-- and finds of unusual, paired red and black ceramics in Predynastic ritual contexts indicate that these colors were also symbolically meaningful during that period (Ch. 7.1).

The analysis of stone tool production contexts showed that for each tool class where data were available, specialized production occurred in conjunction with ritual activity areas some or all of the time. Furthermore, the analysis of stone-tool find contexts showed that most of the tools—fishtail knives, concave-base projectile points, axes, large-blade knives, and microendscrapers—were not restricted to a subset of the population. Rather, they were found in multiple habitation areas within settlements, at settlements of multiple scales, and in cemeteries dedicated to people of different status. Even the figural eccentrics (Ch. 6) were found in both elite and non-elite contexts. Therefore these tools were not restricted to use by an elite subset of the population, and do not fit with the prestige-goods model for the development of specialized production. Furthermore, the find contexts challenge interpretations of the stone tools as either purely utilitarian or symbolic items, since many classes of tools were found in ritually significant contexts such as early 'temples', offering deposits, and tombs, as well as in more traditionally ordinary contexts such as habitation, storage, and trash midden areas.

All together the data for certain tool classes—early fishtails, axes, large-blade knives, and microendscrapers—fit the ritual production model for the development of specialization. Interpretations of each tool class are discussed below based on their patterns of raw material use, production contexts, find contexts, and information on possible ritual uses.

Ripple-flaked knives

Ripple-flaked knives fit best with a prestige-goods model of production where elites sponsored the production of goods that were symbols of status and power, to create and maintain status differences and build alliances. It was not possible to conclude that symbolic considerations were a factor in raw material choice. Instead raw material choice may have been related to the materials available near where the tools were produced, as was indicated by clustering of RFKs of certain raw material type near a known source of that material. The production of RFKs likely took place in at least one ritual structure (HK29A). The production levels evident at that structure, combined with the time estimates and degree of technical skill involved in their manufacture, make it probable that the producers were involved in stone tool production full-time.[85] Motifs on the RFK handles referred to warfare, hunting, domination, and royalty, showing that the use of these tools was related to themes of power, supporting the idea that RFK production was sponsored by elites.

The distribution of RFKs was less restricted than expected given their high degree of workmanship and high-brow motifs. RFKs were certainly found in wealthy and even royal tombs, but also in more modest graves. They were found in cemeteries of all scales, including low-order sites. However they were more common in the high and mid-level sites, and wealthier cemeteries.

Their presence in cemeteries of all scales, and in tombs with more modest amounts of goods, can be reconciled with the evidence for extreme technical skill and ideological themes of royalty and power, by taking into consideration the alliance-building aspects of a prestige goods system. RFKs could have been elements of the prestige goods economy as alliance-building gifts from higher-ups to socio-politically aspiring followers. An analogy can be made to the Pharaonic period where the king would donate items made in the capital with high degrees of workmanship, such as tomb stelae or statues, to prominent officials. Such goods often listed or emphasized the person's interaction with royalty. The royal symbolism found on the RFK knife handles could be seen as a parallel practice. This interpretation of RFKs as alliance-building elements of the prestige goods economy resolves the conundrum of an items with royal symbolism and high skill ending up in wealthy and not-so-wealthy graves.

[85] Although the overall low number of RFKs indicate that they would have worked on other tools in addition to RFKs.

Rhomboids

Rhomboids were somewhat similar to RFKs in their contexts of production and use, and are another class of tools that largely fits with a prestige-goods model of production. No symbolic associations based on color could be discerned for the raw materials of rhomboids, which were made in almost equal numbers from light and dark raw materials. Only a limited number of chert varieties were used for rhomboids, and this probably related to practical necessities related to the size of nodules needed to make these large tools, rather than preferences due to symbolic considerations. Rhomboids were very likely produced at the HK29A ritual enclosure in the early phase of its use. While there was certainly a concentration of bifacial tool production there in the early phase, the artifact densities were not as high as in the later phase and did not necessarily entail sponsored full-time production, but could have occurred seasonally in conjunction with ritual events. This aspect of their production does not align perfectly with the prestige-goods model, but other factors help indicate their importance as status items. The most striking aspects of rhomboids are their large size and shape. The rhomboid shape has been symbolically connected to male power through early depictions of men with pointed beards and conical headgear that formed a pronounced rhomboid shape (Figure 8.1). Hendrickx et al. (2015) interpret such headgear as an early version of the white crown of Pharaonic Egypt. This association, along with their distribution and use in exclusive contexts, supports the interpretation of rhomboid tools as prestige items. Like RFKs, rhomboid tools were quite notably only found in ritual contexts, primarily burials, but also in at least one ritual structure, and never in mundane contexts. The distribution of rhomboid tools was also similar to RFKs in that they were found in cemeteries of all scales, but more frequently in the highest-order sites and wealthy graves.

Fishtails

Fishtail knives were ritually significant items that largely met the expectations for the ritual production model, but also showed change over time. Fishtail knives were found in ritual contexts including tombs, offering caches, and temples, and in non-ritual contexts among general settlement remains. Their widespread distribution in cemeteries and settlements of all scales, in multiple habitation contexts within settlements, and in cemeteries of different status showed that they were used by many members of society, and were not restricted to the upper class. Fishtails were also more numerous than RFKs or rhomboids. Their broad social distribution and higher frequency argue against the idea that they were primarily prestige goods.

There is no doubt that these items were symbolically meaningful. However there is some question as to what that symbolic meaning was. Hikade (2004) argued that they were status items based mainly on a small sample from one cemetery (Abydos), but the widespread distribution of the tools shown here indicates that they do not fit well with that interpretation. Roth (1992) argued that fishtail knives were part of rituals of birth and re-birth, potentially used to cut the umbilical cord at birth, thus ‘opening the mouth’ of the baby so it could take in its own food. In the Old Kingdom period ‘opening of the mouth’ rituals evidenced by text and *psš-kf* artifacts were used to transition the mummy/spirit to the afterlife. *Psš-kf* means ‘chert divider’ or ‘divided chert’ (ibid.:116), and these instruments had a shape very similar to fishtail knives. Furthermore the presence of many model fishtails during the Predynastic period along with later fishtail/*psš-kf* amulets underlines the importance of their use as ritual items.

The archaeological patterns of Predynastic fishtails changed over time. The raw material study indicated that the variability in raw material choice decreased over time, which may be related to a decrease in the number of production areas. Fishtail sizes also became less variable over time, which also points to a decrease in the number of production areas. Additionally, fishtails were very probably produced at the HK29A ritual enclosure, and the intensity of bifacial tool manufacture there increased over time. This higher intensity of work has been interpreted as sponsored production, an aspect that matches well with a prestige goods system. Additionally a number of later-style fishtails were made from obsidian, which is a long-distance trade material that was difficult to obtain and very rare in Predynastic Egypt. Use of obsidian accords well with the idea of a prestige goods system where people would have used materials that were not available to much of the population.

Thus this ritually important item also became a status item during the NIID/early NIII with concomitant changes in the organization of its production and raw material selection. The overall quantity of fishtails made in the later style also decreased somewhat compared to the earlier style. Out of 110 fishtails with an identifiable shape, 61% were the earlier style shapes (1 and 1/a), and 39% were the later style shapes (2 and 3). However the continued use of fishtails in the form of *psš-kf* instruments and *psš-kf* amulets into the Old Kingdom and later periods indicates that the ritually important aspect of the tools proved more durable than their meaning as a status item.

Concave-base projectile points

Concave-base projectile points (CBPPs) met most of the expectations for the ritual production model, but like fishtails, they showed some variability in their patterning that may indicate change over time or regional differences. There was no indication of symbolic considerations in the raw material choice for CBPPs, because many different varieties and colors of chert were used. This variety points to multiple production locations. The existence of multiple production locations for CBPPs was definitively indicated by finds of unfinished examples at a number of sites. Some of these production contexts were ritual activity areas, and the intensity of production was likely part-time. Finished CBPPs were found in both ritual and non- ritual contexts indicating that they were used or at least could be deposited in both settings. The distribution of CBPPs showed that they were used by people in settlements of all scales. CBPPs were not found very commonly in graves, but at a regional level they were included in burials with different degrees of wealth. At el-Mahâsna the CBPPs were not concentrated only in the ritual activity area, but were found in other parts of the site as well. These features agree with the ritual production model: specialist produced goods were used by a cross-section of the population, not a restricted subset, and were produced for use in ritual activities, but not restricted to them. Additionally the production was not necessarily sponsored by elites because it was part-time or periodic, but production may have been facilitated by ritual aggregation, since production remains were sometimes found in ritual contexts.

However the data from Hierakonpolis were somewhat different. There CBPPs were only found in the elite cemetery and in ritual contexts in the settlement. An understanding of the use of CBPPs helps clarify why they have different archaeological patterns at Hierakonpolis. CBPPs were almost certainly involved in activities or rituals related to hunting. Hunting was one of the main iconographic themes during the Predynastic period (Hendrickx 2013), but the faunal evidence indicates that hunted animals were not a major factor in subsistence (Linseele et al. 2009). Rather, hunted animals were important for their symbolic associations, including control over chaos, adoption of powerful forces, and relationships to divinities. Some of these symbolic associations carried over into the dynastic era.

Hendrickx (2006a, 2012) and others (Hendrickx and Eykerman 2010; Hendrickx et al. 2009) discussed the connection between elites and hunting, arguing that (group) hunting gave elites access to more varied food, weapons, social networking, and opportunities for display and spectacle when they returned from the hunt with dead or live animals. This connection to hunting as an elite activity associated with display would seem to support the prestige-goods model for CBPP production. However overall the CBPPs showed a more socially widespread distribution than an activity restricted to elites would imply, so they do not fit perfectly with the prestige-goods model. At Hierakonpolis where there was extensive faunal evidence for hunting wild animals found in ritual and elite contexts, the CBPPs were more restricted in distribution. So the best explanation is that CBPP production was motivated by their use in ritual hunting activities, and that over time or in some areas these activities became associated with or even restricted to high-status individuals. A detailed look at whether the different styles of CBPPs relate to changes over time, regional differences, or to re-shaping of the artifacts could help clarify how they were used and how that use changed.

Figural eccentrics

The archaeological patterns of figural eccentrics (Ch. 6) did not correspond to all of the expectations for the ritual production model, nonetheless they sit very well with the idea of production for ritual purposes. The context of production for figural eccentrics is unknown, but possibly includes the HK29A ritual area, which would accord well with the model. The overall quantity of eccentrics indicates that they themselves could not have been made at full-time production levels, which is also expected in the ritual production model. However, since some of the eccentrics bear similarities to other bifacial tools, they were probably produced in conjunction with other items. Their find contexts indicate that they were used by people of different classes since they were found in both elite (HK6) and non-elite contexts such as the HK11 settlement, and domestic areas of Abydos Kom es-Sultan. The differences in quality of production have also been cited as a possible indication of use by different classes (Hendrickx et al. 2003:13). However the localized nature of the eccentrics and their overall low quantity do not match the expectation of widespread use in the ritual production model. Nonetheless the production and use of these items was very clearly motivated by their use for purposes due to their symbolic forms, and the very good evidence for their use as offerings and/or boundary markers in the elite Hierakonpolis cemetery HK6. Additionally at Abydos' Kom es-Sultan one eccentric was found in a temple or ritually significant area. Another proposed use of these eccentrics was for apotropaic purposes.

Overall the eccentrics constitute a clear case of production for ritual purposes, which in some cases did not necessarily exclude connotations of power and prestige. The important point about these items is that their ritual/ religious use seems to be more integral than their use for purposes of prestige and power, since the later contexts do not have as clear ties to notions of prestige and power. In other words, their use as religious or apotropaic items lasted longer.

Bifacial sickles

The evidence for the specialized production of bifacial sickles does not sit well with either the ritual production model or the prestige-goods model. The data indicating that bifacial sickles were made by specialists showed that at some sites with bifacial sickles, there were few to no thinning flakes of the same raw materials found at the sites, so the tools were likely produced at other sites by people other than those who used them. Additionally, there were stylistic and technological differences between the earlier Badarian bifacial sickles and the Predynastic ones, which support the idea of a change in the organization of production.

The manufacture of bifacial sickles does not fit with the ritual production model for a few reasons. First, no symbolic considerations in raw material choice could be discerned: there was no association between this tool type and any raw material type or color. Additionally the only ritual contexts they were found in were burials, and those did not occur frequently (but neither were they extremely rare). Bifacial sickles were certainly used by a broad cross-section of the population, since they were found in settlements and cemeteries of all scales, multiple domestic contexts within settlements, and in graves with different degrees of wealth, which rules out the possibility that they were produced as prestige items. No information about their precise production locations could be identified, so this parameter cannot help clarify the understanding of bifacial sickle production.

Since the production of these items does not fit with either of the models focused on here, there must have been other factors besides prestige display or use in ritual activities that contributed to the increasing specialization of bifacial sickles. The specialized production of bifacial sickles in the Predynastic period can be better understood when contextualized in a longer-term picture of sickle production.

Badarian bifacial sickles were smaller, more numerous and their denticulations were not as fine. They were also possibly more variable than the later Predynastic versions, which could indicate that their production was more diffuse. Predynastic sickles had finer denticulations than the Badarian versions, and their production was likely more concentrated. This technological change in the denticulations and the increasing concentration of production indicate increasing specialization in production.

The bifacial sickles of the Badarian and Predynastic periods are thick sturdy tools which can be re-sharpened and re-used over time. A substantial amount of work went into preparing each tool before use, including procuring the appropriate sized raw material, bifacial shaping of a preform, and final finishing (possibly with pressure retouch) to form the denticulations. Once made, these bifacial tools could be used for a long time, and re-sharpened as needed (e.g. Kelly 1988:718, 720). Indeed evidence of resharpening after sickle gloss had developed was observed on bifacial sickles in this study, such is in Figure 4.49 (AKAP.1552.1, right image) where the re-sharpening flaking cuts through the sickle gloss. The Predynastic bifacial sickles are often larger than the Badarian versions, showing increasing investment in this system of substantial up-front input into a tool that could be used for a long time.

However at the same time, in the Naqada period production of sickle blades for harvesting grain also began.[86] They are relatively rare in the early Naqada period and become more common in the later Naqada period (see Table 4.25, <1% of tools in early Naqada sites are sickle blades; at later Naqada sites sickle blades tend to account for 2-3% of the tools). These sickle blades were made on medium blade blanks (Table 5.18), and it is quite possible that the blanks were initially used without denticulation, and that denticulation resulted from later resharpening as was the case in the Levant (Rosen et al. 2015; Vardi et al 2010) (although this suggestion should be verified in a future study). Whether or not the blade blanks were pre-denticulated or denticulated during resharpening, production of medium blade blanks for sickle segments does not require as much work or investment as production of bifacial sickles. Sickles

[86] Sickle blades appeared slightly earlier in the Delta (Debono and Mortensen 1990) but in the Nile valley they do not appear until the Naqada period. Holmes (1989:179-180) does not consider sickle blades a part of the Badarian tool industry. The ones mentioned by Brunton from Mostagedda sites could be from later contexts (*ibid*).

on blades were certainly the more efficient tool to produce, requiring much less flaking time per sickle segment and possibly more cutting edge per weight of material. However, these sickle blade segments were small and thin, so their potential for resharpening was probably more limited than for bifacial sickles, so they would not last as long and would have been replaced more often.

As discussed in Chapter 5, production of medium blade blanks was not specialized, but rather was quite diffuse, and took place in multiple areas of many sites, so any household could have produced blade blanks as needed. However by the Early Dynastic period, production of sickle blade segments was highly specialized as is evidenced by the large-scale production of sickle blades at quarry sites like Wadi el-Sheikh (Köhler et al 2017; Briois and Midant-Reynes 2014, 2015), and the attributes and dimensions of the blades themselves were different than the earlier blades, and more standardized (Kindermann 2008; Kobusiewicz 2015:16-17, Fig.1-2).

Therefore three stages in the production of agricultural tools can be discerned from the Badarian to the Early Dynastic period: 1) diffuse production of a high-investment long-lasting bifacial sickles in the Badarian; 2) increased investment in this system of long-lasting high-investment tools in the (early) Predynastic, with more concentrated production and larger bifacial sickles that had finer denticulations, and at the same time diffuse production of low-investment short-term sickle blades began; 3) finally, production of the low-investment short-term sickle blades became highly concentrated and specialized in the Early Dynastic period, and totally replaced the production of the high-investment long-lasting bifacial sickles.

The suggested scenario of the long term phases of development for sickles is meant only as a preliminary overview and should be explored though more study of Badarian-Old Kingdom sickles, paying particular attention to changes in technology, the stage at which denticulation was added to sickle blades, and the metric measurements. The important point for this study is that increasing specialization was influenced not only by motivations associated with ritual uses and prestige, but at the same time there was a third influence related to increasing needs for agricultural tools for a large cross-section of the population, discussed further in section 8.2.

Axes

The archaeological patterns of raw material use, production, and find contexts for axes corresponded to those expected for the ritual production model. While many raw material types were used to produce axes, there was an overwhelming preference for light-colored raw materials. This preference was probably rooted in symbolic considerations since issues like local access to materials and functional constraints did not greatly affect the raw material choice. Production remains from axes, and axes themselves, occurred in both ritual contexts and in domestic contexts. However non-ritual contexts were more prevalent for both production remains and finished axes. Axes had an undeniably widespread distribution, found frequently in settlements of all scales and multiple household contexts within settlements. This widespread distribution and the frequency of axes indicate that they do not correlate well with the prestige-goods model of production, so another model for why and how axes became produced by specialists must be sought. Axes were undoubtedly used for utilitarian purposes such as chopping or hoeing as was indicated by macroscopic wear on the tools. However the color preference, and finds of axe-production remains and finished axes in ritual contexts (like el-Mahâsna Block 3 and some burials), indicate that they were not without additional symbolic meanings. Since there were indications of soil polish on some axes, they were probably agricultural tools, and may have been involved in agricultural ceremonies. One such agricultural ceremony was depicted on the Scorpion macehead. It is also worth noting that Barkai (2011) has argued that (PPNA) axes in the Levant had a symbolic meaning as cultural markers of a Neolithic way of life.

Large-blade knives

The archaeological patterns of large-blade knives matched the expected patterns for the ritual production model quite well. Large-blade knives were very likely tools whose production was related to their use in ritual activities as well as in daily life. Light-colored raw materials were chosen for large-blade knives, and this choice cannot be explained by functional considerations nor simple use of local resources, given current data. Instead, the color may have had symbolic meanings that added value to the tool or were important for the meaning of the tool. The production location of the large-blade knives is not known, but their production certainly did not take place in every settlement. Badari 3000/6 was the only identified possible production location. Unfortunately little is known about the contexts there, but ritual activities were hinted at by the existence of artifacts relating to beer production and caches of symbolically meaningful goods including figurines, ivory tags, mace heads and palettes. More importantly, the find contexts of large-blade knives themselves clearly show that they were used for ritual purposes. Large-blade knives were predominantly found in burials, and they were relatively common, known in far greater quantities than items like ripple-flaked knives, so they must have been an important element in funerals and/or preparations for the afterlife. In addition, they were found in cemeteries of all scales and different degrees of wealth or status, so they were used by many members of society. The knives however were not produced only as grave goods. They have also been found in quite a few settlements, sometimes broken, sometimes complete.

All in all, these data correspond to a pattern of specialized production for use in ritual activities by many members of society. Large-blade knives could be an integral element in funerary proceedings, as indicated by their prevalence in burials, but they were also used during life possibly even for other ritual events and for more quotidian activities, as their presence in settlements shows.

Microendscrapers

Microendscrapers met all of the expectations for the ritual production model. They were preferentially made from one main type of raw material, and that choice could not be explained by access to local resources because it was a pattern across many sites, nor by functional considerations since these small items could have been made out any of the many types of fine grained chert varieties available. Instead their raw material choice of pinkish cherts may have been for symbolic associations with the color, and the heat-treatment may have increased the reddish color and glossiness of the tools. The tools were found in settlements of all scales, in multiple household contexts within settlements, and in graves of different status or wealth, all of which show that they were used by a large portion of society (socially widespread) and not restricted to high-status people. Their production in association with ritual contexts and the finds of these items in ritual contexts including burials and ritual structures in settlements, indicates that they must have had symbolic value. Their symbolic value and use is hinted at by finds of sets of artifacts in burials at different sites. Along with microendscrapers these sets included many symbolically significant items like palettes, pigments, figures of bearded men, ivory items with animal shapes on top, tokens or gaming pieces, and in at least one case with good preservation, plant remains. While the pigments, hair combs, pins, and pendants could relate to personal adornment, these items were not found on the body but away from it, sometimes in containers. The exact nature of ritual activities suggested by these kits is difficult to determine. The existence of these sets in the grave of a female in a non-elite cemetery and a male in an elite cemetery indicate that they addressed issues pertinent to many people.

Heat-treated bladelet and microendscraper production was more common in Lower Egypt where it was not thought to be specialized (Rizkana and Seeher 1988; Schmidt 1992a). However if production of heat-treated bladelets for microendscrapers was adopted in Upper Egypt, it makes sense that the production might have been organized and implemented in a different way than in lower Egypt, adopted by the emerging specialists to make certain items which could be used in ritual activities.

8.2 The Organization(s) of Predynastic Stone Tool Production

What do the observed patterns of raw material use, production contexts and find contexts mean for understanding how specialized production was organized and changed over the Predynastic period? The findings from the preceding chapters indicate two significant points. The first is that the production of stone tools was organized in a variety of ways. The second is that the development of stone tool production cannot be accounted for through any single model. Many factors contributed to the development of specialized production. As discussed at the outset of this dissertation (Ch. 1.2-1.5), models for the development of specialized production in different areas of the world have addressed a number of possible factors contributing to the development of specialized production such as gains from efficiency, elite actions aimed at obtaining prestige goods, and motivations related to socially and ritually significant activities/uses of goods. Below, after a review of the variability in the organization of stone tool production, the specialized production of goods for ritual uses, prestige, and agricultural uses in

Egypt are discussed. This section closes with the consideration that many factors contributed to the development of specialized production in Egypt.

Variation in stone tool production

This study reached conclusions about the organization of production for blade and bifacial stone tools, as discussed in Chapters 5 and 6. Medium blades and bifacial tools of unstylized forms were produced in a completely diffuse manner, in all settlements, with little indication of specialization. Most unifacial flake tool classes were also produced in an unspecialized way since they show little uniformity of style, were found commonly in all settlements, and their production remains (cores, and flakes), were distributed across the same areas.

Other tools were made and used in workshops without ever being distributed more widely. These included microdrills on coarse raw materials, used to make beads. While the people who used the drills were specialists, and the beads could be considered specialized, the drills themselves cannot be considered specialized since they were made and used in the same workshops without ever being distributed more widely. Burins are another example of a tool that could be produced and used in a workshop for making something else. At Elkab 70 burin spalls and numerous burins were found in one layer of a test pit, and may indicate that there was a workshop in the area for working wood or other semi-hard items (Claes et al. 2014:85).

The interesting case of the bifacial animal eccentrics was another type of good with a different organization of production, one with a lot of variability. These items were made and used in only some sites, they were probably produced by specialists within some of those sites, but also may have included items made by non-specialists.

Even within the tool classes which were produced by specialists there was variation in the specifics of some of the parameters of production. Some tools (axes, CBPPs) were made in many communities but were produced by only certain people in those communities, as is indicated by more concentrated distributions of production remains within the settlements. Additionally axes were made in larger quantities at some sites compared to others.

Production of heat-treated microendscrapers also took place in multiple communities, but not in all communities. Additionally there may have been variability in the distribution of different stages of production, with the heat-treatment and core preparation stages of the process probably done by specialists who made prepared ‘cores’, but the blade removals and the retouching of the tools may have been carried out by other people. Early fishtails and bifacial sickles were probably made in even fewer communities than microendscrapers, but there were still probably multiple production locations, as indicated by the diversity of raw materials

Other tools were regionally specialized, with only one or a very few production locations across Upper Egypt. These include the RFKs, and large-blade knives. There were no definitively identified production areas for these tools, and, high skill levels required for production (especially in the case of RFKs), indicating that they probably had a very restricted or concentrated production. It should also be pointed out that there was a trend for increasingly concentrated production over time, since the later tool types—RFKs, later fishtails, and large-blade knives—had the most concentrated production.

There was evidence that the development of specialization was not only a matter of increasing skill. The changes in lithic production did include inventing some new techniques that involved a high degree of skill, such as ripple flaking or microserration, but other techniques used by specialists, such as basic bifacial flaking and heat treatment, were practiced rather widely. Over time, the number of people who did this production decreased. So the process of increasing specialization was not just one of inventing new skills that could not be done by all, but involved a re-alignment of time and effort, a narrowing of skills. Furthermore, many of the tools made by specialists, even the most complicated ones, involved some techniques that did not require a lot of skill, such as grinding. This underlines the fact that the process of specialization was more about who does what, than who *can* do what.

Overall, the rather simple method of looking at the distribution of production remains vs. the distribution of tools at inter- and intra-site levels resulted in quite an array of ways that lithic production was organized for the Predynastic period. A simple dichotomy between ad hoc unspecialized tools and highly technical specialized tools does not capture the diversity of production strategies. More importantly, this study shows that although full-time specialized production was fostered by elites in the latter part of the Predynastic period, this process built on existing multivariate and complex systems of production for stone tools.

Specialized production for ritual goods

The majority of specialist-produced flaked stone tools and their production remains were consistently associated with ritual areas. Accordingly, the tools cannot be regarded as purely utilitarian items. Rather, the tools must have had some sort of symbolic associations.

Previous theories for the development of specialized production in Egypt have posited that there was a prestige goods system, where production of status items was sponsored by elites. Such items are by definition restricted and not widely available; that is where they get their ability to signal status. However, this study has demonstrated that many tools produced by specialists cannot be considered status items. The socially widespread distributions of fishtails, CBPPs, axes, large-blade knives, and microendscrapers simply do not fit the definition of prestige goods. Therefore their production cannot be explained with a model that specialized production developed to make status items for elites.

The problem can be resolved by expanding the possible symbolic meanings connected with specialized tools beyond status to also include cosmological meanings—i.e. those relating to worldview or religion. To simply associate symbolic meanings of artifacts only with status, and disregard the possibility for cosmological meanings associated with the shapes, designs, and uses of the tools sells the richness of Predynastic Egyptians' lives quite short. Moreover, it denies that the content of ritual activities motivated by worldview can have any effect on the course of events or how people acted in them. And really, Egypt is nothing if not a story of worldviews materialized in lasting ways.

Symbolic meanings related to status and those related to worldview were not necessarily distinct or easily disentangled in Predynastic Egypt. It is undeniable that ritual and prestige can be intertwined. The point here is not to attempt to parse them out or set up an untenable dichotomy. Rather, the point is to emphasize that status was not the only thing that Predynastic Egyptians signaled in their symbolic world. There was an array of cosmological views, and these were a part of many people's lives, activities, and motivations, not only related to displaying status via materials, techniques, or products not available to all.

Therefore a ritual production model can help explain the specialized production of some stone tools. This model was built on observations that people often intensify production in order to make things with symbolic meanings for important ritual events and exchanges. Grave goods, bride wealth payments, or gifts associated with weddings, are just a few of the most familiar kinds of examples. Furthermore, these items did not necessarily need to be used only for their symbolic meanings, excluding practical functions. Rather they can and did often include everyday items which were nonetheless critical to have in certain contexts. Production by specialists can increase the comparability of form (such as shape, raw materials, etc.) which facilitates comparable meaning—we all have the same items, and we are all doing the same things. Reasons why people in Predynastic Egypt opted for increasing materialization of ritual activities are discussed in section 8.3, below.

Specialized production of prestige goods

With all that said, the observations that some lithic tools did correspond to expectations for the prestige-goods model of production must also be factored in. Some tools—RFKs, rhomboids, later fishtails, and possibly CBPPs—fit well with the idea that they were produced by specialists as status items since they had more restricted distributions, and in some cases were made in contexts with higher levels of production that probably correspond to full-time sponsored production. Additionally RFKs and rhomboids were found almost entirely in cemeteries, unlike the tools discussed above which were found in a variety of contexts both ritual and domestic, indicating that RFKs and rhomboids had a different overall pattern of use than the other stone tools.

The specialized production of bifacial stone tools as prestige goods increased over time. Rhomboids were an early type of tool that fits this model for the most part, although their production may not have been full-time. CBPPs were another early tool type, and could be considered status items with restricted distribution and use in Hierakonpolis, but not in other areas. RFKs were a later tool type that certainly can be considered a prestige good. Fishtails were the only tool class that spanned the entirety of the Naqada period, and there were differences between the early and late types that indicated a shift toward a pattern of production and use matching a prestige goods system. However it is notable that the later sponsored production of fishtails was *still* associated with ritual activities, so even with change over time and an increasing focus on status, the ritual context of production remained significant.

Specialized production of agricultural implements

A surprising and important finding from this study was that one tool class, bifacial sickles, did not fit with either a ritual production or a prestige-goods model (Ch. 8.1). There was no indication of symbolic uses for the raw material types, their production locations could not be identified so they could not be definitively associated with ritual production areas, and they were only found in limited ritual contexts. Additionally the tools were certainly not prestige goods because they were found with a socially widespread distribution.

Besides ritual and prestige uses, the other main type of model for the development of specialized production discussed in Chapter 1 related to increases in efficiency, which could occur for a number of reasons such as scheduling conflicts, or differential distribution of resources. However a desire for increased efficiency in tool production does not fully explain the changes in sickle production here. With an increasing amount of people settling in the Nile Valley and focusing on agriculture, there was increased specialization of bifacial sickles from the Badarian to the Predynastic (Ch. 8.1). These tools took a substantial amount of effort to produce, and this increase in specialization is best understood as increased investment in the product to make the durable long-lasting bifacial sickles used by a wide cross-section of the population. In other words, production first became more time-consuming, not less, with larger tools and finer serrations. Later, there was a shift toward more efficient production: concentrated production of the easier to produce sickle blades took place at quarry sites in the Early Dynastic and later periods. Presumably economies of scale were in play, so at that point there was increased efficiency in production. However, there was a trade-off, because the sickle blades did not last as long, and had to be replaced more often, so more sickle-blades were also required overall.

Explanations for this shift toward more efficient production in the Early Dynastic and later periods could involve greater demands on time, demands for agricultural taxes, or even state sponsorship of production. Certainly it is possible that the quarrying and production of sickle blades in the Early Dynastic and later were organized by the state, because there are indications of large-scale organization at Wadi el-Sheikh where many such blades were produced (Hart 2017; Kohler et al. 2017). If this is the case, it would rule out a commercial model of production where independent producers responded to local needs. Specialized production in general was well established by the Early Dynastic period, so the switch to mass production of sickle blades rather than bifacial sickles can be seen as a secondary change in specialized production. In all, increasing specialization of sickles related, at minimum, to rising agricultural production and growing needs for agricultural tools.

A model of multiplicity

The finding that no single model accounted for all specialized production is a significant result. This study began by asking whether a ritual production model as outlined by Spielmann (2002) was applicable to the Predynastic Egyptian data, which served as a heuristic starting point highlighting which features of the archaeological record could prove to be significant. These features (raw material use, production location, and find contexts) showed that in addition to tool types that largely fit with the prestige-goods and ritual production models studied here, sickle production responded to different factors related to agricultural production.

Therefore a larger finding of this study was that there were many influences that contributed to the development of specialized production during the Predynastic period in the Egyptian Nile Valley. A unimodal explanation does not account for all of the data. Instead a multi-modal perspective is required, along with recognition that there were numerous simultaneous influences on economic life. Furthermore, it is important to note that these factors included symbolic considerations along with practical ones. Cosmological views, prestige display, and increasing use of agricultural resources all contributed to changes in the organization of stone tool production and the development of specialization.

8.3. Contextualizing Specialization in Egypt

To better understand why there were so many influences contributing to specialized production in Predynastic Egypt, and why ritual uses were among them, these developments need to be placed in the overall context of what was happening in Egypt at the time. The development of specialized production in Predynastic Egypt took place at a time when many facets of life were changing for the Predynastic Egyptians, in terms of environment, demographics, and the subsistence economy.

Rising aridity in the deserts from the late 6th millennium BCE onward led more and more people to settle in the Nile Valley (Bubenzer and Riemer2007; Kindermann et al. 2006; Kuper and Kröpelin 2006; Nicoll 2001; Riemer et al. 2013; Wendorf et al. 2001). In the 6th millennium BCE, the number of known habitation sites in Egypt are few, and these were primarily located in the deserts, where the subsistence economy was based on mobility with both foraging and some limited herding of domesticated animals (Linseele et al. 2014; Riemer 2007). Some settlements may have existed in the Nile Valley in the area that is now beneath the alluvium, but these have not been identified archaeologically. In the 5th millennium BCE, people increasingly relied on domesticated animals, and a few settlements began to appear using domesticated crops introduced from the Near East, first in the Delta and the Fayoum, then later in the Nile Valley (Linseele et al 2014; Wetterstrom 1993). By the early Naqada period in the 4th millennium BCE, there were many agricultural settlements throughout the Nile Valley and the Delta. These increases in population and the number of settlements probably resulted from a combination of sources, including people moving into the Nile Valley from the deserts, into the Delta from the Near East, and internal demographic growth. It is also important to note that while there were many more people in the Nile Valley during the 4th millennium BCE compared to earlier periods, the total numbers of people were still relatively low, and came nowhere near the subsistence carrying capacity of the land (Butzer 1976:101-103; Hassan 1981b; 1988; 1992b).

At the same time that people were moving into the Nile Valley and adopting domesticates, burial practices were also changing. Cemeteries became larger with increasing amounts of material associated with burials. Cemeteries may have served to tie people to specific pieces of land through a focus on bodies as the mediating symbolic factor in identity and social frameworks (Wengrow 2006:69-71).

Overall Predynastic Egyptians were faced with numerous new scenarios that affected how people interacted: new places, more numerous communities, and being more attached to specific locations. Here I argue that Predynastic Egyptians pursued a diverse array of strategies for social interaction in the face of these new scenarios.

New political formations and increasing inequality are two such approaches to, or results of, these circumstances, and they have already been discussed in the framework of theories of state formation and complexity (Ch. 1). Warfare is another form of interaction visible in the Predynastic period. Evidence for warfare is certainly prominent in the iconographic record with smiting scenes such as found on the Narmer palette and in Hierakonpolis tomb 100. The increasing materialization of personal identity (Wengrow 2006) can also be understood as an new approach to social interaction in the changing circumstances of the time.

In addition, new ritual activities, and/or new materialization of ritual activities, would have been another approach to meeting the transformations in the Predynastic period. As was discussed in Chapter 1.6, ritual activities provide a venue for building solidarity, forging identities and divisions, and constructing a base of authority. These likely included communally encompassing rituals such as agricultural ceremonies, and more individualistic rituals such as those associated, for example, with birth, marriage, and of course death. Evidence for ritual activities was mentioned intermittently throughout this study, but evidence for a few specific rituals is described below to illustrate the idea of increasing ritual activity and/or increasing materialization of ritual activities.

Depictions of women in prescribed poses are shown on Decorated Ware ceramics, and these women along with boats, animal skins, and trees are associated with the funerary realm (Graff 2009). The Decorated Ware ceramics themselves were primarily found in funerary contexts, and their imagery gives some hint about the funerary rituals. Hendrickx et al. (2009) have drawn parallels between these images and Predynastic and Pharaonic figurines, which can be linked to textual references about “women of the acacia house” who played music and danced at funerals, and were linked to animal butchery.

Other rituals associated with death are evident from offerings left on the surface or in shallow pits in cemeteries, such as those at HK6 (Friedman 2006, 2010; Friedman et al. 2017).

Some of the offerings were comprised of flaked-stone eccentrics, model fishtail knifes, projectile points and ceramic vessels. Others included incised ostrich eggshells. These offerings may have been associated with rituals for founding or protecting the tomb complex because they were situated in the corners of the tomb complex (ibid.).

Although less well-known, Predynastic Egyptians also participated in rituals associated with life, not just death. Roth (1992) argued that there were elaborate rituals associated with birth and re-birth based on remains in graves and later texts. The Scorpion Macehead depicts an agricultural ceremony, with the King standing by a canal wielding a hoe, presumably to inaugurate a water channel into the fields (Ciałowicz 1992, 1997; Millet 1990; Quibell 1900). Agricultural ceremonies are also attested through remains in the ritual activities areas of HK29A and el-Mahâsna Block 3, which both have seasonality data indicating that activities may have related to the Nile flood and the agricultural cycle (Anderson 2011:20-21; Linseele et al. 2009:134; see Ch. 3.4-3.5). Presumably an array of ritual activities took place in temples such as these. Temples were depicted iconographically on palettes, tags, seals, and other media (Friedman 1996; Hendrickx 1996b; Millett 1990; Spencer 2010).

The development of specialized production of objects for use in rituals and other activities fits with the idea of increasing ritual activities and/or increasing materialization of ritual activities. Escalating use of materials in ritual activities would have generated demand for the objects necessary to appropriately carryout these activities. This demand could be met by specialists because specialization can increase comparability of form (in terms of shape, style, size or materials) which facilitates comparable meaning, which is the significant factor for symbolic items.

However it is important to recognize that this situation does not exclude avenues for variability. The analysis of stone tool production by tool type and the techniques involved indicated that production was organized in a number of ways (Ch. 5 and 6). Different kinds of rituals and activities could have generated diverse requirements which did not all need to be met in the same way.

Moreover, specialized production would have offered advantages to production of other classes of goods in addition to those used in rituals. For instance more concentrated production would have facilitated the ability to control production or distribution of prestige goods. Or, a change in the organization of production toward greater concentration—i.e. fewer producers—might have allowed those producers to develop different techniques, skills, and knowledge not attainable by larger numbers of people in a more diffuse form of production, as may have been the case for changes in bifacial sickle production.

No single one of these benefits of specialization need be primary. Rather, as specialized production was increasingly pursued to make any item, the different possibilities and advantages of specialized production would have become apparent to the Predynastic Egyptians, and could have been applied to a range of items (not just flaked stone tools, but also ground stone, ceramics, and beer). The situations of Predynastic life in the Nile Valley generated many new scenarios and circumstance and Predynastic Egyptians did not respond in only one way, but always pursued diverse strategies.

8.4 Questions Remaining

While this study has accounted for more of the data related to specialized production, it has also raised new questions, particularly about who the producers were and the social significance of production activities.

Who used stone tools?

Through the analysis of the find contexts of tools, this study addressed who used the tools in terms of class, scale of settlement where they lived, and in some cases, gender. For instance at Hierakonpolis microendscrapers were found in the grave of a young elite male and in the grave of an elderly non-elite female. The concave-base arrowheads were used by hunters from many settlements, and eventually or in some areas used by elites who hunted. The animal eccentrics were probably utilized mainly by elites in Hierakonpolis, but they were also found in a non-elite settlement area, and later at Abydos, where they were also probably used by non-elites (for other tool classes see section 8.1).

Who made stone tools?

The question of who produced the tools however, deserves more discussion, since it can be particularly difficult to assess who was working in a particular place (Costin 2001:299). An assumption built into the prestige-goods model is that the producers were not elites, but that elites sponsored others to do the production. This notion stems from a latent association between manual labor and lower status. There are nonetheless many historic and archaeological examples where production of craft items was associated with elite producers. For instance, in Maya society, Inomata (2001) argued that elites often produced textiles and scribal art objects like codices and stelae, based on finds of the associated production remains (pigment grinders, shell ink pots, spindle whorls, bone needles, axes, and chisels) in elite residences at the rapidly abandoned site of Aguateca. Another example of Maya elite production is in the manufacture of jade ritual/prestige goods such as elaborately carved ornaments, plaques, and jewelry. The later stages of production were carried out by the elites who controlled the ritual knowledge necessary to make the objects potent (e.g. Kovacevich 2006:184-185;), although others were involved in earlier stages of jade production or in production of less elaborate jade goods (Kovacevich 2006, 2007; Rochette 2009).

It is worth considering whether elites might have been the producers of concave-base projectile points in Egypt. If they were used during desert hunting expeditions, they could have been damaged during the hunting. Hunters would have needed to bring many of these rather large projectile points, been able to re-work them, or had specialist assistants along with them. One advantage of larger bifacial projectile points is that they can be re-worked if needed, changing the morphology (e.g. Frison 1968; Flennikan and Wilke 1989). Indeed CBPPs come in a wide variety of shapes and styles which have largely defied classification according to chronological variation. If they were re-worked during hunting expeditions, the elites doing the hunting may have needed to be able to re-work or even produce these tools.

A second production consideration associated with desert expeditions is raw material acquisition. Venturing into the desert was a risky endeavor and apparently associated with privilege at least some of the time. Yet more than hunting took place in the deserts. Some raw materials must have been collected or quarried from desert sites (e.g. the imported materials found at Nag el-Qarmila with primary cortex: Ch. 4.1), and some tools may have even been prepared or produced near the raw material collection points (e.g. potentially large-blade knives). Might trips to the desert have incorporated a number of tasks, such as hunting, quarrying, and production or preparation of certain tools? Desert raw material collection may have been embedded within hunting trips or vice versa. Either all of these tasks would have been undertaken by elite hunters, or the expeditions might have included non-elite members.

Many groups of producers

While these suggestions about the class of producers for certain tools are interesting and merit additional consideration, it is clear that there must have been a number of different groups of people who produced stone tools, and that these groups sometimes overlapped or worked together Figure 8.2.

People in many or all households produced some of the tools they needed such as many unifacial tools (notches, denticulates, endscrapers, retouched pieces), unpatterned bifacial tools, and medium blades. It is not possible at this point to say how this production may have been divided up across members of a household. Did each person produce tools for their own tasks? For example, women preparing fish could have made small scrapers for scaling, or people constructing a house might have made notches for shaving reeds. Alternatively, one person in a household might have been responsible for preparing most of the stone tools necessary for daily life.

In addition there was another group of producers in each of the (or most) communities: a smaller more concentrated subset of people who made axes, because axe production remains have been found concentrated in certain parts of settlements. Similarly, in only some communities there was a subset of people who made heat-treated prepared bladelet cores, and possibly also bifacial sickles, although these later two were not necessarily the same people since they entailed different techniques and skill sets.

Another set of techniques and skills was necessary for the production of the thin finely shaped and often microdenticulated bifacial tools—rhomboids, fishtails, CBPPs, and animal eccentrics—and these were probably made by an even smaller group of producers working at fewer sites.

Many of these bifacial tools were probably made together by the same people, sine similar skills and techniques were involved. Additional evidence that this was the case comes from the eccentrics, since some are basically variations on CBPPs and rhomboids (see Ch. 6.1). However even this idea of overlapping production is slightly more complicated. Finds of unfinished CBPPs and the variability in raw material and metric measurements of fishtails, indicate that they were probably made in more sites than some of the other fine bifacial tools, such as rhomboids and animal eccentrics. Later, RFKs and later fishtails, were probably only made in only one or two sites. These ideas about the distribution and overlap of producers are summarized in Figure 8.2.

Social meaning and implications of stone tool production

The suggestion that there were many groups of producers with different levels of skill, making tools for daily needs, prestige, ritual uses, and agricultural production, implies that what it meant to be a stone tool producer also varied. The diffuse and regular production of items of daily life may not have set people apart, but production of other items, carried out by fewer people, must have created a distinction for them. Moreover, there were not just two groups of stone tools producers, but many (see above). Furthermore, it is already possible in the Predynastic period to discern three foci of stone tool production: the temple (ritual), the palace (elites), and the fields (agricultural tools), and these arenas remained significant throughout the Pharaonic period. The various groups of producers and multiple kinds of production indicate that there were many roles or opportunities available for Predynastic Egyptians, but these were differentially distributed across settlements, and certain communities had more kinds of stone tools producers than others. Therefore stone tool production was already contributing to the growing complexity developing in Egypt over this time.

Some stone-tool production probably granted increased opportunities for participation in ritual and social events, since production often took place in ritual structures. This participation may have facilitated a degree of agency for those people to negotiate what occurred and what was involved in the ritual events. Furthermore it is likely that producers of different skill levels or tasks worked together, at least occasionally. For instance the production of RFKs drew on several skill sets (Kelterborn 1984; Midant-Reynes and Tixier 1981). Another example is bead production at HK29, which consisted of making microdrills, shaping the beads, and grinding the beads. There was also bifacial tool production at HK29A which draws on a very different set of techniques. Similarly, in the ritual activity area in Block 3 at el-Mahâsna there was evidence that bifacial tool production and bladelet production both occurred there. These finds of evidence for multiple skill sets and production types occurring together in ritual contexts, further underscores the idea that the ritual events brought producers together, giving many people a chance to participate in and influence ritual events.

8.5 Conclusion

The original question posed here was whether the ritual production model may be applicable to Predynastic Egypt. This study argues that indeed, increased demand for objects which could be used in ritual and other activities likely did affect the organization of stone tool production. This perspective contributes to archaeological research which has already considered numerous other explanations for the development of specialized production (Ch. 1.2). The application of the ritual production model to Egypt has invited a reconsideration of assumptions about the source of demand for specialist-produced goods. Ritual uses must be included among other considerations such as status or needs for increased efficiency in production.

The findings that ritual activities affected the organization of production moves ritual activities from a secondary process only significant from an etic perspective for its role in legitimizing leaders, to a primary process that can affect large socio-economic changes. This should not be surprising for Egypt because later, with pyramid construction, Egypt is perhaps the *quintessential* example of worldviews causing people to move heaven, and especially earth, to materialize those views in lasting ways.

Moreover, by showing that the goods used by specialists were socially widespread, this study also contributes to an understanding of who was involved in large-scale changes. Internal motivations for change were not limited to elites or aggrandizers, but a range of people could contribute to such changes through increasing the demand for ritual goods, and by participating in their production.

This study went beyond the original ritual production model which was the focus of the research and demonstrated that the development of specialized production was likely affected by a number of factors, including ritual, prestige, and changes in subsistence strategy. For Egypt, this research can serve as a basis for looking at how each of these aspects affected specialized production over time, since stone tools continued to be made by specialists for thousands of years after the Predynastic. More broadly, this research encourages the framing of future research questions to include multi-modal explanations for large socio-economic processes, taking into account the complexity of (pre-)history and highlighting the multiplicity of influences on people in the past.

Appendix: Lithic Coding Guide

This coding guide was developed based on the following sources: Andrefsky (2005); Debénath and Dibble (1994); Holmes (1989); Inizan et al. (1999); Luedtke (1992); Midant-Reynes and Prost (2002); Rosen (1997); Tixier (1963); and a lithic technology course taught by Phil Geib at the University of Virginia in 2011. The procedure for analyzing the artifacts is described in Chapter 2.4.

Context Data

ID number

The ID number assigned to each artifact comprised the abbreviation for the project name, such as MAP (Mahâsna Archaeological Project) or AKAP (Aswan- Kom Ombo Archaeological Project), plus the tag number of the artifact bag, plus a subscript which was assigned consecutively to each artifact in a bag starting with one. The combined tag number plus subscript creates a unique identifier such as MAP.3008.1 or AKAP.1552.4. The ID numbers were written on the ventral surface of the artifact below the bulb, or in an inconspicuous area so that the artifacts could be identified in photographs and relocated. The tag number links to data about the context such as Block, Locus, and Habitation Level, (or Area, Square, and Level, depending on the project).

Raw Material Information

Chert varies in the macroscopic properties of color, luster, texture, translucency, inclusions and cortex type (Luedtke 1992). These attributes were recorded for a sample of ~600 artifacts, and were used to create raw material categories within the cherts. Structures and cortex type proved to be the most useful and clearest characteristics for raw material grouping, so those two characteristics along with overall raw material type were assessed for all analyzed material.

Color

Colors were recorded based on comparison to a Munsell soil color chart.

Translucency

Translucency was assessed by holding each artifact about 5 cm in front of a desk lamp and rated on a four-step scale of translucency. Artifacts varied in thickness, which affects the translucency, so the options take into account the thickness of the object and the translucency near the edges.

Opaque: The material is opaque even when held to light, regardless of thickness.

Mostly opaque: The material is opaque to the naked eye, and slightly translucent when held to light, especially at thinner parts.
Semi-translucent: The material is translucent when held to a light.
Translucent: The material is translucent to the naked eye, very translucent when held to the light.
Indeterminate: Transparency cannot be assessed. For example, the piece may be covered by a thick patina.
Other: See comments.

Luster

Artifacts were held under a desk lamp (to improve comparability of conditions) and rated on a three-step scale for luster.

Glossy: Luster was noticeable even before the artifact was put under a lamp. Obsidian and heat treated materials are good examples of glossy artifacts.
Semi-glossy: The artifact has a slight luster, but it was not very pronounced. It is glossier under direct light from a lamp.
Matte: No luster, even under direct lamp light.
Indeterminate: Luster cannot be assessed. For example, the piece may be covered by a thick patina.
Other: See comments.

Texture

Texture was assessed by the feel of the flaked surfaces, compared to type examples. The medium to very fine gradients apply to cherts.

Glossy: Very smooth texture, such as with minerals or obsidian.
Very fine: Not as smooth as glass, but still very smooth, such as with the finest cherts.
Fine: The texture of typical Egyptian chert.
Medium: A coarser texture for chert. Silicified limestones and sandstones here.
Coarse: The texture is actually bumpy, like a porphyry.
Indeterminate: Texture cannot be assessed, often because it is obscured by patina.
Other: Additional description recorded in the notes.

Structures

Structures are patterns or materials in the fabric of the chert, such as banding or fossils. They are often occur due to replacement of features in the sediments during formation or from the process of formation itself (Luedtke 1992: 71-72). Structures were assessed by examining the artifact with 0-40x magnification and were categorized based on the most dominant pattern or inclusion. Representative and unusual examples were photographed with a digital microscope at 30x magnification. Representative examples were set aside for reference when assessing other materials. The designations are descriptive, awaiting identifications of the structures via thin-sections.

Pink bands: Pink bands that range from dark to medium pink, and can vary in thickness and number.

Figure I. Pink bands. MAP.1045.90.

Other bands: Bands of any color other than pink, most often light cream-white.

Figure II. Other Bands. MAP.2439

Red mottles: Tiny red to brown specs, with reasonably well defined outlines. Possibly iron oxide (limonite). The specs are not very frequent or common in terms of the overall composition of the material matrix.

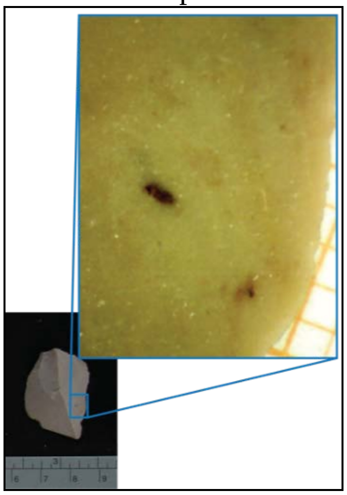

Figure III. Red mottles. MAP.2497.7

Black mottles: Tiny black specs, with reasonably well defined outlines. The specs are not very frequent or common in terms of the overall composition of the material matrix.

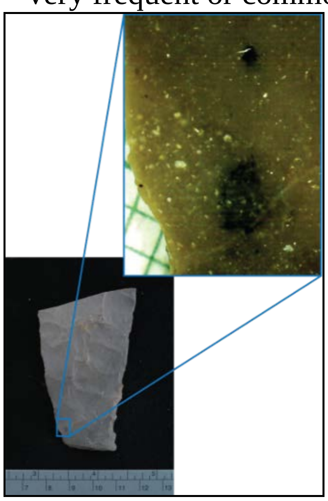

Figure IV. Black mottles. MAP.401.

White mottles: Tiny white specs which can have well defined or slightly diffuse outlines. They are usually quite numerous when present. Sometimes they are arranged in bands. This was the most common type of structure.

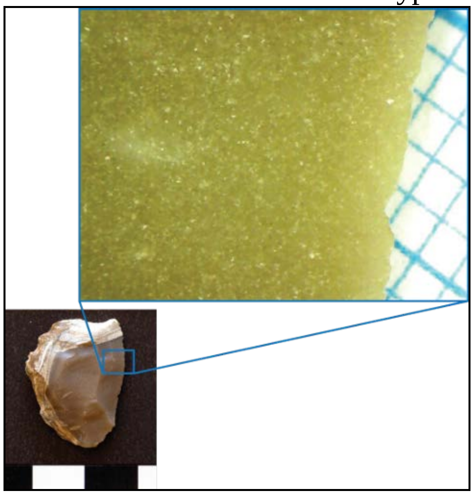

Figure V. Small white mottles. AKAP.2349.5.

Black mossy mottles: Black mottles that have a mossy shape, but are somewhat well defined at the edges. They are usually not very frequent or common in terms of the overall composition of the material matrix.

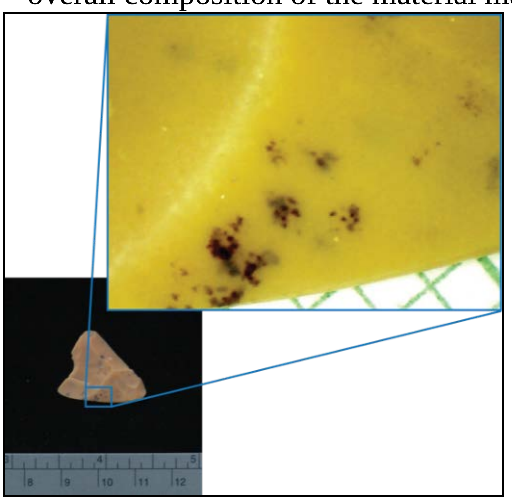

Figure VI. Black mossy mottles. MAP.3278.38.

White mossy mottles: These structures are white, often with diffuse outlines, and often running into each other giving a mossy appearance. They are usually quite numerous when present. They can be mixed with the more well-defined round mottles or the tiny white specs. Sometimes they are arranged in bands. The structures of this type in artifact # MAP 3278.39 were tested for carbonates using lemon juice (ph2) under a microscope. A localized reaction occurred, so these structures are likely calcareous.

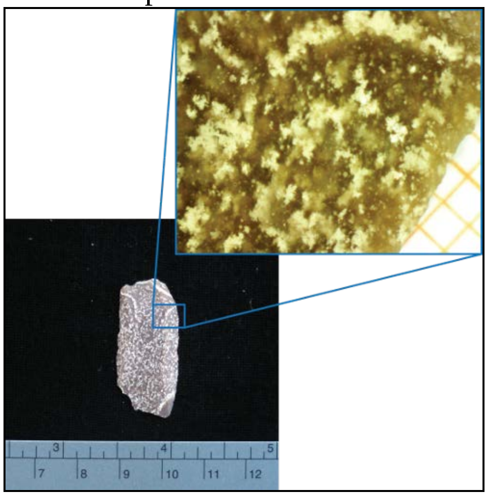

Figure VII. White mossy structures. MAP.2497.36.

Opaque round white structures: These structures are white, round, and have very well defined outlines. They often occur in clusters. They may be oolites, which are "tiny spheres of inorganic origin that form primarily in marine environments where strong bottom currents agitate sediments... Calcium carbonate precipitate[s] in concentric layers around a sand grain or fossil nucleus 1-2 mm...The resulting oolites can become silicified..." (Luedtke 1992:71).

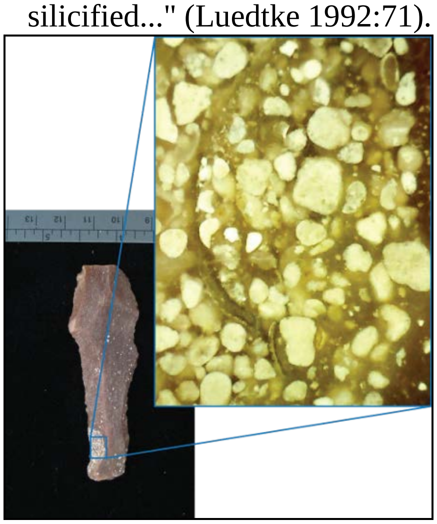

Figure VIII. Opaque round white structures. MAP.304.

Tan diffuse round structures: These structures are very distinctive consisting of small round circles that are diffuse, opaque, and tan.

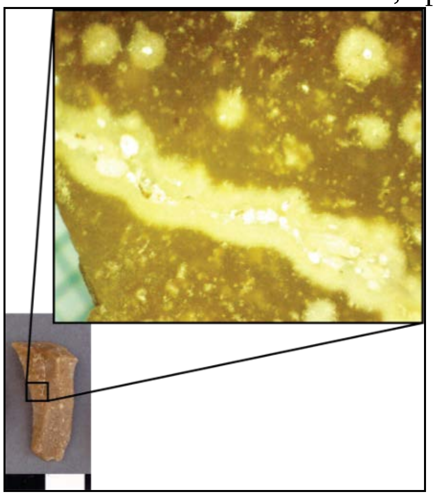

Figure IX. Tan diffuse round structures. ATP.4289.16.

Foraminifera: These are structures can reasonably be identified as foraminifera, single-celled organisms that form shells, and in cherts can become silicified or exist as casts. Preliminary identifications include miliolids, and nummulitids.

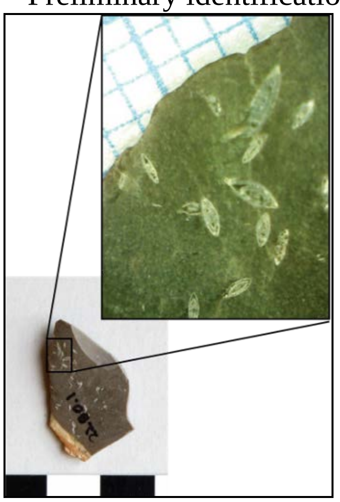

Figure X. Foraminifera structures (probably nummulites). AKAP.2280.1.

Eroding spheres: Small white spheres that erode out and leave holes.

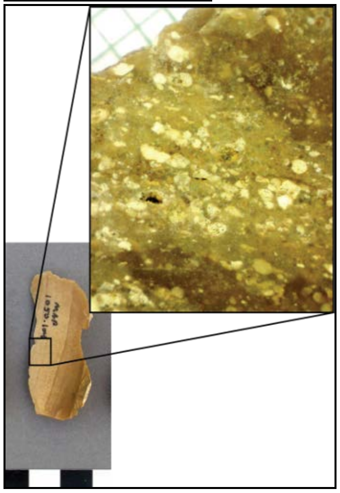

Figure XI. Eroding spherical structures. MAP.1050.104.

Mixed elongated structures: These structures are probably a mixture of fossils, including bivalve shell fragments and other unidentified structures.

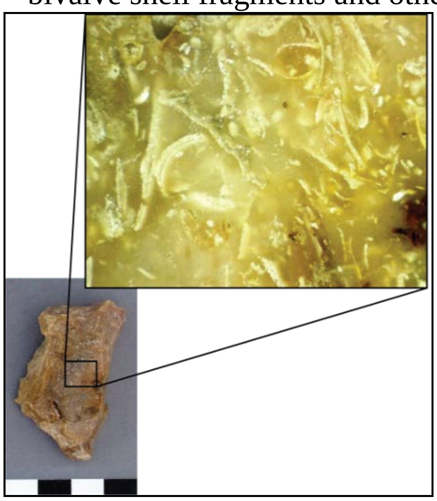

Figure XII. Mixed elongated structures. MAP.1022.132.

Phenocryst: A relatively large and usually conspicuous crystal distinctly larger than the grains of the fabric.

None: no structures are identifiable in the fabric.

Other: Structures do not conform to any of the above categories, see comments.

Indeterminate: Structures cannot be determined, likely because the surface is obscured.

Cortex Type

The wear and characteristics of cortex can indicate whether a nodule was obtained from a primary deposit where the chert formed, or in a secondary deposit (Luedtke 1992). Materials with unmodified cortex probably came from a primary deposit. Materials with cortex that has some pitting from erosion and gravity transport and color change of the cortex from chemical weathering and/or build up could have been collected or quarried from a secondary deposit. Such materials do not have evidence of smoothing from alluvial transportation. Alluvial transportation can result in potting and smoothing of the cortical surface. The stone would have been obtained from a secondary deposit. Other stones collected from secondary deposits may have cortex that displays signs of multiple weathering events, such as pitting from erosion and/or alluvial movement, color change from chemical weathering and/or mineral build up, and smoothing from water action. These are often referred to as gravel nodules.

UNMODIFIED
<u>Chalky</u>: Cortex is white and chalky, not weathered.
<u>Chalky + patina</u>: Cortex is white and chalky without pitting, and with a layer of patina. The patina may have developed after it was quarried.
<u>Chalky pitted</u>: Light pitting shows that the cortex was subject to some wear, but the cortex is still chalky indicating it was not extensively exposed.
<u>Natural fissure planes</u>: The surface of the chert does not have a cortex per se, but has a different texture that results from fracturing by heat, or salt.

TRANSPORT BY EROSION & GRAVITY
<u>Chalky pink-orange</u>: Cortex is chalky but a thin layer of pink to orange material has developed. The color change probably resulted from chemical weathering and/or build up, likely from exposure after eroding out of a primary deposit.
<u>Weathered white to tan heavy patina</u>: Cortex color varies from white to tan, with some pitting and signs of wear, and a heavy patina.
<u>Dark pitted</u>: The cortex color has changed to a dark color (often dark pink) and there is pitting, with no evidence of alluvial smoothing.

ALLUVIAL TRANSPORT
<u>Completely smoothed</u>: Any pitting has been eroded away, the surface is extremely smooth and shiny.

CHEMICAL WEATHERING
<u>Patina</u>: A patina has developed on a non-cortical surface. No determination can be made about quarrying activity.

MULTIPLE
<u>Black or brown pitted smoothed</u>: Cortex has pits and some smoothing, and is black or brown in color.
<u>Dark-pink pitted smoothed</u>: Cortex has pits and some smoothing, and is dark pink in color, which could result from sun exposure or heat-treatment.

Other pitted smoothed: Cortex has pits and some smoothing, and is any other color besides black or Dark pink, such as light tan.

OTHER
Indeterminate: Cortex is present, but it cannot be categorized, for instance if there is only a very small amount of cortex.
Other: The cortex wear does not fit well in any of these categories, see comments.
N/A: No cortex is present.

Raw Material Type

Chert was by far the most numerous raw material type, and it was divided into varieties based on macroscopic properties including color, luster, texture, opacity, and with particular reference to structures and cortex, and are described in detail below. Published descriptions of other researcher's chert varieties were consulted, but without a type collection to reference, there is likely to be some variation.

Agate/chalcedony
Chert (a.k.a. flint, see Ch. 4.1)
1. Indistinct Beige
2. Beige- fine
3. Beige- less fine
4. Yellow-Beige with pink bands
5. Medium Brown
6. Fossiliferous Brown
7. Dark Gray and Brown
8. Translucent Brown Family
9. Translucent Brown with Pink Gravel Cortex
10. Pink-gray Translucent
11. Pink-Purple-Red Family
12. Translucent White
13. Caramel
14. Other Chert
15. Indeterminate Chert

Limestone
Obsidian
Quartzite
Sandstone
Silicified limestone
Silicified sandstone
Other Stone (not one of the types listed above)
Indeterminate (Indeterminate whether the stone is chert or another kind of stone)

1. Indistinct Beige:
Color: Yellow-brown - Beige. 7.5- 10 YR 5-7/ 4-3 (Munsell color names: Brown, light brown, pale brown, very pale brown, light yellowish brown)

Texture: Variable
Luster: Variable
Translucency: Opaque (to mostly opaque)
Structures: Variable- banding, mottles, etc
Cortex: Various pitted-smoothed cortexes and lightly weathered cortexes
Geologic origin: Gravel and lag deposits, although some primary deposits are evident
Comparable descriptions: Briois (2002) (Adaïma): "2"- Gray or brown silex, sometimes banded, often grainy, poor quality. Midant-Reynes and Prost (2002) (Adaïma): "Silex Diverse"- various shades of brown and gray. Takamiya and Endo (2011) (Hierakonpolis): Standard flint, beige, light brown, dark brown.
Image: Figure XIV

2. Beige-Fine:
Color: Beige 7.5-10 YR 5-7 / 3-4 (Munsell color names: Brown, light brown, pale brown, very pale brown, light yellowish brown)
Texture: Fine to very fine
Luster: Semi-glossy
Translucency: Opaque to mostly opaque
Structures: Red mottles, white mottles
Cortex: Chalky and lightly weathered cortexes
Geologic origin: Lag deposits and primary contexts
Comparable descriptions: Kabacinski (2012) (Tel el-Farkha): "Variation I"- smooth cortex, light brown to brown (7.5YR5/3-4, 6/2-4, 7/2), non-transparent, homogeneous, practically free from intrusions, sometimes striped. Nagaya (2011) (Hierakonpolis): "Group 1"- beige/light brown flint.
Image: Figure XIV

3. Beige Less-Fine:
Color: This variety of chert can range from quite light beige to quite dark brown. 10YR 5-8/ 2-3 (Munsell colors: brown, grayish brown, pale brown, very pale brown, light brownish gray, light gray), but variable.
Texture: Fine to medium
Luster: Matte
Translucency: Mostly opaque to semi opaque
Structures: Variable- banding, color variation, etc
Cortex: Various pitted-smoothed cortexes and lightly weathered cortexes
Geologic origin: Mainly gravel and lag deposits
Comparable descriptions: Holmes (1992) (Hierakonpolis), Takamiya and Endo (2011): "coarse gray flint". Pawlik (2006) (Kom al-Ahmar, Middle Egypt): "RM 4"- dark Gray, coarse, matte.
Image: Figure XIV

4. Beige with pink bands:
Color: 7.5-10 YR 5-7 / 3-4 (Munsell colors: Brown, light brown, pink, pale brown, very pale brown, light yellowish brown)
Texture: Fine to very fine

Luster: Any
Translucency: Semi-opaque, mostly opaque, opaque
Structures: Pink bands, often concentric
Cortex: Chalky pink-orange, and pitted smoothed were common.
Geologic origin: Lag and primary deposits. Observed in lag deposits around Abydos. Also identified in a gravel deposits at Elkab.
Possible source: One source of this material is likely located near Abydos. Secondary deposits of the material were found during the desert survey (Ch 4). Additionally certain tools (RFKs, Fishtails) made from this material have been found most frequently around Abydos (Ch7). Holmes (1989:459) also described a similar material available in lag deposits at the entrance to the Valley of the Kings, on the west bank in Luxor.
Comparable descriptions: Briois (2002) (Adaïma):"3"- Light brown silex, beige rosé, often banded, very fine grain. Hikade (2000):18- Light brown, very dense flint with pinkish bands or stripes, known near Abydos, some ripple-flaked knives made of this material. Hikade (2013) (Elephantine): "RM 4"- fine homogenous, light brown to light grayish with pinkish stripes or lenses, available in the desert near Abydos. Midant-Reynes and Prost (2002) (Adaïma): "No 2"- light brown with pink banding. Takamiya and Endo (2011) (Hierakonpolis): "light brown flint with pinkish stripes".
Image: Figure XIV

5. Medium Brown Homogeneous:
Color: 7.5-10 YR 4-6/2-3(4) (Munsell colors: brown, light brown, dark grayish brown, grayish brown, light grayish brown, pale brown, dark yellowish brown, yellowish brown)
Texture: Fine to very fine
Luster: Semi-glossy
Translucency: Mostly opaque
Structures: White mottles, some fine bands, some red or black mottles
Cortex: Chalky or lightly modified.
Geologic origin: Primary and lag deposits
Comparable descriptions: Briois (2002) (Adaïma): "1"- Brown, opaque, fine grain. Midant-Reynes and Prost (2002) (Adaïma): "No1"- homogeneous dark brown fine grained fine beige-cream cortex.
Image: Figure XV

6. Brown with fossils/foraminifera:
Color: 7.5-10YR-2.5Y 4-5/1-2 (Munsell colors: Brown, gray, dark gray, grayish brown, dark grayish brown)
Texture: Fine
Luster: Semi-glossy
Translucency: Opaque, mostly opaque, semi opaque
Structures: Macroscopic foraminifera
Cortex: Chalky, some lightly modified
Geologic origin: Mainly primary contexts, some lag deposits

Comparable descriptions: Midant-Reynes and Prost (2002) (Adaïma): "N°3"- Dark brown fossiliferous silex, identified in local limestone formations to the South west of Adaïma. Pawlik (2006) (Kom al-Ahmar, Middle Egypt): "RM 11"- greenish, semi-opaque, microfossil intrusions.
Notes: Note that the name Brown fossil was chosen because the structures look like small fossils, but the actual mineral content of the structures has not yet been identified. They are probably foraminifera.
Image: Figure XV

7. Dark gray and brown:
Color: 7.5-10 YR-2.5Y 4-5/1-2 (Munsell colors: Brown, gray, dark gray, grayish brown, dark grayish brown)
Texture: Fine to very fine
Luster: Semi-glossy
Translucency: Mostly opaque, opaque
Structures: Variable color and small black mottles. Dark gray and medium brown colors occur together with sharp boundaries between them.
Cortex: Chalky, and a very few have lightly modified cortex. Note that many pieces do not retain any cortex (Ch 4).
Geologic origin: Primary contexts
Comparable descriptions: Briois (2002) (Adaïma): "#1"- Brown, sometimes dark in the middle, light brown or gray, opaque, fine grain. Hikade (2013) (Elephantine): "RM 3"- Dark gray-brown to greenish, heterogeneous, probably mined. Kabacinski (2012) (Tel el-Farkha): "Variation II": Dark-gray and Brown (7.5YR 3/2-4, 4/1-4,5/1-3), translucent or semi translucent, diverse, from nearly homogenous to calcareous inclusions, sometimes lightly striped or milky. Midant-Reynes and Prost (2002) (Adaïma): "No 4"- Brown-black, two distinct hues with a sharp boundary, homogenous, fine grained. Nagaya (2011) (Hierakonpolis): "Group 2"- Dark brown/black, often with lighter veins. Pawlik (2006) (Kom al-Ahmar, Middle Egypt): "RM 3"- Middle brown to black, fine grained, semi-lustrous, semi-opaque, homogeneous. Rizkana ad Seeher (1988) (Maadi): "Nodular"- Dark-brown to dark-gray or blackish- gray, mined cortex not much altered, can be larger than 10cm.
Image: Figure XV

8. Translucent Brown Family:
Color: Variable, slightly reddish browns. This type can have variable color blending and banding. 5-10 YR (mostly 7.5YR) 4-6/ 1-6 (mostly 3-4) (Munsell colors brown, light brown, reddish brown, light reddish brown, pale brown).
Texture: Fine
Luster: Semi-glossy
Translucency: Semi-translucent
Structures: White mottles, white mossy mottles
Cortex: Pitted-smoothed cortex
Geologic origin: Gravel and lag deposits
Comparable descriptions: Briois (2002) (Adaïma): "#4"- Translucent flint in shades of beige, blonde, light brown, pink or purple, mottled and fine grained, in small nodules.

