Title
The Tool Kit of Daily Life: Flaked-Stone Production at the Household Level at the Neolithic Site of 'Ain Ghazal, Jordan

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The Tool Kit of Daily Life: Flaked-Stone Production at the Household Level at the
Neolithic Site of ‘Ain Ghazal, Jordan

A Dissertation submitted in partial satisfaction
of the requirements for the degree of

Doctor of Philosophy

in

Anthropology

by

Theresa Marie Barket

March 2016

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ABSTRACT OF THE DISSERTATION

The Tool Kit of Daily Life: Flaked-Stone Production at the Household Level at the Neolithic Site of ‘Ain Ghazal, Jordan.

by

Theresa Marie Barket

Doctor of Philosophy, Graduate Program in Anthropology
University of California, Riverside, March 2016
Dr. Philip Wilke, Chairperson

The site of ‘Ain Ghazal was occupied from the Middle Pre-Pottery Neolithic B (MPPNB) to the Yarmoukian Period (9250 to 7000 BP). Previous research focused on the naviform core-and-blade industry at ‘Ain Ghazal demonstrated that during the PPNB, naviform core-and-blade production was carried out by a few part-time specialists, who supplied blade products that served as blanks for most of the formal tool kit. The research conducted here considers the generalized component of the lithic economy in order to examine the nature of core reduction and tool production that occurred in most households. Moreover, this research has the potential to provide additional insight into changes in the lithic economy, as well as an understanding of the tasks common to daily life and how they changed through time. The analyses conducted here employed replicative research and technological typologies to analyze a sample of tools, cores, anddebitage from domestic-related contexts. The data accumulated from this analysis suggest that the entire tool kit was produced in most households throughout the occupation of the site, but changes in the specialized economy, along with changes in common tasks

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affected production choices through time. Specifically, the demise of the specialized economy by the end of the Late Pre-Pottery Neolithic (LPPNB) meant that households were responsible for producing their own tool blanks or obtaining blanks by scavenging. Correspondingly, informal tools became more common as standardized blanks became less common, and the resource materials used became more diverse. Along with the alterations in the lithic economy, evidence from the tools suggests some changes in the tasks carried out on a daily basis. In general, however, this research indicates that the tools demonstrate a fair amount of continuity through time.

The findings presented here compared with research at contemporaneous sites show that the way in which past people organized their lithic economy is complex and likely to vary from site to site. Unfortunately, studies as detailed as this one are rare in Neolithic research, but they have the potential to contribute to a more fine-grained understanding of the socioeconomic dynamics during the Neolithic of the southern Levant.
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Chapter 1

INTRODUCTION

The Neolithic site of ‘Ain Ghazal is situated along the Wadi Zarqa in the outskirts of Amman, Jordan. It was occupied continuously from the Middle Pre-Pottery Neolithic B Period\(^1\) until the Yarmoukian phase of the Pottery Neolithic (9,250 to about 7,000 B.P.), making it one of the major Neolithic sites that documents the transition to more settled living and domestication of plants and animals (Rollefson et al. 1992). During the Pre-Pottery Neolithic (PPN), the increased reliance on domesticated plants and animals in the subsistence economy led to a growing population, which ultimately favored a more standardized lithic tool kit based on blades than was available from flake tools alone. In response to this need, Neolithic people refined a particular production technology to produce a consistent blade product ideal for the manufacture of an array of tool types (Quintero and Wilke 1995; Quintero 2010). This technology consisted of bidirectional, opposed-platform core-and-blade production, also called “naviform” core technology.

During the PPNB, the production of naviform core technology is thought to have been specialized at several Neolithic towns (e.g., ‘Ain Ghazal, Abu Suwwan, Wadi Shu‘eib, Basta, and Yiftahel) (Quintero and Wilke 1995; Gebel 1996; Simmons et al. 2001; Al-Nahar 2010; Garfinkel et al. 2012). Alongside this specialized industry, which involved only a few community members, nonspecialized or generalized production of...
tools and other blade/let- and flake-core technologies continued to be practiced by most of the population (Quintero and Wilke 1995).

‘Ain Ghazal is one of the few sites in the southern Levant for which there are published analyses of this dual economic structure comprising both specialized and generalized production (e.g., Quintero and Hintzman 2004; Quintero 2010). Aside from the preliminary work on domestic production at ‘Ain Ghazal, few detailed analyses have been conducted on the nature of tool production, how it was organized, and how and why it may have changed through time. Such research is especially relevant because in the southern Levant there are differing interpretations about the context of formal tool manufacture (especially projectile points and borers) at PPN sites where craft specialists produced blade blanks for tool production from naviform cores, but may or may not have produced blade tools. Understanding the tool production economy thus has implications for the socioeconomic complexity of these villages and the region as a whole. For instance, arguments for the LPPNB site of Basta situate formal tool production as a specialist’s task, undertaken in workshops in conjunction with naviform core reduction (Gebel 1996). Additionally, Barzilai (2010), asserted that centralized workshops, such as those found at ‘Ain Ghazal, Basta, and Yiftahel, produced projectile points and other tools in addition to naviform cores and blade products for distribution to the local community and other villages. Some even speculate that itinerant artisans may have traveled from site to site producing and distributing naviform core technology and products (Price and Bar-Yosef 2010). Few of these studies, however, have considered in
detail the technological constraints of tool production or the probable organization of production at sites with specialization.

The current evidence for ‘Ain Ghazal supports the premise that stone tool production was a nonspecialized activity that occurred domestically at the household level. Nonetheless, it is necessary to address the emerging notion that all apparently skillfully manufactured tools were produced by specialists and exchanged between communities, especially because this view has been tied to specific models for socioeconomic organization and complexity in the southern Levant during the PPNB (e.g., Barzilai 2010). To address this issue at ‘Ain Ghazal, it is necessary to investigate the nature of flaked-stone implement production that actually occurred in domestic contexts, and the impact of changes in the specialized lithic economy.

After the PPN there were significant changes in flaked-stone tool production and in the lithic economy at ‘Ain Ghazal. During the terminal phases of the LPPNB, the population of the site declined and major changes associated with that decline are evident in the lithic record. At this time, specialized production of blades from naviform cores ceased, resulting in considerable changes to the flaked-stone tool assemblage that continued into the PN period until site abandonment (Rollefson et al. 1992; Quintero 2010). Though it may never be possible to know in full the social and economic transformations that accompanied these transitions, a thorough analysis of the context and technological features of tool production can provide important insights into changes in common production tasks, as well as the lithic economy, and the choices the town inhabitants made to address these changes. Along with supplying information on the
lithic economy, the tools produced provide insight into the common tasks in the daily lives of Neolithic people, and how changes in resource availability impacted the tool kit.

Thus, although this analysis focuses only on the flaked-stone assemblage from ‘Ain Ghazal, it is potentially relevant to understanding a complex socioeconomic system of relations between people within a community, between communities within a region, and between regions and supraregions. With this understanding in mind, the following discussion begins with an overview of the current thought regarding aspects of Neolithic adaptations typical of the southern Levant throughout the period. Then, there is a brief description of the excavation history of ‘Ain Ghazal and the material record of its occupation. Next, there is a consideration of the current evidence and arguments for specialization in the southern Levant, the organization of production as it relates to the lithic economy, and what has been studied about domestic, or household-level, production. Additionally, specialization has implications for social complexity and is increasingly included in models of social organization; thus, it is essential to discuss some of these different models and their arguments for the region. The remaining chapters establish the theoretical and methodological approach taken here, the research questions, and the composition and analysis of the data sets. Finally, the results and what they reveal about common tasks and the lithic economy at ‘Ain Ghazal are presented. The results from ‘Ain Ghazal are compared to those of other Neolithic sites, as they may articulate with various models of Neolithic socioeconomic organization in the southern Levant.
NEOLITHIC OF THE SOUTHERN LEVANT

Archaeological research over the last two decades indicates that the transformations commonly associated with the Neolithic occurred over a long period of time, with many features starting in the Epipaleolithic and continuing past the recognized end of the Neolithic. In fact, domestication emerged slowly over an extensive region and many of the traits associated with the Neolithic arose at different times in different places, suggesting that there is not necessarily a clear “revolution” (Finlayson 2013, also see Fuller et al. 2011 and Asouti and Fuller 2012). Given the increasingly problematic notion that the Neolithic revolution represents a discrete period, it is necessary that we, as archaeologists, reframe the way we examine and talk about the Neolithic. This too should be a process, as much of the research carried out on the Neolithic discusses it as a package of traits associated with a particular period in time. It is beyond the scope of this work to address all of these issues here, and given the current state of research, it will only be possible to discuss the patterns at ‘Ain Ghazal within the context of the southern Levant during what is commonly described as the Neolithic revolution in much of the literature. Furthermore, while any review of the features of any period in time necessarily involves glossing over some of the diversity, much of the rest of the discussion and analysis attempts to consider the importance of the differences.

Pre-Pottery Neolithic A

The first period commonly designated as part of the early Neolithic is the Pre-Pottery Neolithic A (PPNA), which in the southern Levant ranges anywhere from 11,700 to 10,500 B.P. In much of the literature, the PPNA is distinguished from the earlier
Natufian period based on changes in settlement size and distribution, some changes in residential architecture, the presence of “nondomestic” or “public” architecture, as well as changes to subsistence and technology. Most recognized PPNA sites occur in the Mediterranean zone or along the Jordan Valley, and include villages larger than 0.5 ha, small hamlets, and short-term specialized sites (Fig. 1.1). Sites also are found in the desert regions (e.g., Wadi Jilat 7, and see Richter et al. [2012] for a possible PPNA site—Shubayqa 6—found during survey in the northern Badia region of Jordan). But at present, there is only limited evidence of PPNA occupation in the arid zones of the southern Levant (Bar-Yosef 1991; Kuijt 1994; Garrard et al. 1994; Kuijt and Goring-Morris 2002).

The primary PPNA pattern of larger sites with longer-term occupations, smaller hamlets, and specialized sites in the Mediterranean zone and Jordan Valley is argued by some to represent a coexistence of groups who employed different settlement and subsistence strategies. That is, more sedentary groups, who foraged, hunted, and cultivated, occurred, as well as mobile forager/hunter groups (Edwards and Highman 2001). Others, however, have pointed out that this pattern may well be too limited, arguing instead that PPNA settlement practices may have involved fluctuating degrees of mobility (Asouti and Fuller 2013).

Along with differences in settlement size and distribution, residential architecture shows some variation. As in the previous periods, residences are circular or oval in configuration, and most are either freestanding or semisubterranean, sometimes with stone foundations and walls of wattle-and-daub construction (Bar-Yosef 1989; Kuijt
1994; Kuijt and Goring-Morris 2002). Though the evidence is ambiguous, some argue that homes were spatially organized along kinship lines and food processing and related behaviors took place in individual households, rather than communally (Belfer-Cohen
and Goring-Morris 2011:213; Goring-Morris and Belfer-Cohen 2011:201; but see Asouti and Fuller 2013 for a contrasting argument). In addition to the residential architecture, there is some evidence for the presence of storage facilities at several sites such as Netiv Hagdud, Gilgal, Dhra’, and Jericho (Kuijt and Finlayson 2009) and nondomestic architecture, such as the tower at Jericho, and a recently discovered structure at the site of Wadi Faynan 16 (Finlayson et al. 2011).

As in earlier periods, subsistence practices in the PPNA included collecting local plants and hunting waterfowl and gazelle, boar, sheep/goat, and aurochs, as well as some hunting of foxes and predatory birds, which may have been for the acquisition of pelts, claws, feathers, etc. (Bar-Yosef 1989:61; Rollefson 1998; Kuijt and Goring-Morris 2002:379). Perhaps, one of the most important differences between the PPN and earlier Epipaleolithic subsistence practices is the evidence for cultivation in the PPNA. The issue of domestication, however, is less clear. Sites with published botanical collections, including Netiv Hagdud (Kislev 1997), Gilgal I (Weiss et al. 2006), Zahrat adh-Dhra‘ 2 (ZAD 2) (Edwards et al. 2004), Iraq ed-Dubb (Colledge 2001), and el-Hemmeh (White and Makarewicz), have ambiguous evidence for the presence of domesticated cereals, but there is good evidence for pre-domestication cultivation of barley, and possibly emmer and pulses (Asouti and Fuller 2012:152).

The nonperishable technology of the PPNA includes a continuation of bladelet production and the use of microliths. The typical PPNA flaked-stone technology included single-platform blade and bladelet cores reduced to produce blanks for tools such as El-Khiam, Jordan Valley, and Salibiya points, as well as sickle blades, perforators, and
burins. Temporally diagnostic tool types include Gilgal and Hagdud truncations.

Woodworking tools such as axes often were bifacially flaked with a tranchet bit. Based on the presence or absence of truncations or woodworking tools, some have argued that the PPNA should be divided into two phases: the Khiamian and Sultanian (e.g., Bar-Yosef 1995). However, there is little consensus on the point (Nadel 1998; Kuijt 2001; Sayej 2004) and, in fact, others have noted that there is a great deal of technological diversity that may reflect local traditions (Mithen and Finlayson 2007). Finally, the milling stone component consisted of limestone and basalt pestles, and shallow limestone mortars.

Unlike some of the other features of the PPNA, burial customs display continuity with the previous Natufian pattern of skull removal and in some of the larger sites, there is caching of skulls in communal locations. Additionally, starting in the late Natufian and continuing into the PPNA, grave goods were no longer interred with burials (Bar-Yosef 1989:60; Kuijt 1994:182).

Accompanying some of these changes in settlement size, location, architecture, and subsistence, there appears to have been a greater frequency of inter- and intra-regional interactions. The most common evidence for interaction in the PPNA consists of shells from the Mediterranean and Red seas, greenstone and malachite from Faynan and Timna, and bitumen from the Dead Sea region. Obsidian traced to central Turkey is present in large quantities, at Dhra‘, Jericho, and Nativ Hagdud (Kuijt 1994:181-182; Kuijt and Goring-Morris 2002:380-382; Belfer-Cohen and Goring-Morris 2011).
**Early Pre-Pottery Neolithic B**

After the PPNA, the density of sites apparently declined, so that the subsequent Early Pre-Pottery Neolithic period (EPPNB) in the southern Levant is not as well represented (refer to Fig. 1.1 for EPPNB sites). A few sites, however, are associated with this period, and include Motza near Jerusalem; Tell Aswad in the Damascus basin; Mujahiya in the Golan; er-Rahib in Wadi Yabis; Horvat Galil, Nahal Oren, Michmoret, Sefunim, and el-Wad in the Galilee; Abu Salem, Nahal Boqer, Nahal Lavan 109 in the Negev highlands and dunes; and Jilat 7 and Jebel Queisa in eastern and southern Jordan. The Rift Valley, however, appears to have been abandoned after the PPNA and not resettled until the MPPNB (Kuijt and Goring-Morris 2002; Khalailly et al. 2007). It is important to note that not all researchers accept that most of the sites listed above are EPPNB sites and few have firm radiocarbon dates (Edwards et al. 2004). Along with the general paucity of sites, there is little evidence pertaining to site size and common architecture, but it appears based on the current dating that sites were no larger than 2 ha and the few examples of residential architecture from Aswad, Horvat Galil, Abu Hudhud, and Jilat 7 are oval to subrectangular (Kuijt and Goring-Morris 2002:385). At Motza, there is oval and rectangular architecture, and both building types have plastered floors (Khalailly et al. 2007:32).

At present, there is only limited evidence pertaining to EPPNB subsistence, but at Motza, mountain gazelle dominated the faunal assemblage, which also includes aurochs, wild boar, goat, fox, wildcat, hare, rodents, tortoise, and avian remains (Khalailly et al. 2007:26). The plant remains indicate that a reliance on wild plants continued, but at
Aswad early research suggested that there are some possible domesticated cereals (Van Zeist and Bakker-Heeres 1985; Hillman and Davies 1990). However, more recent work by Stordeur (2003) and some reanalysis have brought to light several possible discrepancies in the original interpretation (Edwards et al. 2004).

Somewhat like the residential architecture, the lithic technology of the EPPNB appears to be transitional in several ways. For instance, single-platform blade and bladelet cores, tranchet axes, Khiam points, and in northerly sites, Hagdud truncations are still found (Kuijt and Goring-Morris 2002; Khalaily et al. 2007). New technologies include bidirectional opposed-platform core-and-blade production (or naviform), which might have been introduced from the north sometime in the EPPNB along with Helwan points (Gopher 1989a; Khalaily et al. 2007).

Although there is little evidence from the EPPNB, Natufian and PPNA practices of skull removal appear to have continued into the EPPNB. Additionally, evidence from Horvat Galil (if it is to be considered an EPPNB site) shows there was a continuation of placing burials in and around domestic dwellings. At Motza, primary burials are found mostly below living floors or courtyards, but there is no clear patterning to the orientation of the bodies (Khalaily et al. 2007:29).

As with the burial patterns, there is evidence of the continuation of intra- and inter-regional interactions such as trade or exchange from the previous PPNA, by the continued presence of obsidian, marine shells, greenstone, and other minerals.
**Middle Pre-Pottery Neolithic B**

In contrast to the EPPNB period, numerous sites are dated to the MPPNB (ca. 10,200 to 9,500 B.P.) including Jericho, ‘Ain Ghazal, Wadi Shu‘eib, Es-Sifiya, Abu as-Suwwan, Yiftahel, Kfar HaHoresh, Ghwair I, Nahal Hemar, Munhata, Tell Aswad, Beidha, Shakarat Msaied² (Fig. 1.2). Many of the larger communities are located along the Jordan Valley and neighboring areas, and are 4-5 ha in size. In the western areas, sites such as Yiftahel and Abu Gosh are 1 to 1.5 ha in size. MPPNB settlements in the desert areas to the east are less common, and the sites are generally small, but they do show variation in size and permanency (Betts 1989; Byrd 1994; Garrard et al. 1994; Henry et al. 2014).

As in the previous periods, there is variation in residential architecture. At ‘Ain Ghazal, Yiftahel, and Jericho, dwellings are rectangular to sub-rectangular with an entrance at one end and some internal partitions. The floors typically were plastered and painted white, pink, or red with holes for roof supports. At southern sites such as Ghwair I, Beidha, and Shakarat Msaied, typical residential architecture is circular, built in a cell-like manner with central courtyards, some plastered floors, and occasionally a second level. The architecture of the desert seasonal hunting encampments consists of round/oval structures, sometimes semisubterranean, without plastered floors (Banning and Byrd 1987; Byrd 1994; Rollefson 1997, 2010; Goring-Morris and Belfer-Cohen 2013).

Several sites also have buildings interpreted to be nonresidential in nature. Beidha has three structures that differ from residential architecture in construction, size, and location. The contents and character of these buildings suggest that community members constructed them for ritual purposes (Byrd 1994, 2005). Ghwair I also has some probable
nonresidential architecture that includes public areas with major outdoor stairways (Simmons and Najjar 1996; Simmons 2007).

Unlike the previous periods, domestication is more evident by the MPPNB. Subsistence practices included the consumption of both wild and domesticated plants and wild and domesticated animals. Recent research, however, indicated there was much diversity in the use of cultivars at different communities, with some persistence of wild cereal crops (Asouti and Fuller 2012). Additionally, of the MPPNB southern Levantine sites, Jericho has some of the clearest evidence for reliance on a domesticated crop “package”, including barley, emmer, einkorn, flax, lentil, and pea. The situation was different at Beidha, where there was a continuation of cultivation of local wild cereal crops, including barley and emmer, alongside pulses such as lentil and pea (Asouti and Fuller 2012:154). As for animal domestication, there is some evidence that goats were domesticated at ‘Ain Ghazal early in the MPPNB (Köhler-Rollefson 1989; Wasse 2002). It seems, however, that MPPNB peoples in much of the southern Levant remained heavily reliant on wild species, and there is little evidence of domesticated caprines in much of the Mediterranean region (Kuijt and Goring-Morris 2002).

With regard to technology, blade tools and ground-bit axes were important components of the lithic technology of the MPPNB, but at most sites flake core reduction continued to be important and flake blanks remained common for the production of informal tools, such as scrapers. The formal tool blanks at many sites were blades from naviform cores, and at some sites (e.g., ‘Ain Ghazal and Yiftahel), the production of naviform cores and blades was specialized in the MPPNB (Barzilai 2010; Quintero
The lithic assemblages are quite variable from site to site, and in some cases naviform core production and products are not well represented in comparison to other core technologies. Additionally, there is much variation in the presence and frequency of certain tool types. For example, in desert sites, sickle blades are less common and projectile points more common, when compared with sites along the Jordan Valley (Garrard et al. 1994). Such assemblage variation probably depended on several factors, such as access to resource material, the subsistence base, settlement location, and the tools needed to accommodate the other production activities that occurred in the community.

The typical MPPNB millstone assemblage includes saddle and trough querns, grinding slabs, hand stones, bowls, and platters, made of various materials (e.g., limestone, chalk, basalt). Mortars are less common than in the preceding periods. Grooved, incised, polished stones, and shaft straighteners are common, as are palettes and whetstones (Kuijt and Goring-Morris 2002:400-403). In addition, there are also basketry, wood, plaster, and probably early ceramic vessels.

Along with the flaked and millstone assemblage, the MPPNB is notable for the increased production of lime plaster for floors in residences and public buildings. Evidence suggests lime plaster was not easy to produce, and involved the labor of many people (Garfinkel 1987a; but see Goren and Goring-Morris 2008). Furthermore, some have argued that construction activities and fuel for cooking required so much wood that

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3 Resource material is used throughout this text instead of raw material to refer to flint resources used for flaked-stone reduction. This decision to use a different term is intended to avoid confusion, as some researchers may understand the term “raw material” as referring to flint that has not been heat-treated.
it may have contributed to local deforestation at large sites such as ‘Ain Ghazal (Rollefson and Pine 2009).

As in the PPNA and EPPNB, burial customs reflect some degree of continuity with earlier practices. Fortunately, much research has focused on the ritual and mortuary practices of the MPPNB and their possible meanings (Rollefson et al. 1992; Kuijt 1996, 2000, 2002; Price and Bar-Yosef 2010), so some broad trends can be summarized. Kuijt and Goring-Morris (2002:394) noted that during the MPPNB, there were three interrelated mortuary practices: the first is the primary interment mainly of adults, either male or female, in single graves (in many cases subfloor). Second is the interment of infants in single graves, sometimes subfloor, but often in fill or courtyard areas. Third is the removal of some skulls from primary graves (adults only) and their reburial in single or multiple skull caches at a different location. Occasionally, the cached skulls were covered with plaster, often to recreate facial features including nose, eyes, and mouth, as at ‘Ain Ghazal, Jericho and Yiftahel (Bonogofsky 2001, 2006; Khalaily et al. 2013). Discovery of the location of most of the dead has not been possible at many sites, but there are some probable cemetery sites, such as Kfar HaHoresh, where excavators argue there are traces of funerary architecture, monoliths, numerous burials, and possible evidence, from midden deposits, of feasting (Goring-Morris 2005; Goring-Morris and Belfer-Cohen 2008).

In contrast to some of the earlier periods, the MPPNB displays a florescence in the presence and variety of symbolic or ritual-related artifacts including statuary, figurines, and masks (Kuijt and Chesson 2007). Several sites including ‘Ain Ghazal,
Jericho, and Nahal Hemar Cave, had plaster statuary, but ‘Ain Ghazal is unique for its caches of larger plaster statuary. Clay animal figurines, most often cattle, but occasionally goats or equids, have been found at several sites. Though less common, anthropomorphic figurines were recovered at several sites, often they were headless and are variously interpreted as depicting males or females (more often females), but some argue they are sexually ambiguous, with no clear secondary sexual characteristics (Rollefson et al. 1992:466; Kuijt and Chesson 2005, 2007; Rollefson 2008). Additionally, there are rare items such as limestone carved masks but these are recovered mostly from unknown or secondary contexts around Jerusalem and the eastern side of the Jordan Valley. Finally, it is important to note that the distribution of each of these symbolic artifact types was restricted in range (Kuijt and Goring-Morris 2002:397-398).

As in the EPPNB and PPNA, regional trade and exchange relations continued in the MPPNB. Some maintain, however, that the shell beads traded between Mediterranean communities during the MPPNB may imply exchange for subsistence resources (Bar-Yosef and Bar-Yosef Mayer 2002). Additionally, in recent years, some researchers have argued for the exchange of specialist-produced naviform cores and blades (Barzilai 2010; Belfer-Cohen and Goring-Morris 2011).

**Late Pre-Pottery Neolithic B**

A number of sites continued to be occupied or were newly occupied during the LPPNB, including ‘Ain Ghazal, Wadi Shu’eib, Abu as-Suwwan, El-Hemmeh, Khirbet al-
Hammam, Es-Sifiya, Basta, Ba’ja, ‘Ain Jammam, Tell Rakan, and Nahal Issaron⁴ (Fig. 1.2). One of the most noticeable settlement pattern shifts that occurred during the LPPNB was the concentration of sites on the eastern side of the Jordan Valley, with some of the sites becoming quite large (10 ha or more) representing not only a major shift in settlement patterns, but clear population aggregation at certain sites resulting in major changes in the social organization of these communities (Gebel 2004; Rollefson 2004b). The largest of these sites are commonly referred to as “megasites”, the appearance of which has been tied to climatic changes, population growth, environmental degradation, and social change (Gebel 2004; Kuijt 2004; Rollefson 2004b). Likewise, the LPPNB of the desertic zone was different in terms of settlement patterns. During the MPPNB, there were few sites beyond the highlands of the eastern Jordan Valley, but in the LPPNB, there was a noticeable expansion of peoples into desert zones. Desert sites are common, and while they may not have been permanent, their presence is argued by some to be associated with the development of pastoralism (Köhler-Rollefson 1992; Kuijt and Goring-Morris 2002; Quintero et al. 2004; Makarewicz 2013a, 2013b).

LPPNB architecture also has some notable differences, most prominently at megasites, where some dwellings associated with larger coresidential units (extended families?) appear more elaborate with a larger number of rooms and in some cases a second story. Some of these additional rooms likely served as internal storage areas.

⁴ For site specific information refer to the following publications: (Rollefson et al. 1992 and Rollefson and Kafafi 2013 for ‘Ain Ghazal; Gebel and Bienert 1997 for Ba’ja; Hermansen and Gebel 2004 for Basta; Peterson 2004 for Khirbet al-Hammam; Banning 2001 for Tell Rakan; Simmons et al. 2001 for Wadi Shu’eib; Makarewicz et al. 2006 for el-Hemmeh).
(Banning 2004; Gebel 2004; Kuijt 2004). In addition to residential architecture, probable nonresidential buildings or architectural elements occur at several sites. For instance, ‘Ain Ghazal contains several buildings interpreted to be “cult buildings” and “temples” (Rollefson 1997). While the function of these buildings is not certain, they are noticeably different, interpreted as demarcations of communal as opposed to residential spaces. The whole notion, however, that there is any clear demarcation between communal “shrines” or “temples” and residences in the Neolithic of the southern Levant has been questioned by some (Banning 2011; Asouti and Fuller 2013; Rollefson 2014).

Lithic technology of the LPPNB shows some continuity with the MPPNB. First, there was continued use of naviform core technology at many sites, and it was probably a specialized task at several sites, including ‘Ain Ghazal and Basta (Gebel 1996; Quintero 2010). Some LPPNB sites (e.g., es-Sifiya, Khirbet al-Hammam, el-Hemmeh; Ba‘ja), however, reveal little or no naviform technology, and relied instead on other blade and flake technologies (Peterson 2004; Makarewicz et al. 2006). At most sites, Byblos and Amuq projectile point types remained the most common, often with more retouch than is seen among MPPNB assemblages, and sickle blades continued to be important. Millstone technology also exhibited continuity with the MPPNB, and at Basta and Ba‘ja, there was significant production of sandstone and limestone rings (Hermansen and Gebel 2004; Michiels et al. 2012).

The LPPNB subsistence economy included domesticated cereals and pulses and it seems the major domesticated crop choices that first emerged in the MPPNB became widespread during the LPPNB, but the crop types varied some from site to site (Asouti
and Fuller 2012:155). Faunal assemblages reflect a continued transition to a reliance on domesticated animals, with a predominance of domesticated sheep. Desert sites also have evidence of a greater reliance on domesticated animals, but wild species still played a significant economic role (Köhler-Rollefson 1988; Kuijt and Goring-Morris 2002). As suggested by changes in settlement patterns, mounting evidence indicates that pastoralism as a subsistence system started in the LPPNB (Köhler-Rollefson 1992; Quintero et al. 2004; Makarewicz 2013a, 2013b). Moreover, recent evidence suggests that the husbandry practices at this time were complex, differing between settlements and perhaps in some cases oriented toward surplus production (Makarewicz 2013a, 2013b). In fact, Makarewicz (2013a) recently asserted that pastoral practices had great potential to produce surplus and may have been one of the major modes of wealth accumulation at this time (also suggested by Rollefson 2004b).

With regard to mortuary customs and symbolic artifacts in the LPPNB, some practices continued, including individual burials under houses, courtyards, etc., and skull removal and dedicatory caches. Some changes are argued to reflect a greater degree of social differentiation, including a greater presence of grave goods with burials (though not all), and more instances of humans interred with animals. Greater continuity is evident in the presence of symbolic artifacts, including stone masks, clay figurines, and geometric tokens (Kuijt and Goring-Morris 2002; Kuijt 2004; Iceland 2013; Schmandt-Besserat 2013a, 2013b, 2013c).

Evidence for regional exchange during the LPPNB is similar to that of the previous periods, except that obsidian is less common, but there are arguments for the
continuation and elaboration of exchange networks involving flint, flint implements, and stone rings (Gebel 1996, 2010; Hermansen and Gebel 2004; Barzilai 2010).

**Pre-Pottery Neolithic C**

The Pre-Pottery Neolithic C, or Final Pre-Pottery Neolithic B, was once thought to be a period marked by an episode of site abandonment (Kenyon 1979). Work during the past three decades has demonstrated otherwise, and there are now several sites with evidence of occupation continuity or of reoccupation. Relevant sites include ‘Ain Ghazal, Wadi Shu’eib, es-Sifiya, Tell Ali, Ramad, Beisamoun, and Abu as-Suwwan. Some sites were newly occupied or reoccupied in the PPNC, including Beidha, Atlit-Yam, and Ashkelon⁵ (Figure 1.3). Additionally, there was a PPNC presence in the desert, though there are fewer known desert sites, suggesting an overall decline in population density in the drier regions. Residential architecture of the PPNC exhibits some regional differences. At sites like ‘Ain Ghazal, there are two types of residential structures: one is small rectangular structures for permanent inhabitants; and the other is “corridor”-type buildings interpreted to be “storage bunkers” for families that lived only seasonally at the site, or as basements with living space formerly above (Banning and Byrd 1987; Rollefson 1997, 1998; Banning 2004). The residential architecture at other sites relied on

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⁵ For site specific information refer to the following publications: (Garfinkel 1994 for Tell Ali; Rollefson 1998 and Rollefson and Kafafi 2013 for ‘Ain Ghazal; Simmons et al. 2001 for Wadi Shu’eib; Kuijt and Goring-Morris 2002 for additional discussion; Al-Nahar 2010 for Abu as-Suwwan; Bocquentin et al. 2011 for Beisamoun).
a variety of different building materials, such as limestone at Atlit-Yam and kurkar and mudbrick at Ashkelon. Additionally, there are some sophisticated wells at Atlit-Yam (Galili et al. 1993).
Continuing the trends evident in the LPPNB, the subsistence economy of the PPNC was more reliant on fewer species, with a lesser representation of hunted species and greater dependence on domesticates, specifically caprines, with sheep more prominent than goats. Pigs and cattle also occur in assemblages, and some argue they were domesticated (Horwitz et al. 1999). As with the faunal remains, there was a greater reliance on domesticated plant species (Kuijt and Goring-Morris 2002:407).

PPNC lithic technology displays several noticeable changes. First, at some sites such as ‘Ain Ghazal, specialized production of naviform technology ceased by the end of the LPPNB and there was an apparent decline in the presence and use of naviform cores and blades. Clear differences exist in the sickle blades and projectile points, which became smaller and more heavily retouched through time. Truncation burins and informal tools became more common (Rollefson 1990a, 1998). While such changes appear prevalent at many sites, including some of the “megasites”, they are by no means universal. According to Barzilai (2010:158), the PPNC site of Atlit Yam may contain evidence of community specialization of naviform core-and-blade technology. Additionally, some researchers have argued that there is little discernible difference between the lithic assemblages of the PPNC and PN (e.g., Nadel and Nadler-Uziel 2011).

Along with many of the noticeable changes in PPNC material culture, there are apparent differences in burial practices and symbolic artifacts. Secondary burials are more common. Some primary burials have multiple interments of two to three individuals, and grave offerings of animal bones are more common. Finally, skull removal is less common, as is the presence of figurines.
As in the previous periods, the presence of stone bracelets, mother-of-pearl pendants, carnelian, and Dabba marble in site assemblages indicate the continuation of regional exchange of some form (Rollefson 1998:118; Kuijt and Goring-Morris 2002).

**Pottery Neolithic**

The Pottery Neolithic has been subdivided in several different ways (see discussion in Simmons 2007:200). The subdivisions discussed here for the southern Levant include Yarmoukian, Jericho IX, and Wadi Rabah. The PN is not as well dated as previous periods, and there is some confusion about what is terminal PN and what is early Chalcolithic, but the approximate dates are 7,500 to 6,100 B.P. The Yarmoukian phase is the earliest, followed by Jericho IX, and Wadi Rabah (Gopher and Gophna 1993; Simmons 2007:201). PN sites in the southern Levant are most common in what is now central Israel and Jordan (Refer to Fig. 1.3), including the coastal plain, highlands, Jordan Valley, and Jordan Plateau, but the deserts to the east also have evidence of habitation and use in the form of “burin sites” and even semi-permanent seasonal villages (Rollefson et al. 1992; Gopher and Gophna 1993; Kafafi 1998; Rollefson et al. 2014).

Several major changes are evident in PN architecture. For example, plastered floors and interior hearths are no longer common, and unlike previous PPN periods, courtyards are common and large. Typical Yarmoukian dwellings are circular or rectangular and there is often evidence of storage pits (Rollefson et al. 1992; Gopher and Gophna 1993; Banning 2004). Jericho IX dwellings have stone walls and plastered pits; hut-bases, and round, sunken, mud brick structures also are present. Wadi Rabah sites often include rectangular buildings with fieldstone foundations, some of which were quite
large with several internal subdivisions. Different sizes of pits and some circular basins, lined with plaster, have also been associated with Wadi Rabah dwellings (Gopher and Gophna 1993; Kafafi 1998).

Limited information is available on late Neolithic subsistence, but there was a clear reliance on domesticated plants and animals. The domesticated animals are mainly sheep, but goats, and some cattle and pigs are present (Köhler-Rollefson 1988). Paleobotanical remains recovered from a few sites show the use of einkorn, emmer, barley, pea, lentil, bitter vetch, and flax (Kafafi 1998:135).

One of the most notable additions to the material record from the PN is the regular presence of pottery, and evidence of regional and temporal traditions (see Gopher and Gophna 1993 for a summary of characteristics by traditions). Lithics recovered from Pottery Neolithic sites show continuity with the previous PPN, including blade production, some of it being opposed-platform bidirectional cores (e.g., Sha’ar Hagolan), but they are not present at all sites and are about after the Yarmoukian (Barzilai and Garfinkel 2006; Matskevich 2011). In general, flake core reduction dominates during the PN. Small heavily retouched arrowheads and deeply denticulated sickle blades are the most distinctive tools. The most common point types are Ha Parsa, Nizzanim, and Herzliya (Gopher 1994). By the latest phases of the Pottery Neolithic, deeply denticulated sickle blades were replaced by thicker bifacially retouched and also short backed sickle blades, and arrowheads became very rare. Heavy bifacial tools were still common, but for the most part, informal tool varieties on flake blanks dominated (Gopher and Gophna 1993; Kafafi 1998:134; Matskevich 2011). Millstones are also present, and are
represented by elongated querns and hand stones. Additionally, there are clay spindle whorls, indicating the presence of spinning and cloth making (Kafafi 1998:134).

Few burials have been recovered from late Neolithic sites, so little can be stated conclusively about the regional patterning. Nonetheless, limited data suggest that burials were single interments located on-site, and there is no evidence of skull removal or grave goods (Kafafi 1998:135). Possible ritual artifacts include varieties of incised stones and anthropomorphic figurines believed to be related to fertility rites. The most recognizable of these figurines from Yarmoukian sites are those with “coffee-bean” eyes (Kafafi 1998:131). Some sites also have small male figurines and clay or stone phalli that some have argued were used in male initiation rites (Simmons 2007).

By the Yarmoukian period, regional and interregional trade is reflected in the distribution of included mother-of-pearl pendants, shells, bitumen, obsidian, and dabba marble. The PN regional exchange also included pottery. Exchange is thought, for the most part, to have been informal and carried out by individuals through “down-the-line” types of trade networks (Rollefson 1998:118; Simmons 2007:225).

As indicated in this brief review, the excavations at ‘Ain Ghazal have significantly contributed to what is known about the MPPNB through the Yarmoukian periods. The following discussion focuses on ‘Ain Ghazal, and elaborates on the history of its excavation and its immense archaeological record.
Fig. 1.4. Map of ‘Ain Ghazal with excavation units as of 1998 (adapted from Quintero 2010).

NEOLITHIC ‘AIN GHAZAL

Excavations at ‘Ain Ghazal began in 1982 in response to severe erosion along the portions of the site bordering a recent road cut, and persisted intermittently from 1982 to 1996, totaling ten seasons (Fig. 1.4). In 1998, an additional small-scale excavation occurred in the caves and rock shelters along the lowest limestone outcroppings in the East Field (Rollefson and Kafafi 2000). Finally, emergency excavations were conducted in the winter of 2011-2012 to document archaeological material impacted by renewed construction projects (Kafafi et al. 2012).
Site Setting

The Wadi Zarqa, which during Neolithic times contained a running stream (the Zarqa River), is steep-sided, but in the area where ‘Ain Ghazal is located, near the junction of two wadis from the west and southwest, the wadi opens into a shallow basin on the western side. The site lies about 720 m above sea level and is situated within the ecotone between oak-park woodland to the west and open steppe-desert to the east. The local environment today supports dry farming on the surrounding hills (Rollefson 1983:1). At the time that ‘Ain Ghazal was first inhabited, it was located near several ecological zones including oak-park woodland, desert-steppe, and a riparian region along the Zarqa River. Based on excavation findings, it appears that the area surrounding ‘Ain Ghazal was forested, primarily with oaks (*Quercus ithaburensis*) (Simmons et al. 1988:37; Rollefson and Köhler-Rollefson 1989; Köhler-Rollefson and Rollefson 1990). During subsequent periods of occupation, especially during the PPNC, timber resources declined, along with the diversity of species (both plant and animal) relied upon for subsistence (Rollefson and Köhler-Rollefson 1989).

Site Size

‘Ain Ghazal is a large site, the main part of which is situated on the western side of the Wadi Zarqa, with a small extension that was occupied in the LPPNB on the eastern side of the wadi. In total, the site covers 12 to 13 hectares (ha), or 30 to 32.5 acres (Rollefson et al. 1992).
Chronology

The occupation of ‘Ain Ghazal is divided into four major phases: MPPNB, 9,200 to 8,500 B.P.; LPPNB, 8,500 to 8,000 B.P.; PPNC, 8,000 to about 7,750 B.P.; and the Yarmoukian, 7,750 to about 7,000 B.P. The MPPNB is further subdivided into four subphases: phase 1, 9,250 to 9,000 B.P.; phase 2, 9,000 to 8,800 B.P.; phase 3, 8,800 to 8,600 B.P.; and phase 4, 8,600 to 8,500 B.P.6 In addition, transitional deposits are evident between the LPPNB and the PPNC, and between the PPNC and the Yarmoukian that could not always be clearly associated with one or the other temporal phases (Rollefson et al. 1992:447; Rollefson et al. 1994; Rollefson and Kafafi 1994).

Village Life at ‘Ain Ghazal

The following is a summary of the major material culture features. The overview focuses on residential architecture, subsistence choices, and changes in the flaked-stone assemblage, as these are likely to be most informative about changes in tool production strategies through time. For a more comprehensive overview, see Rollefson et al. (1992), Rollefson (1997) and Rollefson and Kafafi (2013).

Architecture

The architecture of the MPPNB was discussed extensively by Banning and Byrd (1987), and Byrd and Banning (1988); it was summarized in Rollefson et al. (1992), Rollefson (1997), and Banning (2004). No clear public buildings are identified from the MPPNB period. MPPNB houses consist of a large single room, and houses are situated close together with external areas consisting of terraced hill slopes. None of the houses

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6 These date ranges are based on uncalibrated \(^{14}\text{C}\) dates.
appear to have been divided by courtyard walls (Rollefson et al. 1992; Rollefson 1997:288-289). As large timber resources declined, houses were remodeled to reflect a more subdivided interior layout, often containing two or more small rooms. The walls typically were constructed of stone, and lime plaster was used to surface the floors. The houses are generally small and are interpreted as suitable for a small coresidential group, or a nuclear family. They are fairly uniform in size across the site, and display no clear differences suggesting status distinctions (Banning 2004:221-222; Rollefson 1997:289, 301-302; Rollefson 2004b, 2010). Additionally, a corner of one room may have been set aside for storage in most households, suggesting that control of storage and distribution of supplies occurred in individual households (Rollefson 1997:289, 301-302; Rollefson 2004b, 2010; Banning 2004:221-222). The small size of most dwellings in the MPPNB and the lack of courtyards suggest that most production activities (tool production, food preparation, etc.) occurred outside of the house, in plain view of passersby and neighbors. Thus, while the household appears to have been independent economically, production activities do not appear to have been private (Rollefson 1997, 2010).

The LPPNB period was marked by major increases in the population and in the areal extent of the settlement with an extension across the wadi. Additionally, excavators identified both domestic and what appear to be ritual buildings. The domestic architecture still employed ground terracing to produce level house floors as in the MPPNB, but during the LPPNB, inhabitants also began to construct split-level or terraced houses. These terraced houses are larger than MPPNB dwellings, with a ground floor that contained a series of small rooms and apparently a partial second story (Rollefson
1997:291). The population increase of the site and the accompanying enlargement of the dwellings indicate that some homes during the LPPNB may have accommodated extended family units, suggesting that significant changes occurred to the social structure of the population (Rollefson 1997, 2010). Rollefson (2004:148) has proposed that the changes associated with population aggregation may represent a social reorganization dictated in part by the “old landowners” in response to the “newcomers”. In his view, the need to reorganize land use in conditions where the amount of arable land was limited and the best lots were in use, meant newcomers likely were left with less desirable land. People may have been forced by necessity to pool their labor and land, resulting in larger coresidential units.

Perhaps associated with this situation, there is evidence to suggest that some inhabitants started to rely more heavily on herding as a more viable subsistence strategy. Herders may have started to move goat and sheep herds into the desert on a seasonal basis away from the settlements and planted crops as early as the LPPNB (Köhler-Rollefson 1992; Quintero et al. 2004). Perhaps reflecting these changes, house size and configuration are not uniform across the site; some houses are the same size as those of the MPPNB with the same kind of storage features, while others are larger and more subdivided and reflect greater emphasis on storage. Additionally, in some parts of the site domestic activities took placed in open, publicly accessible, courtyards (Banning 2004:226-227). Whatever the exact cause of these differences, it appears that households maintained their own storage and distribution of supplies.
Though it is not discussed in detail here, the LPPNB architecture interpreted to be ritual in nature includes six apsidal buildings (two of which were possibly circular shrines) and two “temples” (Rollefson 2005a). The apsidal buildings were found in the Central, East, and North fields. The two circular shrine buildings were uncovered in the North Field excavations, and one shrine contains subfloor channels. Finally, the LPPNB “temple” building was discovered in the East Field excavations, near the top of a steep slope (Rollefson 1997:292-294).

As in the LPPNB, the PPNC at ‘Ain Ghazal shows evidence of significant changes in the population and settlement size. The population of the village decreased significantly in the PPNC and the settlement became smaller in areal extent. Rollefson (1990a, 1996) attributed the PPNC patterns to the effects of years of population growth and land clearing for agriculture that led to a decline in habitat for wild species. Also contributing was overexploitation of grazing resources and timber for fuel and housing construction, which contributed to erosion and loss of arable land (Rollefson and Pine 2009). Additionally, Köhler-Rollefson (1988, 1992) argued that part of the population moved herds away from the settlement seasonally in response to the growing number of domesticated herd animals, especially goats, which would have been difficult to control during times when crops were planted7.

Perhaps in response to these and other changes, the PPNC period at ‘Ain Ghazal exhibited a diverse array of different buildings and architectural features. A typical

7 Some researchers, however, suggest the evidence for the incipient migratory pattern is not well supported by the faunal assemblages of desert sites (Martin 1999).
dwelling, which often involved digging into and remodeling an LPPNB building, appears to have been a single-room structure with some insubstantial interior subdivisions. Floors were no longer plastered, and instead were covered with a mud and chalk mixture called *huwwar*. The houses included small, walled courtyards that served as domestic work areas (Rollefson 1997:294). Another major type of domestic-related architecture is the corridor building, which consisted of a semisubterranean unit containing a series of small storage rooms. There does not appear to have been a substantial structure overlying these storage units, but likely there was a platform covering the top and it may have provided a base for some type of temporary housing (e.g., tents) (Rollefson 1997:294). In addition to the different house styles, there are possible differences in the location of production activities, which seem to have occurred, at least some of the time, in private walled courtyards.

Another architectural feature is a large wall, known as the “great wall”, in the Central Field, which may have been constructed in the PPNC. Some have suggested this may indicate segmentation of the settlement, perhaps as a result of tensions between different family groups (Banning 2004:225-226). Also in the Central Field are the remains of a walled street built first in the LPPNB but maintained through the PPNC and Yarmoukian (Rollefson and Kafafi 2013). Finally, in several parts of the site there are industrial features related to the production of *huwwar* (Rollefson 1997:298).

The dwellings of the Yarmoukian period are similar in style to the MPPNB houses except that they were larger, with thicker walls and more space between houses, and courtyard complexes. The courtyard complexes also contain what appear to have
been shade structures and exterior work areas for activities such as food processing, cooking, and, possibly pottery production. The sizes of the households and the location of storage and production activities, suggests that households again represented a small coresidential unit, which served as the basis for production of necessary goods and their consumption.

During the Yarmoukian period, the population of ‘Ain Ghazal seems to have been less than in the preceding periods, and as a result the village was smaller in areal extent and the housing was less densely situated (Rollefson 1997:298-300; Banning 2004). Other Yarmoukian dwelling types include pit-houses, and later, tents, which Rollefson, suggested were related to occasional visits from the herding component of the settlement, herders may have been living away from the village on a more permanent basis, while those who remained formed a small farming community (Rollefson 1997:300-301).

The Yarmoukian inhabitants used and maintained the “great wall” and walled street. As during the PPNC, Yarmoukian inhabitants often reused architectural features from earlier periods. In one such case, it appears that Yarmoukian people reused an LPPNB structure for public purposes. Finally, although the site appears to have been essentially abandoned after the Yarmoukian, there is sparse evidence of its use during the Chalcolithic (Zeilhofer et al. 2012).

**Subsistence**

The subsistence economy of MPPNB ‘Ain Ghazal, included a diverse array of both wild and domesticated plant and animal resources. The plant remains consisted of some domesticated varieties of wheat, barley, peas, lentils, and chickpeas, along with
wild plants that included figs, almonds, pistachios, and others. The faunal remains include approximately 50% goat with the remaining half comprised of at least 50 mammalian and other vertebrate species (Rollefson et al. 1992). Köhler-Rollefson (1989) concluded that goats were domesticated by the end of the MPPNB at ‘Ain Ghazal, though more recent work by Wasse (2002), indicated that many of the goats represented from the first phase of occupation may have been domesticated.

The subsistence economy of the LPPNB included a greater reliance on domesticated animal species, accompanied by a decline in the representation of wild species, especially gazelle. It was during the LPPNB that goats began to decline in frequency, as domestic sheep apparently were introduced from elsewhere (Wasse 2002).

Following the trends that started in the LPPNB, PPNC subsistence included a heavier reliance on domesticates. The faunal remains indicate a focus on domesticated animals, with more than 80% of the meat protein from domesticated goat, pig, cattle, and sheep (the most common taxon) (Rollefson et al. 1992; Wasse 2002). The associated change in pasturing strategy—“incipient migratory pastoralism”—would have required certain members of the community to live part of the year away from the site, which not only affected the population and social structure, but certainly also the production economies including the lithic economy (Köhler-Rollefson 1988, 1992; Rollefson and Köhler-Rollefson 1993).

By the Yarmoukian period, the pastoral component appears to have lived away from the town on a more permanent basis, but faunal remains excavated from the site suggest that reliance on domesticates increased, with 90% of the identifiable faunal
species (approximately 10) represented by domesticated animals. The flotation samples from the Yarmoukian have yielded few plant remains, even though it is likely that the inhabitants relied mostly on domesticated plant species (as was the case at other sites from the LPPNB on) (Rollefson et al. 1992:454; Asouti and Fuller 2012).

**Flaked-Stone Assemblage**

The flaked-stone assemblage has been the subject of several limited studies, most of which have focused on discrete tool types. Some have focused on context or functional issues (Quintero et al. 1997; Karnes and Quintero 2007), and there has been some attention to blank preference as it relates to tool type and debitage associated with tool production (Rollefson 1996a, 1997; Quintero 2010; Barket 2013). Other research relates to the flaked-stone assemblage and lithic economy of ‘Ain Ghazal (Quintero and Wilke 1995; Quintero 2010), and still other research includes work on resource material acquisition, and source identification and characterization (Quintero 1996; Rollefson et al. 2007). Some trends are evident from these studies and from initial laboratory analyses that occurred during each season of excavation.

During the MPPNB, naviform core-and-blade production was specialized within the village and was carried out by a few individuals who produced blade products to serve as blanks for much of the informal and formal tool kit (Wilke and Quintero 1994; Quintero and Wilke 1995). This specialized industry, however, did not result in the abandonment of generalized production, which continued and included non-naviform

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8 Some of the studies on the flaked-stone tool assemblage at ‘Ain Ghazal include: Beck (1991); Eighmey (1992); Forstadt (1993); Olszewski (1994); Rollefson et al. (1994); Rollefson (1996a); Quintero and Hintzman (2007); Hintzman (2011).
blade/let-core and flake-core reduction and tool production (Quintero 2010), much as in the PPNA and earlier Epipaleolithic. Concerning the tool assemblage, burins were a very common tool form (39%), while projectile points comprised less than 6% of the assemblage, sickle blades 9.2%, borers 8.3%, bifacial tools 5.4%, and knives 1.2% (Rollefson et al. 1992:455). Informal tools (e.g., scrapers and cutting tools) made up the rest of the assemblage (see Table 4 in Rollefson et al. 1992:455). Large projectile points with little retouch except on the haft, such as Byblos or Jericho types, dominated during the MPPNB (Eighmey 1992; Rollefson et al. 1992:459).

Associated with the major changes in population and architecture, the flaked-stone assemblage of the LPPNB still attests to a reliance on core-and-blade products manufactured by specialists, but the quality of production and resource material employed for manufacture became more variable in nature (Quintero 2010). Generalized production continued in the LPPNB, in much the same manner as in the MPPNB, but it too was carried out on a greater diversity of resource materials. In addition, while long and heavy projectile point types were still present, by the end of the LPPNB, points were more heavily retouched and smaller in size. In terms of the representation of different tool types, burins (27.6%) are less common, and knives (16.7%), especially bifacial forms, are more common (Rollefson et al. 1992:455).

The PPNC flaked-stone assemblage appears quite different when compared to those of the previous periods (especially the MPPNB). First, specialized production ceased at the end of the LPPNB, as indicated by the increased reliance on flakes as tool blanks and scavenging of blades and tools from older contexts. The loss of specialized
production had a noticeable impact on the tool kit, including a clear diminution in the size of projectile points. In addition, sickle blades and projectile points were more heavily retouched, suggesting either intensive use, or production from less desirable blanks (Rollefson et al. 1992; Quintero 2010). Preliminary published results indicate that certain tool categories, such as burins (26.4%), remained similar in representation, while nonformal tool forms increased (Rollefson et al. 1992:455).

Representing a continuation of the patterns started in the PPNC, the flaked-stone tool assemblage from the Yarmoukian period depended heavily on flake blanks, recycled/reused/scavenged blade fragments, and recycled tools from previous periods (Quintero 2010). Preliminary published results indicate that burins remained common (29.8%), as did many of the nonformal tool types. Projectile points and sickle blades are similar in proportion to previous periods (3.2% and 2.4% respectively) (Rollefson et al. 1992:455). Of note is the dominance of small point types, and as in the PPNC, the projectile points and sickle blades of the Yarmoukian period are heavily retouched (Eighmey 1992; Rollefson et al. 1992; Quintero 2010).

**Other Tools**

The flaked-stone assemblage throughout the occupation facilitated the production and maintenance of other tools. The other well-preserved tools include bone tools, and milling equipment. Bone tools are comparatively rare and tend to have been used primarily for sewing and weaving. The millstone assemblage, which was mainly made from limestone and basalt and was percussion flaked and pecked to shape, has not been
extensively studied. Common identifiable tool types include mullers, querns, pestles, mortars, rubbing stones, and vessels (Rollefson et al. 1992:460).

Another industry, perhaps less reliant on lithic tools, that appeared during the Yarmoukian period is pottery. Though fired potsherds were found in earlier contexts, it was not until the Yarmoukian that pottery ‘traditions’ became evident. The pottery typical of the Yarmoukian period at ‘Ain Ghazal includes jars, bowls, “craters”, and cup forms (Kafafi 1990; Rollefson et al. 1992). Research conducted thus far indicates that there may be two phases: an early phase typified by red painted or red slipped pottery, and a later phase designated by the addition of chevrons and banded herringbone incisions (Rollefson et al. 1992:460).

**Mortuary and Ritual Practices**

Also providing insight into the overall sociocultural trends from the MPPNB through the PN at ‘Ain Ghazal are burial practices and ritual artifacts. During the MPPNB, the most common burial for noninfants was subfloor interment in a flexed position with the skull removed. Some of these burials are interpreted to have been people of high regard. Additionally, a few skulls recovered during excavation retained plaster intended to recreate soft-tissue facial features. About one-third of the burials were found in trash deposits with the skull intact. Infants most commonly were interred in trash deposits with the skull attached, but some were found in subfloor burials or foundation deposits. Secondary interments were also present towards the end of the MPPNB (Rollefson et al. 1992:461-466). It is worth mentioning that up to 80% of the burials from the MPPNB (and perhaps the LPPNB) are “missing” since it appears that
only one person from each household was buried each generation (Rollefson 2004a). Remains have been recovered from the LPPNB, but due to later occupations and disturbances, preservation of burials was minimal. It does appear, however, that subfloor burial and skull removal were still practiced (at least in the early LPPNB), but there is no definitive evidence of skull plastering (Rollefson et al. 1992:463; Rollefson 1997). The human burials associated with the PPNC are more numerous than those from the LPPNB, but later Yarmoukian construction and pit digging disturbed many burials. It is clear, however, that there were significant differences in the burial patterns from the previous PPNB periods. Chiefly, skull removal ceased, indicating that the belief systems or ritual practices common in the PPNB were no longer practiced (Rollefson et al. 1992:464).

Unfortunately, Yarmoukian contexts yielded only one burial, so little can be concluded about mortuary patterns at this time, except perhaps that the village inhabitants may have mainly buried their dead off site (Rollefson et al. 1992; Kafafi et al. 2012).

With regard to the ritual/symbolic artifacts, there are several categories and clear change through time in frequency and types (Schmandt-Besserat 2013). The MPPNB ritual/symbolic artifacts include human and animal figurines, large plaster statuary, and plastered skulls. Interestingly, some of the clay animal figurines have flint bladelets embedded in them, which suggests ritual or symbolic killing (Rollefson et al. 1992:466). The ritual and symbolic artifacts recovered from the LPPNB are fewer in number and variety than in the MPPNB. Likewise, they are not common in PPNC deposits, and are not always well made, but the Yarmoukian period deposits yielded five figurines,
including “coffee bean” eye figurines and one token (Rollefson et al. 1992:466; Schmandt-Besserat 2013:123-124).

Summary

It is clear from the material record of ‘Ain Ghazal and for the southern Levant that over the span of several thousand years there was substantial change, and a number of instances of continuity. It is also evident, though admittedly somewhat glossed over by any review of trends, that across the Levant the transformations that occurred and the behaviors that stayed the same were rarely universal in their timing and extent; that is, there was considerable variation from site to site. One commonly cited line of evidence for tracking change is lithic studies, which have long played a major role in establishing chronology and examining trade relationships. There is much more, however, that can be derived from these studies, and in the past few decades, such research has become increasingly common (e.g., Wilke and Quintero 1994; Quintero and Wilke 1995; Gebel 1996; Barzilai 2010). This growing body of research includes considerations of specialization and inter- and intra-site interactions as indicated by production techniques and resource material use, which is then related to models of social organization. The research presented here, though focused on one site, is intended to elucidate intra-site socioeconomic interactions as indicated by household tool-production choices and common usage needs, which will contribute, through comparison, to the growing understanding of social organization in the Levant.
Chapter 2
NEOLITHIC ECONOMIES

In the southern Levant, Epipaleolithic bladelet industries geared towards the production of microlithic hunting technology continued to influence PPNA lithic technology, as suggested by a continued production of bladelets and microlithic elements. Blades, blade tools, blade cores, and bifacial tools including tranchet-bit axes and adzes, however, were more common during the PPNA (Finlayson et al. 2003; Simmons 2007). PPNB industries have some continuity from the PPNA, including a continuation of generalized industries aimed at the reduction of blade/let cores and flake cores to serve as tool blanks for blade and flake tools. Despite these similarities, differences exist within PPNB flaked-stone technology, which may be due to several factors, including technological influence from the north, tool demands of a larger population, and a developing reliance on domesticated plants and animals that created new tool needs. Some of these changes influenced the flaked-stone tool kit by creating greater demands for the use of standardized tools (e.g., sickles and projectile points). The resulting industries emphasized well-organized percussion-blade production. These blade blanks provided the basis for much of the formal tool kit, along with the continued production of flake cores, flake tools, and bifacial tools (Quintero and Wilke 1995; Barkai 2005).

The most common blade-production strategy was based on naviform cores, a type of bidirectional, opposed-platform blade core, which is represented in many PPNB sites in the southern Levant, including Abu Gosh, Abu as-Suwan, ‘Ain Ghazal, ‘Ain Jammam, Basta, Beidha, Beisamoun, Ghwair I, Munhata, Wadi Shu’eib, Yiftahel,
Jericho, and others\(^1\). It seems that the reliability and convenience of the standardized products from naviform core-and-blade technology resulted in its specialization at some sites during the PPNB (Quintero and Wilke 1995; Gebel 1996; Khalaily et al. 2000; Barzilai 2010). Several formal tool types were made on these blade products including projectile points, borers, sickle blades, knives, etc. (Mortensen 1970; Gopher 1994; Quintero 2010). In addition to naviform core-and-blade production, there was a significant amount of generalized non-naviform blade and flake production, on which most informal tools were produced (Mortensen 1970; Rollefson et al. 1994; Gebel 1996). There was a bifacial component, including a notable presence of ground axes and adzes (Barkai 2005; Quintero and Hintzman 2007).

The presence at some sites of a specialized lithic economy that operated alongside of and interacted with a generalized household lithic economy created a dual economic structure. This was a new development in the southern Levant in the PPNB. Nonetheless, most PPNB sites do not appear to have had a dual economic structure that involved specialization. At these sites, core reduction and tool production were carried out by most inhabitants. Some suggest there is evidence also of imported blades and blade tools at some sites, including Ayn Abū Nukhayla (Nowell et al. 2014) and Abu Gosh (Marder et al. 2011). At sites that appear to have had specialization in naviform core technology (or some variation of opposed-platform bidirectional-blade technology) the structure of the lithic economy was different. And while the possibility and extent of specialized

\(^1\) See the following publications for information relevant to the blade industry of each site: (Mortensen 1970 for Beidha; Lechevallier 1978 for Abu Gosh and Beisamoun; Garfinkel 1987b for Yiftahel; Gopher 1989b for Munhata; Gebel 1996 for Basta; Quintero and Wilke 1995 for ‘Ain Ghazal; Clegg 2001 for Ghwair; Simmons et al. 2001 for Wadi Shu‘eb; Simmons and Najjar 2003 for Ghwair; Rollefson 2005b for ‘Ain Jammam; Al-Nahar 2006 for Abu as-Suwwan; Wilke et al. 2007 for ‘Ain Jammam).
production at many sites is a growing topic of research in the Levant, little attention has been devoted to understanding the interaction between these two economies.

The following sections review the growing body of research on lithic specialization in the southern Levant and what work has been done to examine the lithic economy at sites with specialization, followed by what these findings indicate about the organization of production.

CRAFT SPECIALIZATION IN THE LEVANT

The early work on craft specialization in the Near East included that by Childe (1951) and Redman (1978), both of whom associated craft specialization with the origins of urbanism. More recently, work by Rosen (1989) suggested the first clear signs of craft specialization arose in the Canaanean blade tradition of the Early Bronze Age in the southern Levant. His argument for craft specialization relied on a core-to-product ratio. That is, at a given site, numerous products and few or no cores indicates the technology was produced off-site, and the presence of numerous cores with few products designates a production site. In this manner, he examined some of the major tool traditions of the Early Bronze Age, Chalcolithic, and Neolithic and found no clear evidence of craft specialization until Canaanean blade production (Rosen 1989:111). While this approach did detect specialization, the use of a core-to-product ratio as the primary measure in the identification of specialization in small-scale villages could be misleading.

The first suggestions of specialization during the PPNB appear in research related to the production of plaster, which was a common component of dwelling construction at PPNB sites. Early research indicated that the production of lime plaster required a
complex arrangement that involved the organization of community participation (Garfinkel 1987a; Rollefson 1990; but see Goren and Goring-Morris 2008). Whether or not plaster production truly represents a specialized industry, it hints at the fact that the economies of some PPNB villages were becoming more complex.

It was not until the mid-1990s, however, that the issue of craft specialization was systematically studied at several sites in the southern Levant. Quintero and Wilke (1995) and Quintero (1997, 1998a, 2010) identified the presence of specialization in the PPNB naviform core-and-blade industry at ‘Ain Ghazal. Since their work, there has been recognition of craft specialization of naviform core-and-blade production at the PPNB sites of Yiftahel in Israel (Khalaily et al. 2000, 2007; Barzilai 2010) and Basta in Jordan (Gebel 1996), and possibly also in the production of limestone and sandstone rings at Ba‘ja and Basta in Jordan (Gebel and Bienert 1997; Gebel and Hermansen 2000), beads at MPPNB sites in the Hisma (Fabiano et al. 2004) and PPNC seasonal sites of Jilat 13 and Jilat 25 (Wright et al. 2008).

Though there were other specialized crafts, the following discussion focuses on specialized naviform core-and-blade production, including the parameters used to define and detect specialization and the supporting evidence. This understanding is important because the features used to identify lithic specialization influence the approach to recognizing generalized production for this region and time period as well. The list of sites where naviform technology is thought to have been the realm of specialists is still short: ‘Ain Ghazal, Basta, Yiftahel, and probably Wadi Shu‘eib and Abu as-Suwwan (Gebel 1996; Simmons et al. 2001; Al-Nahar 2010; Barzilai 2010; Quintero 2010).
research at other sites, such as Aviel in Israel (Barkai and Biran 2011) may display a similar pattern.

The first thorough examination of specialized production in the PPN of the Levant was by Quintero and Wilke (1995) on the naviform assemblage from ‘Ain Ghazal. To identify the presence of craft specialization, Quintero and Wilke (1995: 27) considered several technological conditions. These included a high level of skill and craftsmanship, technical difficulty involved in production, access to difficult-to-acquire or costly resource materials, standardization in production, efficiency in production, specialized production tool kits, and common strategies for error reduction and correction. Additionally, Wilke and Quintero (1994) conducted replicative experiments that demonstrated that the production of blades from naviform cores at ‘Ain Ghazal met most of these criteria. From this work and archaeological evidence from workshop localities containing all stages of manufacture, they concluded that a few part-time specialists produced naviform cores on high-quality flint, mined from the nearby Wadi Huweijir2, and reduced them to blades for the rest of the community (Quintero and Wilke 1995:27; see also Quintero 1996).

Gebel (1996) also identified naviform core-and-blade specialization at Basta. His discussion of the parameters and evidence for identification is less explicit, but it appears he relied on some of the same measures as Quintero and Wilke (1995). The workshop dumps from LPPNB deposits at Basta show that typically two or three types of resource

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2 This flint is part of the Amman Silicified Limestone (ASL) Formation of the Belqa Group, of Late Cretaceous age. It is one of many similar cretaceous-aged sources identified in Jordan (Quintero 1996; Rollefson et al. 2007). The source apparently relied on at ‘Ain Ghazal during the Neolithic is located 2 km from the site in Wadi Huweijir, where it was quarried and mined. The use of the term “Huweijir flint” throughout refers to this particular source location.
material dominated in the production of naviform cores and blades at a given workshop and made up 70% of the resource material at the site. Flint procurement seems to have been carried out near the town, but there is no evidence of systematic mining, or of initial core preparation or shaping at the sources. All stages of the initial core production are present in the waste dumps, and the specialized workshops appear to have been spatially segregated from other site activities. The contextual evidence for who may have conducted tool production on naviform core products is not entirely clear, but there is some argument that specialists produced some formal tools (namely, borers and pressure-flaked exotic forms). Finally, Gebel (1996) and Nissen et al. (2004) suggested that the mass of blanks that were produced might have been so great that they were for both local consumption and for trade.

Recently, Barzilai (2010) completed research on “bidirectional” core-and-blade assemblages from several sites, primarily in the western portion of the southern Levant. His aim was to identify variations in bidirectional, opposed-platform core-and-blade production in order to approach issues of cultural identity and social complexity. He focused specifically on a “regionalism model” (Bar-Yosef and Bar-Yosef Mayer 2002) in order to examine proposed cultural units for the southern Levant. His data were taken from sites within four regions: the northern province (sites include Horvat Galil, Kfar HaHoresh, Munhata, Yiftahel, Beisamoun, and Atlit-Yam); the central province (sites include Nahal Hemar, Motza, Abu Gosh, ‘Ain Ghazal, Cave XII, and Horvat Rabud); the southwestern province (sites include Abu Salem, Nahal Dushon, Nahal Lavan, Nahal Nizzara, and Ramat Matned); and the southeastern province (sites include Beidha, Nahal
Re’uel, Shaqarat Msaied, Nahal Shacharut I and II, Ayn Abū Nukhayla, Basta, and Nahal Issaron).

Barzilai (2010: 141-143) proposed three variants of bidirectional core-and-blade production in the southern Levantine PPNB assemblages. The first he called “predetermined upsilon”, which he argued is the reduction strategy associated with “naviform” core technology and was most common in the northern and central regions. The second variant was the “single dominant platform” which was most common in the southwestern Negev. The third variant was the “one-on-one” technique, which he recognized in the central and southeastern provinces.

To identify the presence of specialized production, Barzilai (2010) examined resource material choice, core management and maintenance strategies, blade production strategies, productivity, and tools and projectile points made on naviform products at each of the examined sites. Additionally, he relied on parameters proposed by Costin (1991) and Clark (1995), including context (attached or independent specialization), concentration (spatial organization of the producers and consumers), scale (quantities of produced items), and intensity (part-time vs. full-time) (Barzilai 2010). From this scheme, he (2010: 151-154) proposed that three types of part-time independent specialization had existed in the southern Levantine PPN: individual specialization, which reflected a lower level of skill and productivity; dispersed workshops, which reflected a moderate degree of skill and productivity; and community specialization, which reflected a high degree of skill and productivity. He also associated the three specialization types with settlement size, and found that community specialization was
present in large permanent villages, dispersed specialization was common in small seasonal villages, and individual specialization was typical in forager camps (Barzilai 2010: 152-153).

Barzilai’s “community specialization” offers the clearest signature of specialization, which was proposed for large regional centers such as ‘Ain Ghazal, Basta, and Yiftahel (Barzilai 2010: 152-153). At Yiftahel, which is a mid- to late-PPNB and PN site (Garfinkel 1987b; Garfinkel et al. 2012), there is evidence of craft specialization of the blade industries (Khalaily et al. 2000, 2007; Barzilai 2010; and Garfinkel et al. 2012). In fact, around 70% of the cores from the PPNB layers were naviform cores, and excavators conclude, based on the presence of workshops and estimated productivity, that the amount of production was so great that it could not have been solely for local use and must also have been for exchange3 (Khalaily et al. 2000; Barzilai 2010; Garfinkel et al. 2012:170, 295). The excavated workshop dumps are from areas C, E, and F, and according to Barzilai (2010:55), evidence of spatial staging is indicated by initial core production and preforming conducted at the resource material extraction site before removal to workshop areas, such as those found at Yiftahel. About 95% of the flint at Yiftahel is of a type called HaSollelim flint. It comes from nearby flint outcrops (such as the nearby Triangulation Point Q-1) and is typically brown-beige in color, but there is some evidence of an imported(?) and possibly heat treated “silky” resource material in

3 Productivity was estimated by Barzilai (2010:35) to have average around 29.6 intended blades per single blade-core reduction sequence. Barzilai and Goring-Morris (2013) provided a full discussion of the approach used to estimate productivity of naviform core reduction. Despite the seemingly high productivity estimates, little has been said about the relationship between productivity and population estimates, or consumption per household, per year.
excavation Area C, also skillfully reduced with the naviform technique (Garfinkel et al. 2012:93-94).

Finally, though only limited studies have been reported for Wadi Shu‘eib and Abu as-Suwwan, both have indications of specialization of naviform core-and-blade production. Based on the initial excavations at Wadi Shu‘eib, that site appears similar to ‘Ain Ghazal and Abu as-Suwwan in the length of site occupation, site size, and the lithic economy (Simmons et al. 2001). Cores and products from naviform technology are common and seven loci in excavation Area 1 appear to have been associated with a “chipping station,” suggesting naviform core reduction technology was specialized.

As with Wadi Shu‘eib, Abu as-Suwwan is still in the initial stages of investigation, with limited excavations and ongoing analyses, but preliminary reports offer some information on the lithic assemblage and insight into the lithic economy. Abu as-Suwwan appears to have been occupied continuously from the MPPNB to the Yarmoukian, and so far characteristics are noted in architecture, site size and placement, and material culture to suggest that it is part of the megasite phenomenon (Al-Nahar 2010). The flaked-stone assemblage includes a large number of naviform cores, and based on the standardized characteristics of the naviform cores and products, and their abundance, it has been suggested that they were produced on-site by individuals who likely were specialists (Al-Nahar 2006, 2010). As at ‘Ain Ghazal, naviform cores and blades were made on a high quality flint from a source that is thought to be nearby, but has not been identified and reported.
In summary, lithic craft specialization appears to have arisen initially at some sites during the MPPNB in the form of naviform core-and-blade production. Since its identification, the focus has been on specialized production, but there has been little explicit attention to the nature of household production or the interaction of the two economic strategies.