Hikade (2013) (Elephantine): "RM 2"- Nodules from the desert surface with brown, black, or reddish brown weathered cortex.
Image: Figure XVI

9. Translucent brown with pink gravel cortex:
Color: Reddish brown- honey colored. 7.5-10 YR 4-6/4-6 (Munsell colors brown, strong brown, light brown, reddish yellow, yellowish brown, light yellowish brown, dark yellowish brown).
Texture: Fine
Luster: Semi-glossy
Translucency: Semi-translucent to mostly opaque
Structures: White mottles, white mossy mottles
Cortex: Pink to brown pitted and smoothed cortex
Geologic origin: Gravel deposits
Comparable descriptions: Briois (2002) (Adaïma): "4"- Translucent flint in shades of beige, blonde, light brown, pink or purple, mottled and fine grained, in small nodules. Rizkana and Seeher (1988) (Maadi): "Gravel Flint"- Alluvial transported pebbles, peck marks, dark reddish brown to med brown, honey colored brown.
Notes: This is a subset of 8, with a distinctive cortex.
Image: Figure XVI

10. Pink-gray translucent:
Color: Pink-gray 2.5-10 YR 5-7/ 2-3 (Munsell colors light gray, pinkish gray, reddish gray, weak red, dark reddish gray, reddish brown, light reddish brown, light brownish gray, pale brown).
Texture: Fine to very fine
Luster: Semi-glossy to glossy
Translucency: Semi-translucent to translucent
Structures: Opaque round white, white mottles, white mossy mottles,
Cortex: Variable. Note that many pieces do not retain any cortex (Ch 4).
Geologic origin: Variable, mainly lag deposits, but some gravel and some primary contexts. Note that many pieces had no cortex.
Comparable descriptions: Briois (2002) (Adaïma): "4"- Translucent flint in shades of beige, blonde, light brown, pink or purple, mottled and fine grained, in small nodules. Ginter et al. (1996) (Armant): Pink transparent flint with opaque light intercalations (structures), non-local to Theban area, might come from the north.
Notes: Similar to 8, but with distinctive pink to light gray color, and sometimes with opaque round white structures that were not usually present in 8.
Image: Figure XVI

11. White translucent:
Color: White 7.5 YR 8/1
Texture: Fine to very fine
Luster: Semi-glossy to glossy
Translucency: Translucent to semi-translucent
Structures: Bands

Cortex: Chalky
Geologic origin: Primary deposit
Comparable descriptions: Holmes (1992) and Takamiya and Endo (2011) (Hierakonpolis): Notes: Only 2 examples identified in this study.
Image: Figure XV

12. Pink-purple-red Family:
Color: 10R-7.5YR 3-6 / 1-3 (Munsell colors weak red, dark reddish brown, reddish gray, dark reddish gray, dark gray, pinkish gray)
Texture: Variable
Luster: Variable, but tends to be glossy
Translucency: Variable
Structures: White mottles, white mossy mottles
Cortex: Various colors of pitted-smoothed cortex, a few more lightly modified pieces
Geologic origin: Mainly Gravel deposits
Comparable descriptions: Briois (2002) (Adaïma): "4"- Translucent flint in shades of beige, blonde, light brown, pink or purple, mottled and fine grained, in small nodules. Holmes (1992), and Takamiya and Endo (2011) (Hierakonpolis): pinkish-orange-purplish shades, glossy, with fine speckling.
Notes: Similar to 8, 9, and 10, this group could be strongly heat-treated versions of varieties 8, 9, and/or 10. However heat treatment was assessed separately from assignment to this category, according to the method described in chapter 4.
Image: Figure XVI

13. Caramel:
Color: Bright yellowy-orange-caramel 7.5YR 6-/6 (Munsell color reddish yellow)
Texture: Very fine
Luster: Semi-glossy
Translucency: Semi-translucent
Structures: Occasional mossy black mottles
Cortex: lightly modified, very few examples with cortex
Geologic origin: lag deposit (?)
Comparable descriptions: Holmes (1992) (Hierakonpolis): fine grained translucent orange, used for bifacial tools. Kindermann (2010) (Djara): "127"-light brown to yellow (Caramel).
Image:

14. Other Chert: Any chert which does not fit into any of the above varieties, and is very distinctive.

15. Indeterminate Chert: A chert that does not clearly fit into one of the above varieties, but is between a number of them.

Figure XIII. Raw Material Types 1-4.

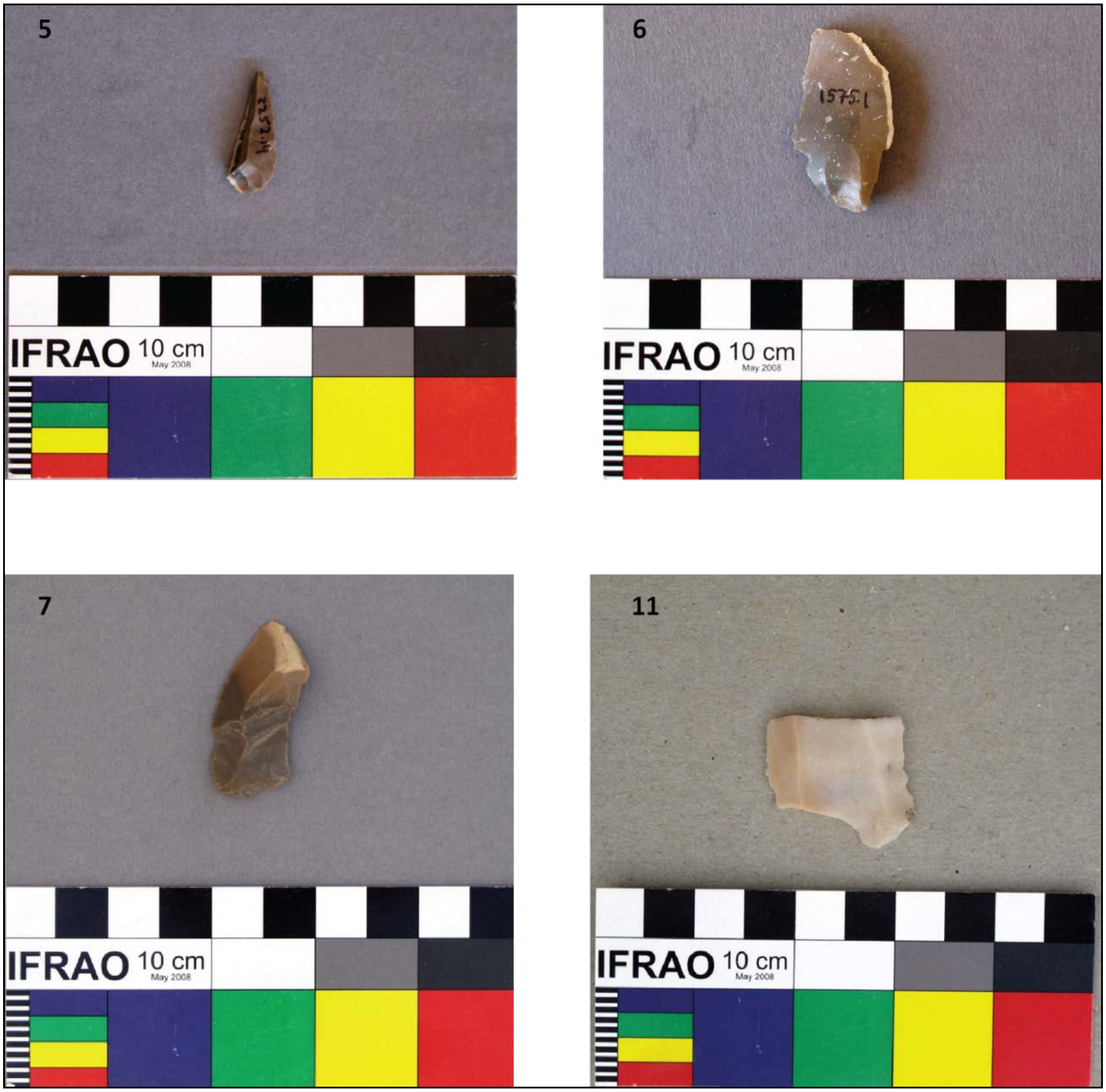

Figure XIV. Raw material types 5-7, 11.

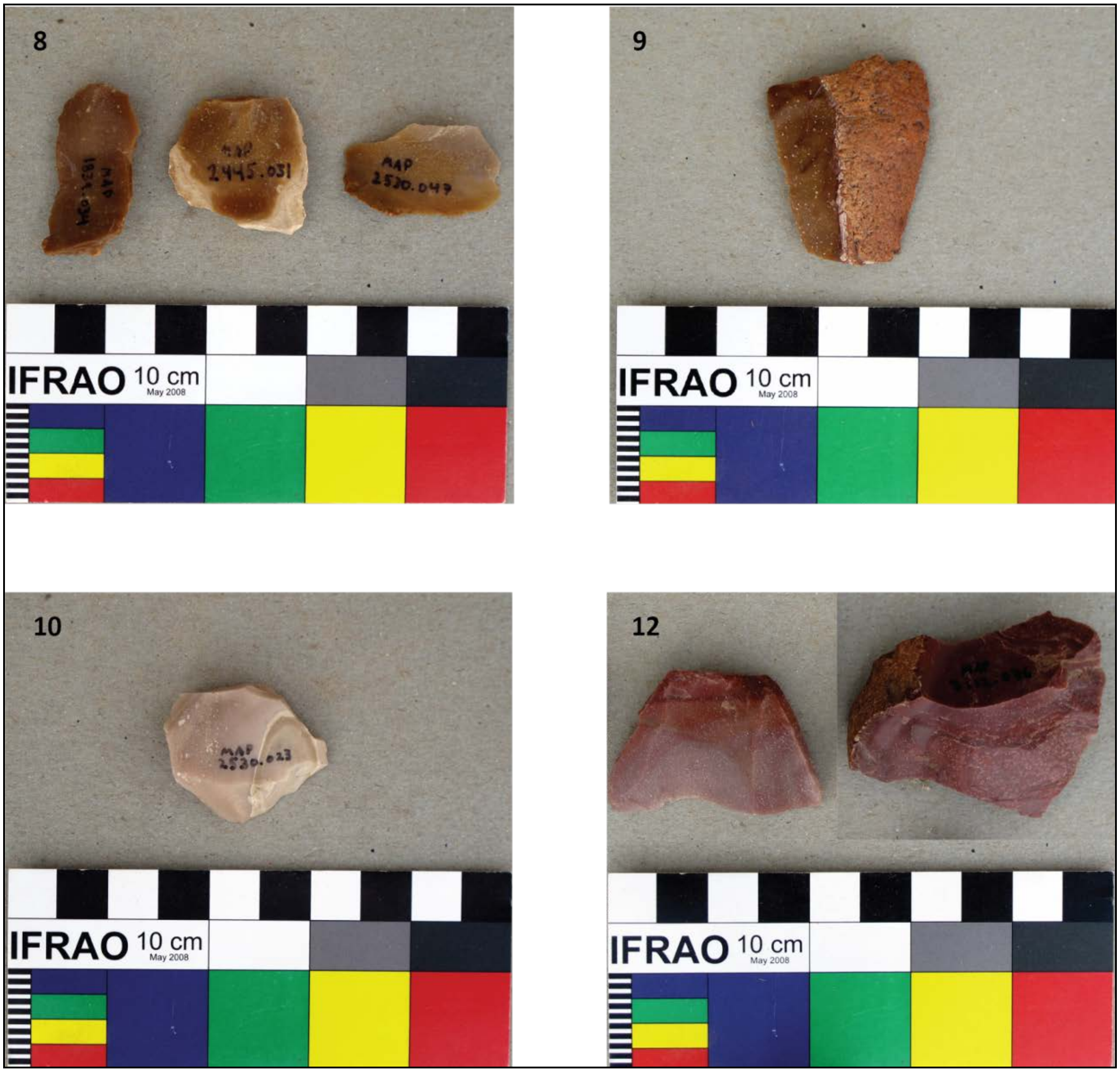

Figure XV. Raw material types 8-10, 12. Note that 12 has had parts of the same original image edited together.

Production/technology Information

Reduction category

Reduction category refers to whether an item was a tool, core, debitage or angular debris. This information was used to analyze the spatial distribution of production remains. Debris (debitage smaller than 1.5cm) were sorted out and recorded separately.

Tool: A tool is a piece of stone that has patterned macroscopically observable retouch scars from flake removals. Flake scars were considered patterned if there were even sized removals or removals focused along a useable edge. If the scars were small and distributed randomly and intermittently around the flake edges the removals were not considered retouch.

Core: A block of raw material from which flakes of any type were detached (Tixier 1974:14). A core is a source for flake blanks for tools manufacture. To be considered a core a piece needed to have identifiable flake scars. Distinguishing between cores and tools was based on familiarity with Predynastic tools and core types.

Core/tool: This category is for items with flake scars where it is not clear whether the mass itself was the intended tool or whether it was a source of flakes (Debénath and Dibble 1994:12; Kelly 1988). This category also includes initially struck or tested cobbles, and cores that may have been subsequently used as tools. Ultimately they were grouped with tools.

Debitage: Debitage, or 'flakes' can broadly be defined as any piece detached from a mass of stone, with clear dorsal and ventral faces, and which is not modified further (Andrefsky 2005:76, 255; Cotterel and Kamminga 1987:676). In addition to the dorsal and ventral surfaces, other characteristic flake features include: a striking platform, a bulb of percussion, ripples, and dorsal flake scars. Debitage includes a variety of characteristic types, such as blades, bifacial thinning flakes, burins, axe preparation flakes etc. For coding purposes, flake fragments were included in this category as long as some flake characteristics were evident, and the preservation was recorded separately.

Angular Debris: Pieces that do not have clear dorsal/ventral characteristics, nor flake scars that could classify them as cores or tools (Debénath and Dibble 1994:11; Rosen 1997:24). They result from shattering of a stone upon impact or as a result of exposure to rapid temperature changes. These items can also be referred to as "chunks" (Holmes 1989:446).

Indeterminate: Any item that did not fit in the above categories. See comments.

Preservation

Preservation identifies whether an item is whole or broken, and which portion of it is present. The categories were based on Debénath and Dibble (1994).

Complete: The item is not broken, margins are intact. There can be small nicks or damage on the margins, but such would not greatly affect measurements.

Proximal: Any broken flake which has the platform preserved, or broken tools made on flakes where the platform is still identifiable. Fragmentary bifacial tools are proximal if the handle or haft portion is present.

Medial: The middle section of a flake or tool. For flakes, both the platform and the distal termination would be missing. Flakes that terminate in a step fracture would be indistinguishable from breaks and could be included in the proximal or medial categories.

Distal: Flakes or tools with a distal termination is but missing the platform, or fragmentary Bifacial tools missing the haft/handle portion.

Corefrag: Any broken core.

Vertical split: A flake that has broken vertically, with a lateral half missing. The platform and distal terminations are both partially preserved, but width measurements would be inaccurate.

Indeterminate: Any item that cannot be put into one of the above categories for some reason.

Amount of cortex

This question assed the amount of surface area covered by cortex on an artifact. These assessments were done by estimating/visualizing quadrants on the flake or tool made on a flake. For cores and bifacial tools, estimations of percentage were based on total surface area, not just one face (and surface area will be calculated differently). The cortex categories were combined with metric size data to assess the amount of cortex in an assemblage relative to the expected amount following Dibble et al. (2005). Comparisons of cortical flakes counts between assemblages that do not consider the preservation and size of the flakes are problematic because different reduction techniques may produce different counts of cortical pieces (Dibble et al 2005).

The publications on Predynastic sites often use different definitions of cortex categories. For example, Holmes (1989:449,456) defined primary pieces as flakes with 50% or more of the surface covered in cortex, and everything else as secondary. Close (1980:50) also defined primary flakes as those with 50% or more cortex, but made a distinction between secondary flakes (25-50% cortex) and tertiary flakes (0-25% cortex). At Adaïma Midant-Reynes and Prost (2002) separated debitage into categories of those with cortex and those without cortex. At Armant, Ginter and Kozlowski (1994) separated flakes into three groups: wholly cortical, partly cortical, and no cortex. The system here with more divisions allows the artifacts to be compared to assemblages that defined cortex groupings differently.

0: No cortex whatsoever

1-10: The piece retains only a very small amount of cortex

11-40: Less than half of the surface has cortex

41-60: Around half of the surface has cortex

61-90: More than half of the surface has cortex, but it is not totally cortical

91-99: Only a very small amount of the surface is not covered by cortex

100: The surface is completely covered by cortex

Indeterminate: It is not possible to determine whether the piece has cortex or not

Platform type

This category describes the platform surface, mostly referring to the number of facets on the platform of a flake. This category is used to consider and compare the reduction technique. Often platform faceting correlates with different kinds of reduction strategies (Debénath and

Dibble 1994:13-14; Tomka 1989:146-147). For instance bifacial thinning flakes tend to have faceted platforms. The categories used here are commonly found in, and comparable to, other publications dealing with Predynastic lithics (Close 1980; Ginter and Kozlowski 1994; Holmes 1989; Midant-Reynes 2001; Midant-Reynes and Prost 2002; Nelson 1999). Some publications refer to platforms as "Butts" (e.g. Vermeersch et al. 2004; Tixier and Newcomer 1974).

Cortical: The platform is entirely covered by cortex.
Flat (a.k.a. "*lisse*" or "plain" or "unfaceted"): The platform is a single flake scar surface.

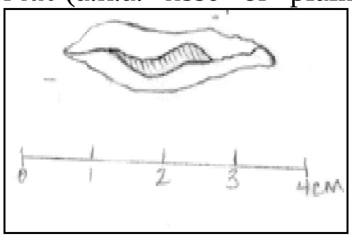

Figure XVI. Flat platform. MAP.2931.15.

Dihedral: The platform consists of parts of two flake scars that intersect, sometimes at a high angle.
Multifaceted (aka "faceted"): The platform has three or more flake scars, multiple ridges.

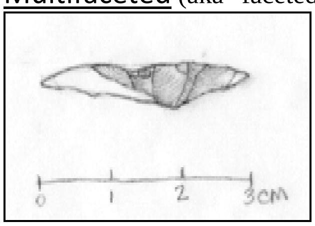

Figure XVII. Multifaceted platform. MAP.1050.28.

Gull-winged: A faceted platform with an undulating shape like that of gull wings (Inizan et al. 1999: 136).
Punctiform (a.k.a. "pointed" or "thinned"): An extremely narrow or small platform (Debénath and Dibble1994:14; Holmes 1989:427).
Linear: The platform is just an edge, width and thickness measurements would not be very precise.
Broken: The platform type is indeterminate because part of the platform has been broken or crushed, possibly during production (Holdoway and Stern 2004:120).
Other: The platform is present but it does not fit clearly into one of the above categories. For instance a fully abraded platform would be recorded here.
Indeterminate: The platform type cannot be identified for some reason.
N/A: Not applicable.

Bulb

This question refers to the size and prominence of a bulb of force relative to the rest of the flake. The formation and size of a bulb relates to the technique of flake detachment including hammer type, force, and application of force (Andrefsky 2005:20). For example, pressure flakes tend to have short fairly pronounced bulbs (Inizan et al. 1992:63). Direct percussion with an

Antler (rather than a stone billet) produced flakes with thinner bulbs of percussion among flakes with a small platform thickness, in an experimental setting (Pelcin 1997).

Diffuse: No bulb is present, the ventral surface is flat.
Moderate: In profile view some protrusion can be seen but it is gradual and not prominent.
Small prominent: The bulb is well defined but short/small (Holmes 1989: 291).
Prominent: In profile view the bulb is well defined and large (the bulb accounts for much of the flake's weight).
Ventral convex: The whole ventral side of the flake is convex. The bulb takes up the entire ventral surface.
Other: The bulb is present but does not fit any of the above categories.
Indeterminate: The bulb type cannot be determined, for instance if it was removed by flaking.
N/A: Not applicable.

Termination

Termination refers to the shape of the distal portion of the flake. The termination is formed by the way the flaking force exited the core, which itself relates to a combination of initiation type, core surface morphology, force, platform thickness, and platform angle (Cotterell and Kamminga 1987:698-703; Holdoway and Stern 2004:132). Feathered terminations are often ideal, but some technologies intentionally produce other terminations such as hinges or overshot flakes (Bradley et al. 2010; Cotterell and Kamminga 1987:701). The categories below derived from Cotterell and Kamminga (1987), Inizan et al. (1999), and Holdoway and Stern (2004). Stepped terminations also occur, but these are indistinguishable from breaks, and would be coded as incomplete flakes.

Feathered: The dorsal and ventral surfaces come together evenly at an acute angle.
Hinged: The ventral surface of the flake curves out to meet the dorsal face, usually ending in an more or less right angle or sometimes carrying over onto the dorsal face.
Plunging (aka "overshot" or "*outrepassée*"): The opposite of a hinged termination, these flakes remove part of the distal end of the object being worked. "The fracture plane curves markedly away from the surface of the core and continues into the core, removing part of the base of the core and resulting in a J shape when viewed in longitudinal cross section" (Holdoway and Stern 2004:132). Plunging flakes can be helpful for estimating nodule/core size, since they show the full length of the core at the time they were removed.
Axial: Axial terminations result when the force travels straight through a core, such as with a wedging initiation in a bipolar reduction technique.
Other: The termination is present but does not fit into any of the above categories.
Indeterminate: The distal end is present, but is unclear for some reason.
N/A: Not applicable.

Dorsal scar pattern

Dorsal scars were classified according to where the scars initiated relative to the axis of the flake. These are the scars that were present on the core before the flake was struck off, not scars resulting from retouch. Dorsal scar pattern information is used for assessing the kind of core and reduction strategy that the flake derived from, in conjunction with other production characteristics. Many Predynastic publications separate the flakes and blades into types based on the direction of dorsal flake scars (Close 1980:49-50; Midant-Reynes and Prost 2002; Vermeersch et al. 2004).

Proximal: Scars are unidirectional starting from the proximal end of the piece.
Distal: Scars are unidirectional starting from the distal end of the piece.
Opposite: Scars start at both the proximal and distal ends of the piece.
Lateral: Scars were initiated lateral relative to the axis of the piece
Proximal +lateral: Scars come from both the proximal and lateral directions.
Distal +lateral: Scars come from both the distal and lateral directions.
Multidirectional: Scars initiate from many/all directions.
Centrifugal: Flakes initiate on a ridge in the center of the flake.
Other: Flake scars are present, but they do not fit any of the above categories.
Indeterminate: There are flake scars present, but the pattern cannot be determined for some reason.
N/A: Not applicable.

Heat treatment

A primary reason to heat treat chert is to effect the mechanical properties of the chert. Controlled heating can make flaking easier to flake, but it also makes the pieces more likely to break. The changes in the visual properties may also have been a desired effect. Heat treatment can be identified through the increased luster and/or color change that occurs with heating. See Chapter 4.2 for a discussion of heat treatment and identification of heat treatment. The categories below were based mainly on luster differences but heat treatment could also be identified though comparison to the experimentally heated collection.

No: The piece is definitely not heat-treated. There is no difference in luster between earlier surfaces and later flake scars. Often the piece is matte rather than lustrous, even on flake scars.
Yes: More recent scars are glossier (more lustrous) than older scars, and/or color and luster changes match experimentally heat-treated materials of the same raw material variety.
Burned: The piece has thermal spalls, crazing, and/or rough breaks. There is also often an extreme color change to black, white, or grey.
Indeterminate: Heat treatment cannot be determined, for instance if the piece has a desert varnish, is burnt, or has a patina. This category also applies to pieces where there is no discernible difference in luster between earlier and later flake scars (which would

definitively indicate heat-treatment), but the scars are semi-glossy to glossy which could result from heat-treatment.

N/A: Not applicable.

Debitage type/ blank type

The debitage type category applies to any piece above 1.5 cm that was detached from a larger chunk of material, and cannot be considered a core or debris. This category was also used to classify the blank types for tools. The production of different tool types can often be associated with certain debitage types. The presence of debitage types is useful for identifying tool production locations. The list of debitage types considered in this study is followed by a description of each type. The characteristics given for each debitage type are the ideal versions. An individual flake would not necessarily have all of the characteristics ideal for a given category. Rather, the attributes are characteristics that are commonly found in an assemblage reduced in a certain way.

Flake: Flakes have a length to width ratio of less than two, which differentiates them from blades. Flakes can be any shape, such as expanding, contracting, or blocky. Flakes can result from core reduction aimed to make blanks for tools, or they can be byproducts of other reduction processes. Therefore they can be quite variable in size. The dorsal scar pattern can be single direction, rotated, or multi-directional.

Cortical flake: Any flake with over 50% cortex was characterized as a cortical flake. Such flakes usually do not have enough characteristic features to identify them with a specific reduction technique or reduction process because they have few dorsal flake scars. They may be the result of early stages in a tool production process.

Flake from a blade core: A piece of flake dimensions but with a dorsal scar pattern consisting of unidirectional evenly spaced straight thin flake scars. Such pieces were likely a result of accidents or core maintenance techniques associated with blade production rather than flake production, or from repurposing a blade core into a flake core.

Blade (medium blade): Blades result from a reduction strategy where flaking follows scar ridges parallel to the flaking axis and the flakes produced have parallel margins and relatively uniform thickness. In order to standardize blade identifications, Tixier (1963:36) defined blades as flakes where the length is (equal to or) more than twice the width. Blades should have parallel sides, although some may converge at the distal end. They can have one or two dorsal ridges forming a triangular or trapezoidal cross section. Blades are usually relatively thin, and usually have a uniform thickness (Andrefsky 2005:165). Blades can be removed through percussion or pressure flaking. Medium blades have a width over 1.2cm to differentiate them from bladelets (below). See Ch 5.2 for more on blade types.

Bladelet: Any piece with a length to width ratio of 2 or more and a width smaller than 1.2cm (1963:36). Bladelets generally have uniform width and thicknesses along with dorsal flake scars and ridges parallel to the flaking axis. Platforms also tended to be small. See Ch 5.2 for a more detailed discussion of bladelets.

Crested blade (a.k.a. *lame à crête*): Crested blades are of medium blade dimensions, have a triangular cross section, and dorsal scars that begin in the center of the dorsal ridge and extend out past the lateral margins. A "crested blade" results from shaping the edge of a blade core into a ridge to prepare it for removal of the first blade (Inizan et al. 1999:137-138). The detached ridge is the crested blade, and its removal sets up straight parallel ridges for subsequent blade removals. The second and third blades removed from a core prepared in such a way may also have signs of the initial shaping, and are called secondary crested blades and tertiary crested blades (Figure 5.7), and were noted in the comments. Unlike the removal of a utilized tool edge, there should not be use wear on the dorsal ridge.

Crested bladelet: A crested blade (see above) of bladelet dimensions.

Large blade: Large blades are quite a bit larger than medium blades in length, width and thickness, and must have resulted from a different production technology. Blades were classified as large blades if they had a length over 10 cm (if complete) or a width over 2.5cm and a thickness over 1.5 cm (if broken). See Ch 5.2 for more on large blades.

Prismatic blades: Prismatic blades with ridges and margins that are very straight and parallel to the flaking axis were made during the Pharaonic period, at least as early as the Early Dynastic period (Köhler et al. 2017). Prismatic blades from Wadi el-sheikh had lengths that ranged from 8-12cm (Barket and Yohe 2011:32), and were very narrow with widths that ranged from .6-2.4cm and averaged 1.2cm (Hart et al. *in prep*). See Ch 5.2 for more on prismatic blades.

Table I. Debitage types.

Debitage Type	Associated Tool Type
Flake	Many
Cortical flake	Many
Flake from a blade core	Blade production
Blade	
Bladelet	
Crested blade	
Crested bladelet	
Large blade	
Prismatic blade	
Alternate	Bifacial tool production
Thinning	
Ripple "C"	
Axe preparation flake / tranchet	
Burin spall	Burin production
Tool Maintenance	Many
Core tablet	
Core rejuvenation	
Maintenance/ recovery	
Bipolar	Scaled pieces & other tools

Side-blow	Side-blow tools
Hammer spall	Many
Bulb removal	
Nodule	

Thinning flake: Thinning flakes are curved in longitudinal section because they follow the shape of the biface. In plan they often expand toward the distal end because they are being removed from a flat surface instead of following strong ridges which would shape the direction of flake removal. They are generally thin. Dorsal flake scars are usually multidirectional since thinning flakes are usually removed from a bifacial preform, and the platforms are often multifaceted for the same reason. Platforms are often small due to the need to have very controlled placement and application of force.

Ripple "C" flake: A special subset of thinning flakes that result from the ripple-flaking was identified by Kelterborn (1984:442) through experimental recreations of ripple-flaked knives. Preforms for ripple-flaked tools were ground very thin before flaking, so one of their most distinctive features is a ground surface on the dorsal side of the flake. Made through pressure flaking each ripple "C" flake follows a ridge left by the previous removal. Kelterborn described these flakes as being relatively large, oval flakes with a curved longitudinal profile, a pronounced bulb, a slightly curved single central ridge in the shape of a "C", and a ground platform with a platform angle around 75 degrees.

Bulb removal flake: Sometimes the bulb of a flake was removed in order to thin a tool. Such flakes are distinctive because the dorsal surface consists of a bulb from part of a ventral surface. The flakes look like they have two ventral surfaces. They are often bi-convex with the axis of flaking rotated 90 degrees relative to the original flake axis.

Alternate flake: Alternate flakes result from removal of a square edge, in order to make a bifacial edge so that a piece can be thinned or shaped (Yerkes and Kardulias 1993:97). These are called alternate flakes because they are removed alternately from one face then the other. The key features are the flake shape relative to the orientation of removal: the flake extends far to one side relative to the flaking axis (most of the flake mass is off-center from the flaking axis). The flakes are wide rather than long. Additionally the dorsal face of the flake carries a ridge or corner making a triangular cross-section.

Axe preparation flake (a.k.a. *tranchet*): Axe-preparation flakes result from a transverse blow along the distal margin of an axe in order to create an acute-angled sharp edge (Holmes 1989: 456-458, 1990). The flake will have a triangular cross section, and the two faces that form the dorsal surface should show bifacial flaking from shaping the axe.

Burin spall: A burin spall is a flake that removes a thin edge rather than a face of a tool or core. It is struck off parallel to the edge, leaving a scar that meets with the dorsal and ventral surfaces of a flake at ~ 90 degree angles. Burin spall removals create a strong working edge. Burin spalls are triangular in cross section, and often extremely narrow.

Tool maintenance: A burin spall that removes a retouched (and utilized) tool edge is classified as a tool maintenance flake.

Core tablet: A core tablet results from the removal of an entire core platform and is often done to rejuvenate a core platform surface. The core platform is struck an angle perpendicular to previous removals. Core tablets often have a scalloped edge(s) in plan-view due to the scars where previous flakes have been removed perpendicular to the core tablet dorsal face. The cross section can be relatively square, with parallel dorsal and ventral surfaces joined by perpendicular margins.

Core rejuvenation: A core rejuvenation flake is like a core tablet, but only part of the core platform was removed, creating a triangular rather than square cross section.

Maintenance flakes (recovery flakes): A flake with a deep hinge or series of compounded step terminations on the dorsal surface is a maintenance or recovery flake. Such flakes were removed in order to correct a mistake or smooth the surface of a core or preform.

Bipolar Flake: A bipolar flake is a wedging initiated percussion flake that is detached by striking a core that is resting on an anvil. These flakes have platforms that are crushed, or missing, and there may be crushing at both ends. Bipolar flakes have no bulbs because they are wedging (axial) initiations rather than conchoidal fractures. The flakes are straight or wedge-shaped in the longitudinal section.

Side blow: Side-blow flakes are characteristic of Egyptian Neolithic sites (Banks 1984:175; Caton-Thompson and Gardner 1934:21; Kindermann 2010:43-44), and have sometimes been found in Predynastic sites (Vermeersch et al. 2004). Side blow flakes are flakes struck from a nodule that is held so that it is wider than it is long. Since it is struck that way the platforms are very wide and thick and the flakes are short. A number may be removed in a row directly behind each other resulting in a dorsal flake scar with a central concavity (from the bulb of the previous removal) and giving the flake a swooping appearance.

Hammer spall: A hammer spall results when a flake detaches unintentionally from the hammer stone rather than from the nodule being reduced. Therefore they are often of a non-chert raw material. There is usually crushing and incipient fractures on the platform of the flake from previous use as a hammer stone. They have characteristics of hard hammer percussion such as being large with prominent bulbs.

Nodule: This category was used to describe tool blanks when cortex could be observed on two faces of the tool showing that it must have been made from a nodule.

Other: Any distinctive flake which is definitely different from the above categories.

Indeterminate: Any flake that cannot securely be attributed to one of the above categories, such as fragments.

N/A: Not applicable.

Retouched Tools Information

Retouched tools have patterned macroscopically observable scars from flake removals that were made as part of making or re-working a tool. The seven categories used to describe the retouch after the 'extent of working' category follow Inizan et al. (1999). See also Holmes (1989: 450-456).

Extent of working

The extent of working codes how intensively a tool was shaped. This information is useful for categorizing the tool types, and for understanding how much investment there was in their production.

Edge retouched- unifacial: The retouch was confined to the edge (not invasive) on only one face of the piece.
Edge retouched- alternate: The retouch was confined to the edge (not invasive), on more than one edge, but on different faces.
Edge retouched- alternating: The retouch was confined to the edge (not invasive), on both faces of an edge, but without overlapping.
Edge retouched- bifacial: The retouch was confined to the edge, on both faces of an edge, and the retouch on both faces meet at the edge.
Invasive unifacial retouch: There is retouch on only one face of the tool, and the scars are invasive, reaching most of the way or all the way to the middle of the piece.
Invasive bifacial retouch: There are invasive scars on at least one face of the piece, and invasive or edge retouch on the other face, that forms a bifacial edge.
Bifacial: There are invasive scars on both faces of a tool.
Bifacially thinned and stylized: There are invasive scars covering most or all of both faces of the tool, and it has been worked into a distinctive shape clearly associated with a well-defined bifacial tool type.
Other: There are retouch or shaping scars that do not fit with any of the above categories.
Indeterminate: The extent of working cannot be securely attributed to one of the above categories, such as for fragments.
N/A: Not applicable.

Delineation

Delineation describes the shape of an edge created by retouch, in plan view (*ibid*:87,138, 140).

Rectilinear: The retouched edge is rectilinear.
Convex: The retouched edge curves outward.
Concave: The retouched edge curves inward.
Denticulated: A series of adjacent notches.
Notch: A single notch or multiple notches that are not adjacent (e.g. on different edges).
Cran: A retouched edge that is partially straight and curves outward at one end.
Shoulder: The retouched edge forms a small convex protrusion, with retouch continuing on one side.
Nose: The retouched edge forms a small convex protrusion, with retouch continuing on either side of the protrusion.
Tongue: The retouched edge forms a long protrusion, with retouch continuing on either side of the protrusion.
Tang: The retouched edge forms a protrusion, which is opposite a working edge and was used for hafting.
Long narrow tang: A longer tang.
Combination: Any combination of the above
Irregular: The retouched edge is variable.
Other: The retouched edge shape cannot be categorized according to the above descriptions.
Indeterminate: The retouched edge shape cannot be determined, for instance if it is broken.
N/A: Not applicable, (e.g. burins).

Extent

Extent characterizes the invasiveness of the retouch (*ibid*:141; Holmes 1989:) invasiveness.

Non-invasive (short): the retouch is confined to the edge, around a quarter of the way to the center of the piece from the edge, or less.
Slightly invasive (long): the retouch reaches from about a quarter of the way to the center of the piece, to around half way to the center of the piece.
Invasive: the retouch reaches over half way to the center of the piece.
Combination: The retouch does not predominantly fit into one of the above categories but a combination (described in the notes).
Other: The retouch scars cannot be categorized according to the above descriptions (e.g. burins).

Indeterminate: The extent of the retouch scars cannot be determined, for instance if the piece is broken.
N/A: Not applicable.

Angle

Angle describes the angle of the removals relative to the opposite face the angle formed by removals relative to the face from which they were initiated (Inizan et al. 1999:129).

Flat (low): Very acute, ~25 degrees or less.
Semi-abrupt: ~ 45 degrees
Abrupt: ~ 90 degrees.
Combination: The retouch scars are not predominantly one of the above categories but a combination (described in the notes).
Other: The retouch scars cannot be categorized according to the above descriptions (e.g. burins).
Indeterminate: The angle of the retouch scars cannot be determined
N/A: Not applicable.

Localization

Localization describes the location of removals along the edges relative to the orientation of the piece (*ibid*:144-145). For tools on debitage blanks the descriptions applies to a piece oriented so that the platform is near the viewer and the dorsal side is up. For tools on nodular blanks the descriptions follow congenital orientations for the tool, usually with the working edge farthest from the viewer and the haft or handle nearest.

Proximal
Distal
Right lateral
Left lateral
Combination: The specifics are described in the notes.
Other: The retouch scars cannot be categorized according to the above descriptions.
Indeterminate: The localization of the retouch scars cannot be determined, for instance if the piece is broken.
N/A: Not applicable.

Position

Position describes the location of the removals relative to the faces of the piece (*ibid*:151-152).

Direct: The scars of the removals are on the dorsal side of the piece, and were initiated on the ventral side of the piece.
Inverse: The scars of the removals are on the ventral side of the piece, and were initiated on the dorsal side of the piece.
Alternate: The removal scars are on multiple edges of the piece, but on different faces.
Alternating: The removals are on both faces of a piece, on the same edge, but were not initiated in the same place (not bifacial).
Bifacial: There are removals on the dorsal and ventral faces, initiating at the same place along the edge. In other words the removals meet at the edge forming an angle less than 90 degrees.
Crossed: The removals were initiated on both faces of the piece, forming a face perpendicular to the dorsal and ventral faces (e.g. backing retouch).
Combination: The removals are not predominantly one of the above categories but a combination (described in the notes).
Other: The removals cannot be categorized according to the above descriptions (e.g. burins).
Indeterminate: The position of the removals cannot be determined, for instance if the piece is broken.
N/A: Not applicable.

Distribution

Distribution describes how much of the edge is occupied by retouch (*ibid*:140-141).

Total: The retouch occurs along the entire length of an edge.
Partial: The retouch is continuous, but does not occupy the entire length of an edge.
Discontinuous: The retouch is not continuous along the edge, there are one or more spaces in between the removals.
Combination: The retouch scars are not predominantly one of the above categories but a combination, for instance total on one margin, but partial on another.
Other: The retouch scars cannot be categorized according to the above descriptions.
Indeterminate: The retouch scars cannot be determined, for instance if the piece is broken.
N/A: Not applicable.

Morphology

Morphology describes the general shape of the retouch removals (Inizan et al. 1999:146)

Scaled: The retouch scars are wide and short, resembling fish-scales. Their terminations can be feathered or slightly hinged.

Stepped: Wide short removals, with stepped and/or hinged terminations. These types of scars result from bending rather than conchoidal initiations. Often the scars are compounded on top of each other on thick blanks.

Parallel: The retouch scars are longer than they are wide, and they are parallel to each other, with feathered terminations or slightly hinged terminations.

Sub-parallel: The retouch scars are longer than they are wide, but the scars are not quite parallel to each other, going in slightly different directions, usually with feathered terminations or slightly hinged terminations.

Combination: The retouch scars are not predominantly one of the above categories but a combination (described in the notes).

Other: The retouch scars cannot be categorized according to the above descriptions (e.g. burins).

Indeterminate: The retouch scars cannot be determined, for instance if the piece is broken.

N/A: Not applicable.

Tool type

The following list of tool types was derived primarily from a number of works dealing with 4th millennium B.C.E. Egyptian lithics: Baumgartel 1960; Hikade (2001); Holmes (1989, 1990); Kabacinski (2012); Midant-Reynes and Prost (2002); Rizkana and Seeher (1985, 1988); Schmidt (1999, 1996, 1992a,b). Kindermann (2010) worked on mid-Holocene Egyptian stone tools and clarified some of the boundaries between tool types. Much research on Predynastic and earlier lithics in Egypt was influenced by Tixier's (1963) work in the Epipaleolithic of the Maghreb. Inizan et al. (1999) provide a glossary of definitions, much of which is based on Tixier's work, but updated and in English. Tixier's work stemmed from and was influenced by European Paleolithic research (Bordes 1961), and a more recent development of that line of research that is also in English is Debénath and Dibble (1994). Another useful source was Rosen (1997) which deals with stone tools for the post-Paleolithic Levant, since that material was chronologically and geographically close to the Predynastic Egyptian lithic stone tools. Also Tixier did not cover bifacial tools, while most of the rest of the above mentioned sources do.

The blank type was recorded separately, so there was no need to make specific tool types related to the blank (reducing the number of tool types from Tixier's list). The total number of tool types is 53, but not all were identified in the assemblages from el-Mahâsna, Abydos, and Nag el-Qarmila.

Table II. Tool types.

Retouch Intensity	Tool Class	Tool type
Edge retouched tools	Burins	Burin
		Multiple burin
		Dihedral burin
		Burin on a retouched edge
		Nucleiform burin
	Notches & Denticulates	Notch
		Denticulate
		Sickle blade
	Scrapers	Endscraper
		Microendscraper
		Circular scraper
		Sidescraper
		Tabular Scraper
	Truncations	Truncation
		Double truncation
		Backed truncation
		Backed double truncation
		Truncation knife
	Geometrics	Transverse arrowhead

		Lunate
	Backed pieces	Backed piece
	Perforators	Perforator
		Drill/double-backed perforator
		Microdrill
	Unpatterned	Retouched piece
Invasively retouched pieces	Knives	Hemmamiya Type A blade knives
		Hemmamiya Type B Blade knives
		El-Omari knives
	Planes	Plane
	Worked nodules	Worked tabular slab
		Chopper
		Pounder
		Grand perçoir
		Chisel
	Scaled pieces	*Piece esquille*
Bifacial Tools	Drills	Bifacial drill
		Crescent drill
		Winged drill
	Axe	Axe

	Varia	Bifacial triangle
		Preform
		Bifacially retouched piece
		Core/tool
Bifacially thinned and stylized tools	Projectile points (symmetrical)	Concave-base projectile point
		Tanged point
	Daggers/lances (symmetrical)	Fishtails
		Rhomboids
		Daggers
	Knives (asymmetrical)	Bifacial knife
		Bifacial sickle
		Ripple-flaked knife
	Eccentrics	Eccentrics
Other	Indeterminate	Unidentifiable tool fragment

EDGE RETOUCHED PIECES

The edge retouched pieces are generally unifacial, unless otherwise noted.

BURINS

A burin is a tool with a scar from a flake removed parallel to a flake margin, rather than off of the face of the tool. The scar meets with the dorsal and ventral surfaces of a flake at ~ 90 degree angles, leaving a very sturdy working edge. Burins are a very common type of Predynastic tools, and more divisions can be made for burins (e.g. Holmes 1989:398-399).

Burin: A tool with a single burin spall facet. Tixier type 19.

Multiple burin: A tool with two or more non-adjacent burin spall facets. Tixier types 20, 27.

Dihedral burin: On dihedral burins the scar of the first burin spall removed becomes the striking platform for the second burin spall, and forms an angle less than 90- degrees. Tixier types 17-18.

Burin on a retouched tool: A tool where a burin spall or spalls was removed from a retouched edge, or a tool that has retouching that is not adjacent to the burin. This kind of tool can be further specified with details on the type of retouching, such as a burin on a truncation, burin on a scraper, or burin on a piece with continuous retouch. Tixier types 21-26, 29-33.

Nucleiform burin: A burin or burins on a very thick blank. Tixier type 28.

NOTCHES AND DENTICULATES

Notch: A notch is a tool with one or more non-adjacent concavities formed by retouch. Sometimes they are found on pieces with other retouch. Tixier types: 73, 74, 76.

Denticulate: A tool is a denticulate when there are two or more adjacent notches (Tixier 1963:117-124). The denticulations can be regular or irregular, with the details noted in the comments. Tixier types 75, 77.

Sickle blade: A blade or bladelet with regular denticulations along one or two lateral margins and sickle gloss. (Holmes 1989:402; Midant-Reynes and Prost 2002:375; Rosen 1997:44-60). Any truncations or backing were described in the comments. It should be noted that the denticulations can be formed by unifacial retouch or bifacial retouch that is confined just to the edges forming the denticulations Tixier type78.

SCRAPERS

As described by Tixier (1963:54) scrapers have continuous regular retouch, the inclination of the retouch at the edge is usually flat to semi abrupt, but can be resharpened to abrupt scalar retouch. Rosen (1997: 86-87) describes scrapers from the Levant as made on flakes from amorphous cores with no preparation. The retouch is varied from rather ephemeral to somewhat invasive and less regular than on Paleolithic scrapers.

Endscraper: An endscraper is a scraper with the retouched edge on the distal margin, although the retouch may extend farther around the piece, and the scraper edge is more or less regularly rounded (Tixier 1963:54). Endscrapers are differentiated from truncations because truncations form at least one corner with a lateral margin. Furthermore, the angle of the retouch for endscrapers is generally flat to semi-abrupt, whereas truncations are semi-abrupt to abrupt, and the working edge for endscrapers is the retouched edge, but the working edge for truncations is the lateral margin (Holmes 1988:400). Additionally, truncations are usually on blades rather than flakes, while scrapers can be made on either kind of blank. Endscrapers may vary in the details of the delineation, angle, position, and morphology. The thickness of the piece and any additional retouch was noted. Tixier types 1, 2, 4, 5, 6, 7,8 , 9, 10, 11.

Microendscraper: "Nibbling retouch on the distal and sometimes lateral edges of bladelets superficially resembling miniature endscrapers on blades" (Rosen 1997:65). Although termed microendscrapers, the small nature of the tools and the retouch on the distal end makes these tools somewhat ambiguous between endscrapers and truncations

(Rizkana and Seeher 1988:27; Holmes 1989:403). Many authors have noted that these bladelets often have more or less ephemeral retouch along a lateral margin in addition to the distal retouch (Hikade 2004:65-66; Holmes 1989:403; Rizkana and Seeher 1988:27). These were sometimes made on heat-treated bladelets, and Holmes (1989:403) termed these "glossy bladelet tools", but most authors use the term microendscrapers, which is followed here. See also Hikade 1996; Midant-Reynes and Prost 2002:376; Schmidt 1999).

Circular scraper: A scraper whose retouched edge extends around at least 75 percent of the entire tool margin. They are circular to oval in shape, and some are D-shaped Holmes 1989:396). They can be any size. Tixier type 3.

Sidescraper: A tool with continuous regular retouch along the lateral margin, usually slightly convex with a flat to semi-abrupt angle, is a sidescraper. Following Kindermann (2010:43) sidescrapers were differentiated form edge-retouched knives based on dimensions, with side scrapers having a length to width ratio of less than 2, and knives a length to width ratio of 2 or more. Tixier type 106.

Tabular scraper: Tabular scraper production is a well known phenomena in the Levant (Rosen 1997:71-80), but they have also been found in Egypt (Rizkana and Seeher 1988:29-31). Tabular scrapers were made on large flat flakes with cortex covering most of the dorsal surface. They were made in shape varieties. They often have pronounced bulbs of percussion and can have flat or faceted platforms. On some pieces the cortex is ground very flat and smooth. Some examples have bulbar thinning. None were identified in the three assemblages studied here.

TRUNCATIONS

Tixier (1963:124-127) defined truncations as abrupt rectilinear continuous retouch at the distal or proximal end of blade or bladelet (only rarely on a flake). The retouch can sometimes be semi-abrupt . The retouch forms at least one angle with the lateral margins the blade or bladelet, which distinguishes the tools from endscrapers (see endscrapers above for more on differentiating endscrapers and truncations). Abrupt retouch on a lateral margin would be considered a backed piece. The delineation of the retouched edge could be straight or convex (but usually straight). A concave delineation would be considered a notch. The orientation of the truncated edge relative to the blade axis (horizontal, oblique) was noted in the comments.

Truncation: A piece with one truncation at either the distal or proximal end. Tixier type 80, 81.

Double Truncation: Also called a bitruncated blade (Rosen 1997:60-65), or a rectangle (Schmidt 1999:35), a double truncation is a blade or bladelet with truncations at both the distal and proximal ends. The "razor blades" of the Pharaonic period would be a subtype of the double truncations, on wide blades and with very neat retouch, but none were observed during this study.

Backed truncation: A blade or bladelet with a single truncation at one end and backing retouch along one lateral margin.

Backed Double truncation: A blade or bladelet with truncation at both the distal and proximal ends, and backing retouch along one lateral margin.

Truncation knife: A truncation knife (Holmes 1989:146, 400), also known as "blade knives of the Badarian Type" (Schmidt 1996:281), is an oblique convex truncation on a blade or bladelet which forms a corner with one lateral margin (the working edge) and is rounded at the other corner. The truncation is usually proximal. The angle of the retouch may be semi abrupt or even flat. The end opposite the truncation is usually retouched round, sometimes ogival. One lateral edge is often retouched with very small to small scars along some or all of the edge.

GEOMETRICS

Tixier (1963:127) defined geometrics as tools of small or very small dimensions, made on a blade or bladelet with two abrupt retouch. The tools have a geometric outline in plan, such as rectangle, half circle, trapeze, triangle, or scalene triangle. At least one edge is not modified, presumably the cutting or working edge. Functionally geometrics were projectile points or parts of composite tools. Although there were many distinct types of tools in the geometric tool class for the Epipaleolithic of the Maghreb, they were less common in Egypt during the 4th millennium B.C.E. so only two types are considered here.

Transverse arrowheads: Transverse arrowheads generally have proximal and distal oblique truncations forming a small tool that is trapezoidal in outline. One lateral margin was longer and unworked, forming the cutting edge. Holmes (1989:X) notes that the proximal or distal edge may be a break instead of a retouched edge. These tools were usually made on blades or bladelets, but could also be made on thinning flakes (Takamiya and Endo 2008). Tixier types 83-93.

Lunate: A very small tool where the proximal end, distal end, and one lateral margin have been retouched into a semi-circular shape leaving one lateral edge unworked as a cutting edge. Tixier type 82.

BACKED PIECES

Backed pieces: Inizan et al. (1999:130) define backed pieces as those with continuous regular retouch that extends along the length of blank (on a lateral margin). This retouch should be abrupt enough not to create a new cutting edge, and could be made through direct or bipolar retouch (Rosen 1997:60; Tixier 1963:84). Backing is more common on blades or bladelets than flakes. For Paleolithic collections Debénath and Dibble (1994:100) emphasize that backing has to be across from a cutting edge, and this rule will be followed here (for instance a tool with continuous abrupt retouch across from a cortical edge would be included with retouched pieces, not backed pieces). Blade knives can be differentiated from backed pieces based on the presence of more standardized shaping and the presence of more invasive retouch (see blade knives below). Holmes (1989:400) observed are few backed pieces in Predynastic assemblages, accordingly Tixier's many separations of backed blade types are not required here. Tixier types 34-37, 39-40.

PERFORATORS/DRILLS

Perforators, also known as borers, piercers, awls, and drills, are a group of tools which can be made from unifacial edge retouch but can also have alternate or alternating edge retouch. Although defined morphologically, they often show usewear indicative of perforating or perforating and twisting .

Perforator: Flake, blade, or bladelet presenting a projection generated by bilateral retouch forming a single or double shoulder (Tixier 1963:63). The retouch can be flat to abrupt. Tixier type 12, 13.

Microdrill: Microdrills are tools made on bladelets with drill tips shaped by small retouch on both lateral edges (Holmes 1989:399). The retouch sometimes continues along the entire length of the edge. Microdrills are small, those from HK29A ranged from 1.8-5.8cm long and averages 2.02cm long (*ibid*). None were identified in the three assemblages studied here.

Drill: A double backed perforator (a.k.a double backed perforator or *mèche de foret*), has a long slender bit, is made with abrupt retouch, the lateral margins are mainly parallel, and does not necessarily have a shoulder or shoulders (Tixier 1963:66).The edges can be formed by burin blows, or they can be made on burin spalls. There is often usewear at the tip. Tixier type 16.

UNPATTERNED

Retouched piece: A unifacially retouched tool which is complete, but does not fit any of the above categories. The retouch is often irregular and does not have any clear design (Holmes 1989:417). Here this category includes Tixier type 105, piece with continuous retouch. These are considered ad-hoc tools.

INVASIVELY RETOUCHED/THINNED PIECES

KNIVES

Hemmamiya type A blade knives (a.k.a. blade knives, end-scraper knives) (Baumgartel 1960:37,40; Holmes 1989:402; Schmidt 1989:85,1992a:32, 1996:281-282, 1999:32): These tools are made on blade blanks, and show a standardized retouch pattern with the knife point at the proximal end, often formed by bifacial retouch, with the bulb removed by flat (invasive) retouch. There is semi-abrupt to abrupt backing retouch along the right lateral margin (dorsal side up, proximal end toward the viewer) on the dorsal side forming a straight back. Often the backing continues onto the distal end forming a rounded handle which looks like a scraper end. The working edge (on the left lateral margin) is straight or slightly convex, and there is often flat (semi-invasive?) retouch on the ventral side of this edge, which may be from re-sharpening. These knives were usually made on large twisted blades. Schmidt (1996) designated the knives that conform precisely to these parameters Hemmamiya knives type A, and called this standardized retouch pattern "Seitenbezogenheit." Holmes (1989:402) gave a size range of 8-15cm in length.

Hemmamiya type B blade knives (AKA other blade knives, endscrapers on blades): Tools made on blades with lateral backing retouch and additional retouch (such as invasive retouch removing a bulb or flat ventral edge retouch), but that do not conform precisely to the retouch patterns or shape outlined for Hemmamiya type A knives, are Hemmamiya Type B blade knives. If a blade only has backing retouch it would be classed as a backed blade. Schmidt (1996:281) also writes that some items classed as endscrapers on blades at Maadi (Rizkana and Seeher 1988:27) should be in this type B blade knife category. Kabacinski 2012 gave a size range of 5-15 cm in length for examples from Tel el-Farkha.

el-Omari knife: These knives have backing retouch forming a convex edge, a straight cutting edge, and a tang-like handle defined by retouch (Schmidt 1996:283).

Plane (A.K.A rabot-plane, adze): Planes are made on thin nodules or flakes, and are expanding (trapezoidal) in plan-view shape. The working edge is the broad distal edge. They have a plano-convex cross section, one face is very flat, either naturally, or through thinning retouch, and the other is convex. The working edge is located closer to the flat face. The convex face often has invasive retouch, or complete facial thinning. The retouch on the working edge is semi-abrupt to abrupt. Holmes (1989:405); Midant-Reynes and Prost (2002:378).

WORKED NODULES

Worked tabular slab: A thin natural piece of material (nodule or natural spall) that has been worked into a tool, often with bifacially edged or invasive bifacial retouch (Holmes 1989). The retouch does not cover the entire tool, and cortex remains. To differentiate them from choppers the width to thickness ratio should be less than 2.

Chopper: a Chopper is an approximately fist-sized nodule (approximately round in plan, and thick) with some flakes removed forming an broad edge. The edge can be bifacial or unifacial. Much of the cortex remains on the nodule. Choppers can be distinguished from cores by indications of use on the working edge (Rosen 1997: 98).

Pounder: This tool type had to be defined based on the find of one such item at el-Mahâsna (Figure 4.51). This thick tool with an expanding shape was partially shaped or thinned from both ends, leaving much of the surface covered in cortex. The working edge was a broad flat face perpendicular to the axis of the tool, which bore many pecking marks from shaping and/or use. The tool may have been used as a pounder or pestle.

Grand Perçoir: As Tixier (1963:66) describes, these are large pointed implements that are partially bifacially worked and made on a nodule. the proximal end is wide, differentiating them form picks/chisels. Holmes (1989:399) and Midant-Reynes and Prost 2002:375-376) drop Tixier's "Caspien" designation and note that the perforator tip need not have a triangular cross section as Tixier specified. Tixier type 15. None of these tools were found in the three sites studied here.

Chisel (A.K.A pick): These are elongated narrow tools with a narrow or pointed working edge that could be made on a nodule or large flake (Midant-Reynes and Prost 2002:378). They are coarsely made and can be trihedral or bifacial (Rosen 1997:93). Chisels can be differentiated from axes, because axes have a broader working edge, and are not as elongated or narrow as chisels. It seems reasonable to suggest a length: width ratio greater than 2 to separate chisels and axes. None of these tools were found in the three sites studied here.

OTHER

Piece esquille (Scaled pieces): *Piece esquilles* are produced through bipolar reduction, and it is debated whether they should be considered wedging tools or cores for very small flakes (Bradbury 2010; LeBlanc 1992; Shott 1999). The flakes usually come off bifacially from both ends and can be invasive. The resulting items are usually rectangular or square in shape (Tixier 1963:146). The bipolar reduction often causes crushing at both ends. Tixier type 104.

BIFACIAL TOOLS

DRILLS

Bifacial drill: Holmes (1989:412,414) defined a bifacial drill as an elongated tool (with no shoulder) that has a thick cross section, and wear at one end. Such tools were shaped by full bifacial retouch. This differs from a double-backed perforator/*meche de foret* which has steep edge retouch blunting the piece (Kindermann 2010:43). None were identified in the three assemblages studied here.

Crescent drill: Holmes (1989:415, 416) described crescent drills as thick bifacially worked tools with a concave upper margin and a convex lower margin that is the working edge. They were used for drilling soft stone into vessels and usually date to the Early Dynastic and Old Kingdom, but have also been found in Predynastic sites (Hierakonpolis and Naqada). Midant-Reynes and Prost (2002:374) note that the crescent drills and winged drills may be related. None were identified in the three assemblages studied here.

Winged Drill: Holmes (1989:412, 415) described winged drills as relatively thick bifacially worked Y-shaped tools where the drill bit tends to have a circular cross section, and wear. the drill bit is thicker than the wings. See also crescent drills. None were identified in the three assemblages studied here.

AXES

Axe: Axes are bifacial tools that are bi-convex in cross section with a wide working edge at the distal extremity. They are relatively thick and their shape in plan view is generally oval, rectangular, or expanding toward the working edge (see Holmes 1990 for more shape details). The working edge of some axes was prepared by a transverse blow (tranchet), creating a smooth sharp cutting edge. The working edge is generally in the middle of the tool in cross section (Rosen 1997:93), but those with a tranchet blow may be skewed more toward one face. Predynastic axes can be relatively small averaging around 6cm in length (Holmes 1990). See chapter 6.1 for more details about axes.

VARIA

Bifacial triangle: Holmes (1989:412) describes these as triangular tools (in plan view) that are fully bifacially thinned and have a triangular shape with slightly rounded corners. Two of the edges may be slightly convex. These are rare items which could be preforms rather than finished tools.

Preform: A preform is defined here as a bifacial piece with relatively fine (rather than course) scars from thinning, and that is somewhat thicker than the bifacially thinned and stylized tools. The edges in profile view may be wavy rather than retouched to be straight, indicating that the final retouching has not been completed. To some degree classifying something as a preform depends on familiarity with the other bifacial tool types.

Bifacially retouched piece (A.K.A Miscellaneous bifacial tool): A bifacially retouched tool which is complete, but does not fit any of the bifacial tool categories. The retouch is often irregular and course and there is no clear design or pattern to the shape (Holmes 1989:417). They may be relatively thick.

Core/tool: The category core/tool is for items that could be either a core (a source of flakes) or a tool.

BIFACAILLY THINNED AND STYLIZED TOOLS

PROJECTILE POINTS

Concave-base projectile point: These are relatively small symmetric fully bifacially retouched and shaped tools which are quite thin. They are triangular in shape and two long barbs form a deep notch or hollow base, which was used for hafting (Clark 1975). The lateral edges may be straight, slightly convex. The barbs can be straight or slightly convex, and the shape of the wing tips can be pointed or square. the distance from the interior of the notch to the tip of the point can vary. Many have very fine microdenticulation along the outer margins. (See Chapter 6.1, Hikade 2001 for more details).

Tanged projectile point: Small pointed symmetrical thin bifacially retouched tools with a tang formed by retouch at the base. The curvature of some examples from Maadi indicate that they may have been made on blades (Rizkana and Seeher 1985:243). See Hikade (2001) for subtypes and more details. None were identified in the three assemblages studied here.

DAGGERS/LANCES(elongated symmetrical bifacial tools)

Fishtail tools: These tools are shaped like an inverted triangle, with a U or V-Shaped notch or fork at the top, which is the working edge. They are fully bifacially thinned, usually with fine flat scars. The haft area often has coarser flake scars. They have microdenticulation in the forked area and along the lateral margins which stops above the haft area. Some later versions have ripple flaking on both faces. The shape of the fork is a chronological indicator. See Chapter 5.1 for more details.

Rhomboid tools: Rhomboid tools are elongated bifacially thinned tools that can be extremely long, over 40cm (Baumgartel 1960:32). They are also quite thin, especially considering their length. They are symmetrical along the vertical and horizontal axes. Rhomboid tools are slightly wider in the center, usually with a rounded corner in the middle of each lateral edge. The tips are usually rounded rather than pointed. They have fine microdenticulations all along the edges except for in the hafting area, which can have slightly courser retouch. See Chapter 5.1 for more details.

Dagger: A dagger is an elongated symmetrical thin bifacial tool. Similar to rhomboid tools they are smaller, with a pointed tip, and convex lateral margins without the marked corner of rhomboids. A rarer kind of tool, they are not always included among Predynastic tool type lists. Examples: Figure 6.7; Petrie and Quibell 1896:Pl 72 (56).

KNIVES

Bifacial knives: Following Midant-Reynes and Prost (2002:374) and Holmes (1989:405) bifacial knives are asymmetrical bifacially thinned tools with a straight or slightly convex back. The working edge is slightly convex and curves back to meet the back forming an acute or right angle. The proximal end can be rounded or have a handle. Holmes (*ibid*) notes that the handle is often formed by indenting from one side only and that truly 'handled' knifes are not common until the Early Dynastic period. The Predynastic bifacial knives are generally thin and the working edge can have fine microdenticulation. They can have edge retouch that follows the same "Seitenbezogenheit" pattern described for blade knives (Schmidt 1989:85,1992a:32, 1996:281-282, 1999:32). The forms and quality of the thinning and retouch can vary widely. Kabacinski 2012 differentiated bifacial knives based on their width. See Chapter 5.1 for more details.

Bifacial sickles: Bifacial sickles are fully bifacially thinned tools that have denticulations along one edge. Some can be symmetrical, but with denticulations along only one margin, while on others the denticulated side can be more convex than the opposite margin. The three shapes are bipointed, pointed on one end and squared on the other, or squared on both ends. The bipointed ones are often larger. These can be differentiated form bifacial knives with denticulations because they lack the rounded or handled proximal end of knives, and the denticulations on bifacial sickles are larger than those on the knives. Bifacial sickles were probably used for reaping or for sawing plant material as they often have sickle sheen. See Chapter 5.1 for more details.

Ripple-flaked knife: Ripple flaked knives follow the same shape as described above fro bifacial knives, but they have a very distinctive type of ripple flaking on one face, and a ground surface on the other face. The ripple-flaking is extremely uniform flat parallel pressure flaking carried out from each lateral edge and meeting in the center of the face. Ripple flaked knives were hafted, and some have small tangs for hafting. See Chapter 5.1; Holmes 1989; Kelterborn 1984; Midant-Reynes and Tixier 1981; Midant-Reynes 1987 for more details.

OTHER

Eccentrics: Eccentrics are flaked stone items which have been shaped into images of figures, usually animals but also including humans, arrows, and unidentifiable figures. Many examples are fully bifacially retouched with very fine flaking, but edge retouched examples also exist. See Chapter 5.1; Friedman 2000; Hendrickx et al. 2003; for more details.

Unidentifiable tool fragment: A fragment of a tool that is not preserved to a sufficient degree for the appropriate type to be identified. The retouch description, such as unifacial edge retouch or bifacial retouch, is recorded in the notes.

Information on Cores

Core platforms

The core platform category indicates the number of flaking platforms and their relationship to each other (Close 1977:54-56).

Single: The core has at least 3 scars going in the same direction off of a single platform.
Opposite platform-one face: Scars initiate from two platforms, at opposite ends of a core, on the same face.
Opposite platform-different face: Scars initiate from two platforms at opposite ends of a core, but on different faces.
90-degree: Scars initiate from two platforms, roughly perpendicular to one another, on the same face.
90-degree-different face: Scars initiate from two platforms, roughly perpendicular to one another, but on different faces.
Multiplatform: Scars initiate from three or more platforms, in many areas of the core (unpatterned), going in many directions.
Discoidal: Discoidal cores have a circular outline and an asymmetrical biconvex section. Flakes were removed by centripetally directed blows (Inizan et al 1999:61).
Bipolar: Flakes were removed by placing the core on a hard surface (anvil) and striking it with a hammer, usually leaving flake scars on two opposite ends of the core, and sometimes on two faces. There tends to be and crushing on the platforms. The flakes scars may be short and wide.
Initial: A nodule or naturally fractured stone fragment with only one or two flakes scars.
Other: The scar patterning on the core is distinctive, but does not fit any of the above categories.
Indeterminate: There are flake scars present, but the pattern cannot be determined for some reason, for example if the piece is a core fragment.
N/A: Not applicable.

Core removal type

Core removal type describes the kind of detached piece removed from the core, based on the patterning and length of flake scars, and the shape of the scar for the last piece removed.

Flake: Flake removals.
Blade: Blade removals.
Bladelet: Bladelet removals.
Blade/Bladelet: Indeterminate the removals were either blades or bladelets, but it is not possible to determine which.
Mixed: The core has scars that are like from different kinds of removals, such as flakes and blades.

Other: The scar patterning on the core is distinctive, but does not fit any of the above categories.
Indeterminate: The type of removal cannot be determined, for instance if the core is a fragment.
N/A: Not applicable.

Extent of working

Extent of working describes the degree of core exploitation, based on Holmes (1989:424).

One area: The removals are confined to a small area, and do not cover the whole face of the core.
One face: The removals cover most or all of one face of the core.
Two faces: The removals cover most of two faces, which can be adjacent or not
Around an edge: This category is mainly for single platform cores where the removals cover multiple faces, but the faces are not distinct facets. The core removals go around the edge of a platform, such as with pyramidal cores.
Entirety: The removals cover all faces, or more than 75% of the core.
Exhausted: Any core for which further exploitation does not seem readily feasible. The core may be small, and the platform angles may be inappropriate for more removals.
Other: The scar patterning on the core is distinctive, but does not fit any of the above categories. *Indeterminate*: The extent of working cannot be determined, for instance if the core is a fragment.
N/A: Not applicable.

Metric Data

All metric information was entered with digital calipers that connect directly to the computer, making for fast and accurate metric data collection.

Length

The length of tools and debitage was measured as the maximum length along the axis orientation. For debitage that was from the point of percussion to the most distal point following flake orientation (Debénath and Dibble 1994:17-18). For tools the maximum length followed the longitudinal tool orientation if flake characteristics were not identifiable.

Width

The width of tools and debitage was measured as the maximum width perpendicular to the length (Debénath and Dibble 1994:17-18). This measurement could be at any point along the flake, not just in the middle

Thickness

The thickness of tools and debitage was measured as the maximum thickness perpendicular to the plane of flaking, or for tools without flake characteristics (such as bifacial tools), perpendicular to the plane of length and width measurements.

Platform width

For any piece of debitage or tool retaining a platform, the width of the platform was measured as the maximum distance of the platform following the direction of one lateral margin to the other. In other words, in the same direction as flake width.

Platform thickness

For any piece of debitage or tool retaining a platform, the thickness of the platform was measured as the maximum distance from the interior (ventral) side of the platform to the exterior (dorsal) side of the platform at the thickest part of the platform. In other words, in the same direction as flake thickness.

Core length

The core length was measured as the maximum distance along the face (or primary face) of the core, usually approximately perpendicular to the platform and parallel to the flaking face (Andrefsky 2005:145-146; Holmes 1989:420).

Core width

The core width was measured as the maximum width perpendicular to the core length.

Core thickness

The core thickness was measured as the maximum thickness perpendicular to the plane of core length-width measurements. Usually the thickness back from the main flaking face.

Weight

The weight of all lithic artifacts was measured in grams.

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Tables

A note on reading the tables. Much of the information in the following tables involves comparing data from different publications and different researchers. In some cases the exact same categories or definitions were not used. Unless otherwise noted, a blank space means that the item in question was not reported, which can mean either that they didn't look for that item, or that they did and it was not there. Zeros mean that an item was specifically reported as a possibility, but that it definitely was not present.

Chapter 1 Tables

Table 1.1. Models for the development of specialized production organized by the kinds of goods made by specialists, and who those goods were for.

	Elites	Commoners
Symbolic	**Elite activities** models: **Political model**: political elites employ specialization and exchange to create social inequality and build alliances (Brumfiel & Earle 1987) **Prestige goods economy**: Political advantage gained by control of external trade and specialized goods (emphasis on external trade) (Rowlands & Frankenstein 1998)	**Symbolic goods** models: **Social model**: Non-elites use specialized goods for social messages in addition to practical functions (Wattenmaker 1998) **Ritual production:** Specialized goods produced for ritual participation and social transactions (Spielmann 2002)
Utilitarian/ subsistence		**Efficiency** models: **Managerial model**: Efficient use of differentially distributed resources (Service 1962) **Scheduling conflicts**: Increased government demands for agriculture leaves households little time to make other items (Blanton et al. 1982)

Table 1.2. Dates and sizes of beer brewing facilities. For more information on chronology, see Ch 3.2.

Location	Date	Size	Publication
Abydos, Cemetery D	Gerzean	8 structures, 35 vats each (?) 19+m x 2.6+m	Peet 1913
Abydos, Seti temple	Gerzean	23 vats, 14.9m x 3m	Peet 1914
Hierakonpolis, HK11C, B4-B5, lower level	NIC-IIB, 3762-3537BC	5+ vats, ~8m x ~7m x .3-.45m (H)	Baba 2007, 2008b, 2009a,b, 2011
Hierakonpolis, HK11C, A6-A7	mid-NII	8 vats, 7m x 3.5m	Hoffman 1982; Takamiya & Endo 2009
Hierakonpolis, HK24A	NII, 3425-3379BC	6 vats	Geller 1992
Hierakonpolis, HK24B	mid-NII	16 vats, 6.5m x 5m (interior)	Geller & Friedman 2009; Takamiya & Shirai 2010
Mahasna, S1	Predynastic	Isolated & groups of 2-3 vats	Garstang 1902; Geller 1992
Naqada, North Town	NIIcd, Gerzean	1 vat, possibly other structures	Petrie & Quibell 1896; Geller 1992
Tel el-Farkha, W47	NIId	3 vats	Cichowski 2008
Tel el-Farkha, W192	NIIc	11 vats	Cichowski 2008
Tel el-Farkha, W201	NIIb	2 rows	Cichowski 2008
Tel el-Farkha, W200	NIIc	2 rows, 4 vats each	Cichowski 2008

Chapter 2 Tables

Table 2.1. Summary of the ritual production model. Description of aspects of the model is on the left (gray) and expectations for archaeological patterns are in the columns to the right.

The Ritual Production Model	Raw Materials	Production Location	Find Contexts
1-Necessary to ritual performance and symbolically laden social transactions	-Symbolic meanings associated with the RM, affecting RM choice. (Correlation between Rm & Tool type)		-Specialist made items are at least sometimes found in ritual contexts
2-Ritual performances and symbolically laden social transactions motivate the production		-Production associated with ritual contexts (adds meaning and facilitates production) -Production can be only part time	
3-The items cross the divide between purely utilitarian and purely symbolic	-RM sets the items apart from others through symbolic meanings and/or materials which are difficult to get (Correlation between Rm & Tool type)		-Specialist made items are found in both ritual & non-ritual contexts
4-The items were used by many people not just a specific subset			Specialist produced items are found in: -settlements of all scales; -multiple contexts within a settlement (not concentrated) -graves of different wealth/status

Table 2.2. Expectations for the ritual production model compared to expectations for other general models of the development of specialized production.

	Raw Materials	Production location	Find Contexts
Ritual production model	-RM adds to the symbolic meaning of the object. Results in a correlation between Rm & Tool type	-Production associated with ritual contexts -Production can be part time	Specialized goods -found in ritual and non ritual contexts -found in settlements of all scales, multiple contexts within a settlement, and graves of different status/wealth (used by many)
Political economy/ Prestige goods model	-RM can be specifically chosen because it is not accessible by all	-Production in discrete (controllable) areas, possibly associated with elite and/or ritual contexts, along with administrative artifacts -full time production (workers sponsored by elites)	-Specialized goods found primarily in non-ordinary contexts (burials, ritual contexts, administrative contexts) -specialized goods concentrated in primary centers, concentrated in limited contexts within settlements, and/or in elite/wealthy graves (used by restricted groups)
Efficiency models	-RM chosen for ease of access near the place of production	-Production locations not associated with ritual contexts -full time production	-not in ritual contexts (utilitarian goods) -found in settlements of all scales, multiple contexts within a settlement (used by many)
Adaptationist model-Service	-specialization based on geographic distribution of raw materials, every place specialized based on its available materials	-Production locations based on the local availability of raw materials -Different places each focus on one kind of technology -full time production	-not in ritual contexts (utilitarian goods) -found in settlements of all scales, multiple contexts within a settlement (used by many)

Chapter 3 Tables

Table 3.1. Correlation of relative and absolute chronologies for the Predynastic and Early Dynastic periods, derived mainly from Buchez (2011b), Hartmann (2011), Hendrickx (2006, 2011b,c), and Dee et al. (2013). Köhler (2004) offers revisions for the NIIIC and divisions of the NIIID (not pictured here). Note that traditionally the Amratian goes only up to SD 37, but here it is put up to the NIIB/C transition to mark that there are more differences between NIIB and NIIC than between NIC and NIIA (Hendrickx 2011c). The heavy lines indicate the three major chronological divisions. [1] These ranges mark the transition between the indicated phases, and are the 68% highest posterior density ranges (Dee et al. 2013). [2]These ranges mark the ranges for the accession dates for the indicated ruler, and are the 68% highest posterior density ranges (Dee et al. 2013).