**HOUSEHOLD PRODUCTION IN THE SOUTHERN LEVANT**

At each of these sites some preliminary insight is possible on the patterns of household production of stone tools. First, for Basta, Gebel (1996) concluded that household production encompassed flake production, bidirectional core production that imitated naviform, and nonformal and ad hoc tool production, along with the recirculation (recycling and reuse) of discarded and worn out flaked-stone artifacts (including naviform cores reused as hammerstones). Additionally, he detailed the contents of a deposit that excavators interpreted to be a primary context where blade blanks apparently were manufactured into an array of different tool types (although the exact composition of the tool assemblage that was produced is unknown). Given the wide array of tool types that appear to have been produced, it may well represent a nonspecialized tool production deposit (perhaps a community flintknapping locus?). In addition to the presence of such deposits, Gebel (1996: 268) asserted that specialized production also included the production of some formal tool classes, specifically, borers, pressure-flaked exotic forms, and projectile points. He noted, however, that the evidence for tool production in workshop dumps is not abundant, concluding that this may be because the tools were mostly removed for use.
At Yiftahel, naviform core-and-blade production may have been the dominant core reduction strategy, with the blanks produced used for projectile point and sickle blade manufacture, but a second strategy included the reduction of “amorphous” cores\(^4\) to create blanks for the production of small- to medium-size ad hoc flake tools. It is assumed here, though not explicitly detailed in much of the literature, that the ad hoc tool production was carried out by most households at Yiftahel. In general, excavators suggest domestic flint working occurred in open plastered courtyards associated with dwellings (Garfinkel et al. 2012:293). Additionally, as part of the ad hoc tool production, excavators noted that naviform cores and core by-products were taken to other locations within the site and used as tool blanks (Marder et al. 2011:424; Garfinkel et al. 2012). Disregarding the possibility of recycling and scavenging, excavators suggested that in general behaviors associated with the conservation of tools were not common. For instance, among sickle blades, recycling seemed uncommon in most areas of the site (except in level C4), and there were few multiple-use tools, which they proposed demonstrated that inhabitants were not concerned with being economical in their choices (Khalaily et al. 2000; Marder et al. 2011). Additionally, tool frequencies appear low in relation to the number of cores.

Interestingly, at Yiftahel excavators found several caches in and around buildings 500 and 501 in Area 1 during the 2007-2008 excavations. One cache (L5047) represented a collection of flint tools and blades proposed by Khalaily et al. (2013:226-227) to be a “tool kit” cache. This conclusion was based on its small size, about 20 items, including

\(^{4}\) Amorphous is a commonly used but senseless term that means ‘without form’. What is meant is “single-platform”, or more often, “multiple-platform” flake cores.
unretouched blades, sickle blades, and burins; a comparison with other sites that contained similar caches (e.g., Beisamoun) supported this conclusion. The larger caches (L4196 and L5068), interpreted to be indoor workshops focused primarily on the production of projectile points, contained over 100 items including blades, projectile points, and other artifacts associated with tool manufacture (e.g., asphaltum on flakes) (Khalailly et al. 2013: 224-227). Based on the presence of these caches in and near buildings interpreted to serve communal functions (e.g., 501 and 502), and the apparent specialized naviform core and blade production, Khalailly et al. (2013:228) concluded that the caching activities associated with tool production in Area 1 “were among the activities performed within the PPNB community tasks at Yiftahel”, implying that they too were specialized.

Given the preliminary nature of investigations at Wadi Shu’eib and Abu as-Suwwan, little can be said specifically about household-level lithic production, but what has been published provides some insight and parallels with other sites. At Wadi Shu’eib, the best-represented period, at least in terms of the flaked-stone assemblage, is the PPNC, and as at ‘Ain Ghazal, use of flakes as tool blanks became more important through time, as did bifacial tool technology. Some changes among the tools also are suggestive of changes in the lithic economy affecting manufacturing choices. For example, Simmons et al. (2001) noted several larger points in the PPNC and PN that appear to be intrusive from earlier periods, indicating that scavenging from earlier deposits may have occurred.

5 The discussion presented in Khalailly et al. (2013:228) for specialization of some tool production activities at Yiftahel is ambiguous and detailed parameters are not discussed, but a similar contention has been made more generally by Barzilai (2010:154) in reference to any finely made projectile points.
Other conservation behaviors are suggested by more extensive retouch on sickle blades and projectile points through time, possibly reflecting resharpening.

Based on the published information and illustrations, at Abu as-Suwwan the tools and manufacturing choices appear to be similar to those at contemporaneous sites. Unfortunately, because the work is still so preliminary, few conclusions can be drawn about changes in the lithic economy; but specialization seems probable, at least in the PPNB, and this would have created a dual economy (Al-Nahar 2006, 2010). The role of household production and its interaction with the specialized economy, however, remains to be determined.

Perhaps most work has been conducted on the ‘Ain Ghazal assemblage, and though the primary focus of her research was on naviform core-and-blade production, Quintero (2010) also examined domestic lithic waste dumps and observed that these contained evidence of tool production from flakes and blade blanks. Among deposits identified to be from the MPPNB, she found tool production debris characterized by projectile point preforms, partially formed projectile points with manufacturing breaks, numerous burin spalls, chamfered-bit spalls, and blade fragments left from sectioning blades. Additionally, retooling activities were evident, and less standardized blade forms and tool blanks were present in these deposits (Quintero 2010:127-130). From the LPPNB contexts, Quintero (2010: 130) identified two secondary deposits with tool production debris from flakes of a variety of resource materials and from some non-naviform blade products. At least one of the deposits had debitage from axe/adze production. Both deposits contained evidence of retooling and tool recycling debitage.
Additional evidence for domestic tool production at ‘Ain Ghazal was reported by Quintero and Hintzman (2007), who found debris from axe/adze production in interior and exterior fill and dump deposits that likely represent domestic household trash, and in household knapping areas. They argued that the pattern of production and use associated with woodworking tools reflected a “consistent, town-wide behavior of tool production, use, and disposal primarily in domestic areas.” Thus, the economic organization of production, use, and discard of woodworking tools occurred within individual households (Quintero and Hintzman 2007:199-202). Moreover, the presence of an MPPNB cache of blades under a house floor at ‘Ain Ghazal, with blanks suitable for manufacture into several different formal tool categories demonstrated that individual households obtained blades from village specialists, cached these blade blanks for future use, and manufactured their own tools on an as-needed basis (Karnes and Quintero 2007). The presence of caches from similar contexts such as at Beidha, Yiftahel, Motza, Ayn Abū Nukhayla and Nahal Issaron suggests the pattern was widespread (Mortensen 1988; Barzilai and Goring-Morris 2007; Barzilai 2010; Nowell et al. 2014).

Quintero (2010) also investigated the PPNC and Yarmoukian lithic industrial pattern at ‘Ain Ghazal and found that naviform core-and-blade production ceased by the PPNC, and the presence of naviform core products in these later contexts can be attributed to scavenging. During these periods, tool production was of a generalized domestic nature, with blanks and tools made by many community members.
ORGANIZATION OF PRODUCTION AND DISTRIBUTION

Concerning the organization of production and distribution at ‘Ain Ghazal, Quintero and Wilke (1995: 28) and Quintero (1998a, 2010) concluded that the specialized naviform core reduction industry was carried out by part-time specialists in a few households who supplied the immediate community with standardized blade blanks. They related this level of organization to cottage industries (Prentice 1983) and argued that at this incipient stage of specialization there would have been no complex distributional networks; thus, ‘Ain Ghazal and similar communities likely had autonomous economic structures.

Conversely, Barzilai (2010) argued for a higher level of complexity, in which specialists at large sites such as Basta, Yiftahel, Abu as-Suwwan, and ‘Ain Ghazal produced enough blade products from reduction of naviform cores to supply not only their own settlements, but also several smaller settlements and ceremonial centers. To construct the hypothesized trade relationships, he reviewed research on the visual sourcing of resource materials from several sites and concluded that only a few source localities supplied each region (a conclusion not supported in other flint resource studies: Quintero 1996; Rollefson et al. 2007). Based on his perception of the evidence, he constructed several possible trade routes for the movement of these products. The networks Barzilai (2010: 154-156) proposed included a “purple/pink flint network” during the EPPNB-MPPNB with proposed northern and southern routes, a “HaSollelim flint network” operating during the MPPNB in the north, a “Bastan flint network” operating during the LPPNB in the southern Transjordan, and a “forager circulation
network” in the Negev. In this model, the northern route of the purple-pink network originated near Abu as-Suwwan and followed two branches to sites such as Mishmar Ha’emeq, and Kfar HaHoresh. The southern route was said to have originated at the Huweijir source near Ain Ghazal, and dispersed to sites such as Jericho and Motza. The HaSollelim flint was reduced at Yiftahel before dispersal to nearby sites. The Bastan flint network, which operated in an apparent core-periphery pattern, consisted of flint procurement at ‘Ain Abu al-Idam and Jiththa flint outcrops near Basta, where the material was reduced in workshops at Basta before transport to sites such as Ba’ja. Finally, the “forager circulation network” in the Negev consisted of the movement of final products between different seasonal groups (Barzilai 2010:154-156).

Barzilai’s (2010) model suggests a high level of complexity in the organization of production, with indications of “spatial staging”. For example, he (Barzilai 2010: 154) proposed that at ‘Ain Ghazal, cores and blades were produced and traded to settlements such as Jericho, where blade products were also produced and then dispersed out to other settlements. The distribution to a number of different sites through a complex series of trade networks indicates a highly coordinated effort. To fit this model into the larger social context, he connected it with territorial distinctions and argued in support of the regionalism model presented by Bar-Yosef and Bar-Yosef Mayer (2002). This trade network model, however, should be viewed with caution, especially given that until recently there has been little attention to the identification of mines and quarries, or likely flint sources (Taute 1994; Quintero 1996; Barkai et al. 2007; Rollefson et al. 2007; Schyle 2007; Delage 2007). However, regarding the purple/pink sources Rollefson et al.
(2007) identified numerous sources of this flint throughout the highlands of Jordan, and even into the black desert of Jordan, thus, it is highly likely that such flint was more widely accessible.

Ali (2010) made similar arguments for social groups and exchange networks in the southern Levant from the Natufian to the MPPNB based on correspondence analyses of tool classes, methods and techniques of manufacture, and spatial distribution, in an effort to differentiate social networks through time. Additionally, Gebel (1996) made other arguments for regional trade networks in the PPNB, and suggested that Basta was a production site for blade blanks detached from naviform cores that were dispersed within and beyond the local settlement. A similar situation was proposed for the sandstone and limestone rings, which were produced at Ba’ja and mainly traded into Basta (Gebel and Bienert 1997; Hermansen and Gebel 2004; Michiels et al. 2012).

Finally, in a recent publication about social complexity in the ancient Near East, Price and Bar-Yosef (2010: 160) argued that the presence of specialized production of naviform cores at some sites reflected the emergence of craft specialization and possibly the appearance of nomadic craftsmen moving from one village or town to another. Similarly, Belfer-Cohen and Goring-Morris (2011: 215) speculated about the potential emergence of protoguilds involved in crafts such as naviform core-and-blade production in the PPNB. They too see the possibility of itinerant craftsmen and the dissemination of products through a network of artisans. It is not unreasonable to argue, however, that for nomadic craftsmen of this sort to exist, they would have been effectively “full-time” specialists, no longer able to participate consistently in subsistence pursuits associated
with settled living. They would have had to exchange goods for necessities on a consistent basis or have had some kind of supporting patron or institution (Brumfiel and Earle 1987; Clark 1995), a pattern that is not well-supported by the current evidence in the southern Levant.

In summary, the two primary models for PPNB lithic economy, Quintero and Wilke’s (1995) autonomous village-based model of craft specialization and Barzilai’s (2010) model of specialized products disseminated through trade networks are not necessarily mutually exclusive. There appears to have been considerable intersettlement diversity and some communities are likely to have been more independent than others, and to have had easier access to resources such as quality flint, than others. The models do imply different levels of overall socioeconomic complexity; an issue that is likely to remain unclear until there is further work on specialized and generalized production in the PPN of the southern Levant.
Chapter 3
SOCIAL ORGANIZATION AND REGIONAL INTERACTION

It is not possible to conceptualize properly the lithic economies and distribution of lithic products within individual settlements or regions without an understanding of potential underlying social and economic environments that they both influenced and were influenced by. The following discussion presents some of the current models proposed to explain the socioeconomic organization of Neolithic settlements and regions in the southern Levant and the role of lithic studies in these models.

Attempts to describe and understand pan-Levantine social complexity and organization during the PPN involve similar lines of evidence, including mortuary practices, types of architecture, flaked-stone tool technology, long-distance trade, and ritual/symbolic expressions (as discussed in the previous chapters). Models developed in the last few decades have attempted to move past reliance on environmental explanations, but interpretations of the available evidence vary widely. These follow several general trends, including cultural-historical approaches (e.g., Bar-Yosef and Belfer-Cohen 1989; Cauvin 2000; Bar-Yosef and Bar-Yosef Mayer 2002; Kozlowski and Aurenche 2005; and elements of Watkins 2008); polycentric models (e.g., Gebel 2004b, 2010; Rollefson and Gebel 2004; Finlayson 2013); social approaches (e.g., Kuijt 1996, 2000a; Cauvin 2000); and a convergence between cultural-historical and social approaches (Asouti 2006)\(^1\).

\(^1\) Recent publications by both Asouti (2006) and Watkins (2008) provide comprehensive criticisms of some of these categories and their related models.
One of the well-known models for social and economic organization during the PPN is the “interaction sphere” model originally applied in the present context by Bar-Yosef and Belfer-Cohen (1989), but elaborated on by Bar-Yosef and Bar-Yosef Mayer (2002) and Belfer-Cohen and Goring-Morris (2011). The primary argument is that the Levant was comprised of independent cultural systems, which over time developed mutual dependence for exchange items (food, resource material, commodities) under conditions of abundance. Researchers asserted that concomitant with the growth of large sites in the seventh millennium, there was evidence of greater territoriality and inter-site hierarchies that reflected the beginnings of socioeconomic differences. They designated these sociocultural units as territorially organized nonegalitarian tribal societies, and defined them based on the distribution of ceremonial centers, architectural house types, technical aspects of heavy-duty tools (axes and adzes), the frequencies of various projectile point types, skull plastering and related mortuary and symbolic practices, and more recently, evidence of craft specialization and exchange of flaked-stone goods (Barzilai 2010). The cultural units of the southern Levantine Neolithic consisted of farmers and herders in the Mediterranean core region, herders and hunters in the eastern deserts, and mobile foragers in the Negev, Sinai, and southeastern Jordan (Bar-Yosef and Bar-Yosef Mayer 2002: 360-361). Increasingly frequent interactions between the groups involved in the interaction sphere (through trade and proximity) resulted in accelerated social change and stratification, and intensified exchange between settlements in the Mediterranean core area and hunter-gatherer groups in the semi-arid zones; these activities resulted in the spread of ideas and cultural practices, generally beginning in the

Though prominent, the interaction sphere model is not without criticism (Gebel 2002, 2004; Rollefson 2004b; Asouti 2006; Watkins 2008). Critics regard it as essentially cultural-historical, glossing over the degree of diversity that existed within these regions. Likewise, it presents an overly simplistic duality between the village sites of the Mediterranean “core” and the forager sites of arid and semiarid desert “margins”. Such an interpretation evokes a problematic core-periphery type of interaction, in which “core area” sites are seen as setting the pace for social and economic development in the whole region (Asouti 2006: 99; Watkins 2008) which is not necessarily supported by the archaeological record in “marginal” zones (e.g., Henry et al. 2014).

Other essentially cultural-historical approaches include that of Kozłowski and Aurenche (2005) and Cauvin (2000). First, Kozłowski and Aurenche (2005) proposed territorial boundaries based primarily on material culture features such as stone tool industries, reduction techniques, and projectile point styles. They argued for the independent emergence of several distinct cultural entities, and in an effort to move away from the common cultural-historical period designations, they suggested the use of the term BAI (Big Arrowhead Industries), which relied on the widespread pattern of large “arrowheads” (also see Kozłowski 2001). Relying on this information, they mapped out the borders of these entities and identified one region that appeared to be culturally dominant. This “core” region, called the “Golden Triangle”, where the earliest
domestication took place and structured villages first developed, included northern Syria and southeast Anatolia. The innovations then spread to other distinct cultural regions, reaching the southern Levant in the MPPNB.

A similar cultural-historical model for Neolithization and pan-Levantine interaction is that of Cauvin (2000), who relied on social and cultural forces, rather than environmental or subsistence related drivers. Cauvin (2000) proposed that the material cultural patterns recognized as typical of the PPNB arose in the Middle Euphrates (the cultural heartland) and dispersed to both the northern and southern regions through population movement. In support of his model, he drew from the familiar list of material culture similarities including production techniques and projectile point styles as indicators of cultural affiliation, all of which were part of a dominant cultural ideology. He contended that the EPPNB culture arose in northern Syria and spread first to Anatolia (Göbekli and Çayönü). The MPPNB in the southern Levant was attributed to a second wave of cultural diffusion from the Middle Euphrates. During the LPPNB, there was a prolific expansion of LPPNB settlements, especially evident in areas such as northern Syria, Turkey, and parts of Iran and Iraq.

Both models have met with resistance by several researchers (Rollefson 2001; Asouti 2006; Simmons 2007; Watkins 2008), in large part because of their outdated cultural-historical approaches and diffusionist narratives.

Recently, a model intended to avoid the problematic notion of culture groups was proposed by Watkins (2008: 151), who borrowed the idea of a “peer-polity interaction sphere” from Renfrew (1986) and argued for the presence of “multi-level, nested
networks” for the entire Levantine region. In his view, the Neolithic Levant consisted of large settlements and clusters of small settlements seen as segmentary societies, or “relatively small and autonomous groups, usually of agriculturalists, who regulate their own affairs; in some cases they may join together with other comparable segmentary societies to form a larger ethnic unit” (Watkins 2008: 162). For these larger Neolithic settlements to have functioned properly there had to have been some kind of internal structure between the household family unit and the community. At a minimum, there were one to two layers of social organization and these consisted of nested networks of cultural, social, and economic interaction (Watkins 2008:151). Borrowing from Renfrew (1986), Watkins (2008: 153) defined a polity as “any society or community that regulates its own affairs, whether corporately, or through elders, chiefs or more hierarchical power-structures.” Viewed in this manner, polities represented sociopolitical dynamics, rather than cultures, and therefore the patterns of exchange and interaction evident through the movement of material goods (e.g., obsidian, shells, etc.) within and between polities (communities) were essentially cultural and social, rather than economic in nature. Polities likely interacted primarily on the local and regional level, but over time, a supraregional peer-polity interaction sphere emerged. Thus, these societies appear to have been tribally organized, with communities incorporated into the larger society through kinship ties².

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² Watkins conceded, however, that there was little evidence of social or political elites, or even hierarchical organization (contra Price and Bar-Yosef 2010).
In contrast to the theories focused on similarity and shared practices, some models posit that the level of regional diversity present in the early Neolithic can only be explained by polycentrism (Gebel 2002, 2004a, 2004b; Rollefson 2004b; Finlayson 2013). Proponents of the polycentric approach assert that there is no single center of cultural and economic innovations, and as such, research should develop from “base to the frame” (Gebel 2004b; also Hermansen 2004). In their view, multiple centers and a diversity of causes shaped local cultures. The mechanisms for change (diffusion, assimilation, splitting, and stagnation) varied and had varying influence in each region (perhaps even at different times). But, while polycentric models account for more of the diversity glossed over by cultural-historical and diffusionist arguments, they have been criticized for being more descriptive than explanatory, obscuring the role of diffusion in cultural change, and assuming cultural continuity at individual sites, which is not always supported by the material record (Gopher 1989a; Asouti 2006).

A recent contribution from the polycentric viewpoint (Gebel 2010) proposed a new approach that considered the process of “commodification” as key to Neolithic social and economic organization and its polycentric development. In this approach, commodification, or imbuing things with value, existed in foraging societies, but was different from the productive commodification found within and between settled villages. The commodification processes that occurred in Neolithic villages led to surplus production, which may have contributed to the eventual formation of markets and wealth. Gebel (2010: 47) argued that commodification as a process gave order to life and helped produce and reproduce social identity through population growth, surpluses of time and
goods beyond the basic subsistence needs, and competition produced by diversification (Gebel 2010: 47). To support his model, which he asserted moves beyond the confines of the material-oriented empirical approach, he drew evidence from the megasite phenomenon, which included specialization in naviform core technology and stone rings, and suggested it as an example of a spreading social and cultural paradigm that resulted in a commodification territory (Gebel 2010: 58).

Another recent contribution to the polycentric approach intended to address some of the shortcomings in the above modeled systems recognized by critics (e.g., Asouti 2006) was suggested by Finlayson (2013), who maintained that perhaps the best way to bring explanatory power to the archaeological record of the Neolithic is to employ a multiscalar polycentric approach that considers what has come to be called agency. His agency-based approach focuses on the community as a larger-scale group agency, because we have little evidence of the individual in the archaeological record. Such an approach considers the interconnected world by examining small-scale variation within communities, and recognizing that these differences are the result of decisions made by different groups. Furthermore, he contended that for the most part the scale of individual communities centered on a single settlement, and while interaction, expression of identity, and innovation occurred between communities and regions, most occurred initially on a small scale.

A different model that attempts to address both the similarities and differences in the material record and to supply social motivations for Neolithic social organization, but without the limitations of a culture-history approach, is that of Kuijt (1996, 2000a, 2002).
Kuijt focused primarily on ritual and ceremonial practices, specifically those during the PPN (primarily PPNA through MPPNB) of the Levant. He (2002) argued that the greater visibility of ritual practices in the MPPNB might signal the appearance of the notion of community and leadership in early Neolithic settlements. The level of segmentation of society, however, may have been limited by a system of egalitarian ideology. Essentially, people made a conscious effort to maintain the social ideal of egalitarianism, while at the same time promoting certain individuals or groups. This situation could have occurred if people gave up some of their own power or freedom to someone that they believed represented their own values and needs (Kuijt 2002). In the context of the Neolithic, this authoritative group may have been ritual specialists comprised of individuals drawn from many households.

In support of the egalitarian ideal argument, Kuijt (2000a, 2002) and Kuijt and Goring-Morris (2002) suggested the possibility of intentional homogenization of burial and ritual customs, indicated by secondary skull removal and reburial in caches, the painting and plastering of skulls, dedicatory caches of cultic objects (at extramural locations), and votive offerings (at intramural locations). Such practices would have been ritual events, perhaps between multiple households that served to reaffirm relationships. Additionally, Kuijt contended, if individual households intended to differentiate themselves, then we should see obvious grave goods and clear indicators of familial or household affiliations, as well as interpersonal violence, but little of this is supported by the archaeological record. Some additional support for Kuijt’s model comes from Byrd

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3 However, see some of the recent arguments about warfare and violence in Neo-Lithics No. 1, 2010.
(2000), who made similar arguments of an “egalitarian ethos” in reference to residential architectural patterns in the southern Levant.

Furthermore, Kuijt (2002) acknowledged that regional similarities are evident in the shared reduction techniques (i.e., the naviform core-and-blade industry), tool styles, and architecture, as well as the trade of shell and stone beads that he believed indicated cooperation in a broader social sphere. This cooperation suggested a common system of governance throughout the region that may have included shared leadership within individual communities, and the possibility that some individuals involved in governance interacted with other regional communities through physical movement or the movement of ideas. Such movement would have been on the supraregional level, as indicated by obsidian trade from Anatolia and evidence of exchange with Cyprus (Kuijt 2002).

The primary criticisms of Kuijt’s (1996, 2000a) argument involve evidence of social differentiation to a degree that is incompatible with the presence of an egalitarian ethos. For example, Price and Bar-Yosef (2010) traced social differentiation to the Natufian period and maintained that increasing complexity and hierarchy occurred throughout the PPNA and PPNB. In contrast to Kuijt, they saw evidence of social hierarchy, and pointed out what they considered proof of inequality in burials at Çayönü and Kfar HaHoresh. Additionally, they viewed the skulls found in domestic houses as representing members of the “elite” and therefore surmised that arguments proposing that mortuary practices were intended to maintain an egalitarian ideal were not supported by the evidence.
The last model of Levantine social organization discussed here is that by Asouti (2006), who, like Watkins (2008), held that most models of social organization are not nuanced enough to account for the differences in temporal and spatial scales of socio-economic interactions, acculturation, and demic diffusion. In contrast, her approach, described as the convergence of cultural-historical and social approaches, or social-historical in nature, focused more on the local socioeconmic contexts of inter- and intra-group actions and population movements. Integral to this more local focus is the view that early Neolithic social organization and exchange were socially situated processes, which, she argued, could be elucidated by paying attention to the reconstruction of Neolithic groups, households, and gender identities, as well as the local and regional strategies of socialization (Asouti 2006: 106).

To demonstrate her approach, Asouti focused on the available evidence for southeastern and eastern Anatolia and the Zagros, arguing that sociocultural developments in the PPN could be traced back to the local Epipaleolithic, and were influenced by “complex, multi-layered, socio-cultural interactions between local and regional Levantine elements, rather than through assimilation of local groups by “culturally ‘superior’ settlers from the Euphrates” (Asouti 2006: 107). Specifically, Asouti (2006: 109-110) cited evidence from the occupation sequence of Aşikli Hüyük, and asserted that it was a self-sufficient and conservative segmentary society that focused its resources on the maintenance of the domestic economy. Thus, in her view, there are pan-Levantine similarities between sites, but there are also substantial differences, and
practices common across regions were adapted to specific sociopolitical agendas intended to maintain individual communities (Asouti 2006: 111).

Furthermore, in contrast to the current interaction sphere arguments, Asouti (2006:112) argued that the procurement and use of local and exotic materials were not focused on production for trade, but instead were components in practices associated with determining and reproducing group and gender identities. Regarding the distribution of naviform reduction technology, she argued (2006: 112) that it may not have been part of an organized regional trade network (contra Bar-Yosef and Belfer-Cohen 1989; Bar-Yosef and Bar-Yosef Mayer 2002; Barzilai 2010; Belfer-Cohen and Goring-Morris 2011) because in most cases the resource materials were obtained from a local source and reduced by knappers engaged in part-time, community-bound craft specialization (cf. Quintero and Wilke 1995). Finally, considering regional diversity, Asouti (2006: 118-119) suggested that interaction spheres should be understood as “region-specific changeable and complex exchange networks between kin groups, factions, moieties, or sodalities spread among adjacent areas and communities.” In this view, the materials exchanged played a role in creating and maintaining social relationships within and between groups and communities.

After reviewing the general trends for the Neolithic of the southern Levant and some of the differing ideas for social and economic organization, it is clear that although all of the models rely on much of the same archaeological evidence, the interpretation and application of that evidence varies greatly. Flaked-stone technology, however, played a significant role through exchange, stylistic, and/or technological considerations in each
of these models, and recently specialization of flaked-stone industries has been given a place in the arguments about social organization (Asouti 2006; Barzilai 2010; Gebel 2010). Nevertheless, more consideration of lithic industries, along with other lines of evidence on the site level are necessary because a growing body of evidence suggests variation is apparent from one site and region to the next. Thus, rather than designating cultural territories and mapping site hierarchies, it is important to consider variation.

Arguments and models that appear most sensitive to variation at the site level are those that also stress somewhat conservative behaviors in the face of changing conditions. Kuijt’s (2000a) maintenance of an egalitarian ideal represents such an idea, as do arguments made by Asouti (2006) and, in a similar manner, Finlayson (2013) for the presence of conservative self-sufficient societies. These views are further supported by the suggestion that much of the procurement and production in Levantine settlements was community-based, focused on reproducing group identities, rather than generating trade goods for other settlements (Asouti 2006, Watkins 2008). As pointed out by Finlayson (2013) most interaction and innovation occurred first on a small scale, and it is important to examine these variations in local histories as they relate to the options chosen by different groups.

Clearly, there is a great deal of diversity in the decisions different groups made, which is likely due in part to reactions to localized conditions, to the interpersonal dynamics of a particular group, and complex variable responses to regional interaction (Gebel 2004; Rollefson and Gebel 2004; Finlayson 2013). Therefore, it seems

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4 For instance, research by Asouti and Fuller (2012) and Fuller et al. (2012) suggests variation in the timing of the appearance of a diverse array of domesticated crops at different sites.
appropriate to start with a local focus, that is, an examination of socioeconomic dynamics at individual sites. To that end, this research is intended to focus on the social and economic interactions at ‘Ain Ghazal as they relate to the lithic economy. Specifically, it concentrates on the nature of household-level stone tool production and the decisions people made in response to changing social and economic conditions throughout the course of the occupation. The intent of this research is not to draw sweeping region-wide conclusions; but inasmuch as lithics were part of everyday tasks and interactions, lithic technologies can be sensitive behavioral indicators of economic and social changes (e.g., Gero 1989; Odell 1996; van Gijn 2010). In this way, they can supply a measure for differences and similarities between sites when included in comparative analyses. Therefore, this work represents a site-specific contribution to the overall effort to understand social and economic organization and interaction in the Levant.
Chapter 4
THEORETICAL AND METHODOLOGICAL CONSIDERATIONS

The analysis of the flaked-stone assemblage from ‘Ain Ghazal, a site with over 2,000 years of continuous occupation, requires an approach that will identify broad patterns of change over time while focusing on specific technological trends. The long occupation span of ‘Ain Ghazal encompassed many significant shifts in subsistence, and in settlement size and configuration that affected every facet of people’s lives including the choices they made with regard to their lithic tool kit. Tools, and the ways in which they were made and used, served to both construct and reflect the traditions of the people who made and used them. Therefore, in order to understand the dynamic nature of flaked-stone tool production at ‘Ain Ghazal, it is necessary to consider the tools and how they were produced in a dynamic way that moves beyond the notion that lithic artifacts are static forms associated easily with a particular cultural group or tradition. To avoid some of the pitfalls of typological approaches based solely on tool morphology, and to attempt to recognize the choices that people made in the past as both practically and socially bounded, the best analytical approach involves reconstructing the tool kit, from resource material acquisition to final tool discard. Specifically, this method is called “replicative systems analysis” (Flenniken 1981) and it is an experimental approach rooted in behavioral systems analyses (cf. Schiffer 1976), which provides compelling interpretations when embedded within a larger framework that recognizes the relationship between human behavior and material culture remains. A suitable approach for this type
of study comes from behavioral archaeology, which considers the complex relationship between people and their things.

Behavioral archaeology is a longstanding venue for examining the relationships between past human behaviors and material culture remains. Much has changed in the last few decades, however, as archaeological practice has moved beyond the strict duality of processual versus postprocessual ideologies, and theoretical diversity has become the norm (Hegmon 2003; Pauketat and Meskell 2010). In this climate of integration of materialist and idealist positions, a different conception of material culture studies arose, called “materiality”. Proponents of materiality studies assert their focus developed a more engaged approach than that of other material culture studies, one that stresses the importance of a historical understanding of objects, emphasizing the interplay between people and the material world. They explicitly criticize “materialist” approaches like behavioral archaeology arguing it concentrates only on changes in morphological and functional characteristics without considering the way in which material culture played a part in structuring as well as reflecting social values about proper behavior (Tringham 1994; Gosden and Marshall 1999; Bradley 2004; Jones 2004; Meskell 2005; Cooney 2008; Dobres 2010). Instead, they draw from Bourdieu’s (1977) practice theory (among other theoretical approaches) and stress that the daily practice involved in the manufacture and use of objects reflects and reinforces a “traditional way of doing things” (van Gijn 2010:3-4).

These criticisms, however, ignore the evolution of “materialist” approaches such as behavioral archaeology over the past several decades and the fact that practitioners aim
to develop their own theories about human behavior rather than borrowing them from other fields or subdisciplines (McGuire and Schiffer 1983; Zedeno 1997; Schiffer and Skibo 2008; Schiffer 2010; Cordell 2011; Gifford-Gonzalez 2011; Reid and Skibo 2011). Furthermore, few materiality-centered studies supply explicit frameworks for examining material objects in archaeological contexts beyond suggesting the use of chaîne opératoire (e.g., Dobres 2010, but see Jones 2004; van Gijn 2010). Also, they often ignore the role of formation processes and downplay the importance of utilitarian performance characteristics. These arguably fundamental and practical concerns, however mundane, must be addressed in advance of any a cogent argument for considerations such as agency, social preferences, or the role of production in cultural construction.

From its beginnings, behavioral archaeology as conceived by Schiffer (1976, 1987, 1988, 1995), considered site formation processes, both cultural and noncultural, as they related to the study of artifacts and sites. Cultural formation processes address the effects of human behavior on structuring and transforming the archaeological record (Schiffer 1987:7). This is essentially the idea that it is behavior, not cultural or mental states, that create the archaeological record through manufacture, use, and discard of material goods. As such, the only way to truly study humans, who “live in a material world of their making” is to study the material remains they leave behind (LaMotta and Schiffer 2001; Schiffer and Skibo 2008:6-7). Additionally, noncultural processes address transformations and changes brought about by natural processes, which can significantly
alter the archaeological record, and consequently impact interpretations if not properly considered (Schiffer 1987:7).

Ethnoarchaeology and experimental methods provide the laboratory through which some of these formation processes may be studied and identified, which makes behavioral archaeology well suited to generate theory or to accommodate different approaches and theoretical viewpoints (see LaMotta and Schiffer 2001 and Schiffer and Skibo 2008), and importantly, to do it with a rigorous scientific approach. The core component of the behavioral archaeology approach is to study “relationships between people and things in all time and all places” (Schiffer and Skibo 2008:6). A significant aspect of this approach is the study of technology, and in order to understand a technology, one must examine the remains of that technology, which should retain the traces of manufacture, design, and use (Schiffer and Skibo 2008:7-8). Specifically, Schiffer and Skibo (2008:10) developed a design theory approach to understanding technology, and identified four major considerations: behavioral chain/life history, activities and interactions, technical choices, and performance characteristics.

Life history or behavioral chain analyses have been used for a long time in lithic analyses (e.g., reduction sequences). In their particular approach, they suggested that all links in a behavioral chain were composed of an activity, which consisted of interactions between people and artifacts, people and people, and between artifacts. Additionally, each of these links (interactions in manufacture, maintenance, reuse, discard, etc.) is potentially valuable in understanding artifact design. Even when it is not possible to reconstruct the entire behavioral chain, which is often the case with the archaeological
record, reconstructing fragments of a behavioral chain is still valuable and informative (LaMotta and Schiffer 2001). Finally, technical choices made in response to activities pertain mainly to the design process (resource material choices and manufacturing strategies) and relate to a technology’s formal properties and performance characteristics, or how well an object performs its function, which could be social, symbolic, sensory, or utilitarian (or some combination of all of these).

Schiffer provides a theoretical model for the study of technology in relation to past human behavior, but his is not the only behavioral approach. The chaîne opératoire is a product of the French behaviorist approach initiated by Andre Leroi-Ghourhan who recognized the connection between technology and human behavior and was the first to use the term chaîne opératoire (Audouze and Leroi-Ghourhan 1981; Soressi and Geneste 2011). Both chaîne opératoire and the Americanist “reduction sequence modeling” are sequence models aimed at understanding people-artifact interactions. In fact, as discussed by Bleed (2001), sequence models have a great deal of utility and application because they directly address issues like artifact diversity, changes in artifact form and use over time, and historical events. They also deal with the process of making things and in this way provide a dynamic view of the activities apparent in the archaeological record, which is only possible because they supply a “conceptual basis for linking apparently diverse objects into patterns that can themselves be studied in behavioral, cultural, or cognitive terms” (Bleed 2001:123). Despite some similarities among sequential models, there are features of particular approaches worth comparing; accordingly, the following discussion focuses on Americanist reduction sequence analyses and chaîne opératoire.
Reduction sequence analyses, or the technological reconstruction of a reduction sequence, which are heavily influenced in their aims by the behavioral archaeology of Schiffer (1976), attempt to reconstruct a technology from resource material acquisition to final discard (including episodes of recycling). Others label this approach under “organization of technology” or the “TO” approach (Carr and Bradbury 2011), which relies on several key concepts to operate. First, practitioners recognize that lithic assemblages can provide information about human behavior, and that the most effective way to make such inferences is to examine the entire assemblage (e.g., debitage, cores, and tools). Second, the best framework for conducting analysis and understanding human behavior is to reconstruct the life history (acquisition, manufacture, use, reuse, and discard) of a technology and employ experimentation designed to better identify the remains of particular behaviors in the archaeological record (Carr and Bradbury 2011:311).

With regard to experimentation, replication or “replicative systems analysis” supplies the most salient means of inference for understanding the patterns of tool production and use, and their social and economic implications (Flenniken 1981). Yerkes and Kardulias (1993:90) supplied a good description of why archaeologists undertake replicative analysis: “In order to understand stone artifacts and the people that made and used them, archaeologists must understand the processes involved in the acquisition, production, exchange, and consumption of lithic artifacts.” Furthermore, replicative experimentation produces compelling relational analogies with causal connections between the source of the analogy (replication) and the subject (past human behavior as it
relates to archaeological technologies) (cf. Wylie 1985). Consequently, it provides
greater interpretative capability than can be achieved by ethnographic or
ethnoarchaeological studies alone because it demonstrates actual processes of production.
While there may be some variation in decision making between prehistoric and modern
flintknappers, there are, as suggested by Schiffer (1974), particular correlates or
nomothetic features that can be assessed to identify law-like principles in the reduction of
lithic objects. These principles can be used to identify the functional necessities of a
technology, and they can provide solid inference into cultural notions of the *right* way of
doing things. Such analyses are the most accurate when the archaeological data are used
as the experimental control and replicative work is carried out following the same
inferred reduction techniques and resource materials. The replicated assemblage is then
compared to the archaeological assemblage to discern which debitage types and tool
attributes are meaningful for identifying the production sequence and goal of a particular
reduction strategy (Flenniken 1981; Flenniken and Raymond 1986; Bradley and Giria
1996; Johnson 1996; Quintero 2010). The type of classification that results from
experimental replication is then based on the technological characteristics of an

Beyond the focus of reconstructing how a technology was produced, used, and
reused, it must be related to other classes of archaeological data, in order to understand
more fully the different types of technological determinants (Jochim 1986). Relating
lithic studies to other aspects of technological organization has long been used in
investigations of mobility, and more recently attempts to understand agency, gender, risk,
cost, design, social alliances, and trade. A key component of these studies is that they tend to emphasize situational and practical qualities of the production process rather than viewing production as part of a predetermined sequence of steps intended to achieve a predetermined goal (Bleed 2001; Tostevin 2011; Carr and Bradbury 2011:311). Overall, the goal of many Americanist lithic analysts who employ this methodological approach is to properly characterize past technologies, in order to understand how technologies relate to social and economic strategies and how technological change is related to cultural change.

*Chaîne opératoire* is understood as a “succession of mental operations and technical gestures, in order to satisfy a need, immediate or not, according to a preexisting project” (Perlés 1987:23 from Sellet 1993:106). Essentially, *chaîne opératoire* attempts to identify the cultural transformations that a specific resource material goes through from procurement to discard (Lemonnier 1983; Pelegrin 1990; Leroi-Ghourhan 1993; Sellet 1993). It does this by following a research procedure that considers the source and quality of resource material, recognizes the knapping techniques or methods (can include experimentation or refitting), then produces a technological classification according to the stages of manufacture represented. Importantly, *chaîne opératoire* also considers the types of blanks used for certain types of tools, and changes that occur after the tool is complete (e.g., resharpening, discard) (Pelegrin et al. 1988; Pelegrin 1990). The aim of this procedure is to recognize the psychological factors that underpin knapping ability and choices, with the goal of understanding human behavior.
This approach can be divided into three levels of analysis. The first level involves the tools and by-products themselves, and this is followed by the series of actions and technical sequences involved in manufacture. The consistency with which these actions occur is what allows for the determination of the conceptual scheme (or technical knowledge) that drives the operational scheme. This represents the final level of analysis in *chaîne opératoire*, that is, achieving an understanding of the technical knowledge shared by all group members (Sellet 1993; Soressi and Geneste 2011). This focus on technical knowledge of a group, views the choices behind particular techniques as a social product and part of a subsystem (in this case, a lithic subsystem) that interacts with other technical subsystems (e.g., bone tool subsystem or a wood tool subsystem) (Soressi and Geneste 2011). As pointed out by Bleed (2001:121), the *chaîne opératoire* approach is often teleological in nature with the assumption that there is an underlying plan that informs the overall reduction process. As such, *chaîne opératoire* can be classified as emic in approach, which accounts for why practitioners often view it as both a theory and a method (Bleed 2001; Tostevin 2011:354).

The goal of both research programs is to understand past human behavior and what environmental, social, and economic factors may have influenced it. Methodologically, both explicitly claim to consider a tool from resource material acquisition to final discard; both incorporate replication analysis and claim to consider issues of reuse or recycling (Pelegrin 1990; Audouze and Leroi-Ghourhan 1981; Shott 2007; Soressi and Geneste 2011). Critics of *chaîne opératoire*, however, have argued that its studies tend to categorize reduction as occurring in discrete stages, when in some
cases reduction is more fluid, displaying continuous variation in metrical attributes (Shott et al. 2011). Along with its lack of flexibility, in practice, researchers who employ chaîne opératoire rarely consider the possibility of recycling and reuse; likewise, others have argued that its broadness as a conceptual device produces interpretations of past technology in relation to human behavior that are less dynamic (Shott 2007; Schiffer and Skibo 2008; Quintero 2010). While methodological differences certainly result in interpretive differences, some assert the primary differences between the two approaches are evident in high-level theory (i.e., Thomas 1998). Proponents of chaîne opératoire argue that one of the primary goals—attempting to understand the technical knowledge shared by a group—is not accounted for in reduction sequence modeling as it is conceptualized in North American archaeology (Sellet 1993; Soressi and Geneste 2011; Tyron and Potts 2011). Chaîne opératoire tends to be emic in approach, viewing tool reduction as a process that follows a predetermined set of steps (the technical knowledge of a group), while most practitioners of reduction sequence or technological organization approach tend to view tool production as more etic, guided by situational and practical concerns (Bleed 2001; Tostevin 2011).

Clearly, each approach must consider at least minimally both emic and etic aspects, but the primarily emic focus of the chaîne opératoire approach tends to concentrate more narrowly on social logics that guide technological choice, often at the expense of utilitarian explanations (Schiffer and Skibo 2008). Furthermore, because chaîne opératoire studies tend to be more reductionist with a focus on discrete staging, and many practitioners do not employ replication, instead relying on generalized
technological frameworks available in published materials (such as those presented in Inizan et al. 1999), it lacks the interpretive capabilities of technological analyses based on replication (Quintero 2010). The inclusion of replication in lithic analyses is especially important for sites with complex occupational histories, like ‘Ain Ghazal, where few deposits reflect discrete knapping events and refitting analyses are nearly impossible. In such situations, replicative analyses allow the researcher a means of not only reconstructing the probable reduction schemes, but also identifying sources of variation in production and reuse. Essentially, replicative analyses are capable of identifying more of the variables that influence manufacturing choices, and therefore they provide a more nuanced interpretation of human behavior as reflected in the archaeological record.

The inclusion of the replicative analyses to reconstruct reduction sequences within a behavioral archaeology framework is especially useful because it examines technology from a historical perspective reconstructing behavioral chains that consider practical influences on decision making, while recognizing that these choices interact with a group’s traditional knowledge and social system (Flenniken 1981; LaMotta and Schiffer 2001; Schiffer and Skibo 2008). In essence, it provides an adaptable but systematic approach intended to look at the relationship between people and their things. How this relationship is examined at ‘Ain Ghazal and the types of questions to be answered are addressed in the next section.

**Research Questions**

The primary question to be considered in this research is “what was the nature of flaked-stone implement production that occurred at the household level at ‘Ain Ghazal
during each period of occupation?” It is necessarily broad because it is only through thoroughly characterizing the nature of household-level production that more encompassing socioeconomic questions can be addressed with the flaked-stone assemblage. Quintero (1998a) initially studied the patterns of generalized household production that occurred along with specialized production at ‘Ain Ghazal. This work recognized the dual economy at ‘Ain Ghazal and provided evidence about the scope of household-level production, but it focused mainly on the role of the specialized blade-production industry. Recently, research conducted at other sites appears to show that some tool production was also undertaken by specialist producers (Gebel 1996; Barzilai 2010). Thus, further information from studying household-level flaked-stone tool production at ‘Ain Ghazal stands to clarify what types of production occurred in the households and the nature of interaction between households and specialized economy through time.

It is clear that most households were not involved in the specialized production of naviform cores and blades (Quintero 2010), but this does not exclude the possibility that other reciprocal cottage industries existed (e.g., basketry, textiles, etc.) (Prentice 1983). Also, stone tools were involved in a variety of activities, including weapon production and maintenance, hunting, butchery, harvesting, food or hide processing, and numerous crafts (e.g., making bone tools, basketry, wooden implements, etc.). Thus, understanding flaked-stone tool production has the potential to provide insight into other activities that occurred in the ordinary household. It is expected however that, for the most part, flaked-stone tool production was generalized in nature. The analytical framework used to test
this expectation is presented below. First, it is necessary to discuss different considerations involved in the identification of specialized and generalized production.

Identifying craft specialization is an extensively covered topic, and involves a wide array of definitions\(^1\). Because the lithic craft specialization recognized at ‘Ain Ghazal was the first of its kind, it represents the initial, incipient form of specialization, and as such required a definition appropriate to its scale. Therefore, following Quintero and Wilke (1995:26), initial craft specialization should be understood as “a production activity performed on a part-time basis by relatively few individuals for the benefit of a larger population.” Conversely, generalized production could have been carried out by all or most members of a community, primarily for their own use.

**Identifying Generalized Production**

Determining what constitutes generalized production, especially in a dual economy, is likely to be somewhat difficult. The following categories represent features that are the most likely to distinguish generalized from specialized production.

The first consideration is the context of the deposit from which the evidence is derived. In order to determine the kinds of production that occurred in household contexts, it is necessary to study known domestic-related deposits. To that end, the following is a discussion of current views on what constitutes a household. This discussion primarily considers households in the Levantine Neolithic, but it is recognized

\(^1\) See the following articles for a discussion of some of the parameters of specialization: (Clark 1986; Torrence 1986; Michaels 1989; Clark 1990; Costin 1991; Cross 1993; Quintero and Wilke 1995; Flad and Hruby 2007; Bamforth and Finlay 2008).
here that the exploration of what constitutes a household has been extensively discussed both conceptually and organizationally in specific times and places (e.g., Wilk and Rathje 1982; Ashmore and Wilk 1988; Tringham 1991, 1995).

Kuijt (2000:140) defined a Neolithic household as a “cooperative coresidential economic unit” with internal organization and decision-making authority, and members of households were most likely, but not exclusively, kin. In accordance with this definition, the household can be viewed as a “corporate body that perpetuates itself through the exchange of goods, titles, and membership along real or imaginary lines” (Kuijt 2000:140). As such, households were conservative and traditional, focused on the maintenance of the existing social arrangement (Kuijt 2000:141). Though not contrary to Kuijt’s assessment, Byrd’s definition (2005:119) relied on a more functionalist understanding of households, defining them as “task-oriented residence units that shared a combination of production, co-residence, reproductive, and consumptive tasks.” Neolithic households, in his view, were comprised of nuclear or extended family units. Similarly, at ‘Ain Ghazal, the composition of households changed through time, with single-family structures housing nuclear families common in the MPPNB and housing extended families common in the LPPNB (Rollefson 2010).

Given that little is really known about familial and social structure in the early Neolithic of the southern Levant, it is difficult to determine confidently the composition and internal organization of the Neolithic household. Additionally, it is important to remember that even though “households” may have been focal points for domestic activities, they may also have been locations of ideological and ritual expression (with
subfloor burials, painted walls and floors, etc.). Similarly, publicly used communal spaces, sometimes ritual spaces, may also have been loci for domestic activities. It is increasingly apparent that the distinctions between communal or ritual space versus private or domestic space are not always clear (see arguments in Banning 2011 and Asouti and Fuller 2013). Considering the available evidence and interpretations, it seems reasonable to conclude that Neolithic households consisted of coresidential economic units, in which members were related in some manner and participated in production tasks allocated according to age and gender intended to insure subsistence, to maintain the existing social arrangements, and to reflect and reinforce ideology. Furthermore, as this research focuses on the context and scope of flaked-stone tool manufacture, it is also necessary to define household production activities. These consist of tasks that occur within the dwelling unit, which can be understood as the outdoor and/or indoor space in which people live and undertake most of their daily activities (Wilk and Rathje 1982).

Ideally, studying household production involves primary deposits. Realistically, this rarely happens because archaeological deposits at settlements with long occupation sequences are more often secondary, or deposits that result from the removal of refuse from activity areas for deposition at a spatially removed dumping location, such as a midden or abandoned structure (Schiffer 1987; LaMotta and Schiffer 1999; Byrd 2005; Schiffer 2010; Andrieu 2013). Deposits found in domestic structures are usually associated with abandonment or are the product of post-abandonment processes, which can include reuse of structures, dumping activities, structural collapse, scavenging, and a

\(^2\) Also, see a recent review by Goring-Morris and Belfer-Cohen (2013) for more discussion on Neolithic households.
whole host of noncultural disturbance processes (LaMotta and Schiffer 1999). It is also well known from ethnographic studies that the activity areas in commonly used spaces are frequently cleared of bulky or hazardous refuse. All that is left as primary refuse are objects that are not considered hazardous, such as, microdebitage (Clark 1991; LaMotta and Schiffer 1999; Hardy-Smith and Edwards 2004). Thus, in lithic studies the presence of microdebitage is often used to identify locations of primary reduction (Clark 1991).

The depositional situation at ‘Ain Ghazal, and the nature of the archaeological record of most Near Eastern Neolithic sites generally, ranges from well intact to disturbed. For example, at ‘Ain Ghazal the PPNC and Yarmoukian inhabitants appear to have excavated considerably into cultural strata from earlier periods. The LPPNB structures and associated cultural strata were especially impacted by these activities (Rollefson et al. 1992:447). Additionally, many intact deposits are secondary, having been intentionally removed from their original contexts. Given these complex formation processes, it may not always be possible to assess the activities of specific households or individuals.

The research presented here focuses on the debris from production activities that were distributed broadly across the site and that were associated with domestic structures directly or indirectly. Based on context information and the assemblage characteristics, the debris is inferred to have been the result of production that occurred in many or most households and the items produced could have been made by almost anybody within these households. While many of the loci considered here are interpreted to be intact and appear to have been associated with interior and exterior domestic activity areas,
numerous deposits represent dumps associated with the disposal of detritus from various domestic activities and therefore are aggregate deposits. They potentially represent several different reduction events and/or activities undertaken at several of the surrounding dwellings. Despite some of the issues with secondary contexts, they still provide valid information about household production, as most of the dumps or fill deposits were derived from the dwelling or dwellings located immediately nearby\(^3\) (see Andrieu 2013).

The second major consideration involves resource material usage. Specialized lithic technologies tended to be undertaken on homogenous high-quality resource material. This was the case in the southern Levant where bidirectional blade technologies typically relied on only one or two types of high-quality flint\(^4\). On the other hand, less structured technologies are more likely to have been produced on flint that was easily available, with less regard for quality. Furthermore, tool needs dictate resource choices and most informal flake tools, like scrapers, did not have to be made on high-quality flint. At ‘Ain Ghazal, however, resource material quality may not be as reliable a measure for generalized production of tools made from blade blanks produced from naviform cores, as these are almost exclusively made on high-quality flint mined from the nearby Wadi Huweijir, which is located about 2 km away, and perhaps other sources not yet located. The issue is further obscured by the practice of scavenging and recycling of naviform core products and by-products that are made on high-quality flint, a practice that occurred

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\(^3\) It is unlikely that people went great distances to dump their waste or to procure fill for floor leveling or construction.

\(^4\) Sites such as ‘Ain Ghazal (Quintero and Wilke 1995, Quintero 2010), Jericho (Crowfoot Payne 1983), Basta (Gebel 1996), Abu as-Suwwan (Al-Nahar 2006), Yiftahel (Barzilai 2010), Wadi Shu’eib (Simmons et al. 2001).
throughout the occupation sequence, but was very common after the LPPNB period at ‘Ain Ghazal and at Basta (Gebel 1996; Quintero 1996; Quintero 2010; Barket 2013).

The third major consideration involves the technological nature of debitage, cores, and tools in the deposit. As with standardized production debris resulting from specialization, there should be technologically consistent debris from generalized production (Clark 1990). This means that there should be cores and manufacturing waste consistent with the technologies represented—if flake tools are created, then there should be flake cores, manufacturing debris (e.g., flakes, shatter, flake fragments) from core reduction, and manufacturing breaks from tool production. Additionally, deposits with generalized tool production should include retooling activities attested by the presence of broken and worn-out implements (Keeley 1982). A diversity of reduction strategies also should be represented in domestic debris, and cores and products should be less standardized in form and size (e.g. Ford and Olson 1986; Quintero 2010). Finally, with generalized production there should be evidence of flintknapping errors in the production waste that were either not corrected or the approaches to correcting them were not standardized. Ideally, this expectation for technological consistency will be the case, but given the complex nature of site formation processes and the likelihood that many deposits are in some way aggregate, it is unlikely the pattern will always be so clear. It is expected, however, that even in secondary contexts, if core reduction or production of certain tool forms occurred within a household or household group, that debitage and debris consistent with those technologies will be present.
The pattern of tool production on blades from naviform cores, however, is expected to be different. Production of tools in household deposits should not result in debris that is technologically consistent with naviform core-and-blade manufacture. Evidence for the production of the blade blanks themselves should be present in workshop deposits. Additionally, the production of tools from blades should be evident by the presence of recognizable tool blanks (mostly for formal tools), manufacturing breaks, and blade trimming/sectioning waste, as indicated by initial investigations conducted by Quintero (2010).

The fourth major consideration explores the technical difficulty of producing the technologies. In the production of specialized flaked-stone products, a high level of skill is necessary to produce a relatively standardized product consistently (Michael 1989). Conversely, generalized production should reflect variable levels of skill, as it does not require the same consistently high levels necessary for standardization, which entails maintenance of skill through frequent practice. Clark and Bryant (1997) noted this for Mesoamerican pressure-blade production, and Wilke and Quintero (1994) gave a similar assessment for production of percussion blades from naviform cores. Assessing skill in lithic production is complex. As every accomplished stone-worker knows, one of the major influences on the outcome of any one lithic production attempt is the quality, form, and availability of resource material. Other factors that are thought to influence production success include the quality of tools involved in production, time available for production, changes in motor skills associated with age or illness, practice and experience, inherent abilities, and cultural incentives (Bamforth and Finlay 2008;
Bamforth and Hicks 2008; Bleed 2008; Ferguson 2008; Finlay 2008; Olausson 2008; and Eren et al. 2011a, 2011b).

Approaches to identifying skilled production in archaeological contexts are varied and include experiments in replicative stone-working that include knappers of varying levels of experience (Ferguson 2008; Finlay 2008; Eren et al. 2011 a). Others use refitting studies (Audouze and Cattin 2011; Perdaen and Noens 2011), or even surveys of modern flintknappers (Olausson 2008). The findings from these observational studies indicate that experienced knappers spend more time in production, produce consistent products, and leave behind cores with fewer obvious reduction errors (Finlay 2008). Similarly, many studies recognize skill based on the efficiency and consistency with which a product is made, and the standardization of the products based on metrical attributes—those who are more skilled will produce more symmetrical products with more precise flaking and fewer errors, breaks, and waste. Essentially, in some lithic industries the most obvious indicators of skillful production are the regularity of flaking and the symmetry of the finished product (Stout 2002; Bleed 2008). It also follows that skilled artisans will more often produce regularly flaked symmetrical products with little variability between the products (Bamforth and Hicks 2008; Ferguson 2008; Eren et al. 2011a). The relationship among skill and variability in production, however, is complex. Some learners can create products comparable to those of master stone-workers (Eren et al. 2011a), and even among skilled knappers of approximately the same level of experience, there can be great variation between products. As any stone-worker can tell you, skill can
vary from day to day or piece to piece. Essentially, the relationship between skill and variability must be addressed on a case-by-case basis.

The situation at ‘Ain Ghazal during the PPNB was such that various formal tools (e.g., sickle elements, projectile points, borers, knives, etc.) were made on standardized blades from naviform core reductions, with the exception of woodworking tools (axes, adzes, chisels) and bifacial knives. Informal tools were made on flakes, and blades from non-naviform blade and bladelet cores, and some core production by-products and debitage from naviform core reduction (Rollefson et al. 1992; Quintero 2010). Consequently, at sites such as ‘Ain Ghazal, the manufacture of formal and informal tools in generalized production complicates the identification of generalized versus specialized tool production. It may be easy to mistake skilled production of formal tools made from blades as products of specialized production and, conversely, to categorize informal tools as nonspecialized. The basic distinction between informal and formal tools relies on the amount of effort put into their manufacture. Tools that may require a greater investment of time in manufacture and have a more consistent morphology are considered formal (e.g., projectile points), while those involving less effort and variable forms are considered informal or expedient (Parry and Kelly 1987; Andrefsky 1998). When applied to the archaeological record, however, the clarity of this distinction is problematic and much depends on the particular situation (see Odell 1996). Therefore, the most productive approach to identifying the skill involved and the amount of effort expended in formal and informal tool production at the household level is through replicative work.
Initial replicative work conducted by Quintero (1998a) and data analyses by Quintero and Hintzman (2007), suggested that most of the tool-production activities observed at ‘Ain Ghazal including making tools on naviform core products, axe and adze production, and other flake-tool production activities, could have been carried out without a high level of technical skill. Some tool forms, such as point varieties with diagonal parallel pressure retouch (Abu Gosh retouch), however, are thought by various researchers to require more skill to produce, which has prompted some to suggest they are products of specialized production (e.g., Barzilai 2010). Nevertheless, skilled production does not necessarily indicate the work of a specialist, that is, some skillful knappers may have made such points for their own use. Additional replicative work will help to further clarify the skill and effort necessary for the production of formal and informal tools and whether any of it appears to be the work of specialists. Overall, it is expected that with generalized tool production, variation should be evident in the quality of production related to blank choice (e.g., standardized blade blank vs. flake blank), innate skill, and time and effort put forth for tool manufacture.

Other considerations include efficiency, productivity, and areal extent of production activities, but these are considered here to be less definitive indicators and less useful. Efficiency in specialized production is often tied to product demand and standardization (Clark 1987; Costin 1991), while efficiency in terms of generalized production is expected primarily to have been affected by the availability of resource materials and the activity for which specific tools were needed. As for productivity, generalized production lacks standardization in form and consistent staging of reduction,
often making it too variable to estimate productivity reliably. Finally, specialized production as an activity was commonly restricted in its areal extent at sites, which is attributed to the fact that it was conducted by a small number of artisans. Conversely, generalized production is likely to occur in most or all households and should be present throughout a site (Costin 1991). While these patterns alone are not conclusive, they can be used as important supporting evidence for the identification of generalized production.

**Additional Considerations**

In addition to the considerations involved in the identification of generalized production, other pertinent lines of inquiry need exploration, including what household-level production can indicate about the interaction of households with the specialized blade-production portion of the economy. Also, in what way did this pattern change throughout the course of the PPNB? That is, when specialized production of flaked-stone products, in this case standardized blades detached from naviform cores, was present at the site (MPPNB and LPPNB), how much did site occupants depend on these blades and to what extent did they produce on their own blade blanks? Dependence can be determined, in part, by looking at the proportion of specialist to nonspecialist blades and other tool blanks in the tool and debitage assemblages. Similarly, what aspects of household-level flaked-stone production changed as specialized production eventually declined and disappeared? In addition, what can these patterns tell us about the changes in socioeconomic dynamics of the site? This final question explores the way in which people reacted to changes over the course of the occupation, whether conservative—generally maintaining the same or similar practices in procurement, production, etc.—or
innovative, devising new ways to accommodate the changes around them. An effective means of gaining insight into patterns of continuity and change is studying patterns of technological choices and tool needs, including blank selection, resource material use, core-reduction strategies frequency, frequency of tool types, tool styles, manufacturing techniques, and proportions of recycling.

*Tool blank Preference*

In exploring blank preference, two major questions address the technological evolution of the flaked-stone assemblage. First, what was the preference for specific types of blade or flake blanks for certain tools? Second, how did blank preference change for the different tool categories during each phase of occupation (MPPNB, LPPNB, PPNC, and Yarmoukian)? It already is evident that during the MPPNB and LPPNB the majority of formal tools (e.g., projectile points, sickle elements, borers, etc.) at ‘Ain Ghazal and elsewhere were made on blades from naviform cores (Mortensen 1970; Quintero 2010); some preferences are evident in blank selection (e.g., pointed blades were often fashioned into projectile points) (Mortensen 1988; Karnes and Quintero 2007). Naviform core-and-blade specialization ceased at the end of the PPNB. During the PPNC and Yarmoukian periods at ‘Ain Ghazal, mostly nonformal tool production was carried out on flakes and some blades produced on lower-quality chert and flint available at the site, and on scavenged naviform core-reduction products and production debris (Quintero 2010). Therefore, in a broad sense, blank selection changed from one primarily focused on blade blanks to one focused on flake blanks and on scavenged blade debris (Rollefson 1996a). But, in order to understand more thoroughly the dynamics of this
transition and its material traces, it is necessary to conduct an in-depth inventory of debitage, tools, and cores from domestic-related contexts, which would provide more specific insight into the types of choices that went into tool production.

**Core Type and Representation**

With regard to the core assemblage, the non-naviform component of the assemblage has received limited attention. Initial work on domestic-related contexts by Quintero (2010) indicated that flake cores and non-naviform blade cores were present throughout the occupation sequence, but were more common in deposits associated with the post-PPNB periods, after specialization had ceased and households were responsible for producing their own tool blanks. It is expected that a larger sample will reflect the same pattern and provide additional information related to tool blank production and resource material preference.

**Resource Material Use**

Resource material use, which should be more varied with generalized production strategies, is expected to have been even more diverse after specialization ended. This is the case because naviform cores and blades were almost exclusively produced on high-quality flint from Wadi Huweijir, which does not appear to have been systematically mined after the PPNB (Quintero 1996, 2010). However, the scavenging and recycling of Huweijir flint products throughout the course of occupation, but especially in the later periods, is likely to complicate this pattern. Therefore, examining features such as the
size and/or exhaustion of cores, tools, and debitage of Huweijir flint versus flint of lesser quality will provide a more nuanced understanding of changes in resource material use.

*Frequency of Different Tool Types*

It is already clear from the research conducted at ‘Ain Ghazal (e.g., Rollefson et al. 1992; Rollefson et al. 1994; Quintero 2010) that the proportion of formal tools compared to informal tools declined in the PPNC and Yarmoukian periods, and that certain tool forms (e.g., truncation burins) became more represented or less represented (e.g., glossed sickle blades) through time (Rollefson et al. 1992; Olszewski 1994; Quintero et al. 1997). Changes in the representation of certain tool forms likely was related, at least in part, to the cessation of specialized blade production, which had provided a consistent supply of standardized blanks and loaned a greater degree of formality to many of the tools types. Consequently, it is expected that certain tool types, especially nonhafted ones, became more variable in form later in time and, concomitantly, certain tool types became more, or less, common. Though use-wear studies are not included in this research, changes in the frequency of different tool types are informative about changes in harvesting, processing, and production activities. For example, Quintero et al. (1997) described important changes in harvesting practices that were indicated by sickle blade attributes. The increase and decrease of certain tool types, therefore, also may have been tied to changes in other aspects of daily life.
Changes in Style

Changes in tool style are expected to be most identifiable among formal tool varieties (e.g., projectile points, sickle blades, and woodworking tools). Some research has already been conducted on how and, to a more limited extent, why some changes in artifact form occurred through time among certain tool types in the ‘Ain Ghazal assemblage (Olszewski 1994; Rollefson et al. 1994; Quintero et al. 1997; Quintero 2010). Stylistic changes among projectile points across much of the Levant also have been studied extensively (e.g., Gopher 1994). The meaning of these changes has been applied broadly to differing models of social organization, cultural affiliation, diffusion, chronology, etc. (see previous chapter for discussion and citations related to this). It is not a goal of this research, however, to define cultural groups based on artifact types or to study “style” in a larger sense, but this research does address changes in artifact attributes considered by many researchers in the Levant to be stylistic in nature. So, what is style, and how do we study it?

Style in the past was often discerned as those aspects of artifact form that appear to be nonfunctional (Sackett 1973; Wobst 1977; Cunningham 2003). This view, however, was challenged (e.g., Wobst 1977; Weissner 1983, 1984), so that today there are essentially two views on this issue. One considers artifact form, as mostly defined by utilitarian features (the materialist view), the other values cultural notions of how an artifact should look regardless of function (the idealist view). According to Cunningham (2003), each of these views creates “blind spots” in scientific research and assumes that style and function are cultural givens. In reality, it may be very difficult to discern where
function ends and style begins. An early challenge that touches on this issue was that by Wobst (1977) who proposed that style functions as a type of information exchange. Furthermore, style is not universal in its appearance, transformations, or disappearance through space and time. There are also issues of tool reworking and its affect on alleged stylistic attributes (e.g., Flenniken and Raymond 1986; Flenniken and Wilke 1989; Rick 1996:246). So, how does one go about examining artifact form? One suggestion is the approach of pluralism (Cunningham 2003), which requires that a researcher approach the archaeological record with theoretical neutrality, adopting neither an explicitly materialist or idealist approach but instead viewing both as “different perspectives on a complex phenomenon” (Cunningham 2003:35). Rather than focusing on “style” and “function”, this approach looks for the underlying processes that go into creating a specific form, that is, how do changes in one process affect form and how do different processes interact to create specific forms (Cunningham 2003:35). Moreover, some believe that it is more informative to focus on the dimension of time as it relates to stylistic changes that in turn reflect transformations in social processes, than it is to focus on defining groups and individuals (Rick 1996:246).

This sort of “unbiased” approach is best executed with an analytical method that seeks to understand the processes that created specific tool forms, that is, a method that considers the life history of an artifact. Certainly, the inclusion of replicative studies in this technological reconstruction is integral to understanding the nature of “stylistic” change and some of the practical and social conditions that may have been involved in it.
Proportion of Recycling and Related Behaviors

Recycling or reuse is defined by Schiffer (2010:32) as “a change in the use, user, or form of an artifact after it has served a specific function in a particular activity.” Following Amick (2007:223), I recognize several different types of recycling including lateral recycling, which occurs when a used or discarded tool or core is reworked or reused as a different tool form or as a different core with a different reduction aim (e.g., a projectile point reworked into a borer, and a blade core reused as a multiplatform flake core). Another type of recycling is secondary recycling which occurs when flaked-stone artifacts are scavenged from the old deposits and reused as different tools, reworked and used for the initial purpose, or used as cores. Also part of this behavioral suite are items that are continually reworked and display heavy retouch indicating a long use-life with several reworking episodes.

Recycling and related behaviors are complicated but informative aspects of technology that have been studied extensively. The vast majority of the studies of recycling look at technological choices in flaked-stone assemblages, and many focus on factors related to mobility (e.g., Binford 1979; Nelson 1991; Hayden et al. 1996; Odell 1996; Amick 2007). They recognize that the technological choices of a group or individual are responsive to numerous factors, such as resource predictability, distribution, patchiness, periodicity, productivity, and to group mobility, size, and potential environmental hazards (Nelson 1991:59). The most commonly recognized behaviors in response to environmental and resource constraints are tool curation and expedient tool production (e.g., Binford 1979; Bamforth 1986; Parry and Kelly 1987;
Nelson 1991; Hayden et al. 1996; Holdaway and Douglass 2012). Curated tools are those that appear to have had a lot more time and energy put into maintenance and continual use, and are sometimes linked with mobility and less consistent access to resource material. Production of expedient tools requires less planning and is often seen as ad hoc in nature. This tool-production choice is sometimes associated with sedentary groups (e.g., Parry and Kelly 1987). This perception is now recognized by many to be too simplistic (Odell 1996; Andrefsky 1998), as exemplified in a recent assessment provided by Holdaway and Douglass (2012:122-123). They demonstrated that heavily retouched or curated artifacts might be associated with either sedentism or mobility due to a wide range of variables, including resource material availability, duration of occupation, and variation in site activities, all of which must be considered in order to understand variability in choices about artifact use and reuse.

The behavioral implications of recycling and reuse are often considered in the literature as a part of a larger strategy or design criterion (e.g., Nelson 1991; Hayden et al. 1996; Odell 1996), but recent work by Amick (2007) focused specifically on discerning some of the behavioral causes and archaeological traces of recycling behavior for mostly mobile groups. There are considerations, however, that apply to sites in which sedentism was the norm. For example, Amick (2007:224) cited work conducted at the Tosawihi quarries in Nevada, USA, by Elston and Raven (1992) who maintained, in relation to resource material procurement, that direct extraction in the form of quarrying had the potential for high yields of high-quality resource material, but the energy expended was quite high; conversely, with surface procurement of resource material, less energy was
expended, but yields were lower because the quality of the surface material was likely to be variable. Recycling, however, had the potential to provide high returns with little investment of time or energy. Amick (2007:227) also recognized that where site deposits are exposed on the surface, recycling of old tools, debitage, and cores would be a common lithic procurement strategy. This behavior could certainly extend to sedentary villages where ongoing construction and maintenance activities would expose old deposits and their contents, as at ‘Ain Ghazal.

So, what factors influence the presence and intensity of recycling? Amick (2007:228) suggested several possibilities: “(1) opportunism; (2) mobility constraints (the extremes of either high or low mobility can limit time and energy available for direct procurement); (3) restricted access to resource material sources, and (4) the organization of technology (recycling can be a regular component of curated or expedient strategies).” Additionally, changes in technology over time impact conservative behaviors. Beyond just practicality, recycling may also be related to the aesthetics or “specialness” of an object, as suggested by van Gijn (2010) for recycling of broken axes in the Single Grave culture in the Netherlands. Essentially, recycling is specific to context and should be determined on a case-by-case basis, considering the localized variables related to a particular group of people, who made artifacts under particular conditions. To achieve this contextual approach, it is necessary to examine all aspects of the flaked-stone assemblage including debitage, cores, and retouched tools, rather than just formal tools and cores (Holdaway and Douglass 2012).
Behaviors such as scavenging, recycling, and reuse (or extensive reworking) have received some limited attention at ‘Ain Ghazal, but from this initial research it is clear that all of these phenomena occurred throughout the course of the occupation, and were especially obvious in the later periods. During the PPNC and Yarmoukian, inhabitants produced their own tool blanks through nonspecialized reduction of blade/let and flake cores, and scavenged old tools and cores from PPNB deposits (Quintero 2010). Additional examination of the recycling and related behaviors at ‘Ain Ghazal is expected to be informative and should elaborate on the potential dynamics through time that contributed to these kinds of conservative behaviors.

Manufacturing Techniques

Manufacturing techniques refer to the ways in which certain tool forms were produced; they can include the type of hammer used for percussion (for example, organic or stone hammers, soft or hard hammer or anything in between), or whether percussion, pressure, some combination of these, or other technique was used to create blanks or shape certain tool forms. Changes in manufacturing techniques are expected to have been dependent on blank choices; resource material quality, form, and availability; the task at hand; and notions of successful flintknapping strategies and of the appropriate way of doing things. Therefore, identifying changes and potential causal factors in manufacturing techniques requires a consideration of all of the factors outlined here as well as replicative experiments. Work of this kind has been done on the ‘Ain Ghazal lithic assemblage. For instance, replicative work carried out by Wilke and Quintero (1994) on bidirectional opposed-platform naviform core reduction at ‘Ain Ghazal
indicated that naviform blade cores were shaped and reduced by direct percussion using a hammerstone. Therefore, the blades with punctiform platforms were detached by direct percussion, not by indirect percussion as had previously been claimed by persons who had not established their identities as skilled stone-workers. Additionally, replicative work conducted by Quintero and Hintzman (2007) shows that woodworking tools were shaped by percussion flaking, followed by pecking of ridges and grinding of the working edge. No changes are apparent in the way these heavy woodworking tools were produced and maintained throughout the occupation of ‘Ain Ghazal. It is expected, however, that there will be some changes in manufacturing techniques among other tool technologies reflecting different choices made throughout the occupation history, and that these instances of continuity or change will be informative about some of the socioeconomic dynamics through time.