Time period name	Petrie Sequence Date	Kaiser Stufe	Hendrickx Naqada Chronology	Hartmann Naqada Chronology	Characteristic Ceramics		Prominent Figure	Approximate absolute date cal. BCE
2nd Dynasty/ Archaic/ Early Dynastic	83-86		NIIID				Hetep-sekhemwy to Khasekhemwy	
1st Dynasty/ Archaic/ Early Dynastic	81-82	IIIc3	NIIIC2		Late ware most frequent		Djet – Qaa	Qaa[2]: 2906-2886
	79	IIIc2	NIIIC1				Hor Aha - Djer	Aha[2]:3111 -3045
Proto-dynastic / Dynasty 0	77-78	IIIc1			Wavy-Handled most frequent & Late Ware common		Ka-Narmer	
		IIIb2	NIIIB				Iri-hor	
		IIIb1						
	63-76	IIIa2	NIIIA2				Abu-Zeidan	
			NIIIA1				Tomb U-J	NIID to NIIIA[1]: 3352-3297
		IIIa1	NIID		Rough Ware	Decorated Ware with figures		
Gerzean	40/45 – 62/63	IId2						
		IId1	NIIC					
		IIc						NIIB to NIIC[1]: 3498-3413
	38-40/45	IIb	NIIB	IC		Decorated		
				IB2				
		IIa	NIIA	IB1	Black-Topped Ware	White Cross-Lined Ware		
Amratian	30-37/38	Ic	NIC	IA3				NIB to NIC[1]: 3690/3605
		Ib	NIB	IA2				
		Ia	NIA					
				IA1				

Table 3.2. Summary of excavation Blocks at Mahâsna, (Anderson 2006).

Block	Description	Date	Reference
1	Habitation structure & midden deposits	Ic-IIab	Anderson 2006:89
2	Outdoor area with large hearth & trash disposal (probably associated with the structure in Block 3)	Ic-IIc	Anderson 2006:89-97; 162, 246
3	Ritual activity area with a partially exposed structure	Ic-IIc	Anderson 2006:97-123
4	Domestic activity area	Ic-IIb	Anderson 2006:123-132
5	Outdoor activity & trash disposal area like Block 2	Ic-IIa-c	Anderson 2006:133-137, 246
6	Area disturbed by Garstang's habitation	Modern	Anderson 2006:137-138
7	Garstang's Excavation house	Modern	Anderson 2006:138
8	Habitation structure	Ic-IIb	Anderson 2006:139-146
9	Partial habitation structure?	Ind.	Anderson 2006:147-149

Table 3.3. Classification of settlement sites according to population size and functional variability, for comparing the distribution of artifacts. Cemetery estimates for Abydos, Naqada, and Hierakonpolis are combined from a number of cemeteries. All sites include habitation, subsistence, and disposal activities. See Ch. 3.4 & 3.5 for site descriptions and references. *See section 3.7 for issues regarding area comparisons.

Site	Date	Area*	Cemetery size	Activities	Classification
Abydos	NI-NIII	Unknown	>2000	Administration, ritual, Beer, beads?	High Level
Naqada South Town	NIIc-NIII	3ha	>2000	Administration, ritual, (beer North town)	High Level
Hierakonpoli s	NI-NIIIA	Very large	>2000	Administration(?), ritual, beer, pottery, stone tools	High Level
Maadi	NI-NIIb	4 - 13ha	~500	Trade, groundstone, copper?,	Mid Level
Badari 3000/6	NI-NIID	Unknown	?	Beer	Mid Level
Mahâsna	NIC-NIID	7ha	~600	Ritual, Beer	Mid Level
Adaïma	NI-NIII	<35ha	1500	Grain processing	Mid Level
Hemmamiya North Spur	Badarian-NI-NIIB or C	<1ha	?		Low Level
Naqada-Khattara	NI-NIIab	<1-3ha	?		Low Level
Abadiya 2	NI-NIIA/B	<1ha	?		Low Level
Armant	NI-NIIab	<1ha	~200		Low Level
Nag el Qarmila	NIC-IIAB	<1ha	>52		Low Level

Chapter 4 Tables

Table 4.1 (part 1). Raw material survey data. For raw material category descriptions, see Appendix.

Nodule ID	UTM coordi-nates E	UTM coordi-nates N	Elevation (M ASL)	Location	Geological context	Nodule shape	Cortex Description	Munsell	RM category	Length	Width	Thick-ness	Weight	Volume (ml)
A1				Abydos	Secondary-Wadi Wash	Cube		10YR 6/3 & 10YR 7/2	2	190.68	103.75	46.45	1058	
A2				Abydos	Secondary-Wadi Wash	Irregular		10YR 7/2	1	105.39	56.71	34.04	217.7	90
A3b	391069	2894773	112.6 +/- 6.6	Abydos	Secondary-Wadi Wash	Cube	Light weather & patina	10YR 6/4	4	81	61.16	40.71	289.2	115
A4a	391316	2894639		Abydos	Secondary-Wadi Wash	Cube	Other	7.5YR 5/6	1	52.91	46.86	21.9	77.6	30
A4b	391316	2894639		Abydos	Secondary-Wadi Wash	Sphere	Lightly weathered	7.5YR 4/1	8	58.12	41.54	40.92	138.9	50
A5	391319	2894625	138.3 +/- 5.1	Abydos	Secondary-Wadi Wash	Irregular		7.5YR 4/1-2	8	45.74	34.15	24.66	43	20
A6a	391311	2894592	143.1 +/- 5.1	Abydos	Secondary-Wadi Wash	Right cylinder	Light weather & patina	5YR 6/1	10	130.74	52.61	45.53	468.3	180
A6b	391311	2894592	143.1 +/- 5.1	Abydos	Secondary-Wadi Wash	Right cylinder	Lightly weathered	2.5YR 5/1	10	139.09	74.93	82.61	1200	495
A7	391117	2894269	161.5 +/- 8.5	Abydos	Secondary-Lag	Cube	Chalky & lightly weathered	not recorded	1	70.92	49.96	38.06	214.7	80
A8	391034	2894134	155.9 +/- 7.8	Abydos	Secondary-Lag	Right cylinder	Chalky & lightly weathered	10YR 6/1	1	118.96	96.6	67.54	1000	400
A9	391022	2894104	156.5 +/- 6.1	Abydos	Primary	Right cylinder	Lightly weathered	7.5YR 4/1	8	81.14	62.91	47.24	302.4	115
A10	391036	2893943	161.7 +/- 22.6	Abydos	Primary	Cube	Chalky	7.5YR 4/1	8	47.06	23.44	18.84	29.5	10
A11b				Abydos	Secondary	Right cylinder	Lightly weathered	10YR 6/1-2	1	91.38	68.64	50.25	500	195
A12a	391094	2893870	180.1 +/- 24.2	Abydos	Primary	Irregular	Lightly weathered	10YR 4/1	1	74.04	36.91	35.77	141	50
A12b	391094	2893870	180.1 +/- 24.2	Abydos	Primary	Cube	Chalky & lightly weathered	10YR 4/1	1	62	39.4	23.22	70.7	25
A12c	391094	2893870	180.1 +/- 24.2	Abydos	Primary	Cube	Chalky & lightly weathered	10YR 4/1	1	51.87	41.01	24.58	71.4	25

Table 4.1 (part 2). Raw material survey data. For raw material category descriptions, see Appendix. R= Rock crystal/ quartzite.

Nodule ID	UTM coordi-nates E	UTM coordi-nates N	Elevation (M ASL)	Location	Geological context	Nodule shape	Cortex Description	Munsell	RM category	Length	Width	Thick-ness	Weight	Volume (ml)
A13	391049	2893736	177.7 +/-11.6	Abydos	Primary	Cube	Chalky	10YR 5/1	3	76.61	45.77	10.97	52.8	12
A14	391154	2893496	209.4 +/- 16.2	Abydos	Primary	Right cylinder	Chalky & lightly weathered	7.5YR 4/1	8	63.67	43.74	39.54	161.8	55
A15	391145	2893497		Abydos	Secondary	Cube	Lightly weathered	5YR 5/2	4	49.15	28.09	20.74	39.2	10
A16	391316	2893413	258.4 +/- 5.4	Abydos	Primary	Cube, irregular	Chalky & lightly weathered	10YR 4/1	1	123.8	63.43	41.45	471.9	180
A17	391454	2894011	298.6 +/- 5.4	Abydos	Secondary-Lag	Cube, irregular	Chalky & lightly weathered	7.5YR 6/4	4	58.98	50.71	42.55	229.6	85
A18	391510	2894019	299.9 +/- 12.8	Abydos	Secondary-Lag	Cube, irregular	Natural fissure planes		R	82.52	29.48	26.1	96.1	30
A19	390875	2893824	296.3 +/- 4.9	Abydos	Secondary	Right cylinder	Pitted & smoothed	10YR 6/1 & 10YR 7/3	8	83.17	65.69	41.29	299.7	115
A20b	391078	2893277	251 +/- 6	Abydos	Secondary-Lag	Right cylinder	Lightly weathered	10YR 6/2	1	122.15	41.66	36.66	276.2	105
A20c	391078	2893277	251 +/- 6	Abydos	Secondary-Lag	Cube	Chalky & lightly weathered	10YR 7/2	4	64.5	42.52	30.89	140.9	52
A20d	391078	2893277	251 +/- 6	Abydos	Secondary-Lag	Sphere	Chalky & lightly weathered	7.5YR 4/2	8	53.57	44.78	37.51	114.2	40
A21				Abydos	Not Recorded	Cube	Chalky & lightly weathered	7.5YR 5/4	8	106.54	86.03	33.37	424	~125-150
A23				Abydos	Not Recorded	Irregular	Chalky & lightly weathered	10YR 5/2 & 10 YR 7/2	1	124.87	48.89	29.99	297.2	110
A25				Abydos	Not Recorded	Irregular	Light weather & patina	10YR 5/4	1	71.53	49.9	37.33	137.3	55
A26				Abydos	Not Recorded	Cube	Chalky & lightly weathered	7.5YR 6/4	4	51.84	34.12	18.01	62.6	25
A27				Abydos	Not Recorded	Cube	Chalky & lightly weathered	7.5YR 5/3	4	43.09	37.02	11.08	22.6	10

Table 4.1 (part 3). Raw material survey data. For raw material category descriptions, see Appendix. SL= silicified limestone.

Nodule ID	UTM coordinates E	UTM coordinates N	Elevation (M ASL)	Location	Geological context	Nodule shape	Cortex Description	Munsell	RM category	Length	Width	Thick-ness	Weight	Volume (ml)
A32				Abydos	Not Recorded	Cube	Light weather & patina	10YR 7/3 & 10YR 5/3	4	110.98	33	17.81	120.4	45
A 35				Abydos	Secondary	Sphere		7.5YR 4/3	8	10.09	4.87	4.22	150	100
A 38				Abydos	Secondary	Sphere		10YR 5/2	8	9	7.27	4.88	510	125
A 41				Abydos	Secondary	Cube		10YR 6/2-4	1	6.27	6.25	3.03	190	100
BK1				Beit Khallaf	Secondary-Wadi Wash	Sphere	Pitted & smoothed	10YR 6/2	8	90.12	69.75	63.65	550	240
BK2				Beit Khallaf	Secondary-Wadi Wash	Cube, irregular	Dark-pink pitted & smoothed	10YR 5/2 & 10YR 6/6	8	88.8	50.8	35.02	241	95
BK3				Beit Khallaf	Secondary-Wadi Wash	Cube, irregular	Dark-pink pitted & smoothed	2.5YR 4/3 to 10 YR 5/3	9	85.63	79.01	37.99	384	150
BK4				Beit Khallaf	Secondary-Wadi Wash	Right cylindar	Pitted & smoothed	10YR 6/2	SL	118.66	107.73	40.39	500	300
BK5				Beit Khallaf	Secondary-Wadi Wash	Cube, irregular	Pitted & smoothed	10YR 7/2	1	114.38	61.14	44.91	486.9	185
Wk1				Wadi Kubbaniya	Secondary	Cube	Completely smoothed	10YR 6/3	1	59.75	40.17	16.95	70.6	25
WK2				Wadi Kubbaniya	Secondary	Irregular	Pitted & smoothed	10YR 6/4	8	47.19	35.61	19.82	28.4	10

Table 4.2. Comparison of counts and percentages of raw material varieties. The most prevalent type at each site is highlighted in bold.

	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
1. Indistinct beige	521	12.36	43	7.93	106	9.19
2. Beige (Fine)	91	2.16	18	3.32	98	8.49
3. Beige (Less-Fine)	200	4.74	20	3.69	5	0.43
4. Yellow-Beige with Pink Bands	98	2.33	**136**	**25.09**	5	0.43
5. Medium Brown	48	1.14	2	0.37	57	4.94
6. Brown Fossil	2	0.05	0	0	**120**	**10.4**
7. Dark Gray and Brown	18	0.43	2	0.37	70	6.07
8. Translucent Brown Spectrum	**1585**	**37.6**	122	22.51	85	7.37
9. Translucent Brown with Pink Gravel Cortex	290	6.88	28	5.17	3	0.26
10. Pink-Gray Translucent	380	9.02	69	12.73	69	5.98
11. Whitish Translucent	2	0.05	0	0	0	0
12. Pink-Purple-Red Family	292	6.93	30	5.54	0	0
13. Caramel	20	0.47	2	0.37	0	0
14. Other Chert	198	4.7	24	4.43	15	1.3
Indeterminate Chert	188	4.46	23	4.24	**255**	**22.1**
Burnt Chert	129	3.06	7	1.29	76	6.59
Indeterminate Stone	75	1.78	7	1.29	15	1.3
Agate	0	0	1	0.18	15	1.3
Silicified Limestone	36	0.85	3	0.55	0	0
Silicified Sandstone	7	0.17	3	0.55	17	1.47
Sandstone	1	0.02	1	0.18	0	0
Quartzite	3	0.07	0	0	85	7.37
Other Stone	31	0.74	1	0.18	58	5.03
TOTAL	4215	100.01	542	99.98	1154	100.02

Table 4.3. Comparison of the proportions of non-chert materials.

	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Cherts	4062	96.37	526	97.05	964	83.54
Other stones	153	3.63	16	2.95	190	16.46
Total	4215	100	542	100	1154	100

Table 4.4. Proportions of recorded cortex types found at el- Mahâsna, Abydos and Nag el-Qarmila. 'Other' includes natural fissure planes, thermoclastic fracture surfaces, and types not clearly classifiable into the other groups. Indeterminate pieces often only retained very tiny amounts of cortex.

	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	131	3.9	10	1.88	11	2.11
Alluvial- Smooth shiny cortex	43	1.28	12	2.26	63	12.07
Multiple- Gravel cortex	**1063**	**31.67**	97	18.23	28	5.36
Gravity/wind- Lag deposits	444	13.23	**127**	**23.87**	42	8.05
Unmodified- Chalky	132	3.93	58	10.9	**176**	**33.72**
Other	186	5.54	38	7.14	24	4.6
Indeterminate	334	9.95	38	7.14	50	9.58
No cortex	1024	30.5	152	28.57	128	24.52
Total	3357	100	532	99.99	522	100.01

Table 4.5. Proportions of recorded cortex types for the chert variety '1.Indistinct Beige'.

1. Indistinct Beige	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	28	6.32	0	0	2	2
Alluvial-Smooth shiny cortex	5	1.13	2	4.65	0	0
Multiple- Gravel cortex	98	22.12	5	11.63	1	1
Gravity/wind- Lag deposits	78	17.61	7	16.28	5	5
Unmodified- Chalky	25	5.64	7	16.28	22	22
Other	20	4.51	3	6.98	0	0
Indeterminate	46	10.38	5	11.63	6	6
No cortex	143	32.28	14	32.56	64	64
Total	443	99.99	43	100.01	100	100

Table 4.6. Proportions of recorded cortex types for the chert variety '2.Beige Fine'.

2.Beige Fine	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	1	1.49	0	0	2	2.08
Alluvial-Smooth shiny cortex	0	0	1	5.56	0	0
Multiple- Gravel cortex	3	4.48	0	0	0	0
Gravity/wind- Lag deposits	10	14.93	8	44.44	5	5.21
Unmodified- Chalky	11	16.42	3	16.67	31	32.29
Other	3	4.48	0	0	1	1.04
Indeterminate	5	7.46	2	11.11	3	3.13
No cortex	34	50.75	4	22.22	54	56.25
Total	67	100.01	18	100	96	100

Table 4.7. Proportions of recorded cortex types for the chert variety '3.Beige less fine'. Percentages not calculated for samples below 25.

3. Beige Less-Fine	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	10	5.21	0		0	
Alluvial-Smooth shiny cortex	6	3.13	2		1	
Multiple- Gravel cortex	60	31.25	7		0	
Gravity/wind- Lag deposits	50	26.04	1		0	
Unmodified- Chalky	1	0.52	0		0	
Other	8	4.17	3		0	
Indeterminate	18	9.38	1		1	
No cortex	39	20.31	6		3	
Total	192	100.01	20		5	

Table 4.8. Proportions of recorded cortex types for the chert variety '4.Beige with Pink Bands'. Percentages not calculated for samples below 25.

4. Beige w Pink Bands	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	3	4	4	2.94	0	
Alluvial-Smooth shiny cortex	1	1.33	0	0	0	
Multiple- Gravel cortex	2	2.67	1	0.74	0	
Gravity/wind- Lag deposits	15	20	**65**	**47.79**	1	
Unmodified- Chalky	13	17.33	30	22.06	3	
Other	2	2.67	9	6.62	0	
Indeterminate	3	4	7	5.15	0	
No cortex	36	48	20	14.71	1	
Total	75	100	136	100.01	5	

Table 4.9. Proportions of recorded cortex types for the chert variety '5.Medium Brown'. Percentages not calculated for samples below 25.

5. Medium Brown	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	1	3.23	0		2	4
Alluvial-Smooth shiny cortex	0	0	0		0	0
Multiple- Gravel cortex	1	3.23	1		1	2
Gravity/wind- Lag deposits	5	16.13	1		5	10
Unmodified- Chalky	5	16.13	0		**20**	**40**
Other	1	3.23	0		0	0
Indeterminate	5	16.13	0		5	10
No cortex	13	41.94	0		17	34
Total	31	100.02	2		50	100

Table 4.10. Proportions of recorded cortex types for the chert variety '6.Brown Fossil'. Percentages not calculated for samples below 25.

6.Brown Fossil	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	0		0		0	0
Alluvial-Smooth shiny cortex	0		0		0	0
Multiple- Gravel cortex	0		0		0	0
Gravity/wind- Lag deposits	0		0		4	3.74
Unmodified- Chalky	0		0		39	36.45
Other	0		0		0	0
Indeterminate	0		0		5	4.67
No cortex	2		0		59	55.14
Total	2		0		107	100

Table 4.11. Proportions of recorded cortex types for the chert variety '7.Dark Gray and Brown'. Percentages not calculated for samples below 25.

7.Dark Gray and Brown	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	0		0		0	0
Alluvial-Smooth shiny cortex	0		0		0	0
Multiple- Gravel cortex	0		0		0	0
Gravity/wind- Lag deposits	0		0		4	6.25
Unmodified- Chalky	2		1		17	26.56
Other	1		0		0	0
Indeterminate	1		1		6	9.38
No cortex	13		0		37	57.81
Total	17		2		64	100

Table 4.12. Proportions of recorded cortex types for the chert variety '8.Brown Translucent'.

8. Brown Translucent	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	66	4.97	5	4.1	2	2.44
Alluvial-Smooth shiny cortex	12	0.9	4	3.28	1	1.22
Multiple- Gravel cortex	400	**30.14**	34	**27.87**	3	3.66
Gravity/wind- Lag deposits	177	13.34	27	**22.13**	6	7.32
Unmodified- Chalky	50	3.77	8	6.56	11	**13.41**
Other	58	4.37	6	4.92	3	3.66
Indeterminate	118	8.89	10	8.2	5	6.1
No cortex	446	33.61	28	22.95	51	62.2
Total	1327	99.99	122	100.01	82	100.01

Table 4.13. Proportions of recorded cortex types for the chert variety '10.Pink-Gray'.

10. Pink-Gray	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	7	2.19	0	0	1	1.61
Alluvial-Smooth shiny cortex	0	0	0	0	0	0
Multiple- Gravel cortex	15	4.69	4	5.8	1	1.61
Gravity/wind- Lag deposits	29	**9.06**	7	**10.14**	1	1.61
Unmodified- Chalky	9	2.81	2	2.9	5	8.06
Other	18	5.63	8	11.59	1	1.61
Indeterminate	18	5.63	3	4.35	4	6.45
No cortex	224	70	45	65.22	49	79.03
Total	320	100.01	69	100	62	99.98

Table 4.14. Proportions of recorded cortex types for the chert variety '12.Pink-Purple-Red Family'. Percentages not calculated for samples below 25.

12. Pink-Purple-Red Family	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	0		0	0		
Alluvial-Smooth shiny cortex	0		0	0		
Multiple- Gravel cortex	2		12	40		
Gravity/wind- Lag deposits	3		3	10		
Unmodified- Chalky	0		1	3.33		
Other	0		1	3.33		
Indeterminate	0		2	6.67		
No cortex	3		11	36.67		
Total	8		30	100	0	

Table 4.15. Proportions of recorded cortex types for the chert variety '13.Caramel'. Percentages not calculated for samples below 25.

13. Caramel	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Chemical- Patina	1		0			
Alluvial-Smooth shiny cortex	0		0			
Multiple- Gravel cortex	0		0			
Gravity/wind- Lag deposits	2		0			
Unmodified- Chalky	2		0			
Other	2		0			
Indeterminate	2		0			
No cortex	8		2			
Total	17		2		0	

Table 4.16. Details of the five heat treatment tests.

Test	rate of heating (°C/Hr)	Maximum temperature (°C)	Length of time at Max temp (Hrs)	Sand packing
1	37.77	300	6	no
2	25	350	7	no
3	10 to 25	400	7	no
4	10 to 25	350	7	yes
5	10 to 25	300	6	yes

Table 4.17. List of tests for individual pieces.

ID	Test		ID	Test
A1.1	2		K3.5	2
A1.2	1		K4.1	3
A1.3	1 & 4		K5.1	1
A1.4	1		K5.2	1
A1.6	1		K5.4	2
A1.7	2		K6.1	3
A1.8	3		K6.2	3
A2.2	1		K7.1	1
A2.3	1		K7.2	1
A2.4	2		K7.4	1
A2.5	3		K7.5	4
K1.2	1		K8.1	1
K1.3	2		K8.2	1
K1.4	5		K8.3	1
K3.1	1		K8.7	2
K3.3	1			

Table 4.18. Ratings of the ease of flaking after materials were heated to different temperatures. Great = easy to pressure flake. All ratings were made by Phil Geib according to his personal assessment of the ease of flaking.

Nodule	No heat	300	350	400
A1		Ok	GREAT	Burnt
A2		Ok	Ok	GREAT
K1		GREAT	Burnt	
K3	GREAT	Burnt	Burnt	
K4	OK			Burnt
K5		GREAT		
K6	OK			Burnt
K7		Ok	GREAT	
K8		GREAT	Burnt	

Table 4.19. Comparison of the percentage of complete flakes and blades with more than 50% cortex. These numbers do not include tools, angular debris, cores, or "characteristic debitage" (e.g. burins, core rejuvenation flakes, biface thinning flakes). The numbers on the left refer to Figure 4.34.

	Site	N	UCL	%	LCL
1	MAP	1679	27.71	25.55	23.54
2	ATP	229	18.17	13.1	9.39
3	KH3B	2416	9.49	8.32	7.29
4	KH3XXI	4641	16.96	15.88	14.86
5	KH7	437	9.92	7.09	5.06
6	South town	1090	11.15	9.27	7.69
7	MA21/83	6047	10.29	9.53	8.81
8	MA21a/83	12206	8.16	7.68	7.22
9	HK11C	2514	9.08	7.96	6.97
10	HK11C	736	18.45	15.63	13.2
11	HK14	142	18.48	11.97	7.69
12	HK24A	352	17.67	13.64	10.48
13	HK25D	77	27.14	16.88	10.31
14	HK29	1489	16.54	14.64	12.95
15	AKAP	421	11.91	8.79	6.47

Table 4.20. Percentages of tools and debitage at Naqada period Nile valley settlement sites. Blank spaces indicate that the category was not counted separately. Debris includes flake fragments, <1.5cm pieces, and shatter. *The percents given for el-Mahâsna include 14 tools and 1 flake from surface collections, and 4 special find tools from units 2 and 5,. † Noted, but not counted as a separate category. [1] Holmes 1989, [2]Vermeersch et al. 2004, [3] Ginter & Kozlowski 1994, [4] Midant-Reynes & Prost 2002, [5] Holmes 1996, [6] Takamiya & Endo 2011, [7] Hikade et al. 2008, [8] Usai 2012

Site	**Mahâsna***	**Abydos ATP**	**South Town[1]**	**Naqada KH3B[1]**	**Naqada KH7[1]**	**Abadiya 2[2]**	**Armant MA21/83[3]**	**Armant MA21a/83[3]**	**Adaïma[4]**	**HK11C 0N6E[5]**	**HK11C Op A[6]**	**HK14[5]**	**HK24A[5]**	**HK25D[5]**	**HK2910L10[1]**	**HK29A[5]**	**HK29B[7]**	**HK25[7]**	**AKAP WK15 Area B[8]**	**AKAP WK15 Area A**	**AKAP WK22**
Time period	NIC-IIC	NI-IIAB	NIIc-III	NI-IIAB	NI-IIAB	NI-IIAB	NI-IIAB	NI-IIAB	NI-NIII	NI-IIAB	NIIB-D	NI-IIa	NIb-IIab	NIIa	NIC-IIAB	NIIA-C; NIIIA	NIIB-C, NIID	NIIC-D	NIC-IIAB	NIC-IIAB	NIC-IIAB
# Artifacts (withdebris)	6267	609	2206	5055	623	21090	11326	19831	12023	1190	3677	214	711	183	3557	54000	10451	7481	2595	2042	50
# Tools	660	79	177	194	48	546	743	1206	826	131	307	16	35	9	468	~1944	279	225		204	17
Tools	10.53	12.97	8.02	2.91	7.7	2.5	6.56	6.13	6.85	11.01	8.35	7.48	4.92	4.92	13.16	3.6	2.67	3.01	7	9.99	34
Cores (& core remnants)	3.57	1.97	1.04	0.57	1.12	0.88	3.27	1.35	2.94	1.01	1.06	3.74	0.42	1.09	1.07	0.3	1.21	1.98	1	1.57	2
Flakes	19.24	28.41	44.02	44.29	59.23	20.77	45.47	39.64	21.66	46.05	46.29	57.01	41.07	34.43	56.84	6.6	5.27	5.72	42	15.48	32
Blades	5.11	7.39	5.39	3.5	10.91	2.43	7.98	6.71	3.11	11.18	15.28	9.34	5.62	5.47	13.52	4.8	5.59	5.51	3	2.11	2
Burin spalls	0.88	0.82				1.36	0.5	0.87	0.53	1.01	0.41	0	0.84	1.09	2.78	0.5	0.96	0.31	1	1.47	2
Rejuvenation pieces	0.88	1.81	0.54	0.1	0.16	0.18	0.53	0.11		0		0.47	0.14	0	0.31	0.1	0.06	0.05		0.78	2
Crested blades	0.05	0.16				0.05	0.36	0.17	0.25						0		0.01	0.05		0.05	0
Axe prep flakes	0.02	0	0.14	0.26	0.16	0.21	0.31	0.57							0		0.03	0	†	0	0
Thinning flakes	1.79	4.6				†	4.35	6.48	0.03	4.62	6.8	0	2.81	2.19		15.4	8.66	5.91		1.76	0
Other debitage	10.29	12.15	0.05	0.45	1.28	5.24	1.3	0.77	9.64		1.39				2.98					9.41	12
Debris	47.65	29.72	40.8	47.91	19.42	63.77	29.36	37.21	54.99	25.12	20.42	21.96	44.17	50.82	9.33	68.6	75.53	77.41	47	57.4	14
TOTAL	100.01	100	100	99.99	99.98	97.39	99.99	100.01	100	100	100	100	99.99	100.01	99.99	99.9	99.99	99.95	101	100.02	100

Table 4.21. Calculations for Cortex ratio at el-Mahasna using largest artifact dimensions as estimate of average nodule size.

MAP	Cube	Rt cylinder
# of artifacts	4013	4013
Weight (g)	51225.56	51225.56
Density (g/cm^3)	2.42	2.42
Total Volume (cm^3) (weight / density)	21167.59	21167.59
Average nodule size (cm)	10.7 x 8.1 x 5.6	h=10.7, r=3.425
Average nodule shape	cube	Rt cylinder (V=pi*r^2*h)
Estimated avg nodule volume	485.35	394.3254
Estimated surface area per avg nodule (cm^2)	383.9	315.0261
Estimated # of nodules (Total volume / est avg nodule volume)	43.61	53.6805
Expected surface area (cm^2) (est avg SA * est # nodules)	16741.88	16910.76
Observed surface area (cm^2) SUM of (SA * mid point of cortex amount)	224836.8	224836.8
Ratio	**13.43**	**13.3**

Table 4.22. Calculations for Cortex ratio at el-Mahasna using the observed number of cores as the estimate for the number of nodules represented.

MAP	Cube	Rt cylinder
# of artifacts	4013	4013
Weight (g)	51225.56	51225.56
Density (g/cm^3)	2.42	2.42
Total volume (total weight / density)	21167.59	21167.59
Observed # of cores	224	224
Estimated nodule volume (Total volume / observed # of cores)	94.49816	94.49816
Shape	Cube (SA=6V^2/3)	Rt cylinder (SA=4pi(V/pi)^2/3)
Estimated surface area per nodule	124.4802	121.5418
Expected surface area (SA per nodule x # of nodules)	27883.56	27225.35
Observed SA	224836.8	224836.8
Ratio	**8.06**	**8.26**

Table 4.23. Calculations for Cortex ratio at Nag el-Qarmila WK15 using largest artifact dimensions as estimate of average nodule size.

AKAP	Cube	Rt cylinder
# of artifacts	757	757
Weight (g)	2277.7	2277.7
Density (g/cm^3)	2.42	2.42
Total volume (cm^3) (weight / density)	941.1983	941.1983
Average nodule size (cm)	7.28 x 5 x 2.67	7.28 x 5 x 2.67
Shape	cube	Rt cylinder (V=pi*r^2*h)
Estimated avg nodule volume	97.188	84.3109
Est surface area per avg nodule (cm^2)	138.3752	110.9862
Estimated # of nodules (total volume / avg nodule volume)	23.43602	27.01549
Expected surface area (cm^2) (est avg SA * est # nodules)	3242.964	2998.346
Observed surface area (SUM of (SA * mid point of cortex amount))	5695.978	5695.978
Ratio	**1.76**	**1.9**

Table 4.24. Calculations for Cortex ratio at Nag el-Qarmila using the observed number of cores as the estimate for the number of nodules represented.

AKAP	Cube	Rt cylinder
# of artifacts	757	757
Weight (g)	2277.7	2277.7
Density (g/cm^3)	2.42	2.42
Total volume (cm^3) (total weight / density)	941.1983	941.1983
Observed # of cores	17	17
Estimated nodule volume (cm^3) (Total volume / observed # of cores)	55.36461	55.36461
Shape	cube (SA=6V^2/3)	rt cylinder (S=4pi(V/pi)^2/3)
Est surface area per nodule (cm^2)	87.15776	85.10037
Expected surface area (SA per nodule x # of nodules)	1481.682	1446.706
Observed SA	5695.978	5695.978
Ratio	**3.84**	**3.94**

Table 4.25. Tool types. All %s were re-calculated from published counts. %s for sites with <30 tools were not calculated, except for WK22 (not reported elsewhere). HK25 counts do not include burnt bifacial artifacts. MAP frequencies only include material from Blocks 1,3,4. See Table 4.20 for references.

Site	Mahâsna	Abydos ATP	South Town[1]	Naqada KH3B[1]	Naqada KH7[1]	Abadiya 2[2]	Armant MA21/83[3]	Armant MA21a/83[3]	Adaïma[4]	HK11C 0N6E[5]	HK11C Op A[6]	HK24A[5]	HK29 17L12[5]	HK29 10L10[1]	HK29A[5]	HK29B[7]	HK25[7]	AKAP WK15 Area A	AKAP WK22
Time period	NIC-IIC	NI-IIAB	NIIc-III	NI-IIAB	NI-IIAB	NI-IIAB	NI-IIAB	NI-IIAB	NI-NIII	NI-IIAB	NIIB-D	NIb-IIab	NIC-IIAB	NIC-IIAB	NIIA-C; NIIIA	NIIB-C, NIID	NIIC-D	NIC-IIAB	NIC-IIAB
#Tools	660	79	177	194	48	546	743	1206	826	131	307	35	240	468	1921	279	225	204	17
Notches	10	7.59	11.86	13.4	8.33	4.03	7.67	7.25	7.87	9.92	3.9	17.14	3.33	4.3	3.7	0.36	0.89	5.39	17.65
Denticulates	9.09	10.13	3.95	3.61	2.08	4.95	11.31	9.4	8.11	2.29	1.6	0	2.92	2.8	1.1	6.09	2.66	2.94	17.65
Sickle blades	0.45	0	3.39	0.52	0	0.37	0.27	0.33		0	2	0	0	0	0.2			0	0
Endscrapers	6.06	8.86	16.38	16.49	16.67	6.23	9.02	7.16	5.21	4.58	14	2.86	10	4.9	4.6	4.3	6.22	3.43	5.88
Sidescraper & other scrapers	2.58	5.06	0	0	0	0.73	4.16	4.93	1.69	0	12	0	2.5	1.1	1.9	18.6	16	0.98	0
Truncations	4.7	5.06	2.26	2.58	2.08	0.18	1.88	3.79	1.69	4.58	2	0	3.75	4.1	5.3	1.08	0.89	1.96	11.76
Micro-endscrapers	1.97	0								0.76		0	5.83		4.5	2.51	1.78	3.43	0
Backed pieces	0.76	1.27	1.69	0.52	0		0.67	0.66	0.73	1.53		0	1.67	1.3	1.9	0.72	0	0.98	0
Transv. Arrowh	0	0				0.18	0.27	0.74		0		0	0	0.9	0.6	0.36	0	1.96	0
Retouched pieces	24.24	21.52	27.12	22.68	12.5	42.13	15.34	20.44	21.8	35.88	52	25.71	19.17	31	12.8	29	24	29.9	11.76
Burins	17.42	27.85	25.99	29.38	45.83	26.56	15.75	22.34	17.4	27.48	7.2	34.29	32.08	25	24.5	10.8	16.89	14.71	23.53
Piece esquille	0	0	0	0	0				2.54	0		0	0		0.1	1.43	4.89	17.16	5.88
Perforators	5.3	3.8	2.82	2.58	6.25	3.3	5.79	5.51	14.2	0		5.71	3.33	2.1	1	4.66	4.89	8.33	0
Micro drill	0	0								0		2.86	1.25	1.7	34.3	15.8	15.11	0	0
Winged drills	0	0								0		0	0.42	3	0.1			0	0
Other drills	0.3	0					1.08	1.4	0.97	0	1	0	2.5	0	0			1.47	0
Blade knives	1.06	1.27					1.62	1.23	1.69		0.3			0				0	5.88
Planes	0.45	0	0	0.52	0		1.08	0.25						0				0	0
Axes	0.45	0	0	3.61	2.08	8.42	5.92	2.8						0				0	0
Proj. points	0.3	0						0.25	0.97	0		0	0		0.5			0	0
Other BFC tools	0.76	0	3.39	2.06	4.17	2.56	7.31	3.05		2.29	3.3	2.86	1.25	4.5	1.4	4.3	5.78	0.98	0
Other	13.48	7.59	1.13	2.06	0	0.36	4.72	4.62	13.2	2.29	1	5.71	0.83	1.5	1.4			5.39	0
Unidentifiable	0.61	0					5.79	3.22	1.94	8.4		2.86	9.17	12				0.98	0
TOTAL	99.98	100	99.98	100.01	99.99	100	99.65	99.37	100	100	100	100	100	100	99.9	100	100	99.99	99.99

Chapter 5 Tables

Table 5.1. Summary of characteristics for types of blades.

Blade Subtype	Characteristics
Bladelets	•Length equal to twice the width, or longer •Maximum width 1.2cm •Parallel edges and ridges •Generally shorter and less thick than 'blades' •Cores often show regular removals •Non-heat treated flint
Bladelets for microdrills	•Length equal to twice the width, or longer •Maximum width 1.2cm •Parallel edges and ridges •Made on a coarse grey flint
Heat-treated bladelets	•Length equal to twice the width, or longer •Maximum width 1.2cm •Parallel edges and ridges •Made on heat treated flint
Medium Blades	•Length equal to twice the width, or longer •Width greater than 1.2cm •Roughly parallel edges & ridges
Large Blades	•Length equal to twice the width, or longer •Width greater than 1.2cm, closer to 3 cm •Length over 10 cm •Very thick
Twisted Large blades/ Medium blades/ bladelets	•Length equal to twice the width, or longer •Size dimensions correspond to those for large blades, medium blades, or •Twist around the longitudinal axis
Trapezoidal blades	•Length equal to twice the width, or longer •Narrow width ranging from .6cm to 2.4cm, averaging ~1.2cm •Length around 8-12 cm •Very straight parallel margins and dorsal ridges

Table 5.2. Average dimensions of complete bladelets from el-Mahasna, Abydos, and Nag el-Qarmila.

Site	MAP	ATP	AKAP
N	42	4	4
Mean Length (cm)	3.05	3.16	3.01
Length Range	1.83-5	2.51-4.43	2.47-4.22
Mean Width (cm)	1.02	1.12	1.11
Width range	.53-1.19	.98-1.19	1.02-1.15
Mean Thickness (cm)	.45	.34	.41
Thickness range	.19-1.18	.27-.41	.27-.72

Table 5.3. Average dimensions of complete medium blades from el-Mahasna, Abydos, and Nag el-Qarmila. *1 outlier was 10.8cm.

Site	MAP	ATP	AKAP
N	171	39	20
Mean Length (cm)	4.4	4.3	3.64
Length Range	2.65-7.18*	2.63-6.34	1.76-7.4
Mean Width (cm)	1.78	1.81	1.86
Width range	1.21-3.53	1.22-3.08	1.21-2.98
Mean Thickness (cm)	0.72	0.66	0.53
Thickness range	.22-2	.27-1.59	.24-1.24

Table 5.4.Dimensions of large blades from Nile valley settlement sites.

Publication	Holmes 1989:118	Analyzed here	Payne 1993:156-158	Takamiya & Endo 2011:739
Site	Badari	el-Mahâsna	Naqada South Town	HK11C
N	3	1	7	1
Mean Length (cm)	15.4	12.7	11.03	13.5
Length range	13.7-17.4	n/a	9.5-15.3	
Mean Width (cm)	3.2	4.4	2.6	2.7
Width range	3-3.5	n/a	2.2-3.5	
Mean Thickness (cm)	2.3	1.5		
Thickness range	1.8-3.2	n/a		
Tool/blank	2 blanks & 1 Retouched Blade	Blade Knife	Blanks	Blade knife

Table 5.5. Counts and percentages of blade type categories among the debitage. The counts are of complete and proximal examples of each type. Medial and distal pieces are counted under fragments. The sample from el-Mahâsna includes all the analyzed material from el-Mahâsna, not just that from Blocks 1, 3, & 4.

Artifact type	MAP		ATP		AKAP WK15	
	Count	%	Count	%	Count	%
Medium blades	223	44.33	32	52.46	32	47.06
Bladelets	60	11.93	3	4.92	7	10.29
Crested blades	1	0.2	1	1.64	1	1.47
Crested bladelets	2	0.4	0	0	0	0
Large blades	0	0	0	0	0	0
Twisted blades	27	5.37	9	14.75	3	4.41
Twisted bladelets	10	1.99	1	1.64	1	1.47
Fragments	180	35.79	15	24.59	24	35.29
Total N	503	100	61	100	68	100

Table 5.6. Counts and percentages of the identifiable tools blanks for blade types. Note that the counts for ATP and AKAP WK15 are below 30, so the percentages are not as reliable.

Tool Blank type	MAP		ATP		AKAP WK15	
	Count	%	Count	%	Count	%
Medium Blades	80	84.21	8	88.89	10	55.56
Bladelets	10	10.53	0	0	6	33.33
Crested blades	1	1.05	0	0	0	0
Crested bladelets	0	0	0	0	0	0
Large blades	1	1.05	1	11.11	0	0
Twisted blades	3	3.16	0	0	1	5.56
Twisted bladelets	0	0	0	0	1	5.56
TOTAL	95	100	9	100	18	100.01

Table 5.7. Counts and percentages of the relative degree of twist for a sample of 91 twisted medium blades & twisted bladelets from el-Mahâsna.

Degree of twist	Count	%
Slightly twisted	11	12.09
Twisted	77	84.62
Very twisted	3	3.3
Total	91	100.01

Table 5.8. Counts and percentages platform types by blade types.

Platform type	Medium blades		Bladelets		Twisted medium blades		Twisted bladelets	
	Count	%	Count	%	Count	%	Count	%
Cortical	32	11.72	8	10.96	1	3.03	0	0
Flat	134	49.08	39	53.42	25	75.76	5	41.67
Dihedral	9	3.3	4	5.48	1	3.03	1	8.33
Multifaceted	27	9.89	1	1.37	4	12.12	2	16.67
Linear	8	2.93	9	12.33	0	0	0	0
Broken	18	6.59	5	6.85	1	3.03	3	25
Other	9	3.3	2	2.74	0	0	0	0
Indeterminate or not recorded	36	13.19	5	6.85	1	3.03	1	8.33
TOTAL	273	100	73	100	33	100	12	100

Table 5.9. Platform area data for blade types, showing that there is variability in the means and that the log transformed variances are basically similar. Note that one outlier was removed from the medium blade category (platform area =251.23)

	Medium blade	Bladelet	Twisted blade	Twisted bladelet
N	187	47	31	9
Mean	30.168	9.067	14.859	10.643
SD	27.99	14.14	13.83	12.96
Variance	783.41	199.8	191.27	167.95
LOG Variance	1.268	2.112	1.131	1.167

Table 5.10. ANOVA of platform area results showing a p value less than .05, so at least two of the means are significantly different.

Platform Areas ANOVA	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Blade type	3	83.7	27.895	20.31	6.71e-12
Residuals	270	370.8	1.373		

Table 5.11. Results of Tukey's HSD test. The probability that the means of the blades and bladelets are similar is 0.

TukeysHSD	diff	lwr	upr	p adj
Twisted bladelet-Bladelet	0.337668	-0.76461	1.439942	0.8580907
Twisted medium blade-Bladelet	0.762078	0.061134	1.463022	0.0270813
Medium blade-Bladelet	1.413979	0.919663	1.908294	0
Twisted medium blade-Twisted bladelet	0.424411	-0.72267	1.57149	0.7742181
Medium blade-Twisted bladelet	1.076311	0.042474	2.110147	0.037702
Medium blade-Twisted medium blade	0.6519	0.064421	1.239379	0.0229354

Table 5.12. Counts and percentages of bulb types by blade types.

Bulb type	Medium blades		Bladelets		Twisted medium blades		Twisted bladelets	
	Count	%	Count	%	Count	%	Count	%
Prominent	5	2.53	1	1.92	0	0	0	0
Moderate	90	45.45	7	13.46	16	50	1	9.09
Diffuse	68	34.34	27	51.92	12	37.5	6	54.55
Small prominent	20	10.1	13	25	4	12.5	3	27.27
Other	9	4.55	2	3.85	0	0	1	9.09
Indeterminate	6	3.03	2	3.85	0	0	0	0
TOTAL	198	100	52	100	32	100	11	100

Table 5.13. Summary of the tests on the comparability of blade type categories. Color coding is to facilitate reference of the same pairings. Parentheses indicate that the conclusion is not very strong.

Test	Not significantly different	Significantly Different
Platform Chi sq		Blades - Bladelets
Flat Platform Cls	Bladelets-Twisted bladelets Twisted Blades- Twisted Bladelets Blades - Bladelets Bladelets- Twisted Blades Blades- Twisted Bladelets	Blades - Twisted Blades
Platform area Anova	Bladelets-Twisted bladelets (Twisted Blades - Twisted bladelets)	Blades - Bladelets (Bladelets- Twisted Blades) (Blades- Twisted Blades) (Blades- Twisted Bladelets)
Bulb Chi Sq		Blades – Bladelets
Moderate Bulb Cls	Blades-Twisted Blades Bladelets- Twisted Bladelets	Blades - Bladelets Blades- Twisted Bladelets Bladelets- Twisted Blades Twisted Blades - Twisted Bladelets

Table 5.14. Counts and percentages of platform types for medium blades from three sites.

Platform type	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Cortical	32	11.72	6	17.65	1	2.56
Flat	134	49.08	19	55.88	17	43.59
Dihedral	9	3.3	3	8.82	1	2.56
Multifaceted	27	9.89	2	5.88	5	12.82
Linear	8	2.93	1	2.94	3	7.69
Broken	18	6.59	2	5.88	6	15.38
Other	9	3.3	1	2.94	2	5.13
Indeterminate	36	13.19	0	0	4	10.26
TOTAL	273	100	34	99.99	39	99.99

Table 5.15. Counts and percentages of bulb types for medium blades from three sites.

Bulb type	MAP		ATP		AKAP	
	Count	%	Count	%	Count	%
Prominent	5	2.53	0	0	0	0
Moderate	90	45.45	16	47.06	12	31.58
Diffuse	68	34.34	14	41.18	13	34.21
Small prominent	20	10.1	3	8.82	3	7.89
Other	9	4.55	0	0	0	0
Indeterminate	6	3.03	1	2.94	10	26.32
TOTAL	198	100	34	100	38	100

Table 5.16. Presence/absence of medium blade production elements and tools across sites.

Publication	Holmes 1989	Here	Here	Holmes 1989	Holmes 1989	Holmes 1989	Ginter & Kozlowski 1994	Midant-Reynes & prost 2002	Takamiya & Endo 2011	Holmes 1989	Holmes 1992	Hikade et al. 2008	Hikade et al. 2008	Here
Site	Badari	MAP	Abydos-ATP	Naqada-KH3B	Naqada-North Town	Naqada- SouthTown	Armant (combined)	Adaïma	HK11C	HK29	HK29A	HK29B	HK25	AKAP-WK15
Total # of artifacts W/ debris	N/A	6267	609	5055	1031	2206	31157	12023	3677	3557	54000	10451	7481	2042
Cores	•	•	•	X	X	•	•	•	X	•	•	•	•	•
Core re-juvenation	•							•						
Plunging blades		•	•				•	•						•
Crested blades	•	•	•				•	•	•	X		•	•	•
Blade Blanks	•	•	•	•		•	•	•	•	•	•	•	•	•
Tools	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Table 5.17. Presence/absence of specific tool types for medium blades across sites. For references see Table 5.16. *Blank types were not specified for all tools.

Site	**Badari**	**MAP**	**Abydos-ATP**	**Naqada-KH3B**	**Naqada-North Town***	**Naqada- South Town**	**Armant***	**Adaïma**	**HK11C**	**HK29**	**HK29A***	**HK29B***	**HK25***	**AKAP-WK15**
Total # of tools	N/A	767	75	194	59+	177	1949	826	307	468	~2000	279	225	97
Backed	●	●				●		●		●		●		
Blade knives	●	●												
Burins	●	●	●	●		●	●	●	●	●				●
Dent-iculates	●	●	●	●		●		●	●	●		●	●	
End-scrapers	●	●		●		●	●	●	●	●				
Notches	●	●		●		●		●	●	●		●	●	
Other		●					●	●	●	●				●
Perfor-ators	●	●		●		●	●	●	●	●				●
Retouched	●	●	●	●		●	●	●	●	●		●	●	●
Sickle blades	●	●			●	●		●	●		●			
Trun-cations	●	●	●	●		●	●	●	●	●				●

Table 5.18. Counts and percentages of specific tool types made on medium blades across sites. For references see table 5.16. *The reported number is the minimum number of tools made on blade blanks from that site because not all blanks types were identified.

Site	MAP		ATP	Naqada-KH3B		Naqada- South Town		HK11C		HK29		AKAP-WK15
# of tools total	767		75	194		177		307		468		97
	Count	%	Count	Count	%	Count	%	Count	%	Count	%	Count
Backed	1	1.49	0	0	0	3	4.41	0	0	5	4.1	0
Blade knives	5	7.46	0	0	0	0	0	0	0	0	0	0
Burins	17	25.37	4	19	57.58	19	27.94	6	6.82	28	22.95	5
Denticulates	11	16.42	2	1	3.03	5	7.35	1	1.14	5	4.1	0
Scrapers, end	1	1.49	0	2	6.06	4	5.88	16	18.18	8	6.56	0
Notches	4	5.97	0	2	6.06	2	2.94	2	2.27	5	4.1	0
other	2	2.99	0	0	0	0	0	3	3.41	4	3.28	1
Perforators	1	1.49	0	2	6.06	7	10.29	1	1.14	3	2.46	1
retouched	11	16.42	1	6	18.18	12	17.65	49	55.68	54	44.26	1
Sickle blades	3	4.48	0	0	0	11	16.18	4	4.55	0	0	0
truncations	11	16.42	1	1	3.03	5	7.35	6	6.82	10	8.2	1
Total	67	100	8	33*	100	68*	99.99	88	100.01	122*	100.01	10

Table 5.19. Presence/absence of production remains and tools for heat-treated bladelets across sites. For references see Table 5.16, plus Abydos cemeteries: Hikade (1998, 2000); and Adaima cemetery: Crubezy et al. (2002:268-273).

Site	Badari	MAP	Abydos -ATP	Naqad a-KH3B	Naqad a-	Naqad a-	Adaïm a	HK11C	HK29 10L10 &	HK29A	AKAP-WK15
Total # of artifacts W/ debris	N/A	6267	609	5055	1031	2206	12023	3677	3557	54000	2042
Cores	●	●		X	X	X	●	●	●	●	X
Core re-juvenation											
Plunging bladelets		●	X								X
Crested bladelets		●	X								X
Blanks	●	●	X				●	●	●	●	X
Tools (settlements)	●	●	X	X	X	X	●	●	●	●	●
Tools (cemeteries)			●		●		(●)		(●)		

Table 5.20. Presence/absence of specific tool types for heat-treated bladelets across sites. For references see Table 5.16. *Blank types were not specified for all tools.

Site	Badari	MAP	Abvdos-ATP	Naqada-KH3B	Naqada-North Town*	Naqada- South Town	Armant*	Adaïma	HK11C	HK29	HK29A*	HK29B*	HK25*	AKAP-WK15
# of total tools	N/A	767	75	194	59	177	1949	826	307	468	~ 2000	279	225	97
Backed														
Blade knives														
Burins														
Dent-iculates														
Scrapers, micro-end	●	●						●		●	●	●	●	●
Notches														
Other											●	●	●	
Perfor-ators														
Retouched								●						●
Sickle blades		●							●					
Trunc-ations										●				●

Table 5.21. Presence/absence of production remains and tools for microdrill bladelet tools across sites. For references see Table 5.16.

Site	Badari	Map	ATP	Naqada-	Naqada-North Town	Naqada-South Town	Armant (combined)	Adaïma	HK11C	HK29	HK29A	HK29B	HK25	AKAP-WK15
Total # of artifacts W/ debris	N/A	6267	609	5055	1031	2206	31157	12023	3677	3557	54000	10451	7481	2042
Cores		X	X								•		•	X
Core re-juvenation														
Plunging bladelets		X	X											X
Crested bladelets		X	X											X
Blanks		X	X							•	•			X
Tools		X	X					X		•	•	•	•	X

Table 5.22. Presence/absence of production remains and tools for large blades across sites. For references see Table 5.16.

Site	Badari	Map	ATP	Naqada-	Naqada-South	Armant (combin	Adaïm	HK11C	HK29	HK29A	HK29B	HK25	AKAP-WK15
Total # of artifacts W/ debris	N/A	6267	609	5055	2206	31157	12023	3677	3557	54000	10451	7481	2042
Cores	(?)	X	X	X	X		(X)	X	X				X
Core re-juvenation							(X)						
Plunging blades		X	X				(X)	X					X
Crested blades		X	X				(X)	X					X
Blanks	•	X	X		•		(X)	X					X
Tools	•	•	•		•		•	•					X

Table 5.23. Presence/absence of production remains and tools for non-heat-treated bladelets across sites. For references see Table 5.16. NS1= item was present, but not specified whether the item was Heat-treated or not; NS2= blades not separated from bladelets; NS3= blanks of tool types not specified.

Site	Badari	MAP	ATP	Naqada-	Naqada-North Town	Naqada- South Town	Armant (combined)	Adaïma	HK11C	HK29	HK29A	AKAP-WK15
Total # of artifacts W/ debris	N/A	6267	609	5055	1031	2206	31157	12023	3677	3557	54000	2042
Cores	X	●	X	X	●	X	NS1 &2	NS1 &2	●	●	●	X
Core re-juvenation												
Plunging bladelets		●	X									X
Crested bladelets	NS2	●	X				NS2			X		X
Blanks	X	●	●				NS1	●	●	●	●	●
Tools	NS3	●	X				NS3	●	●	NS3	NS3	●

Table 5.24. Counts and percentages of medium blade production remains and tools found in three blocks at el-Mahâsna. Complete & proximal pieces.

Artifact Type	Block 1		Block 3		Block 4	
	Count	%	Count	%	Count	%
Cores	3	2.91	4	3.28	5	5.43
Crested blades	0	0	1	0.82	1	1.09
Plunging blanks	9	8.74	8	6.56	2	2.17
Blade blanks	68	66.02	89	72.95	66	71.74
Tools	23	22.33	20	16.39	18	19.57
Total	103	100	122	100	92	100

Table 5.25. Presence/absence of specific tool types for non-heat-treated bladelets across sites. For references see Table 5.16. *Blanks types were not specified for all tools.

Site	Badari	Map	ATP	Naqada KH3P	Naqada -North	Naqada - South	Armant *	Adaïma	HK11C	HK29	HK29B *	HK25*	AKAP-
# of total tools	N/A	767	75	194	59	177	1949	826	307	468	279	225	97
Backed								●					
Blade knives													
Burins													
Dent-iculates								●					
Scrapers, microend		●											●
Notches													
Other								●					
Perforators													
Retouched		●						●	●				●
Sickle blades													
Truncations								●					

Table 5.26. Counts of production remains and tools for non-heat-treated bladelets from three blocks at el-Mahâsna. Complete & proximal pieces. The tool in Block 3 is a microendscraper, and the tools in Block 4 are a microendscraper and two retouched pieces.

Artifact Type	Block 1	Block 3	Block 4
Cores	**0**	3	**0**
Crested blades	**0**	1	**0**
Plunging blanks	1	1	2
Bladelet blanks	28	17	11
Tools	0	1	3
Total	29	23	16

Artifact Type	Block 1	Block 3	Block 4
Cores	1	3	0
Crested blades	1	0	0
Plunging blanks	1	0	1
Blanks	7	3	5
Tools	3	1	1
Total	13	7	7

Table 5.27. Counts of production remains and tools for heat-treated bladelets from three blocks at el-Mahâsna. Complete & proximal pieces. All the tools are microendscrapers.

Artifact Type	Block 1	Block 3	Block 4
Cores	1	6	0
Crested blades	1	1	0
Plunging blanks	2	1	3
Bladelet blanks	35	20	16
Tools	3	2	4
Total	42	30	23

Table 5.28. Counts of production remains and tools for all bladelet remains combined from three blocks at el-Mahâsna. Complete & proximal pieces.

Table 5.29. Presence/absence of production remains and tools for medium blades from Hierakonpolis localities. Complete & proximal pieces. For references see table 5.16.

Site	HK 11C	HK 29	HK 29A	HK 29B	HK 25
Total # of artifacts W/ debris	3677	3557	54000	10451	7481
Cores	X	●	●	●	●
Crested blades	●	X		●	●
Blade blanks	●	●	●	●	●
Tools	●	●	●	●	●

Table 5.30. Counts and percentages of production remains and tools for medium blades from Hierakonpolis HK11C and HK29. The percentages of HK11C were calculated without the "several" crested blades because the exact count was not known. However those few would probably only make the percentages even more similar. For references see table 5.16.

Site	HK11C		HK29	
	Count	%	Count	%
Cores	0	0	5	0.82
Crested blades	several		0	0
Blade blanks	356	79.29	481	79.11
Tools	93	20.71	122	20.07
TOTAL	449	100	608	100

Table 5.31. Counts of specific tools types made on blades from HK11C and HK29. *Blanks types were not specified for all tools. Because of that the percentages were not calculated. For references see Table 5.21.

Site	HK 11C	HK 29*
# of total tools	307	468
# of blade tools	88	122
Backed	0	5
Blade knives	0	0
Burins	6	28
Denticulates	1	5
Scrapers, end	16	8
Notches	2	5
Other	3	4
Perforators	1	3
Retouched	49	54
Sickle blades	4	0
Truncations	6	(10)

Table 5.32. Presence/absence data for non-heat-treated bladelets from Hierakonpolis localities. The tool from HK11C is a retouched piece. *Blanks of tool types not specified. For references see Table 5.16

Site	HK11C	HK29	HK29A
Total # of artifacts W/ debris	3677	3557	54000
Cores	●	●	●
Core rejuvenation			
Plunging bladelets			
Crested bladelets		X	
Blanks	●	●	●
Tools	●	*	*

Table 5.33. Presence/absence data for heat-treated bladelets from Hierakonpolis localities. For references see Table 5.16

Hierakonpolis Heat-treated Bladelets	HK11C	HK29	HK29A
Total # of artifacts W/ debris	3677	3557	54000
Cores	●	●	●
Core rejuvenation			
Plunging bladelets			
Crested bladelets			
Blanks	●	●	●
Tools	●	●	●

Chapter 6 Tables

Table 6.1 (part 1). Figural eccentrics.

Item ID	Figure	Site	Acquisition	Context	Context Detail	Date	Preserv-ation	Reduction	Length (cm)	Width (cm)	Thick (cm)	Ref. #
ÄM.15708	Model arrowhead						Complete	Bifacial				1
ÄM.15709	Model arrowhead						Complete	Bifacial				2
ÄM.15711	Model arrowhead						Complete	Bifacial				3
ÄM.15712	Barbary sheep		Purchased				Broken	Ind- probably bifacial				4
ÄM.15774	Hartebeest		Purchased				Complete	Bifacial				5
ÄM.15775	Nubian ibex		Purchased				Complete?	Bifacial				6
BM.EA.49284	indeterminate	Abydos- Um el-Qa'ab	Excavated	Cemetery			Broken	Bifacial	10.3	1.8+	.3	7
BM.EA.30411	Antilope					NII	Complete	Edge (bi or unifacial)	7.4	5	.4 (?)	8
BM.EA.32124	Bovine head						Complete	Ind- probably bifacial	7.5	5.2	0.6	9
BM.EA.37269	Crocadile	Abydos	Excavated	Settlement	Settlement Osiris temenos, lvl 50	NII or Djer	Complete	Bifacial	15.7	4.6	0.7	10
BrM.09.889.291	Quadruped (dog?)	Hierakonpolis-Kom el-Ahmar	Excavated	Settlement	"kitchen middens"		Broken	Edge (bi & unifacial)	>4.7	>2.9	1- 3	11
EM.43085	Fish	Saqqara	Excavated	Cemetery			Ind	Bifacial				12
FMcGC.1	Bovine head						Ind					13
HK.6.1980.1	Hippo	HK6	Excavated	Cemetery	Surface Near tomb 1. Reg. 179		Complete	Bifacial				14
HK.6.1999.1	Giraffe head	HK6	Excavated	Cemetery	Surface. Reg.#519	Prob. NIC-IIA	Complete	Bifacial				15
HK.6.2000.1	Nubian Ibex	HK6	Excavated	Cemetery	Surface near tomb 23 Reg.532	NIIB	Complete	Bifacial				16
HK.6.2005.1	Ram head	HK6	Excavated	Cemetery	T. 23 enclosure, NE section	NIIAB	Complete	Edge (bi & unifacial)				17
HK.6.2006.1	Quadruped	HK6	Excavated	Cemetery	Structure E8, NW corner	NIIAB	Broken	Bifacial				18

Table 6.1 (part 2). Figural eccentrics. *Based on Hendrickx & Depraetere 2004.

Item ID	Figure	Site	Acquisition	Context	Context Detail	Date	Preserv-ation	Reduction	Length (cm)	Width (cm)	Thick (cm)	Ref. #
HK.6.2006.2	Elephant head	HK6	Excavated	Cemetery	Structure E8, NE corner	NIIAB	Broken (?)	Bifacial				19
HK.6.2007.1	Nubian Ibex	HK6	Excavated	Cemetery	Modern pit near SE corner of Str.7		Broken	Bifacial				20
HK6.2007.2	Nubian Ibex	HK6	Excavated	Cemetery	Near Tomb 42		Fragment	Bifacial				21
HK.6.2011.1	Human (Dwarf?)	HK6	Excavated	Cemetery	T 16 enclosure, NW section.	NIC-IIA orlater	Complete	Bifacial				22
HK6.2011.2	Donkey	HK6	Excavated	Cemetery	Shallow pit along the NE of T49		Complete	Bifacial				23
HK.11.2000.1	Quadruped	HK11	Excavated	Settlement	Square G	NIC-IIC	Broken	Bifacial				24
HK.11.2000.2	Dog	HK11	Excavated	Settlement	Square C4- trash pit		Broken	Ind. (bifacial?)				25
KAS.96.24.1	Serpent?/ jewelery	Kom el Ahmar /Sharuna	Excavated	Settlement			Broken	Bifacial	11	1.1 to 2.2	.6 to .85	26
MANStGL.56.53 2	Dog (?)	Hierakonpolis										27
MANStGL.71.08 6	Human (?)	Kom Auchim	?									28
MrM.98.88	Scorpion						Complete	Bifacial	11.9	3.5	0.8	29
OIC.E.7477	Crocadile (?)	Abydos	Excavated	Settlement	Settlement Osiris temenos	NIII-D1	Ind	Ind				30
OIM.E.10534	Bovine(?)						Complete	Edge (bifacial)	6	3.75		31
PAHMA.5.210	Hippo or Elephant		Purchased?			Prob. NI-IIA*	Complete (repaired)	Bifacial				32
PAHMA.5.211	Hippo		Purchased?			Prob. NI-IIA*	Complete	Bifacial				33
RMAH.E.6185A	Bovine head	Naqada	Excavated	Cemetery	Royal tomb	D1	Broken	Bifacial	17.1	10.4		34
UC.15166	Gazelle (?)						Complete	Edge (bi or unifacial)	7.2			35

Table 6.1 (part 3). Figural eccentrics. Where the reduction type is indeterminate, it is often because photographs of one or both faces were not available. The main reference for each entry is the relevant online museum database. Additional sources are noted. See Table 7.1 for museum list and abbreviations.

Item ID	Figure	Site	Acquisition	Context	Context Detail	Date	Preserv-ation	Reduction	Length (cm)	Width (cm)	Thick (cm)	Ref. #
UC.15167	Dog (?)/ Quadruped		Purchased				Complete	Edge (bi or unifacial)	3.3			36
UC.15168	Bird (flying)		Purchased				Complete	Edge (bi or unifacial)	6.8			37
UC.15169	Ind- Vulture (?)		Purchased				Complete	Edge (bi or unifacial)	6.9			38
UC.15170	Serpent		Purchased				Ind	Ind	9.5			39
UC.15171	Serpent	Coptos (?)	Purchased				Broken	Ind	8.2			40
UC.15172	Ind- Turtle (?)		Purchased				Complete	Edge (bi or unifacial)	6.6			41
UC.15173	Ind						Ind	Ind				42
UC.16780	Hippo	Kahun	Excavated	Other	Lahun	D 12 (?)	Complete	Edge (bi or unifacial)	5			43
UC.42705 A+B	Crocadile (?)	Abydos	Excavated	Settlement	Osiris 'temple'		Ind	Edge (bi or unifacial)	9.4	6	1	44
Unknown.1	Crocadile (?)	Abydos	Excavated	Settlement	Settlement Osiris temenos	NIII-D1	Complete	Edge (bi or unifacial)				45
Unknown.3	Serpent (?)	Abydos	Excavated	Settlement	Settlement Osiris temenos	NIII-D1	Broken	Ind				46
Unknown.4	Bovine head (?)	Abydos	Excavated	Cemetery	Umm el-Qa'ab- Djer Tomb	D1	Broken	Ind- probably bifacial				47
Unknown.5	Serpent (?)						Broken	Ind				48
Unknown.6	Serpent (?)						Broken	Ind				49
Unknown.8	Ind						Complete	Ind				50
Unknown.10	Scorpion (?)						Complete	Edge (bi or unifacial)				51
Unknown.12	Crocadile						Complete	Bifacial	23	4.7		52
Unknown.13	Hippo						Complete	Bifacial	13	6		53

References for Tables 6.1

[1] Personal photograph
[2] Personal photograph
[3] Personal photograph
[4] Hendrickx et al. 2003; Scharff 1929: 68, n° 99. (photo couleur: Tokyo 1988: 60, fig. 26, 1)
[5] Hendrickx et al. 2003; Scharff 1929: 67-68, n° 97. (photo couleur: Tokyo 1988: 60, fig. 26, 2)
[6] Hendrickx et al. 2003; Scharff 1929: 68, n° 98. (photo couleur: Tokyo 1988: 60, fig. 26, 3)
[7] Naville 1914. The cemeteries of Abydos I. 39, Pl.XIV
[8] Budge 1909: 148; Capart 1905: 153; Casini 1988: 129, fig. 92,5; Hendrickx et al. 2003
[9] Capart 1905: fig. 115, 32124; Casini 1988: 129, fig. 92,5; Hendrickx et al. 2003
[10] Budge 1909: 148; Capart 1905: fig. 115, A.294; Hendrickx et al. 2003; Petrie 1902: 12, 22 pl. XXVI, 294;
[11] Hendrickx et al. 2003; Needler 1984: n° 292
[12] Casini 1988: 129, fig. 92,1; Hendrickx et al. 2003
[13] Capart 1905: 153; Hendrickx et al. 2003
[14] Adams 2000a: 70, n° 83; Behrmann 1989: 16 b; Hendrickx et al. 2003
[15] Adams 2000b, 2001; Hendrickx et al. 2003
[16] Adams 2001: 6; Hendrickx et al. 2003
[17] Friedman 2005:4-6
[18] Friedman 2006:7-8, 2010:71
[19] Friedman 2006:7-8, 2010:71
[20] Friedman 2007:8
[21] Friedman et al. 2017
[22] Friedman 2011a:4-6; Friedman et al. 2017 in press
[23] Droux 2011:16-17; Friedman et al. 2017 ; Nagaya 2011
[24] Friedman 2000b; Friedman et al. 2002; Hendrickx et al. 2003; Watrall 2000
[25] Friedman 2000; Hendrickx et al. 2003; Watrall 2000
[26] Pawlik 2006:557, fig 25
[27] Cleyet-Merle & Vallet 1982: 126; Hendrickx et al. 2003
[28] Cleyet-Merle & Vallet 1982: 92; Hendrickx et al. 2003
[29] Hendrickx et al. 2003
[30]Capart 1905: fig. 115, A.293; Hendrickx et al. 2003; Petrie 1902: 12, pl. XXVI, 293
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[33]Elsasser & Fredrickson 1966 : 21; Behrman 1989: Dok. 16a
[34] Bavay & Hendrickx 2000: 131; Hendrickx 2002: 284, fig. 16.3; Hendrickx et al. 2003
[35] Hendrickx et al. 2003; Petrie 1920: 11, pl. VTI, 1
[36] Capart 1905: fig. 115,19; Hendrickx et al. 2003; Petrie 1920: 10, pl. VII,2
[37] Capart 1905: fig. 115, 17; Hendrickx et al. 2003; Petrie 1920: 13, pl. VII,3
[38] Hendrickx et al. 2003; Petrie 1920: pl. VII, 4
[39] Hendrickx et al. 2003; Petrie 1920: 13, pl. VII, 5
[40]Capart 1905: fig. 115, 18; Hendrickx et al. 2003; Petrie 1920: 13, pl. VII,6
[41]Hendrickx et al. 2003; Petrie 1920: pl. VII, 9
[42]Hendrickx et al. 2003; Petrie 1920: pl. VII, 10
[43]Capart 1905: fig. 115, K22; Hendrickx et al. 2003; Petrie et al. 1890: 30, pl. VIII,22
[44]Hendrickx et al. 2003
[45]Capart 1905: fig. 115, A.292; Hendrickx et al. 2003; Petrie 1902: 12, pl. XXVI, 292
[46] Hendrickx et al. 2003; Petrie 1903: pl. X, 220
[47] Hendrickx et al. 2003; Petrie 1902: pl. XIV
[48] Hendrickx et al. 2003; Petrie 1920: pl. VII, 7
[49] Hendrickx et al. 2003; Petrie 1920: pl. VII, 8
[50] Hendrickx et al. 2003; Hoffman 1980a: 112, fig. 30, 1
[51] Hendrickx et al. 2003; Hoffman 1980a: 112, fig. 30, 1;
[52] Cahn 2005:4
[53] Derricks 2012

Table 6.2 (part 1). Figural eccentrics which are probably not authentic.

Item ID	Figure	Site	Acquisition	Context	Context Detail	Date	Preserv-ation	Reduction	Length (cm)	Width (cm)	Thick (cm)	
BM.EA.unknown	Lizard/ arrowhead						Complete	Ind				53
BM.EA.65508	Bird						Complete		4	3		54
BM.EA.65509	Bird						Complete		4.5	5		55
CLMA.1995.40	Bird						Complete	Unifacial	5.2	5.2		56
FGC.2	Bird	Hierakonpolis (?)					Complete	Edge (bi or unifacial)				57
FWM.E.GA.4240.1943	Camel?						Complete	Edge (bifacial)				58
FWM.E.GA.4304.1943	Quadruped						Complete	Edge (unifacial)				59
FWM.E.GA.4305.1943a	Ind.						Complete	Edge (unifacial)				60
FWM.E.GA.4305.1943b	Quadruped						Complete	Edge (unifacial)				61
FWM.E.GA.4306.1943	Bird						Complete	Edge (unifacial)				62
FWM.E.GA.4308.1943	Bird						Complete	Edge (unifacial)				63
FWM.E.GA.4309.1943	Bird						Complete	Edge (unifacial)				64
FWM.E.GA.4310.1943	Bird						Complete	Edge (unifacial)				65
FWM.E.GA.4311.1943	Bird						Complete	Edge (unifacial)				66
FWM.E.GA.4312.1943	Bird						Complete	Edge (unifacial)				67
FWM.4313.1943	Lizard/ arrowhead						Complete	Edge (unifacial)	7.5			68
Gnefer.1	Bird						Complete	Edge (bi or unifacial)				69
Kassel	Bird						Complete	Edge (bi or unifacial)				70
MbC.1	Bird						Complete	Edge (bi or unifacial)				71
MbC.2	Bird						Complete	Edge (bi or unifacial)				72
MbC.3	Bird						Complete	Edge (bi or unifacial)				73

Table 6.2 (part 2). Figural eccentrics which are probably not authentic. See Table 7.1 for museum list and abbreviations. Scharff (1929: 68, figure 47) reported that flaked-stone (bird) figures bought in Luxor in the 1920's were locally made fakes. The birds are all very uniform in shape and style, and are quite numerous, and these characteristics differ from the authentic eccentrics. The possible lizard from the Fitzwilliam museum, listed as a modern item, was obtained from the same collection as many of the birds, so may be from the same source. Given that, two other similar "lizard" figures may also be fake. The one from the British museum looks like it could be an arrowhead, but no direct parallels could be found. The only line of evidence indicating that some birds may not be fakes is the bird from the Nefer gallery ,which in the photograph looks like it has significant wear over the retouch scars.