Finally, these are complex issues to resolve, but it is only by addressing the interrelated lines of inquiry that it will be possible to discover some of the potential causal factors influencing technological change at ‘Ain Ghazal. Admittedly, it will not always be easy to discern between choices rooted in practicality and those that may be the product of a group’s particular way of doing things, especially given that lithic artifacts were always in a state of transformation during their use-lives. But the only way to begin to understand these transformations and account for their potential socioeconomic underpinnings is to employ an approach that considers the entire range of reduction sequences through a behavioral framework. Furthermore, this kind of site-level

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5 Except that it was learned through replicative work that refining the intended bit by pressure flaking shortened substantially the time needed for grinding.
analysis of the relationship between people and artifacts represents an initial step to
obtaining a more nuanced understanding of social and economic organization on the
regional and supraregional level.
Chapter 5

ANALYSIS OF FORMAL TOOLS

To address the issues raised in the previous chapters, this chapter first describes the total sampled assemblage, the contexts from which it was drawn, and the procedures employed in its analysis; it then addresses the findings from the analysis of the formal tool assemblage. Chapter 6 addresses the informal tool assemblage, woodworking tools, and hammerstones/pecking stones. Chapter 7 examines the debitage, cores, and tool production debris. Finally, Chapter 8 explores the evidence of tool production that was located in selected loci from each period of occupation.

ANALYZED ASSEMBLAGE

The total sample is presented by general categories in Table 5.1, and the complete assemblage tabulation by artifact type per period is presented in Table 5.2. Sampling of the majority of the tools and cores was random, mainly drawn from a stratified random sample accumulated from numerous seasons of excavation that sampled all known periods and the areal extent of the site occupation. Additionally, some of the sample consisted of tools from previous analyses. The debitage sampling was both random and judgmental in nature, guided by information from excavation reports and loci analyses of the assemblage character. The sampling strategy was designed to identify broad patterns of core reduction and tool production from each period of occupation, and to examine particular loci for evidence of domestic stone working or tool production activities.
Table 5.1 Total analyzed sample.

<table>
<thead>
<tr>
<th>Tools (formal and informal)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile points</td>
<td>956</td>
</tr>
<tr>
<td>Sickle elements</td>
<td>1,368</td>
</tr>
<tr>
<td>Knives</td>
<td>1,980</td>
</tr>
<tr>
<td>Borers</td>
<td>986</td>
</tr>
<tr>
<td>Burins</td>
<td>1,067</td>
</tr>
<tr>
<td>Scrapers</td>
<td>829</td>
</tr>
<tr>
<td>Denticulates</td>
<td>34</td>
</tr>
<tr>
<td>Notches</td>
<td>133</td>
</tr>
<tr>
<td>Used and retouched blades</td>
<td>693</td>
</tr>
<tr>
<td>Used and retouched flakes</td>
<td>637</td>
</tr>
<tr>
<td>Chamfered-bit tools</td>
<td>147</td>
</tr>
<tr>
<td>Combination tools</td>
<td>109</td>
</tr>
<tr>
<td>Woodworking tools</td>
<td>197</td>
</tr>
<tr>
<td>Hammerstones/pecking tools</td>
<td>50</td>
</tr>
<tr>
<td><strong>Tool Total</strong></td>
<td>9,186</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Debitage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flakedebitage</td>
<td>19,480</td>
</tr>
<tr>
<td>Bladedebitage</td>
<td>2,195</td>
</tr>
<tr>
<td><strong>Debitage Total</strong></td>
<td>21,675</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tool Production Debris and Cores</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production by-products</td>
<td>1,258</td>
</tr>
<tr>
<td>Spalls (burin and chamfered)</td>
<td>700</td>
</tr>
<tr>
<td>Tool blanks</td>
<td>203</td>
</tr>
<tr>
<td>Production failures</td>
<td>75</td>
</tr>
<tr>
<td>Cores</td>
<td>1,144</td>
</tr>
<tr>
<td><strong>Tool Production Debris and Core Total</strong></td>
<td>3,380</td>
</tr>
</tbody>
</table>

| TOTAL SAMPLE                        | 34,241|

**SAMPLE LOCI**

The total sample of debitage, cores, and tools came from over 1,500 individual loci\(^1\). Most of these loci were domestic-related and derived from interior fill deposits in house structures and adjacent exterior trash dumps and activity areas. The locus sample

\(^1\) The full list of sampled loci and their detailed contextual information are available upon request to the ‘Ain Ghazal project director, Gary Rollefson.
Table 5.2. Assemblage characteristics by chronological period.

<table>
<thead>
<tr>
<th></th>
<th>MPPNB</th>
<th>MPPNB/ LPPNB</th>
<th>LPPNB</th>
<th>LPPNB/ PPNC</th>
<th>PPNC</th>
<th>PN</th>
<th>Mixed/ unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile points</td>
<td>220</td>
<td>0</td>
<td>272</td>
<td>11</td>
<td>92</td>
<td>193</td>
<td>168</td>
</tr>
<tr>
<td>Sickle elements</td>
<td>459</td>
<td>2</td>
<td>562</td>
<td>12</td>
<td>61</td>
<td>121</td>
<td>151</td>
</tr>
<tr>
<td>Knives</td>
<td>905</td>
<td>5</td>
<td>564</td>
<td>22</td>
<td>192</td>
<td>262</td>
<td>30</td>
</tr>
<tr>
<td>Borers</td>
<td>221</td>
<td>3</td>
<td>221</td>
<td>15</td>
<td>118</td>
<td>315</td>
<td>95</td>
</tr>
<tr>
<td>Burins</td>
<td>276</td>
<td>1</td>
<td>344</td>
<td>15</td>
<td>115</td>
<td>272</td>
<td>44</td>
</tr>
<tr>
<td>Scrapers</td>
<td>115</td>
<td>1</td>
<td>163</td>
<td>7</td>
<td>189</td>
<td>290</td>
<td>64</td>
</tr>
<tr>
<td>Denticulates</td>
<td>4</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Notches</td>
<td>12</td>
<td>0</td>
<td>48</td>
<td>0</td>
<td>25</td>
<td>27</td>
<td>21</td>
</tr>
<tr>
<td>Retouched/used blades</td>
<td>157</td>
<td>3</td>
<td>341</td>
<td>17</td>
<td>86</td>
<td>82</td>
<td>7</td>
</tr>
<tr>
<td>Retouched/used flakes</td>
<td>93</td>
<td>1</td>
<td>248</td>
<td>19</td>
<td>161</td>
<td>104</td>
<td>11</td>
</tr>
<tr>
<td>Chamfered-bits</td>
<td>104</td>
<td>1</td>
<td>27</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Combination tools</td>
<td>39</td>
<td>0</td>
<td>28</td>
<td>0</td>
<td>7</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>Woodworking</td>
<td>19</td>
<td>0</td>
<td>52</td>
<td>4</td>
<td>34</td>
<td>41</td>
<td>47</td>
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<tr>
<td>Hammer/pecking stones</td>
<td>15</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>12</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Flake debitage</td>
<td>2,725</td>
<td>177</td>
<td>6,582</td>
<td>1,244</td>
<td>5,298</td>
<td>3,454</td>
<td>0</td>
</tr>
<tr>
<td>Blade debitage</td>
<td>676</td>
<td>31</td>
<td>776</td>
<td>95</td>
<td>384</td>
<td>233</td>
<td>0</td>
</tr>
<tr>
<td>Production by-products</td>
<td>382</td>
<td>17</td>
<td>506</td>
<td>55</td>
<td>174</td>
<td>122</td>
<td>2</td>
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<tr>
<td>Spalls</td>
<td>124</td>
<td>2</td>
<td>340</td>
<td>13</td>
<td>153</td>
<td>51</td>
<td>17</td>
</tr>
<tr>
<td>Tool blanks</td>
<td>95</td>
<td>2</td>
<td>70</td>
<td>3</td>
<td>10</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Production failures</td>
<td>29</td>
<td>0</td>
<td>31</td>
<td>1</td>
<td>9</td>
<td>5</td>
<td>0</td>
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<tr>
<td>Cores</td>
<td>108</td>
<td>1</td>
<td>99</td>
<td>12</td>
<td>269</td>
<td>434</td>
<td>221</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>6,778</td>
<td>247</td>
<td>11,299</td>
<td>1,544</td>
<td>7,397</td>
<td>6,055</td>
<td>921</td>
</tr>
</tbody>
</table>

represents all major regions of the excavation and all of the recognized periods of occupation (see Figure 1.4). A distributional comparison shows differences between the MPPNB and LPPNB, and generally between the PPNB periods and post-PPNB periods. From loci with large assemblages of flaked-stone material, percentages of Huweijir flint and blades from naviform cores were compared between both excavation squares and excavation areas (North Field, East Field, Central Field, West Field, and South Field).
from each chronological period\(^2\). Consistent differences are identified only in the LPPNB sample, and therefore are discussed only for the LPPNB. Additionally, excavators were sometimes able to assign the LPPNB deposits to early and late phases, so for each of the categories examined here differences within the LPPNB, if present, are discussed. Finally, although the majority of the loci sampled are domestic-related, several loci from each period with more substantive evidence of flint working or tool production activities were selected for discussion in Chapter 8, but the data are included here as part of the overall findings.

**ANALYTICAL APPROACH**

The classification approach taken here is technological and focuses heavily on blank use and manufacturing approaches. The technological typology developed for this research was influenced by work from many other researchers, including Mortensen (1970), Crowfoot Payne (1983), Eighmey (1992), Rollefson et al. (1992, 1994), Gopher (1989b, 1994), Olszewski (1994), Wilke and Quintero (1994), Rollefson (1995), Quintero (1998a, 2010), and Quintero and Hintzman (2007)\(^3\).

Replicative experimentation also was conducted as part of this research, which occurred over the course of several years and included replication of naviform (bidirectional opposed-platform) core-and-blade technology, other forms of blade-core production and reduction, the manufacture of bifacial tools (including woodworking tools

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\(^2\) Tight chronological associations between deposits were not always possible; the interpretation of differences between deposits must be viewed as tentative.

\(^3\) I have also drawn insight from conversations with, and from the previous work of, Mark Hintzman, Philip Wilke, and Leslie Quintero.
and knives), and the replication of much of the Neolithic formal and informal tool kit. The resource materials that were most readily available for use in experimentation included flint and chert from Texas (Georgetown and other Edwards Plateau sources), and obsidian from various sources in the western United States, although it was possible to use some Jordanian flint varieties from Eocene deposits for bifacial implement production. Insights from replicative experiments were especially informative in identifying debris from tool production and examining issues of skill.

Other analytical categories include blank choice (blades from naviform cores and blades from other core-reduction strategies, flakes, etc.), blank portion (proximal, medial, distal, or complete), resource material, presence and type of cortex, proximal and distal treatment (if applicable), metric attributes, presence of backing (if applicable), working edge treatment (if applicable), evidence of recycling, period, and context.

As discussed in the previous chapter, the goal of this research is to identify the extent of production that occurred in households, a major focus of which involves examining the tool kit made and used on a daily basis by most inhabitants, how that tool kit changed through time, and the potential meaning of those changes. This chapter addresses these major lines of inquiry for the formal tools, which are mostly drawn from domestic-related contexts.

A brief survey of other typologies and site reports demonstrates that each investigator recognizes a slightly different array of major functional categories identified
as formal tools\textsuperscript{4}. Most typologies, however, identify several tool types, such as projectile points and sickle elements, as formal tools that have some temporal sensitivity. The formal tool types recognized here include projectile points, sickle elements, knives, and borers. The decision to include knives and borers, but not burins, scrapers, or chamfered-bit tools rests mainly on the fact that some types of knives and borers were hafted, while other types (e.g., bifacial knives) may have required more time and effort in production. This designation is not without problems, as some borer and knife types require little planning and effort to produce, as with informal tool varieties. To address these issues in the ‘Ain Ghazal assemblage, ambiguities among certain types are discussed for each major functional category.

**PROJECTILE POINT ANALYSIS**

Historically, Pre-Pottery Neolithic projectile points have been classified in several different ways at different sites (for instance, Beidha [Mortensen 1970], Abu Gosh and Beisamoun [Lechevallier 1978], Jericho [Crowfoot Payne 1983], and Munhata [Gopher 1989b] all have different typologies for projectile points). The lack of a standardized typology often made comparisons between site assemblages difficult. In response to these difficulties, simplified typologies were proposed by Bar-Yosef (1981) and Gopher (1989a, 1994), and are now widely used in site reports\textsuperscript{5}.

\textsuperscript{4} For example, Nissen et al. (1987:91-104) for Basta; Gopher (1989b:28-129) for Munhata; Gebel and Bienert (1997:242) for Ba’ja; Khalaily et al. (2003) for Abu Gosh; and Barzilai (2010:142) and Garfinkel et al. (2012:84-93; 162-168) for Yiftahel.

\textsuperscript{5} Application of the simplified typology, however, is by no means universal. For instance, Eighmey (1992) conducted an analysis at projectile points from ‘Ain Ghazal and applied some different categories (e.g., Munhata points and ‘Ain Ghazal points) and some considerations other than those used by Gopher.
Eighmey (1992) previously analyzed a sample of projectile points from all
temporal periods at ‘Ain Ghazal. Drawing on commonly recognized types presented in
other typologies (e.g., Gopher 1994), he constructed a typology specifically for ‘Ain
Ghazal. His typology differs from that of Gopher (1994) with the inclusion of Munhata
points, Abu Gosh points (rather than Byblos or Amuq points with Abu Gosh retouch),
‘Ain Ghazal points (Ha-Parsa points), Yarmoukian tanged points (includes both Ha-Parsa
and Nizzanim), and Yarmoukian leaf-shaped points (Herzliya) (Eighmey 1992:96-98).

Beyond just noting changes in frequency of the different types through time,
Eighmey (1992) sought to explain the range of forms and sizes that coexisted within
relatively short temporal periods. He found that projectile points became smaller and
more heavily retouched through time, which he attributed to functional concerns.
Specifically, he observed that the form and size of a projectile point were determined
significantly by the haft zone of the projectile (e.g., beveled haft, split haft, etc.), the
weapon technology (bow and arrow or spear thrower and dart), and the size of the
intended prey. Eighmey (1992) argued that the differences in the sizes of projectile points
were primarily associated with their intended function, that is, the small points were
intentionally manufactured small to serve as arrow points. He concluded that by the
Yarmoukian period, people mainly hunted small-to medium-sized prey with bow and
arrow technology, which accounts for the prominence of smaller point types.

Issues of Technological Change and Projectile Point Size

Eighmey’s (1992) explanation for the source of variation in projectile point size
and form is not the only such attempt to identify technological change in the Levant. The
appearance of bow and arrow technology in the Near East has been inferred by some as far back as the Epipaleolithic, when it is suggested that microliths may have served as arrow tips (Olszewski 1993). Evidence from Egypt demonstrates the use of bow and arrow technology by at least the Neolithic and clearly by the Predynastic, but perhaps as early as the Epipaleolithic or Late Stone Age (Clark et al. 1975). Additionally, the presence of shaft straighteners at some Natufian sites has been interpreted to be associated with bow and arrow technology (e.g., Henry 1989:196). Shaft straighteners, however, could have been used for dart shafts, drill shafts, or any other technology that used reed shafts (Wilke and Quintero 2009). Although it is possible that the bow and arrow was in use by the Epipaleolithic in the Near East, the current evidence is hardly unambiguous. In fact, an osteological examination of skeletal remains from the Natufian (Peterson 1998) indicates that atlatl technology was still in use and may have coexisted with the bow and arrow, perhaps employed for different hunting purposes.

Other arguments place the appearance of the bow and arrow in the early Neolithic period (Gopher 1994:265), but they mainly are based on differences in projectile point size between the early and later Neolithic (e.g., Mozel 1978). Some argue the larger PPNB varieties were associated with the atlatl, or spear thrower, and dart technology, while smaller PPNB points and later PPNC and PN points were associated with the bow and arrow, suggesting the coexistence of these technologies in the Neolithic (Eighmey 1992:163-165)⁶. Moreover, some researchers associate weapon point size with the size of

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⁶ Additionally, some researchers imply (perhaps unintentionally) through the blanket use of the term “arrowhead” that both small and large Neolithic point varieties are associated with bow and arrow technology (e.g., Burian et al. 1976; Nadel 1994; Garfinkel et al. 2012).
the intended prey (e.g., Burian et al. 1976; Eighmey 1992:166-170; Ibáñez et al. 2007:161). Equating small weapon points with the hunting of small-sized prey, however, is problematic. The late prehistoric tribes of the North American Plains used the bow and arrow exclusively to hunt *Bison bison* on which they heavily relied. The small arrow points used in hunting these animals weighed 1-2 grams (Bell and Brooks 2001:212), and bison of the late prehistoric period weighed about 540-800 kilograms (Hall and Kelson 1959:1024). Thus, no claims should be made that small projectile points necessarily imply use primarily on small game.

Clearly, tracing technological change in weapons systems is complicated because these systems involve multiple working parts, and the most commonly recovered remains from these interacting parts are the stone points\(^7\). As such, it is tempting to look to size attributes to distinguish between technologies. In general, it is accepted that the bow propels lighter projectile points than the atlatl or spears thrown by hand, but evidence, both archaeological and experimental, suggests there is some degree of allowable variation in point size, especially for atlatl and dart technology (Couch et al. 1999; Cattelain 1997; Hughes 1998). For instance, Couch et al. (1999:32) found little difference in the distance achieved by larger versus smaller (arrowhead-sized) points when used with an atlatl. Likewise, it has been demonstrated in many studies conducted in North America that relying on point size (including attributes such as weight, neck width, shoulder width, maximum width, length, and thickness) to identify the arrival of bow and arrow technology can be problematic (Geib and Bungart 1989; Hughes 1998; Nassancy 1997).

\(^7\) Such issues are comprehensively discussed in Knecht (1997).
and Pyle 1999; Sliva 1999; Webster 1980). Relying on size can trace morphological change through time, but without considering other variables such as reuse modifications, it is difficult to clearly discern the potential cause of these changes.

Despite the popular reliance on size attributes, some studies consider other features. For instance, Nassaney and Pyle (1999) considered both size and reduction strategies among North American projectile point assemblages. Not only did they get a bimodal distribution of size, interpreted to be consistent with dart points versus arrowheads, they also observed a change in reduction strategies, with dart points made on bifaces and arrowheads made on flakes. While this study may be a useful consideration for some North American point traditions, it is not as useful a distinguishing feature in the Near East where most projectile points were made on blade/lets through much of the Neolithic and earlier periods.

Other important variables to consider include resource material quality and availability, which can influence the degree to which a point may have been reworked. In some cases, dart points can be intensively reworked and by the time they reach exhaustion they may be typed differently (Flenniken and Wilke 1989), or fall within the sizes/weights observed for arrowheads.

Design requirements associated with a particular weapon system are also important factors in weapon point size and form. Hughes (1998:351-360) discussed four variables that influence projectile penetration: mass, velocity, tip cross-sectional area, and projectile shape. Variability in projectile points may be attributable to the fact that

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8 A contention that is somewhat problematic because dart points were also made on large flakes.
projectile mass, which depends in part on the point used, can be manipulated to increase velocity or penetration. Tip design, for example, is crucial for penetration, with a gradually expanding body designed to create a wound large enough to allow the shaft to enter (Hughes 1998:353). Other features impact functionality, including barbs, ears, and serrations, all of which may amplify drag, but are crucial at increasing damage (serrations) and keeping the weapon in the wound (barbs or ears) (Flenniken and Wilke 1989). Thrusting spears, however, are designed better without barbs, so they can easily be removed for repeated thrusting injury. Hughes (1998:370) also argued the innovation of fletching impacted dart point size, observing that unfletched darts were likely to show more variation in size and generally were larger, while fletched darts were smaller, and in some cases, overlap considerably with larger arrow point varieties.

In addition to design features, it is critical to consider issues of hunting strategy, intended prey, and portability. For instance, atlatls and darts, which require a standing position, substantial motion, and cannot be rapidly and repeatedly used (Raymond 1986; Frison 1989; Whittaker 2010), may have been better suited for long distance hunting that requires greater projectile force (Raymond 1986:173). Bow and arrow technology, on the other hand, tends to be more useful for a variety of different hunting strategies at relatively close ranges.

Other sources of variation in projectile point form and size include style, variation in skill, blank configuration and size, resharpening, recovery from manufacturing breaks, and hafting requirements (Burian et al. 1976; Flenniken and Raymond 1986; Flenniken and Wilke 1989; Weissner 1983). In sum, examining size alone can demonstrate
differences, but without other supporting evidence, the meaning of these differences cannot unequivocally be equated to use in a particular weapon system. It seems likely that aspects of both technologies overlapped, but it is beyond the scope this work to consider all of the potential lines of evidence associated with identifying changes in the weapons systems. It is evident, however, that projectile point production was definitely affected by changes in the availability of high-quality flint and suitable blanks at ‘Ain Ghazal (Quintero 2010), which is discussed in detail below.

**Anthropological and Economic Significance of Projectile Points**

Projectile points appear to have remained important throughout the Neolithic (Gopher 1994). At ‘Ain Ghazal, they were important for the subsistence economy in the PPNB, and were used for hunting large and small animals for food, pelts, and feathers, which is supported by the great diversity of wild species in the faunal collection (Rollefson et al. 1992:452-453). Projectile points remain present throughout the occupation of ‘Ain Ghazal and they continued to show damage from impact throughout. This implies that they continued to be a valued part of the tool kit into the Yarmoukian period when hunted species declined to less than 10% of the faunal assemblage. Given this pattern at ‘Ain Ghazal and elsewhere, some have suggested warfare was involved in their continued use (Bar-Yosef 2010:8; Clare 2010:19-20), but so far little evidence of conflict has been found at ‘Ain Ghazal (Rollefson 2010b) and generally for Neolithic sites in the southern Levant (e.g., Bernbeck 2010). Köhler-Rollefson and Rollefson (1993:35) argued that the relatively consistent presence of projectile points into the PPNC and Yarmoukian at ‘Ain Ghazal might have been a result of on-site surplus production of
points for later use by the members of the settlement involved in the herding of animals in the steppe and desert for much of the year, where hunting was a major subsistence strategy. Also, it is probable that projectile points continued to be used for personal protection against predatory animals or adversaries when inhabitants engaged in tasks away from the village; likewise, hunting game for pelts, feathers, sinew, and other usable products likely continued.

**Projectile Point Typology**

This analysis relies mainly on Gopher’s (1994) simplified typology, but borrows some from Eighmey (1992) in the inclusion of a variant—the Munhata subtype—for Amuq points. The major types recorded at ‘Ain Ghazal are common southern Levantine Pre-Pottery and Pottery Neolithic types, including Jericho, Byblos, Amuq (includes Munhata subtype), Nizzanim, Ha-Parsa, and Herzliya. Other less represented point types include lanceolate points, and some rare types (e.g., Transverse, El-Khiam). Numerous unidentifiable fragments are also present.

**Jericho Projectile Points**

Jericho points are common in the earlier part of the PPNB, generally in the EPPNB and MPPNB (Gopher 1994:199). Sites occupied earlier in the PPNB tend to have higher percentages of Jericho points, though this is by no means a universal pattern (Gopher 1994). As shown in Tables 5.3 to 5.6, they are most common in the MPPNB at ‘Ain Ghazal, but they are much less numerous than Byblos points. When compared to other MPPNB site assemblages, ‘Ain Ghazal seems to have a lower representation of
Jericho points\(^9\). After the MPPNB, Jericho points are present in low frequencies and their recovery from post-PPNB period contexts is attributed to scavenging.

Gopher’s (1994:36) description of a Jericho point is consistent with those found at ‘Ain Ghazal, which are most often made on large blades from naviform blade cores. The haft portion often contracts, shaped by bifacial pressure flaking with subtle to pronounced barbs created by bilateral notching at the distal end of the haft element. The body and tip of the point were only retouched to regularize the symmetry (Plate 5.1). They appear to be the largest point type at ‘Ain Ghazal with completed points averaging approximately 65.75 mm in length.

None of the production failures examined in this analysis are identifiable as Jericho points. Nevertheless, given that numerous tool blanks (\(n=43\)) and production failures (\(n=27\)) consistent with projectile point manufacture were recovered from domestic contexts, it seems likely Jericho points were among the types made in most households. This interpretation is supported by the range of variation in production quality, which also suggests numerous community members undertook their production. Further discussion on this matter is presented in Chapter 8.

\(^9\) At Beidha, Byblos and Jericho points are present in relatively equal percentages (each between 40% and 50%) (Mortensen 1970; Gopher 1994:62); at Jericho, Jericho points seem to be more common than Byblos (Crowfoot Payne 1983:683); at Munhata, Jericho points are more common, at 53.2%, versus 33.6% for Byblos (Gopher 1989b:31-44); at Shakarat Msaied, Jericho points make up 70% of the assemblage (Jensen et al. 2005:126); at Motza, in the EPPNB assemblage, Helwan points are most common (\(n=426\)), followed by Jericho points (\(n=322\)) (Khulailay et al. 2007:17); at Yiftahel, Jericho and Byblos points are both common, but Jericho is a little more common, at 41.5% versus 29.2% of the Area C assemblage (Garfinkel et al. 2012:87, 162, 189); and at Abu as-Suwwan, Byblos is only slightly more common than other types during the MPPNB and LPPNB (Al-Nahar 2013:128). However, at Ghwair, as at ‘Ain Ghazal, Byblos points are the most common, at 65.7% (Simmons and Najjar 2003:418-419). In general, Helwan and Jericho points are more common in the EPPNB and early part of the MPPNB, and Byblos and Amuq points in the later MPPNB and LPPNB; as such, some of the differences in point types between sites may reflect variation in timing of site occupation.
Only four Jericho points are complete, and of the broken specimens, five have impact damage attesting to their breakage in use. Additionally, some exhibit evidence of recycling and reshaping. The most common trajectory for recycling of Jericho points is into cutting implements, including sickle elements and knives (see Plate 5.1. Two of the points are recycled; one into a sickle element, the other is a knife). The MPPNB sample includes six pieces (24%) with apparent signs of recycling and four pieces (16%) with invasive pressure retouch along the medial portion of the blade, suggesting reshaping for maintenance and reuse. The LPPNB sample is much smaller (n=4) but three of the points retain evidence of reshaping. The PPNC sample has two Jericho points that undoubtedly are derived from earlier deposits, and while no evidence indicates recycling into other tools, one has extensive pressure retouch suggesting more intensive reshaping and reuse.
The PN sample also contains two scavenged Jericho points, and of these, one was recycled into a borer and the other has retouch indicative of continual reshaping and reuse.

Jericho points in this sample were produced exclusively on Huweijir flint, and blade blanks from naviform cores make up 97% (n=38) of the sample. Trapezoidal-to-triangular blades are the most common blanks used, followed by triangular blades and trapezoidal blades. Because post-PPNB Jericho points were scavenged from other site deposits, blank selection and blade type preferences do not change through time.

**Byblos Projectile Points**

Byblos points appear in the southern Levant in the early part of the PPNB (last quarter of the 9th Millennium) and remain a common point type through the PPNC at some sites (Gopher 1994:197, 201; Galili et al. 1993; Garfinkel 1994). They are the most prevalent type of point at ‘Ain Ghazal making up 44.5% (n=426) of the total sample. Generally, Byblos points are most common in the PPNB periods, which is true at other MPPNB and LPPNB sites\(^\text{10}\). They are also present, although in lower quantities, in the PPNC and Yarmoukian samples at ‘Ain Ghazal.

Byblos type points are a broad category of blade-based projectile points primarily identifiable by the shape of the haft element or tang, which can range from subtly shouldered to markedly shouldered (Plate 5.2). The finished points show a large range of variation in production from roughly crafted to finely shaped. In general, manufacture

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\(^\text{10}\) For instance, Abu as-Suwwan (Al-Nahar 2013); Khirbet Hammam (Peterson 2004:10); El-Hemmeh (Makarewicz et al. 2006:197); Ghwair 1 (Simmons and Najjar 2003:418-419); Basta (Nissen et al. 1987:98); Es-Sifiya (Mahasneh 1997:207).
was relatively simple, the body and tip of the point only required minimal noninvasive retouch to regularize the distal end. The tangs were fashioned by removing several abrupt, nonsystematic pressure flakes, or in the case of Abu Gosh varieties, with diagonal parallel pressure retouch, removing a series of invasive systematic pressure flakes angled diagonally across the dorsal surface, generally from lower left and upper right. The diagonal retouch was sometimes accomplished along only one margin, but most often on both. Some tangs tapered to a point, while others were squared off with abrupt retouch, possibly reflecting different hafting choices (cf. Eighmey 1992:124). Of the 426 Byblos points, 23.7% (n=101) have diagonal parallel pressure retouch, which is most common in the MPPNB sample (n=60).

Some researchers suggest the finely made points, such as those with Abu Gosh retouch, may have been produced by specialists (e.g., Barzilai 2010:153-154). At ‘Ain Ghazal, however, production failures consistent with Byblos points (at least three of the 27) are present in domestic-related production contexts along with tool blanks and discarded used and broken points, suggesting they were manufactured by members of most households.

Recycling and other similar behaviors are also present, and commonly involved either reworking the point for further use or reusing the tool for a different purpose. During the MPPNB, about 12.6% (n=18) of Byblos points display recycling or extensive reworking. As with Jericho points, Byblos points often were recycled into knives or sickle elements (See Plate 5.2). The LPPNB sample has a slightly lower
Plate 5.2. Byblos points. The first two points retain evidence of recycling into cutting implements. Also, all but two of the points display evidence of impact damage.

incidence, at 8% (n=12) with clear signs of recycling or extensive reworking. The PPNC sample includes two Byblos points with apparent signs of recycling (again, as cutting implements) and eight (34.8%) with probable signs of scavenging from older deposits and reuse, and they generally have a much higher frequency of extensive retouch (43.5%, n=10). Similarly, the Byblos points recovered from Yarmoukian deposits have a higher representation of extensive retouch (42.4%, n=14). Perhaps due to the high rate of
retouch it is not always apparent that a piece was recycled, but they likely were scavenged.

Among Byblos points from ‘Ain Ghazal, Huweijir flint is the preferred resource material at 99%, which probably is because blades were nearly exclusively chosen as the blanks. Blade blanks from naviform cores are the most common blank category among Byblos points, and the preferred blade types are triangular (n=153) and trapezoidal (n=100) blades, followed closely by trapezoidal-to-triangular blades (n=90), with the rest indeterminate. Only 48 of the points from the sample are complete or nearly complete, and about 60 have indications of breakage from impact. The average length of a complete Byblos point is 50.86 mm, making them smaller than Jericho and Amuq points, but they are the most numerous type, and they show greater variation in production quality and size.

Byblos points are the most common point type in the PPNB deposits, and blank choice and blade type changed little from the MPPNB to the LPPNB. The seemingly lower incidence of blades from naviform cores in the post-PPNB periods is in part because the points tend to be heavily retouched, obscuring blank type. Also, many of the scavenged points and blade blanks from earlier deposits probably were broken (some with impact damage) and required a greater degree of retouch to shape the point into a usable form. It is also possible later Byblos points were made on a wider range of blank types (including flakes), which required more retouch to regularize and shape the tool.
Table 5.3. Summary of projectile point attributes from MPPNB contexts.

<table>
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<tr>
<th>Blade type</th>
<th>MPPNB (220)</th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
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<tr>
<td></td>
<td>Byblos (143)</td>
<td>Jericho (25)</td>
<td>Amuq (4)</td>
<td>Leaf-shaped (4)</td>
<td>Unknown (42)</td>
<td>Other(^a) (2)</td>
</tr>
<tr>
<td>Triangular</td>
<td>63 (44.1%)</td>
<td>9 (36%)</td>
<td>2 (50%)</td>
<td>2 (50%)</td>
<td>11 (26.2%)</td>
<td>1 (50%)</td>
</tr>
<tr>
<td>Trapezoidal</td>
<td>38 (26.6%)</td>
<td>7 (28%)</td>
<td>1 (25%)</td>
<td>0 (0%)</td>
<td>4 (9.5%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Trapezoidal-Triangular</td>
<td>25 (17.5%)</td>
<td>9 (36%)</td>
<td>1 (25%)</td>
<td>0 (0%)</td>
<td>8 (19%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>17 (11.9%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>2 (50%)</td>
<td>19 (45.2%)</td>
<td>1 (50%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource material</th>
<th>Huweijir flint</th>
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<th></th>
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<tbody>
<tr>
<td>Naviform</td>
<td>141 (98.6%)</td>
<td>25 (100%)</td>
<td>4 (100%)</td>
<td>4 (100%)</td>
<td>42 (100%)</td>
<td>2 (100%)</td>
</tr>
</tbody>
</table>

\(^a\) Includes one preform and one Nizzanim point.

Table 5.4. Summary of projectile point attributes from LPPNB contexts.

<table>
<thead>
<tr>
<th>Blade type</th>
<th>LPPNB (272)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Byblos (150)</td>
<td>Jericho (4)</td>
<td>Amuq (12)</td>
<td>Ha-Parsa (3)</td>
<td>Herzliya (2)</td>
<td>Nizzanim (4)</td>
<td>Preform (5)</td>
</tr>
<tr>
<td>Triangular</td>
<td>64 (42.7%)</td>
<td>1 (25%)</td>
<td>4 (33.3%)</td>
<td>0 (0%)</td>
<td>2 (100%)</td>
<td>2 (50%)</td>
<td>3 (60%)</td>
</tr>
<tr>
<td>Trapezoidal</td>
<td>34 (22.7%)</td>
<td>1 (25%)</td>
<td>5 (41.6%)</td>
<td>1 (33.3%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Trapezoidal-Triangular</td>
<td>39 (26%)</td>
<td>1 (25%)</td>
<td>1 (8.3%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>2 (40%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>13 (8.7%)</td>
<td>1 (25%)</td>
<td>2 (16.7%)</td>
<td>2 (66.6%)</td>
<td>0 (0%)</td>
<td>2 (50%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource material</th>
<th>Huweijir flint</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Naviform</td>
<td>149 (99.3%)</td>
<td>4 (100%)</td>
<td>12 (100%)</td>
<td>3 (100%)</td>
<td>1 (50%)</td>
<td>4 (100%)</td>
<td>5 (100%)</td>
</tr>
</tbody>
</table>

\(^a\) The other category here includes one El-Khiam point and one lanceolate point.
Table 5.5. Summary of projectile point attributes from PPNC contexts.