Item ID	Figure	Site	Acquisition	Context	Context Detail	Date	Preserv-ation	Reduction	Length (cm)	Width (cm)	Thick (cm)	Ref. #
MdO.unknown	Bird						Complete	Edge (bi or unifacial)				74
MMA.26.2.148	Bird	Dra Abu el-Naga	Purchased			NIII-Dyn 1	Complete	Unifacial	6.9	5.2	1	75
MMA.26.2.153	Bird	Dra Abu el-Naga	Purchased			NIII-Dyn 1	Complete	Unifacial	7.4	6.1	1	76
MMA.26.2.256	Bird	Dra Abu el-Naga	Purchased			NIII-Dyn 1	Complete	Unifacial	4.4	3.9	0.9	77
Unknown.7	Falcon (?)						Complete	Ind				78
Unknown.9	Bird						Complete	Edge (bi or unifacial)				79
Unknown.11	Lizard / arrowhead						Complete	Edge (bi or unifacial)				80
YPM.131127	Bird	Coptos					Complete	Edge (bi or unifacial)				81
YPM.7290.1	Bird	Coptos					Complete	Edge (bi or unifacial)				82
YPM.7290.2	Bird	Coptos					Complete	Edge (bi or unifacial)				83
YPM.7290.3	Bird	Coptos					Complete	Edge (bi or unifacial)				84

References for Table 6.2

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Table 6.3. Comparison of figural eccentrics types to faunal remains in HK6, HK29A, and Mahâsna Block 3 (Anderson 2011; Friedman 2009b, 2011a:4-6 ; Linseele et al. 2009; Rossel 2007). • indicates that remains from that animal were present.

Classification	Figure	HK6	HK29A	Mahasna Block 3
Aquatic wild hunted	Crocadile	•	•	•
Aquatic wild hunted	Hippo	•	•	•
Aquatic wild hunted	Turtle?	0	•	•
Aquatic wild hunted	Fish	?	•	•
Desert wild hunted	Antilope/ gazelle	•	•	•
Desert wild hunted	Hartebeest	•	•	•?
Desert wild hunted	Barabry sheep	0	•	•
Desert wild hunted	Elephant	•	0	0
Desert wild hunted	Bird	?	•	•
Wild or domestic	Bovines	•	•	•
Wild or domestic	Dog	•	•	•
Wild or domestic	Donkey	•	•	0
Wild or domestic	Ram	(sheep/goat)	(sheep)	(sheep)
Desert wild, not hunted	Giraffe	•	0	0
Desert wild, not hunted	Ibex	•	0	0
Desert wild, not hunted	Serpent			
Desert wild, not hunted	Scorpion			
Human	Dwarf	•	0	0

Table 6.5. Percentages of tools and debitage categories at Naqada period Nile valley settlement sites. *Debris includes flake fragments, pieces less than 1.5cm and angular debris. **Thinning flakes were present, but not counted as a separate category.

Publication	Here	Here	Holmes 1989	Holmes 1989	Holmes 1989	Vermeersch et al 2004	Ginter & Kozlowski 1994	Ginter & Kozlowski 1994	Midant-Reynes et al 2008	Holmes 1996	Takamiya & Endo 2011	Holmes 1996	Holmes 1996	Holmes 1989	Holmes 1992, 1996	Hikade 2008	Hikade 2008	Holmes 1996	Here	Here
Site group	**Mahâsna**	**Abydos**	**Naqada**				**Armant**		**Adaïma**	**Hierakonpolis**									**Aswan**	
Site	Mahâsna	Abydos ATP	South Town	Naqada KH3B	Naqada KH7	Abadiya 2	Armant MA21/83	Armant MA21a/83	Adaïma	HK11C	HK11C A6-A7	HK14	HK24A	HK29 10L10	HK29A†	HK29B	HK25	HK25D	AKAP-WK15	AKAP-WK22
Time period	NIC-IIC	Early Naqada	3440 BC	NI-IIAB 3830BC	NI-IIAB	NIA-IB	NI-II	NI-II	NIC-NIIID	3550 BC	NIID and later	3625 BC	Late Amratian	Late Amratian	NIID-NIIIA	Later Naqada	NIIC-D	Late Amratian	NIC-IIAB	NIC-IIAB
Total # artifacts	6276	609	2206	5055	623	21090	11326	19831	12023	1190	3677	214	711	3557	~54,000	10451	7481	183	2042	50
Total #tools	660	79	177	194	48	546	743	1206	826	131	307	16	35	468	~1944	279	225	9	204	17
Tools	10.53	12.97	8.02	2.91	7.7	2.5	6.56	6.13	6.85	11.01	8.35	7.48	4.92	13.16	3.6	2.67	3.01	4.92	9.99	34
Cores (& core frags)	3.57	1.97	1.04	0.57	1.12	0.88	3.27	1.35	2.94	1.01	1.06	3.74	0.42	1.07	0.3	1.21	1.98	1.09	1.57	2
Rejuvenation pieces	0.88	1.81	0.54	0.1	0.16	0.18	0.53	0.11		0		0.47	0.14	0.31	0.1	0.06	0.05	0	0.78	2
Crested blades	0.05	0.16				0.05	0.36	0.17	0.25					0		0.01	0.05		0.05	0
Blades	5.11	7.39	5.39	3.5	10.91	2.43	7.98	6.71	3.11	11.18	15.28	9.34	5.62	13.52	4.8	5.59	5.51	5.47	2.11	2
Flakes	19.24	28.41	44.02	44.29	59.23	20.77	45.47	39.64	21.66	46.05	46.29	57.01	41.07	56.84	6.6	5.27	5.72	34.43	15.48	32
Burin spalls	0.88	0.82				1.36	0.5	0.87	0.53	1.01	0.41	0	0.84	2.78	0.5	0.96	0.31	1.09	1.47	2
Axe prep flakes	0.02	0	0.14	0.26	0.16	0.21	0.31	0.57						0		0.03	0		0	0
Thinning flakes	1.79	4.6				**	4.35	6.48	0.03	4.62	6.8	0	2.81		15.4	8.66	5.91	2.19	1.76	0
Other debitage	10.29	12.15	0.05	0.45	1.28	5.24	1.3	0.77	9.64		1.39			2.98					9.41	12
Debris*	47.65	29.72	40.8	47.91	19.42	63.77	29.36	37.21	54.99	25.12	20.42	21.96	44.17	9.33	68.6	75.53	77.41	50.82	57.4	14
TOTAL	100.01	100	100	99.99	99.98	97.39	99.99	100.01	100	100	100	100	99.99	99.99	99.9	99.99	99.95	100.01	100.02	100

Table 6.6. Counts of bifacial tool types at Naqada period Nile valley settlement sites. •=Present. * Including preforms & choppers. †The bifacial tools were not specifically identified in the article, 3 could be identified from drawings, the rest were put in this category. ††This total does not include piece esquilles,.

Publication	Here	Here	Holmes 1989	Holmes 1989	Holmes 1989	Vermeersch et al 2004	Ginter & Kozlowski 1994	Ginter & Kozlowski 1994	Midant-Reynes et al 2008	Holmes 1996	Takamiya & Endo 2011	Holmes 1996	Holmes 1996	Holmes 1989	Holmes 1992, 1996	Hikade 2008	Hikade 2008	Holmes 1996	Here	Here
Site group	**Mahâsna**	**Abydos**	**Naqada**				**Armant**		**Adaïma**	**Hierakonpolis**									**Aswan**	
Site	Mahâsna	Abydos ATP	South Town	Naqada KH3B	Naqada KH7	Abadiya 2	Armant MA21/83	Armant MA21a/83	Adaïma	HK11C	HK11C A6-A7	HK14	HK24A	HK29 10L10	HK29A†	HK29B	HK25	HK25D	AKAP-WK15	AKAP-WK22
Time period	NIC-IIC	Early Naqada	3440 BC	NI-IIAB 3830BC	NI-IIAB	NIA-IB	NI-II	NI-II	NIC-NIIID	3550 BC	NIID and later	3625 BC	Late amratian	Late amratian	NIID-NIIIA	Later Naqada	NIIC-D	Late amratian	NIC-IIAB	NIC-IIAB
Total # aftifacts	6276	609	2206	5055	623	21090	11326	19831	12023	119 0	3677	214	711	3557	~54, 000	10451	7481	183	2042	50
Total #tools	660	79	177	194	48	546	743	1206	826	131	307	16	35	468	~1944	279	225	9	204	17
RFK	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Rhomboid	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Fishtail	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Concave-Base PP	2	0	1	0	0	0	0	1	1	0	0	0	0	0	•	0	0	0	0	0
Eccentric	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Other Fine Bifacials	1	0	1	3	1	0	0	0	0	2	3	0	0	2	•	0	0	0	0	0
Bifacial Knife	1	0	2	0	0	0	1	0	14	0	0	0	0	1	•	0	0	1	1	0
Bifacial Sickle	0	0	0	0	0	2	3	1	3	0	0	0	0	0		0	0	0	1	0
Bifacial Plane	1	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0
Axe	3	0	0	7	1	40	22	25	0	0	0	0	0	0		0	0	0	0	0
Drills: winged/ crescent/cylindrical	0	0	0	1	0	0	0	0	0	0	3	0	0	14	•	0	0	0	0	0
Pic/Grand Perçoir	0	0	0	1	0	1	12	13	0	0	0	0	0	0		0	0	0	0	0
Non-standard, & Unidentifiable*	16	1	4	15	2	13	54	43	1	1	7†	0	1	18	•	12	13	0	0	0
Axe Preform	0	0	0	0	0	0	22	9	0	0	0	0	0	0		0	0	0	0	0
Total # Bifacial Tools	24	1	8	27	4	56	92	83	19	3	13	0	1	35	?	12	13	1	2††	0

Table 6.7. Percentages of bifacial tool types at Naqada period Nile valley settlement sites. Sample sizes smaller than 30 are grayed-out. See Table 6.6 for references, specific counts, and notes.

Site group	Mahâsna	Abydos	Naqada				Armant		Adaïma	Hierakonpolis									Aswan	
Site	Mahâsna	Abydos ATP	South Town	Naqada KH3B	Naqada KH7	Abadiya 2	Armant MA21/83	Armant MA21a/83	Adaïma	HK11C	HK11C A6-A7	HK14	HK24A	HK29 10L10	HK29A†	HK29B	HK25	HK25D	AKAP-WK15*	AKAP-WK22
Time period	NIC-IIC	Early Naqada	3440 BC	NI-IIAB 3830BC	NI-IIAB	NIA-IB	NI-II	NI-II	NIC-NIIID	3550 BC	NIID and later	3625 BC	Late amratian	Late amratian	NIID-NIIIA	Later Naqada	NIIC-D	Late amratian	NIC-IIAB	NIC-IIAB
Total # artifacts	6276	609	2206	5055	623	21090	11326	19831	12023	1190	3677	214	711	3557	~54000	10451	7481	183	2042	50
Total #tools	660	79	177	194	48	546	743	1206	826	131	307	16	35	468	~1944	279	225	9	204	17
RFK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhomboid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fishtail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concave-Base PP	0.3	0	0.56	0	0	0	0	0.08	0.12	0	0	0	0	0	0.3	0	0	0	0	0
Eccentric	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Fine Bifacials	0.15	0	0.56	1.55	2.08	0	0	0	0	1.53	0.98	0	0	0.43	1.1	0	0	0	0	0
Bifacial Knife	0.15	0	1.13	0	0	0	0.13	0	1.69	0	0	0	0	0.21	0	0	0	11.11	0.49	0
Bifacial Sickle	0	0	0	0	0	0.37	0.4	0.08	0.36	0	0	0	0	0	0	0	0	0	0.49	0
Bifacial Plane	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Axe	0.45	0	0	3.61	2.08	7.33	2.96	2.07	0	0	0	0	0	0	0	0	0	0	0	0
Drills: winged/ crescent/cylindrical	0	0	0	0.52	0	0	0	0	0	0	0.98	0	0	2.99	0.1	0	0	0	0	0
Pic/Grand Perçoir	0	0	0	0.52	0	0.18	1.62	1.08	0	0	0	0	0	0	0	0	0	0	0	0
Non-standard, & Unidentifiable	2.42	1.27	2.26	7.73	4.17	2.38	7.27	3.57	0.12	0.76	2.28	0	2.86	3.85	0.5	4.3	5.78	0	0	0
Axe Preform	0	0	0	0	0	0	2.96	0.75	0	0	0	0	0	0	0	0	0	0	0	0
Total Bifacial Tools (%)	3.62	1.27	4.51	13.93	8.33	10.26	12.38	6.88	2.29	2.29	4.24	0	2.86	7.48	2	4.3	5.78	11.11	0.98	0

Table 6.8. Counts of bifacial tool types found in other related areas of the sites studies here, but not from the above statistically comparable samples. •=Present. *Spurrell (1896) described one of these with material from the cemeteries, but Holmes (1989) thinks it is from the settlement. **Harlan (1985) reported 32 bifacial tools but did not give specific types.

Site group	**el-Mahasna**			**Abydos**	**Naqada**						**Adaïma**			**Hierakonpolis**								**Aswan**
Site	MAP[1]	S1& S2[2]	S1& S2[3]	Abydos ATP[4]	North town[5]	South Town[6]	KH4[5]	KH1[5]	KH3 [7]	KH3 X/XI[5]	Adaïma[8]	Adaïma[9]	Adaïma[10]	HK11C[11]	HK11 [12]	HK11C B4-B5[13]	HK11C C3-C4[14]	HK Settlement site[15]	HK29 17L13[16]	HK29A 140L50[17]	Hk25-older group[18]	AKAP-WK15 Area B[19]
Total # of Lithic artifacts	23	44	n/a	74	1031	124+	6342	?	?	5388+	?	?	106	8793	2601	1714	?	61	2758	9000	?	2595
total # of tools	22	42	n/a	28	59	117+	178	?	?	407	?	?	106	?	287	226	48	61	240	?	776	~155 (6%)
RFK	0	0	0	0	0	0	0			0	0	0	0		0	0		0	0			
Rhomboid	0	0	0	0	0	0	0			0	0	0	0		0	0		2	0		3	
Fishtail	1	0	1	0	0	0	0			0	1	0	1		0	0		0	0		24	
Concave-Base PP	1	0	3	1	0	3*	1	•	•	0	0	0	0		0	0		5	0		15	
Eccentric	0	0	0	0	0	0	0			0	0	0	0		2	0		1	0			
Other Fine Bifacials	0	3	0	1	0	3	5		5	0	0	0	1		0	0		0	0			
Bifacial Knife	1	1	3	0	0	8	0			0	2	6	4		6	4		5	0	1	17	
Bifacial Sickle	1	0	1	3	0	1	0			0	4	3	4		0	0		0	0			
Bifacial Plane	0	0	0	0	0	1	0			1	1	0	0		0	0		0	0			
Axe	0	12	6	0	4	29	12		1	26	2	0	1		0	0		11	0			
Drills: winged/ crescent/cylindrical	0	0	0	0	0	1	0			0	1	0	0		0	0		4	4			
Pic/Grand Perçoir	0	0	0	0	0	0	2			2	0	0	0		0	0		0	0			
Non-standard, & Unidentifiable	1	0	6	1	2	5	7			22	2	0	1	32**	0	0	•	2	3			1
Unfinished Concave-Base PP	0	0	0	0	0	0	3			0	0	0	0		0	0		0	0			
Unfinished Knife	0	1	0	0	0	0	0			0	0	0	0		0	0		0	0			
Preform/ Unfinished Axe	0	0	0	0	0	1	0			0	0	0	0		0	0		0	0			
Axe Prep. Flake	0	0	0	0	0	0	1			2						0		0	0			1

References for Table 6.8

[1] Anderson's (2006) excavations: surface, blocks 2 & 5. Materials analyzed as part of this dissertation research.

[2]University of Pennsylvania Museum collection, from Garstang's (1903) excavations.

[3] Artifacts reported in Garstang (1903) but not found in the University of Pennsylvania Museum collection.

[4] Harvey (1998) excavations: Material recovered from other Ops besides 8 & 19. Materials analyzed as part of this dissertation research.

[5] Prehistoric of Naqada Project (Holmes 1989:201-258).

[6]Petrie's South Town excavations (Baumgartel 1960:28, Pl1; Holmes 1989:258-276; Petrie & Quibell 1896:PL LXXI).

[7]Prehistoric of Naqada Project. Material from other areas of KH3 besides area B or X/XI (Holmes 1989:201-258).

[8] Material from excavations by Midant-Reynes and others, from other parts of the settlement, outside of block 1001 mainly surface (Midant-Reynes & Prost 2002:336-369).

[9]Material in the St-Germain-en-Laye Museum collection, mainly excavated by Morgan, and reported in Midant-Reynes & Prost (2002:336-369).

[10] Brooklyn Museum Collection, from Morgan's excavations (Midant-Reynes & Prost 2002:336-369; Needler 1984:83-87).

[11] Middens, kiln, and domestic areas of Hk11 (Harlan 1985: 103-104, 269).

[12] Watrall's excavations in HK11 Square G (Friedman et al. 2002; Watrall 2000:12; Watrall 2001:8-9).

[13] 2008 & 2009 excavation material analyzed by Nagaya (Friedman et al. 2011:148-149).

[14] 2013 excavations (Nagaya 2013:14-15).

[15] Brooklyn Museum collection from Morgan's excavations (Needler 1984).

[16] House remains excavated by Hoffman, and analyzed by Holmes (1996).

[17] Material from 1986 excavations, find 4, analyzed by Takamiya & Endo (2008:7-8).

[18]Friedman & Nagaya's (2013:21-22) re-analysis of the older burnt bifacial group of material from HK25.

[19] Usai's analysis of material from WK 15, Area B, in Gatto et al. (2009b:201-203); Usai report 2012.

References for Table 6.9

[1] Ayrton & Loat 1911

[2]Garstang 1903

[3] Naville 1914; Peet 1914

[4] Hikade 1998, 2000; Date & grave count: Hartmann 2011

[5] Baumgartel 1970; Hendrickx 2002:283-284; Holmes 1989:274, 276-280; Petrie & Quibell plates LXXII; LXXIII; LXXIV; LXXVI; Spurrel 1896:56; Dates: Hendrickx & van den Brink 2002:360

[6]Mond & Meyers 1937; Dates: Hendrickx & Van den Brink 2002:361

[7]Crubezy et al. 2002; Midant-Reynes & Prost 2002:353-354

[8] Friedman 2003:18-19, 2004a:5, 2004b:8-9; Friedman et al. 1999.

[9]Adams 2000a:24,26-27,54,60,70,72,83-93,148,265,269,270,299-301photo-268,drawings-299,300,PL- XXXa&b, Fig 13, Fig 14, Adams 2000b:5, Adams 2001:5-6; Droux 2008:20, Droux 2011:16-17; Droux & Friedman 2014: 6, 2007: 7-9; Friedman 2000b:14, 2005:4-6, 2009:7, 2010:68-71, 2011a:4-6, 2011b:13, 2012:6-7 , 2013:7,16; Friedman et al. 2008:90-91; Friedman et al. 2009: 194; Friedman et al. 2011:159-160, 168-169; Friedman et al. 2011:120, 134; Friedman et al. 2011:143,145; McNamara & Droux 2006:9-10, 16; Nekhen News inset box 2012:7; Van Neer & Linselle 2008:12-13

Table 6.9. Counts of bifacial tool types found cemeteries associated with the sites studied here. References on previous page. Note that lithic artifacts were collected from the Nag el-Qarmila cemetery, but they have not been analyzed. No comment or description was given in the excavation notes so it is unlikely that they are bifacial tools (personal observation; Gatto, pers. comm.). *Including preforms & choppers. **This RFK, sold to Morgan, probably came from the cemetery (Needler 1984:271). †Painted tomb cemetery (Quibell and Green 1902:48, Pl60, 17).

Site group	el-Mahâsna		Abydos		Naqada	Armant	Adaïma-	Hierakonpolis	
Site	Mahâsna Cemetery H[1]	Mahâsna-Alawaniyeh[2]	Abydos-cemetery E[3]	Abydos-Cemetery U[4]	Naqada-main, B & T[5]	Armant- 1200, 1300, 1400-1500[6]	Adaïma- East , West cemeteries[7]	HK43[8]	HK6[9]
Date	IA-IIIB	SD 36-38/ NIC-II	Predynastic	NIA-IID2; NIII	NIA-IIID1	NIC-NIIIA1; NIIIC-NIIID	NIC-NIIIA1	NIIA-C	NIC-IIB; NIIIA-C
# of total graves / # of graves described	~600/ 135	45/ 20	~200 /36	~600/	~2000/ ~1300	?/210	211+/205	462+ /	72+ (not all human)/
RFK	0	0	2	2	7	3	1**	0	0
Rhomboid	0	0	0	1	6	1	0	0	2
Fishtail	3	1	1	8	30	2	0	1	2
Fishtail model	1	0	0	0	0	0	0	0	1
Concave-Base PP	0	0	0	1	0	0	0	0	8+
Model Concave-Base PP	0	3	0	0	0	0	0	0	0
Eccentric	0	0	0	0	(1)	0	0	0	12+
Other Fine Bifacials	1	0	0	2	7	2	0	0	6
Bifacial Knife	2	0	0	6	13	0	0	0	10
Model Knife	0	0	0	0	0	0	1	0	0
Bifacial Sickle	0	0	0	0	2	1	1	0	2
Bifacial Plane	0	0	0	0	0	0	0	0	0
Axe	0	0	0	0	3-4	1-2	0	1†	0
Drills: winged/crescent/cylindrical	0	0	0	0	0	0	0	0	0
Pic/Grand Perçoir	0	0	0	0	0	1	0	0	0
Non-standard, & Unidentifiable*	0	0	0	0	2	1	0	0	0
Axe Preform	0	0	0	0	0	0	0	0	0

Table 6.10. Presence absence of Ripple-flaked knives and production remains across Nile valley settlement sites. Note that the Naqada and Hierakonpolis sites have each been collapsed for easier comparison. n/a mans the cemetery is not of the right date for RFKs.

RFKs	Mahâsna	Abydos	Naqada	Armant	Adaïma	Hiera-konpolis	Aswan
RFKs- cemetery	\	●	●	●	\	n/a	n/a
RFKs- settlement	\	\	\	\	\	\	\
Unfinished RFKs- settlement	\	\	\	\	\	?	\
Bifacial thinning flakes- settlement	●	●	●	●	●	●	●

Table 6.11. Presence absence of rhomboid tools and production remains across Nile valley settlement sites. Note that the Naqada and Hierakonpolis sites have each been collapsed for easier comparison.

Rhomboid Tools	Mahâsna	Abydos	Naqada	Armant	Adaïma	Hiera-konpolis	Aswan
Rhomboids- cemetery	\	●	●	●	\	●	\
Rhomboids- settlement	\	\	\	\	\	●	\
Unfinished Rhomboids– settlement	\	\	\	\	\	\	\
Bifacial thinning flakes- settlement	●	●	●	●	●	●	●

Table 6.12. Presence absence of fishtails and production remains across Nile valley settlement sites. Note that the Naqada and Hierakonpolis sites have each been collapsed for easier comparison.

Fishtails	Mahâsna	Abydos	Naqada	Armant	Adaïma	Hiera-konpolis	Aswan
Fishtails- cemetery	●	●	●	●	\	●	\
Fishtails- settlement	●	\	\	\	●	●	\
Unfinished Fishtails- settlement	\	\	\	\	\	\	\
Bifacial thinning flakes- settlement	●	●	●	●	●	●	●

Table 6.13. Presence absence of concave-base projectile points and production remains across Nile valley settlement sites. *A preform from el-Mahâsna looks like the right shape to be a CBPP. Note that the Naqada and Hierakonpolis sites have each been collapsed for easier comparison.

Concave-Base PP Tools	Mahâsna	Abydos	Naqada	Armant	Adaïma	Hiera-konpolis	Aswan
CBPPs- cemetery	\	●	\	\	\	●	\
CBPPs- settlement	●	●	●	●	●	●	\
Unfinished CBPPs - settlement	●*	\	●	\	\	●	\
Bifacial thinning flakes - settlement	●	●	●	●	●	●	●

Table 6.14. Presence absence of figural eccentrics and production remains across Nile valley settlement sites. (●) indicates that the eccentric is probably an heirloom. Note that the Naqada and Hierakonpolis sites have each been collapsed for easier comparison.

Figural Eccentrics	Mahâsna	Abydos	Naqada	Armant	Adaïma	Hiera-konpolis	Aswan
Eccentrics- cemetery	\	?	(●)	\	\	●	\
Eccentrics- settlement	\	●	\	\	\	●	\
Unfinished Eccentrics- settlement	\	\	\	\	\	\	\
Bifacial thinning flakes- settlement	●	●	●	●	●	●	●

Table 6.15. Presence absence of bifacial knives and production remains across Nile valley settlement sites. Note that the Naqada and Hierakonpolis sites have each been collapsed for easier comparison.

Bifacial Knives	Mahâsna	Abydos	Naqada	Armant	Adaïma	Hiera-konpolis	Aswan
Knives- cemetery	●	●	●	\	\	●	\
Knives- settlement	●	\	●	●	●	●	●
Unfinished Knives- settlement	●	\	\	\	\	●	\
Bifacial thinning flakes- settlement	●	●	●	●	●	●	●

Table 6.16. Presence absence of bifacial sickles and production remains across Nile valley settlement sites. Note that the Naqada and Hierakonpolis sites have each been collapsed for easier comparison.

Bifacial Sickles	Mahâsna	Abydos	Naqada	Armant	Adaïma	Hiera-konpolis	Aswan
Bifacial Sickles- cemetery	\	\	●	●	●	●	\
Bifacial Sickles- settlement	●	●	●	●	●	\	●
Unfinished BFC Sickles- settlement	\	\	\	\	\	\	\
Bifacial thinning flakes- settlement	●	●	●	●	●	●	●

Table 6.17. Presence absence of axes and production remains across Nile valley settlement sites. Note that the Naqada and Hierakonpolis sites have each been collapsed for easier comparison.

Axes	Mahâsna	Abydos	Naqada	Armant	Adaïma	Hiera-konpolis	Aswan
Axes- cemetery	\	\	●	●	\	●	\
Axes- settlement	●	\	●	●	●	●	\
Unfinished Axes- settlement	\	\	●	●	\	\	\
Axe Preparation Flakes- settlement	●	\	●	●	\	●	●
Bifacial thinning flakes- settlement	●	●	●	●	●	●	●

Table 6.18. Ripple-flaked knife metrics. C=Complete, C-N= Complete-notched, C-R= Complete-repaired, MD=Minor Damage. The reference for each entry is the relevant online museum database. Additional sources are noted. See Table 7.1 for museum list and abbreviations. *Measurement taken from drawing.

ID	Site	Preservation	Length (cm)	Width (cm)	Thick (cm)	Reference
BM.EA.29286	Unknown	C	26.7	6	0.62	Kelterborn 1984
BM.EA.29289	Unknown	C	23.5	5.4	0.6	Kelterborn 1984
BM.EA.29290	Abydos?	C	21.4	5.4		
BM.EA.32095	Unknown	C	22.9	5		
BM.EA.32096	Unknown	C	25.3	5.3		
BM.EA.32489	Unknown	C-R	23.5	6.3		
BM.EA.59235	Unknown	C	23.1			
BMFA.03.1390	Naqada	C-N	21.5	5		
BrM.09.889.120	Abu Zaidan	C-MD	24.6	5.9		Needler 1984:272-3
BrM.09.889.121	Adaima	C-MD	20	6	0.7	Needler 1984:272-3
EM.Abydos.U.503	Abydos-U	C	14.9	5.8	0.5*	Hikade 2013: Pl1; 2003: 146, Fig 3
EM.R.536	Tel el Farkha	C-R	30.4	8.3	0.9	Kabacinski 2012
FwM.E.GA.3193.1943	Unknown	C-R	25.2			
LvpM.56.20.77or80	Unknown	C-R	22.8	5.3	0.7	Bienkowski &Tooley 1995:76, Pl 117
MANStGL.84.087	Unknown	C-R	20.9	6	0.6	Musée des antiquités 1982:100
MMA.07.228.105	Unknown	C	21.9			
MMA.11.167.1	Unknown	C	29.8			
OIM.10533	Unknown	C	23	5.8	0.7	Teeter 2011
PR.1911.33.1	Gerzeh	C-R	25.5	6.3	0.7	Petrie 1912; Stevenson 2009
UC.73354	Abydos	C-R	27.2	6.7		
UC.73355	Abydos	C-R	30.1	6.6		
UC.73364	Unknown	C-R	18.4	4.6		

Table 6.19. Rhomboid metrics. C=Complete, C-R= Complete-repaired, MD=Minor Damage, MF=Medial Fragment, PF=Proximal Fragment. The reference for each entry is the relevant online museum database. Additional sources are noted. See Table 7.1 for museum list and abbreviations. *Measurement taken from photo with scale.

ID	Site	Preservation	Length (cm)	With (cm)	Thick (cm)	Reference
Abydos.U.220	Abydos	C-R	22.6*			Hikade 2000
Ash.1895.1020	Naqada	C-R	37.4	5.3		Payne 1993:167(1385)
Ash.1927.3069	Unknown	PF	23+	5.5		Payne 1993:167(1389)
BM.EA.34297	Unknown	C-R	22	4.3	0.6	
BM.EA.49723	Unknown	C-R	35.5	5.6	0.8	
BM.EA.52848	Unknown	C	34.5	5.2	0.9	
BMFA.13.3766	Mesaed	C-R	23	4	0.3	
BMFA.17.83.R	Khor Bahan, Nubia	MF	6.8+	>=3.9	0.6	
BrM.09.889.126	Hierakonpolis	C-R	41	6.4	0.65	Needler :114, 265
CMA.1914.672	Unknown	C-MD		4		
FwM.E.GA.4218.1943	Unknown	C-MD	18.25			
FwM.E.GA.4224.1943	Unknown	C-R	29			
MMA.16.2.11	Unknown	C	18.5*			
MMA.7.228.106	Unknown	C-R	21.5			
OIM.E.11226	Saghel el-Baglieh	C-R	22.2	4.3	0.7	
UC.4130	Naqada	C-MD	37.1	5.3		Baumgartel 1970; Payne 1987
UC.4389	Naqada	C-R	18.5	3.6		
UC.4828	Naqada/Ballas	C-MD	19.2	3.5		

Table 6.20 (part 1). Fishtail metrics.

ID	Site	Shape type	Preserv-ation	Length (cm)	Width (cm)	Thick (cm)	Reference
A.U.178	Abydos-U	1	TTM	15.5	7.6+	0.8*	Hikade 2003: 144
A.U.395	Abydos-U	3	C-R	12.9	5.7	0.5*	Hikade 2003: 143
Ash.1895.1000	Naqada/Ballas	1	C	10.1	7.3		Payne 1993:170 (1401)
Ash.1895.1001	Naqada	1	C	13.4	9.3		Payne 1993: 170 (1400)
Ash.1895.1023	Naqada	3	C	17.2	5.6		Payne 1993:170 (1407)
Ash.1927.3065	Unknown	2	C-R	15.8	4.7		Payne 1993:171 (1410)
Ash.1927.3066	Unknown	2	C-R	17	5.2		Payne 1993:171 (1409)
Ash.1927.3067	Unknown	1	C	7.7	5.9		Payne 1993:170 (1405)
BM.EA.32496	Unknown	3	C	11.2	5.2	0.4	
BM.EA.59240	Unknown	1a	C	14.2	6.6	0.8	
BM.EA.59241	Unknown	1	C	11.6	8.4	0.8	
BMFA.03.1386	Abadiya	1	C	13.5		0.7	
BMFA.03.1387	Abadiya	1	C	11.5			
BMFA.03.1391	Unknown	1	TTM	13.5			
BMFA.11.247	Mesaeed	1	TTM	19.5	6+	0.8	
BMFA.11.250	Mesaeed	3	TTM	15.6	4.8+	0.5	
BMFA.11.257	Mesaeed	1	C-N	9.5	4.5		
BMFA.11.259	Mesaeed	3	C	14.6	4.9	0.4	
BMFA.13.3915	Mesaeed	1	C	13.5	7.5		
BrM.07.447.866		1	C-N	12.22	5.87		
BrM.07.447.870	el-Ma'mariya	1a	C-R	12.5	6.5		Needler 1984:266-267
CMA.1914.673	Unknown	1	C	15	10		
CMA.1914.674	Unknown	1a	C	11	6		
CMA.1914.717	Unknown	2	C	18.5	6.5		
EM.34831	Unknown	2	C-MDTT	16			Currelly 1913: 272
FwM.E.214.1932	Unknown	2	C-MDTT	16.5			
FwM.E.49.1899	Unknown	1	C-MDTT	10.5			
FwM.E.50.1899	Unknown	1	C-R	11			
FwM.E.51.1899	Diospolis Parva	1	C-MDTT	12			
Fwm.E.52.1899	Unknown	2	C	16			
FwM.E.GA.4144.1943	unknown	1a	C	12.3			
FwM.E.GA.4148.1943	Unknown	2	TTM	16.5			
FwM.E.Misc.94	Unknown	1a	C-R	12			
FwM.GA.3162.1943	Unknown	2	C	14.9	5	0.4	
FwM.GA.3174.1943	Unknown	1a	C-R-MD	10			
HK.6.2006.2	HK6	1a	C	7.9	4.4	0.6	Friedman2006:7; Nagaya 2011
LACMA.1998.94.1	Unknown	2	C	17.15	5.27	0.32	
LvpM.1973.2.254	Abydos?	3	C-R	14	4.8	0.5	Bienkowski & Tooley 1995:48
LvpM.56.20.42	Naqada?	2	C	10.5	4.4	0.5	
MAP.301.1	MAP	1a	MF	7.76+	4.05+	0.61	
MMA.10.176.96	Unknown	1a	C	15.2	4		
MMA.16.2.4	Unknown	2	C	15.7	5.8	0.8	
MMA.16.2.8	Unknown	1	C	9.5			
MMA.17.6.25		2	DF	>9.7	5.6		
MMA.20.5	Unknown	3	C	12	5		
OIM.11250	Unknown	2	C	18.3	6.1	0.8	
OIM.11252	Unkown	1	C	11.5	7.9	0.6	
OIM.11253	Unknown	1a	C-R	11.8	6.9	0.9	

Table 6.20 (part 2). Fishtail metrics. This survey did not include Fishtails that were clearly re-worked, nor fishtails that had handles where it was not clear if the handles were included in the length measurement). C=Complete, C-MDTT= Complete- minor damage on 1 tang tip, C-N= Complete-notched, C-R= Complete-repaired, DF=Distal Fragment, MD=Minor Damage, MF=Medial Fragment, TTM=Tang Tip Missing. The reference for each entry is the relevant online museum database. Additional sources are noted. See Table 7.1 for museum list and abbreviations. *Thickness measured from drawing.

ID	Site	Shape type	Preservation	Length (cm)	Width (cm)	Thick (cm)	Reference
OIM.11254	Unknown	1	C-N-MD	11.6	5.5	0.6	
PR.1900.42.1	Abydos-G	2	TTM	16	5.3	.5	Petrie 1902
PR.1901.42.107	Mahasna	1a	C	14.6	5.3	0.7	Garstang 1903: Pl5 (6)
PR.1901.42.114	Mahasna	1a	DF	>9.5	4.7	0.8	Garstang 1903:5,8
RMAH.5663	El-Haraga	2	C	20	4.5		
RVFAM. E1.01.015.1998	Unknown	2	C	16.5	5.1	0.32	Kaplan 2005:124
SNHM.A328574.0	Unkown	1	C	13			
UC.4133	Naqada	1	C-R	13.3	7.5		Petrie & Quibell 1896:Pl73(66)
UC.4133a	Naqada	1a	C-R	12.4	7		Petrie & Quibell 1896:Pl73(66)
UC.42817	Abydos?	2	C	16.4	5.4		
UC.4429	Naqada	2	C	17.5	6.6		
UC.4527	Naqada	1	C	13.2	5.6		
UC.4528	Naqada	1	TTM	9	4.3+		
UC.4827	Naqada	1a	C-R	13.5	6.4		
UC.4919	Naqada	1a	C	9	3.2		
UC.5405	Naqada	1	C-R	12.5	8.8		
UC.6070	Armant	1a	TTM	11.4			
UC.8965	Unknown	2	C	11.7	5.7		

Table 6.21. Metric data for the lengths of Fishtails showing that they became longer and less variable over time.

	Type 1	Type 1a	Type 3	Type 2
N	24	14	7	18
Mean (cm)	12.23	11.99	13.93	16.16
Standard deviation	2.44	2.07	2.09	2.2
CV	19.94%	17.28%	14.99%	13.63%

Table 6.22. Metric data for Concave base projectile points.

	Length (cm)	Width (cm)	Thick (cm)
N	11	18	15
Mean (cm)	6.45	2.49	0.597
Standard deviation	1.89	0.315	0.092
CV	29.3%	12.65%	15.41%

Table 6.23. Concave-base projectile point metrics. C=Complete, C-R= Complete-repaired, DF=Distal Fragment, MD=Minor Damage, MF=Medial Fragment, 1TB= One Tang Broken. The reference for each entry is the relevant online museum database. Additional sources are noted. See Table 7.1 for museum list and abbreviations. *Thickness taken from photo with scale.

ID	Site	Preservation	Length (cm)	Width (cm)	Thick (cm)	Reference
Ad.409	Adaima	1TB	4.7	1.7	0.6	Midant-Reynes & Prost 2002: 366(409)
AMC.12.48	Abydos	DF	6.57+	2.53	0.53	
Ash.E.1612	Mahasna	1TB	7.5			Payne 1993: 180 (1479)
Ash.E.1613	Hierakonpolis-Nekhen	DF	5.2+	3		Payne 1993: 180 (1478)
BrM.09.889.127	Hierakonpolis	C-R	8.3*	2.6*	0.5*	Needler 1984:263
BrM.09.889.128	Hierakonpolis	1TB	6.7			Needler 1984:263
EK.2012.3.38	Elkab	DF	5.9+	>=2.52	0.6	Claes et al. 2014:85
HK.6.str7.363	Hierakonpolis-HK6	C	10			Friedman2010:69; Droux&Friedman2007
KH4.c	Naqada-KH4	MF	3.6+	2.8	0.8	Holmes 1989:248-249
MAP.2528.1	el-Mahasna	1TB	7.4	2.55	0.58	
MAP.3029.1	el-Mahasna	1TB	4.22	2.46	0.6	
MAP.395.1	el-Mahasna	MF	4.85+	2.21	0.54	
UC.10028	Hemmamiya North spur	DF	3.2+	2.5	0.5	Holmes 1989:83-84
UC.10345	Hemmamiya North spur	1TB	3.4	2.5	0.5	Holmes 1989:83-84
UC.27229	Badari 3000/10	1TB	4.4+	3.1	0.4	Holmes 1989:163
UC.5343	Naqada-South Town	C	6.5	2.4	0.8	Holmes 1989:274
UC.5352	Naqada-South Town	C	5.8	2.3	0.5	Holmes 1989:274-275
UC.6230	Naqada	1TB	6.5*	2.5*		
UC.9433	Badari 3000/3	DF	6.2+	2.6	0.6	Holmes 1989:163
UC.9434	Badari 3000/3	DF	5.4+	2.6	0.6	Holmes 1989:163
UC.9436	Badari 3000/6	DF	6+	2.2	0.5	Holmes 1989:163
UC.9437	Badari 3000/6	MF	4.4+	2.2	0.6	Holmes 1989:163
UC.9438	Badari 3000/6	DF	4.7+	2+	0.6	Holmes 1989:163

Table 6.24. Metric data for Bifacial sickles.

	Width (cm)	Thick (cm)
N	22	19
Mean (cm)	2.87	0.79
Standard deviation	0.713	0.235
CV	24.84%	29.74%

Table 6.26. Metric data on the lengths of axes. Data on the Naqada sites is from Holmes (1990).

Site	Mahasna	Armant	Naqada-KH3	Naqada-KH4	HK
N	12	31	34	12	10
Mean (cm)	6.79	7.49	6.18	6.62	7.79
Standard deviation	1.51	1.86	1.03	1.84	1.65
CV	22.24%	24.83%	16.67%	27.79%	21.18%

Table 6.25. Bifacial sickle metrics. C=Complete, EF=End Fragment, MF=Medial Fragment. The reference for each entry is the relevant online museum database. Additional sources are noted. See Table 7.1 for museum list and abbreviations. *Measurement taken from photo or drawing with scale.

ID	Site	# of points extant	Preservation	Length (cm)	Width (cm)	Thick (cm)	Reference
Ab2.Fig22.11	Abadiya 2	1	EF	3.54+	1.3		Vermeersch et al. 2004:234,237
Ad.256	Adaima	1	EF	6.5+	2.1	0.6	Midant-Reynes & Prost 2002:354
Ad.258	Adaima	1	C	8	2.4	0.8	Midant-Reynes & Prost 2002:354
Ad.259	Adaima	1	EF	8.8+	2.7	0.5	Midant-Reynes & Prost 2002:354
Ad.261	Adaima- West cemetery	2	C	16.3	3.1	1.1	Midant-Reynes & Prost 2002:354
AKAP.1552.1	Nag El-Qarmila	1	EF	5.76+	2.44	0.77	
ATP.3418	Abydos	2	C	16			
ATP.3419	Abydos	2	C	17.6	4.24	1.31*	
ATP.3420	Abydos	2	C	22			
BrM.07.447.802	Adaima	1	EF	15.6+	3.7	0.9	Needler 1984:286
BrM.07.447.806	Adaima	0	EF	7.3+	3.6	0.5	Needler 1984:85-86 (72)
BrM.07.447.807	Adaima	0	MF	7.3+	3.6	1*	Needler 1984:85-86 (71)
EK.TP4.1	Elkab	0	MF	9.08+	3.84	0.91	Claes et al. 2014:85
MA2183.Y.S.Pl12.4	Armant	0	MF	5.9+	2.86	1.14	Ginter & Kozlowski 1994:61
MAP.2861.1	Mahasna	1	EF	8	3.8	0.86	
UC.10525	Hemmamiya, North Spur	1	EF	5.6	2.4	0.5	Holmes 1989:81-82
UC.10619	Hemmamiya, 1900	1	EF	7+	2.7	0.6	Holmes 1989:162
UC.10620	Hemmamiya, 1900	0	MF	4.6+	2.3	0.6	Holmes 1989:162
UC.26823	Badari, 3000/3	0	EF	4.2+	2.6	0.6	Holmes 1989:162
UC.4609	Naqada	1	EF	~11.7*	2.6		
UC.5332	Naqada- South Town	1	EF	7.6	2.9	0.7	Holmes 1989:267
UC.9618	Badari, 3000/3	0	MF	4.5+	3	0.9	
UC.9653	Badari 3000/6	0	MF	3.9+	1.9	0.7	Holmes 1989:162
UC.9879a	Hemmamiya, 1700	2	C	~11.7	3		

Table 6.27. Metric data on the widths of axes. Data on the Naqada sites is from Holmes (1990).

Site	Mahasna	Armant	Naqada-KH3	Naqada-KH4
N	15	31	34	12
Mean (cm)	5.44	5.27	4.38	4.78
Standard deviation	1.095	1.08	0.791	0.98
CV	20.12%	20.49%	18.06%	20.5%

Table 6.28. Metric data on axe thickness. Data on the Naqada sites is from Holmes (1990).

Site	Mahasna	Armant*	Naqada-KH3	Naqada-KH4
N	15	10	34	12
Mean (cm)	2.26	2.64	1.935	2.175
Standard deviation	0.456	0.45	0.485	0.436
CV	20.15%	17.04%	25.06%	20.05%

Table 6.29 (part 1). Axe metrics. C=Complete, DF=Distal Fragment.

ID	Site	Preservation	Length (cm)	Width (cm)	Thick (cm)	Reference
BrM.07.447.1008	Hierakonpolis	C	9.3			Needler 1984:117
BrM.07.447.1009	Hierakonpolis	C	8.9			Needler 1984:279
BrM.07.447.1011	Hierakonpolis	C	7.1			Needler 1984:279
BrM.07.447.1018	Hierakonpolis	C	9.9			Needler 1984:117
BrM.07.447.1019	Hierakonpolis	C	8.3			Needler 1984:114
BrM.07.447.1020	Hierakonpolis	C	5.7			Needler 1984:117
BrM.07.447.1022	Hierakonpolis	C	8.5			Needler 1984:117
BrM.07.447.990	Hierakonpolis	C	8.2			Needler 1984:117
BrM.07.447.994	Hierakonpolis	C	4.5			Needler 1984:117
BrM.07.447.998	Hierakonpolis	C	7.5			Needler 1984:279
Man.23428	Armant	C	8.8	5.4	2.3	
ManM.23382	Armant	C	10.2	7.9		Mond & Meyers 1937: 233, Pl 62 (12)
ManM.23383	Armant	C	10.5	6.4	3	Mond & Meyers 1937: 234,243, Pl57,62
ManM.23384	Armant	C	8.8	5.7		
ManM.23385	Armant	DF	8.5+	5.9		
ManM.23386	Armant	C	7.7	5.5		
ManM.23387	Armant	C	9.1	6.2		
ManM.23388	Armant	C	9.5	5.6		
ManM.23389	Armant	C	8.4	5.8	3	Mond & Meyers 1937: 243, Pl62 (15)
ManM.23390	Armant	C	9.8	6.4		Mond & Meyers 1937:233, Pl 57 (17)
ManM.23391	Armant	C	8.8	5.2	2.3	Mond & Meyers 1937:234,244,Pl57 (19)
ManM.23392	Armant	C	8.3	5.4		Mond & Meyers 1937:133, Pl 57 (18)
ManM.23393	Armant	C	9.4	6.2	2.2	Mond & Meyers 1937:244, Pl 62 (17)
ManM.23394	Armant	C	9.2	6.2	2.9	Mond & Meyers 1937: 244, Pl 62 (21)
ManM.23396	Armant	C	8.5	5.7		Mond & Meyers 1937:243, Pl 62 (14)
ManM.23397	Armant	C	8	6.9		Mond & Meyers 1937:234, Pl 57 (23)
ManM.23399	Armant	C	8.9	6.2		
ManM.23405	Armant	C	5.3	4.7	3	Mond & Meyers 1937:244, Pl 62 (18)
ManM.23405	Armant	C	5.4	4.8	3.1	Mond & Meyers 1937:244, Pl 62 (18)
ManM.23412	Armant	C	4.9	4.5		Mond & Meyers 1937:233, Pl 57 (5)
ManM.23644	Armant	C	7.6	5		
ManM.23645	Armant	C	7.5	5.1		
ManM.23658	Armant	C	6.7	6.5		Mond & Meyers 1937:243, Pl 61 (11)
ManM.23659	Armant	C	4.7	5		
ManM.23660	Armant	C	5.4	4.7		
ManM.23692	Armant	DF	6.5+	5.9		
ManM.23704	Armant	C	5.5	3.7		
ManM.23705	Armant	C	4.9	3.3		
ManM.23706	Armant	C	5.1	3.3		
ManM.23707	Armant	C	4.2	3.7		
ManM.23848	Armant	C	5.8	3.7		
ManM.23859	Armant	C	7.1	4.9	1.8	Mond & Meyers 1937:48, Pl 16 (1)
ManM.23862	Armant	C	8.2	4.4	2.8	Mond & Meyers 1937:48
MAP.1973.30	el-Mahasna	C	7.11	4.74	2.5	
MAP.2522.26	el-Mahasna	DF	4.73+	5.29	1.64	
MAP.2522.31	el-Mahasna	C	8.06	6	2.33	
PM.E.9633	el-Mahasna	DF	10.02+	8.07	2.34	

Table 6.29 (part 2). Axe metrics. C=Complete, DF=Distal Fragment. The artifacts from el-Mahasna were analyzed by the author. The reference for each entry is the relevant online museum database. Additional sources are noted. See Table 7.1 for museum list and abbreviations.

ID	Site	Preservation	Length (cm)	Width (cm)	Thick (cm)	Reference
PM.E.9634	el-Mahasna	C	9.14	6.96	2.9	
PM.E.9653	el-Mahasna	DF	6.79+	3.97	1.72	
PM.E.9654	el-Mahasna	C	4.96	5.98	2.7	
PM.E.9655	el-Mahasna	C	5.96	4.75	2.35	
PM.E.9656	el-Mahasna	C	6.08	4.96	2.81	
PM.E.9681	el-Mahasna	C	7.26	6.08	1.69	
PM.E.9682	el-Mahasna	C	9.22	5.13	2.05	
PM.E.9687	el-Mahasna	C	4.98	4.36	2.18	
PM.E.9689	el-Mahasna	C	5.05	4.23	2.67	
PM.E.9690	el-Mahasna	C	6.16	5.12	2.58	
PM.E.9692	el-Mahasna	C	7.49	6.02	1.48	

Table 6.30. Comparison of reduction categories in different blocks at el-Mahâsna.

	Block 1		Block 3		Block 4	
	count	%	count	%	count	%
Tools	186	7.46	214	10.05	214	13.01
Core/tools	9	0.36	21	0.99	16	0.97
Cores (& core remnants)	54	2.17	83	3.9	87	5.29
Rejuvenation pieces	19	0.76	28	1.31	8	0.49
Crested blades	1	0.04	2	0.09	0	0
Blades	78	3.13	97	4.55	74	4.5
Bladelets	35	1.4	20	0.94	17	1.03
Flakes	516	20.7	582	27.32	359	21.82
Burin spalls	21	0.84	17	0.8	17	1.03
Axe prep flakes	**0**	**0**	**1**	**0.05**	**0**	**0**
Bifacial thinning flakes	**36**	**1.44**	**57**	**2.68**	**19**	**1.16**
Other debitage	138	5.54	132	6.2	105	6.38
Debris less than 1.5cm	950	38.11	274	12.86	312	18.97
Debris-Flake fragments	321	12.88	503	23.62	254	15.44
Debris- Angular	126	5.05	91	4.27	154	9.36
Indeterminate pieces	3	0.12	8	0.38	9	0.55
TOTAL	2493	100	2130	100.01	1645	100

Table 6.31. The total percentage of bifacial tools in each block. And the 95% binomial confidence limits. The intervals overlap significantly showing that although the percentage in Block 3 appears higher, it could be due to chance or sample size.

All Bifacial Tools	Block 1	Block 3	Block 4
UCL (95%)	4.43	9.79	6.74
%	1.54	5.97	3.48
LCL (95%)	0.56	3.62	1.81

Table 6.32 . The percentage of only the standardized identifiable bifacial tools in each block and the 95% binomial confidence limits. The intervals overlap significantly showing that the higher percentage in Block 3 could be due to chance or sample size.

Standardized Bifacials	Block 1	Block 3	Block 4
UCL	2.82	6.6	1.29
%	0.51	2.99	0
LCL	0.13	1.77	0

Table 6.33. Comparison of bifacial tool types in different blocks at el-Mahâsna.

Bifacial Tool Type	Block 1		Block 3		Block 4	
	count	%	count	%	count	%
RFK	0	0	0	0	0	0
Fishtail	0	0	0	0	0	0
Rhomboid	0	0	0	0	0	0
Concave-Base PP	0	0	2	0.85	0	0
Figural eccentric	0	0	0	0	0	0
Other Fine Bifacials	0	0	1	0.43	0	0
Bifacial Knife	0	0	1	0.43	0	0
Bifacial Sickle	0	0	0	0	0	0
Bifacial Plane	1	0.51	0	0	0	0
Axe	0	0	3	1.28	0	0
Drills:winged/crescent/cylindrical	0	0	0	0	0	0
Pic/Grand Perçoir	0	0	0	0	0	0
Non-standard, & Unidentifiable	2	1.03	6	2.55	8	3.48
Unfinished BFC	0	0	1	0.43	0	0
Unfinished Concave-Base PP	0	0	0	0	0	0
Unfinished Knife	0	0	0	0	0	0
Preform/ Unfinished Axe	0	0	0	0	0	0
Other Tools (Bifacially Edged & Unifacial)	192	98.46	221	94.04	222	96.52
total N of tools	195	100	235	100.01	230	100

Table 6.34. Percentages of bifacial production flakes and tranchet flakes in different sectors of Armant MA 21/83. Note that these counts do not include artifacts from features.

	Northern part		Southern Part	
Total # of artifacts	2818		6691	
count/%	count	%	count	%
Thinning flakes	68	2.41	306	4.57
Axe prep flakes	8	0.28	25	0.37

Table 6.35. Percentages of bifacial tool types in different sectors of Armant MA 21/83.

Bifacial Tools	Northern part		Southern Part	
	count	%	count	%
RFK	0	0	0	0
Rhomboid	0	0	0	0
Fishtail	0	0	0	0
Concave-Base PP	0	0	0	0
Figure	0	0	0	0
Other Fine Bifacials	0	0	0	0
Knife	0	0	0	0
Bifacial Sickle	0	0	2	0.48
Bifacial Plane	3	1.43	4	0.97
Axe	8	3.81	11	2.66
Drills: winged/crescent/cylindrical	0	0	0	0
Pic/Grand Perçoir	2	0.95	9	2.18
Non-standard, & Unidentifiable	0	0	0	0
Axe preform	4	1.9	12	2.91
Bifacial tool preform	6	2.86	40	9.69
Other Tools (Bifacially Edged & Unifacial)	187	89.05	335	81.11
Total # of tools	210	100	413	100

Table 6.36. 95% binomial confidence intervals for proportions of bifacial tools in different sectors of Armant MA 21/83.

	Northern	Southern
UCL (95%)	10.35	9.09
Bifacial tools	6.19	6.29
LCL (95%)	3.69	4.35

Table 6.37. Summary of the organization of production for bifacial tool types.

Tool Type	Inter- site specialization	Intra- site specialization
RFKs	•	
Fishtails	•	
Rhomboids	•	
CBPPs	?	•
Figural eccentrics	No	•
Bifacial Knives	Some	
Bifacial Sickles	•	
Axes	No	•

Table 6.38. Counts and percentages of bifacial tool types at Hierakonpolis localities. •=Present. Sample sizes smaller than 30 are grayed-out.

Site	HK11C		HK11C (A6-A7)		HK14		HK24A		HK29 (10L10)		HK29A†		HK29B		HK25		HK25D	
Date	NIID and later		3550 BC		3625 BC		Late Amratian		3500BC Late Amratian		NIID-NIIIA††		2nd half 4th mill BC		NIIC-D		Late Amratian	
Total # of artifacts	1190		3677		214		711		3557		~54000		10451		7481		183	
Total # of tools	131		307		16		35		468		~1944		279		225		9	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
RFK	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Rhomboid	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Fishtail	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Concave-Base PP	0	0	0	0	0	0	0	0	0	0	•	0.3	0	0	0	0	0	0
Eccentric	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Other Fine Bifacials	2	1.53	3	0.98	0	0	0	0	2	0.43	•	1.1	0	0	0	0	0	0
Bifacial Knife	0	0	0	0	0	0	0	0	1	0.21	•	0	0	0	0	0	1	11.11
Bifacial Sickle	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Bifacial Plane	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Axe	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Drills: winged/crescent/cylindrical	0	0	3	0.98	0	0	0	0	14	2.99	•	0.1	0	0	0	0	0	0
Pic/Grand Perçoir	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0
Non-standard, & Unidentifiable	1	0.76	7	2.28	0	0	1	2.86	18	3.85	•	0.5	12	4.3	13	5.78	0	0
Other Tools (Bifacially Edged & Unifacial)	128	97.71	294	95.77	16	100	34	97.14	433	92.52	?	?	267	95.7	212	94.22	8	88.89
Total	131	100	307	100.01	16	100	35	100	468	100	0		279	100	225	100	9	100

Chapter 7 Tables

Table 7.1. List of museums, excavation projects, or other entities, and their abbreviations.

Abbreviation	Museum or Responsible entity	Location
ÄM	Ägyptisches Museum	Berlin, Germany
Ash	Ashmolean Museum	Oxford, UK
BM	British Museum	London, UK
BMFA	Boston Museum of Fine arts	Boston, MA, USA
BrM	Brooklyn Museum	Brooklyn, NY, USA
CMA	Clevland Museum of Art	Clevland, OH, USA
EM	Egyptian Museum	Cairo, Egypt
FwM	Fitzwiliam Museum	Cambridge, UK
Hild	Roemer- und Pelizaeus-Museum Hildesheim	Hildesheim, Germany
Kassel	Staatliche Museen Kassel	Kassel, Germany
KhM	Kunsthistorisches Museum (Art History Museum)	Vienna, Austria
LACMA	Los Angeles County Museum of Art	Los Angeles, USA
LV	Louvre	Paris, France
LvpM	World Museum of Liverpool	Liverpool, UK
ManM	Manchester Museum	Manchester, UK
MANStGL	Musée Archéologie Nationale	St. Germain-en-Laye, France
MCCM	Michael C. Carlos Museum	Atlanta, GA, USA
MdO	Museo delle Origine	Rome, Italy
MMA	Metropolitan Museum of Art	New York, NY, USA
MRM	Musée Royal de Mariemont	Morlanwelz, Belgium
NMI	National Museum of Ireland	Dublin, Ireland
NMA	Nubian Museum	Aswan, Egypt
OIM	Oriental Institute Museum	Chicago, IL, USA
PAHMA	Phoebe A. Hearst Museum of Anthropology	Berkeley, CA, USA
PM	University of Pennsylvania Museum	Philadelphia, PA, USA
PR	Pitt Rivers Museum	Oxford, UK
RISD	Rhode Island School of Design Museum	Providence, RI, USA
RVFAM	Robert V. Fullerton Art Museum	San Bernadino, CA, USA
RMAH	Royal Museums of Art and History	Brussels, Belgium
SNHM	Smithsonian Natural History Museum	Washington, DC, USA
UC	Petrie Museum (University College London)	London, UK
YPM	Yale Peabody Museum	New Haven, CT, USA
	Project/Site/Responsible entity	
Abydos / A.U	Abydos	German dig house at Abydos
AMC	Abydos Middle Cemetery	American dig house at Abydos
Ad	Adaima	French storeroom for Adaima
AKAP	Aswan-Kom-Ombo Archaeological Project	Government store rooms in Kom Ombo
CAH	Christie's Auction House	Location of items unknown
EK	Elkab	Belgian Dig house at Elkab
FGC	Former Garstang Collection	Location of items unknown
FMcGC	Former McGregor Collection	Location of items unknown
Gnefer	Galerie Nefer	Location of items unknown
HK	Hierakonpolis	Storerooms for Hierakonpolis
KAS	Kom al-Ahmar /Sharuna	Storerooms for Kom al-Ahmar /Sharuna
MAP	El-Mahâsna	American dig house at Abydos
MbC	Mildenberg Collection	Location of items unknown

Table 7.2 (part 1). Ripple-flaked knives with identifiable raw materials.

Site	ID	RM	Light/ Dark	Notes	Publication
Unknown	BM.EA.29286	Other:VTO	Light		
Unknown	BM.EA.29289	1,2,4	Light		
Abydos?	BM.EA.29290	4	Light		
Unknown	BM.EA.32095	1,2,4	Light		
Unknown	BM.EA.32096	Other:VTO	Light		
Unknown	BM.EA.32489	7	Dark		
Unknown	BM.EA.59235	1,2,4	Light		
Unknown	BM.EA.68512	4	Light	"Pitt-rivers Knife". Ivory handle. Purchased.	
Naqada	BMFA.03.1390	Other:VTO	Light		
Abu Zaidan	BrM.09.889.118	2,4	Light	"Abu Zaidan Knife." Ivory handle. Tomb 32.	Midant-Reynes 1987; Needler 1984:268-271
Abu Zaidan	BrM.09.889.120	Other:VTO	Light	Tomb 32.	Needler 1984:272-3
Adaima	BrM.09.889.121	1,2,4	Light		Needler 1984:271
Harageh	CMA.1915.30	4	Light	Cemetery G Tomb 413.	
Abydos	EM.Abydos.U.50 3	4	Light	Ivory Handle. Tomb 503.	Hikade 2013: Pl1; Hikade 2003:Fig 3
Gebel Tarif?	EM.Gebel Tarif	4	Light	"Gebel Tarif knife." Gold handle.	
Tel el Farkha	EM.R.536	5	Dark		
Unknown	FwM.E.204.1939	4	Light		
Unknown	FwM.E.48.1899	4	Light		
Unknown	FwM.E.GA.4193. 1943	4	Light		
Unknown	KhM.8017	1,2,4	Light		
Gebel Arak	LV.E 11517	4	Light	"Gebel Arak Knife." Ivory Handle.	Delange 2009; Dreyer 1999
Unknown	ManM.38160	Other:VTO	Light		
Gerzeh	ManM.5305.a-e	Other:VTO	Light		
Unknown	MCCM.L.2012.28 .1	4	Light		
Unknown	MMA.11.167.1	4	Light		
Unknown	MMA.16.2.22	Other:VTO	Light		
Unknown	MMA.26.241.1	Other: Chocolate	Dark	“Carter knife” or the “New York knife.” Ivory Handle.	
Unknown	MMA.7228.105	2,4	Light		
Qushtamna	NMA.187	2,4	Light		Gaballa N.D. Firth 1912:9, Pl 38a
Unknown	OIM.10533	4	Light		
Unknown	OIM.9390	4	Light	registration number:E 9390 A&B, Accession number: 138	
Unknown	OIM.9391a-b	5	?		
Naga-ed-Deir	PAHMA.6.4752	Other:VTO	Light	Cemetery 7000 Tomb 151	
Abydos	PR.1900.42.2	Other:VTO	Light	Cemetery G	Petrie 1902
Abydos	PR.1901.40.23	4	Light	Um el Gaab- Tomb of Djer	Petrie 1901
Gerzeh	PR.1911.33.1	Other:VTO	Light	Grave 25	Petrie. 1912; Stevenson 2009
Unknown	RISD.23.002	Other:VTO	Light		
Fayoum	RMAH.E.01236	1,2,4	Light		Global Egyptian Museum

Table 7.2 (part 2). Ripple-flaked knives with identifiable raw materials. In all cases, especially when no publication is given, the publication reference is the online collection database of the museum for that item. See Table 7.1 for museum list and abbreviations. “Other:VTO” = “Other: Variable Translucent – Opaque.”

Site	ID	RM	Light/ Dark	Notes	Publication
Unknown	UC.16294	Other: Chocolate	Dark	“London knife” or “UCL knife.” Ivory handle.	
Abydos	UC.35723	Other: Chocolate	Dark	Um el Gaab- Tomb of Djer	
Ballas/Naqada	UC.6147	2,4	Light		
Abydos?	UC.73354	1,2,4	Light		Petrie & Quibell 1896: Pl 86.
Abydos?	UC.73355	2,4	Light		Petrie & Quibell 1896: Pl 86.
Unknown	UC.73364	5	Dark?		Petrie & Quibell 1896: Pl 86.

Table 7.3. Raw material types of different specialist produced tool types. Blanks = 0. New raw material groups include: ‘Other: variable translucent-opaque’, which is light in color ranging from beiges to light or medium yellowish browns, with opaque and translucent patches that occurred in swirls or large bands; ‘Other: chocolate’ which is homogeneous dark brown, fine grained, and with chalky white cortex, it corresponds to a raw material described by Hikade (2013:23, Pl 2c-d) as looking like chocolate.

		RFKs		Rhomboids		Fishtails		CBPPs		Bifacial sickles		Axes		Large blade knives		Micro-endscrapers	
Raw material	**Light/ Dark**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
Agate (?)	Light					1	.99										
Rock Crystal						1	.99										
1. Indistinct Beige	Light											15	18.29	10	14.08		
2. Beige (Fine)	Light											4	4.88	15	21.13		
4. Beige w/ Pink Bands	Light	14	31.82			15	14.85	1	3.23	1	5	2	2.44				
1,2,4 Indistinguishable	Light	12	27.27	5	25	20	19.8	4	12.9	4	20	34	41.46	29	40.85		
8. Brown Translucent with White Mottles	Light					9	8.91	1	3.23	3	15	8	9.76	2	2.82	11	44
10. Pink-Grey Translucent	Light					1	.99			1	5	2	2.44			2	8
11. Pink-Purple-Red	Light							1	3.23							6	24
13. Caramel	Light							6	19.35					1	1.41		
Other: VTO	Light	11	25	3	15	2	1.98										
Other Light Cherts	Light					3	2.97	2	6.45			8	9.76	3	4.23	6	24
Other Indeterminate or light & dark mixed	Both											1	1.22	2	2.82		
5,6,7,8 Indeterminate Mid-Browns	Dark?					4	3.96			1	5	4	4.88	4	5.63		
5. Medium Brown Homogeneous	Dark	3	6.82														
6. Brown w/ Foraminifera	Dark																
7. Dark Grey and Brown	Dark	1	2.27	11	55	35	34.65	14	45.16	8	40	1	1.22	4	5.63		
Other Dark Grey or Black Cherts	Dark			1	5	8	7.92	2	6.45	2	10	3	3.66	1	1.41		
Other: Chocolate	Dark	3	6.82														
Obsidian	Dark					2	1.98										
TOTAL		44	100	20	100	101	99.99	31	100	20	100	82	100	71	100	25	100

Table 7.4. Frequencies of dark and light chert varieties by tool type.

	RFK		Rhomboids		Early Fishtails		Late Fishtails		Concave-base projectile points		Bifacial sickles		Axes		Large-blade knives		Micro-endscrapers	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Light *ds ḥḏ*	37	84.09	8	40	19	35.19	28	77.78	15	48.39	8	40	73	89.02	60	84.51	25	100
Dark *ds km*	7	15.91	12	60	31	57.41	8	22.22	16	51.61	11	55	8	9.76	9	12.68	0	0
In-determinate	0	0	0	0	4	7.41	0	0	0	0	1	5	1	1.22	2	2.82	0	0
TOTAL	44	100	20	100	54	100.01	36	100	31	100	20	100	82	100	71	100.01	25	100

Table 7.5. Locations of provenienced RFKs, by raw material type. Note that "Other:VTO" is an abbreviation for "Other: Variable Translucent – Opaque."

Site	Type 4	Type 1,2,4	Type Other: VTO	Type 5	Type Other: Chocolate
Tel El Farkha				1	
Gerzeh			2		
Faiyum		1			
Haragah	1				
Naga ed-deir			1		
Abydos	3	2	1		1
Gebel Tarif	1				
Ballas		1			
Naqada			1		
Adaima		1			
Abu Zaidan		1	1		
Qushtamna		1			

Table 7.6. Rhomboid tools with identifiable raw materials. Note that "Other:VTO" is an abbreviation for "Other: Variable Translucent – Opaque." In all cases, especially when no publication is given, the publication reference is the online collection database of the museum for that item. See Table 7.1 for the list of museums and their abbreviations.

Site	ID	RM	Light/ Dark	Notes	Reference
Abydos	A.U.220	7	Dark	Tomb U220	Personal observation; Hikade 2000
Unknown	BM.EA.34297	7	Dark		
Unknown	BM.EA.49723	Other: VTO	Light		
Unknown	BM.EA.52848	2,4	Light		
Mesaeed	BMFA.13.3766	7	Dark		
Unknown	CMA.1914.672	2	Light		
Unknown	EM.52852	7	Dark		
Unknown	FwM.E.GA.4140.1943	7	Dark		
Unknown	FwM.E.GA.4224.1943	Other: VTO	Light		
HK6/25	HK6.25.unknown	Other: Murky Black	Dark	From "pillared halls", so HK25 or HK6	Nagaya 2011
HK6	HK6.2009.30	7	Dark		Droux 2009:15
HK6	HK6.2014.T72.439	1,2,4	Light	Tomb 72	Droux 2014:4-7, 18-19
Naqada	ManM.2428	Other: VTO	Light		Petrie & Quibell 1896:Pl 72, no. 52
Unknown	MMA.16.2.11	7	Dark		
Unknown	MMA.16.2.17	1,2,4	Light		
Unknown	MMA.7.228.106	7	Dark		
Naqada	RMAH.E.06185c	7	Dark	Royal tomb	
Naqada	UC.4130	2,4	Light	Tomb 1437	Baumgartel 1970; Payne 1987
Naqada	UC.4389	7	Dark	Tomb 1241	
Naqada/Ballas	UC.4828	7	Dark	Tomb 1898	

Table 7.7. Locations of provenienced rhomboid tools, by raw material type. Note that "Other: VTO" is an abbreviation for "Other: Variable Translucent – Opaque."

Site	Light		Dark	
	Type 1,2,4	Type Other: VTO	Type 7	Type Murky Black
Mesaeed			1	
Abydos			1	
Naqada	1	1	3	
HK6	1		1	1

Table 7.8 (part 1): Fishtails.

Site	ID	RM	Light/ Dark	Shape Type	Notes	Reference
Abydos	A.U.127	4	Light	2	Tomb U 127	Hikade 1998, 2001, 2003: 145
Abydos	A.U.178	Other: Dark Gray	Dark	1	Tomb U 178	Hikade 2003:144; personal observation
Abydos	A.U.211	7	Dark	1	Tomb U 211	Hikade 2003: 144
Abydos	A.U.279	7	Dark	1	Tomb U 279	Hikade 2003: 145; 2013 Pl1
Abydos	A.U.381a?	8	Light	3	Tomb U381a	Hikade 2003:144; personal observation
Abydos	A.U.395	4	Light	3	Tomb U 395	Hikade 2003:143; personal observation
Unknown	BM.EA.32098	2,4	Light	2		
Unknown	BM.EA.32496	7	Dark	3		
Abydos	BM.EA.37279	8	Light	Other	From Osiris temple	Petrie 1902:24, Pl 51, no.22
Unknown	BM.EA.59240	8	Light	1a		
Unknown	BM.EA.59241	7	Dark	1		
Abadiya	BMFA.03.1386	Other IND Light	Light	1		
Abadiya	BMFA.03.1387	7	Dark	1		
Unkown	BMFA.03.1391	4	Light	1		
Mesaeed	BMFA.11.247	8	Light	1	Tomb 26.1	
Mesaeed	BMFA.11.248 &11.249	7	Dark	Frag.	Tomb 40.2. RM designation based on description	
Mesaeed	BMFA.11.250	4	Light	3	Tomb 123.13	
Mesaeed	BMFA.11.251&252	4	Light	1/1a Frag.	Tomb 26.5a&b	
Mesaeed	BMFA.11.257	8	Light	1	Tomb 123.14	
Mesaeed	BMFA.11.259	8	Light	3	Tomb 123.15	
Giza	BMFA.11.765	7	Dark		Ground Fishtail. Inscribed. Menkaure valley temple.	
Giza	BMFA.11.766	7	Dark		Ground Fishtail. Inscribed. Menkaure valley temple.	
Mesaeed	BMFA.13.3915	2,4	Light	1	Tomb 825	
el-Ma'mariya	BrM.07.447.870	5,7	?	1a	Tomb 83	Needler 1984:266-267
Unknown-Akhmim?	BrM.35.1445	Obsidian	Dark	Other	Purchased, said to come from Akhmim	Needler 1984:274-275
Unknown	CAH.1032.4-1	Other IND Light	Light	1a		
Unknown	CAH.1032.4-2	7	Dark	1		
Unknown	CAH.1691.4	Other: Dark Gray	Dark	3	Wrapped gold handle.	
Unknown	CAH.unknown	Other: Dark Gray	Dark	3	Wrapped gold handle.	
Unknown	CMA.1914.673	7	Dark	1		
Unknown	CMA.1914.674	Other: Dark Gray	Dark	1a		
Unknown	CMA.1914.717	1,2,4	Light	2		

Table 7.8 (part 2): Fishtails.

Site	ID	RM	Light/ Dark	Shape Type	Notes	Reference
Unknown	EM.34210	4	Light	2	Elaborate gold handle, fake? (Additional reference number: 64868)	Currelley 1913:272, Pl47
Unknown	EM.34813	1,2,4	Light	2		
Unknown	EM.67932	Rock crystal	Light	Other		
Unknown	FwM.E.214.1932	Other IND Light	Light	2		
Unknown	FwM.E.49.1899	8	Light	1		
Unknown	FwM.E.50.1899	7	Dark	1		
Diospolis Parva	FwM.E.51.1899	7	Dark	1	Burial 86	
Unknown	FwM.E.52.1899	2,4	Light	2		
Unknown	FwM.E.GA.4144.1943	Agate?	Light	1a		
Unknown	FwM.E.GA.4146.1943	4	Light	1		
Unknown	FwM.E.GA.4148.1943	4	Light	2		
Unknown	FwM.E.Misc.94	4	Light	1a		
Unknown	FwM.GA.3162.1943	4	Light	2		
Unknown	FwM.GA.3174.1943	5,6,8	?	1a		
Unknown	Hild.5106	1,2,4	Light	2		
HK43	HK.43.2004	Other: Dark Gray	Dark	3	Burial 412	Friedman 2004:8-9
HK6	HK6.2006.2	Other: Dark Gray	Dark	1a	Structure E8	Friedman 2006:7-8; Nagaya 2011
Unknown	LACMA.1998.94.1	4	Light	2		
Abydos?	LvpM.1973.2.254	2,4	Light	3	Also listed as number 56.20.23	Global Egyptian Museum
Naqada	LvpM.56.20.42	7	Dark	2	Additional reference number 1978.291.266	
Naqada	ManM.2424	4	Light	2		Petrie & Quibell 1896: Pl. 73 no. 63
Unknown	ManM.5576	7	Dark	1		
Naqada	ManM.5577	7	Dark	3		Petrie & Quibell 1896: Pl. 73 no. 62
Naqada	ManM.5579	7	Dark	1		Petrie & Quibell 1896: Pl. 72 no. 66
Naqada	ManM.5581.a-b	1,2,4	Light	1/1a Frag.		Petrie & Quibell 1896: Pl. 73 no. 66
MAP	MAP.301.1	7	Dark	1a		Here
Unknown	MMA.10.130.1222	2,4	Light	2		
Unknown	MMA.10.130.1223	8	Light	1		
Unknown	MMA.10.176.96	7	Dark	1a		
Unknown	MMA.16.2.4	2,4	Light	2		
Unknown	MMA.16.2.8	7	Dark	1		
Unknown	MMA.20.5	4	Light	3	Found with wrapping over the forked end	

Table 7.8 (part 3). Fishtails with identifiable raw materials.

Site	ID	RM	Light/ Dark	Shape Type	Notes	Reference
Abydos?	MMA.24.2.13	Obsidian	Dark	2a		
Unknown	MMA.7.228.162	2,4	Light	1		
Khor Bahan	NMA.133	Other: Dark Gray	Dark	1		Gaballa N.D.
Unknown	NMA.unknown	7	Dark	1a		Gaballa N.D.
Hu/Diospolis Parva	NMI.1901.803	7	Dark	1		Global Egyptian Museum
Hu/Diospolis Parva	NMI.1901.804	5,8	?	1		Global Egyptian Museum
Unknown	OIM.11250	4	Light	2		
Unknown	OIM.11252	7	Dark	1		
West Theban Plateau	OIM.12333.570	7	Dark	1		
Unknown	PAHMA.6.17270	7	Dark	2		
Unknown	PAHMA.6.17272	7	other-both	1a		
Naga-ed-Deir	PAHMA.6.4751	7	Dark	1a	Cemetery 7000 Tomb 14	
Abydos	PR.1900.42.1	10	Light	2	Cemetery G	Petrie 1902
Mahasna	PR.1901.42.107	7	Dark	1a	Found in Garstang's "settlement 2"	
Mahasna	PR.1901.42.114	1,2,4	Light	1a	From cemetery	Garstang 1903:5,8
Harageh	RMAH.05663	1,2,4	Light	2	Tomb 537	
Unknown	RVFAM.E1.01.015.1998	4	Light	2		Kaplan 2005
Unknown	SNHM.A328574.0	7	Dark	1		
Hemmamia North Spur	UC.10244	2,4	Light	2	E:216 at 2'6"	Brunton&Caton-Thompson 1928:Pl80no.72,Pl72no. 98
Naqada	UC.4133	Other: Dark Gray	Dark	1	Tomb 1676	Baumgartel 1970; Petrie & Quibell 1896: Pl. 73 no. 66
Naqada	UC.4133a	8	Light	1a	Tomb 1676	Baumgartel 1970; Petrie & Quibell 1896: Pl. 73 no. 66
Naqada	UC.4273	7	Dark	1	Tomb 1412	
Abydos?	UC.42817	Other: VTO	Light	2		
Naqada	UC.4429	2,4	Light	2	Tomb 430	
Naqada	UC.4527	5, 8	?	1	Tomb 211	
Naqada	UC.4528	7	Dark	1	Tomb 211	
Naqada	UC.4564 & 4955	1,2,4	Light	Frag.	Tomb 1660	
Naqada	UC.4826	7	Dark	Frag.	Tomb 1856	
Naqada	UC.4827	Other: VTO	Light	1a	Tomb 1856	
Naqada/ Ballas	UC.4919	7	Dark	1a	Tomb 663	
Naqada	UC.5369	7	Dark	Frag.	Tomb 260	
Naqada	UC.5404	1,2,4	Light	Frag.	Tomb 100	

Table 7.8 (part 4). Fishtails with identifiable raw materials. Note that “Other:VTO” is an abbreviation for “Other: Variable Translucent – Opaque.” In all cases, especially when no publication is given, the publication reference is the online collection database of the museum for that item. See Table 7.1 for the list of museums and their abbreviations.

Site	ID	RM	Light/ Dark	Shape Type	Notes	Reference
Naqada	UC.5405	7	Dark	1	Tomb 100	
Naqada	UC.5918	2,4	Light	Frag.	Tomb 1332	
Armant	UC.6070	1,2,4	Light	1a		
Unknown	UC.8965	2,4	Light	2		
Mahasna	YPM.ANT.006807	7	Dark	1a	Tomb H	

Table 7.9. Frequencies of fishtail raw materials by fishtail shape type.

Raw Material	Light/Dark	Type 1		Type 1a		Type 3		Type 2	
		Count	%	Count	%	Count	%	Count	%
Agate(?)	Light	0	0	1	4.55	0	0	0	0
1. Indistinct Beige	Light								
2. Beige (Fine)	Light								
4. Beige with Pink Bands	Light	2	6.25	2	9.09	3	27.27	8	32
1,2,4 Indistinguishable	Light	2	6.25	3	13.64	1	9.09	11	44
8. Brown Translucent w/ White Mottles	Light	4	12.5	2	9.09	2	18.18	0	0
10. Pink-Grey Translucent	Light	0	0	0	0	0	0	1	4
11. Pink-Purple-Red Group	Light								
13. Caramel	Light								
Other: Variable Translucent and Opaque	Light	0	0	1	4.55	0	0	1	4
Other Light Cherts	Light	1	3.13	1	4.55	0	0	1	4
Other Indeterminate or Light & Dark Mixed	?/Both								
5,6,7,8 Indeterminate Mid-Browns	?	2	6.25	2	9.09	0	0	0	0
5. Medium Brown Homogeneous	Dark								
6. Brown with Foraminifera	Dark								
7. Dark Grey and Brown	Dark	18	56.25	8	36.36	2	18.18	2	8
Other Dark Grey or Black Cherts	Dark	3	9.38	2	9.09	3	27.27	0	0
Other: Chocolate	Dark								
Obsidian	Dark	0	0	0	0	0	0	1	4
Total		32	100.01	22	100.01	11	99.99	25	100

Table 7.10. Raw material types of Early fishtails (shape types 1 & 1a) by site.

Site	Light					?	Dark		
	Type 4	Type 1,2,4	Type 10	Other light	Type 8	Type 5,6,8	Type 7	Other grays	Obsidian
Harageh									
Hemmamiya									
Mesaeed	1	1			2				
Naga d-Deir							1		
Mahasna		1					3		
Abydos							2	1	
Abadiya/Hu/ Diospolis parva				1		1	3		
Naqada/Ballas		1		1	1	1	5	1	
West Theban Plateau							1		
Armant		1							
Adaïma									
Hierakonpolis						1			
el-Ma'mariya						1			
Khor Bahan						1			

Table 7.11. Raw material types of Later fishtails (shape type 2) by site.

Site	Light					?	Dark		
	Type 4	Type 1,2,4	Type 10	Other light	Type 8	Type 5,6,8	Type 7	Other grays	Obsidian
Harageh		1							
Hemmamiya		1							
Mesaeed	1				1				
Naga d-Deir									
Mahasna									
Abydos	2	1	1	1	1				1
Abadiya/Hu/ Diospolis parva									
Naqada/Ballas	1	1					2		
West Theban Plateau									
Armant									
Adaima									
Hierakonpolis								2	
el-Ma'mariya									
Khor Bahan									

Table 7.12 (part 1). Concave Base Projectile Points with identifiable raw materials.

Site	ID	RM	Light/ Dark	Notes	Publication
Abydos	AMC.12.48	7	Dark	From Abydos Middle Cemetery (Cem. E/G)	Here
Elkab	EK.2012.3.38	7	Dark		Claes et al. 2014:85
HK6	HK.6.str7-1	7	Dark	Photo in Friedman 2011c:42	Friedman 2010:69-70; Friedman et al. 2009: 194; Droux & Friedman 2007:7-9
HK6	HK.6.str7-2	7	Dark	Photo in Friedman 2011c:42	Friedman 2010:69-70; Friedman et al. 2009: 194; Droux & Friedman 2007:7-9
HK6	HK.6.str7-3	7	Dark	Photo in Friedman 2011c:42	Friedman 2010:69-70; Friedman et al. 2009: 194; Droux & Friedman 2007:7-9
HK6	HK.6.str7.363	1,2,4	Light	Photo in Friedman 2011c:42	Friedman 2010:69-70; Friedman et al. 2009: 194; Droux & Friedman 2007: 7-9
HK6	HK.6.str7-4	7	Dark	Photo in Friedman 2011c:42	Friedman 2010:69-70; Friedman et al. 2009: 194; Droux & Friedman 2007:7-9
HK6	HK.6.str7-5	7	Dark	Photo in Friedman 2011c:42	Friedman 2010:69-70; Friedman et al. 2009:194; Droux & Friedman 2007:7-9
K6	HK.6.str7.648	7	Dark	Photo in Friedman 2011c:42	Friedman 2010:69-70; Friedman et al. 2009: 194; Droux & Friedman 2007:7-9
HK6	HK6.2006.str8 -1	13. Caramel	Light	Photo in NN 18 (2006)	Friedman 2010:71; Friedman et al. 2008:90
HK6	HK6.2006.str8 -2	1,2,4	Light	Photo in NN 18 (2006)	Friedman 2010:71; Friedman et al. 2008:90
HK6	HK6.2014	7	Dark	Tomb 72	Droux 2014:4-7, 18-19
HK6	HK6.2015.75-1	7	Dark		Friedman & Droux 2015:4-6
Qushtamna	LvpM.49.47.5 86A-D	8	Light		Global Egyptian Museum
Qushtamna	LvpM.49.47.5 86A-D	Other: Dark Grays	Dark		Global Egyptian Museum
Mostagedda	ManM.8732	13. Caramel	Light		
Mahasna	MAP.2528.1	7	Dark		Here
Mahasna	MAP.3029.1	13. Caramel	Light		Here
Hemmamiya, North Spur	UC.10345	11	Dark	A3:60 at 1'6" but possibly not in situ	Brunton & Caton-Thompson 1928:78, PL79, no41
Badari 3000/10	UC.27229	Other Light IND	Light		Holmes 1989:163
Naqada-South Town	UC.5343	7	Dark?		Holmes 1989:274; Petrie & Quibell 1896: Pl55
Naqada-South Town	UC.5352	4	Light		Holmes 1989:274-275; Petrie & Quibell 1896: Pl 72, no 57
Unknown-Abydos?	UC.6144	Other Light IND	Light	Purchased at Abydos	
Naqada	UC.6230	7	Light		
Badari 3000/3	UC.9433	13	Light		Holmes 1989:163
Badari 3000/3	UC.9434	13	Light		Holmes 1989:163
Badari 3000/6	UC.9436	1,2,4	Light		Holmes 1989:163

Table 7.12 (part 2). Concave Base Projectile Points with identifiable raw materials. In all cases, especially when no publication is given, the publication reference is the online collection database of the museum for that item. See Table 7.1 for the list of museums and their abbreviations.

Site	ID	RM	Light/ Dark	Notes	Publication
Badari 3000/6	UC.9437	1,2,4	Light		Holmes 1989:163
Badari 3000/6	UC.9438	Other: Dark Grays	Dark		Holmes 1989:163
Badari 3000/6	UC.9442	7	Dark	Wing fragment	
Hemmamiya, 1700	UC.9443	13	Light	From cemetery 1700	

Table 7.13. Raw material types of concave base projectile points by site.

Site	Light						Dark	
	Type 1/2/4	Type 4	Type 8	Type 11	Type 13	Other Light	Type 7	Other Dark
Mostagedda					1			
Badari	2				3	1	1	1
Hemmamiya				1				
Mahasna					1		1	
Abydos						1	1	
Naqada		1					2	
HK6	2				1		8	
Elkab							1	
Qushtamna			1					1

Table 7.14. Bifacial sickles with identifiable raw materials. In all cases, especially when no publication is given, the publication reference is the online collection database of the museum for that item. See Table 7.1 for the list of museums and their abbreviations.

Site	ID	RM	Light /Dark	Notes	Publication
1Nag El-Qarmila	AKAP.1552.1	7	Dark	Settlement	
4Abydos	ATP.3418	7	Dark	Settlement	Here
3Abydos	ATP.3419	7	Dark	Settlement	Here
2Abydos	ATP.3420	1,2,4	Light	Settlement	Here
5Adaima	BrM.07.447.802	1,2,4	Light	Settlement, excavated, sickle gloss	Needler 1984:286
6Elkab	EK.2012.4.1	7	Dark	Settlement	Claes et al. 2014:85
7HK6	HK6.14.440	7	Dark	Tomb 72; used	Droux 2014:4-7, 18-19
8HK6	HK6.14.441	8	Light	Tomb 72; used	Droux 2014:4-7, 18-19
9Armant	ManM.23814	7	Dark	Sickle gloss; Settlement level: I.O.10, 14a, 22A	
10Armant	ManM.23824	5,8	Dark	Settlement level:14a, Area 31 (1000), 22J	
11Armant	ManM.23832	7	Dark	Sickle gloss; Settlement, unstratified 14a	
12Mahasna	MAP.2861.1	10	Light	Settlement	
13Hemmamiya, North Spur	UC.10525	4	Light	Under a Naqada Period hut curcle	
14Hemmamia, 1900	UC.10619	7	Dark	Settlement	Holmes 1989:162
15Hemmamia, 1900	UC.10620	Other dark grays	Dark	Settlement	
16Badari, 3000/3	UC.26823	8	Light	Settlement	Holmes 1989:162
17Naqada	UC.4609	1,2,4	Light	Tomb 1906	
18Naqada, South Town	UC.5332	8	?	Settlement	
19Badari, 3000/3	UC.9618	Other dark grays	Dark	Settlement	
20Hemmamia	UC.9879a	1,2,4	Light	Cemetery 24/1700	

Table 7.15. Raw material types of bifacial sickles by site.

Site	Light				Dark		
	Type 4	Type 1,2,4	Type 8	Type 10	Type 5,6,7, 8	Type 7	Other Dark Grays
Badari			1				1
Hemmamiya	1	1				1	1
Mahasna				1			
Abydos		1				2	
Naqada		1	1				
Armant					1	2	
Adaima		1					
HK6			1			1	
Elkab						1	
Nag el Qarmila						1	

Table 7.16 (part 1). Axes with identifiable raw materials.

Site	ID	RM	Light/ Dark	Notes	Reference
Abydos	BM.EA.37268	2,4	Light		Petrie 1902
Naqada	FWM.E.4.1895	Other light-1/8	Light		
Naqada	FWM.E.5.1895	1,2	Light		
Elkab	FWM.E.74.1902	1	Light		
Armant	ManM.23382	1,2,4	Light	Area 31, 1000. 21F	Mond & Meyers 1937:233 (12); Pl 62 (12)
Armant	ManM.23383	Other light: Beige w/ dark bands	Light	Level: 3 N 12 (1081), 24 B	Mond & Meyers 1937:234 (21), 243 (16), Pl 57 (21), 62 (16)
Armant	ManM.23384	1,2,4	Light	Level II M 11a, 24 P	
Armant	ManM.23385	1	Light	Level: 2 J 14, 24	
Armant	ManM.23386	1,2,4	Light	Level: I J 10 (1010), 24Q	
Armant	ManM.23387	1	Light	Level: I J 10 (1013), 24N	
Armant	ManM.23388	Other light-1/8	Light	Level: I L 12 (1056), 24F	
Armant	ManM.23389	1,2	Light	Level: I O 5, 24E	Mond & Meyers 1937:243 (15), Pl 62 (15)
Armant	ManM.23390	1	Light	Level: I J 12 (1035), 24C	Mond & Meyers 1937:233 (17), Pl 57 (17)
Armant	ManM.23391	Other light: Beige w/ dark bands	Light	Level: I L 12 (1061), 24 L	Mond & Meyers 1937:244 (19), 234 (19), Pl 57 (19), 62 (19)
Armant	ManM.23392	1,2,4	Light	Level: I M 8, 24K	Mond & Meyers 1937:133 (18), Pl 57 (18)
Armant	ManM.23393	7	Dark	Level: I J 12 (1034) 24 R	Mond & Meyers 1937:244 (17), Pl 62 (17)
Armant	ManM.23394	1,2,4	Light	Level: I K 11 (1019), 24 O	Mond & Meyers 1937:244 (25), Pl 62 (25)
Armant	ManM.23396	1,2,4	Light	Unstratified (cultivation) 6A	Mond & Meyers 1937:243 (14), Pl 62 (14)
Armant	ManM.23397	1,2	Light	Unstratified (cultivation)	Mond & Meyers 1937:234 (23), Pl 57 (23)
Armant	ManM.23399	1	Light	II.L.7 30J	
Armant	ManM.23405	1,2,4	Light	Level 3 K 13, 29 L	Mond & Meyers 1937:244 (18), Pl 62 (18)
Armant	ManM.23412	1,2,4	Light	Level I L 14, 29 C	Mond & Meyers 1937:233 (5), Pl 57 (5)
Armant	ManM.23644	1,2,4	Light	Level I.H.12 (1036), 31A	
Armant	ManM.23645	1	Light	Level i.F.4, Area 30-31, 37M	
Armant	ManM.23658	4	Light	Level: III.C.1, 4, 37	Mond & Meyers 1937:243 (11) Pl 61 (11)
Armant	ManM.23659	1, 4	Light	Level: III.K.14, 32B	
Armant	ManM.23660	1,2	Light	Level: I.K.10 (1003), 32E	
Armant	ManM.23692	1, 2, 4	Light	Level: I.G.8	
Armant	ManM.23704	1,2,4	Light		
Armant	ManM.23705	5,7	Dark	Level: II.K.8, 14Q	
Armant	ManM.23706	1,2	Light	Level: I.M.14, 8	
Armant	ManM.23707	1,2,4	Light	Level: I.J.14, 8	
Armant	ManM.23848	Other: Light & Dark	Both	Level: III.K.8, 38b	
Armant	ManM.23859	Other light-1/8	Light	Cemetery 1300	Mond & Meyers 1937:48, Pl 16 (1)
Armant	ManM.23862	1,2	Light	Cemetery 700	Mond & Meyers 1937:48
Mahasna	MAP.1973.30	1	Light		Here
Mahasna	MAP.2522.26	2	Light		Here

Table 7.16 (part 2). Axes with identifiable raw materials.

Site	ID	RM	Light/ Dark	Notes	Reference
Mahasna	MAP.2522.31	1	Light		Here
Mahasna	PM.E9633	1	Light		
Mahasna	PM.E9634	1	Light		
Mahasna	PM.E9653	1	Light		
Mahasna	PM.E9654	1	Light		
Mahasna	PM.E9655	4	Light		
Mahasna	PM.E9656	Other light- 1/8	Light		
Mahasna	PM.E9681	8	Light		
Mahasna	PM.E9682	1	Light		
Mahasna	PM.E9687	Other Dark grays	Dark		
Mahasna	PM.E9689	10	Light		
Mahasna	PM.E9690	10	Light		
Mahasna	PM.E9692	2,4	Light		
Mahasna	PR.1901.42.87	8	Light		
Naqada	UC.4953	1,2	Light	Tomb 1578	
Naqada	UC.5357	5	Dark		
Naqada	UC.5358	8	Light		
Naqada South Town	UC.5510	1,2	Light		
Naqada South Town	UC.5511	1,2,4	Light		
Naqada South Town	UC.5530	1,2	Light		
Naqada South Town	UC.5531	8	Light		
Naqada South Town	UC.5532	1,2	Light		
Naqada South Town	UC.5533	1	Light		
Naqada South Town	UC.5534	6,7	Dark		
Naqada	UC.5541	Other light- 1/8	Light		
Naqada	UC.5542	Other light- 1/8	Light		
Naqada	UC.5543	2	Light		
Naqada	UC.5544	Other Dark grays	Dark		
Naqada	UC.5546	8	Light		
Naqada	UC.5547	8	Light		
Naqada	UC.5551	1,2	Light		
Naqada	UC.5552	2	Light		
Naqada	UC.5555	1	Light		
Naqada	UC.5558	1,2	Light		
Naqada	UC.5605	2,4	Light	Tomb 350 fill	
Naqada	UC.6229	1,2,4	Light	Cemetery B surface	
Badari	UC.9745	1,2	Light	From Area 3000/6	

Table 7.16 (part 3). Axes with identifiable raw materials. In all cases, especially when no publication is given, the publication reference is the online collection database of the museum for that item. See Table 7.1 for the list of museums and their abbreviations.

Site	ID	RM	Light/ Dark	Notes	Reference
Badari	UC.9760	5	Dark	Refashioned from an older (patinated) piece	Brunton & Caton-Thompson 1928:Pl 57(4)
Badari	UC.9762	2	Light	From Area 3000/10	
Badari	UC.9839	8	Light	Cemetery 25/5500	
Badari	UC.9865	8	Light		

Table 7.17. Raw material types of axes by site.

Site	Light							Dark		
	Type 1	Type 2	Type 4	Type 1,2,4	Type 8	Type 10	Other light	Type 5,6,7,8	Type 7	Other grays
Badari		1		1	2			1		
Mahasna	7	1	1	1	2	2	1			1
Abydos				1						
Naqada	2	2		13	4		3	2		2
Armant	5		1	18			4	1	1	
Elkab	1									

Table 7.18 (part 1). Large blade knives with identifiable raw materials.

Site	ID	RM	Light /Dark	Notes	Publication
Abydos	ATP.1990.36	13	Light		Here
Mahasna	BM.EA.49002	Other: Dark unknown	Dark	Tomb H23	
Mesaeed	BMFA.11.781	1,2	Light	Tomb 21 (M/21/8)	
Mesaeed	BMFA.11.783	1,2	Light	Tomb 4 number 4	
Unknown	FWM. E.56.1899	1,2	Light	Ripple-flaking on the ventral	
Unknown	FWM.E.416.1982	7	Dark		
Unknown	FWM.E.46.1899	2,4	Light		
Unknown	FWM.E.700.1954	2,4	Light		
Naqada	ManM.5570	1,2	Light		Petrie & Quibell 1896:Pl. 73 (71)
Naqada	ManM.5571	Other IND	Both		
Naqada	ManM.5572	1,2	Light		
Hemmamiya	MANM.7637	1,2	Light		
Naqada/Ballas	ManM.8382a	6,7	Dark		
Naqada/Ballas	ManM.8382b	2	Light		
Mahasna	MAP.2176	2	Light		Here
Gerzeh	RMAH.E.05017a	1,2,4	Light	Tomb 97?	
Naqada	UC.4235	1	Light	Tomb 1345	
Naqada	UC.4236	1	Light	Tomb 1345	
Naqada	UC.4268	1	Light	Tomb 1866	
Naqada	UC.4315	2	Light	Tomb 108	
Naqada	UC.4408	2,4	Light	Tomb 370	Holmes 1989:280; Petrie & Quibell 1896: Pl 74 (81)
Naqada	UC.4420	1,2,4	Light	Tomb 1203	
Naqada	UC.4474	2	Light	Tomb 294	
Naqada	UC.4534	2	Light	Tomb 162	
Naqada	UC.4779	2,4	Light	Tomb 1791	
Naqada	UC.4779a	2	Light	Tomb 1791	
Naqada	UC.4793	1	Light	Tomb 456	
Naqada	UC.4813	2	Light	Tomb 653	
Naqada	UC.4821	8	Light	Tomb 1298	
Naqada	UC.4830	7	Dark	Cemetery B	
Naqada	UC.4845	1	Light	Tomb 1233	
Naqada	UC.4848	1	Light	Tomb 1233	
Naqada	UC.4879	1,2	Light	Tomb 379	
Naqada	UC.4881	2	Light	Tomb 394	
Naqada	UC.4883	1	Light	Tomb 436. Unusual example	
Naqada	UC.4892	1,2	Light	Tomb 458	
Naqada	UC.4923	1	Light	Tomb 675	
Naqada	UC.4951	2	Light	Tomb 1434	
Naqada	UC.4956	1,2	Light	Tomb 1692	
Naqada	UC.4958	1,2	Light	Tomb 1796	
Naqada	UC.4959	2	Light	Tomb 1796	
Naqada-South Town	UC.5330	1,2	Light		
Naqada-South Town	UC.5339	2	Light		Holmes 1989:265, Baumgartel 1960:40

Table 7.18 (part 2). Large blade knives with identifiable raw materials. In all cases, especially when no publication is given, the publication reference is the online collection database of the museum for that item. See Table 7.1 for the list of museums and their abbreviations.

Site	ID	RM	Light /Dark	Notes	Publication
Naqada-South Town	UC.5340	2	Light		
Naqada-South Town	UC.5518	1,2,4	Light		
Naqada-uth Town	UC.5520	2	Light		
Naqada	UC.5919	1	Light	tomb 1385	
Naqada	UC.5920	Other IND	Both	Tomb 1385	
Abydos?	UC.6145	2	Light		
Naqada	UC.6234a	1,2	Light	Tomb 1849	
Naqada	UC.6234b	1,2	Light	Tomb 1849	
Naqada	UC.6234c	1,2	Light	Tomb 1849	
Naqada	UC.6235a	1	Light	Tomb 1849	
Naqada	UC.73366	1,2	Light	Cemetery?	Petrie & Quibell 1896:51, Pl 72
Badari	UC.9655	8	Light		Holmes 1988
Badari, 3000/6	UC.9656	1,2,4	Light	Settlement	Holmes 1989:154-155
Badari, 3000/6	UC.9657	7	Dark	Settlement	
Badari, 3000/6	UC.9658	1,2,4	Light	Settlement	Holmes 1989:154-155
Badari, 3000/6	UC.9659	2	Light	Settlement	
Badari	UC.9660	1,2	Light		
Badari, 3000/6	UC.9662	1,2,4	Light	Settlement	Holmes 1989:154-155
Badari, 3000/6	UC.9664	Other light semi translucent	Light	Settlement	Holmes 1989:154-155
Badari, 3000/6	UC.9669	Other light semi translucent	Light	Settlement	Holmes 1989:154-155
Badari, 3000/6	UC.9685	1,2,4	Light	Settlement	Holmes 1989:154-155
Badari, 3000/6	UC.9692	5?	?	Settlement	Holmes 1989:154-155
Badari	UC.9801	5?	Dark	Cemetery 3800	
Badari	UC.9802	5?	Dark	Cemetery 3800	
Hemmamia, North Spur	UC.10308	1,2,4	Light	Shaped haft; Level 1'6"';inside a pot w/ other blades	Brunton & Caton-Thompson 1928: Pl71, no 85a; Holmes 1989:75
Hemmamia, North Spur	UC.10309	1,2,4	Light	Found in a pot w other blades	Brunton & Caton-Thompson 1928: Pl71, no 85b
Hemmamia, North Spur	UC.10339	7	Dark	Shaped handle; 1'-1'6"	Brunton & Caton-Thompson 1928: Pl71, no 57/50
Hemmamia, North Spur	UC.10341	Other light semi translucent	Light	Posibly Heat-treated; Level 1f'-1'6"	Brunton & Caton-Thompson 1928: Pl71(56/74); Holmes 1989:75

Table 7.19. Raw material types of large blade knives by site.

Site	Light							Dark		
	Type 1	Type 2	Type 1,2,4	Type 8	Type 13	Other Light	IND	Type 5,6,7	Type 7	Other Grays
Gerzeh			1							
Badari		1	5	1		2		3	1	
Hemmamia			3			1			1	
Mesaeed			2							
Mahasna		1								1
Abydos		1			1					
Naqada	10	12	15	1			2	1	1	

Table 7.21. Microendscrapers with identifiable raw materials organized by site.

Site	Light			
	Type 8	Type 10	Type 8 or 10	Type 11
Badari			1	
Hemmamiya	1			
Mahasna	3			6
Abydos			1	
Naqada	3		4	
Nag el-Qarmila	2	2		
Khor Bahan	1			

Table 7.20. Microendscrapers with identifiable raw materials. When no publication is given, the reference is the online collection database of the museum for that item. See Table 7.1 for the list of museums and their abbreviations.

Site	ID	blank	RM	Light/ Dark	Notes	Reference
Abydos-U	A.U.127 (20)	Heat-treated Bladelets	8 or 10	Light	Tomb U-127; 20 examples from the same core	Hikade 1996
Nag el-Qarmila	AKAP.1555.1	Bladelet	10	Light		Here
Nag el-Qarmila	AKAP.1756.2	Heat-treated Bladelet	10	Light		Here
Nag el-Qarmila	AKAP.1808.18	Heat-treated Bladelet	8	Light		Here
Nag el-Qarmila	AKAP.1890.4	Bladelet	8	Light		Here
Khor Bahan	BMFA.17.58	Bladelet (HT Indeterminate)	8	Light	Possible notch right lateral	
Mahasna	MAP.1302.33	Heat-treated Bladelet	8	Light		Here
Mahasna	MAP.1307.10	Heat-treated Bladelet	11	Light		Here
Mahasna	MAP.1595.1	Heat-treated Bladelet	11	Light		Here
Mahasna	MAP.1595.12	Heat-treated Bladelet	11	Light		Here
Mahasna	MAP.1872.30	Heat-treated Bladelet	11	Light		Here
Mahasna	MAP.2317.19 & 64	Bladelet	8	Light		Here
Mahasna	MAP.2387.52	Heat-treated Bladelet	11	Light		Here
Mahasna	MAP.2439.98	Heat-treated Bladelet	11	Light		Here
Mahasna	MAP.2484.124	Heat-treated Bladelet	8	Light		Here
Hemmamiya	UC.10184	Bladelet (HT Probable)	8	Light	North Spur, H:319 at 3’	Brunton & Caton-Thompson:114 Pl80(83)
Naqada	UC.4614; 4615; 4620; 4622; 4629	Heat-treated Bladelets	8	Light	Tomb 144; 5 examples probably from the same core	
Naqada	UC.4619	Bladelet	8 or 10	Light	Tomb 144	
Naqada	UC.4621; 4624(?)	Bladelet (HT Indeterminate)	8 or 10	Light	Tomb 144; 2 examples probably from the same core	
Naqada	UC.4628; 4634	Bladelet	8	Light	Tomb 144; 2 examples probably from the same core	
Naqada	UC.4802; 4804	Bladelet (HT Probable)	8 or 10	Light	Tomb 471; 2 examples probably from the same core	
Naqada	UC.4857	Bladelet (HT Indeterminate)	8	Light	Tomb 1233	
Naqada	UC.4931	Heat-treated Bladelet	8	Light	Tomb 1041	
Naqada	UC.4968; 4970	Bladelet	8 or 10	Light	Tomb 1786; 2 examples probably from the same core	
Badari, 3000/6	UC.9694	Bladelet (HT Indeterminate)	8 or 10	Light	Small notch right lateral	

Table 7.22 (part 1). Summary of findings relative to the expectations for the ritual production model, by tool class. Continued on next page.

Tool	**Raw materials:** Symbolic meanings associated w/ RM -Association between tool type (or color) & RM	**Production:** Ritual production contexts, part time production	**Context:** Ritual & Domestic contexts?	**Context** Widespread distribution?	**Best fitting model**
Ripple-flaked knives	No. Preference for type 4 may be due to prod. location, and the RM changes over time.	Unknown. Possibly associated with Ritual, contexts, but sponsorship and/or full-time production likely.	No. Only ritual contexts.	Partially. Found in cemeteries of all scale, most common in highest order sites like Abydos. Tombs of upper or middle status/wealth.	Prestige goods model
Rhomboid tools	No. Functional considerations dominant, no color preference.	YES Production in at least 1 ritual area. Possibly part time production.	No. Only ritual contexts.	Partially. Found in cemeteries of all scale, most common in highest order sites like Nagada. Definitely in wealthy graves.	Prestige goods model
Fishtail tools	No. No correlation between Rm type and tool type, but change toward prevalence of one type which may relate to changes in production Also changed to include use of rare materials.	YES Multiple production locations, at least some in ritual contexts, probably part-time production. Then changing to fewer production locations and full time production.	YES Ritual & habitation contexts.	YES. Cemeteries of all scales, multiple locations in settlements, cemeteries and graves of different status/wealth.	Both. Change over time. Ritual production then Prestige goods
Concave-base projectile points	No. No correlation between RM and tool type. Many materials used. May indicate multiple prod locations.	YES. Production in both ritual & non-ritual contexts. Probably part time.	YES Ritual & habitation contexts.	YES (For the most part) Settlements & cemeteries of all scales. Graves of different wealth/status. At Mahâsna found in multiple settlement contexts, but at HK concentrated in ritual contexts.	Both, change over time or regional differences.

Table 7.22 (part 2). Summary of findings relative to the expectations for the ritual production model, by tool class.

Tool	**Raw materials:** Symbolic meanings associated w/ RM -Association between tool type (or color) & RM	**Production:** Ritual production contexts, part time production	**Context:** Ritual & Domestic contexts?	**Context** Widespread distribution?	**Best fitting model**
Bifacial sickles	No. No correlation between RM and tool type. Many materials used. May indicate multiple prod locations.	Indeterminate.	Yes. Burials & habitation contexts.	YES. Settlements & cemeteries of all scales. Multiple HH contexts within settlements, graves of different status/wealth.	IND
Axes	Yes. Preference for one color, not explainable by functional considerations or available materials.	YES- Both ritual & non-ritual contexts	Yes, Some ritual contexts & many habitation contexts	Yes. Settlements & cemeteries of all scales. Multiple HH contexts in settlements.	YES-ritual production model (but the ritual contexts are not strong
Large blade knives	Yes. Preference for one color. Functional explanations and local material indetermiante.	Indeterminate. (possible)	Yes. Burials & habitation contexts.	Yes. Cemeteries of all scales, upper & mid level settlements. Multiple contexts in settlements, graves of different wealth/status.	YES- mainly for burials, but had by all, and special RM selection.
Micro-endscrapers	Yes. Correlations between tool type and raw material type, which is not explainable by functional considerations or easy access to local resources.	YES Production in both ritual & non-ritual contexts. Part time, possibly eventually transitioning to full-time.	YES. Ritual & habitation contexts.	Yes Settlements of all scales & some cemeteries. Multiple HH contexts in settlements, graves of different status.	YES-ritual production model

Chapter 1 Figures

Figure 1.1. Fishtail knife. Egypt, Predynastic Period, Naqada Ia-IIa periods. Dark brown- to dark green-colored flint; overall: 10.00 cm (3 7/8 inches). Image credit: The Cleveland Museum of Art, Gift of the John Huntington Art and Polytechnic Trust 1914.673 .

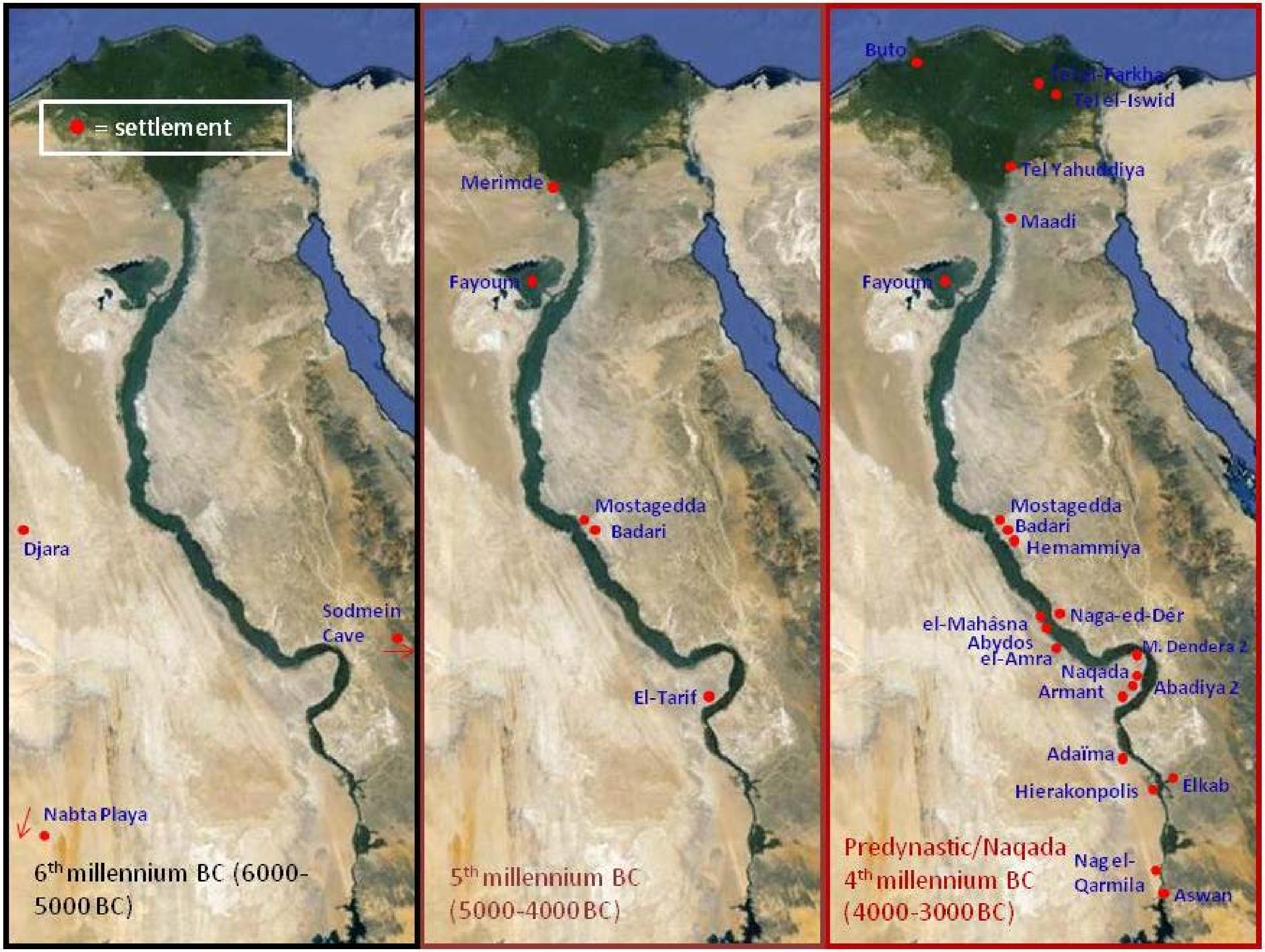


Figure 1.2. Settlement sites in the Nile Valley during the process of aridificaiton.

Chapter 2 Figures

Figure 2.2. Map of sites Mentioned in this study. Not pictured are Khor Bahan, and Qushtamna, in Nubia. Base map form Google Earth.

Chapter 3 Figures

Figure 3.1 Overview of the Abydos-Mahâsna Area. See Figure 3.8 for more sites near Abydos.

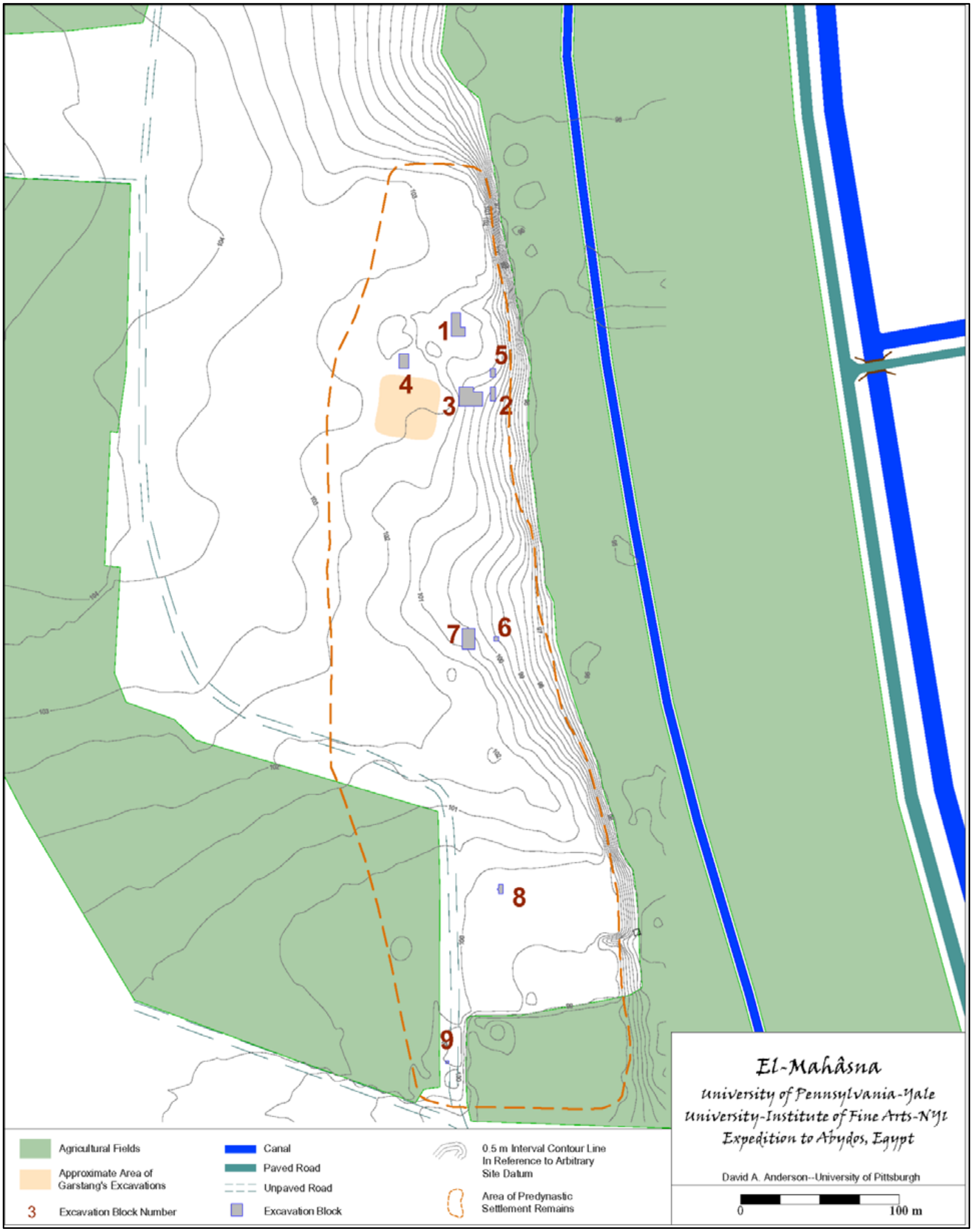


Figure 3.2. Map of the Blocks excavated by Anderson (2006). Image credit: David Anderson.

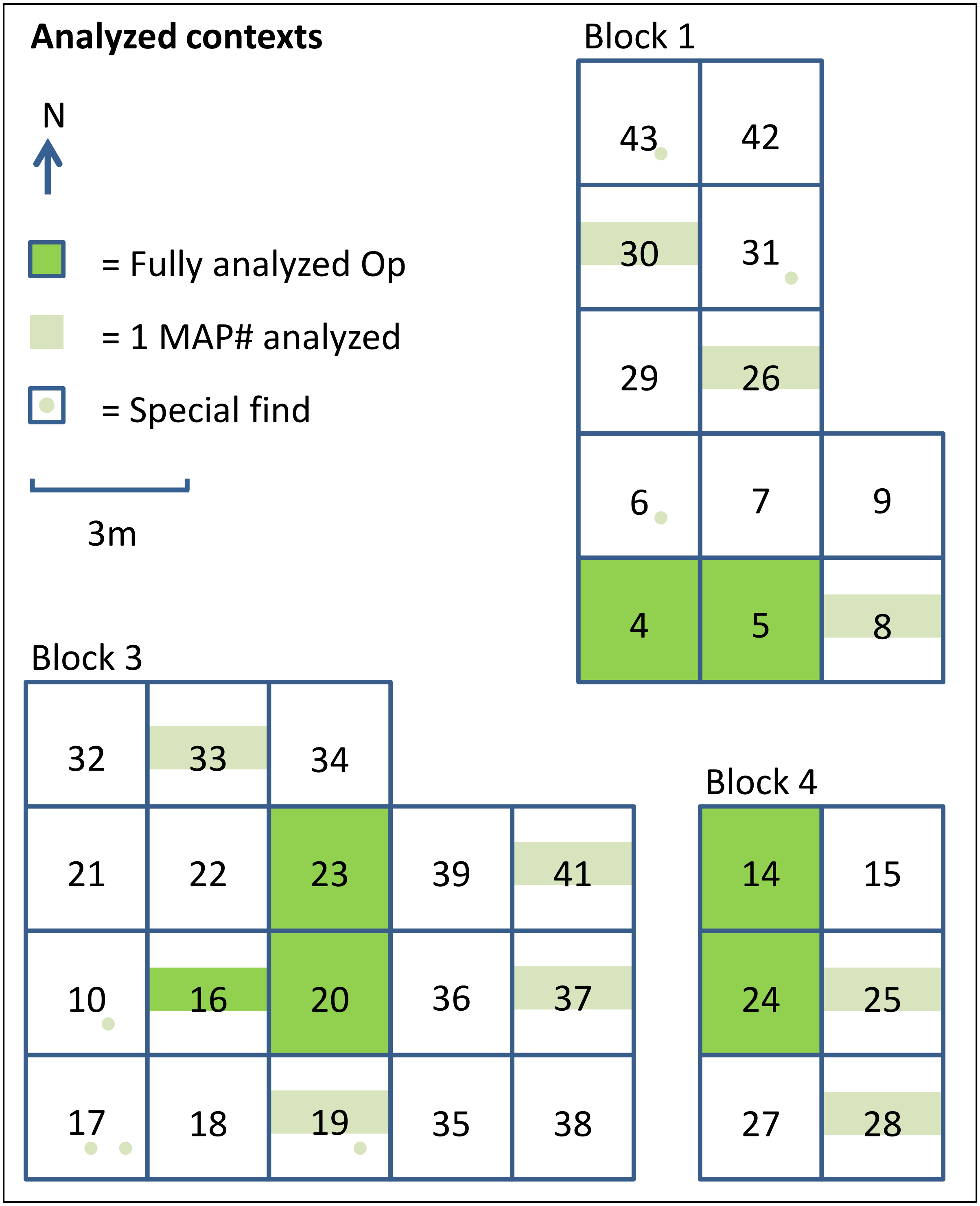


Figure 3.3. Locations and amounts of analyzed material from each excavation block at el-Mahâsna.

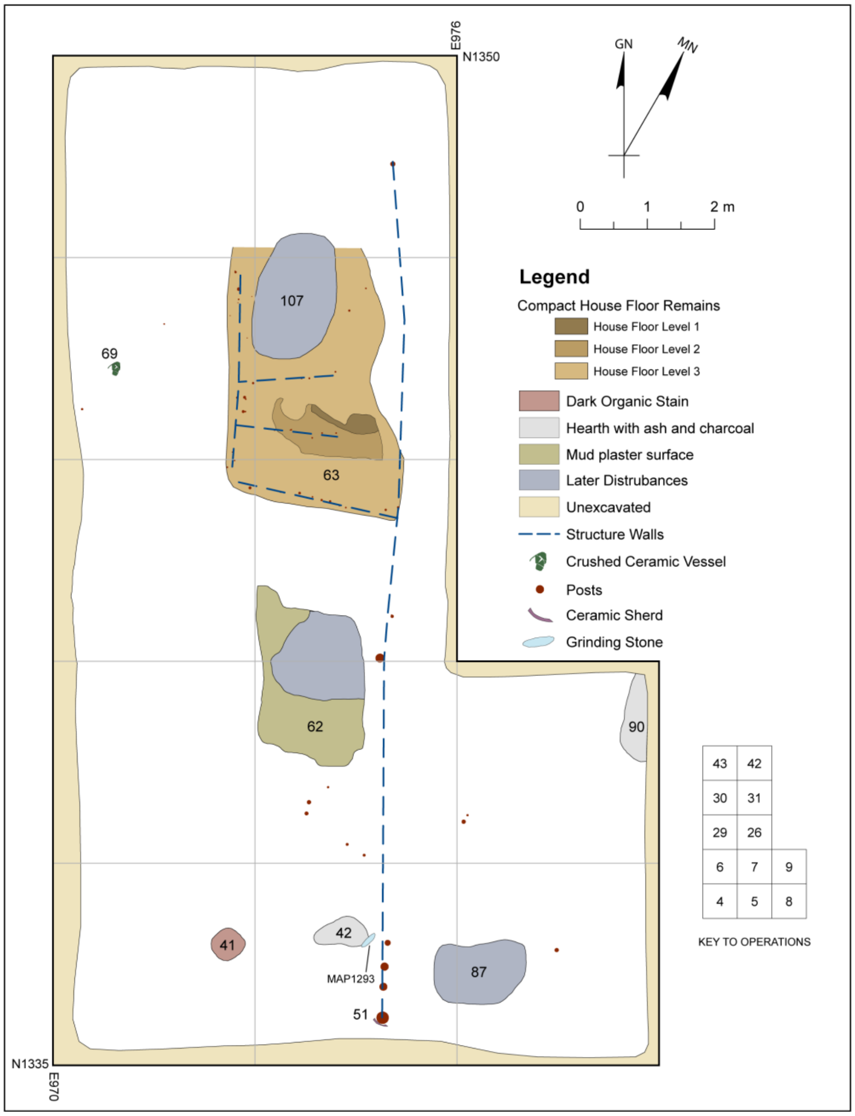


Figure 3.4. Features in el-Mahâsna Block 1 (Anderson 2006). Image credit: David Anderson.

Figure 3.5. Figurines from el-Mahâsna Block 3. Left: fragments of a seated female figurine. Right fragment of a cattle figurine with incisions at the neck. Image credits: David Anderson.

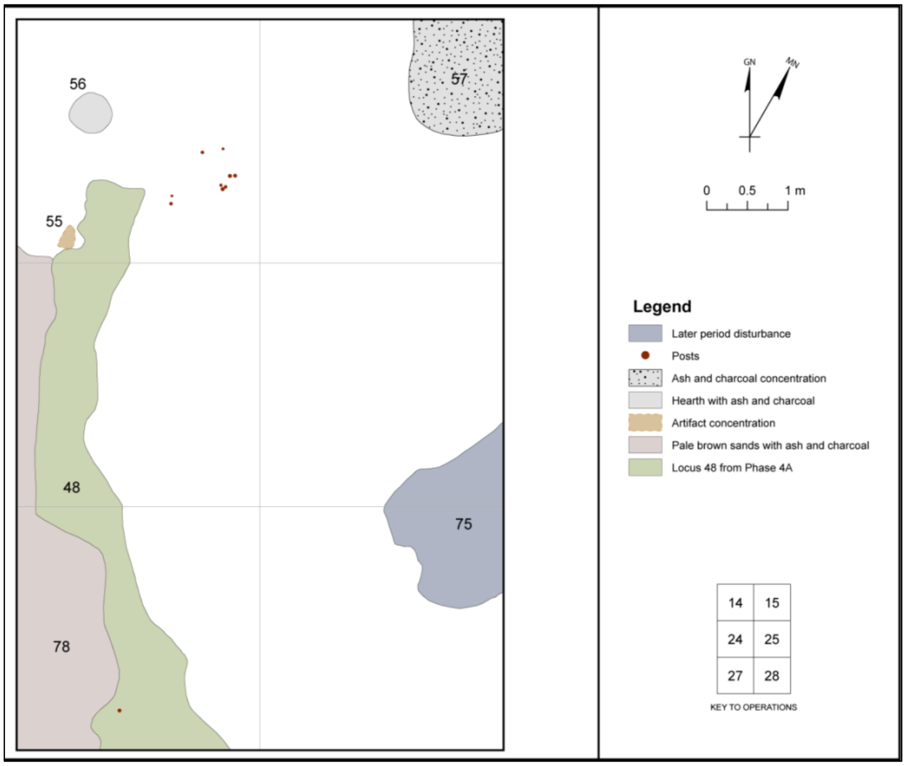


Figure 3.6. Features in el-Mahâsna Block 4. From Anderson (2006).

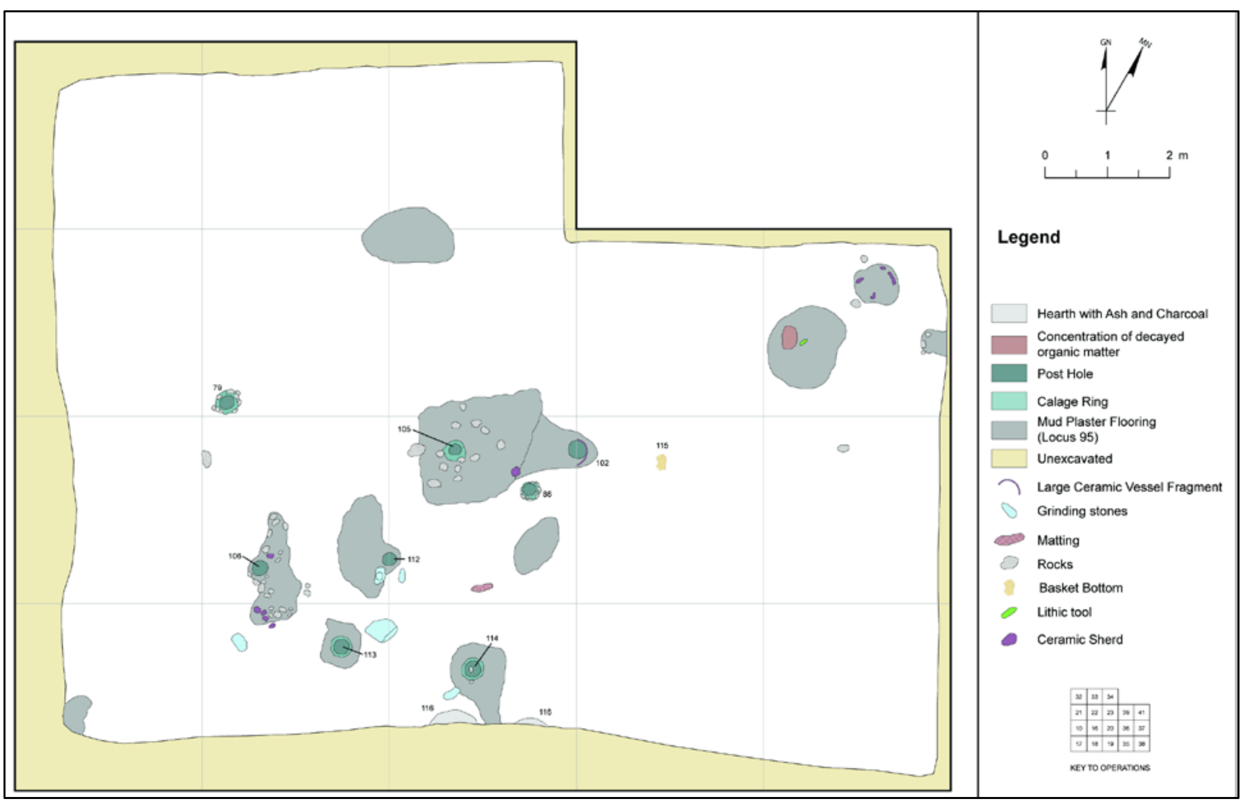


Figure 3.7. Features in el-Mahâsna Block 3. From Anderson (2006).

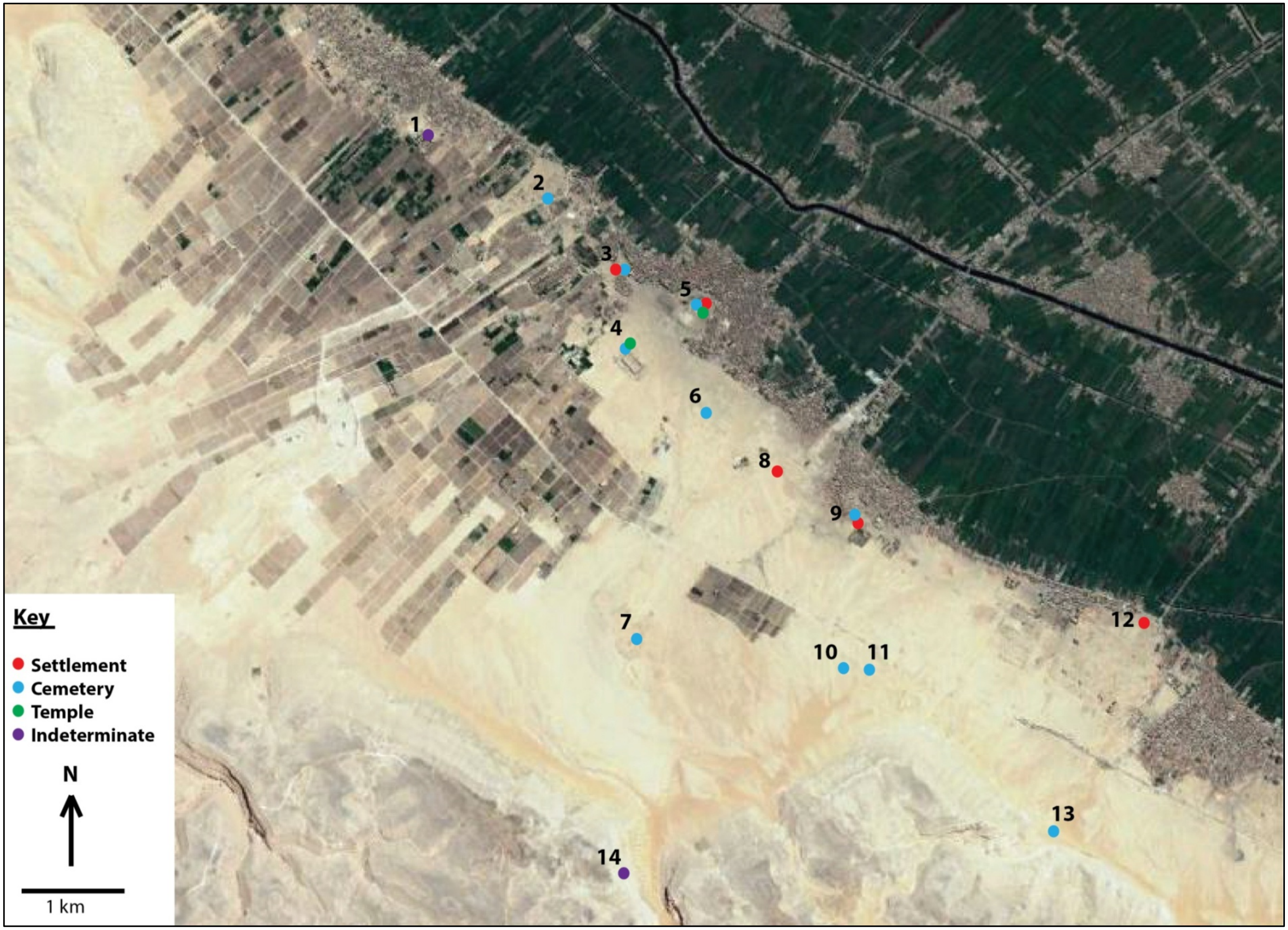
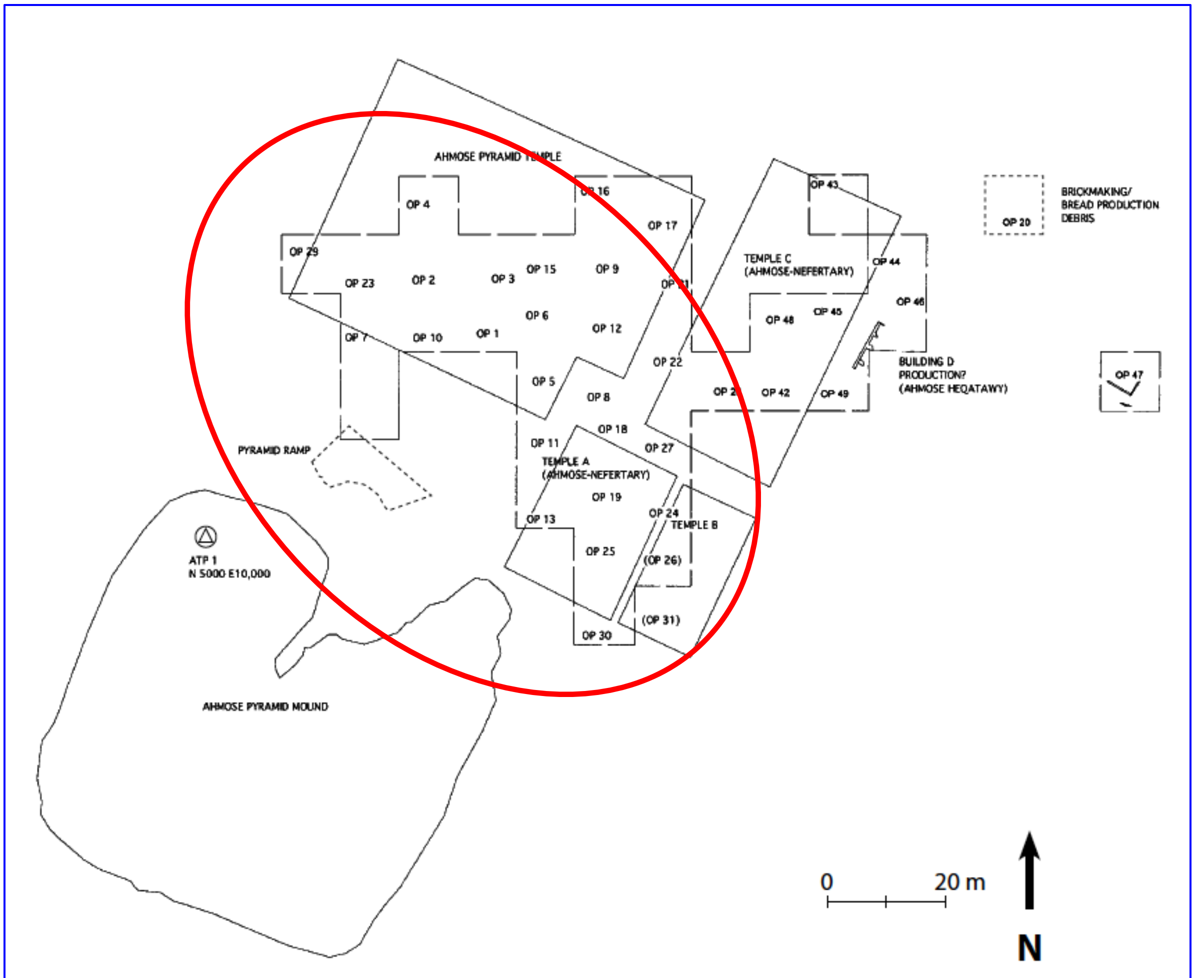


Figure 3.8. Location of the Predyastic-Early Dynastic remains in the Abydos Area. See table on the next page for site information.

#	Site	Site type	Patch #	Date	Publication
1	S83-54	?	S83-54		Patch 1991:426
2	Salmani	Cemetery	S83-53	NIC-NIIIA2	el-Sayed 1979; Patch 1991:424-425
3	D	Beer kilns & Cemetery	n/a	IId-IIIa1 (Kilns); E D (tombs)	Peet 1914; Peet & Loat 1913
4	S/ Funerary enclosures	Temple & cemetery	S83-59	Early Dynastic	D. Adams & O'Connor 2003; Bestock 2008, 2009; O'Connor 1999:102, 2009:158-181; Patch 1991:434-435; Peet 1914:30-34; Petrie 1925
5	Kom es-Sultan	Settlement & Temple	NIII/ D.0- 2	Early Dynastic	D. Adams 1999:108; Petrie 1902, 1903
5	M (Kom es-Sultan)	Cemetery	S83-56	NIIIC1/D 1	Petrie 1900: 27-28; 1901:36-37; 1902: 14-22; Patch 1991:428-429
6	E/G (AMC)	Cemetery	S83-46/47	NIA-IIIA2	Naville 1914:12-17; Patch 1991: 415-418; Peet 1914:17-19; Petrie 1902:34-35
	Frankfort	Cemetery	N/A	NIIC-NIID2	Frankfort 1930:213-215: On the high ground south of the northern expedition house.
7	Umm el-Qa'ab	Cemetery		NI-Early Dynastic	Amelineau 1899; Dreyer et al. 1996 – 2011; Hartmann 2011; Naville 1914; Peet 1914; Petrie 1900, 1901, 1902
8	Seti temple breweries	Settlement & Beer kilns	S83-61	NIId-IIIa1	Patch 1991:437; Peet 1914; Peet & Loat 1913
9	Habachi & Others	Cemetery & Settlement	S83-72	1st dynasty/ NIIC2?	el-Aref 2016; Habachi 1939; Hossein 2011; Patch 1991:414, 448;
10	χ/X/B	Cemetery	S83-43	NIID1- NIIIB	Randall-MacIver & Mace 1902:53-55; Patch 1991:411-412; Location approximate
11	ϕ/C	Cemetery	S83-44	NI-IIa or IC?[2]	Randall-MacIver & Mace 1902:51-53; Patch 1991:413. Location approximate
12	Abydos ATP	Settlement	S83-3	NIB-NIC/IIA	Harvey 1998:146-147; Randall-MacIver &Mace 1902:76; Patch 1991:376-377
13	S83-16	Cemetery	S83-16	Predynastic	Patch 1991:384-385; Ayrton et al. 1904:Pl. LXI
14	S83-52	Workshop?	S83-52	Predynastic?	Patch 1991: 423 ; Location approximate
	Hawashim	Cemetery	S83-71	IIC-III?	el-Sayed 1979:259-60; Patch 1991:447:"west" of Hawashim, ~2km south of Ramses temple

Figure 3.8 references



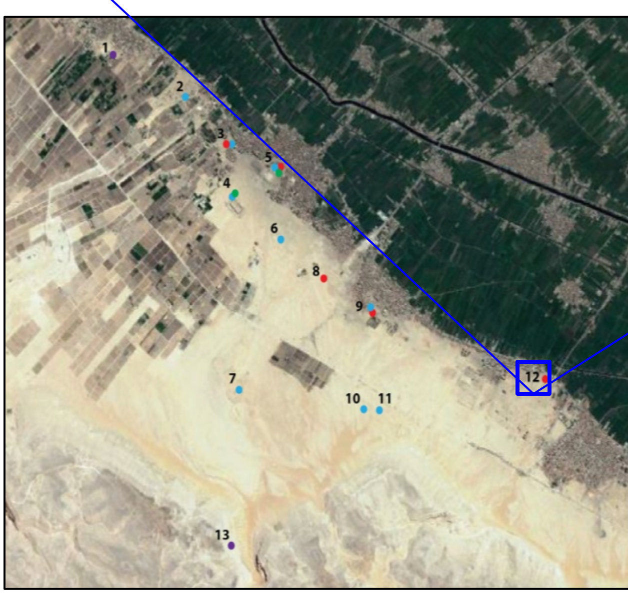
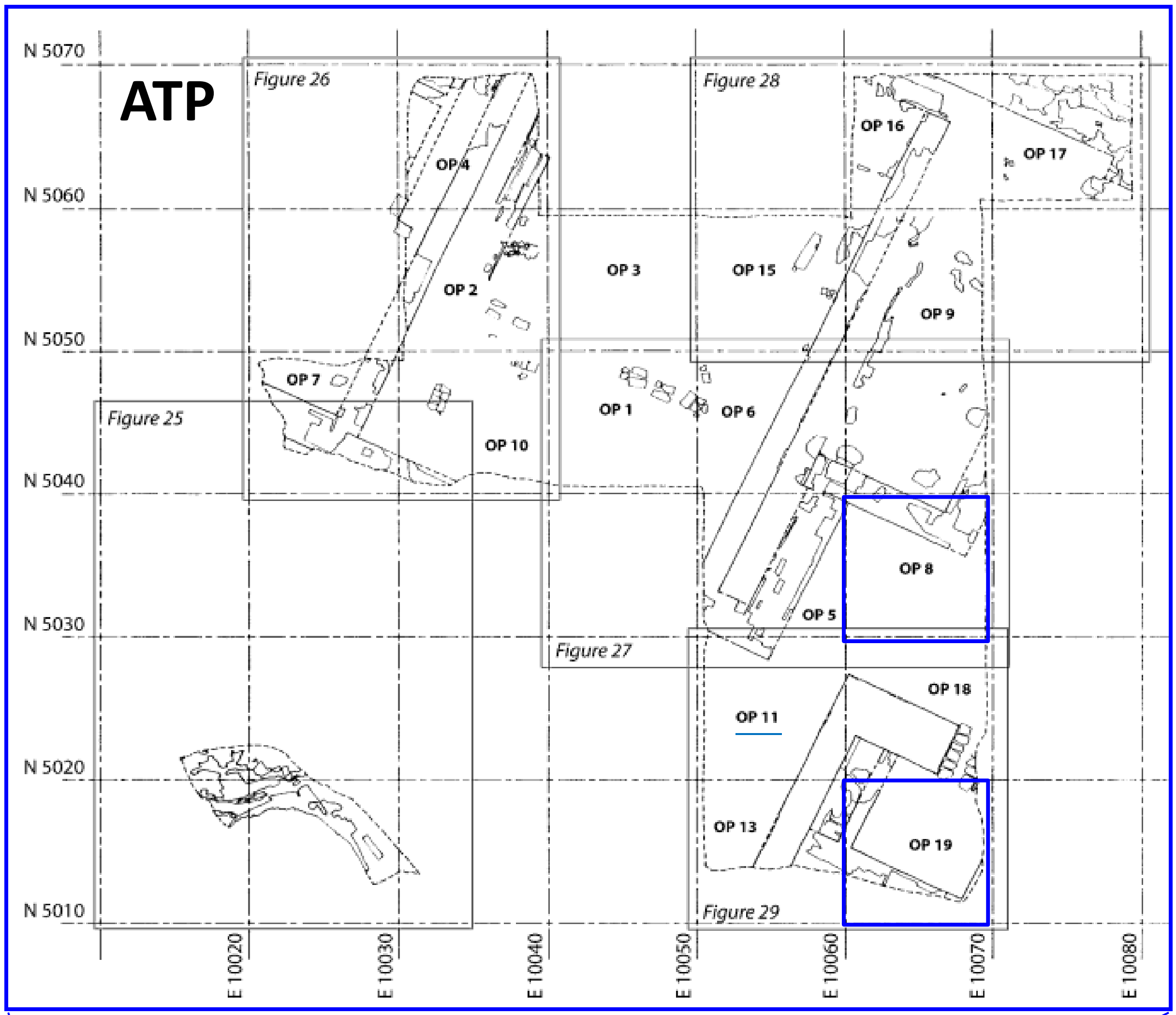


Figure 3.9. Approximate location of the Predynastic settlement site (red circle) relative to the New Kingdom Ahmose pyramid complex based on descriptions by Harvey (1998, personal communication), and Patch (1991). Maps courtesy of Stephen Harvey.



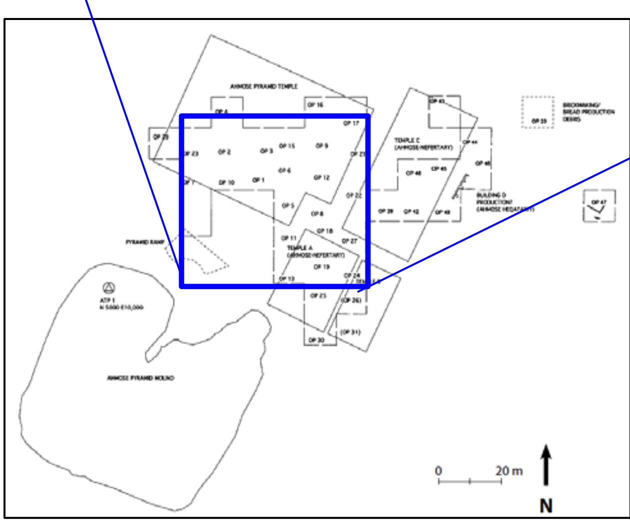


Figure 3.10. Location of the Abydos ATP Operations analyzed here. Maps courtesy of Stephen Harvey.