<table>
<thead>
<tr>
<th>Blade type</th>
<th>PPNC (92)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Byblos (23)</td>
<td>Jericho (2)</td>
<td>Amuq (7)</td>
<td>Ha-Parsa (12)</td>
<td>Herzliya (3)</td>
<td>Nizzanim (7)</td>
<td>Lanceolate (4)</td>
<td>Unknown (31)</td>
<td>Other* (3)</td>
<td></td>
</tr>
<tr>
<td>Triangular</td>
<td>8 (34.8%)</td>
<td>1 (50%)</td>
<td>1 (14.3%)</td>
<td>3 (23%)</td>
<td>1 (33.3%)</td>
<td>1 (14.3%)</td>
<td>0 (0%)</td>
<td>12 (36.4%)</td>
<td>2 (66.7%)</td>
<td></td>
</tr>
<tr>
<td>Trapezoidal</td>
<td>2 (8.7%)</td>
<td>1 (50%)</td>
<td>2 (28.6%)</td>
<td>0 (0%)</td>
<td>2 (66.7%)</td>
<td>2 (28.6%)</td>
<td>0 (0%)</td>
<td>6 (18.25%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Trapezoidal-Triangular</td>
<td>6 (26.1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (14.3%)</td>
<td>0 (0%)</td>
<td>4 (12%)</td>
<td>0 (0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7 (30.4%)</td>
<td>0 (0%)</td>
<td>4 (57.1%)</td>
<td>10 (77%)</td>
<td>0 (0%)</td>
<td>3 (42.9%)</td>
<td>4 (100%)</td>
<td>9 (27%)</td>
<td>1 (33.3%)</td>
<td></td>
</tr>
</tbody>
</table>

Resource material

| Huweijir flint            | 23 (100%)         | 2 (100%) | 7 (100%) | 13 (100%) | 3 (100%) | 7 (100%) | 3 (%) | 32 (97%) | 3 (100%) |

Blank Technology

| Naviform                  | 13 (56.5%) | 2 (100%) | 2 (28.6%) | 2 (15%) | 0 (0%) | 0 (0%) | 0 (0%) | 13 (39.4%) | 0 (0%) |

*The other category here includes one leaf-shaped point and two preforms.

Table 5.6. Summary of projectile point attributes from Yarmoukian contexts.

<table>
<thead>
<tr>
<th>Blade type</th>
<th>Yarmoukian (193)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Byblos (33)</td>
<td>Jericho (2)</td>
<td>Amuq (4)</td>
<td>Ha-Parsa (49)</td>
<td>Herzliya (12)</td>
<td>Nizzanim (30)</td>
<td>Preform (3)</td>
<td>Unknown (59)</td>
<td>Other* (1)</td>
<td></td>
</tr>
<tr>
<td>Triangular</td>
<td>14 (42.4%)</td>
<td>0 (0%)</td>
<td>1 (25%)</td>
<td>5 (10.2%)</td>
<td>5 (41.7%)</td>
<td>3 (10%)</td>
<td>0 (0%)</td>
<td>17 (28.8%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Trapezoidal</td>
<td>5 (15.2%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>2 (4.1%)</td>
<td>1 (8.3%)</td>
<td>4 (13.3%)</td>
<td>1 (33.3%)</td>
<td>9 (15.3%)</td>
<td>1 (100%)</td>
<td></td>
</tr>
<tr>
<td>Trapezoidal-Triangular</td>
<td>5 (15.2%)</td>
<td>2 (100%)</td>
<td>1 (25%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (3.3%)</td>
<td>1 (33.3%)</td>
<td>1 (1.7%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>8 (24.2%)</td>
<td>0 (0%)</td>
<td>2 (50%)</td>
<td>42 (85.7%)</td>
<td>5 (41.7%)</td>
<td>20 (66.7%)</td>
<td>0 (0%)</td>
<td>32 (54.2%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Flake</td>
<td>1 (3%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (8.3%)</td>
<td>2 (6.7%)</td>
<td>1 (33.3%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
</tbody>
</table>

Resource material

| Huweijir flint            | 32 (97%)         | 2 (100%) | 4 (100%) | 48 (98%) | 11 (92%) | 29 (96.7%) | 3 (100%) | 52 (88.1%) | 1 (100%) |

Blank Technology

| Naviform                  | 19 (57.6%) | 2 (100%) | 2 (50%) | 5 (10.2%) | 2 (16.7%) | 1 (3.33%) | 0 (0%) | 12 (20.3%) | 1 (100%) |

*The other category here includes one transverse arrowhead.
**Amuq Projectile Points**

Amuq points also appear in the southern Levant in the PPNB, but they are most common in the later part of the PPN (Gopher 1994:197). At ‘Ain Ghazal, Amuq points were most common in the LPPNB and PPNC, which is consistent with other LPPNB and PPNC sites in the southern Levant\(^\text{11}\).

Amuq points are foliate-shaped projectile points fashioned on blades, and are without a developed shoulder. The tang, which required only minimal shaping, often was formed by unifacial pressure retouch. Several of the preforms identified in this sample are consistent with Amuq points and some of the points classified as Amuq or Munhata points were in the final stages of production when they broke. Production of most Amuq points involved retouch along the body and distal end to regularize the point. The Munhata variant of Amuq points was fashioned essentially the same way, except along the tang, where a series of systematic collateral pressure flakes were removed along each margin (plate 5.3). The average length of a complete Amuq point is 55.9 mm, which makes them longer than the average Byblos point, but the sample is also smaller with only 13 complete Amuq points.

The Amuq points are represented by 37 specimens, which make up about 4% of the total projectile point sample. From the total sample, 10 have evidence of impact damage (27%). In addition to use breaks, some points have evidence of recycling into other tool forms or reshaping for continued use as a point. From the MPPNB period

\(^{\text{11}}\) Including Tel ‘Ali, where Byblos and Amuq points are both found (Garfinkle 1994:553); at Atlit-Yam, where Byblos and Amuq type points are the dominant types (Galili et al. 1993:142); at Abu as-Suwwan, where Amuq points are most in PPNC/Yarmoukian (Al-Nahar 2013); and at Basta, where Amuq points dominate the projectile point assemblage along with Byblos points (Nissen et al. 1987:98).
sample of four, two pieces have unmistakable signs of recycling to a sickle or knife, and one piece has possible signs of reshaping. The LPPNB sample contains three clearly recycled pieces, one as a borer, and two that appear to have been scavenged points (original type unknown) reworked into Amuq-style points (indicated by a double patina). Additionally, four pieces have extensive retouch. The PPNC assemblage has two points with signs of reshaping of the body and tip, and two points with extensive retouch. Finally, the Yarmoukian assemblage contains two pieces with extensive retouch.

The preferred resource material is Huweijir flint (n=36). Blades from naviform cores comprise 44% (n=16) of the identifiable blank types, but many are unidentifiable due to extensive retouch or breakage. The identifiable blade types preferred for
manufacture includes triangular blades (n=10), followed by trapezoidal blades (n=9) and trapezoidal-to-triangular blades (n=6). The distribution by period for blank choice demonstrates blade blanks from naviform cores were most common in the MPPNB, declining significantly in the LPPNB and PPNC. Blade type preference by period is a bit more variable, and small differences exist in the prominence of trapezoidal, triangular, and trapezoidal-to-triangular blades by period.

**Late Neolithic Projectile points**

Ha-Parsa, Nizzanim, and Herzliya are small late Neolithic point types originally identified by Bar-Yosef (1981:561). Gopher (1994:219) argued that Ha-Parsa, Nizzanim, and Herzliya points should be treated as a group, as they have similar production techniques, the types grade into each other, and typically they are all present in assemblages of this time. These point types are most common in sites dating to the Pottery Neolithic and eventually are replaced by transverse points. Late Neolithic points, however, were identified in small numbers in the assemblages from PPNC Tel ‘Ali and Atlit-Yam (Garfinkel 1994:555; Galili et al. 1993:142), but they are more common in PN occupation layers. Additionally, they appear throughout the Levant, in Egypt, and in the Arabian Peninsula at this time (Gopher 1994:219-220).

The continued presence of large PPN types are reported in several PN assemblages (Gopher 1994), for instance, at Jericho (Crowfoot Payne 1983:708),

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12 For example, at Abu Gosh (Khalailly et al. 2003: 40), Jericho (Crowfoot Payne 1983:708), Munhata (Gopher 1989b:89), Sha’ar Hagolan (Matskevich 2011:233), and Abu Thawwab (Kafafi 2001:118).
Munhata (Gopher 1989b:94), Wadi Shu‘eib (Simmons et al. 2001:12), and Sha’ar Hagolan (Matskevich 2011:233), which is also the case at ‘Ain Ghazal. The persistence of these types at ‘Ain Ghazal is interpreted as a product of scavenging from earlier deposits and reuse, which may be the case at other multicomponent Neolithic sites.

**Ha-Parsa Projectile Points**

At ‘Ain Ghazal, Ha-Parsa points are represented by 75 specimens or about 7.8% of the total assemblage. The first period with any Ha-Parsa points is the LPPNB with three specimens (though they may be intrusive). They begin to increase in frequency in the PPNC, and by the Yarmoukian period, Ha-Parsa points are the most common type.

At ‘Ain Ghazal, Ha-Parsa points are small and fashioned on both flakes and blade/lets. They are similar in morphology to Jericho points (Gopher 1994), but production of these points, unlike those of the PPNB type points, often involved extensive retouch along both margins of the body and distal end, sometimes bifacially, to regularize the point. The retouch along the body includes systematic diagonal parallel pressure retouch and/or nonsystematic pressure retouch. The pressure retouch on some of the more finely made points is quite delicate and would have required a narrow-bit pressure flaker. The tang portions, as with Jericho points, sometimes show bifacial pressure removals, which generally involved nonsystematic pressure retouch, though in some instances it was systematic. The form of the discarded points shows much of variation, with some points barbed, requiring notching-flake removals, and some points are shouldered (Plate 5.4). As with the PPN varieties, blanks and preforms (at least 10) consistent with the PN-type points were recovered from domestic-related contexts along
with production failures (at least three), suggesting that community members produced them. A finished Ha-Parsa point averages about 29.6 mm long, making the type considerably smaller on average than the Jericho, Byblos, and Amuq types.

The percentage of complete specimens is much higher among Ha-Parsa specimens than is found among PPNB points, with 36% (n=27) complete, which may be because small and short points do not break as easily along the medial portion. Of the broken points, 10 (13.3%) have signs of impact damage. As mentioned above, the Ha-Parsa points are nearly all heavily retouched and many are exhausted. As such, behaviors of tool conservation, including recycling and extensive retouch indicative of continual resharpening and reshaping, serve as an identifying feature of this and other later point types (see plate 5.4). The LPPNB sample has two Ha-Parsa points with signs of reshaping. The PPNC assemblage has one point with probable evidence of recycling into a knife, and seven that may have been scavenged and reshaped. The Yarmoukian sample has 39 Ha-Parsa points that may have been made on scavenged blanks and/or reshaped, while, about 17 were used to the point of exhaustion.

As with other projectile point types and varieties, Huweijir flint is the preferred resource material in the sample at 98.7% (n=74). One of the major differences with this point type is the level of retouch: nearly all of the specimens have pressure retouch across much of one or both faces. As a result, the technological origin of the blank and its type are difficult to identify. In fact, 40% (n=30) of the blank origins are unidentifiable (that is, the core-reduction strategies that produced the tool blanks are not identifiable). Of the identifiable blanks, blades of unknown origin or of core-reduction strategies other than
naviform cores are the most common at 48% (n=36), followed by blades from naviform cores at 9% (n=7), and flakes at 2.6% (n=2). The blade forms too are largely unidentifiable (82.7%, n=62), but of those that are identifiable, triangular blades make up 13.3% (n=10) and trapezoidal blades 4% (n=3).

**Nizzanim Projectile Points**

Nizzanim points represent 6% (n=58) of the total projectile point assemblage at ‘Ain Ghazal. As with other sites in the southern Levant, at ‘Ain Ghazal, they are most common in Yarmoukian contexts (see citations above). Though it is most likely a product of mixing, at least one Nizzanim point came from an MPPNB context.

Nizzanim points are generally smaller and fashioned on flakes or blade/lets. The most common shapes range from somewhat triangular or rhomboidal without a well-developed shoulder, to those that are nearly shouldered (Plate 5.5). Because blank selection showed greater variation, production involved removing nonsystematic pressure flakes along both margins and across both faces. The tangs too were often bifacially retouched. The length of the average complete Nizzanim point is 25.3 mm, making them generally smaller than other PN points.

As with Ha-Parsa points, Nizzanim points have a greater percentage of complete specimens at 41.4% (n=24), and of those that are broken, ten have signs of impact damage. Evidence of tool conservation including recycling, evidence of scavenging, or reuse/resharpening is also present. In the PPNC assemblage, four pieces have signs of
Plate 5.4 Ha-Parsa points from PPNC and PN contexts. Note the first and second points appear to be resharpended PPNB-type points, while the other points exhibit extensive retouch and abundant evidence of reworked distal ends.

Plate 5.5 Nizzanim points from PN contexts. Note the impact damaged specimen two from the left and resharpended distal ends on specimens three through six.
extensive reshaping or use-wear that may indicate recycling, and from the Yarmoukian assemblage, 18 pieces attest to these activities.

Nizzanim points tend to be heavily retouched, and as a result, blank technology and type are not always identifiable. In fact, 34.4% of the blank origins and forms are unknown, but where the core technology of origin was recognizable, blades from non-naviform core reductions are common, accounting for 58.6% of the assemblage (n=34), followed by flakes at 5% (n=3), and finally blades from naviform technology at 1.7% (n=1). Blank types were also more difficult to determine with 58.6% unknown (n=34). Of the identifiable forms, triangular blades are the most common (n=14), followed by trapezoidal blades (n=6). Preferences in blank origin and form, when compared by period (excluding the MPPNB), show little apparent change over time.

*Herzliya Projectile Points*

At ‘Ain Ghazal, Herzliya points are represented by 19 specimens, which account for 2% of the total assemblage. They are most common in the Yarmoukian period, but are also present in low frequencies during the PPNC, which is the case at other PPNC and PN sites.

It is worth mentioning that Herzliya “points” appear to have been blanks or preforms for Ha-Parsa and Nizzanim points (Plate 5.6). Furthermore, none have evidence of impact damage. And although some broke in bending breaks, such breaks could have occurred during production as well as during use. Despite their ambiguous status, Herzliya points are discussed in the same manner as the other types. Herzliya style points
include small leaf-shaped points without well-developed shoulders, made on flakes or blade/lets. They are similar to Amuq points but are much smaller (cf. Gopher 1994), and they tend to be made on a broader range of blanks. The tang portion merges into the body, and manufacture generally involved removing nonsystematic pressure flakes along both margins and often both faces. They are not always as heavily retouched as Ha-Parsa and Nizzanim points, but they are more heavily retouched than PPNB point types. Complete Herzliya points average about 34.95 mm in length, making them the largest of the PN types.

The blank production technology and type preferences for Herzliya points are most obvious in the Yarmoukian assemblage, which also has the largest sample, so little can be said about change through time in these choices. Most of the Herzliya points are complete (68%, n=13) and as with the other later point types, show heavy retouching, and
evidence of scavenged and reworked points and recycling to or from other tools are common. The PPNC sample is small, with only one point displaying signs of remanufacture. The Yarmoukian assemblage has ten points with extensive retouch.

The most common blank for Herzliya points is a blade of unknown origin, or blade varieties from various core-reduction strategies, at 79% (n=15), followed distantly by blades from naviform cores at 10.5% (n=2), and flakes and unknown blanks, each at 5.3%. Of the identifiable blade types, 42% (n=8) are triangular blades, followed by 21% (n=4) trapezoidal blades.

**Uncommon Point Types and Fragments**

In addition to the major types outlined above, a small number of points either do not fall into any of these taxa or they represent singular examples of a form that is otherwise not commonly found at ‘Ain Ghazal. They include, for example non-Amuq leaf-shaped points, lanceolate points, El-Khiam points, transverse arrowheads, and fragments of unknown forms. Atypical or very rare types are treated cursorily, and little can be said of common manufacturing choices and changes through time.

*Non-Amuq Leaf-Shaped Points*

This form includes leaf-shaped points inconsistent with Amuq or Herzliya types. It accounts for only 10 specimens. As shown in Tables 5.3 to 5.6, this group is most common in the MPPNB assemblage. All were produced on Huweijir flint, but because they are heavily retouched, blank origin and type are not always determinable. Unknown blanks account for 50% of the assemblage, followed by blades from naviform cores at
30%, and blades from other core-reduction strategies at 20%. The blank types include six that are unknown, followed by three triangular blades, and one trapezoidal blade.

*Lanceolate Points*

Another uncommon point group includes several lanceolate examples. From the total sample, only six such points (0.6% of the total) occur, in the LPPNB, PPNC, and in unknown or mixed assemblages. Most were made on bifaces, but some are bifacially retouched blades, and due to the extensive retouch, blade types are not determinable. All of the points are heavily retouched, and two appear to have impact damage.

*Other Point Types*

The remaining pieces are rare or intrusive point types. In the LPPNB assemblage, there is one El-Khiam point. This type was common in the PPNA in the southern Levant (Gopher 1994). No evidence exists to suggest that ‘Ain Ghazal was inhabited during the PPNA, so it may have been a surface find brought to the village by one of the inhabitants. The Yarmoukian assemblage includes one transverse arrowhead, perhaps from the later Pottery Neolithic or Chalcolithic activity at the site (Zeilhofer et al. 2012).

*Preforms*

The preforms number 15 pieces, or 1.57% of the assemblage. The MPPNB, LPPNB, PPNC, Yarmoukian, and mixed context assemblages each contain at least one preform (Tables 5.3 to 5.6). All of the preforms are made on Huweijir flint and most are blades from naviform cores, comprising 53% (n=8) of the assemblage, followed by
blades from other core-reduction strategies at 40% (n=6), and one flake. A few of the preforms have a fair amount of retouch, so blank type is indeterminable for three pieces, and among the remaining specimens triangular blades are the most common at 40% (n=6), followed by trapezoidal-to-triangular blades at 26.7% (n=4), one trapezoidal blade, and a flake. Several preforms display retouch consistent with the production process of projectile points. In fact, some appear to be Amuq or Herzliya points (which may be preforms themselves) but also could be preforms for other point types. They are included here rather than with the unspecified tool blanks because the intention to make them into projectile points is clear. About 10 of the preforms are complete. Those that are broken cannot clearly be assigned to production failures; although it is possible they are failures.

*Unclassified Fragments*

In addition to the identifiable types are projectile point fragments that are too incomplete to classify. These fragments consist of 269 pieces (28% of the total projectile point sample). The most common resource material is Huweijir flint, 96% (n=259) of the sample. Blank technology and type are not always clear, but it appears that blades from naviform cores were the most common blanks, making up 44.6% of the assemblage (n=120), followed by blades of other core-reduction strategies at 32.7% (n=88), unknown blank technologies at 19.3% (n=52), six flakes (2.2%), and three possible bifaces (1.1%). As evident in the chronological point data (Tables 5.3 to 5.6), blades from naviform cores are most common in the MPPNB and LPPNB, dropping off in the PPNC and Yarmoukian. Among the identifiable blank types (n=98), triangular blades are the most
common at 32% (n=87), followed by trapezoidal blades (16.7 %, n=45) and trapezoidal-
to-triangular blades at (11%, n=30).

**Transitional and Unknown/Mixed Contexts**

A small number of points come from transitional contexts (e.g., LPPNB/PPNC or
LB/C) and mixed or unknown contexts. Some attributes of the points from these contexts
were discussed above, but for clarification, Table 5.7 shows a distribution by type.

**Size Change by Period**

Given the inconsistent sample size by type for each period and the fact that most
types are temporally correlated, the most meaningful way to detect and illustrate changes
in size through time is to present the averages and basic statistics for all complete
specimens by period. Furthermore, based on the averages by type, length appears to be
the most sensitive measure for size change; thus the numbers presented in Table 5.8 are
for the length of complete specimens. Based on the averages alone, a clear decline in size
through time is evident. As discussed above, Eighmey (1992) postulated that the potential
cause for this change at ‘Ain Ghazal was due to changes in the weapon system and
hunting strategies. He argued the small points were manufactured as such to serve as
arrow points for hunting small game. He may not ultimately be wrong that the small
types are arrowheads, but changes in resource material availability, the availability of
suitable blanks, and clear indications of scavenging, suggest many influences impacted
point size through time. The most obvious among those observed here is the increase in
the presence of scavenging, extensive resharpening and reshaping, and recycling through
Table 5.7 Types for transitional LPPNB/PPNC contexts and Mixed/Unknown contexts.

<table>
<thead>
<tr>
<th>Point Type</th>
<th>Mixed context</th>
<th>LPPNB/PPNC</th>
<th>Unknown context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Byblos</td>
<td>68</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Jericho</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Amuq/Munhata</td>
<td>5</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Ha-Parsa</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Herzliya</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nizzanim</td>
<td>11</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Leaf-shaped</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lanceolate</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Transverse</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Preform</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>39</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>149</strong></td>
<td><strong>11</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

Table 5.8. Complete projectile point lengths by period.

<table>
<thead>
<tr>
<th></th>
<th>MPPNB (23)</th>
<th>LPPNB (35)</th>
<th>PPNC (18)</th>
<th>PN (46)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>59.78 mm</td>
<td>51.19 mm</td>
<td>35.03 mm</td>
<td>30.58 mm</td>
</tr>
<tr>
<td>St Dev</td>
<td>±14.19 mm</td>
<td>±15.69 mm</td>
<td>±9.97 mm</td>
<td>±11.58 mm</td>
</tr>
<tr>
<td>Range</td>
<td>32.5 mm-95.5 mm</td>
<td>16 mm-92 mm</td>
<td>19 mm-62 mm</td>
<td>14 mm-68 mm</td>
</tr>
</tbody>
</table>

a Excludes transitional points. b Includes one transverse point.

time. Scavenging became more common through time, which is the likely explanation for many of the Byblos, Jericho, and some of the Amuq points in the PPNC and Yarmoukian contexts. Furthermore, blades from naviform cores declined in the late LPPNB, so many of the blanks from naviform cores in the PPNC and Yarmoukian were scavenged from even earlier contexts. Moreover, the later point types are nearly all heavily retouched, associated with using less regular and scavenged blanks, and more episodes of reworking.

The increase in tool conservation behaviors through time was therefore accompanied by a decrease in size of projectile points. Undoubtedly, the preference for Huweijir flint and regular blanks and the greater scarcity of both in the later periods, meant people had to
more intensively rework points. In fact, the PPNC and especially the Yarmoukian sample include a number of completely exhausted projectile points.

**Summary of Projectile Point Analysis**

The frequency of the different point types identified here agrees with Eighmey’s (1992:98) findings, in which Byblos points were the predominant type. He also recognized the gradual replacement through time of Byblos, Jericho, and Amuq points by Pottery Neolithic types. Additionally, aside from the comparatively low representation of Jericho points in the MPPNB, the patterns at ‘Ain Ghazal in regard to changes in point types through time correspond well with the patterns recognized at other southern Levantine Neolithic sites (e.g., Crowfoot Payne 1983; Gopher 1994; Simmons et al. 2001; Garfinkel et al. 2012).

As suggested in Eighmey’s (1992) analysis, and the one conducted here, hunting remained an important activity that many of the site inhabitants engaged in throughout the occupation of the town. Likewise, the presence of preforms and evidence of retooling in domestic-related deposits indicates projectile points were manufactured in most households to meet their own needs for the duration of the occupation. At no time can the production of projectile points be claimed to have been a task of specialists.

Huweijir flint is the preferred resource material for projectile points across all periods. At ‘Ain Ghazal, blades from naviform cores are present in the greatest percentages during the MPPNB and LPPNB. Likewise, the production of large PPNB point types on high-quality flint and blades from naviform cores is recognized in many other assemblages (e.g., Mortensen 1970; Crowfoot Payne 1983; Gopher 1989b, 1994;
Eighmey 1992; Gebel 1996; Khalaily et al. 2003; Barzilai 2010; Quintero 2010; Garfinkel et al. 2012), and is typical at sites where blades from naviform cores were easily available. At ‘Ain Ghazal, blank selection strategies became more variable through time, being especially evident among the later point types. Similarly, the preferred blank types vary some by point type and period, in general, triangular, trapezoidal, or trapezoidal-to-triangular blade blanks were consistently selected. Therefore, the most obvious change over time is the transition from large PPNB point types to small post-PPNB point types, which coincides with the decline of specialization of the naviform core technology. Despite the loss of naviform core reduction, blade blanks from naviform cores made on Huweijir flint remained preferred into the post-PPNB periods, as indicated by the presence of scavenged points and blades in the PPNC and Yarmoukian assemblages, along with smaller, heavily retouched points, sometimes reworked to exhaustion.

The stability and persistence of resource material and blank preference also corresponds with a certain degree of stylistic continuity (Gopher 1994; Matskevich 2011) and similar manufacturing techniques between PPNB and post-PPNB point types. Thus it seems the primary influences on changes in the point assemblage were related to the availability of high-quality resource material, the blank-production technology, and perhaps technological changes related to the weapons systems.

**SICKLE ELEMENT ANALYSIS**

Experimental studies on the function of sickle elements have provided an understanding of the possible sources of gloss accumulation and wear, which has aided in
their identification in the archaeological record (Unger-Hamilton 1988, 1989; Quintero et al. 1997). A comprehensive standard typology of sickle elements is elusive, however, with most typologies only applied to the site for which they were conceived.\(^{13}\)

The general trend through time for sickle elements is a transition from an emphasis on blades (often from naviform cores) with minimal edge modifications in the PPNB (Lechevallier 1978; Crowfoot Payne 1983; Gopher 1989b; Olszewski 1994; Quintero et al. 1997; Simmons et al. 2001; Khalaily et al. 2003:32; Garfinkel et al. 2012), to sickle elements that show a greater degree of retouch and sometimes deep denticulations in the PPNC and Yarmoukian (Crowfoot Payne 1983; Gopher 1989b; Quintero et al. 1997; Matskevich 2011). In addition to recognizing these general trends in sickle element configuration, it is important to recognize that not all sickle elements have gloss,\(^{14}\) and not all gloss is attributable to cereal harvesting (Unger-Hamilton 1988:83-86; Anderson 1999). Thus, gloss cannot always be an identifying feature, which also complicates the designation between sickle inserts and hafted reaping knives (if there even is much of a difference).

\(^{13}\) For example, Crowfoot Payne (1983:683-686) designated two major classes during the PPNB: blades with denticulations and those without. Mortensen (1970:33-36) recognized four types of sickle elements at Beidha dependent on the blank used, the presence or absence of gloss, and the type of retouch. Gopher (1989b:44-51) also recognized four major types of sickle blades during the PPNB: plain on blade, finely denticulated, backed, and \textit{varia}. Though fewer sites of PPNC age have been identified, Garfinkel (1994:555) presented a typology for the sickle blades from Tel ‘Ali, where he designated eight types, five of which have coarse denticulations or deep serrations along the working edge. Despite the presence of denticulated elements, which are generally more common in the PN, PPNB types also were present at Tell ‘Ali. For Pottery Neolithic sickle element classification, Crowfoot Payne (1983:708-710) identified three types at Jericho depending on the retouch along the working edge (e.g., denticulations or bifacial retouch), shape of the sickle element, and the extent and type of retouch along the other margins. At Munhata, Gopher (1989b:95-108) divided the sickle assemblage from the PN layers into eight types (types A to H); and of these, types A through D have large denticulations, but differ in the extent of retouch, presence of truncations, etc.

\(^{14}\) As suggested by a hafted sickle element with no discernable gloss recovered from Yiftahel (Khalaily et al. 2005:378; also see Quintero et al. 1997:282).
Previous analyses of sickle elements at ‘Ain Ghazal include Olszewski (1994), who examined a sample of glossed blades. Her treatment of the assemblage was intended to describe common retouch choices, gloss patterns, hafting possibilities, and the potential information that can be derived from gloss invasiveness. Most of the sickle elements were assigned to the PPNB periods, but she thought the few PPNC sickle elements present in the assemblage were not significantly different from those in the PPNB, and thus examined them together as PPN sickle blades. Among her findings were observations that one-quarter to one-third of the working edges displayed fine denticulation, that gloss configuration can produce insight into how the element was situated in the haft, and that sickle elements were primarily unilateral (about 88%).

Additional analysis on the ‘Ain Ghazal sickle element assemblage includes experimental work carried out by Quintero et al. (1997), who conducted reaping experiments to examine the effects of resource material type and quality, edge modification, reaping motion, and the timing of harvesting on the accumulation of gloss and the type of wear. Their work, although broadly applicable to sickle blade assemblages at many sites, distinguished some interesting patterns at ‘Ain Ghazal with respect to domestication. Apparently, much of the harvesting done during the MPPNB involved dough-stage\textsuperscript{15} cereal grasses, suggesting that during that time people relied on cultigens that may not have been fully domesticated. By the LPPNB, this pattern switched, as indicated by the much lower proportion of heavily glossed sickle blades, when it appears that fully domesticated crops were harvested (Quintero et al. 1997:282).

\textsuperscript{15} Implying the stage of maturity when the grains are still “chewy”.
The Anthropological and Economic Significance of Sickle Elements

It has long been recognized that sickle elements became more common as cultivars became a larger portion of the diet, and functional studies indicate sickles were often used in the harvesting of grasses, both wild and domesticated (Unger-Hamilton 1988, 1989; Quintero et al. 1997; Anderson 1999; Yamada 2000). Current evidence suggests the development of domesticated plant varieties at ‘Ain Ghazal and elsewhere in the southern Levant occurred during the PPNB (Rollefson et al. 1985, 1992; Quintero et al. 1997; Asouti and Fuller 2012). The increasing dependence on plant foods, both wild and domesticated, would have meant harvesting implements such as reaping knives and sickles were commonplace in the tool kit, and that it would have been necessary for many of the inhabitants to be able to make, use, and maintain these implements. Given the reliance during the PPNB on blades from naviform cores, only minor modification was necessary to create a sickle element or reaping knife. It stands to reason then, that most inhabitants were able to make, trim, and modify their own sickle elements.

In addition to the clear importance of these tools to daily life, it is necessary to understand how and if their role changed through time. Part of considering these changes and their potential causes involves examining and understanding the choice of edge modification, which can shed light on the function of certain features. Both unmodified and finely to moderately-serrated sickle elements are present in PPN assemblages (including PPNB and PPNC) and by the PN, deeply denticulated and heavily retouched elements are common. In their replicative experiments, Quintero et al. (1997:269, 279) found that though unmodified edges worked for reaping, sickle blades with fine to
moderate serrations cut better and maintained their edge longer. As for the appearance of
deep denticulations in the later Neolithic, several researchers have examined their
potential role (Cauvin 1968; Unger-Hamilton 1988; Quintero et al. 1997; Yamada 2000;
Vardi and Gilead 2013). Quintero et al. (1997:281) noted that although the deeply
denticulated sickle elements common in the Pottery Neolithic are suitable for cutting dry
cereals, the pronounced serrations are not necessary. Others have suggested that these,
and perhaps other glossed sickle elements, were used for cutting other plant materials
such as reeds (Unger-Hamilton 1988:183, 194-205; Anderson 1999). Experimental
studies conducted by Yamada (2000:241-242), however, indicate the pronounced
serrations made cutting reeds difficult, and that fine denticulations would be more
effective and less troublesome. Additionally, serrated edges on sickle blades do have
contemporary analogs. For instance, Wulff (1966: 272) noted the presence of “tooth-
edged” sickles in certain districts in Iran, but cited no explanation of their particular
function. Turkowski (1969:105), however, observed that in the mid twentieth century,
farmers in the Judean hills used a curved knife with a serrated edge for cutting tough
stalks or twigs. In addition, he noted that serrated knives were considered the best
implements for cutting sorghum, which is tough to cut. Similarly, it is entirely possible
that the serrated sickle element of the PN was designed to serve for tougher sawing and
cutting jobs, or for several different tasks.

**Sickle Element Typology**

Given the lack of a straightforward and meaningful typology available for the
southern Levant, and the fact that sickle element identification often depends heavily on
the existence of gloss, my criteria for identification derive from suggestions made by Quintero et al. (1997:281). I consider the presence and type of edge modification, as well as evidence for the modification of blades to accommodate the haft, including trimming, or retouching sickle element ends and sectioning elements to specific sizes. I also draw from Mortensen’s (1970) typology in the focus on blank technology, and I draw some from Olszewski’s (1994) analysis, for the descriptions of edge retouch.

**Sickle Element Analysis**

As noted in the previous research at ‘Ain Ghazal (Olszewski 1994; Quintero et al. 1997) and elsewhere at southern Levantine PPNB and PPNC sites (e.g., Mortensen 1970; Crowfoot Payne 1983; Gopher 1989b; Garfinkel 1994), some sickle elements were complete or nearly complete blades. In many cases, one end was intentionally broken, or bent in two, or retouched. It also was common for the alteration on the proximal and distal ends of sickle elements to be intentionally sized, involving breaks initiated on the dorsal or ventral faces, burinations, or retouch. The working edge(s) have a range of treatments including simple nicking along the edge, perhaps made with another blade or flake, or small to medium serrations. Fewer examples exhibit nonsystematic retouch, and sometimes, bifacial pressure retouch. After use, sickle elements sometimes were discarded, but often they were resized, retouched, and rehafted. Sometimes this replacement included reversing the element to make use of the previously unused margin (as is the case with bilaterally used sickles, which have two cutting margins). Sickle elements from the PPNB most commonly were made on blades, especially blades from
naviform cores (85.3%, n=1167), and they often have at least partial backing (24.8% in the MPPNB and 32.4% in the LPPNB).

Yarmoukian sickle elements exhibit more retouch. In fact, they were nearly always shaped with invasive pressure flaking and edge-retouched, often with large serrations fashioned along the working edges (Crowfoot Payne 1983; Gopher 1989b; Matskevich 2011). Sickle elements that vary from the “Yarmoukian type”, however, can be hard to identify because their blanks and treatments are more variable and fewer of them are glossed.

Beyond the common margin and end treatments, the sickle elements examined here mostly were made on Huweijir flint, which comprises 95% of the 1,368 sickle elements in the sample. The common blank types in the assemblage are trapezoidal blades (47.2%, n=647) and triangular blades (36.3%, n=497), followed by trapezoidal-to-triangular blades (10.4%, n=143). The lesser-represented blank types include ridge-straightening blades (2.2%, n=30), blades of unknown configuration (2.5%, n=34), uncommon blade types (0.5%, n=4), bifacial pieces (n=2), and flakes (n=2).

Suitable tool blanks (at least 56 blades identified as tool blanks, suitable for manufacture into a sickle element) and evidence of retooling and resizing are widespread in all periods throughout the site, which suggests that sickle elements along with other tools were produced in most households. The above production choices generally were expressed through time, but there were some differences in the treatments of working edges and in the look of the finished tool, which are discussed in the following assessments by period.
Middle Pre-Pottery Neolithic B Sickle Element Assemblage

Sickle elements appear to be more frequent in the MPPNB and LPPNB assemblages, as indicated in Table 5.9, which is likely an effect of the higher incidence of sickle gloss aiding in their identification (Quintero et al. 1997:282). The majority of the MPPNB sickle blades show evidence of unilateral use (85%, n=390), and of these, 44% are heavily glossed, 28.2% have a moderate gloss, and the rest have a light gloss (9.7%) or no gloss at all (18.2%). Bilateral use was present on 15% (n=69) of the sickle elements, and of these, 77% have some gloss accumulation along one or both lateral margins. Working edge treatments often display nonsystematic or unpatterned retouch (38.01%, n=174), serrations or fine denticulations (37.8%, n=174), nicking (21.8%, n=100), and nibbling or abrupt noninvasive retouch (7.8%, n=36), with 8.7% (n=40) containing no edge modification at all. Recycling is occasionally evident; most often sickle elements were recycled into burins16 (see Plate 5.7).

The average size and descriptive statistics for all MPPNB sickle elements are presented in Table 5.10. Clearly, length has the greatest amount of variation, as indicated by the large standard deviation, which is an expected pattern, as blade width and thickness are blank characteristics that are less likely to be altered when fitting the blade for a haft. As indicated in Table 5.11, medial segments are the most common blank portions found among the sickle assemblage. For the most part, when the ends were not intact, bending breaks and intentional sectioning are the most common end treatments.

16 Recycling was noted by Gopher (1989b:44-51) at Munhata and Crowfoot Payne (1983: 689) at Jericho. Both noticed that the blades selected as sickle elements were of the finest quality and often were recycled into other tools, specifically, projectile points, burins, and chamfered-bit tools.
Table 5.9. General information on sickle element assemblages by major period\textsuperscript{a}.