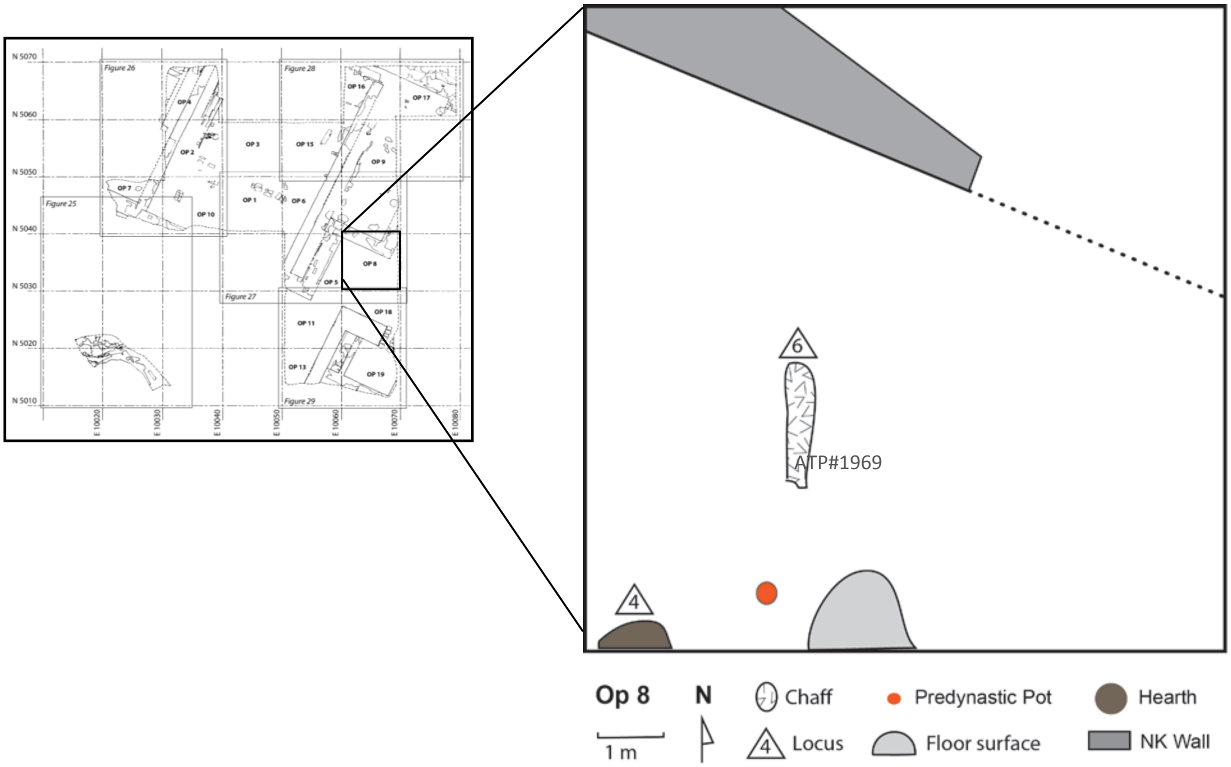


Figure 3.11. The uppermost features in the Predynastic layer of Op 8. NK=New Kingdom.

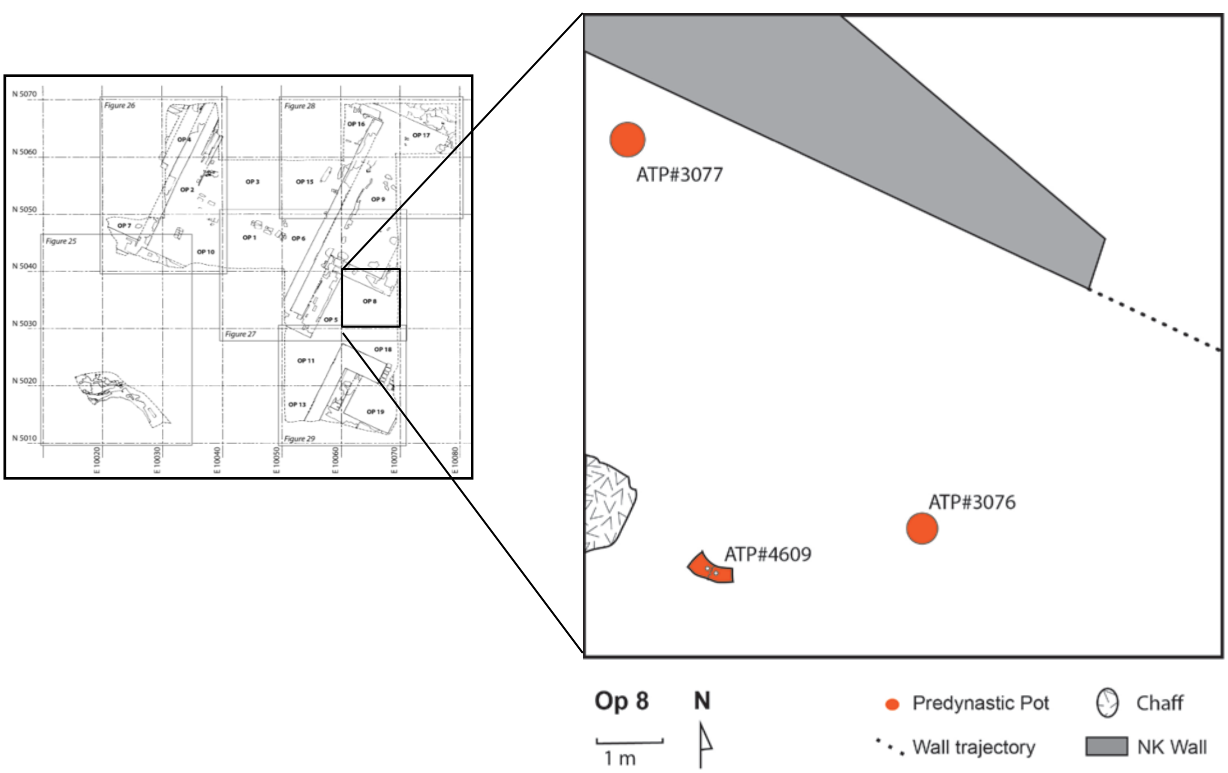


Figure 3.12. The lower features in the Predynastic layer of Op 8. NK=New Kingdom.

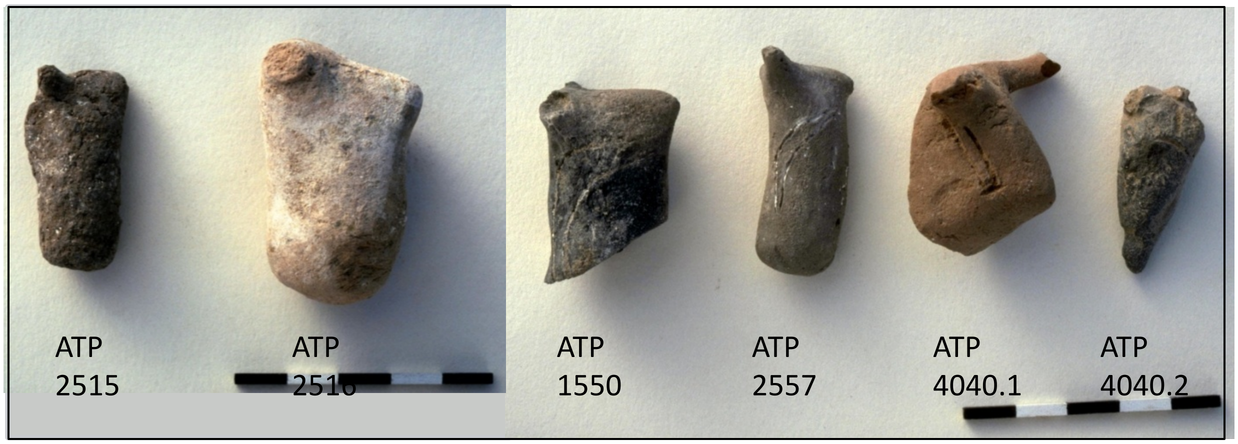


Figure 3.13. Figurine fragments in the shape of cattle. Left: ATP.2515 &2516-Op 8; Right: ATP.1550- Op 4, ATP.2577-Op11, ATP.4040- Op 19. Image credits: Ahmose-Tetisheri Project.

Figure 3.14. The Predynastic remains in Op 19.
NK=New Kingdom.

Figure 3.15a. Black-topped ceramic vessel with repair holes. ATP4615- Op11.

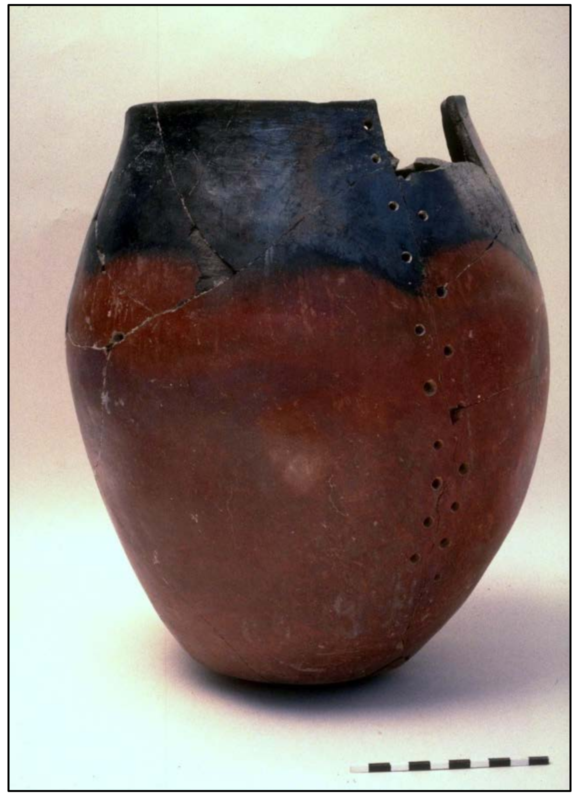


Figure 3.15b. Black-topped ceramic vessel with repair holes. ATP1969- Op 8. Image credit: Ahmose-Tetisheri Project.

Figure 3.16a. Large open-mouthed jar.

Figure 3.16b. Large open-mouthed jar. ATP3076- Op8. Image credit: Ahmose-Tetisheri Project.

Figure 3.17a-c. Cache of pottery and baskets in Op 11. Top: Cache in situ. Middle: Detail after removal of some piece showing parts of the cache underneath a New Kingdom structure. Bottom: Detail of Basketry. The Basketry does seem to be Predynastic in date since it compares favorably to known Predynastic styles of basketry (Wendrich 2000). Image credits: Ahmose-Tetisheri Project.

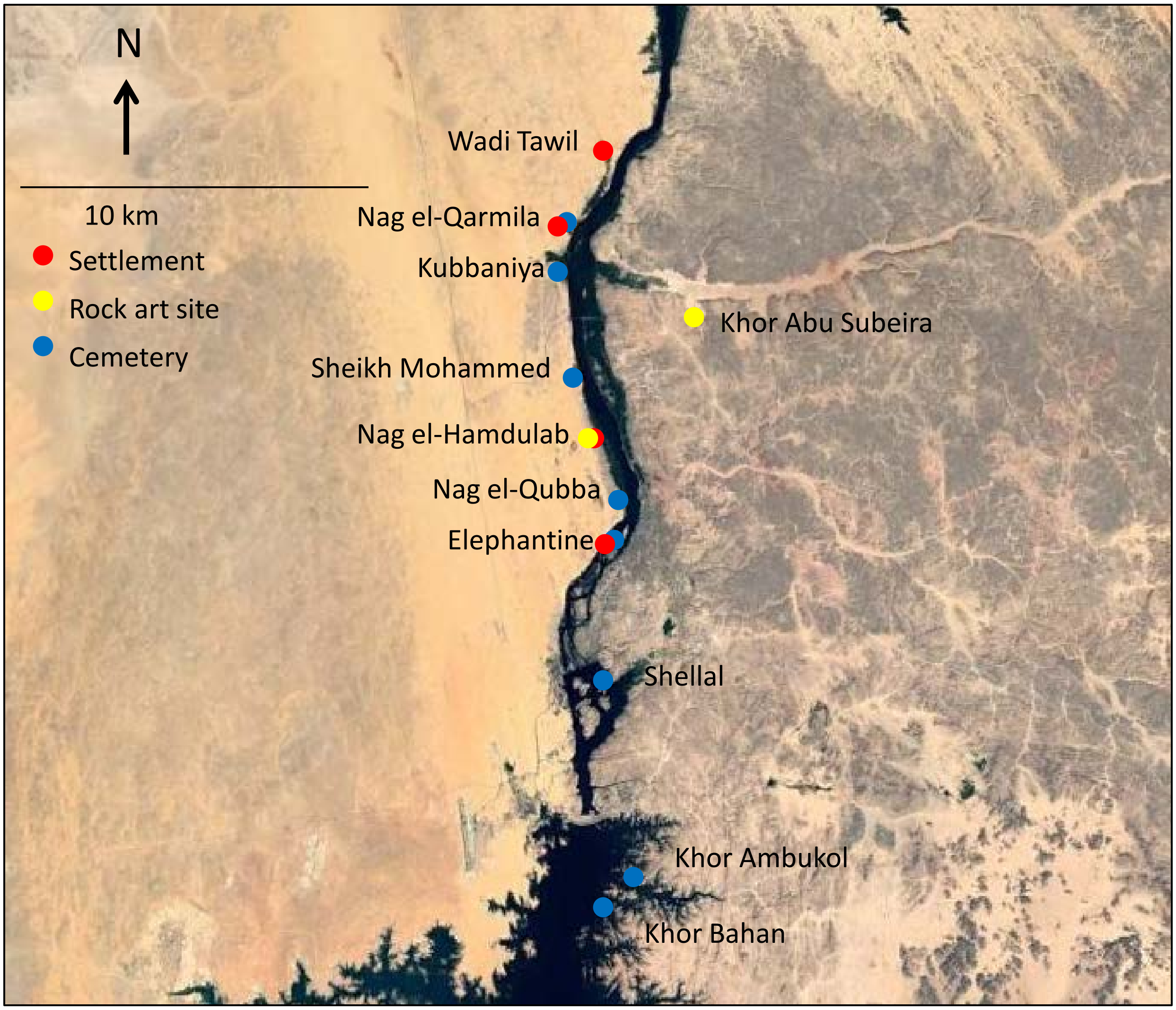


Figure 3.18. Predynastic sites in the Aswan area.

Figure 3.19: Artist's reconstruction of the Nag el-Qarmila landscape, from Gatto et al. (2009c).

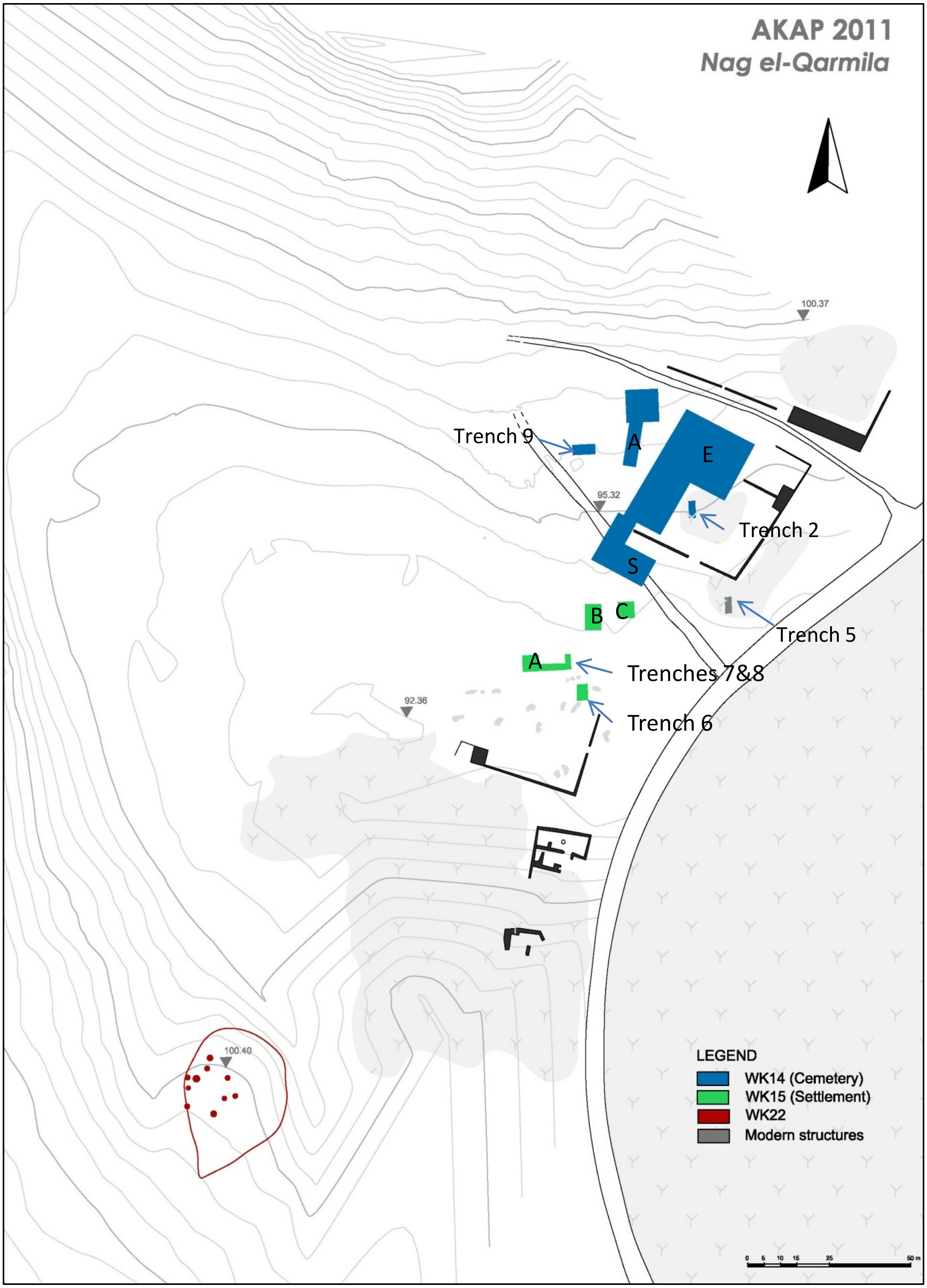


Figure 3.20. Nag el-Qarmila. Image credit: Aswan-Kom Ombo Archaeological Project.

Figure 3.21. Fragment of a model boat with red ochre from Nag el-Qarmila (AKAP WK15). Image credit: Aswan-Kom Ombo Archaeological Project.

Figure 3.22. Excavation of a cracked in-situ pot with repair holes Nag el-Qarmila (AKAP WK15).

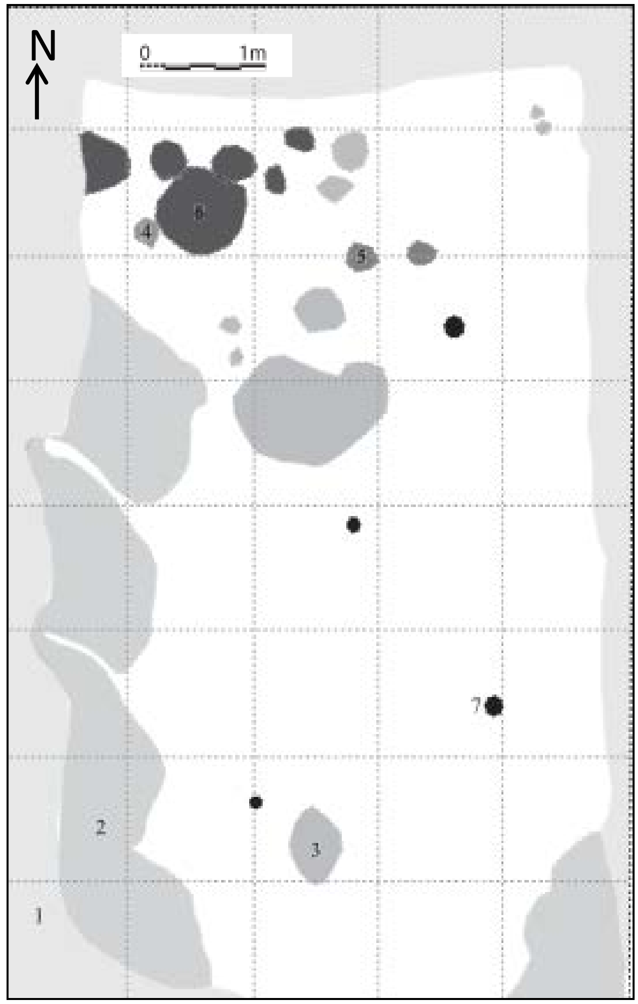


Figure 3.23. Nag el-Qarmila, WK15 Area B, Lowest level. 1)Sand; 2)Silt extraction pits; 3) Depressions; 4) Pot emplacements; 5) Mud-lined pits; 6) Hearths; 7) Post holes. Image credit: Aswan-Kom Ombo Archaeological Project.

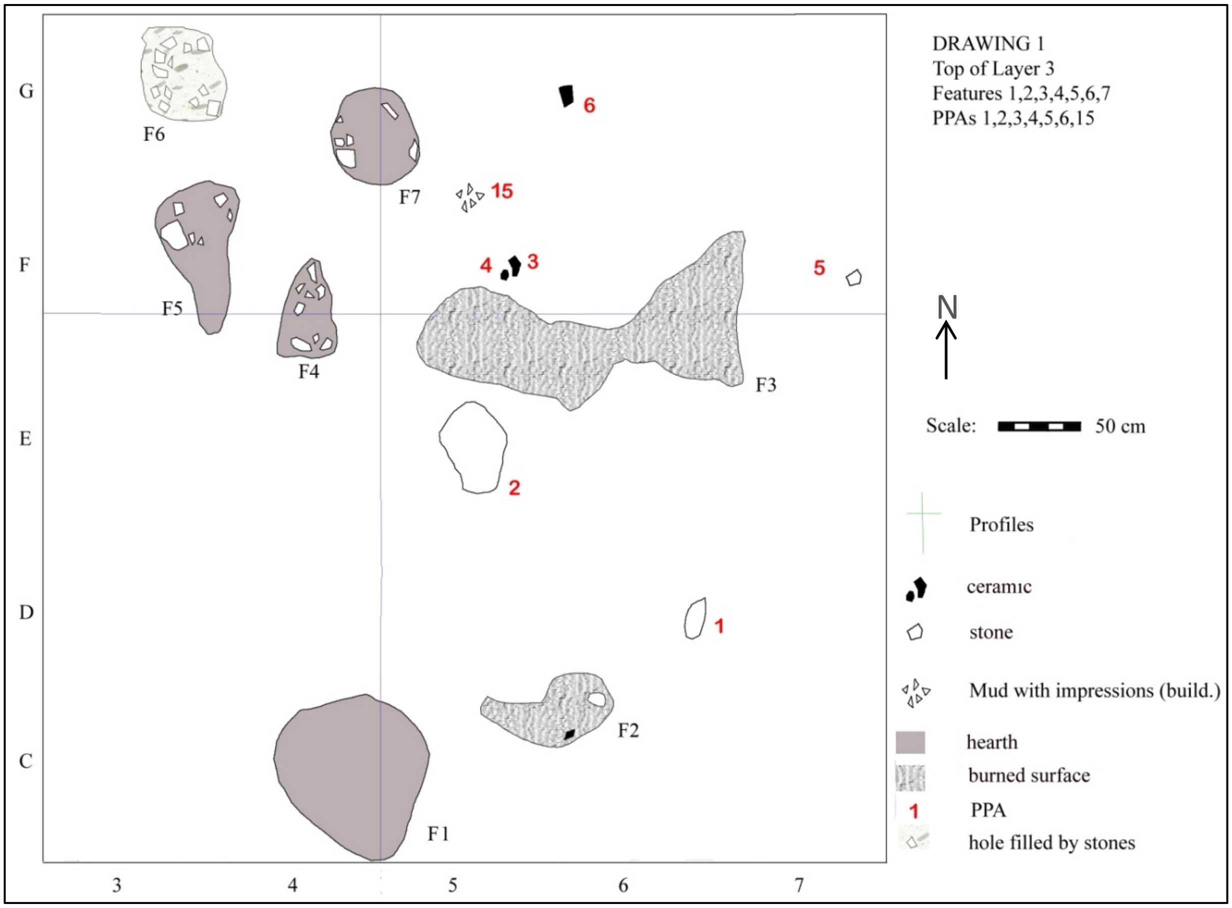


Figure 3.24. Nag el-Qarmila, WK15 Area A, Layer 3. 1=upper grinder, 2= mortar, 3=ceramic sherd with repair hole, 4=sherd, 5=hammerstone, 6=incised ceramic sherd. Image credit: Aswan-Kom Ombo Archaeological Project.

Figure 3.25. Nag el-Qarmila, WK15 Area A, in-situ stone mortar. Image credit: Aswan-Kom Ombo Archaeological Project.

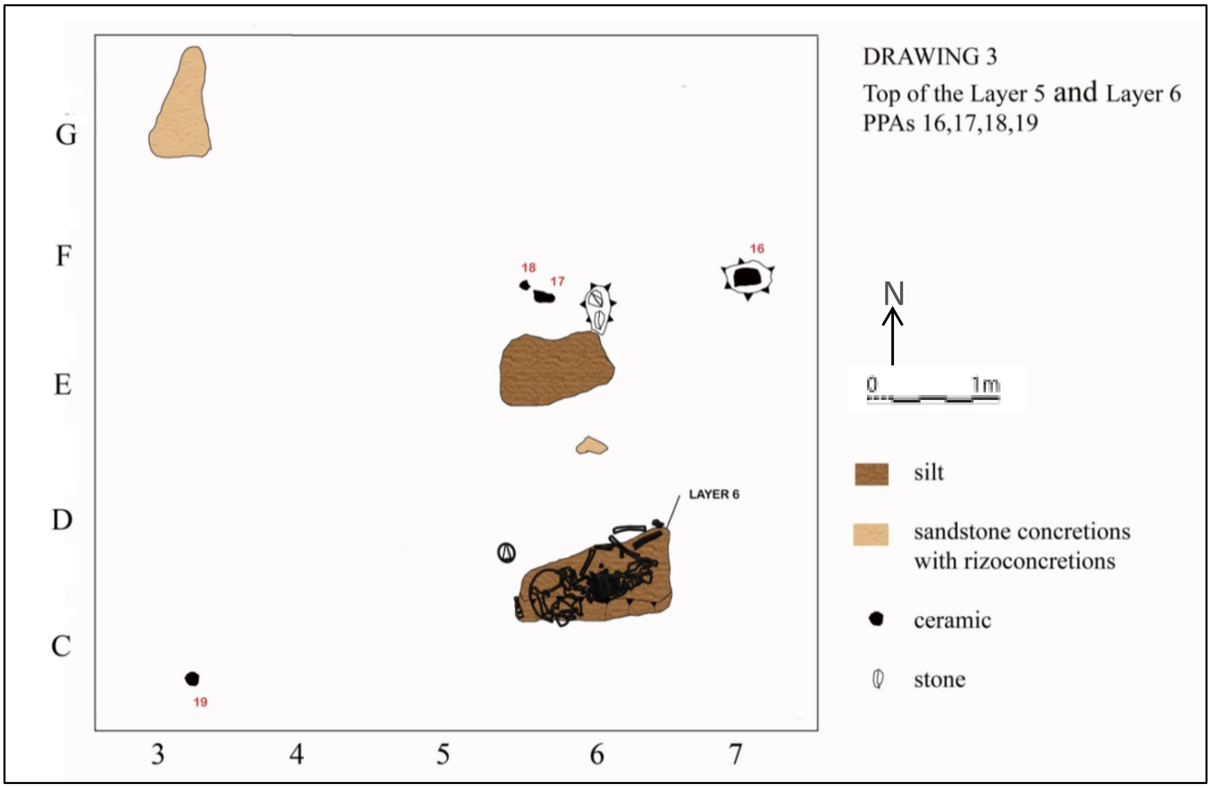


Figure 3.26. Nag el-Qarmila, WK15 Area A, lowest layer with child burial. Image credit: Aswan-Kom Ombo Archaeological Project.

Figure 3.27. Child burial in Nag el-Qarmila, WK15 Area A. Image credit: Aswan-Kom Ombo Archaeological Project.

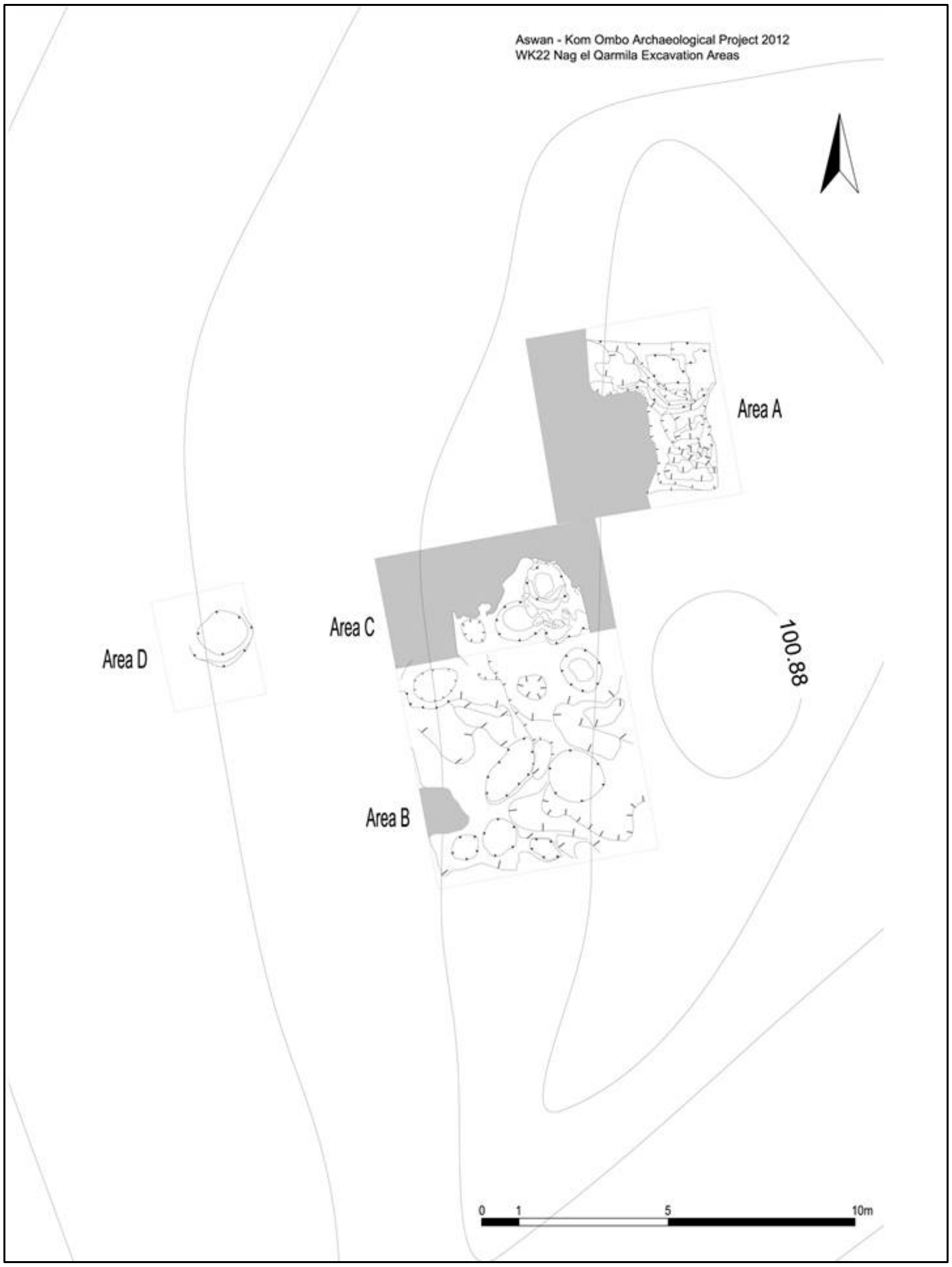


Figure 3.28. Plan of features in Nag el-Qarmila, WK22. Image credit: Aswan-Kom Ombo Archaeological Project.

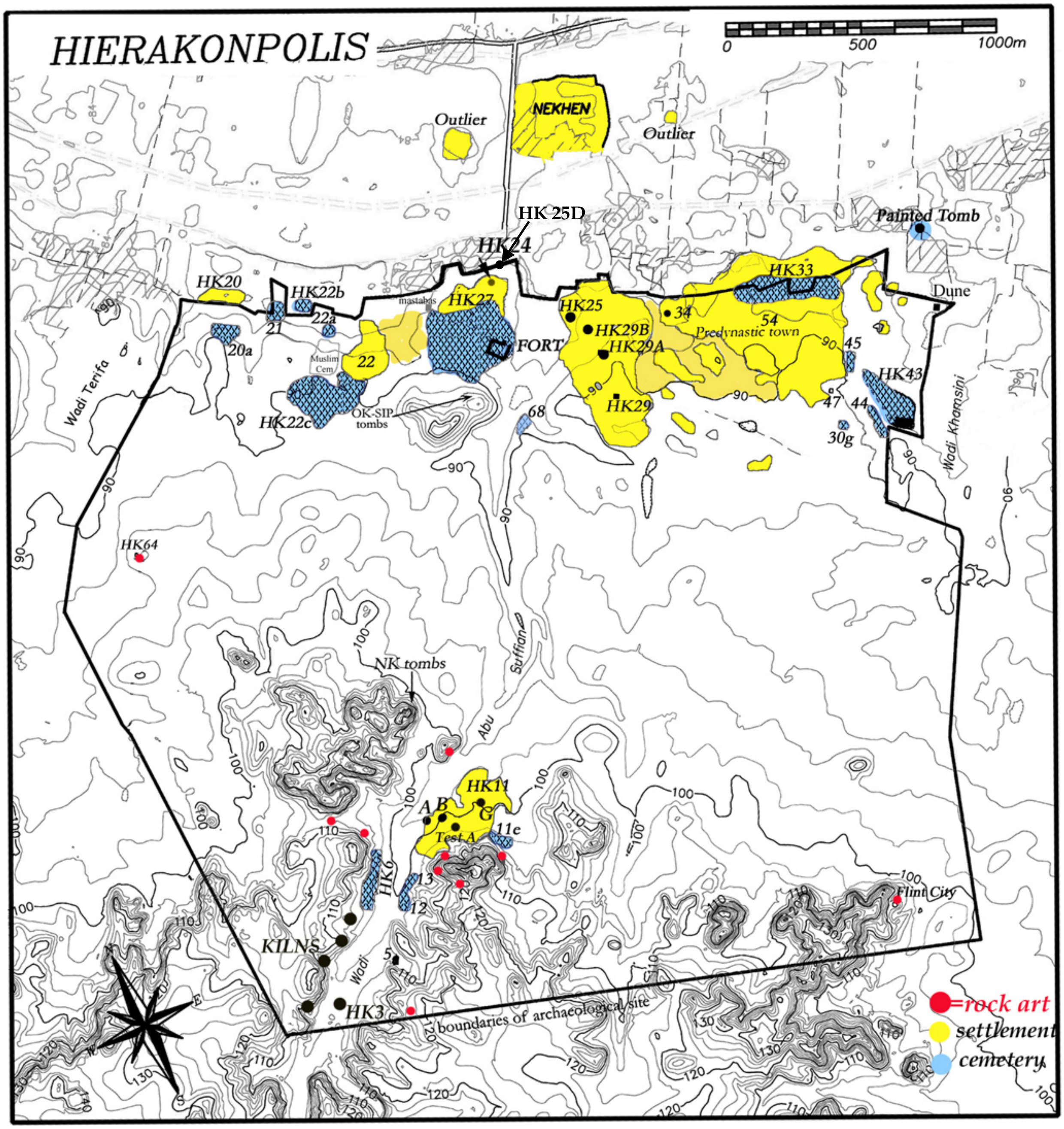


Figure 3.29. Hierakonpolis map. Courtesy of the Hierakonpolis Expedition, cartography by Joel Paulson.

Chapter 4 Figures

Figure 4.1. Variability in microcrystaline quartz rocks (chert) in Egypt.

Figure 4.2. Forming groups of chert varieties based on macroscopic properties of cortex type, structures, color, luster, translucence, and texture.

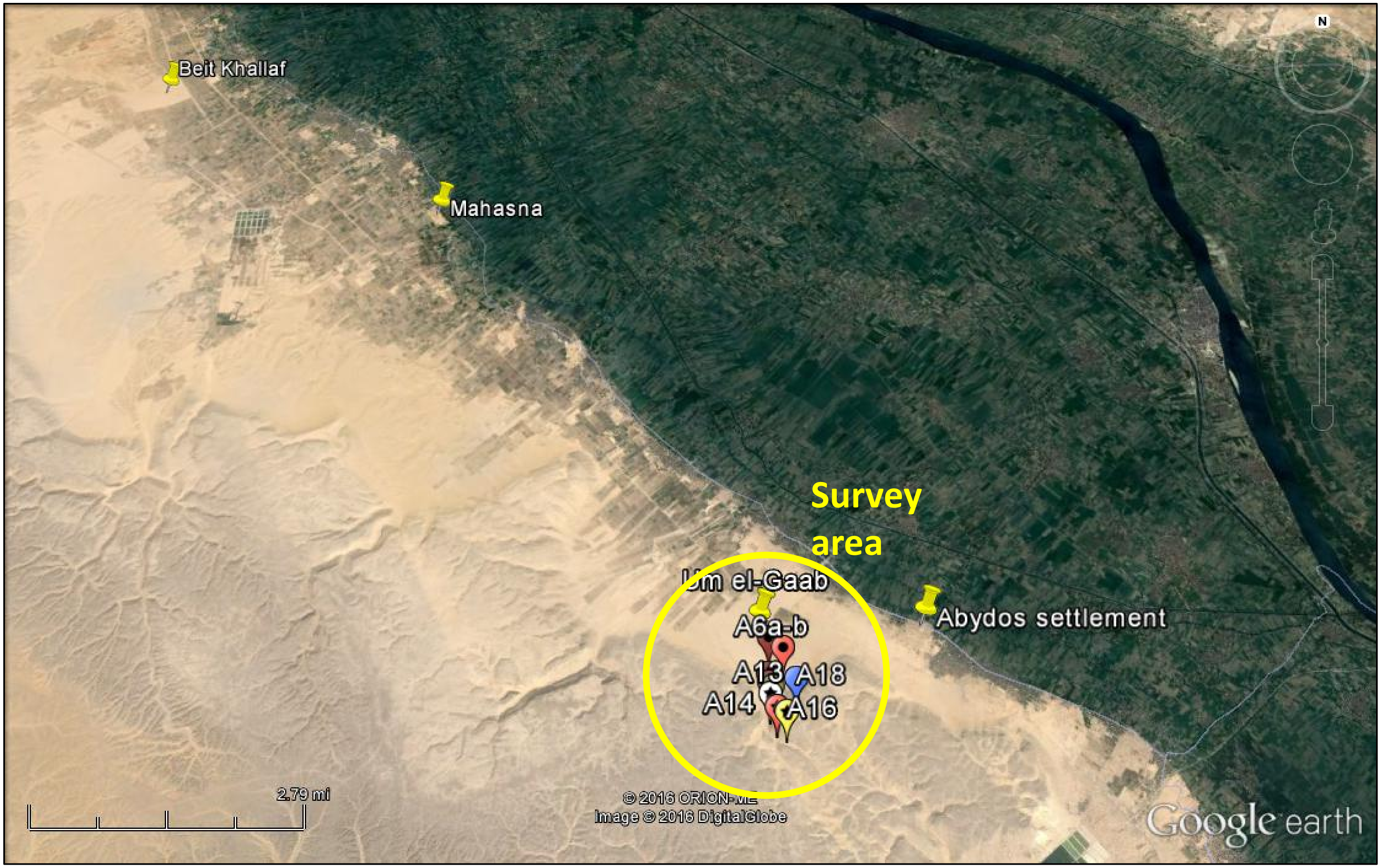


Figure 4.3. Overview of Raw material survey sites in the Abydos region.

Figure 4.4. Panorama from the top of the high desert plateau.

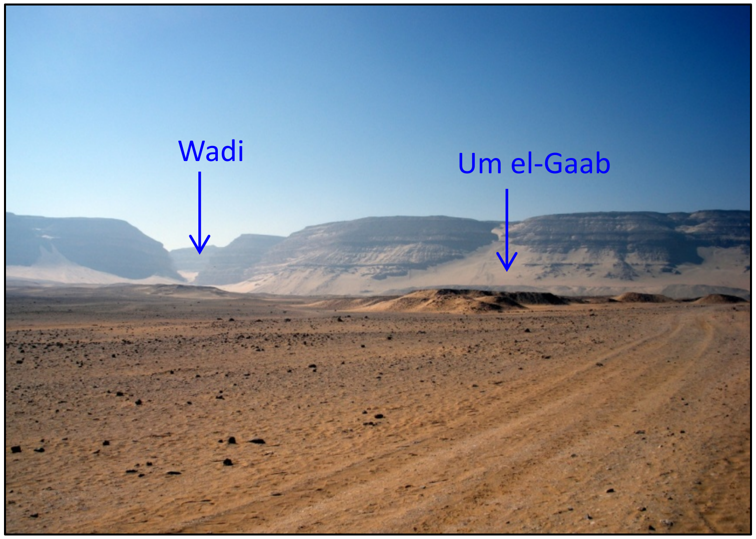


Figure X4.5. High desert plateaus, low desert surface, Um el-Gaab cemetery in front of a wadi leading up into the high desert.

Figure 4.6. The wadi leading up to the high desert, along which raw materials were observed.

Figure 4.7. High desert plateau in survey area. For a sense of scale, there is a person just below the arrow, barely visible.

Figure 4.8. The cliff faces of the high desert plateaus and the lag deposits and slopes in front of them.

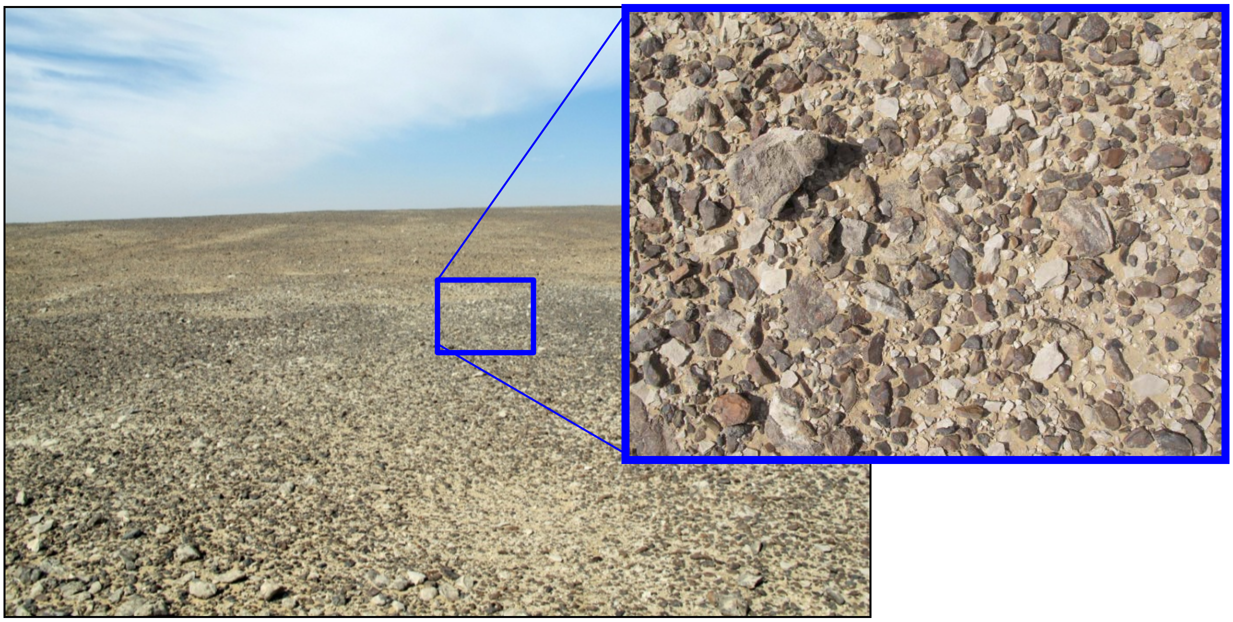


Figure 4.9. High desert surface with chert pavement, & close up showing scatter of natural chert fragments and artifacts. Approximate average size of pieces in the close up is ~3cm.

Figure 4.10. High desert surface in an area with larger stone fragments.

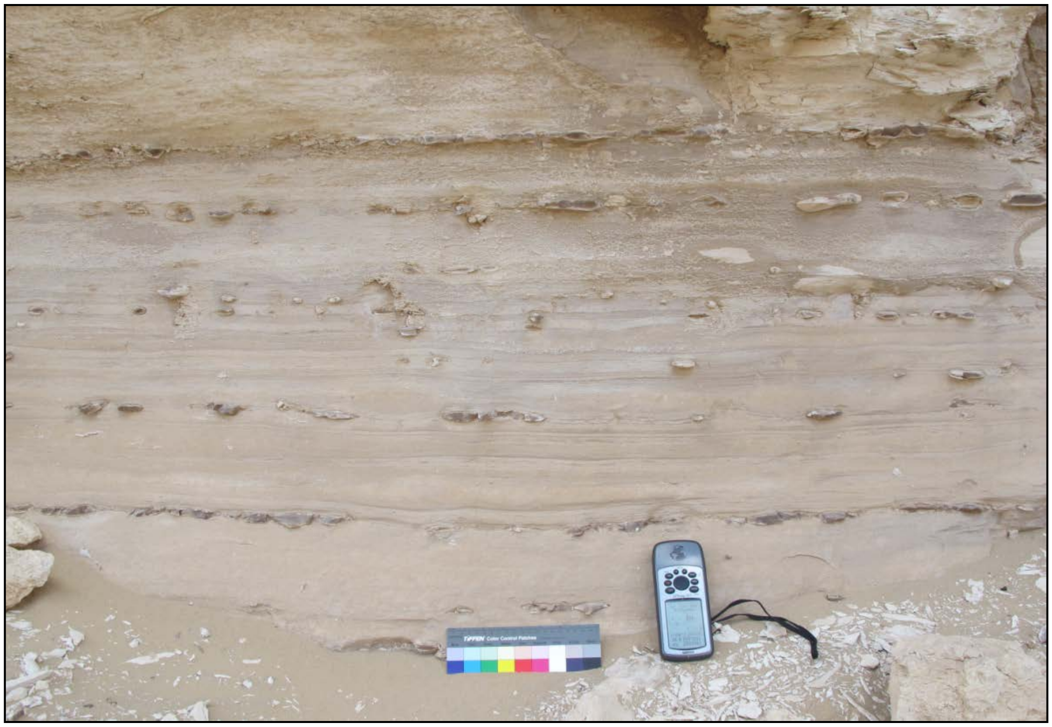


Figure 4.11. Exposed thin chert nodules in primary context. Nodule A 10.

Figure 4.12. Exposed thin chert nodules in primary context. Nodule A 14.

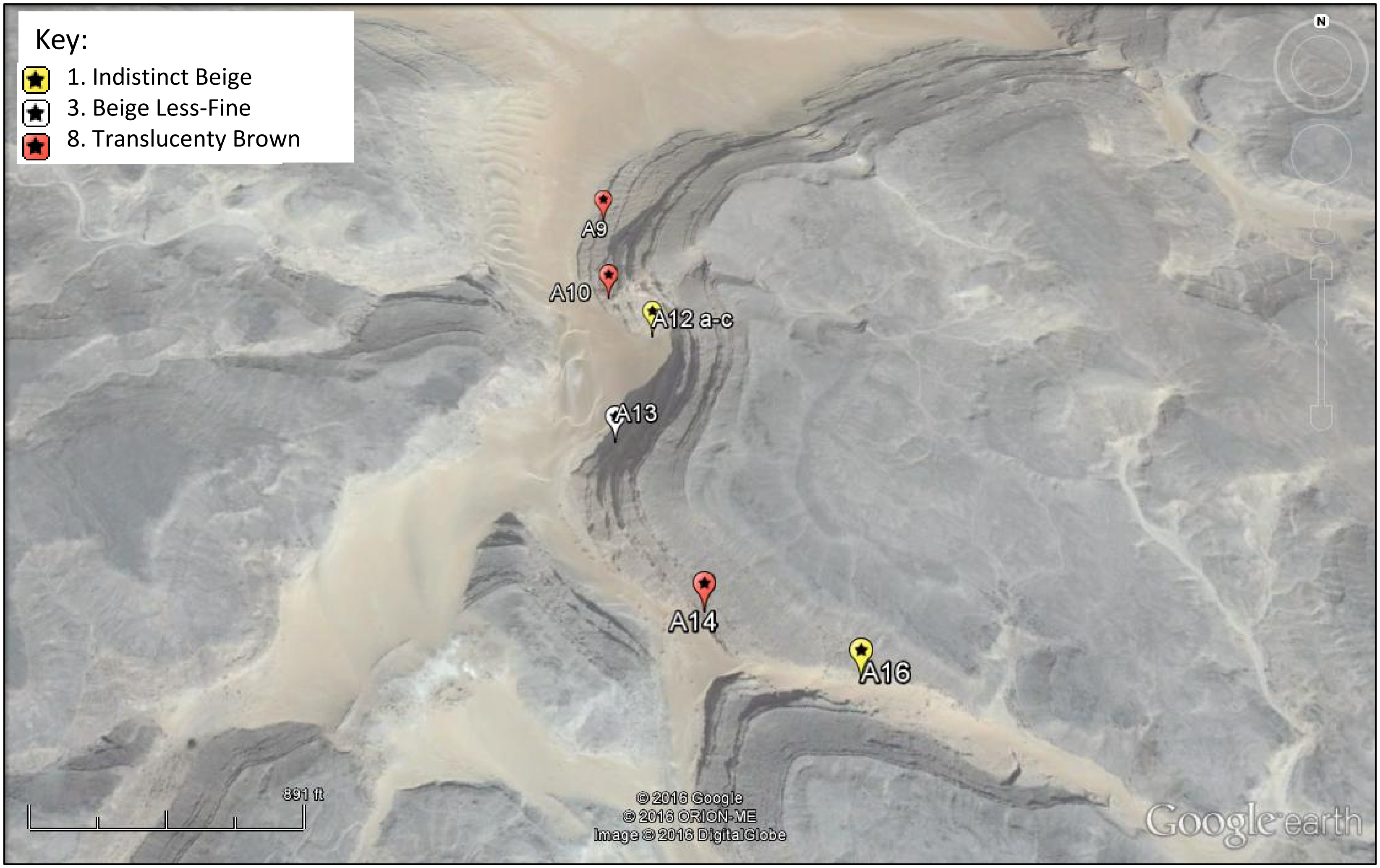


Figure 4.13. Map showing locations of primary contexts for chert varieties.

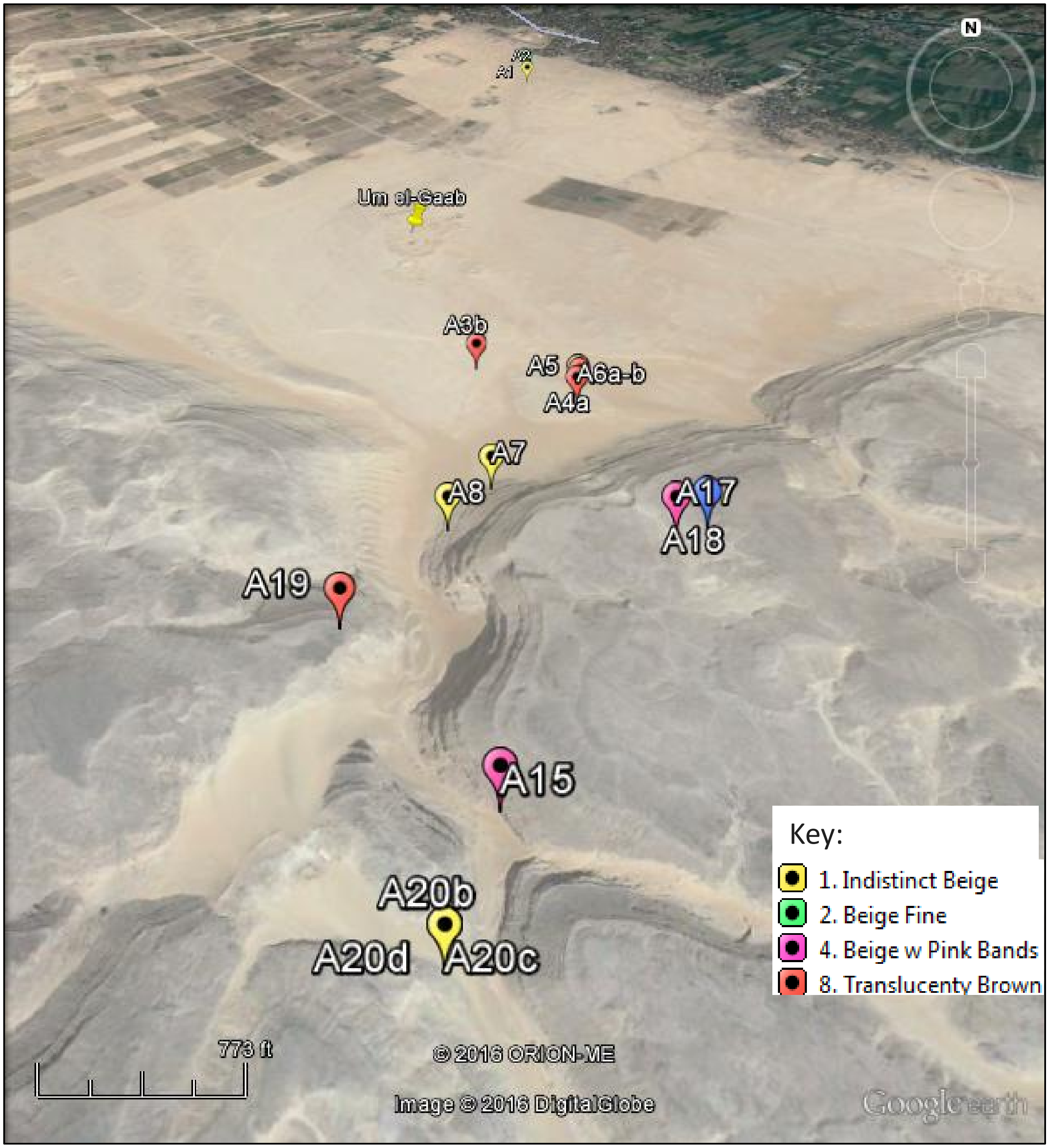


Figure 4.14. Map showing locations of chert varieties found in secondary context.

Figure 4.15. Examples of raw materials identified during the raw material survey in the Abydos area.

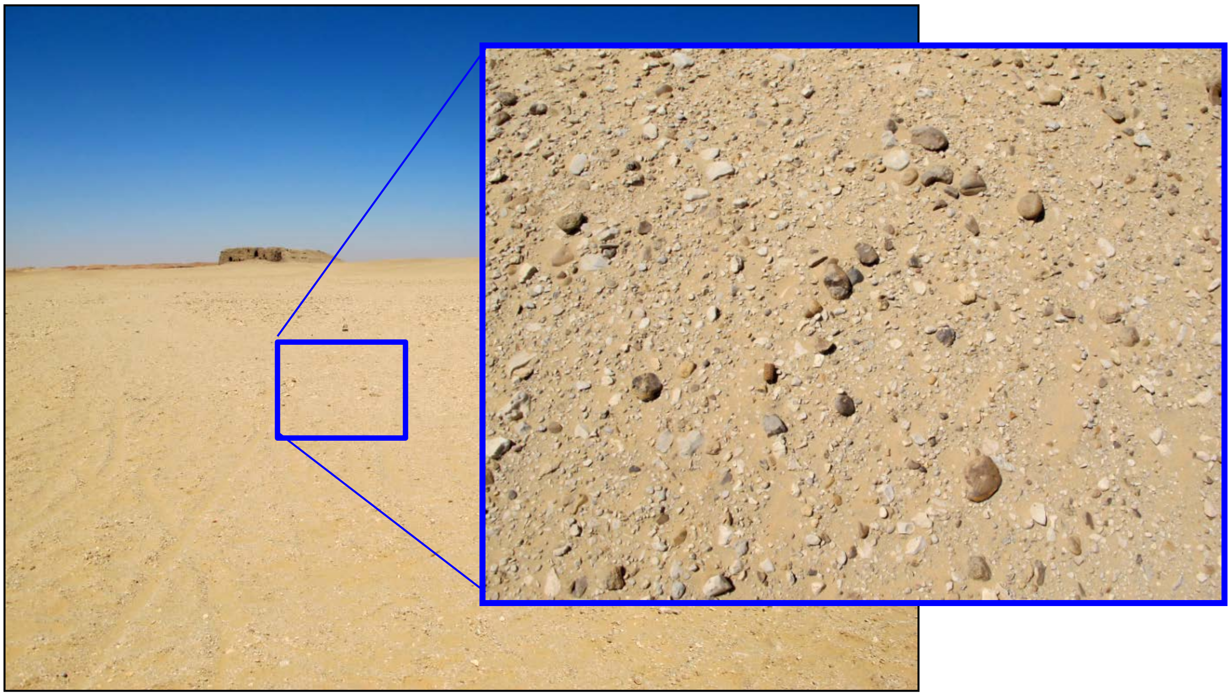


Figure 4.16. Desert surface around Beit Khallaf.

Figure 4.17. Chert variety 9.Translucent Brown with pink gravel cortex.

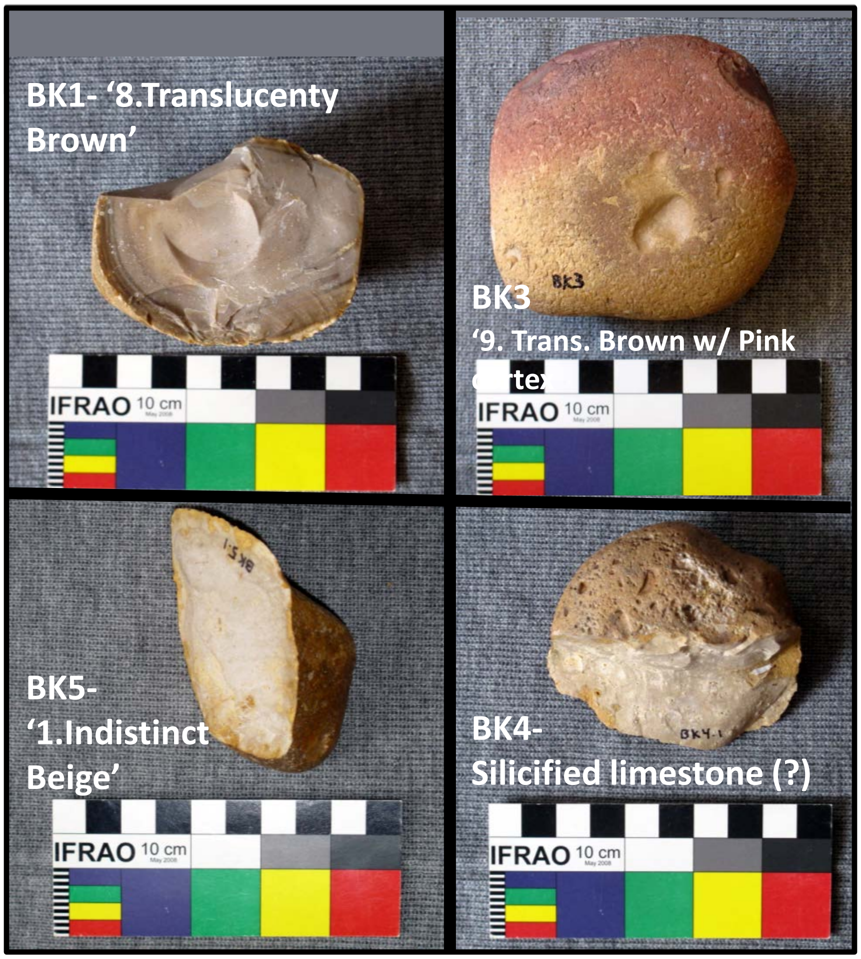


Figure 4.18. Raw material types identified at Beit Khallaf.

Figure 4.19. Two views of each of the raw material types identified in the vicinity of Nag el-Qarmila.

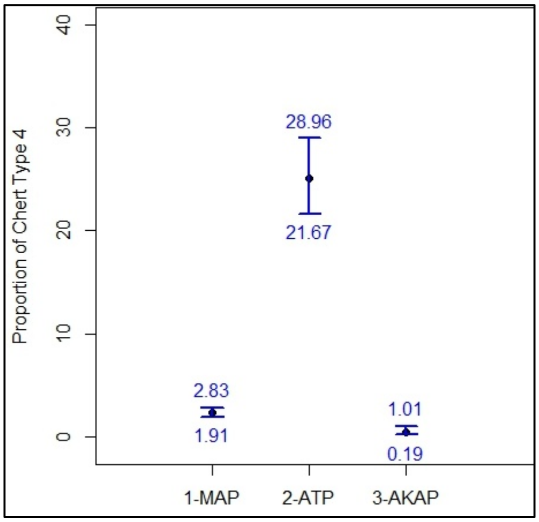


Figure 4.20. 95% binomial confidence intervals for chert type '4. Beige with Pink Bands' at el-Mahâsna, Abydos and Nag el-Qarmila.

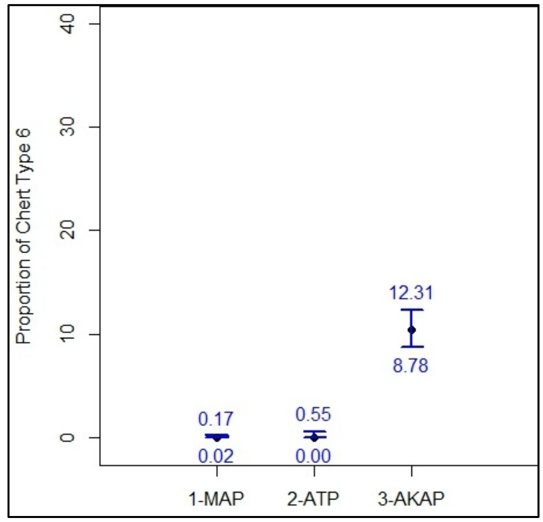


Figure 4.21. 95% binomial confidence intervals for chert type '6. Brown Fossil' at el-Mahâsna, Abydos and Nag el-Qarmila.

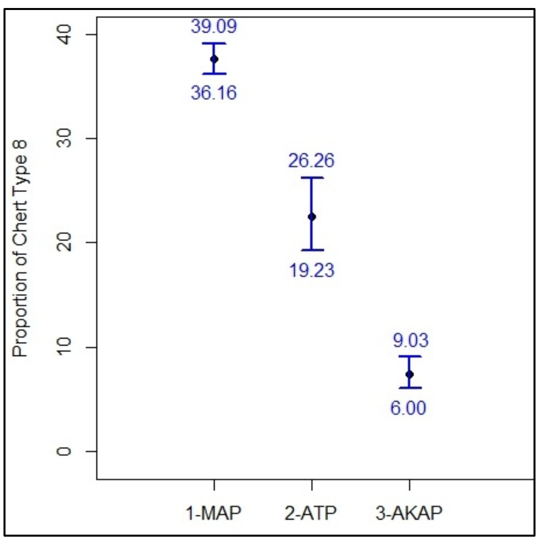


Figure 4.22. 95% binomial confidence intervals for chert type '8. Translucenty Brown' at el-Mahâsna, Abydos and Nag el-Qarmila.

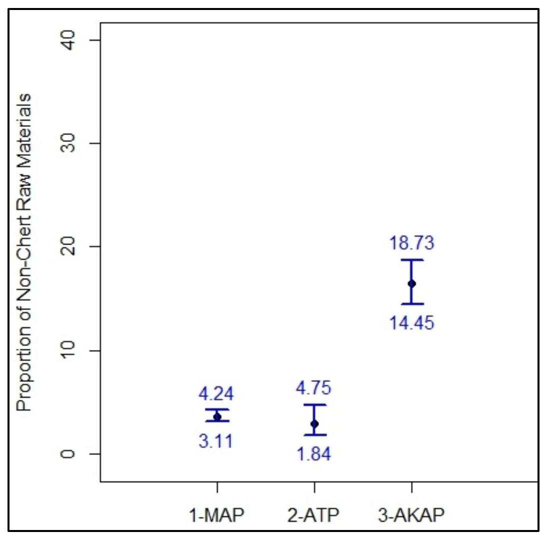


Figure 4.23. 95% binomial confidence intervals for the proportions of Non-Chert materials at el-Mahâsna, Abydos and Nag el-Qarmila.

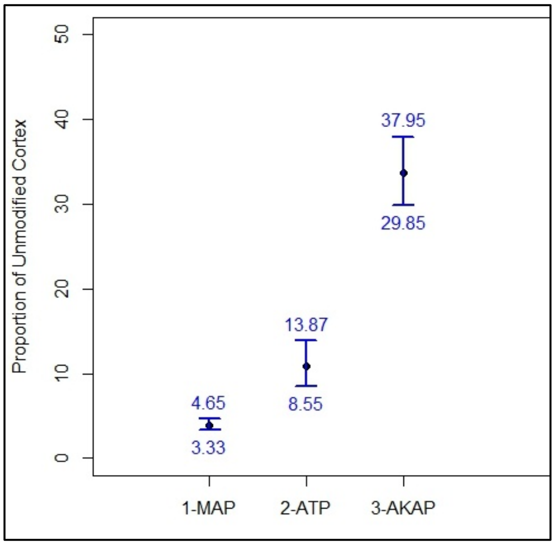


Figure 4.24. Proportions of unmodified cortex at el- Mahâsna, Abydos and Nag el-Qarmila, with the 95% binomial confidence intervals.

Figure 4.25. Three artifacts analyzed with X-ray Fluorescence.

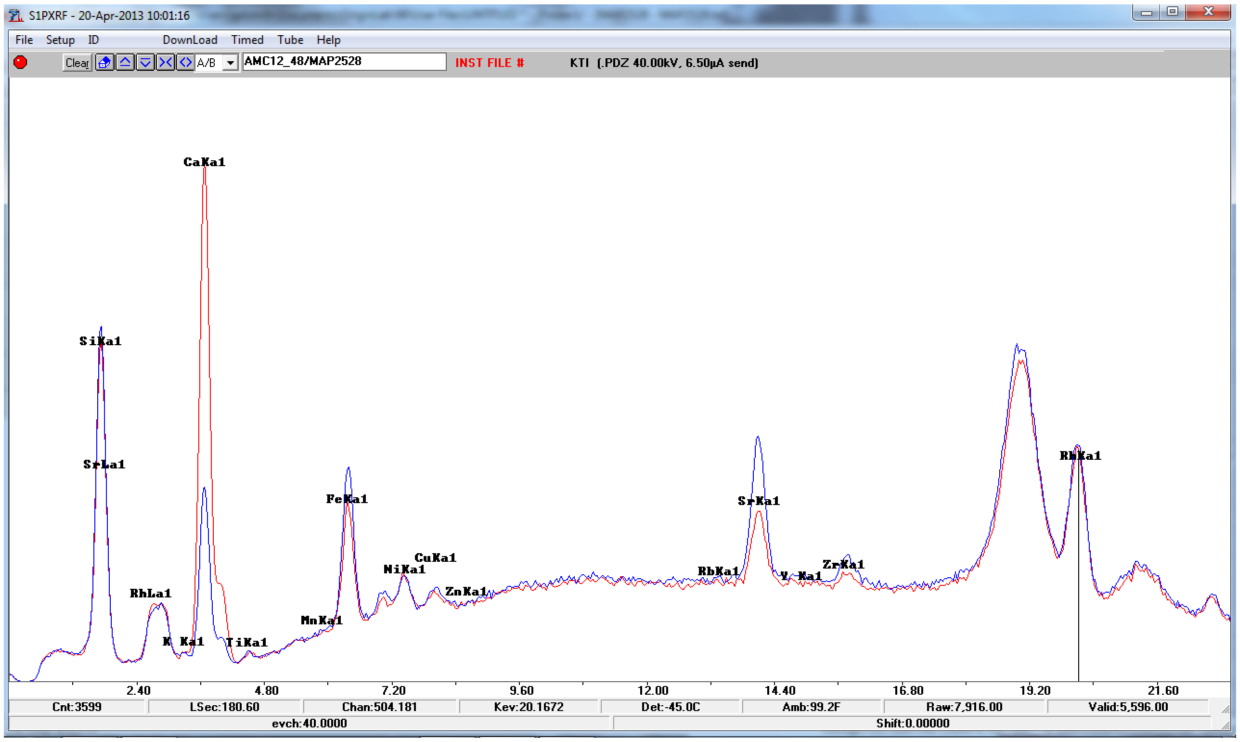


Figure 4.26. X-ray Fluorescence results comparing AMC 12.48 and MAP 2528, showing peaks in the same places. Note that the Rh, Cu, and Ni peaks are due to the instrument. Normalized to Rh Ka1 peak. Bruker Tracer III-V, 40 keV, 6.5 uA, 180 sec, Rh anode, no filter, no vacuum.

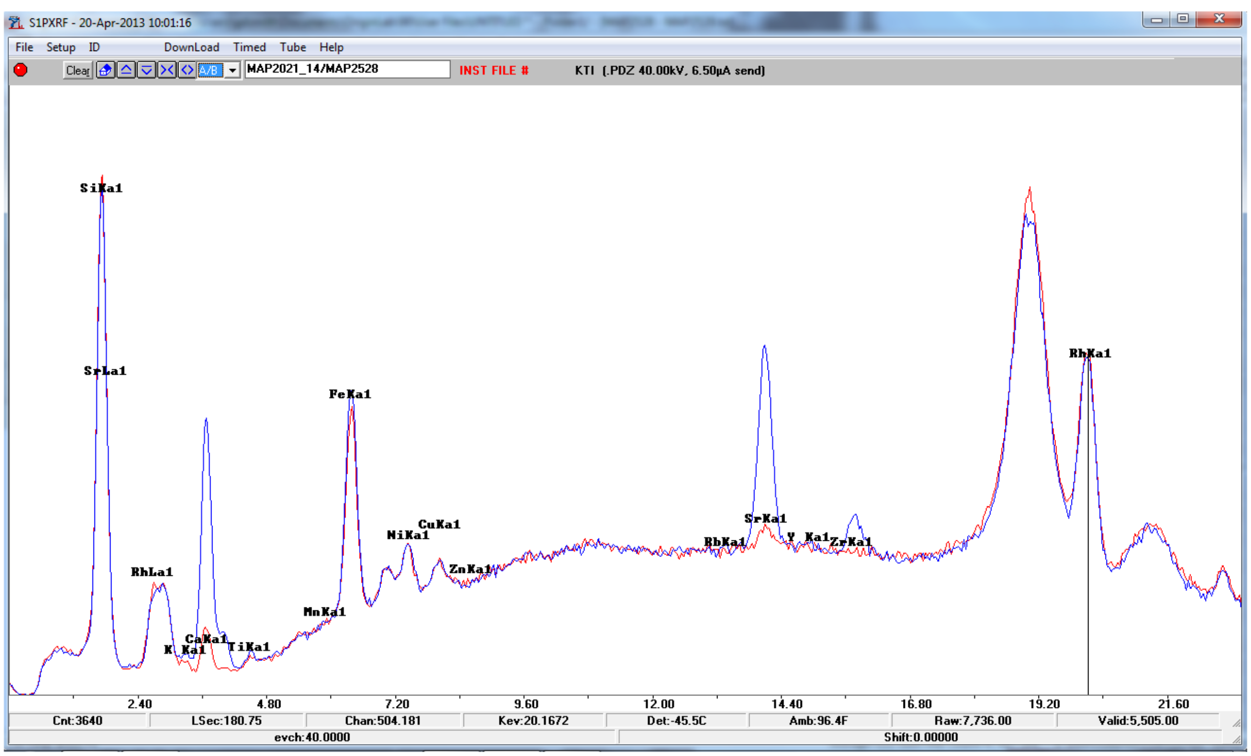


Figure 4.27. X-ray Fluorescence results comparing MAP 2021.14 and MAP 2528 showing peaks in different places. Note that the Rh, Cu, and Ni peaks are due to the instrument. Normalized to Rh Ka1 peak. Bruker Tracer III-V, 40 keV, 6.5 uA, 180 sec, Rh anode, no filter, no vacuum.

Figure 4.28. Left: Pinkish raw material sample with light speckling. Right: Heat treated artifact. Is it only the pinkish variety of chert that turns so red during heat treatment?

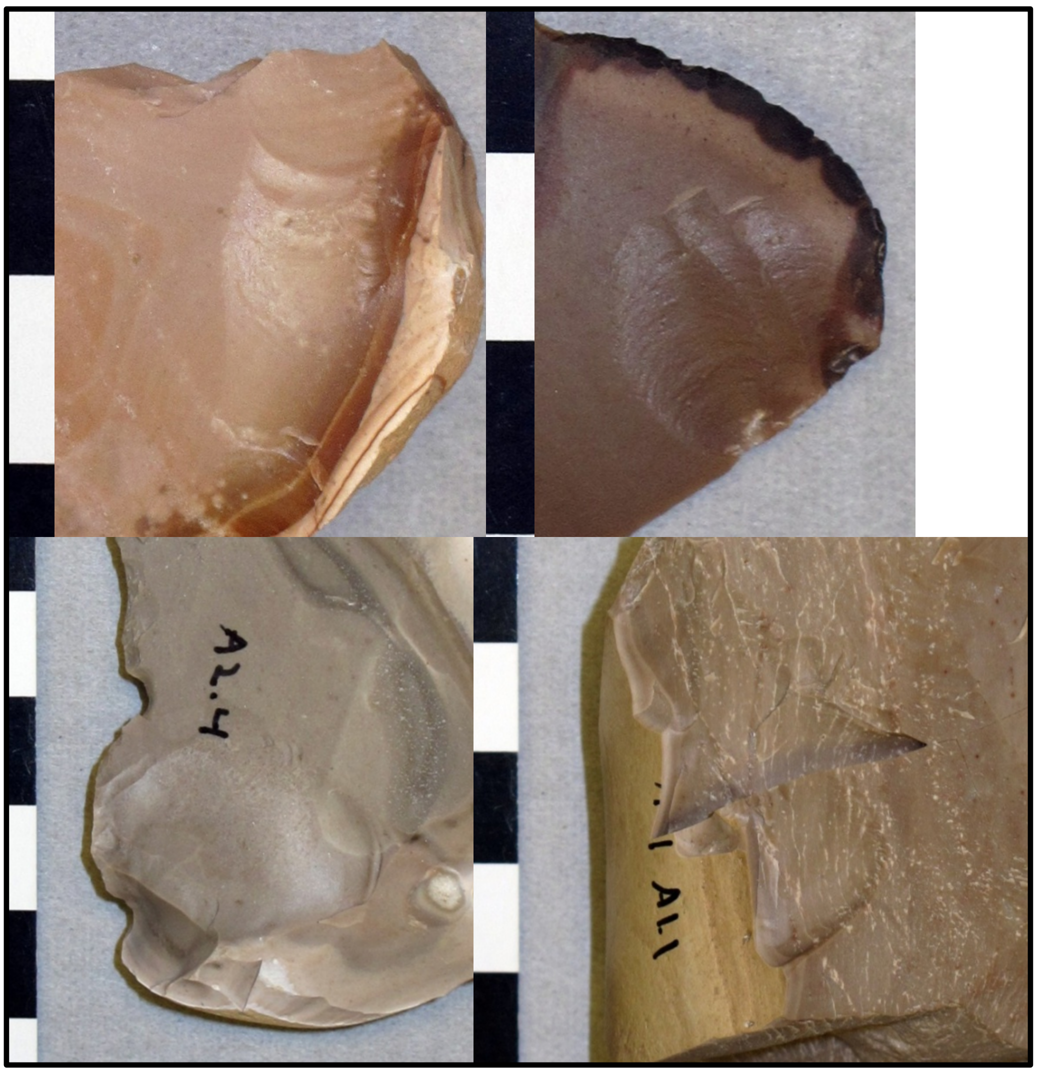


Figure 4.29. Heat treated pieces with glossy scars of flakes removed after heating. The surface exposed during heating is more matte than the fresher scar.

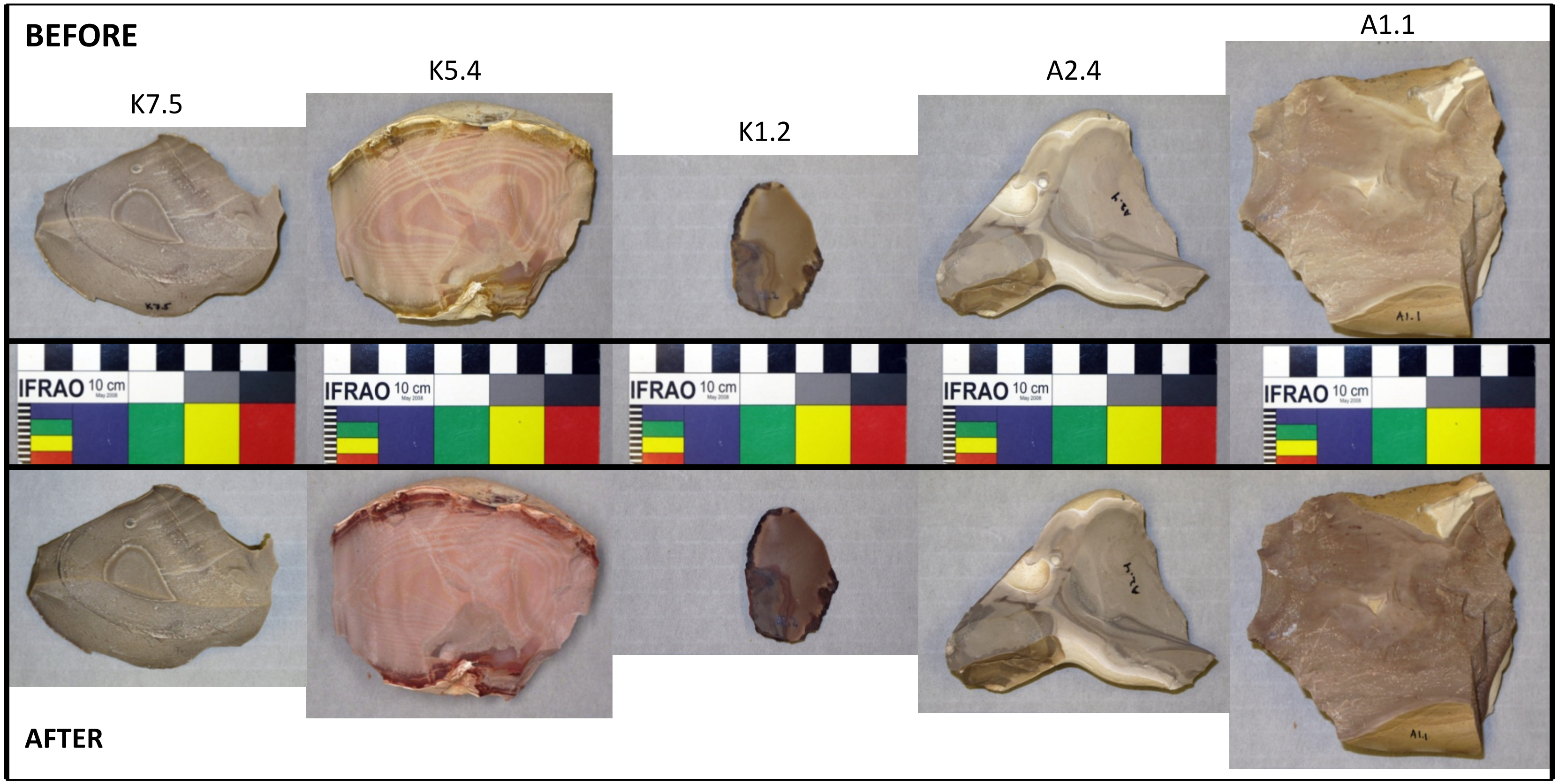


Figure 4.30. Examples of stones before and after heat-treatment.

Figure 4.31. Comparison of two pieces heated to the same temperature. Left: K3, 350°, burnt. Right: K7, 350˚, perfect.

Figure 4.32. Examples of differential luster of flake scars before and after heating. In the archaeological example, upper left, the flake was heated causing the exposed surface to become matte, then a flake was removed, leaving a glossier scar. The two flakes In the archaeological example refit. The outermost surface of the outermost flake (lower right) is matte, while the ventral surface of that flake (not shown), and the surface of the refitting flake (lower right,) is glossy. Note that with patinas you get the opposite effect- the *older* surfaces are glossy and the *fresher* scars reveal a more matte material underneath.

Figure 4.33. Raw material sample showing natural white speckling.

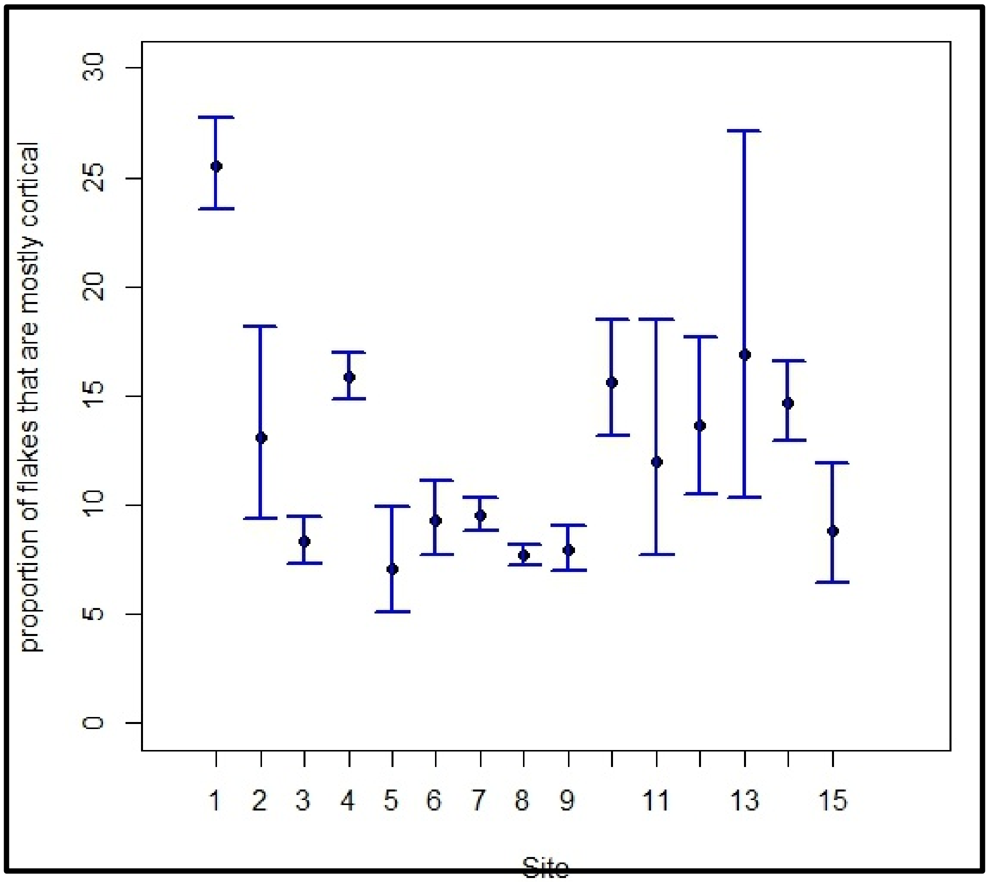


Figure 4.34. Comparison of the percentage of flakes with more than 50% cortex, showing the 95% confidence limits for the proportions. For site numbers see Table 4.19.

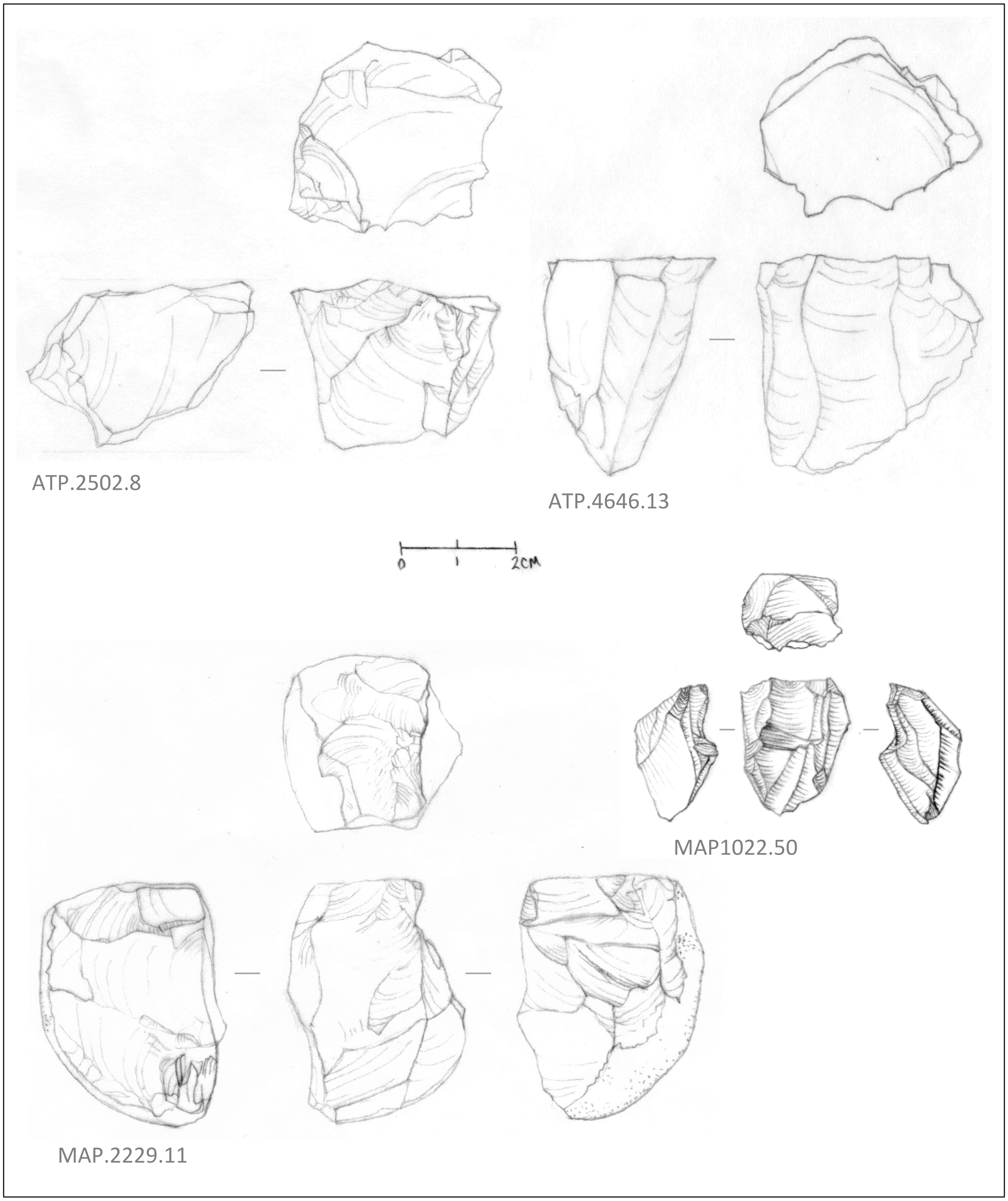


Figure 4.35. Cores. ATP.2502.8 Multi-platform flake core. LDH; ATP.4646.13. Single platform blade core. LDH; MAP.2229.11. Flake core with 90 degree rotated platforms. LDH; MAP1022.50. bladelet core.

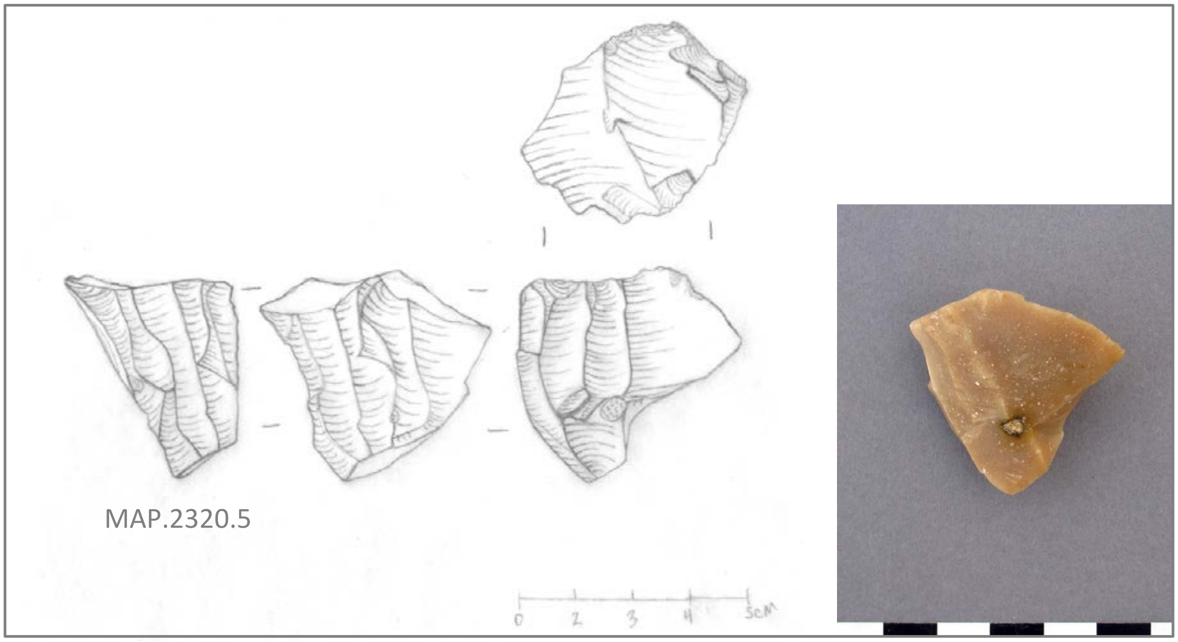


Figure 4.36. MAP.2320.5. Bladelet core. MC.

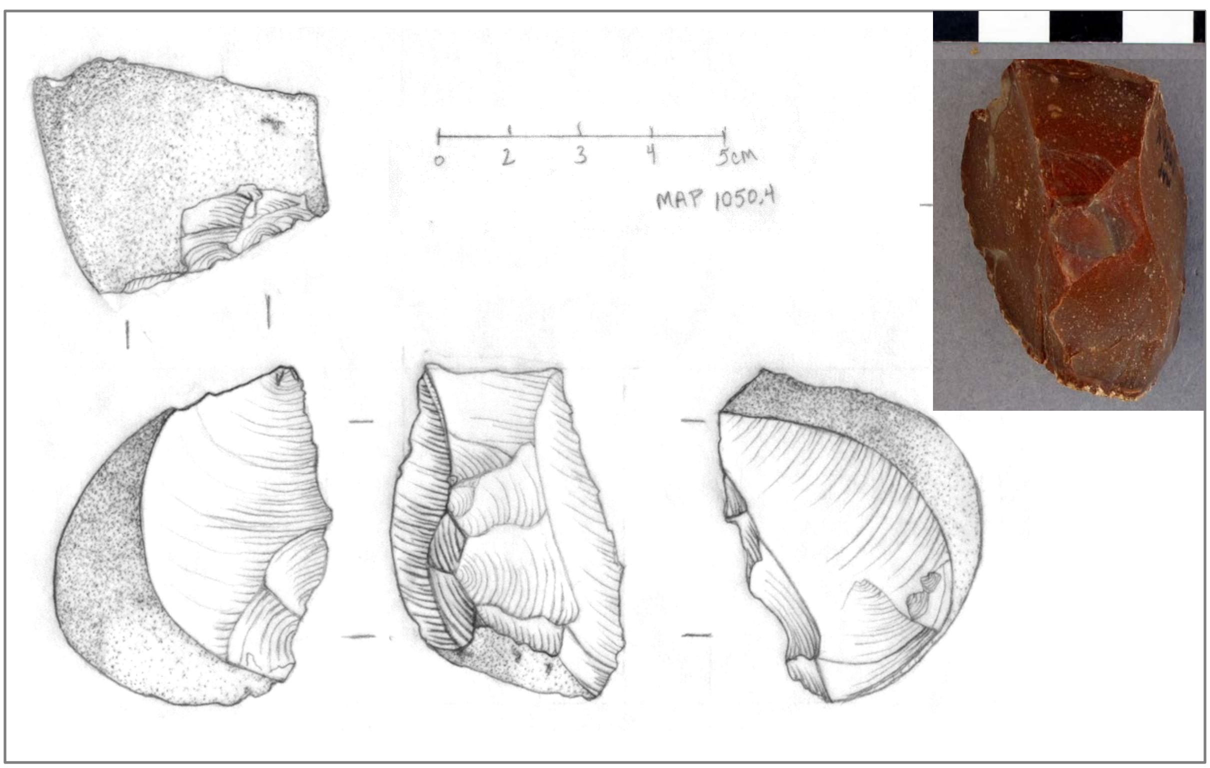


Figure 4.37. MAP.1050.4 Heat-treated core with a prepared crest, probably for bladelet production. MC.

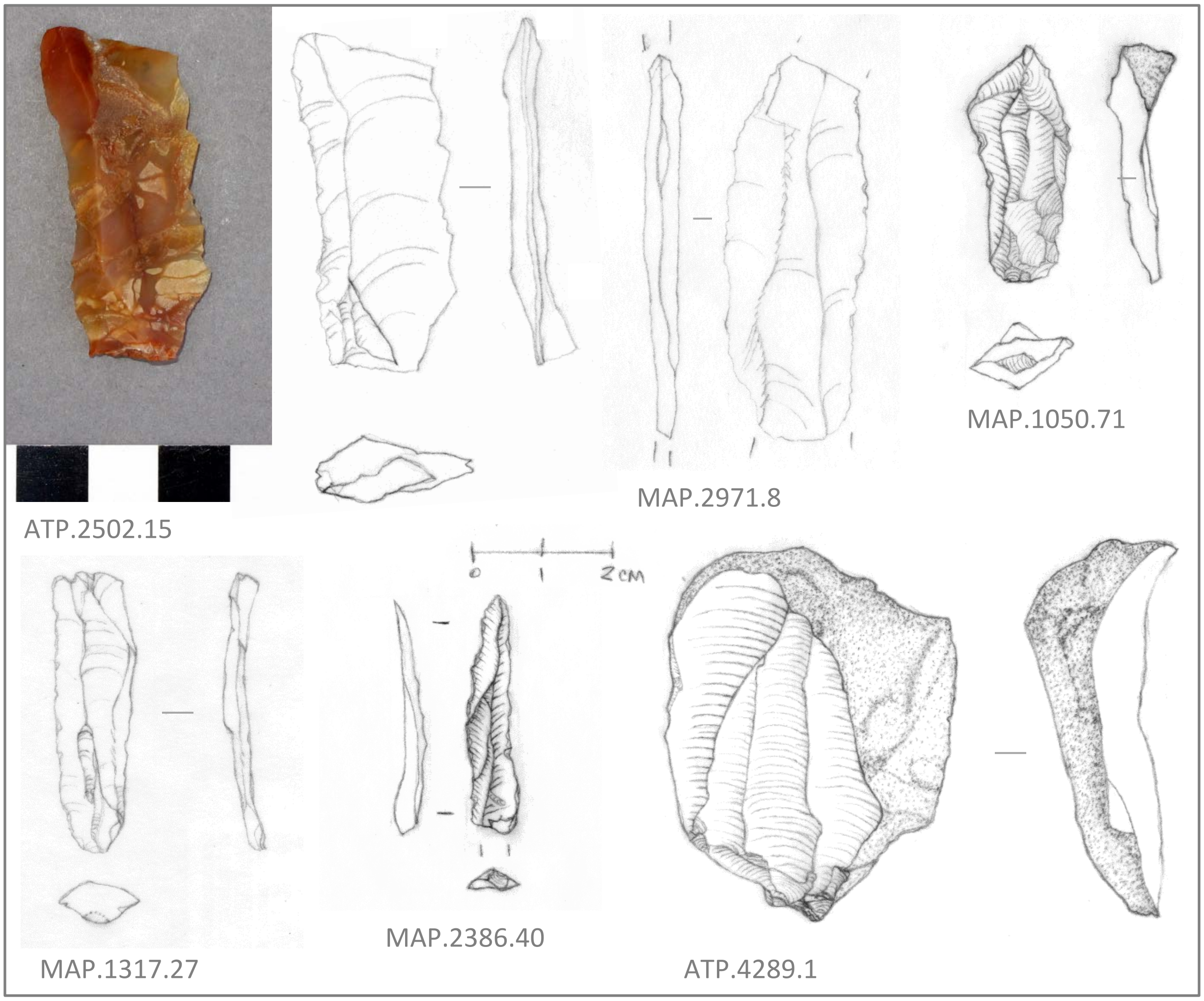


Figure 4.38. Blade debitage. ATP.2502.15. Agate Blade. LDH; MAP.2971.8. Medial blade fragment. LDH; MAP.1050.71. Secondary crested blade. MC; MAP.1317.27. Bladelet. LDH; MAP.2386.40. Bladelet. MC; ATP.4289.1. Flake from a blade core.

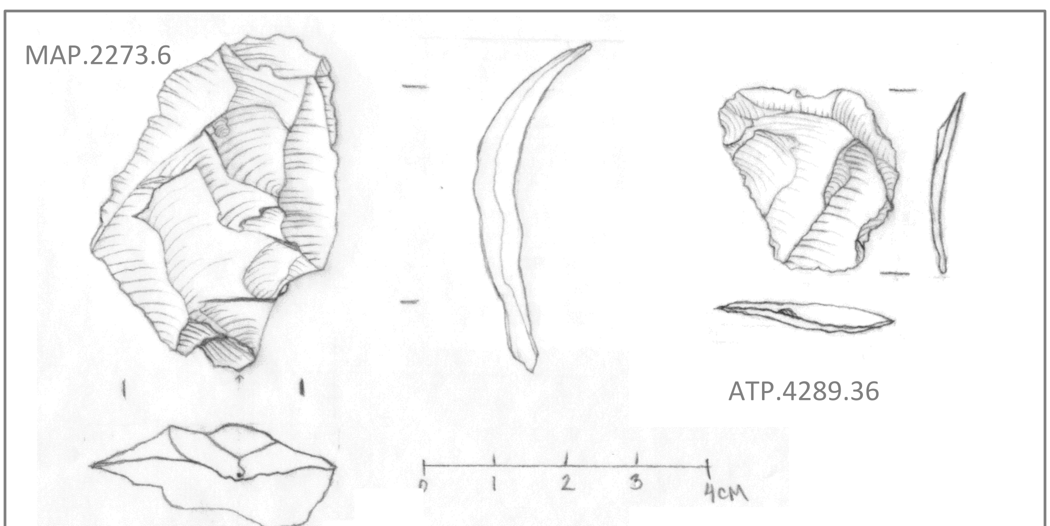


Figure 4.39. Characteristic debitage, thinning flakes. MAP.2273. 6.Thining flake with punctiform platform; ATP.4289.36. Thinning flake. With punctiform platform. MC.

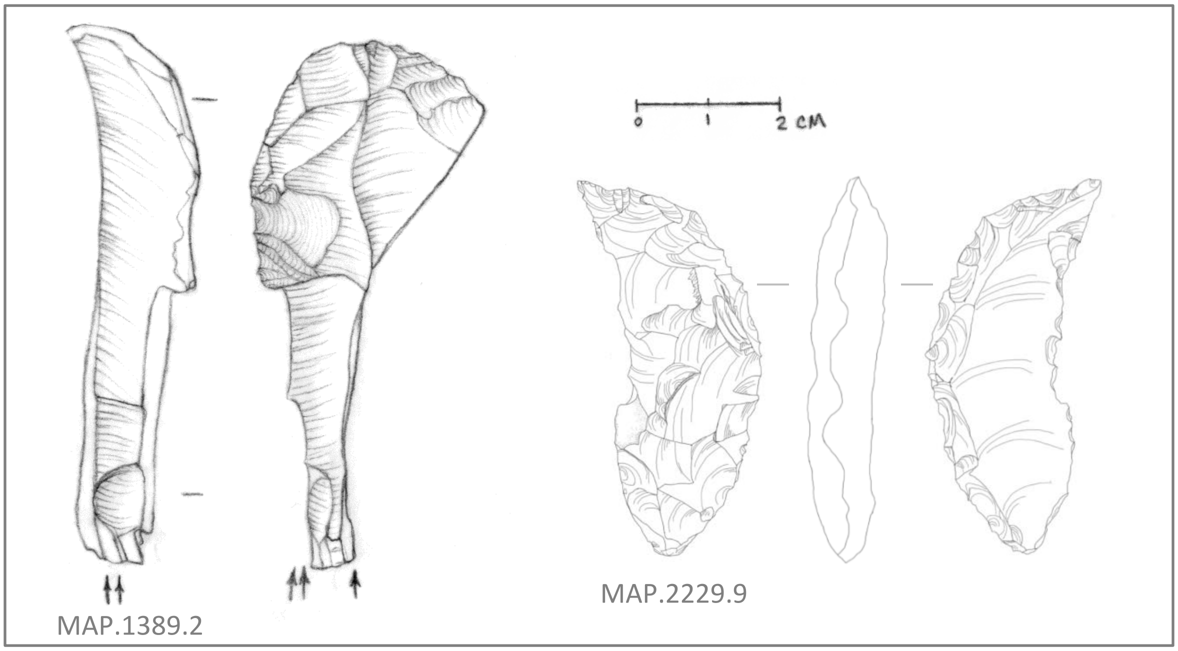


Figure 4.40. Characteristic debitage. MAP.1389.2. Plunging burin spall off of a scraper with previous burin spall scars. MC. MAP.2229.9. Axe preparation flake (tranchet). Digital drawing LDH.

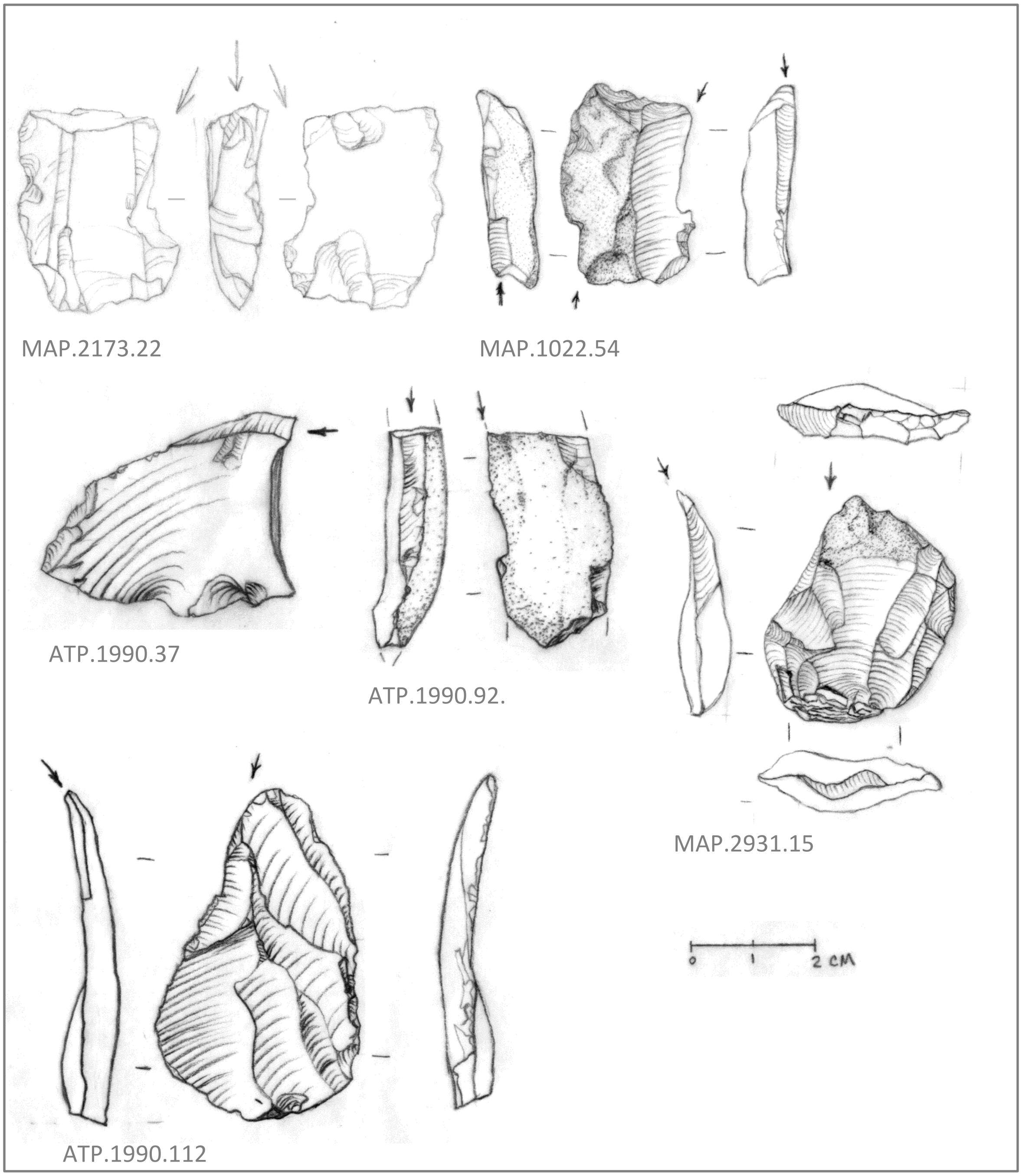


Figure 4.41. Burins. MAP.2173.22. Burin. LDH; MAP.1022.54. Multiple Burin on a truncation. MC; ATP.1990.37. Burin. MC; ATP.1990.92. Burin. MC; MAP.2931.15. Burin on a scraper. MC; ATP.1990.112. Burin. MC.

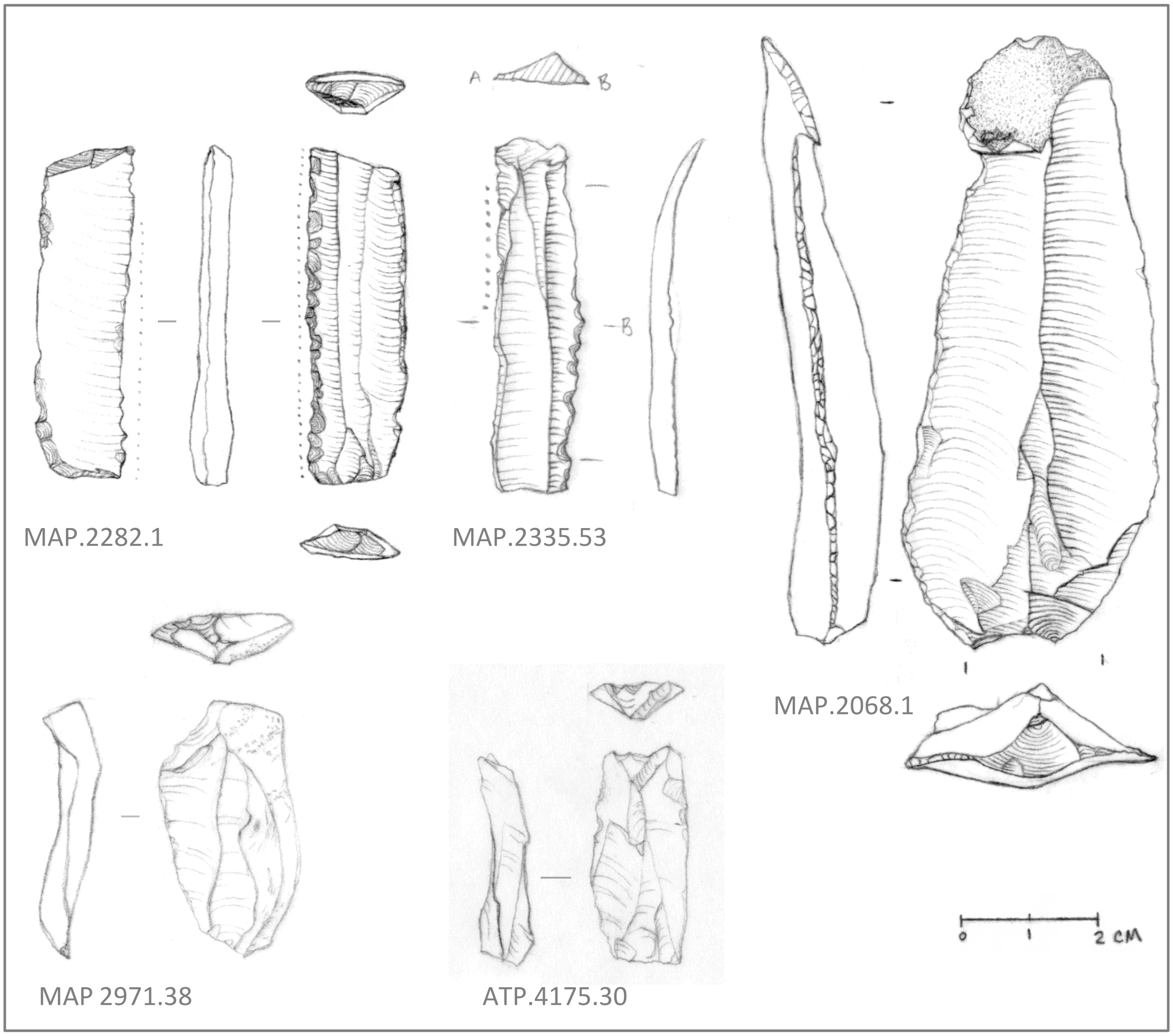


Figure 4.42. Unifacial blade tools. MAP.2282.1. Double-truncated Sickle blade. MC; MAP.2335.53. Sickle blade. MC; MAP.2068.1 Backed blade. MC; MAP 2971.38. Truncation. DH; ATP.4175.30. Truncation on a blade. LDH.

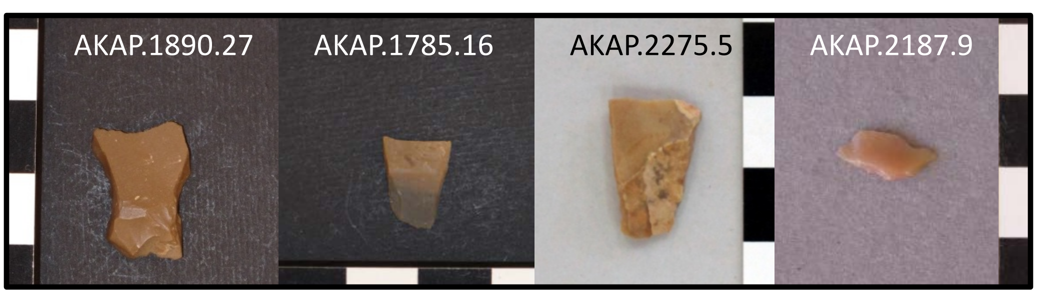


Figure 4.43. Unifacial tools: projectile points from Nag el-Qarmila. AKAP.189027, AKAP1785.16, AKAP2275.5, transverse arrowheads. AKAP.2187.9 Lunate.

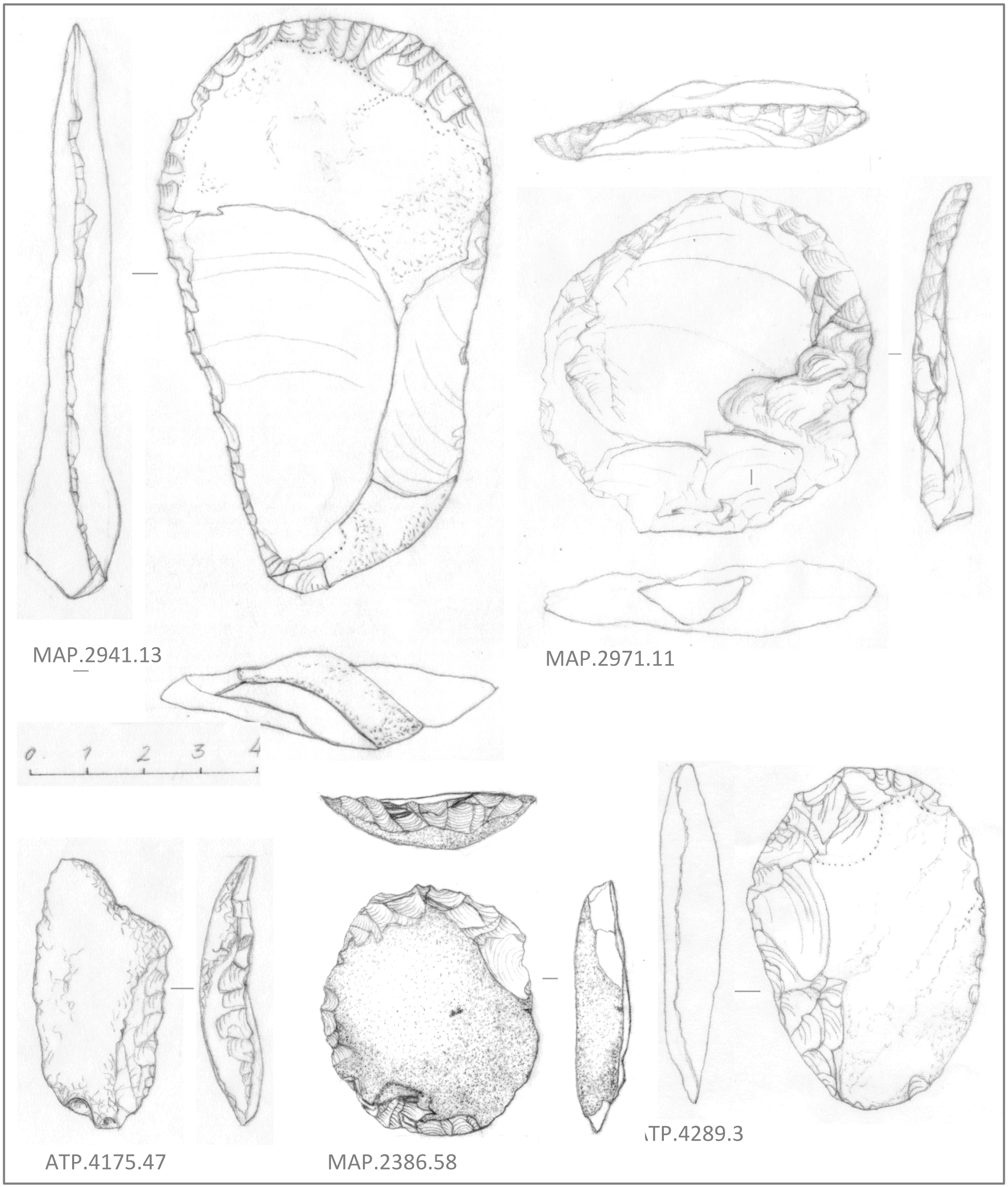


Figure 4.44. Unifacial tools: scrapers. MAP.2941.13. Endscraper. LDH; MAP.2971.11. Endscraper. LDH; ATP.4175.47. Side scraper. LDH; MAP.2386.58. Endscraper. MC; ATP.4289.3. Endscraper. LDH.

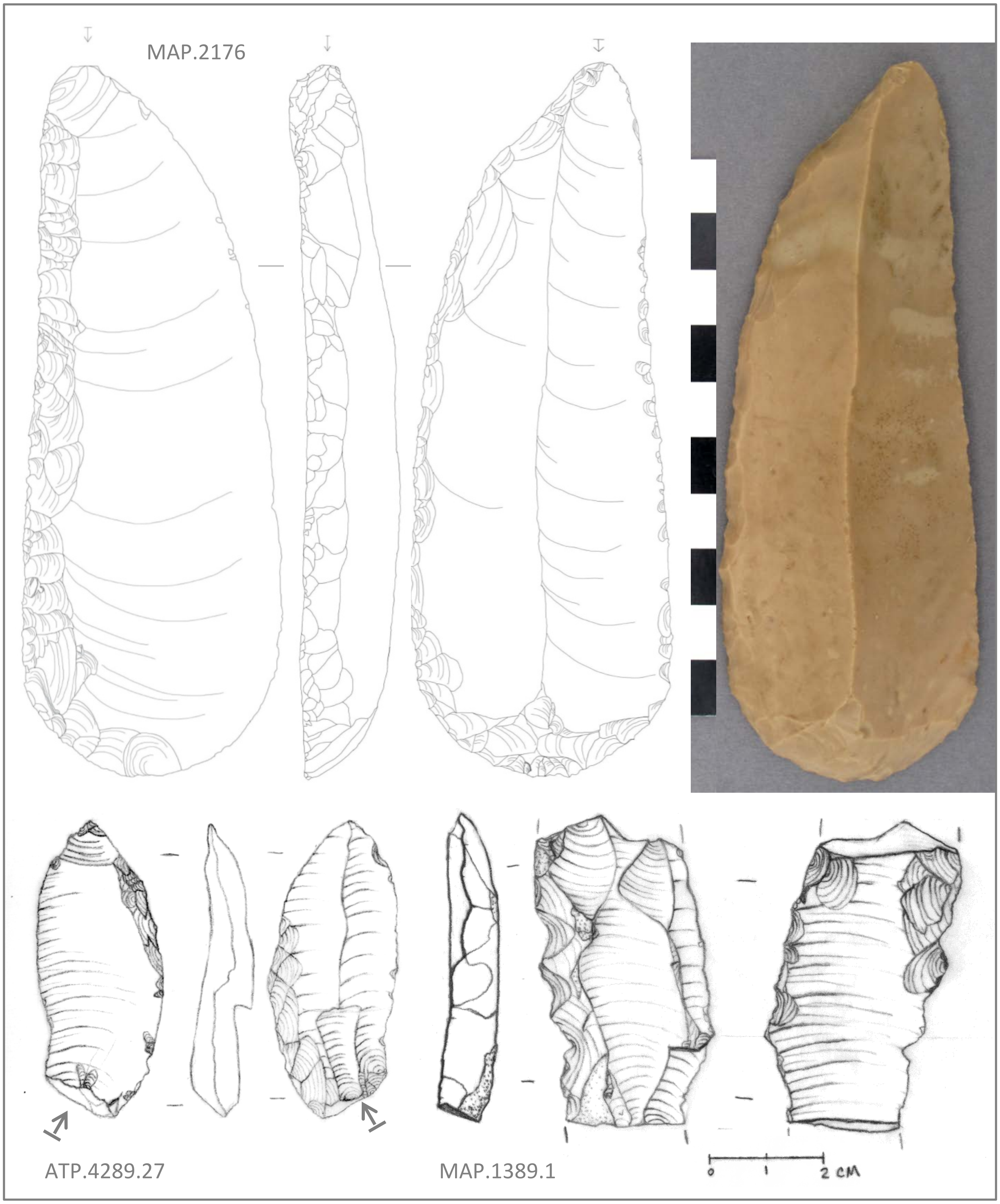


Figure 4.45. Edge retouched tools. MAP.2176. Endscraper knife; ATP.4289.27 knife on a blade-like flake; MAP.1389.1. Denticulated blade. MC.

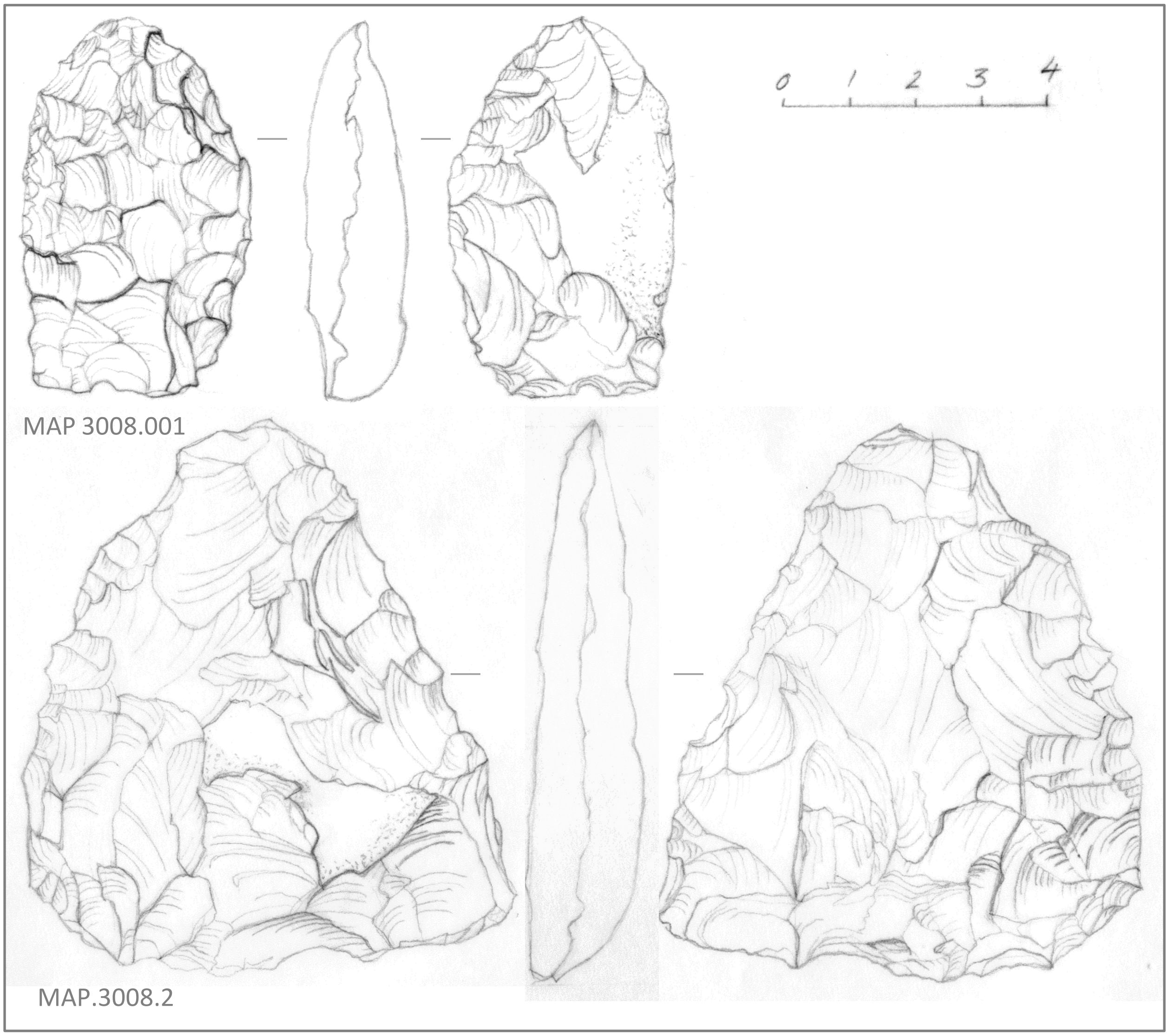


Figure 4.46. Bifacial tools. Preforms. MAP 3008.001. Preform. LDH; MAP.3008.2 Bifacial triangle. (Preform?)

Figure 4.47. Bifacial tools. Preforms. MAP 400. Probably preform for a concave base projectile point.

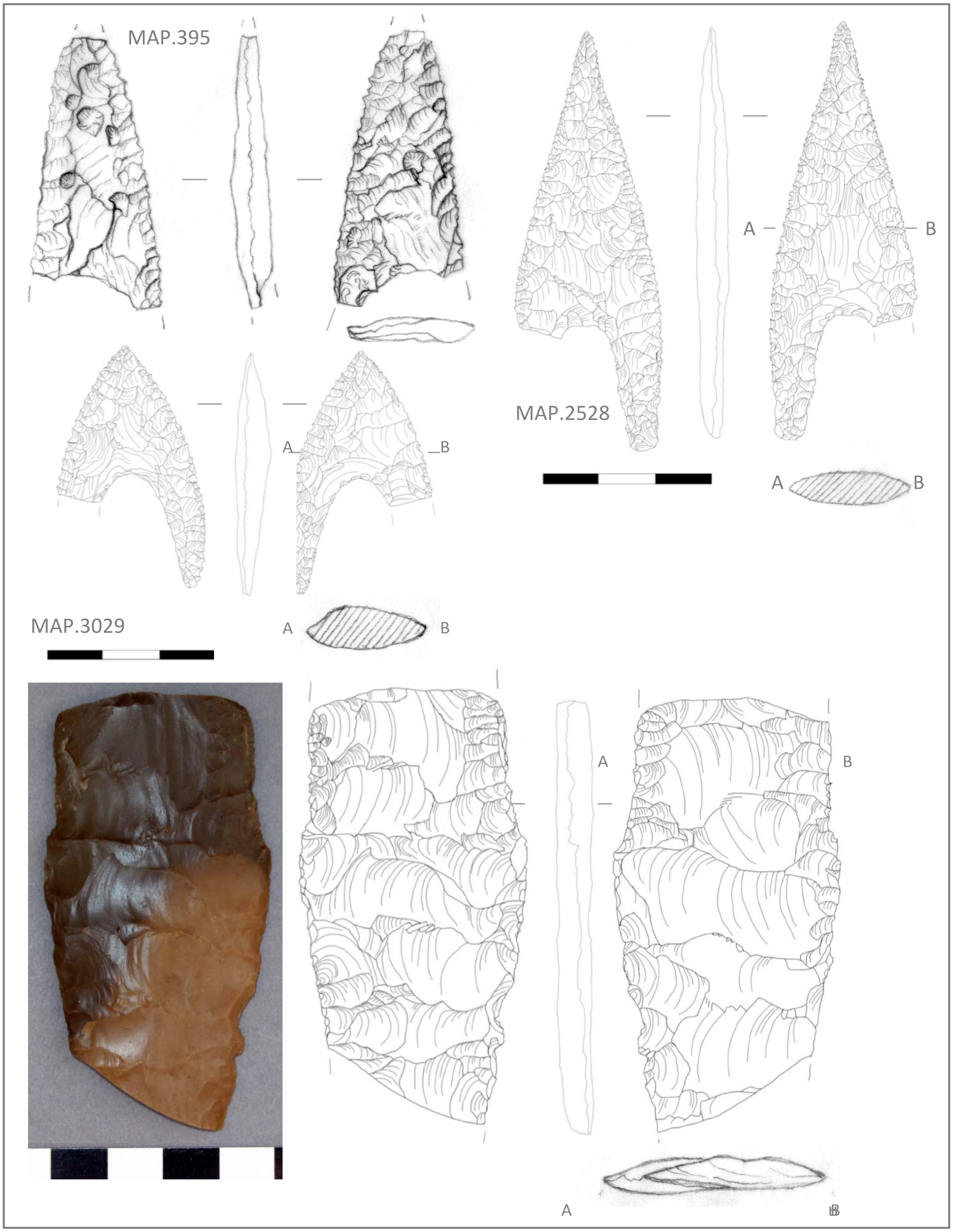


Figure 4.48. Bifacial tools. MAP.395. Burnt concave-base projectile point fragment. LDH; MAP.2528. Concave base projectile point. LDH. Photos Figures 4.25, 6.14, 7.4; MAP.3029. Concave base projectile point. LDH. Photos Figures 6.14, 7.4; MAP.301 Fishtail knife fragment. LDH.

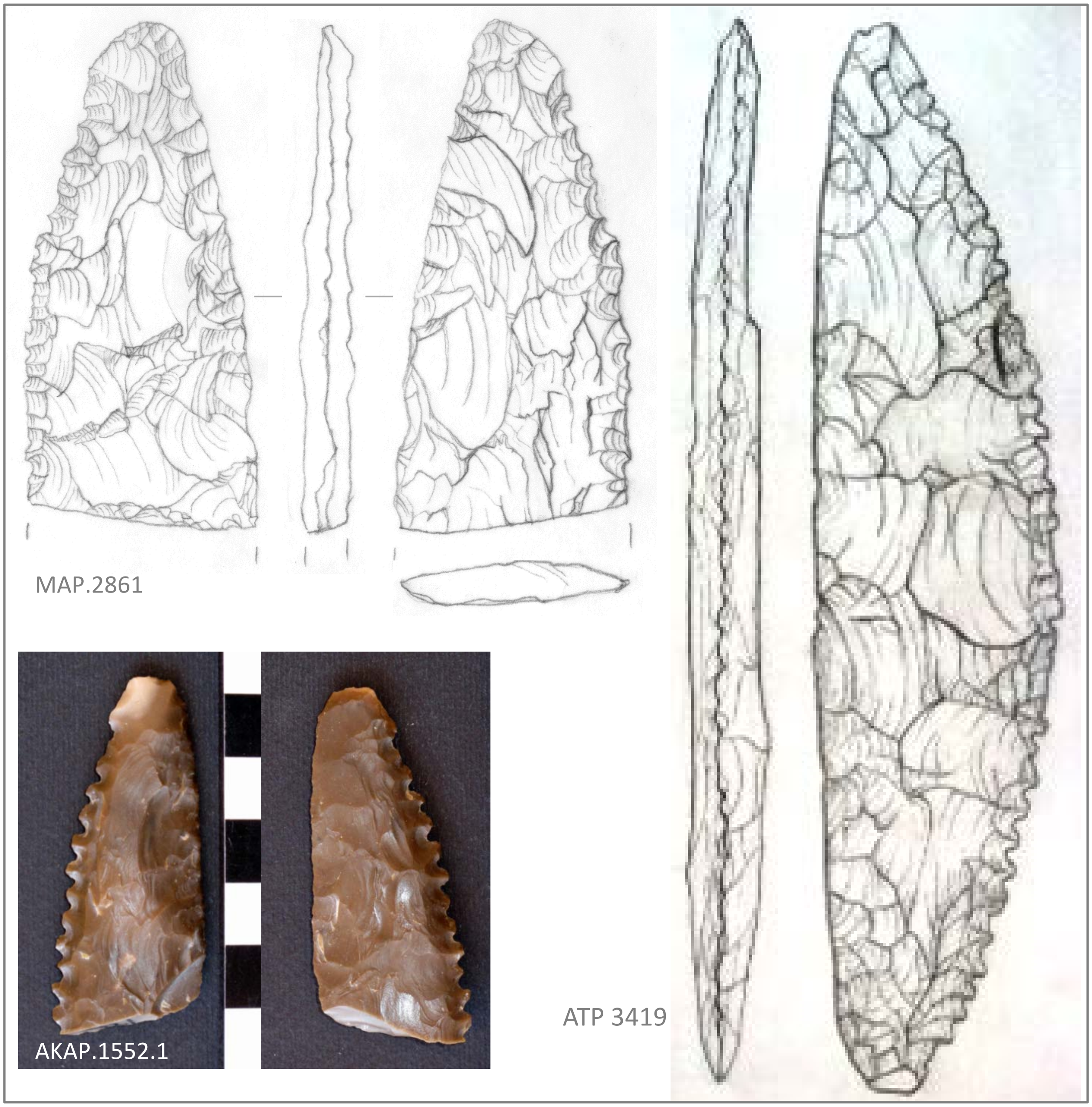


Figure 4.49. Bifacial sickles. MAP.2861. LDH. Photo Figure 7.5; AKAP.1552.1; ATP.3419. Drawing by Matthew Loeser. Photo Figure 7.5.

Figure 4.50. Bifacial knife fragments, above, right.

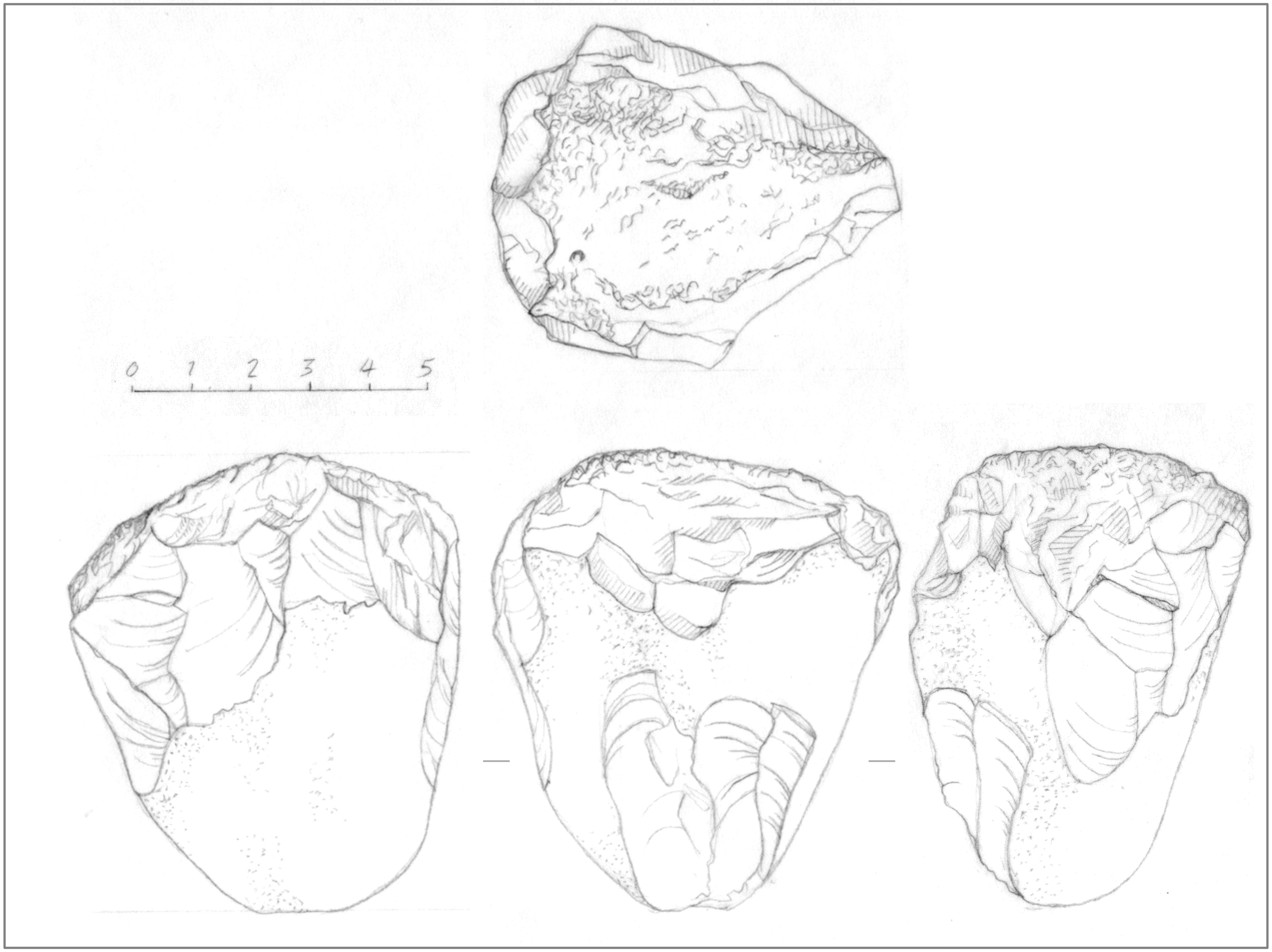


Figure 4.51. Pounder/pestle. MAP.2173.1. LDH.

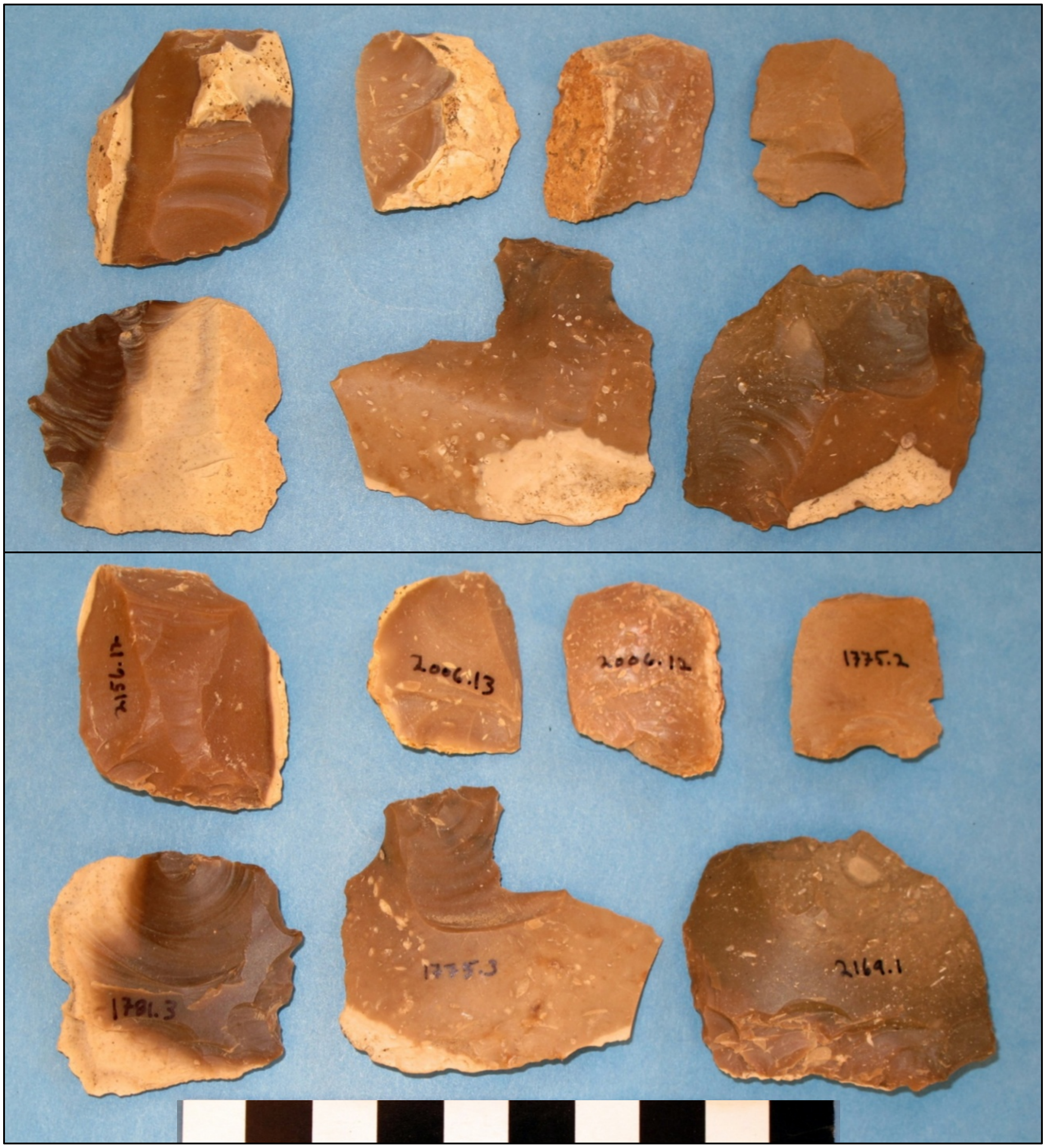


Figure 4.52. *Piece Esquilles* from Nag el-Qarmila (AKAP).Dorsal and ventral views.

Chapter 5 Figures

Figure 5.1. Examples of bladelets (el-Mahâsna MAP 1030).

Figure 5.2. Examples of medium blades (el-Mahâsna).

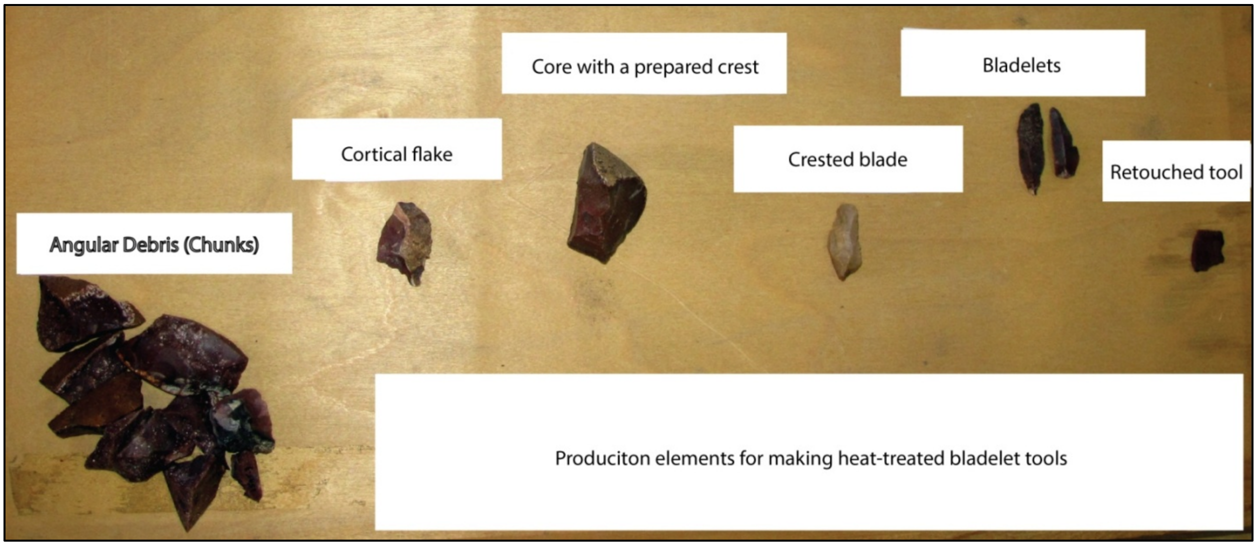


Figure 5.3. A full sequence of production remains from making heat-treated bladelet tools. From el-Mahasna.

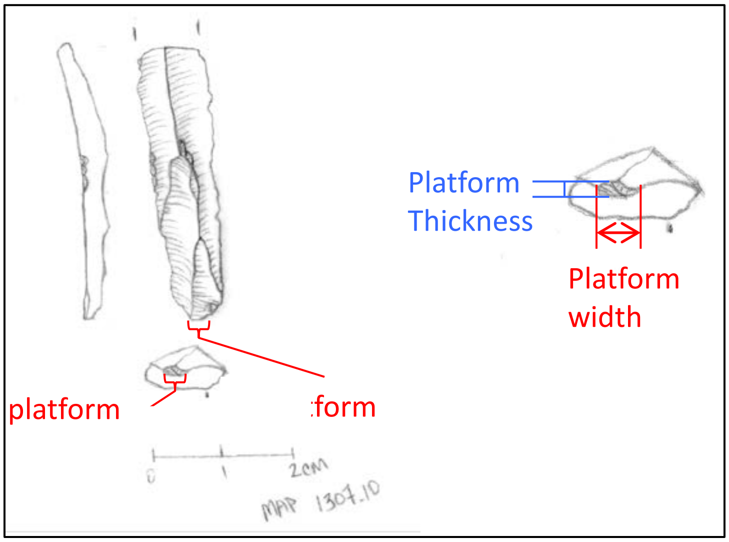


Figure 5.4. Left: Location of the platform (shown on MAP 1307.10). Right: Platform width and thickness measurements, following Debenath & Dibble (1994:17) (not to scale).

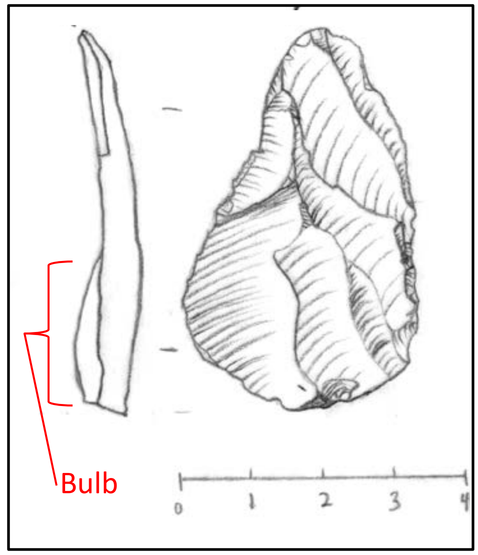


Figure 5.5. Bulb of percussion on a retouched flake (ATP 1990.112).