<table>
<thead>
<tr>
<th>Resource Material</th>
<th>MPPNB (n=459)</th>
<th>LPPNB (n=562)</th>
<th>PPNC (n=61)</th>
<th>PN (n=121)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huweijir Flint</td>
<td>457 (99.6%)</td>
<td>533 (94.84%)</td>
<td>54 (88.5%)</td>
<td>104 (85.95%)</td>
</tr>
<tr>
<td>Blank Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naviform Core</td>
<td>456 (99.3%)</td>
<td>493 (87.7%)</td>
<td>31 (50.8%)</td>
<td>50 (41.3%)</td>
</tr>
<tr>
<td>Tool Conservation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycling</td>
<td>18 (3.9%)</td>
<td>22 (3.9%)</td>
<td>3 (4.9%)</td>
<td>9 (7.4%)</td>
</tr>
<tr>
<td>Resizing</td>
<td>54 (11.8%)</td>
<td>64 (11.4%)</td>
<td>7 (11.5%)</td>
<td>40 (33.1%)</td>
</tr>
<tr>
<td>Blade Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trapezoidal-Triangular</td>
<td>70 (15.2%)</td>
<td>47 (8.4%)</td>
<td>3 (4.9%)</td>
<td>5 (4.1%)</td>
</tr>
<tr>
<td>Trapezoidal</td>
<td>212 (46.2%)</td>
<td>281 (50%)</td>
<td>32 (52.5%)</td>
<td>41 (33.9%)</td>
</tr>
<tr>
<td>Triangular</td>
<td>163 (35.5%)</td>
<td>212 (37.8%)</td>
<td>23 (37.7%)</td>
<td>45 (37.2%)</td>
</tr>
<tr>
<td>Other</td>
<td>14 (3.1%)</td>
<td>21 (3.7%)</td>
<td>5 (8.2%)</td>
<td>6 (4.96%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>0 (0%)</td>
<td>1 (0.2%)</td>
<td>1 (1.6%)</td>
<td>24 (19.8%)</td>
</tr>
</tbody>
</table>

\textsuperscript{a} A small sample of sickle elements were recovered from transitional (MPPNB/LPPNB=2, LPPNB/PPNC=12) and mixed or unknown contexts (mixed=146, unknown=5).

Table 5.10. Average size per chronological period for sickle blades\textsuperscript{a}.

<table>
<thead>
<tr>
<th></th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Width</td>
<td>Thick</td>
<td>Length</td>
</tr>
<tr>
<td>Mean</td>
<td>42.63</td>
<td>16</td>
<td>4.77</td>
<td>35.6</td>
</tr>
<tr>
<td>St. dev.</td>
<td>18.59</td>
<td>2.96</td>
<td>1.21</td>
<td>13.36</td>
</tr>
<tr>
<td>Min/Max</td>
<td>3.5/129</td>
<td>7.5/25</td>
<td>2/10</td>
<td>6/89</td>
</tr>
</tbody>
</table>

\textsuperscript{a} All measurements are mm.
Huweijir flint is nearly the only resource material represented. Likewise, blades from naviform cores make up the vast majority of the sample, with the preferred blade blank types presented in Table 5.9.

Late Pre-Pottery Neolithic B Sickle Element Assemblage

The majority of LPPNB sickle elements show unilateral use (78.1%, n=439) but the frequency of gloss is less than in the MPPNB, with only 8.7% heavily glossed, 8.9% moderately glossed, and 13.7% lightly glossed. Bilaterally used sickle elements are a little more common, comprising 21.9% (n=123) of the sample, and of these, 48.78% (n=60) have some gloss accumulation on one or both lateral margins. The working edge treatments are similar to those of the MPPNB, but during the LPPNB, serrations (10.97%, n=61.7) and nicking (15.2%, n=85.4) are less common, nibbling (19.7%, n=111) and nonsystematic retouch (46.55%, n=262) are more common, and about 3.7% (n=19) have pressure retouch. In general, in the LPPNB sample, retouch is more invasive than that observed in the MPPNB (Plate 5.8). Despite, or perhaps because of, the heavier retouch, the incidence of recycling, reworking, and resizing behaviors are about the same as in the MPPNB (see Table 5.9).
Plate 5.7. MPPNB sickle elements. Note the evidence of recycling into burins, the nicking edge treatment, glossing of edges, and length.

As indicated in Table 5.10, the average length is a little shorter in the LPPNB examples. As in the MPPNB, when an end is not intact, bending breaks and intentional
breaks account for much of the end alteration. Medial segments are the most common portions among the LPPNB sickle element assemblage (see table 5.11).

As shown in Table 5.9, the LPPNB sample is comprised principally of Huweijir flint and blade blanks from naviform cores, although both decreased some in frequency when compared to the MPPNB sample. The favored blade types reflect those of the MPPNB.

*Pre-Pottery Neolithic C Sickle Element Assemblage*

The PPNC sample is the smallest sickle element assemblage of any period in large part due to sampling (see Table 5.9). As with the PPNB assemblages, unilaterally used sickle elements are dominant (80.33%, n=49), but gloss is much less common, with 47.54% (n=29) displaying no traces of gloss and only 52.5% (n=32) with any gloss present (heavy, moderate, and light gloss are relatively evenly represented). Identifiable bilaterally used sickle elements account for about 19.7% (n=12) of the sample. Working edge modifications remained about the same as in previous periods and included nonsystematic retouch (63.9% n=39), abrupt retouch (18%, n=11), nibbling (11.5%, n=7), serrations (8.2%, n=5), nicking retouch (4.9%, n=3), and no retouch (1.6%, n=1) (see Plate 5.9). As noted by Olszewski (1994), the PPNC sickle element assemblage from ‘Ain Ghazal is more consistent in form and edge treatment with the PPNB types than with PN types17 (Plate 5.9). Invasive retouch, however, is more apparent in the PPNC assemblage than in the PPNB assemblages, suggesting tool conservation was important.

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17 This general pattern of continuity of PPNB type elements is consistent with findings from other PPNC sites, such as Tel ‘Ali (Garfinkel 1994:553-555).
Plate 5.8. LPPNB sickle elements. Note the presence of some nicking along edges and greater variation in blade types.

Plate 5.9. PPNC sickle elements. Note the greater incidence of retouch and that variation in blade blanks.
or poor blank choice was a constraint. As in the other periods, some of the PPNC sickle elements display signs of recycling (one from a chamfered-bit tool and two into burins) and resizing.

The average dimensions of PPNC sickle segments (presented in Table 5.10) are slightly shorter than in previous periods. Proximal and distal end treatments include mostly intentional sectioning and bending breaks. As in the other periods, medial blank portions are the most common (see Table 5.11).

Huweijir flint is the preferred resource material, although to a slightly lesser extent than in the PPNB. Blade blanks from naviform cores, however, are much less frequent than in the PPNB. Despite the decline in regular blades, there is little change in the preferred blade types. Those that are present likely were scavenged from earlier deposits (see Table 5.9).

Pottery Neolithic Sickle Element Assemblage

In the Yarmoukian assemblage, unilaterally used sickle elements are slightly more common than in previous periods at 85.95% (n=104), and compared to the PPNC sickle element assemblage, Yarmoukian sickle elements have a slightly greater percentage of gloss (55.8%, n=58). Bilaterally used sickle elements make up about 14.4% (n=15) of the assemblage, and of these, about 40% (n=6) have no gloss accumulation at all. The PN sickle element assemblage includes many minimally modified blade-based elements, but the classic “Yarmoukian-type” sickle element typified by large serrations and invasive pressure retouch over much of the surface is nonetheless common (Plate 5.10). From the total PN sickle element assemblage, 34.7% (n=42) have serrations, and 56.5% (n=68)
have invasive nonsystematic pressure retouch. Only 1.6% (n=2) of the sickle elements have no retouch. As indicated in Table 5.9, recycling is also present in the PN sickle assemblage, with the most common trajectory from a sickle element into a burin, but at least one element was made on a chamfered-bit tool.

As shown in Table 5.10, the average length of PN sickle elements is a little longer than it was in the PPNC, which may be due to the relatively limited PPNC sample. It also may be due to the higher rate of scavenging in the Yarmoukian. Unlike the other assemblages, retouch is much more common on the proximal and distal ends, followed by alteration from bending breaks and/or intentional breaks. When blank features were
identifiable, medial portions were the most common in the Yarmoukian sickle element assemblage (see Table 5.11).

Among the Yarmoukian sample, Huweijir flint is the predominant resource material, although at a lower percentage than in the previous periods. Likewise, the extent of retouch on many of the pieces makes blank identification difficult, but fewer blanks appear to be blades from naviform cores. In general, the blanks used during the Yarmoukian period were more variable, including blades from naviform cores, blades from other blade-core technologies, two flakes, two bifaces, and six blanks of unidentifiable technological origins.

**Summary of Sickle Assemblage Analysis**

Based on the analysis of this sample, sickle elements appear to be more commonly represented in the MPPNB and LPPNB, likely a result of the higher incidence of gloss, making them more easily identifiable. As suggested by Quintero et al. (1997:282), the frequent presence of gloss may also be taken as an indication that the inhabitants of ‘Ain Ghazal still relied heavily on cultigens that may not have been fully domesticated. The lower proportion of identified sickle elements and the general paucity of plant remains recovered from post-PPNB deposits, however, should not be taken as evidence that the need for sickle elements declined through time. Instead, the lower incidence of gloss appears to affect the rate of identification, rather than representing an actual decline in the use of sickles. In fact, evidence suggests an increased dependence on domesticated plants and animals from the MPPNB to the LPPNB, with no apparent indication that this trend changed in the PPNC or Yarmoukian. Moreover, the greater
reliance on domesticates, especially certain faunal species (goats and sheep), has been cited as a potential causal factor responsible for some of the major changes obvious in the PPNC (Köhler-Rollefson 1988, 1992; Rollefson and Köhler-Rollefson 1989).

With regard to manufacturing choices, Huweijir flint remained the preferred resource material for sickle elements through time. This choice reflects the preference for blanks from naviform cores, which are most common in the PPNB samples, but continue into the PPNC and Yarmoukian periods, probably because of scavenging and recycling behavior. The general continuity in manufacturing preferences through time meant that as blades from naviform cores became less readily available, townspeople used and reused sickle segments more intensively. This pattern of an increasing emphasis on tool conservation behaviors is also supported by size change through time. From the MPPNB to the PPNC, the length of sickle elements generally declined, although a small increase occurred in the Yarmoukian. Increased retouch is associated with a growing reliance on less regular blanks through time, but, as discussed above, the higher incidence of large serrations among Yarmoukian sickle elements is not related to conservation, and may be a result of use for sawing of tough-stalked plants rather than for cereal harvesting (Turkowski 1969; Unger Hamilton 1988; Quintero et al. 1997).

As noted above, other southern Levantine sites demonstrate similarities in blank preferences, working edge treatments, changes in gloss accumulation, and recycling preferences through time (Mortensen 1970; Crowfoot Payne 1983; Gopher 1989b; Yamada 2000). These similarities suggest that technological choices in response to
changes in subsistence practices and blank and tool stone availability were broadly similar in the southern Levant.

**KNIFE ANALYSIS**

Beyond the recognition of Nahal Hemar knives (Bar-Yosef and Alon 1988) in several lithic analyses (e.g., Barzilai 2010; Henry et al. 2014:164), few reports include a blade- or flake-knife category (Khalailey et al. 2003; Simmons and Najjar 2003; Garfinkel et al. 2012). More than likely, most knives are grouped with retouched or used blades and flakes in many reports. Even those analyses that recognize the presence of knives or present an explicit typology differ in their categorizations, and thus, comparison between sites is still difficult.

**The Anthropological and Economic Significance of Knives**

Few use-wear analyses have been conducted on tools recognized as “knives” from Neolithic contexts. Microwear analyses carried out on retouched blades, however, such as that conducted by Yamada (2000:152, 154) on artifacts from Kfar HaHoresh, found wear consistent with use on plants, wood, or bone/antler, which could be among the many uses of knives. Additionally, Ibáñez et al. (2007:159-160) identified blades from PPN sites in the Middle Euphrates region with use-wear indicative of plant working, specifically, that associated with scraping plant materials for basketry. Conversely, Unger-Hamilton (1988:139-147) conducted experiments to identify use-wear traces from a variety of

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different materials on retouched flakes and blades. She then compared the experimental objects to archaeological specimens from Arjoune (5th millennium B.C. site in Syria), and found that determining the materials on which they were used was nearly impossible, but they were generally used as cutting implements on both soft and hard materials. Knives as a functional category are any implements used for cutting; as such, they are expected to have been widely used for many activities. Furthermore, given their broad utility as cutting implements, they would have been tools used on a daily basis by most people throughout the Neolithic.

At ‘Ain Ghazal, Forstadt (1993:48-53) (also presented in Rollefson et al. 1994:451) identified six types of knives, classified in the following manner: bifacial-lenticular knives (type 1); tabular knives, divided into two subtypes, tile and tabular-lenticular knives (type 2); blade knives, further divided into four subtypes, utilized, unifacial, bifacial, and tanged knives (type 3); flake knives (type 4); other knives, including knives made on core-trimming elements (type 5), and knives made on platform spalls (type 6). His findings suggested that blade knives were the most common in all four periods, but were least frequent in the PPNC and Yarmoukian. Concomitantly, flake knives steadily increased through each chronological period. Additionally, bifacial knives were uncommon until the PPNC and Yarmoukian, and other knives (type 5 and 6) were uncommon in every period. Forstadt also recognized that the increasing presence of invasive retouch could be associated with the declining importance of blades from naviform cores (Rollefson et al. 1994:455).
Knife Typology and Assemblage Analysis

The categories used in this analysis borrow heavily from Forstadt (Forstadt 1993: 48-53; Rollefson et al. 1994:451) and Mortensen (1970), and unpublished work by Mark Hintzman on portions of the ‘Ain Ghazal collection. The knife assemblage is categorized into the five following types: bifacial knives (K1); tabular knives (K2 a and b) including a tile knife subtype; knives on blades (K3 a and b), including a tanged blade knife subtype; knives on flakes (K4); knives on platform spalls (K5); and knives on recycled tools (K6). The typology used here considers the blank form and edge and haft modification, as described for each type below.

It is important to recognize that while knives are considered to be a formal tool type, they exhibit considerable variation, ranging from formal to informal tools, which seems to depend on the expected use-life, the blank chosen, and whether or not the object was hafted. It is also possible that some of the hafted knives could be unglossed sickle elements or reaping knives, so it should be understood that some overlap exists between these two categories. Additionally, for those knife types that are more irregular in form, sorting often was based on the location of use-wear and possible backing.

Bifacial Knives (K1)

K1 knives (n=60) are bifacial, often with invasive percussion and/or pressure shaping. They typically are lenticular in cross section. They clearly require more time in production than blade or flake knives and a more regularized conception of form; thus, they are considered here to be a formal tool type (Plate 5.11). In spite of the fact that they appear more formal, their size attributes, production quality, and resource material (only...
32 are on Huweijir flint) lack standardization. The average complete knife length is 68.3 mm, but they exhibit a wide range of sizes (34.2 mm to 160 mm). Unfortunately, few bifacial knives from each period are complete; thus, it is not possible to get a sense of change in size over time. Additionally, the blanks chosen for use also show variation, some were made on tabular flint, others produced on flake blanks or blades. Moreover, the amount of time and skill involved in the production of this knife type likely was variable.

*Tabular Knives (K2)*

Tabular knives (n=80) were made on thin tabular flint that was shaped bifacially by percussion and/or pressure retouch. They often retain cortex on both faces. Forstadt (1993:48-53) suggested two subtypes distinguished from each other based on the thickness of the tabular flint used and the extent of pressure retouch. Those tabular flint fragments that are thicker often were shaped with invasive percussion and/or pressure retouch, resulting in a tabular knife with a somewhat lenticular cross-section (K2a). The other subtype, tile knives (K2b), is comprised of 34 knives made on very thin tabular flint fragments that often were too thin to invasively percussion flake and much of the pressure flaking used to shape the working edges was restricted to the edge. For both subtypes, the tabular flint usually is dark brown with white specks. Tabular knives generally are not “complete” in the same way as bifacial knives because they so often were made on fragments of tabular flint with several margins unretouched (Plate 5.12). As a result, size information is not particularly useful.
Knives on Blades (K3)

As suggested by Rollefson et al. (1994:451), K3 knives are the most numerous (n=1,689) in the sample. Unlike the typology employed by Forstadt (1993:48-53), however, only two subtypes of blade-based knives are identified in this analysis. The first subtype (K3a) includes complete and segmented blades with evidence of use along one or both margins. This type sometimes has backing and often retouch on the working edge, which can range from light nibbling to invasive bifacial pressure retouch. Like many other tool types, knives on blades display much variation in the quality of blank chosen and some knives required more work to produce (Plate 5.13). Therefore, the possibility that a blade may have been hafted was noted. The second subtype (K3b) includes complete or segmented blades with a tang fashioned on one end. They exhibit a similar range of edge treatments and macroscopic use-wear traces as described for K3a knives. Both subtypes were produced mainly on Huweijir flint (n=1,585) and blades from naviform cores (n=1,349). These blades are usually triangular and trapezoidal blade/lets with one or more edges containing traces of use (minute edge chipping, rounding, or polish). The average length of a knife on a blade (including both subtypes) is 64.74 mm, but a large size range (11.5 mm to 166.7 mm) is evident. While the sample includes enough knives on blades to track size over time, change in the metrical attributes through time appear to have been minimal.
Plate 5.11. Bifacial type knives (K1). Note that most of these are broken in bending breaks, although a few broke in perverse fractures and two broke from heat damage.
Plate 5.12. Tabular knife types (both K2 subtypes pictured). Note the large amount of cortex present on nearly all of the specimens. Those pieces with more invasive retouch, or the K2a tabular knife, also tend to be thicker.
Plate 5.13. Typical knives on blades (K3). Note that most of those pictured are from the PPN periods and all of the blades are from naviform cores.

**Knives on Flakes (K4)**

K4 knives (n=142) are flake-based knives that tend to be more expediently and less regularly fashioned. They were identified by the presence of use-wear along at least one lateral margin but no preference for a particular flake type is apparent. Huweijir flint (n=110) is the most common resource material in the sample. The working edges sometimes exhibit retouch and occasionally the margin opposite the working edge has partial backing, suggesting that these may have been hand-held tools (Plate 5.14). The average length is about 50 mm, but as with the other types, considerable variation in size
is apparent, ranging from 14 mm to 84 mm. No obvious patterns of size change over time are evident.

*Knives on Platform Spalls (K5)*

Knives on platform spalls (n=4) were included in this analysis to determine the potential role of platform spalls as tool blanks for knives, which was not common in this assemblage. These knives are most identifiable by the presence of retouch and use-wear along one or more margins (Plate 5.15). Because so few of these knives are in the assemblage, they are not reliable indicators of change through time.

*Knives on Recycled Tools (K6)*

K6 knives (n=5) are those produced on a variety of recycled tools. The sequence of production is not always evident, but their function as knives appears to be clear. Like knives on platform spalls, knives on recycled tools are too rare to reveal meaningful attribute changes over time. Of the five K6 knives, three pieces are from the MPPNB and two of these are recycled from borers (Plate 5.16). The remaining knife appears to have been fashioned on a heavily retouched Jericho point. All show evidence of use in the form of edge chipping and rounding. The other two in this sample are from the Yarmoukian period. One made on a scraper and the other on a borer. Both have use-wear, and one has polish along the working edge. Additionally, although K6 knives represent clear examples of recycling, indications of maintenance and resizing behavior are present.

Plate 5.15. Knives on platform spalls (K5).
among other knife types in the form of intentional snapping and extensive retouch, which are discussed separately for each type by period.

**Distributional Analysis of Knives**

Beyond the differences between the types in production strategies and blank choice, variation through time is apparent among the different types. This variation by type through time is discussed below.

*Middle Pre-Pottery Neolithic B*

The knife sample from the MPPNB is the largest. As shown in Table 5.12, knives on blades, followed distantly by knives on flakes, comprise the majority of the MPPNB
sample. The three tabular knives (one is the tile knife subtype) were all fashioned on tabular flint by percussion and/or pressure retouch. All three have evidence of use-wear in the form of small microchipping all along the working edge, hereafter referred to as chipping, and dulling or rounding from use of the working edges, but no signs of hafting.

Focusing specifically on knives made on blades (K3), 36 are the tanged subtype (K3b). Based on the regularity of certain K3 knife segments (both subtypes), including intentional snapping on one or both ends, partial or total backing, and possible wear from hafting, about 22.8% (n=191) have signs of hafting, and an additional 59% (n=495) appear regular enough for hafting. The latter specimens require further study to determine if they were hafted. Use-wear is widespread, with chipping and rounding present on 76.2% (n=637) and 57.6% (n=482), respectively, and 3.5% (n=29) have some form of polish along one or both margins. Evidence of intentional breakage of blades interrupting retouch and/or use-wear consistent with resizing of the segment, is indicated on 4% of the K3 sample. And 12% (n=101) have evidence of reworking during the course of use.

Among knives on blades, Huweijir flint is the predominant resource material (see Table 5.13) and blades from naviform cores dominate. As indicated in Table 5.14, the most used blank types are trapezoidal and triangular blades.

Knives on flakes from the MPPNB consist principally of Huweijir flint (see Table 5.13), and 33.3% (n=20) are complete. As would be expected for flake-based knives, evidence of hafting is uncommon. Use-wear is present on most of the pieces. The most frequent forms are edge chipping (53.3%, n=32), rounding (68.3%, n=41), and 5% (n=3) have a slight polish. None has clear signs of resizing or reworking.
Table 5.12. Knife types by period.

<table>
<thead>
<tr>
<th>Type</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Transitional</th>
<th>Mixed&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bifacial knives</td>
<td>0</td>
<td>21 (3.7%)</td>
<td>22 (11.5%)</td>
<td>11 (4.2%)</td>
<td>3 (11.1%)</td>
<td>3 (10%)</td>
<td>60</td>
</tr>
<tr>
<td>Tabular knives</td>
<td>3 (.33%)</td>
<td>23 (4.08%)</td>
<td>23 (12%)</td>
<td>27 (10.3%)</td>
<td>3 (11.1%)</td>
<td>2 (6.7%)</td>
<td>81</td>
</tr>
<tr>
<td>Blade knives</td>
<td>837 (92.5%)</td>
<td>489 (86.7%)</td>
<td>132 (68.8%)</td>
<td>188 (71.8%)</td>
<td>20 (74%)</td>
<td>21 (70%)</td>
<td>1687</td>
</tr>
<tr>
<td>Flake knives</td>
<td>60 (6.6%)</td>
<td>30 (5.3%)</td>
<td>15 (7.8%)</td>
<td>33 (12.6%)</td>
<td>1 (3.7%)</td>
<td>4 (13.3%)</td>
<td>143</td>
</tr>
<tr>
<td>Platform spall knives</td>
<td>2 (.22%)</td>
<td>1 (.18%)</td>
<td>0</td>
<td>0 (.38%)</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Recycled knives</td>
<td>3 (.33%)</td>
<td>0</td>
<td>0</td>
<td>2 (.76%)</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>905 (100%)</td>
<td>564 (99.9%)</td>
<td>192 (100%)</td>
<td>262 (100%)</td>
<td>27 (100%)</td>
<td>30 (100%)</td>
<td>1,980</td>
</tr>
</tbody>
</table>

<sup>a</sup> Includes knives from contexts for which the chronological association is unknown.

Table 5.13. Huweijir flint representation by period.

<table>
<thead>
<tr>
<th>Type</th>
<th>MPPNB H/NH&lt;sup&gt;a&lt;/sup&gt;</th>
<th>LPPNB H/NH</th>
<th>PPNC H/NH</th>
<th>PN H/NH</th>
<th>Total H/NH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bifacial knives</td>
<td>0/0</td>
<td>14/7</td>
<td>9/13</td>
<td>4/7</td>
<td>27/27</td>
</tr>
<tr>
<td>Tabular knives</td>
<td>0/3</td>
<td>0/23</td>
<td>1/22</td>
<td>1/26</td>
<td>2/74</td>
</tr>
<tr>
<td>Blade knives</td>
<td>816/21</td>
<td>469/20</td>
<td>107/25</td>
<td>157/31</td>
<td>1,549/97</td>
</tr>
<tr>
<td>Flake knives</td>
<td>55/5</td>
<td>21/9</td>
<td>8/7</td>
<td>23/10</td>
<td>107/31</td>
</tr>
<tr>
<td>Platform spall knives</td>
<td>2/0</td>
<td>1/0</td>
<td>0/0</td>
<td>1/0</td>
<td>4/0</td>
</tr>
<tr>
<td>Recycled knives</td>
<td>3/0</td>
<td>0/0</td>
<td>0/0</td>
<td>1/1</td>
<td>4/1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>876/29</td>
<td>505/59</td>
<td>125/67</td>
<td>187/75</td>
<td>1,693/230</td>
</tr>
</tbody>
</table>

<sup>a</sup> H=Huweijir flint varieties and NH=Non-Huweijir flint varieties, including wadi-rolled and bedded flint and chert varieties present in the immediate site area.

Table 5.14. Common blanks for knives on blades (K3).

<table>
<thead>
<tr>
<th>Core Strategy</th>
<th>MPPNB (n=837)</th>
<th>LPPNB (n=489)</th>
<th>PPNC (n=132)</th>
<th>PN (n=188)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naviform</td>
<td>779 (93.1%)</td>
<td>407 (83.2%)</td>
<td>57 (43.2%)</td>
<td>75 (39.9%)</td>
</tr>
<tr>
<td>Blank Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trapezoidal blade</td>
<td>407 (48.6%)</td>
<td>222 (45.4%)</td>
<td>50 (37.9%)</td>
<td>53 (28.2%)</td>
</tr>
<tr>
<td>Triangular blade</td>
<td>269 (32%)</td>
<td>159 (32.5%)</td>
<td>48 (36.4%)</td>
<td>78 (41.5%)</td>
</tr>
<tr>
<td>Trapezoidal-Triangular blade</td>
<td>55 (6.6%)</td>
<td>37 (7.6%)</td>
<td>5 (3.8%)</td>
<td>7 (3.7%)</td>
</tr>
<tr>
<td>Ridge-straightening blade</td>
<td>38 (4.5%)</td>
<td>17 (3.5%)</td>
<td>7 (5.3%)</td>
<td>6 (3.2%)</td>
</tr>
<tr>
<td>Other blade</td>
<td>68 (8%)</td>
<td>54 (11%)</td>
<td>22 (16.7%)</td>
<td>44 (23.4%)</td>
</tr>
</tbody>
</table>
Late Pre-Pottery Neolithic B

Bifacial knives appear first in the LPPNB assemblage, represented by 21 examples. Only three of the bifacial knives are complete and the rest broke in bending breaks, which may have been occurred during production or in use. Proximal/distal (not always possible to determine that it is a proximal rather than distal fragment) and medial fragments are the most common, with 11 and 5 specimens, respectively. All have percussion and/or systematic pressure retouch and most retain signs of use in the form of edge chipping and rounding. Two (9.5%) have some evidence of reworking. As indicated in Table 5.13, During the LPPNB, Huweijir flint is more common than other bedded and nodular chert and flint types.

Tabular knives are common in the LPPNB with 23 examples, nine of which are the tile-knife subtype (K2b). All were made on tabular flint and only two appear to be complete specimens. Bending breaks, fractures along pre-existing cracks in the stone, and perverse fractures account for most of the breaks, the latter suggesting breakage during production. Percussion and/or pressure flaking were used to shape the working edges, and one piece has signs of reworking.

The LPPNB sample of knives on blades (K3) is comprised primarily of the untanged subtype (K3a). Twenty-five or 5.1% of the knives on blades are the tanged subtype (K3b). The presence of a tang suggests these knives were hafted (perhaps in a similar manner to a reaping knife?). From the total K3 assemblage (including knives with tangs) 24% (n=118) of the blades or blade segments appear to have been hafted with evidence of intentional modification to the proximal or distal end, partial backing or
roughening of one margin, and sometimes wear suggestive of placement in a haft. An additional 64.6% (n=315) appear regular enough to be suitable for hafting. Use-wear is well represented, and as with all the other types, chipping (83.1%, n=406) and rounding (42.5%, n=208) of margins are the most common. Also, 3.7% (n=18) display a slight polish along the working edge, from use. Finally, 3.9% (n=18) have signs of resizing of the same sort seen in the MPPNB assemblage, and 104 pieces (21.3%) have retouch along the working edges, which appears invasive or interrupts use-wear, suggesting maintenance of the edge during the course of use. The LPPNB blade knives are mostly of Huweijir flint (see Table 5.13). Blade blanks from naviform cores are less common than in the MPPNB; however, as indicated in Table 5.14, the preferred blank types are similar. Proximal and distal end treatments consist mainly of bending breaks and deliberate anvil truncation (indicated by cones or shearing from impact), burinations, or retouch.

Knives on flakes (K4) are represented by 30 specimens in the LPPNB sample. Fifty percent of the knives made on flakes are complete. All of the pieces retain some evidence of use, in the form of edge chipping (66.7%, n=20) and edge rounding (40%, n=12). Polish is present on two specimens. As in the MPPNB, no pieces with clear signs of reworking are present. In regard to resource material changes, Huweijir flint is the preferred resource material, but it is less common than in the previous MPPNB (Table 5.13).

*Pre-Pottery Neolithic C*

Both bifacial and tabular knives are well represented in the PPNC sample. Eleven or 5.6% of the bifacial knives have evidence of percussion shaping, and 58% have some
pressure retouch. Only one is complete. The majority of fragments are proximal/distal (n=10) and medial (n=10), with the remaining fragment a small portion of the margin.

Seven knives have clear signs of use-wear on one or both margins in the form of chipping and rounding, but have no polish. Four pieces have indications of resharpening. In the PPNC sample, bifacial knives are slightly more often made of locally available bedded and nodular chert and flint than in the previous LPPNB.

The PPNC sample of tabular type knives includes 10 specimens of the tile knife subtype (K2b). The resource material used for both subtypes mainly consists of dark brown, thin, tabular flint, but one piece appears to be a tabular Huweijir flint. Only one knife is complete; the rest are broken in bending breaks, or along natural impurities or fractures. Twenty knives have clear signs of chipping and/or rounding from use. Only one piece has probable signs of resharpening in the form of intensive, invasive retouch along previously retouched margins.

As with the PPNB periods, blade-based knives are the most represented type from the PPNC (see Table 5.12). Eight or 6% of the blade-based knives are the tanged subtype, and including these, 15.2% (n=20) of the knives on blades have attributes consistent with hafting. An additional 49.2% (n=65) appear suitable for hafting, but use-wear analyses may supply the only definitive answer. As in the other periods, bending breaks and deliberate sectioning are the most common end treatments. Use-wear is present on all of the pieces and consists of edge chipping 63% (n=83) and rounding (56.8%, n=75), with about 3% (n=4), showing traces of polish. Evidence of resizing is present on two pieces,
but 40% (n=53) of the knives on blades have heavy retouch, suggesting continual reworking during use.

In addition, Huweijir flint is the preferred resource material, although to a lesser extent than in the PPNB (See Table 5.13). Blades from naviform cores, however, are less common. The preferred blade types are similar to those of the PPNB periods, except trapezoidal-to-triangular blades are less frequent (see Table 5.14).

In the PPNC sample, 60% (n=9) of the flake knives are complete; the rest have bending breaks. All of the pieces retain evidence of use, mostly edge chipping (40%, n=6) and rounding (60%, n=9), but one piece has a polish along the working edge. Resharpening is present on five pieces with pressure retouch along the working edge, indicating reworking during the course of use. Finally, Huweijir flint was used less frequently in the PPNC sample of knives on flakes but it was still slightly more common than the other lower quality flints and cherts used.

Pottery Neolithic

The Yarmoukian sample contains only two complete bifacial knives; the rest are fragments with bending breaks. Seven bifacial knives have evidence of use consisting of chipping and rounding. Only one piece has evidence of reworking, suggested by intensive retouch. In the Yarmoukian sample, bifacial knives are mainly of locally available bedded and nodular chert and flint, as shown in Table 5.13.

In the Yarmoukian sample, 14 of the tabular knives are the tile knife subtype. As in the previous period, only one knife is complete, and the rest are mostly broken along impurities in the stone or in bending breaks. The working edges were shaped with
percussion and/or pressure retouch, and 85.2% (n=23) have evidence of use on one or both margins, but none has clear evidence of hafting. Only one piece has indications of possible recycling or reworking. Tabular knives are almost all (89%) of dark brown, tabular flint, with two of bedded chert and flint, and one piece of tabular Huweijir flint.

Knives on blades are the predominant type in the Yarmoukian sample (see table 5.12). Seven percent (n=14) of the PN knives made on blades have tangs (subtype K3b). Including the tanged subtype, 12.2% (n=23) of the knives on blades have traces consistent with placement in a haft. Another 46% (n=86) of the blade-based knives are regular enough for hafting, but require further analysis to draw any firm conclusions. The end treatments are mostly bending breaks, deliberate truncation, and pressure retouch. As in the other periods, use-wear is widespread and includes edge chipping (52.15%, n=98) and rounding (59.7%, n=112); 2.1% (n=4) of the working edges have traces of polish. Finally, four pieces have evidence of having been resized for resetting in a haft, and an additional 44.1% (n=83) have pressure retouch consistent with resharpening.

Huweijir flint is the preferred resource material, although at a lower frequency than in the PPNB periods. As shown in Table 5.14, blades from naviform cores are less frequent. The preferred blank forms are similar to those in the previous periods, except that triangular blades are most represented, and other blades are more common.

Flake knives (K4) make up about 12.7% of the Yarmoukian knife assemblage, more than in the other periods. About 55% (n=18) of the flake knives are complete, and the rest are fragments broken in bending breaks. All have evidence of use along one or more margins, which includes rounding (78.8%, n=26) and chipping (21.2%, n=7), with
one piece showing traces of polish along the working edge. As with the other periods, recycling is not well represented, but evidence of pressure retouch suggesting resharpening is present on about 48.5% (n=16) of the examples. Huweijir flint again is the most represented resource material, less than in the PPNB assemblage, but slightly higher than the PPNC distribution for these knives. The other resources commonly used for knives on flakes were the locally available bedded and nodular cherts and flints.

**Summary Thoughts on the Knife Assemblage**

Consistent with Forstadt’s (1993) and Rollefson et al.’s (1994) findings, knives on blades (K3) are the predominant type in all periods, declining only a little after the MPPNB. Bifacial and tile knives increase in the LPPNB and remain steady through the Yarmoukian period. The motivation for these changes in types through time is unclear, and there is no reason to believe the need for cutting implements waned at any point in the Neolithic. Perhaps bifacial knives served specific functions that did not come about until after the MPPNB. They certainly would have been easier to hold in the hand, as well as having a longer potential use-life. Unfortunately, until more use-wear analyses are conducted it is difficult to say if particular knife types served specific functions. What is clear is that knives in general would have been used on a daily basis for a variety of tasks, and as such, they remained an important part of individuals’ tool kits throughout the occupation of ‘Ain Ghazal.

Finally, comparisons of the analysis from ‘Ain Ghazal with those from other sites in the southern Levant are still difficult at this time because so few give knives as a category the same level of consideration that is presented here. It is clear, however, that
bifacial knives and tabular knives are common in the later Neolithic at other sites in the region (for instance, at Jericho [Crowfoot Payne 1983:710-711], at Wadi Shu‘eib [Simmons et al. 2001], and at Sha‘ar Hagolan [Matskevich 2011:235]).

Across most of the knife types (except tabular knives), Huweijir flint declined in prominence through time, but remained the preferred resource material for the production of knives on blades. Conversely, among bifacial and tabular knives, other locally available bedded and nodular cherts and flints were more commonly used. As among the sickle blades, trapezoidal and triangular blades were the preferred blanks for knives on blades in each period because they were regular in form and easier to haft. Additionally, the majority of knives in the sample have use-wear, mostly consisting of edge chipping and/or rounding. The rate of recycling remained low through time, but the percentage of heavily retouched pieces increased among blade-based and flake-based knives through time, indicating an emphasis on tool conservation. Blades from naviform cores are most frequent in MPPNB and LPPNB, but they continue to be present in the PPNC and Yarmoukian assemblage, indicating scavenging from earlier deposits. Although some of the breakage evident in the knife assemblage may have occurred in production (as indicated by perverse fractures), especially among bifacial knives, most breaks appear to have occurred after the tools were in use.