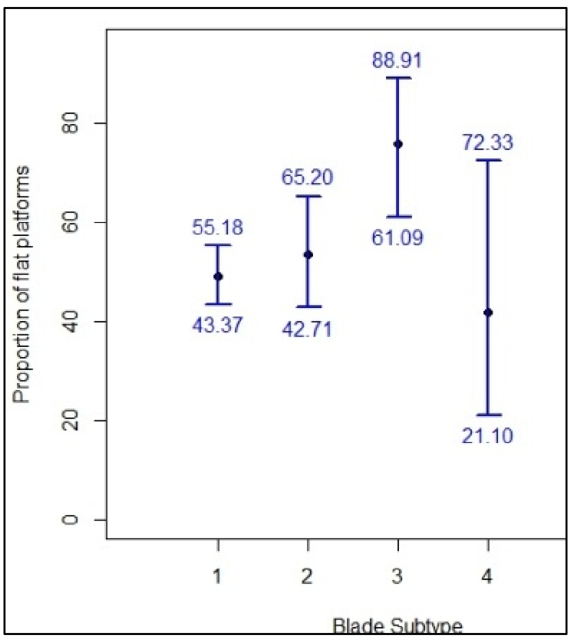


Figure 5.6. Frequency of flat platforms of four blade subtypes, and their 95% binomial confidence intervals. 1=medium blades, 2=bladelets, 3=twisted medium blades, 4=twisted bladelets.

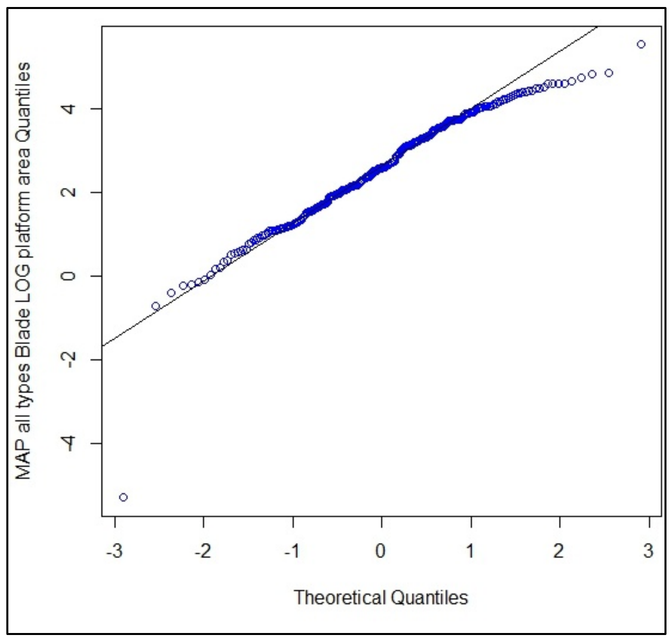


Figure 5.7. QQ plot of the log transformed platform areas showing that the data are normally distributed.

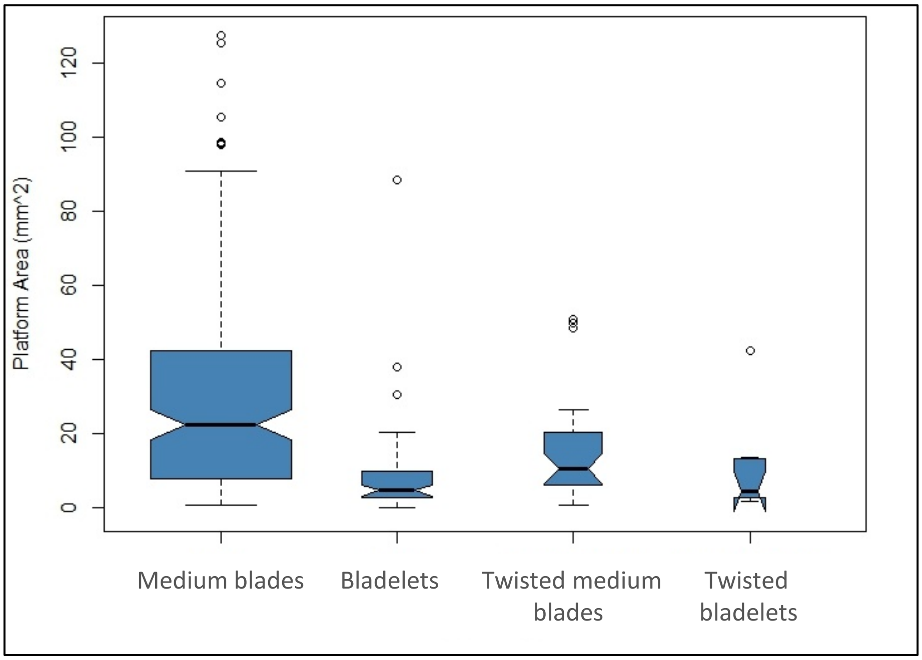


Figure 5.8. Box plot of the platform areas of blade types. One outlier from el-Mahâsna with a platform area of ~250 is not shown.

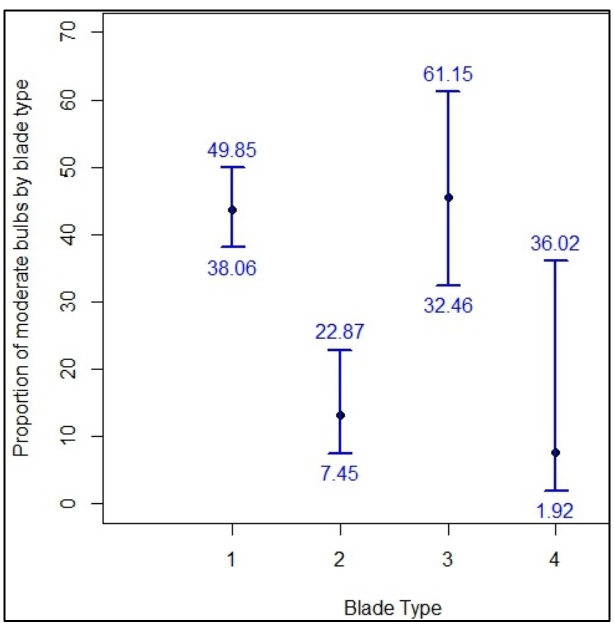


Figure 5.9. Percentages and 95% binomial confidence intervals for moderate bulbs by blade types. 1:Medium blades, 2:Bladelets, 3:Twisted medium blades, 4:Twisted bladelets. The confidence intervals show two separate groups: medium blades and twisted medium blades vs. bladelets and twisted bladelets.

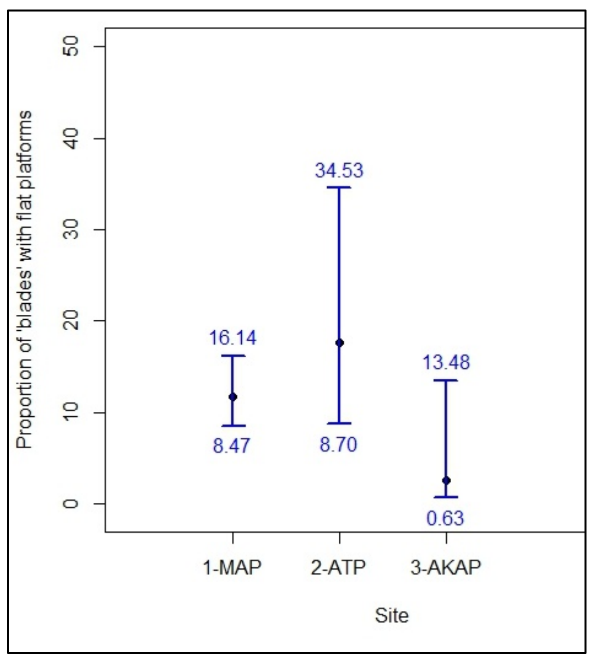


Figure 5.10. The 95% binomial confidence intervals for the frequencies of medium blades with cortical platforms at each of the three sites.

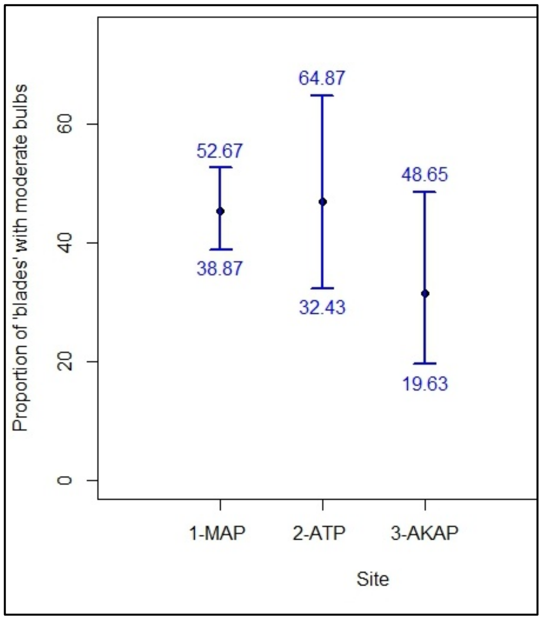


Figure 5.11. The 95% binomial confidence intervals for the frequencies of medium blades with moderate bulbs at each of the three sites.

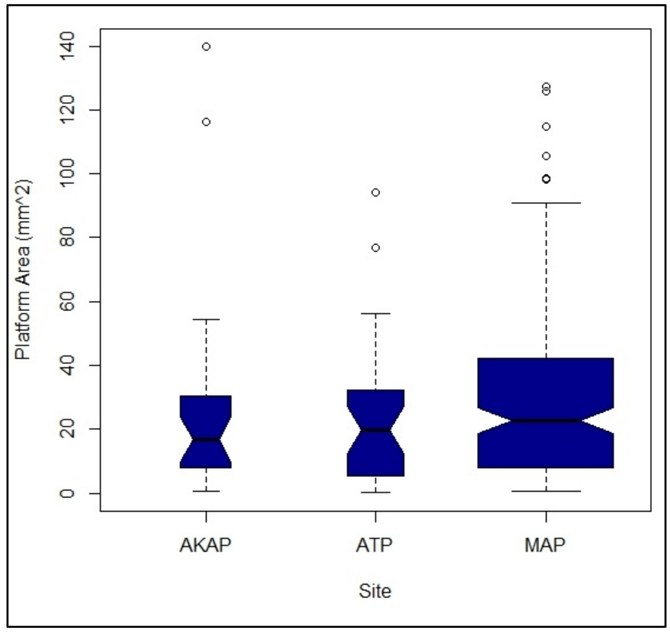


Figure 5.12. Box plot of the platform areas of medium blades from three sites. Mean platform areas are as follows: AKAP- 25.67 (N= 27); ATP- 24.36 (N=31); MAP- 30.17 (N=188).

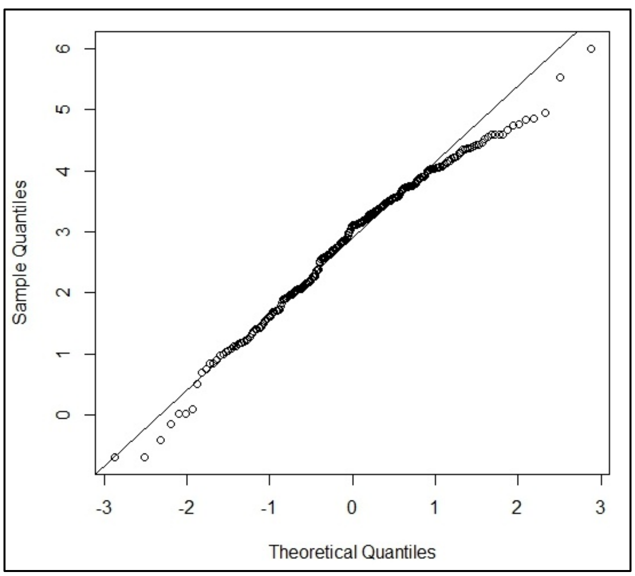


Figure 5.13. A qq plot of the Log transformed platform areas of medium blades from all three sites showing that the data are normally distributed. A Bartlett's test of the homogeneity of the log transformed variances returned a p-value of 0.1869, so the null hypothesis that the variances are equal should not be rejected.

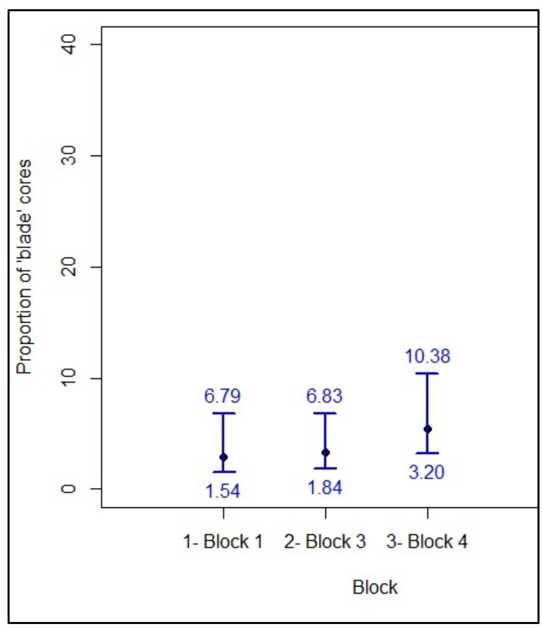


Figure 5.14. The 85% binomial confidence intervals for the proportions of medium blade cores among all medium blade debitage and tools at el-Mahasna. Note that the 85% confidence intervals are shown rather than the 95% intervals to demonstrate that even at a smaller confidence interval there is still significant overlap.

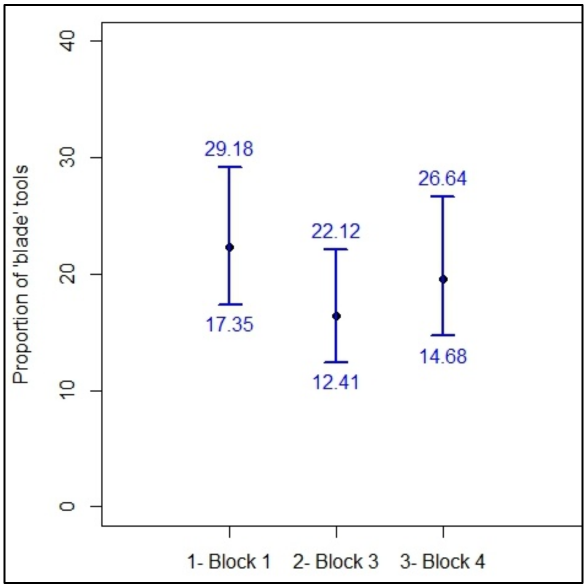


Figure 5.15. The 85% binomial confidence intervals for the proportions of medium blade tools among all medium blade debitage and tools at el-Mahasna. Note that the 85% confidence intervals are shown rather than the 95% intervals to demonstrate that even at a smaller confidence interval there is still significant overlap.

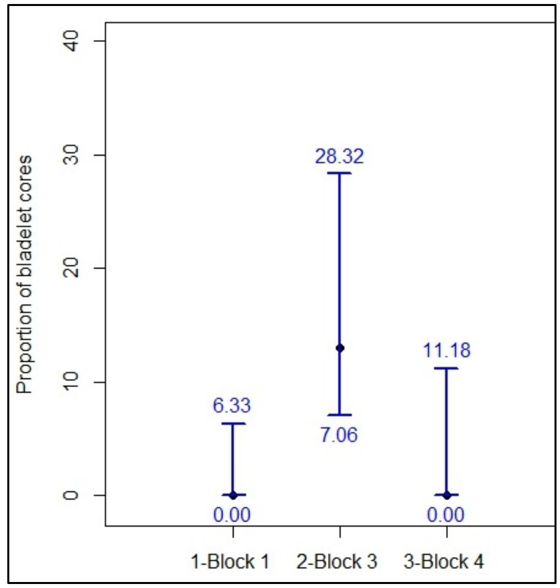


Figure 5.16. The 85% binomial confidence intervals for the proportions of non-heat-treated bladelet cores among all non-heat-treated-bladelet debitage and tools at el-Mahasna. Note that the 85% confidence intervals are shown since the sample size is so small. It is not until the 80% confidence level that the proportion of cores from Block 3 can be differentiated from the rest.

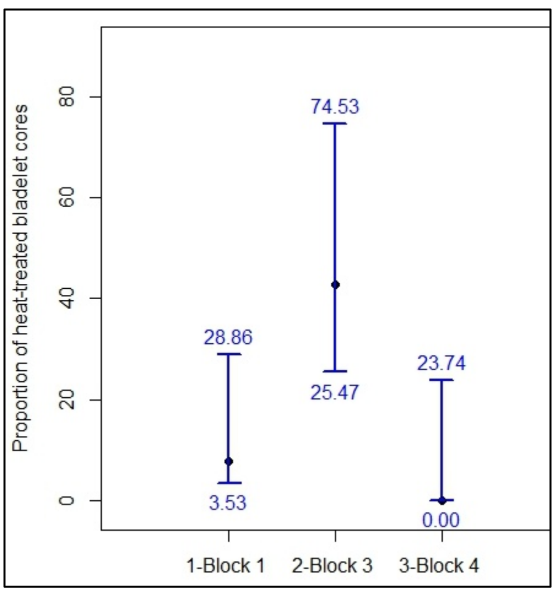


Figure 5.17. The 85% binomial confidence intervals for the proportions of heat-treated bladelet cores among all heat-treated-bladelet debitage and tools at el-Mahasna. Note that the 85% confidence intervals are shown rather than the 95% intervals because the sample size is so small. It is not until the 80% confidence level that the proportion of cores from Block 3 can be differentiated from the rest.

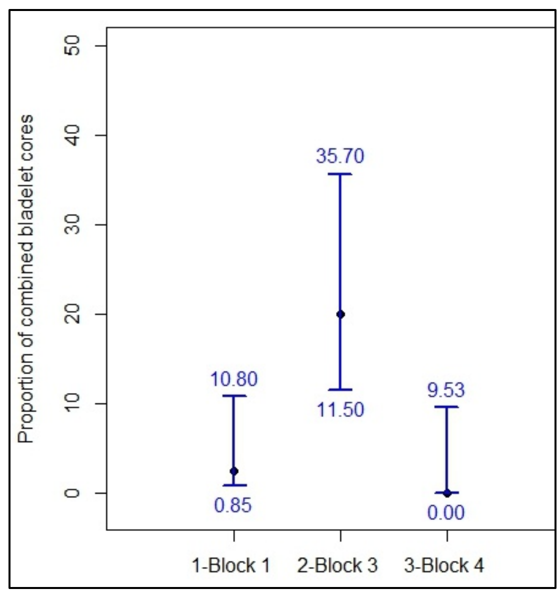


Figure 5.18. The 90% binomial confidence intervals for the proportions of heat-treated and non-heat-treated bladelet cores combined among all the heat-treated and non-heat-treated bladelet debitage and tools at el-Mahasna.

Chapter 6 Figures

Figure 6.1. Ripple Flaked knife. Image Credit: Pete Bostrum . http://lithiccastinglab.com/gallery-pages/2012septemberpredynasticknivespage1.htm

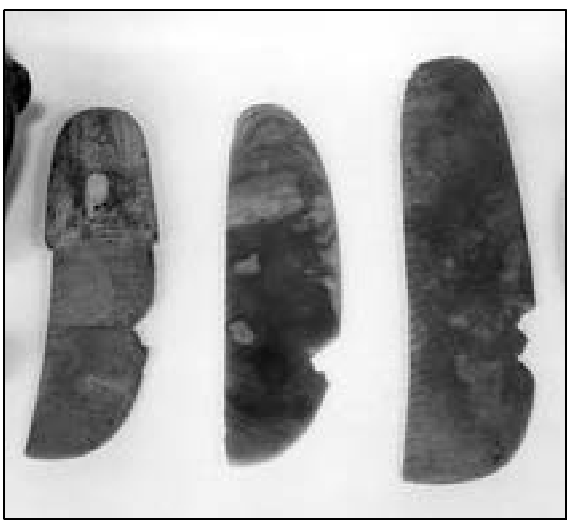


Figure 6.2. Three ripple-flaked knives from Abu Zaidan, broken in the same way. Image credit: Brooklyn Museum, Charles Edwin Wilbour Fund, 09.889.118. CC-BY 3.0.

Figure 6.3. Ripple-flaked knife with decorated ivory handle from Gebel Arak . Image credit: User:Rama/ Wikimedia/ CC-BY-SA- 2.0 FR

Figure 6.4. Ripple-flaked knife and handle from Abu Zaidan. Image credit: Brooklyn Museum, Charles Edwin Wilbour Fund, 09.889.118. CC-BY 3.0.

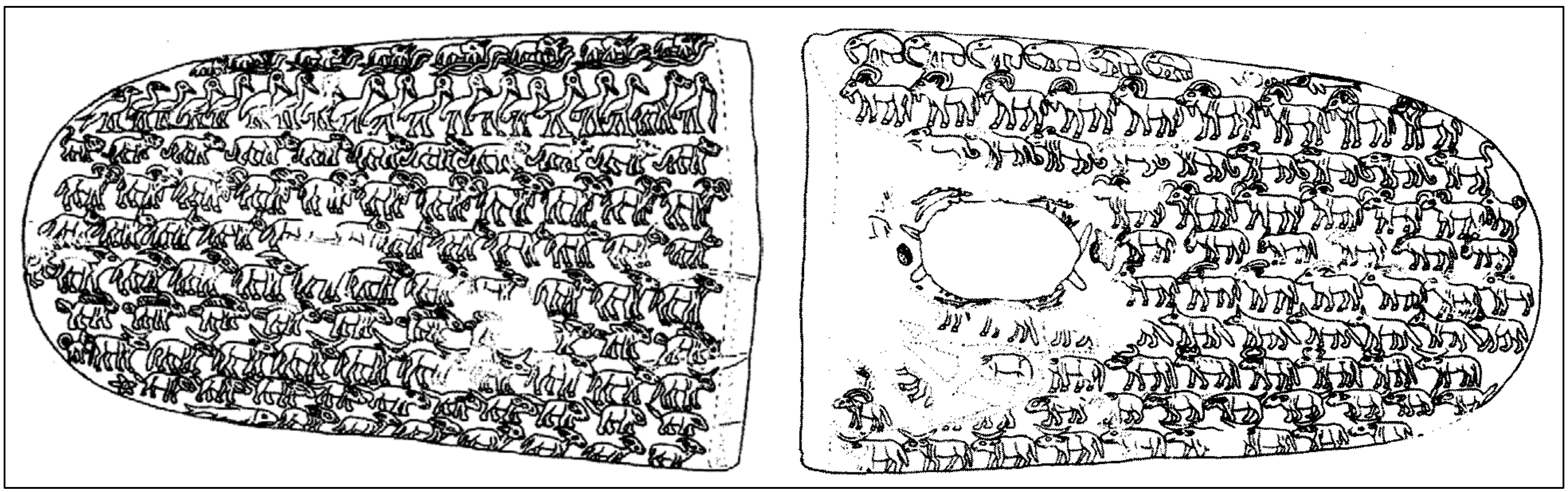


Figure 6.5. Drawing of the Abu Zaidan knife handle. Image credit: Brooklyn Museum, Charles Edwin Wilbour Fund, 09.889.118. CC-BY 3.0.

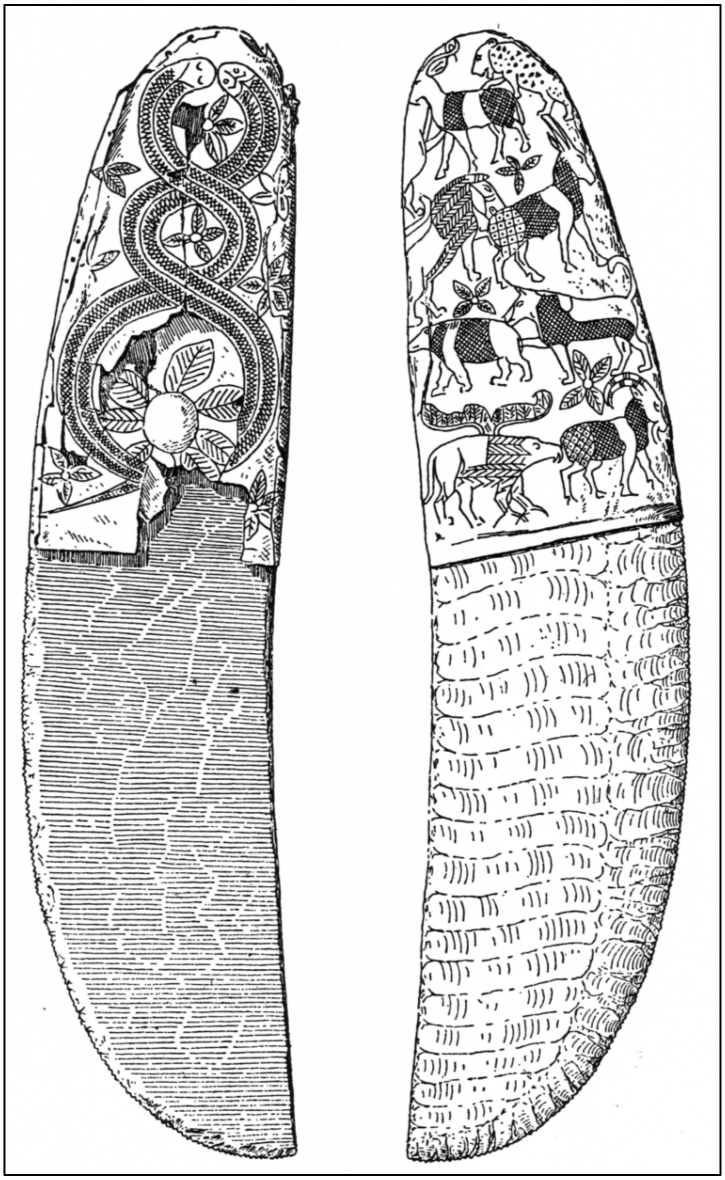


Figure 6. 6. Drawing of the Gebel Tarif ripple-flaked knife with gold embossed handle from Quibell (1905). Note that the knife face in the handle has been flipped since the drawing was made .

Figure 6.7. Dagger/lance with Ripple flaking that is not a ripple-flaked knife. Image credit: University of Pennsylvania Museum E.1114.

Figure 6.8. Rhomboid tool. BM.EA.49723. Image credit: © Trustees of the British Museum. CC BY-NC-SA 4.0.

Figure 6.9. Detail of a fishtail knife showing microserrations and notches. Abydos cemetery U, tomb 178. Image taken with permission of the German Archaeological Mission to Abydos.

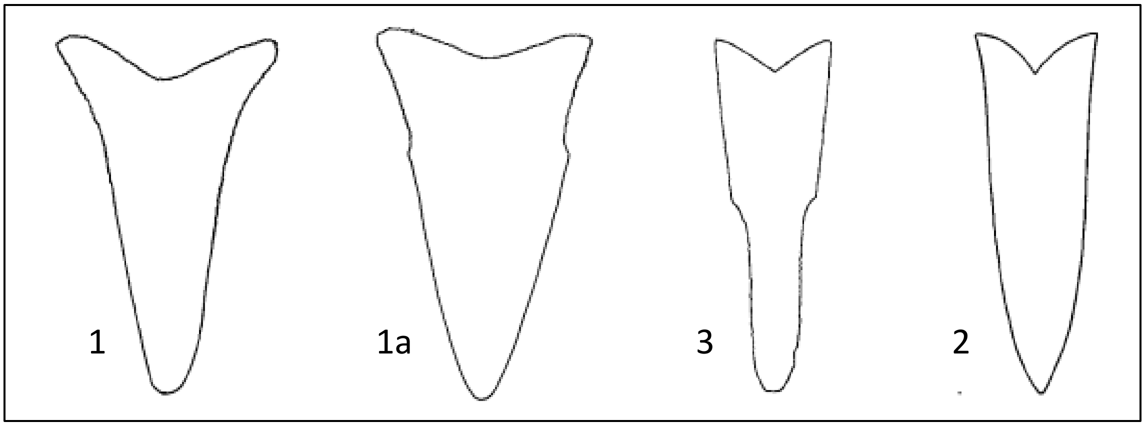


Figure 6.10. Fishtail shapes (from Massoulard 1936; van Walsem1978:237-242). The shape of the fishtails varied over time. See Ch 7.1.

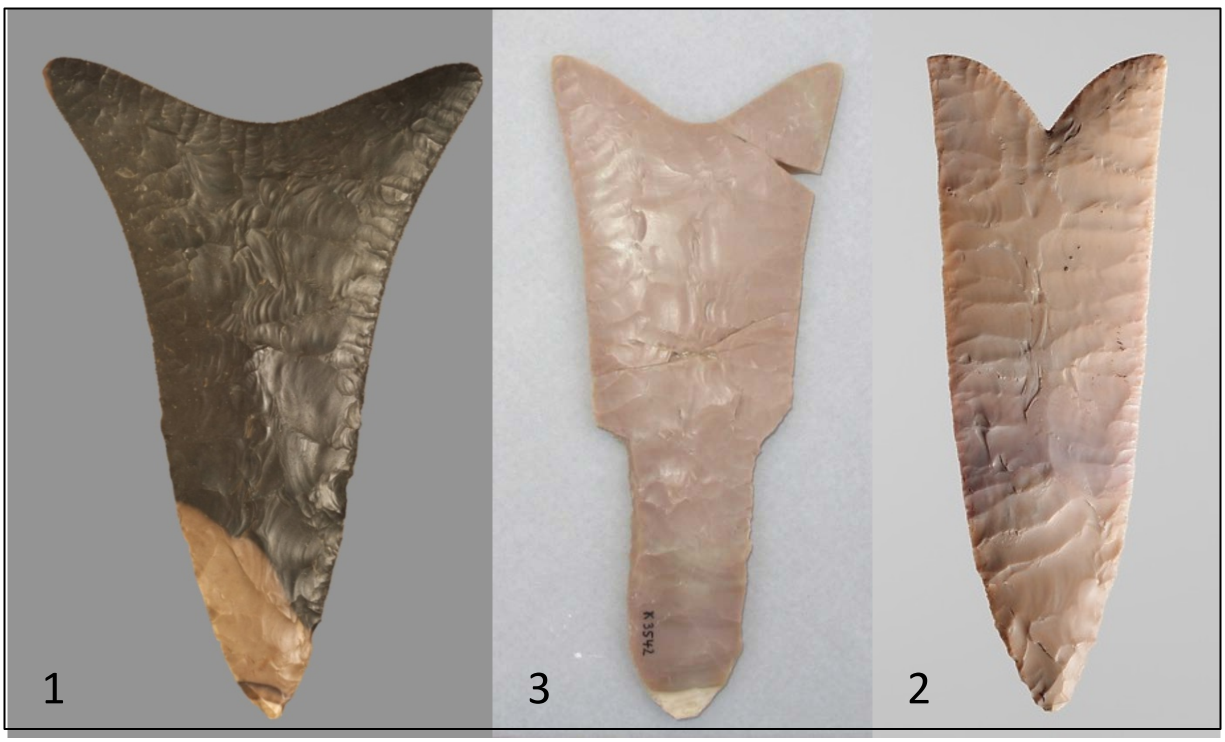


Figure 6.11. Three stylistic shapes of fishtails (Massoulard 1936; van Walsem 1978). Images not to scale. Image 1 credit: Egypt, Predynastic Period, Naqada Ia-IIa periods. Dark brown- to dark green-colored flint; overall: 10.00 cm (3 7/8 inches). The Cleveland Museum of Art, Gift of the John Huntington Art and Polytechnic Trust 1914.673 Image 3 credit: Abydos U tomb 395. Image taken with permission of the German Archaeological Mission to Abydos. Image 2 credit: MMA.16.2.4 The Metropolitan Museum of Art, Rogers Fund, 1916. www.metmuseum.org.

Figure 6.12. A *Psš-kf* set for use in the opening of the mouth reanimation ceremony. Image credit: The Metropolitan Museum of Art, Rogers Fund 1907. www.metmuseum.org

Figure 6.13. Model fishtails with hafts. Image credits: The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0.

Figure 6.14. Concave-base projectile points from el-Mahasna and the Abydos Middle Cemetery.

Figure 6.15. Crocodile eccentric BM.EA.37269. Image credit: © Trustees of the British Museum. CC BY-NC-SA 4.0

Figure 6.16. Crocodile(?) eccentric UC.42705a Image credit: The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0.

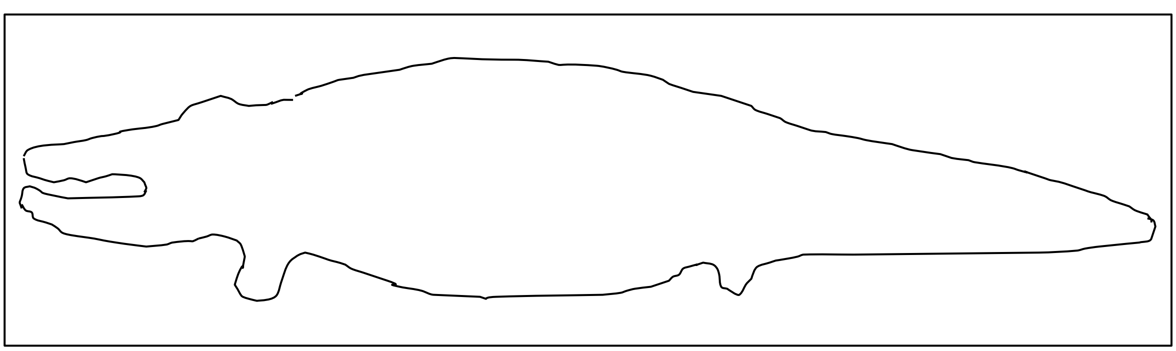


Figure 6.17. Approximate outline of the crocodile eccentric in Cahn 2005 (no.4), drawn from photo. Not intended to be a technical drawing, only to convey the basic shape.

Figure 6.18. Figural eccentric showing a human, possibly a dwarf. Image courtesy of the Hierakonpolis expedition, photo by Renée Friedman.

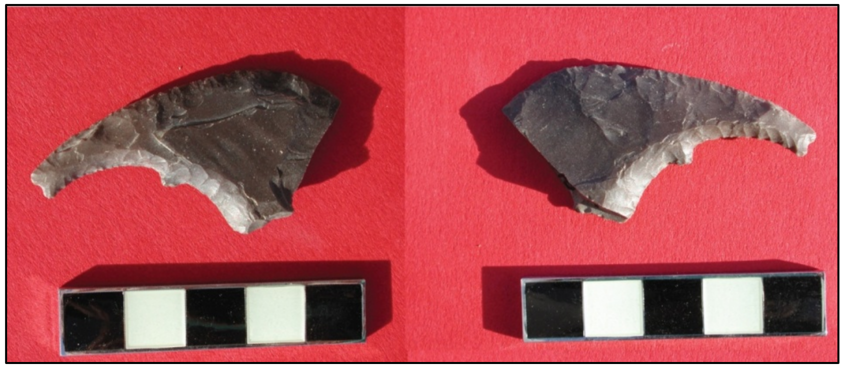


Figure 6.19. Elephant eccentric from Hierakonpolis. Image courtesy of the Hierakonpolis Expedition, photo by Renée Friedman.

Figure 6.20. Bull head figural eccentrics. Left RMAH.E.6185a. Image credit: Royal Museums of Art and History, Brussels. Right: BM.EA.32124. Right: BM.EA.32124. drawn from personal photo. Not intended to be a technical drawing, only to convey the basic shape. Images approximately to scale.

Figure 6.21. Hippopotamus eccentrics (images not to scale). Top: Hierakonpolis, image courtesy of the Hierakonpolis Expedition, photo by Renée Friedman. Middle: UC.16780. The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0.

Figure 6.22. Snake figural eccentrics, UC15170 & 15171. Image credit: The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0.

Figure 6.23. Ibex eccentrics from Hierakonpolis. Images courtesy of the Hierakonpolis expedition, left photo by James Rossiter, right photo by Laurent Bavay.

Figure 6.24. Dog and quadruped eccentrics from Hierakonpolis. Upper left: UC.1567 Image credit: The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0. Upper right and lower: Images courtesy of the Hierakonpolis expedition, photos by Renée Friedman.

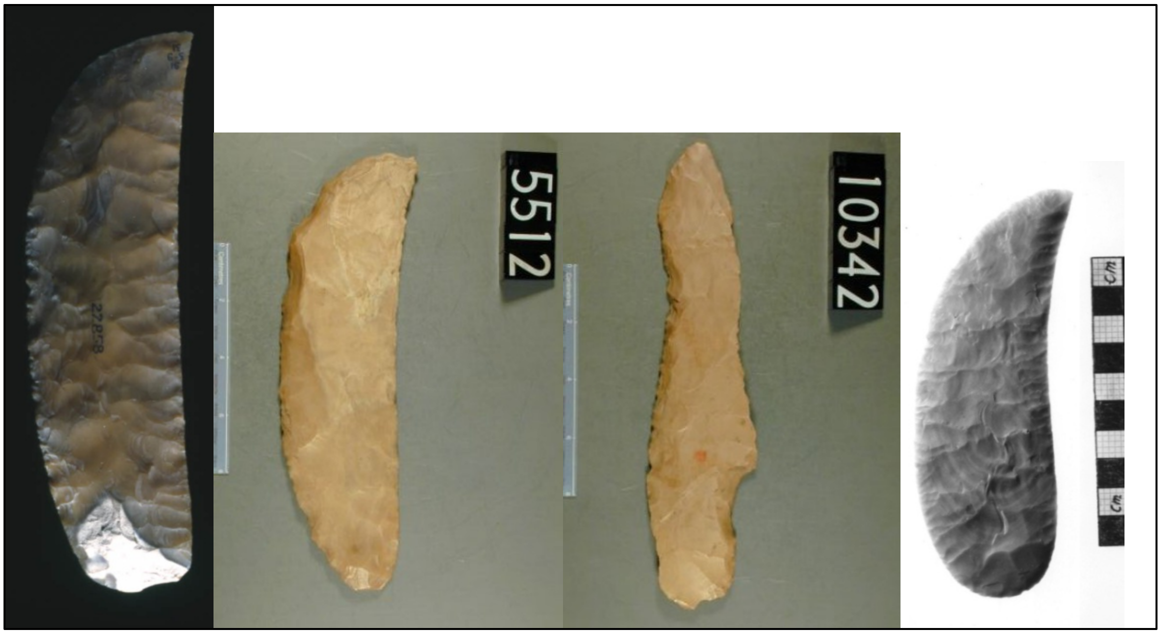


Figure 6.25. Bifacial knives. Images approximately to scale. From left: BM.22858, Image credit: © Trustees of the British Museum. CC BY-NC-SA 4.0; UC.5512 & UC.10342, Image credits: The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0; BrM.09.889.122, Image Credit: Brooklyn Museum, Charles Edwin Wilbour Fund, CC-BY 3.0.

Figure 6.26. Axes with soil polish. University of Pennsylvania Museum (E.9681, E.9682).

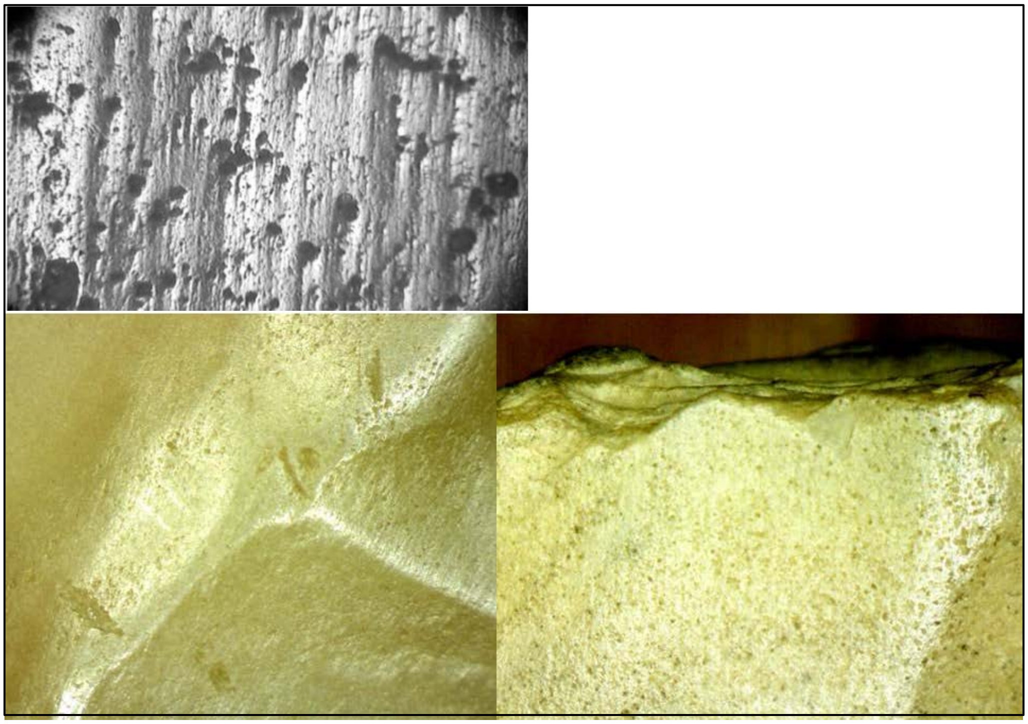


Figure 6.27 Axes with soil polish. Upper: From Yerkes et al. (2003:1056, fig 4). Width of photomicrograph is 1.3mm. Bottom: el-Mahâsna artifacts from the University of Pennsylvania Museum, Left E.9681, Right E.9682, both photographs taken at 30x magnification. Note that the upper photograph has a higher magnification.

Figure 6.28. Bifacial tool preform from the the 'M2' (S2) portion of the el-Mahasna settlement. A flake has been initiated but did not fully detach, showing that the tool was unfinished. University of Pennsylvania Museum E.9632.

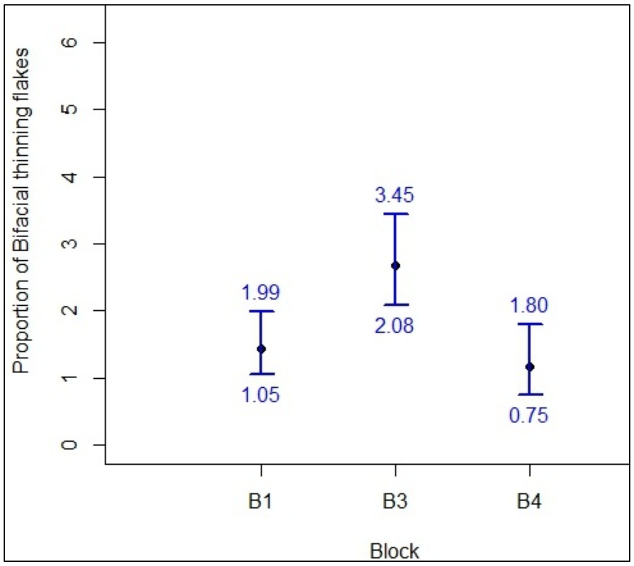


Figure 6.29. Percentages of bifacial thinning flakes in different blocks at el-Mahâsna, with the 95% upper and lower binomial confidence intervals, showing that the higher amount in Block 3 is differentiable from the other blocks. See also Table 6.30.

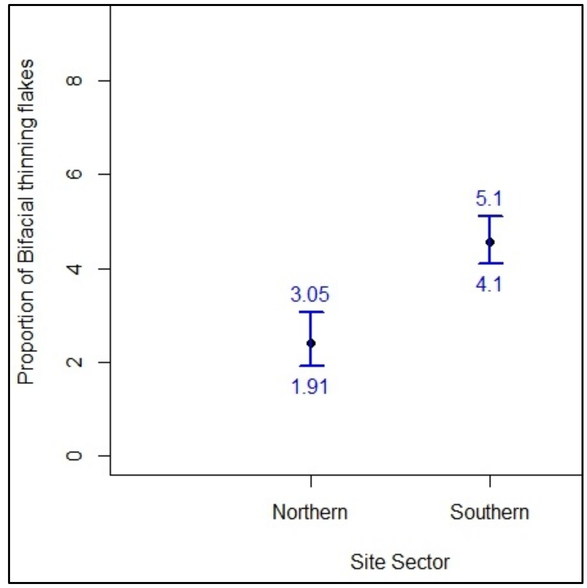


Figure 6.30. Percentages of bifacial thinning flakes in different parts of Armant MA21/83, with the 95% upper and lower binomial confidence intervals, showing a clearly higher amount in the southern part of the site.

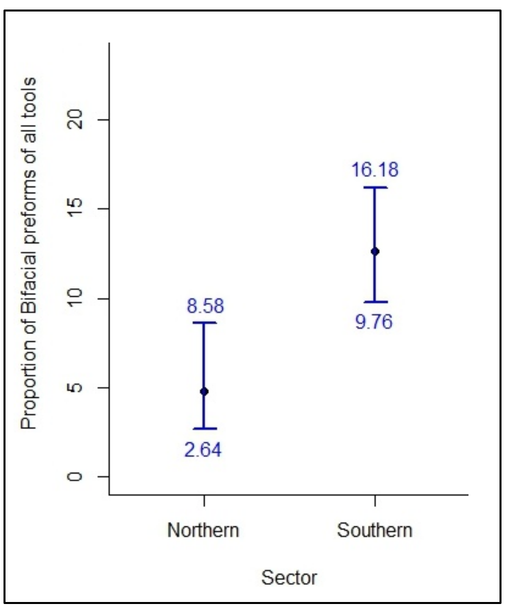


Figure 6.31. 95% binomial confidence intervals for the proportions of bifacial preforms in two sectors of Armant MA 21/83. Bifacial preforms constituted 4.76% of the tools in the northern sector, and 12.6% in the southern sector.

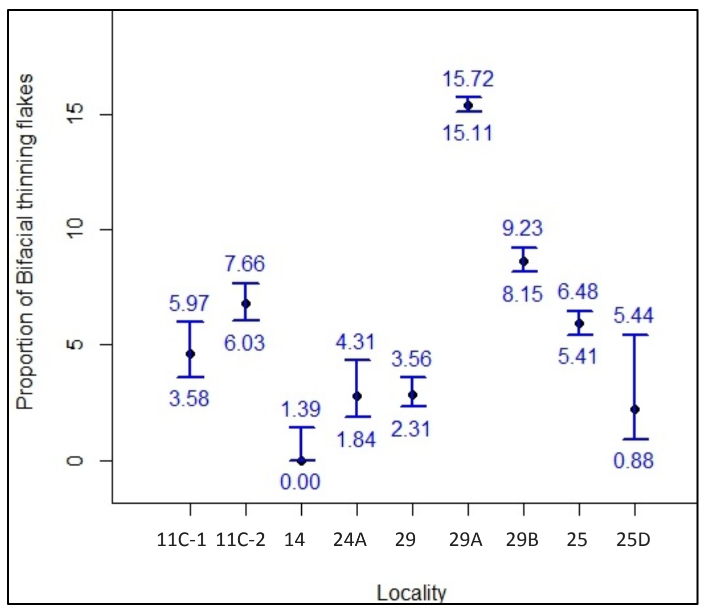


Figure 6.32. Percentages of bifacial thinning flakes in different Hierakonpolis localities, and the 95% binomial confidence intervals. HK11C-1 (Holmes 1996); HK11C-2 (Takamiya & Endo 2011); HK29 17L13 (Holmes 1996). For other references see table 6.5.

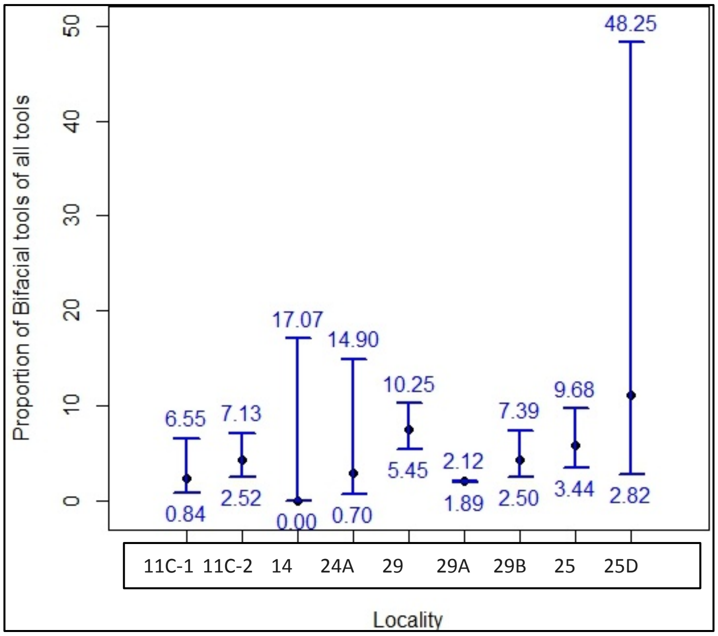


Figure 6.34. Percentages of bifacial tools in Hierakonpolis localities, and the 95% binomial confidence intervals. HK11C-1 (Holmes 1996); HK11C-2 (Takamiya & Endo 2011); HK29 10L10 (Holmes 1996). For other references see table 6.5.

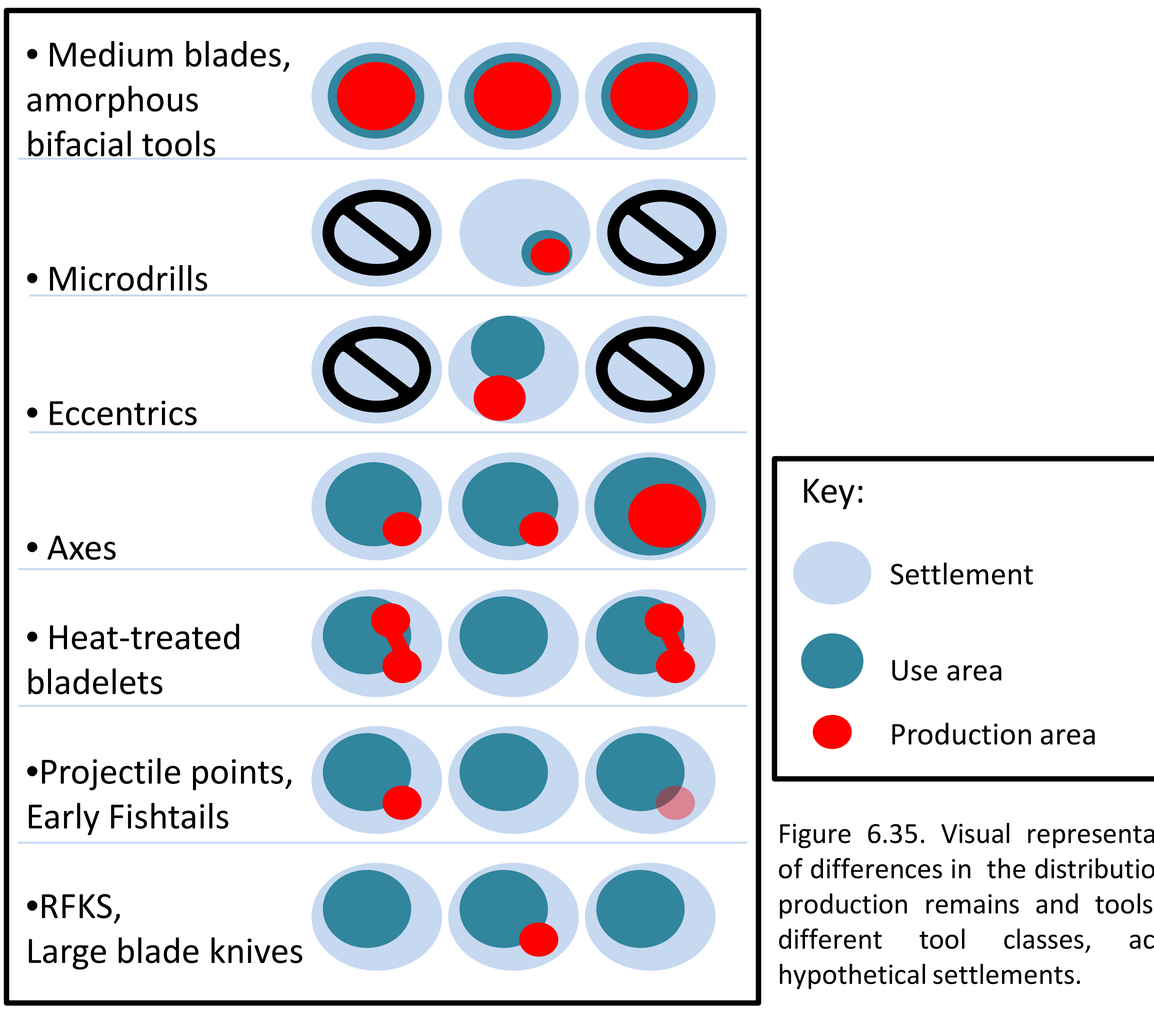


Figure 6.35. Visual representation of differences in the distribution of production remains and tools for different tool classes, across hypothetical settlements.

Chapter 7 Figures

Figure 7.1. Ripple flaked knives. Images not to scale. See also Figures 6.1-6.6 Left, from top:
-BM.EA.29286 RM type Other:Variable Translucent-Opaque.
-BM.EA.29289 RM type 1/2/4;
-BM.EA.32096 RM type Other: Variable Translucent-Opaque;
-BM.EA.32489 RM type 7;
-BM.EA.59235 RM type 1/2/4;
-BM.EA.68512 Pitt Rivers Knife RM type 4;
British museum images credit: ©Trustees of the British Museum. CC BY-NC-SA 4.0;
Right from top:
-EM.R.536 RM type 5;
-UC.16294 RM type Other: Chocolate;
-UC.6147 RM type 2/4;
UC image credits: The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0.

Figure 7.2. Rhomboid tools. Images not to scale. From top.
-A.U.720 RM type 7; Image taken with permission of the German Archaeological Mission to Abydos.
-MMA.16.2.17 RM type 1/2/4; Image credit: The Metropolitan Museum of Art, Rogers Fund, 1916. www.metmuseum.org;
-UC.4130 RM type1/2/4;
-UC 4828 RM type 7;
Petrie Museum image credits: The Petrie Museum of Egyptian Archaeology UCL CC BY-NC-SA 3.0.

Figure 7.3. Fishtails. Images not to scale. Top row from left:
-A.U.178 RM type Other Dark Grays;
-A.U.395 RM type 4;
-A.U.381a RM type 8;
Abydos fishtail image taken with permission of the German Archaeological Mission to Abydos.
-BrM.35.1445 RM type obsidian; Image credit: Brooklyn Museum, Charles Edwin Wilbour Fund, CC-BY 3.0
-BM.EA.32098 RM type 1/2/4; Image credit: © Trustees of the British Museum. CC BY-NC-SA 4.0
-MMA. 16.2.4 RM Type 2/4; Image credit: The Metropolitan Museum of Art, Rogers Fund, 1916. metmuseum.org.
Bottom row from left:
-UC.4133a RM Type 8;
-UC.4919 RM Type 7;
-UC.5405 RM Type 7;
-UC.6070 RM Type 1/2/4;
Petrie Museum image credits: The Petrie Museum of Egyptian Archaeology UCL CC BY-NC-SA 3.0.

Figure 7.4. Concave Base Projectile Points & gazelle-shaped eccentric. Top row from left:
-AMC.12.48 RM type 7;
-MAP.3029.1 RM type 13;
-MAP.2528.1 RM type 7;
-EK.2012.3.38 RM type 7 (Image courtesy of the Belgian Archaeological Mission to Elkab);
Bottom row from left (Image courtesy of the Hierakonpolis Expedition, photo by James Rossiter. Not to scale with top row images. ID numbers refer to table 7.12):
-HK.6.str7-1 RM type 7;
-HK.6.str7-2 RM type 7;
-HK.6.str7.648 RM type 7;
-HK.6.str7.363 RM type 1/2/4;
-HK.6.str7-3 RM type 7.

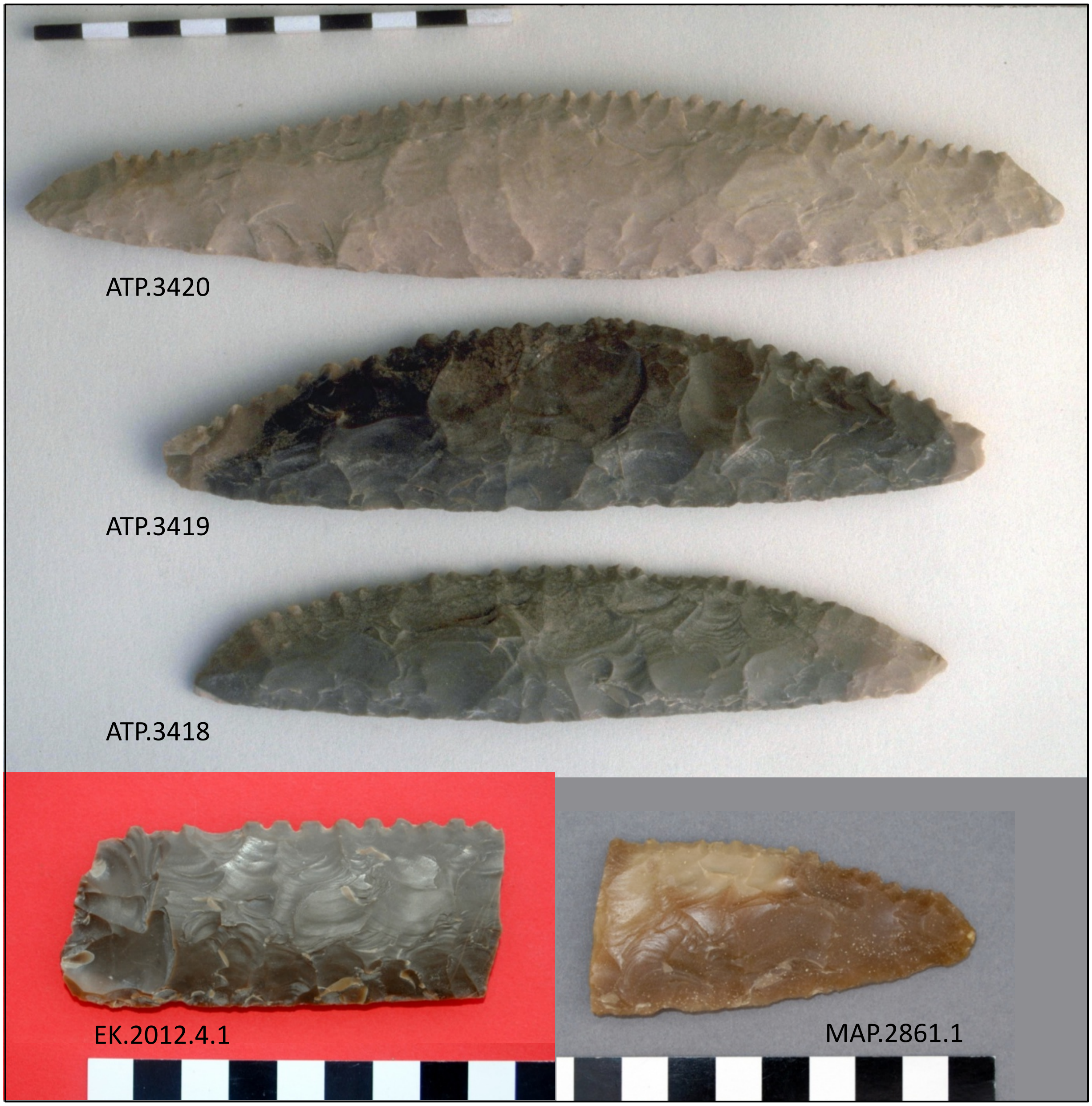


Figure 7.5. Bifacial sickles. Images approximately to scale. Top, from top:
-ATP.3420 RM type, 1/2/4;
-ATP.3419 RM type 7;
-ATP.3418 RM Type 7; (Image courtesy of the Ahmose-Tetisheri Project)
Bottom row, from left:
-EK.2012.4.1 RM type 7 (Image courtesy of the Belgian Archaeological Mission to Elkab);
-MAP.2861.1 RM type 10;

Figure 7.6. Axes. Images to scale. From top left:
-MAP. 1973.30 RM type 1;
-MAP.2522.31 RM type 1;
-PM.9692 RM type 2/4;
-PM.9690 RM type 10;
-PM.9655 RM type 4;
-PM.9681 RM type 8;
-PM.9653 RM type 1;
-PM.9633 RM type 1;
-PM.9634 RM type 1;
-PM.9687 RM type Other Dark Gray;
-PM.9682 RM type 1.

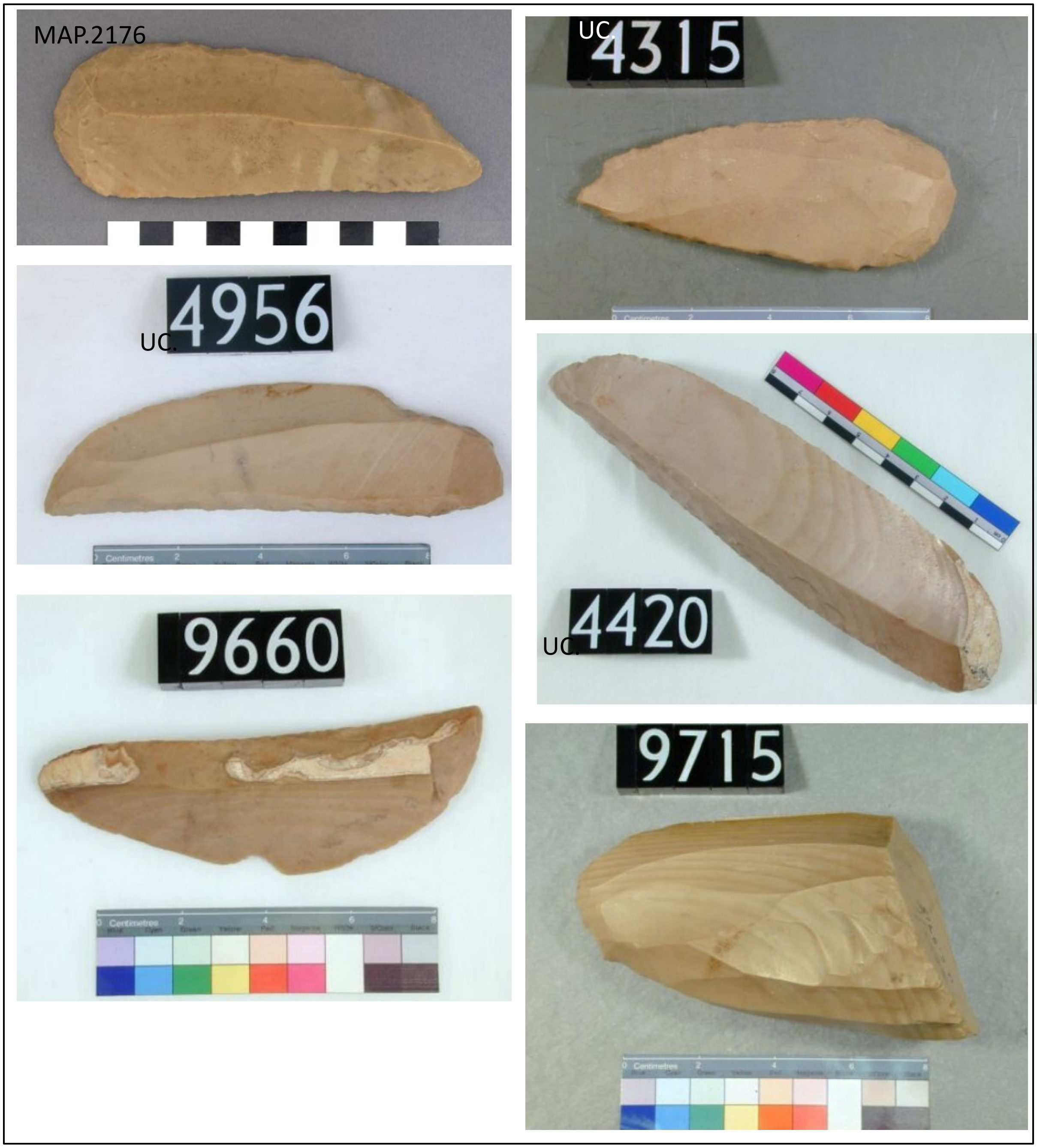


Figure 7.7. Large blade knives. Images not to scale. From top left and across:
-MAP.2176 RM type 2;
-UC.4315 RM type 2;
-UC.4956 RM type 1,2;
-UC.4420 RM type 1,2;
-UC.9660 RM type 1,2;
-UC.9715 possible core for large blades from Badari 3000/6.
Petrie Museum Image credits: The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0.

Figure 7.8. Microendscrapers / Glossy bladelet tools.
Images to scale. From top left and across:
-MAP.1872.30 RM type 11;
-MAP.1307.10 RM type 11;
-AKAP.1808.18 RM type 8;
-MAP.2439.98 RM type 11;
-MAP2317.19&64 RM type 8 (2 fragments that refit together);
-MAP.1302.33 RM type 8;
-UC.4614 RM type 8;
-UC.4634 RM type 8;
-UC.4621 RM type 8 or 10;
-UC.4968 RM type 8 or 10.
Petrie Museum Image credits: The Petrie Museum of Egyptian Archaeology UCL. CC BT-NC-SA 3.0.

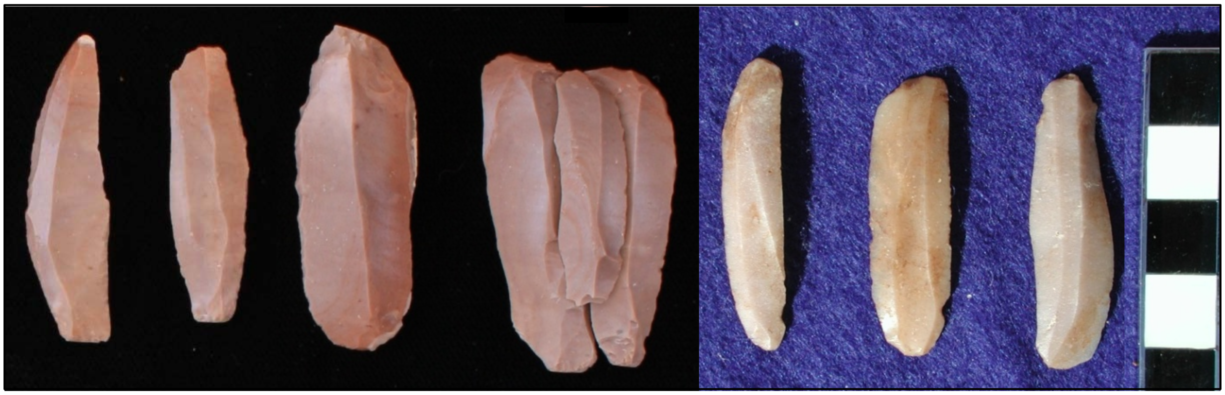


Figure 7.9. Bladelets & bladelet tools including microendscrapers from Hierakonpolis. Left: HK6 Tomb 72 Right: HK43 Tomb 333. These items show that similar raw materials were used to make bladelets and microendscrapers at Hierakonpolis as at el-Mahâsna, Nag el-Qarmila, and Naqada (compare to Figure 7.8). Images courtesy of the Hierakonpolis expedition. Left photo by Xavier Droux, right photo by Renée Friedman.

Figure 7.10. Bladelets from Abydos cemetery U. Hikade (1998) reported that at least 33% of bladelets were retouched into microendscrapers. These items show that similar raw materials were used for the Cemetery U bladelets as at el-Mahâsna, Nag el Qarmila, Naqada, and Hierakonpolis (compare to Figures 7.8 & 7.9)., and that bladelets were struck form the same core, with some turned into microendscrapers. Image taken with permission of the German Archaeological Mission to Abydos.

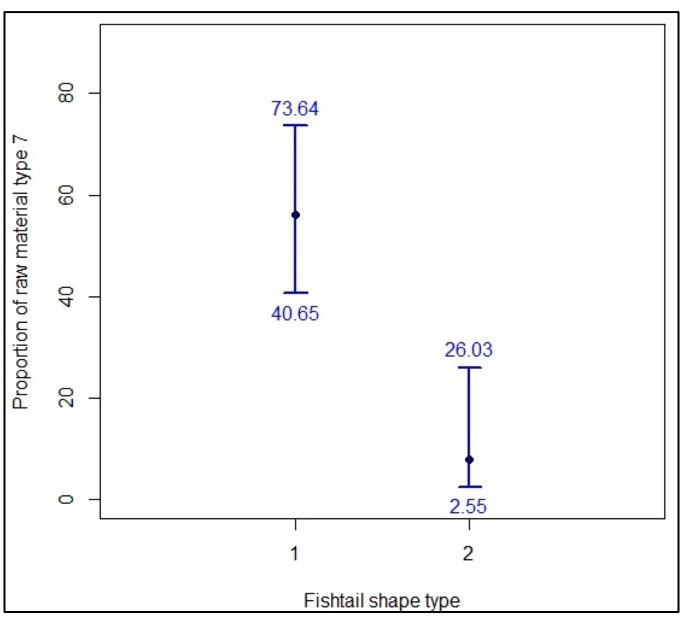


Figure 7.11. The 95% binomial confidence limits for the proportion of raw material type 7. Dark gray and brown among fishtails of shape types 1 and 2.

Chapter 8 Figures

Figure 8.1. Statuette depicting a bearded man with conical headware that forms a rhomboid shape. From Gebelein. Musee des Confluences 90000172. Image credit: Museum of Confluences (Lyon, France), CC BY-SA

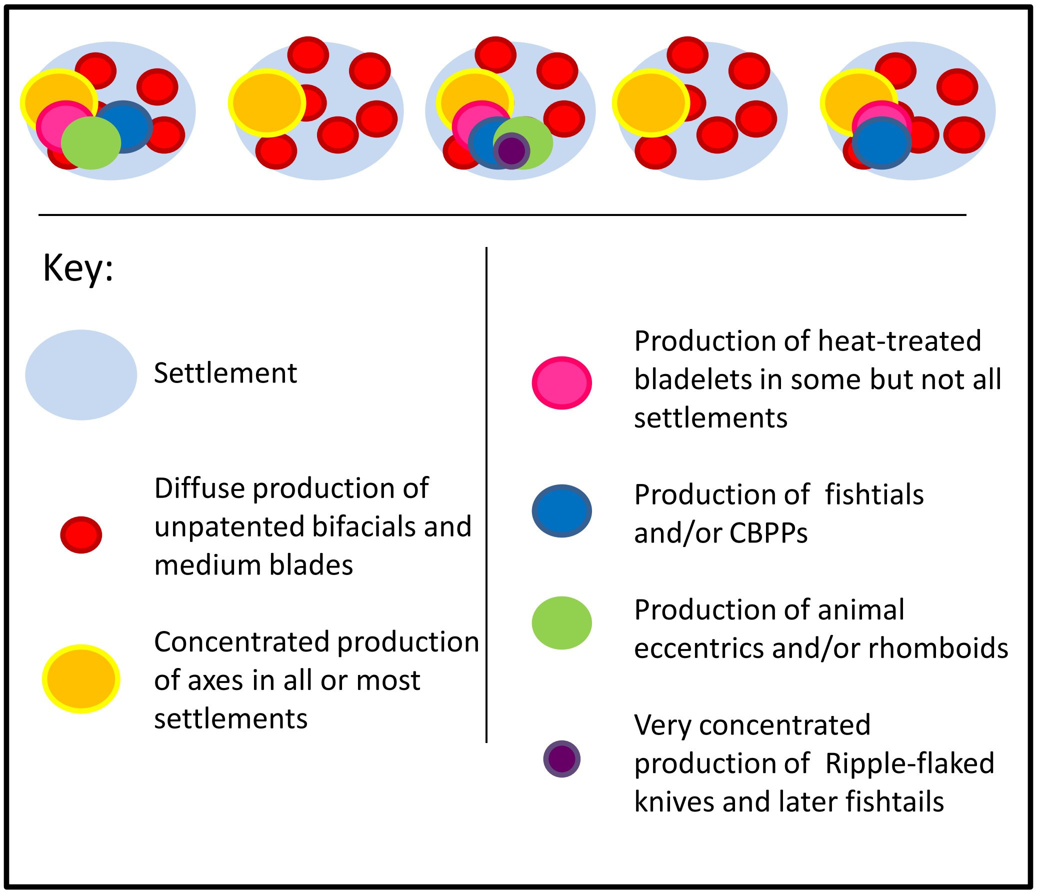


Figure 8.2. Visual representation of differences in production of tool types across hypothetical settlements. Even this does not capture the full variability since there are additional differences in the distribution of different tool types. See Ch. 6.