**BORERS**

**Anthropological and Economic Significance of Borers**

Boring tools include a variety of implements designed to create holes in a range of different materials. Given the clear evidence that bead making was a common activity in
the Neolithic of the southern Levant (see citations below), and the likelihood that leather working, bone/antler working, and woodworking would all have required some hole-making implement, it is probable the tools that fall into this larger functional category were employed on a daily basis for a variety of different tasks. Furthermore, their widespread distribution in domestic-related deposits and the range of forms, suggest that hole-making tools frequently were manufactured and used by most people to suit whatever task was at hand.

For those tools identified as drills, which are most often associated with bead production, use-wear studies suggest the traces of such use are easily identifiable, including obvious rounding, and in some cases, stone residues adhering to the bit (Ibáñez et al. 2007:157). Additionally, it may be possible to distinguish between hand drills and those used with a bow (Coskunsu 2008:33). Starting in the LPPNB and PPNC, truncation burins, which are believed to have served as cores for spall production (Finlayson and Betts 1990; Yamada 2000; Quintero et al. 2004) became more numerous at sites such as ‘Ain Ghazal, reaching frequencies that cannot be explained solely by the use of spalls for drills. Coinciding with the increase of truncation burins at some sites, numerous specialized sites devoted to burin spall production appear in the deserts in the PPNC and PN (Betts 1987, 1992, 1993). Although it is possible that bead making was an activity undertaken at these specialized sites, it seems there are simply too few drills to account for the probable numbers of spalls taken off truncation burins. In an effort to explain this phenomenon, Quintero et al. (2004:209) suggested that the numerous spalls produced at burin sites might have been insets placed into wood or other material, which were then
used as combs to harvest the wool of molting sheep. This explanation suggests that spall production may not be strictly associated with drilling and bead production and one ought to be careful about associating a higher frequency of truncation burins with a greater emphasis on bead production.

The ambiguities surrounding drills notwithstanding, other hole-making implements appear to be even less well understood. For instance, perforators are generally believed to have been used for piercing holes into softer materials such as hide, but use-wear studies are hardly conclusive and it is possible they had multiple uses on a variety of different materials (Coskunsu 2008:34). One suggested use for borers includes woodworking, with certain types (e.g., mèche de forêt) more clearly associated with use as wood drills, perhaps to prepare pieces for joinery (Keeley 1983; Unger-Hamilton 1988:137). Generally, however, borers and perforators appear to have been used on a variety of different materials, which can be hard to discern in use-wear analyses (Unger-Hamilton 1988; Yamada 2000).

**Borer Types**

Some reports describe hole-making tools as piercing or boring tools without much typological distinction (e.g., Lechevallier 1978; Simmons and Najjar 2003; Peterson 2004; Gebel and Bienert 1997). And among those that present discrete types (Mortensen 1970; Crowfoot Payne 1983; Gopher 1989b; Beck 1992; Rollefson et al. 1994; and Barzilai 2010), little standardization exists across typologies. The presence of borers,

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19 Although some reports follow Gopher’s (1989b) borer designations (e.g., Garfinkel 1994) or Mortensen’s (1970) borer typology (e.g., Beck 1992; Rollefson et al. 1994).
especially those that appear to have been used as drills, is associated with bead production at several PPNB sites (e.g., Rollefson [2002]; Rollefson and Parker [2002] for Al-Basit; Waheeb and Fino [1997] for ‘Ayn el-Jammam; and Kaliszanz et al. [2001] for Shakarat Msaied). Additionally, desert sites apparently devoted to bead production with large borer assemblages have been identified starting in the MPPNB (Fabiano et al. 2004 in the Hisma) and becoming more common in the LPPNB and PPNC (Rollefson et al. 1994; Wright et al. 2008). Beyond the common connection of drills with bead making, most other boring implements appear to be perforators or general borers.

At ‘Ain Ghazal, Beck (1992) conducted the first systematic analysis of boring and piercing tools. He (Beck 1992:77) examined several general attributes, including tool type, temporal period, spatial location, resource material color, and tool condition. The technological attributes recorded, included manufacturing techniques, blanks, platforms, percussion bulbs, bit quantity, cortex amount, cortex backing, retouch location, dorsal and ventral retouch patterns, and flaking direction. Beck (1992:54-73) borrowed eleven types distinguished by Mortensen (1970) and added four additional types to incorporate PPNC and Yarmoukian material. His new types included borers on burin spalls, as well as two additional blade-based borers, and a latitudinal flake-based borer. His findings suggested that complete boring tools became more common through time, and “prismatic blades” (blades from naviform cores) decreased through time, while borers made on flakes became more common. Additionally, he found that burin spalls worked into drills increased, as did the presence of retouch from the PPNB to the Yarmoukian (Beck 1992:147-150). A version of Beck’s (1992) typology consisting of only 12 types was
presented in Rollefson et al. (1994:453), and included a summary of the major findings presented in his thesis.

The typology used here also draws from Mortensen (1970), and includes some of the types presented in Rollefson et al. (1994), specifically drills on burin spalls. Additional typological considerations on the ‘Ain Ghazal borer assemblage are from previous work by Marc Hintzman, Leslie Quintero, and Philip Wilke. The types are classed into 15 categories, which encompass borers, perforators, and drill bit tools.

B1 type boring tools are borers or perforators on flakes or flake-based debitage (Plate 5.17). The bit is often fashioned on the distal end, but sometimes along the lateral margins. Because they are not fashioned on blades, flake-based boring implements are generally shorter, with an average length of 34.4 mm. The bit, which usually is short (average complete bit length is about 6.38 mm) is sometimes fashioned with just one or two flake removals (as is the case for perforators), but often by several pressure-flake removals.

The B2 borer type is a borer made on a blade with semi-steep retouch, but without a developed shoulder (Plate 5.18). They do not appear to have been hafted. This blade-based borer type is on average longer than flake-based borers at 37.9 mm, and examples typically have longer bits exhibiting more retouch (averaging roughly 9 mm long).

The B3 borer is any borer or drill fashioned on another tool, indicating recycling. The most common tools recycled into borers are burins, knives, and projectile points (Plate 5.19). They are mostly recycled blade tools, so the average length is 44.07 mm,
making them longer than many of the other blade-based borer types. When complete bits are present they are about 10.77 mm long.

The B4 borer is a leaf-shaped tool, usually fashioned on a blade, with extended lateral retouch (Plate 5.20). These borers are on average a little shorter than some of the other blade-based borers (37.7 mm) and are sometimes bipointed. When the bit is complete, the average length is about 12 mm, which is long, but the bits are also generally wide. Smaller borers of this type are of such a size that they may have more easily used as a hafted implement and some have retouch on the proximal end that may be from preparation for hafting; however, use-wear analysis is necessary to determine if they in fact were hafted.

B5 borers are also leaf-shaped, but narrower, with complete lateral retouch. They are often bipointed, and because of the extent of retouch to shape the body and bit of this borer type, it is often difficult to determine if they were produced on naviform or non-naviform blade blanks (Plate 5.21). On average, they are a little longer than the other leaf-shaped borer variety, at 43.5 mm, with longer bits (averaging 15.2 mm). The bits are generally thicker, so they likely were employed as boring implements for tasks that required larger holes, but some do get narrow enough to be considered drills. As with B4 type borers, smaller borers of this type may have been hafted.

B6 borers are drills (though some may have been perforators or used for more general boring) made on blades. They have a short beak or bit and probably were not hafted. They average 37.7 mm long, with complete bit size of 4.42 mm (Plate 5.22).
Plate 5.17. Borers on flakes (B1).

Plate 5.18. Simple borers on blades (B2).
Plate 5.19. Recycled borers (B3). From the top are borers on burins (A), borers fashioned on knives (B), and borers on projectile points (C).
Plate 5.20. Leaf-shaped borers fashioned on blades (B4).

Plate 5.21. Narrow leaf-shaped borers (B5).
B7 type borers are drills characterized by steep retouch with a shoulder or narrow bit following a central ridge on a blade, and given their elongated bit, they may have been hafted (Plate 5.23). They are similar in size to other blade-based types with an average length of 42.2 mm, and an average complete bit length of 12.5 mm.

B8 borers are drilling or general boring implements with tangs fashioned on the proximal ends, suggesting they may have been hafted. The bit and body often display steep retouch (Plate 5.24). This type is rare in the assemblage, and often is broken, so average length and bit length measurements are not available.

B9 borers are also tanged, and while some of the smaller specimens may well have been hafted, the large ones easily could have been used in the hand (Plate 5.25). They were fashioned on blades with bits varying in thickness, suggesting some were used for drilling, while others may have been employed in other hole-making tasks. On average, this tanged borer type is quite long (57.7mm), with a long bit (16.06 mm).

B10 borers are long, narrow drills made on blades that have been retouched steeply on both margins (mèche de forêt). The distal end often appears to be blunted from use. They can be trapezoidal or triangular in cross-section (Plate 5.26). Few of this type are complete, so averages of overall length and bit length are not calculable.

B11 borers are fashioned on crested blades. They include some probable drills, but these more often have expanding bits, suggesting use in other boring activities. They typically show few modifications that would indicate they were hafted (e.g., tangs), so were most likely hand held (Plate 5.27). On average, they are quite long at 51.3 mm, but
Plate 5.22. Borers and perforators with a short bit or beak or B6 type borers.

Plate 5.23. Borers with steep retouch following a central ridge (B7).
Plate 5.24. Borers with tangs fashioned on the proximal end (B8).

Plate 5.25 Tanged borers on blades (B9).
Plate 5.26. Long and narrow drills often made on blades (B10 or mèche de forêt).
Plate 5.27. Borers on crested blades (B11).
because complete boring implements can be made on blade fragments, a range of sizes is present. The average bit length is 7.41 mm.

B12 borers are drills fashioned on burin spalls (Plate 5.28). On average, they are shorter than the other types (28.6 mm), but most likely were hafted. Complete bits average around 7.97 mm, but they often are heavily rounded, sometimes with suggestions of prior chips and breaks.

B13 borers are boring implements (and an occasional perforator) made on platform spalls. Complete specimens have an average length of 76.75 mm, but a short bit (on average 12.17 mm). They are often fashioned with steep retouch that is restricted mainly to the bit portion (Plate 5.29). Due to their large size and lack of features associated with hafting, they appear to have been hand held.

Borer B14 is a category for borer bit fragments for which the type is unclear. They are included here because their function as a boring implement is clear, even though the tool type is not (Plate 5.30).

Borer B15 includes drills made on spall-like bladelets (Plate 5.31). As with borers on burin spalls, the length of complete specimens is short (29.9 mm), bits are comparatively long (10.68 mm). Given the small size of these bladelets, this type is likely to have been used in a haft in much the same way as burin spalls.

**Borer Analysis**

At ‘Ain Ghazal the most informative feature about potential borer function was usually the bit, which most often was shaped with abrupt pressure retouch. The level of
Plate 5.28. Borers on burin spalls (B12).

Plate 5.29. Borers on platform spalls (B13).
Plate 5.30. Borer fragments (B14).

Plate 5.31. Borers on spall-like bladelets (B15).
retouch necessary for production depended on the chosen blank, whether or not the piece was hafted, and the desired bit length and width. The identification of haftable borers was based on size, such as those that are too small to be effectively used by hand (e.g., borers on burin spalls or spall-like bladelets), and elements that appear to have been shaped for a haft (e.g., tangs or retouch along proximal end). Production of most all the borer types would have been relatively simple, and given that these were tools used in many tasks, most people must have produced and maintained them. For blade-based borers, high-quality flint, especially Huweijir flint, is more common, while among borers on flakes, bedded and nodular cherts and flints are more common throughout, but became especially common by the PN. Additionally, some changes in proportions of borer types exist from one period to the next, which are reviewed in the following sections. Size, however, fluctuates through time for most borer types, and the level of tool maintenance also varies by type, especially between haftable and hand-held types, thus no clear overall increase or decrease is apparent; accordingly, size is not addressed by period.

**Middle Pre-Pottery Neolithic B**

The MPPNB borer sample is presented in Tables 5.15 and 5.16. The most frequent borer types in the MPPNB include hand-held borers on blades (B2, B6), hand-held borers on flakes (B1), and hafted drills on blades (B7). The generally lower incidence of hafted borers and drills suggests that while finer drilling tasks, such as that associated with bead making, occurred at MPPNB ‘Ain Ghazal, many boring implements were associated with other tasks.
Among the blade-based borer types, blades from naviform cores were the preferred blanks, accounting for 64.3% of the MPPNB assemblage. Blades from naviform cores are, however, less frequent among the MPPNB borer assemblage than among other MPPNB formal tools. This difference indicates that borers as tools do not as often require standardized blanks. In general, the MPPNB borer assemblage is comprised predominately of Huweijir flint, although in lower frequency than the other formal tool types. In fact, among borers the locally available bedded and nodular cherts and flint are used more often, especially for flake-based borers. Behaviors associated with tool conservation are indicated mostly by reworking to extend use-life, suggesting that though some types may be less formal, few of the implements are truly of an expedient nature. Recycling to or from other tool categories (often knives and burins) is also present. Such tools are categorized as type B3. From the MPPNB assemblage 12 examples have clear evidence of recycling (three from projectile points, six from knives, and the rest into or from burins).

The MPPNB borer assemblage at ‘Ain Ghazal shows some obvious similarities to types at Beidha (Mortensen 1970), but it is difficult to compare with many of the other PPNB sites because analysts applied different typologies (e.g., Gopher 1989b; Khalaily et al. 2003; Garfinkel et al. 2012). Despite the difficulties with comparison of types, it is clear that blades are often preferred blanks for boring and piercing tools at MPPNB sites (Crowfoot Payne 1983: 691; Khalaily et al. 2003: 38; Garfinkel et al. 2012: 89).
Late Pre-Pottery Neolithic B

The most frequent types in the LPPNB borer assemblage are borers made on flakes (B1), hand-held blade-based borer and drill types (B2 and B6) and haftable drills (B12 and B7) (see Table 5.15). Haftable types are present in similar frequencies as in the MPPNB, but B7 drills are less common and drills on burin spalls (B12) are more common. These trends suggest that finer drilling tasks remained a frequent activity in the LPPNB, but as in the MPPNB, most borers appear to have been used in other hole-making activities. The frequency of recycling and of reworked borers remained steady, with about 6% of the assemblage (including B3 type borers) displaying such evidence.

The LPPNB assemblage consists mostly of blade-based types, but borers on flakes (B1) and borers on burin spalls (B12) are more common than in the MPPNB. Also, in contrast to the MPPNB, blades from naviform cores make up only 36.7% of the LPPNB blade assemblage, indicating a marked decline in the use of blanks from this technology for borers. Similar to the MPPNB assemblage, however, Huweijir flint is the most-represented resource material (83.7%). The other tool stone resources used include bedded, nodular, and wadi-rolled chert and flint found in the immediate vicinity of the site.

A comparison with other LPPNB sites suggests that boring and piercing tools remained important elsewhere (Nissen et al. 1987; Simmons et al. 2001; Peterson 2004; Makarewicz et al. 2006: 197, 200), and as at ‘Ain Ghazal, flakes appear to be more commonly used as blanks, even dominating at some sites (e.g., El-Hemneh).
Table 5.15. Borer types per chronological period.

<table>
<thead>
<tr>
<th>Type</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Transitional</th>
<th>Mixed</th>
<th>Total</th>
<th>Total%a</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>38 (17.2%)</td>
<td>53 (24%)</td>
<td>55 (46.6%)</td>
<td>159 (50.5%)</td>
<td>7 (29.2%)</td>
<td>40 (46%)</td>
<td>352</td>
<td>35.7%</td>
</tr>
<tr>
<td>B2</td>
<td>76 (34.4%)</td>
<td>53 (24%)</td>
<td>21 (17.8%)</td>
<td>34 (10.8%)</td>
<td>5 (20.8%)</td>
<td>13 (14.9%)</td>
<td>202</td>
<td>20.5%</td>
</tr>
<tr>
<td>B3</td>
<td>12 (5.4%)</td>
<td>7 (3.2%)</td>
<td>2 (1.7%)</td>
<td>9 (2.86%)</td>
<td>1 (4.2%)</td>
<td>2 (2.3%)</td>
<td>32</td>
<td>3.25%</td>
</tr>
<tr>
<td>B4</td>
<td>3 (1.4%)</td>
<td>2 (0.9%)</td>
<td>4 (3.4%)</td>
<td>10 (3.17%)</td>
<td>2 (8.3%)</td>
<td>2 (2.3%)</td>
<td>23</td>
<td>2.33%</td>
</tr>
<tr>
<td>B5</td>
<td>1 (.45%)</td>
<td>2 (.9%)</td>
<td>2 (1.7%)</td>
<td>2 (.63%)</td>
<td>0 (0%)</td>
<td>2 (2.3%)</td>
<td>9</td>
<td>.91%</td>
</tr>
<tr>
<td>B6</td>
<td>26 (11.8%)</td>
<td>21 (9.5%)</td>
<td>8 (6.8%)</td>
<td>23 (7.3%)</td>
<td>2 (8.3%)</td>
<td>9 (10.3%)</td>
<td>89</td>
<td>9.03%</td>
</tr>
<tr>
<td>B7</td>
<td>35 (15.8%)</td>
<td>18 (8.1%)</td>
<td>11 (9.3%)</td>
<td>27 (8.6%)</td>
<td>3 (12.5%)</td>
<td>6 (6.9%)</td>
<td>100</td>
<td>10.14%</td>
</tr>
<tr>
<td>B8</td>
<td>2 (.9%)</td>
<td>3 (1.4%)</td>
<td>0 (0%)</td>
<td>2 (.63%)</td>
<td>1 (4.2%)</td>
<td>0 (0%)</td>
<td>8</td>
<td>.81%</td>
</tr>
<tr>
<td>B9</td>
<td>2 (.9%)</td>
<td>4 (1.8%)</td>
<td>1 (.85%)</td>
<td>1 (.32%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>8</td>
<td>.81%</td>
</tr>
<tr>
<td>B10</td>
<td>4 (1.8%)</td>
<td>8 (3.6%)</td>
<td>4 (3.4%)</td>
<td>9 (2.9%)</td>
<td>2 (8.3%)</td>
<td>4 (4.6%)</td>
<td>31</td>
<td>3.14%</td>
</tr>
<tr>
<td>B11</td>
<td>5 (2.3%)</td>
<td>11 (5%)</td>
<td>1 (.85%)</td>
<td>1 (.32%)</td>
<td>0 (0%)</td>
<td>3 (3.4%)</td>
<td>21</td>
<td>2.13%</td>
</tr>
<tr>
<td>B12</td>
<td>2 (.9%)</td>
<td>31 (14%)</td>
<td>3 (2.5%)</td>
<td>19 (6.6%)</td>
<td>0 (0%)</td>
<td>1 (1.1%)</td>
<td>57</td>
<td>5.78%</td>
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<tr>
<td>B13</td>
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<td>3 (1.4%)</td>
<td>2 (1.7%)</td>
<td>2 (.64%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>9</td>
<td>.91%</td>
</tr>
<tr>
<td>B14</td>
<td>7 (3.2%)</td>
<td>3 (1.4%)</td>
<td>3 (2.5%)</td>
<td>8 (2.5%)</td>
<td>0 (0%)</td>
<td>5 (5.7%)</td>
<td>26</td>
<td>2.64%</td>
</tr>
<tr>
<td>B15</td>
<td>6 (2.7%)</td>
<td>2 (.9%)</td>
<td>1 (.85%)</td>
<td>9 (2.9%)</td>
<td>1 (4.2%)</td>
<td>0 (0%)</td>
<td>19</td>
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<tr>
<td>Total</td>
<td>221</td>
<td>221</td>
<td>118</td>
<td>315</td>
<td>24</td>
<td>87</td>
<td>986</td>
<td>100%</td>
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a Percentage of total sample by type
Table 5.16. Distribution of key attributes for borers by type and period.

<table>
<thead>
<tr>
<th>Type</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Huweijir Flinta</td>
<td>Naviform Productsb</td>
<td>Recycle/Reuse</td>
<td>Huweijir Flint</td>
</tr>
<tr>
<td>B1</td>
<td>32</td>
<td>NA</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>B2</td>
<td>72</td>
<td>66</td>
<td>1</td>
<td>48</td>
</tr>
<tr>
<td>B3</td>
<td>12</td>
<td>11</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>B4</td>
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<td>B5</td>
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<td>B6</td>
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<td>0</td>
<td>4</td>
</tr>
<tr>
<td>B10</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
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<td>9</td>
</tr>
<tr>
<td>B12</td>
<td>1</td>
<td>NA</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>B13</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>B14</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>B15</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>202</td>
<td>142</td>
<td>14</td>
<td>185</td>
</tr>
</tbody>
</table>

a Huweijir flint refers to high quality flint mined from several resource locations in the nearby Wadi Huweijir. Other flints and cherts used at ‘Ain Ghazal include bedded, nodular, and wadi-rolled cherts and flint, often of lower quality.
b Naviform products refers to intended blade types, ridge-straightening blades, profile correction blades, error correction blades, crested blades, and occasionally platform spalls used as blanks for boring implements.
c This category refers to borers with evidence of resharpening for most of the types. For B3 type borers, it refers to recycling from one type of tool into another, for instance, a projectile point repurposed as a borer.
Comparison between sites regarding changes in types is difficult for the LPPNB, but where it is possible, some differences are apparent. For instance, at ‘Ain Ghazal drills remained present in consistent numbers from the MPPNB to the LPPNB, while at Wadi Shu‘eib, drills decline in frequency to their lowest point during the LPPNB (Simmons et al. 2001: 15-16). Furthermore, at some LPPNB village sites, there was a pronounced emphasis on fine drilling tasks (e.g., at Al-Basit, Rollefson and Parker 2002), with drills dominating the borer class. All of this may suggest differences between sites in the emphasis on finer boring and drilling tasks, or at least between the sampled loci at reported sites.

Pre-Pottery Neolithic C

As indicated in Table 5.15, the most represented borer types in the PPNC sample include borers made on flakes (B1), non-hafted blade-based borers (B2 and B6), and haftable drills on blades (B7). Evidence of recycling (borers made on other tools–B3) and extensive reworking is present on 4.2% of the assemblage. This pattern suggests a consistent presence of tool conservation behaviors. The most striking change in the representation of types is the decline in drills made on burin spalls (B12), which coincides with lower numbers of other hafted boring and drilling implements. Curiously, the decline in drills made on spalls does not signal a decline in the frequency of spall production, as concave truncation burins are even more common in the PPNC than they were in the LPPNB (see Chapter 6). Perhaps, this pattern is associated with a decline in fine drilling activities, with spalls used for other purposes (e.g., comb teeth; Quintero et al. 2004). It may also be an effect of the comparatively smaller PPNC sample.
Overall, the PPNC borer assemblage has a much higher proportion of borers made on flakes (46.6%), but borers made on blades are still common. Huweijir flint is still predominant at 70.3% (n=83), and is most represented among blade-based borer types and lowest among borers on flakes. Blades from naviform cores are also still present in the PPNC (undoubtedly scavenged), although in an even lower proportion (22%, n=26) than in the PPNB.

It is difficult to compare the PPNC borer assemblage to those from other village sites in the southern Levant because of the use of different typologies (e.g., Galili et al. 1993) or because of the preliminary nature of much of these data. A comparison with the assemblage from Wadi Shu‘eib (Simmons et al. 2001:15-16) suggests there are some similarities in the dominance of awls and boring implements, but differences are evident in the representation of drills. At ‘Ain Ghazal, drills decrease in number in the PPNC, but at Wadi Shu‘eib, they are again more common, increasing from their least occurrence in the LPPNB. This pattern of differences from site to site suggests that, as in the previous periods, differences in emphasis on certain boring and drilling tasks may exist between sites, or at least between sampled loci at sites in the PPNC period.

Pottery Neolithic

The Yarmoukian borer assemblage is the largest of all the samples, and as indicated in Table 5.15, the most represented borer type is a borer made on a flake (B1), followed by nonhafted and hafted borers made on blades (B2, B6, B7) and borers made on burin spalls (B12). In contrast to the PPNC, borers on burin spalls are again more frequent, though at a lower proportion than in the LPPNB. Bead production, however,
does not seem to increase significantly in the PN\textsuperscript{20}, which suggests a continued emphasis on spalls for use in tasks other than drilling. The incidence of hafted borers and drills appears comparable to the PPNB, however, suggesting that finer hole-making tasks were common through the PN. Tool conservation behaviors, including recycled tools and tool maintenance or reworking, are present on about 6.98\% (n=22) of the assemblage, the highest of any other chronological period. The proportion of Huweijir flint is similar to the PPNC, with 62.2\% of the assemblage. As in the PPNC, high-quality flints such as Huweijir flint, are most represented among borers made on blades, while lesser-quality bedded and nodular cherts and flints are most commonly seen among borers on flakes. Along with the increasing emphasis on the locally obtainable tool stone, blade blanks from naviform cores are fewer, at 14.6\%. Examples that are present surely were scavenged from earlier deposits.

At several village sites in the southern Levant, boring and piercing tools are much less common by the Pottery Neolithic (for example, at Jericho [Crowfoot Payne 1983:712]; Munhata [Gopher 1989b]; Abu Thuwwwab [Kafafi 2001:150]; and Abu Gosh [Khalaïly et al. 2003]). However, as at ‘Ain Ghazal, they are still common at Sha‘ar Hagolan and Wadi Shu‘eib. Additionally, based on the descriptions and illustration of borers, both of these other borer assemblages appear to have commonalities with that at ‘Ain Ghazal, although, it is difficult to compare changes in the representation of specific types (Simmons et al. 2001: 15-16; Matskevich 2011: 236-237).

\textsuperscript{20} As indicated by bead counts presented in ADAJ excavation reports (Rollefson 1983; Rollefson and Simmons 1985; Rollefson and Kafafi 1994; Kafafi and Rollefson 1995; Rollefson and Kafafi 1997; Rollefson and Kafafi 2000).
Summary Thoughts on the Borer Assemblage

Within the borer assemblage, several changes through time are worth mentioning. First, B2, or simple borers made on blades, make up the greatest proportion of blade-based borers, and they decrease noticeably through time. Other borer on blade types, including hand-held borers made on blades (B6) and haftable drills made on blades (B7) decline slightly through time. Borers on burin spalls fluctuate through time but are most frequent in the LPPNB and Yarmoukian. Some of these fluctuations, specifically, the decline during the PPNC, could signal a shift in the use of burin spalls for other, nondrilling functions. Additionally, although there are fluctuations among the haftable borers through time (B7, B8, B10, B12, and B15), they remained present in relatively consistent frequencies, even as expedient flake-based borers became more common. The potential reason for this pattern is that activities that necessitated fine drilling or boring, such as bead production, hide working, bone working, and woodworking, continued to be undertaken by many townspeople throughout the occupation of ‘Ain Ghazal.

Perhaps the most noticeable change in blank selection is a gradual shift through time from a higher percentage of blade-based borers to flake-based borers. The change in blank choice through time is tied to the decline in blades produced from naviform cores, especially those produced from Huweijir flint, resulting in a greater reliance on less regular flake and blade blanks produced in households. One interesting feature of the borer assemblage, however, is that unlike the other formal tools, borers tend to have been made on a larger range of blanks and resource materials even in the MPPNB, a situation that is more consistent with findings from the informal tool assemblage. The presence of
recycled borers and specimens with extensive reworking, however, suggests that tool maintenance was important and remained consistent through time.

As discussed for each period, a comparison of the borer assemblage at ‘Ain Ghazal with those at other village sites in the southern Levant is complicated by the use of several different typologies. Despite some of the difficulties in comparing the proportions of different types, some similarities in blank choice and general types (e.g., drills, borers, perforators) are apparent, but there are also enough differences to suggest the range of boring and drilling activities may vary from site to site, or from sampled loci at various sites. Unfortunately, until a more standardized approach to classification is widely used, detailed comparisons will remain difficult to implement.

Finally, before presenting the summary of findings from the formal tool assemblage, it is necessary to discuss the variation within these tools assemblages during the LPPNB.

**SOME CONCLUSIONS REGARDING LPPNB PHASE DIFFERENCES**

As discussed at the beginning of this chapter, many of the deposits from the LPPNB can be associated with early or late phases. A comparison of the formal tool categories from the different phases suggests some changes in artifact types, resource material, and blank type occurred within the LPPNB period.

In the projectile point sample, little change is apparent in the proportion of certain types or the commonly used resource materials. The greatest differences are in the use of blades from naviform cores as blanks. From the early LPPNB sample of 139 examples,
about 84.9% of the projectile points were made on blades from naviform cores, while only 56.3% from a sample of 80 in the late LPPNB were made on similar blades.

A comparison between the early (sample size of 178) and late phases (sample size of 109) of the LPPNB sickle element assemblage shows little difference in the frequency of Huweijir flint, but some differences are evident in blank choice. The early LPPNB sample relied mainly on blades from naviform cores, which make up 97.8% of the blanks, while the later phases have a somewhat lower percentage, at 89.9%\(^{21}\). Most other characteristics (e.g., blank type, unilateral vs. bilateral, completeness, etc.) are consistent throughout the LPPNB in their representations.

The knife assemblage also displays some differences between the early and later LPPNB. For instance, the predominant knives in each period are blade-based knives (K3), but they are more common in the early LPPNB sample of 241 at 95% compared to 80% in the late LPPNB sample of 137 (which has more bifacial knives and tabular knives). In regard to preferred resource materials and blades, Huweijir flint comprises 96.7% of the early LPPNB sample, and 86.3% of the blanks are from naviform technology. The late phase assemblage is 83.7% Huweijir flint and 55.3% are on blanks from naviform technology.

The LPPNB borer sample also displays differences among tools recovered from the early and later phases. For example, the early LPPNB sample of 65 is 89.2% Huweijir flint, and type B2 borers are the most common type at 27%. Borers from the late phase

\(^{21}\) Some differences in size are also evident between the samples, specifically length. For the earlier LPPNB an average length of 37.8 mm (median of 34 mm and st.dev. of 14.4 mm) compares to the later LPPNB average of 32.9 mm long (median of 31.5 mm and st.dev. of 11.94 mm).
deposits (sample of 83) are 84.3% Huweijir flint, and only 15.7% of the borers are type B2, although a marked increase in B1 borers (from 17% to 27.7%) is apparent.

The general decline in naviform technology during the LPPNB is the likely cause for the differences in blank choice, resource material representation, and the prominence of certain tool types between the early and late phases. Thus, it appears naviform core-and-blade production not only became more variable in quality (e.g., core setup and blade production) during the LPPNB (Quintero 2010), it also declined substantially, and both changes had clear impacts on the formal tool kit. However, the differences in the representation of certain tool types between the LPPNB phases do not appear to be associated with significant changes in the tasks for which these tools were used or their role in daily life.

ASSEMBLAGE VARIATION BETWEEN LPPNB EXCAVATION AREAS

In addition to the differences between the early and late LPPNB, variation is evident among the formal tool categories (except for the borer assemblage) from the separate excavation areas (mostly Central Field, East Field, and North Field). A comparison of projectile points from deposits in the North Field (n=8), Central Field (n=31), and East Field (n=220) shows similarities in resource material preference and prominent point types (Byblos is the most common in all three), but differences exist in the common blanks from particular core-reduction strategies chosen for manufacture of projectile points. For instance, use of blades from naviform cores is more common among points recovered from the Central Field and the East Field at 78.1% and 74.3%,
respectively; only 25% of the blanks used for points in the North Field are from naviform cores.

Similarly, among the sickle element assemblage, a comparison of LPPNB deposits from different excavation areas shows some differences in the representation of Huweijir flint, but not in the frequency of blades from naviform cores. Twenty-seven sickle segments came from deposits in the Central Field and 96.7% are of Huweijir flint. The North Field sickle element assemblage of 27 has a lower percentage of Huweijir flint at 85.2%. The East Field, which has the largest sample at 493, is represented mainly by Huweijir flint at 95.3%.

Additionally, a comparison of the knife assemblage from the different excavation areas of the site shows some variation in resource material and preferred blanks for knives on blades, but not significant differences in the representation of different types. The East Field sample is the largest with 380 knives, which are predominately made on Huweijir flint (92.4%) and the knives made on blades are primarily on blanks from naviform cores (75.6%). The Central Field sample of 88 has a lower representation of Huweijir flint (85.2%) and a comparable frequency of blades from naviform cores (75%) used for knives on blades. In comparison to both the East Field and the Central Field, the North Field (sample of 33) has a lower representation of Huweijir flint at 84.8% and only 45.5% of the blanks for knives are blades from naviform cores.

Although more data with clear chronological associations are necessary before firm conclusions can be reached, the potential source of the differences between the excavation areas in the LPPNB could be associated in part with proximity to old
workshop deposits. That is, workshop deposits have been identified in MPPNB occupation layers in the Central Field and East Field. The intact Central Field workshop deposit (unit 3282, locus 122) is associated with the earliest phase of the MPPNB. The additional presence of waste disposal dumps from naviform core-production and core-reduction (unit 3283, loci 155 and 133; unit 3077, locus 009) suggests numerous deposits of this type may have been present in the Central Field portion of the site. The intact East Field workshop deposit (unit F14, locus 037) is associated with the latest phase of the MPPNB, and perhaps the earliest use of the East Field (Quintero 2010:120-127). In both locations, the existence of such deposits may have provided a resource for later scavenging, which would explain the higher percentages of Huweijir flint and blades from naviform cores in the Central Field and East Field deposits. Alternatively, it is possible that the products from naviform core reduction were no longer distributed in the same manner as in the MPPNB to households across the site, resulting in variation between excavation areas. Unfortunately, until additional research with greater chronological association is done, it will be difficult to draw firm conclusions about the causes of these patterns.

**SUMMARY**

The findings from the formal tool assemblage indicate that projectile points, sickle elements, knives, and borers remained important implements used on a regular basis throughout the occupation of ‘Ain Ghazal. Furthermore, the regularity of their presence in domestic-related deposits suggests these were implements made and used at the household level through time.
The most significant changes in each assemblage appear to be associated with the cessation of naviform core reduction, which resulted in the greater use of less regular flake and blade blanks produced in households. Additionally, site inhabitants exerted more effort towards tool conservation, and often scavenged blades, flakes, and tools to supply their needs for formal tool blanks. The changes in types that are evident among the different functional categories, suggest some potential changes in weapon technology, plant resource exploitation, and perhaps fluctuations in the importance of finer drilling tasks.

An evaluation of the formal tool assemblage at ‘Ain Ghazal with those from other southern Levantine sites displays some difference in the representations of certain tool types (e.g., Jericho points, hafted drilling and boring implements). Despite these differences, the formal tool types and their changes through time show general similarities with other southern Levantine Neolithic sites. Unfortunately, few reports apply the same typologies and consistently record the same attributes, which hinders detailed comparison between sites.

Finally, the variation evident in the formal tool categories between the early and late LPPNB suggests many of the changes commonly associated with the PPNC started earlier. Likewise, differences evident among the tools from the separate excavation areas suggest variation in access to products from naviform cores during the LPPNB. Taken together, these findings indicate it was during the LPPNB that the lithic economy underwent the significant transition from the dual-economy typical of the MPPNB to an economy solely reliant on household-level production. This reliance continued in the
PPNC and PN. Further research is necessary to clarify these issues, but clearly, the LPPNB was a period during which major changes occurred in the lithic economy as well as in the population size, the size of the settlement, and socioeconomic makeup of the town.
In addition to the mostly blade-based formal tool assemblage are informal tools, woodworking tools, and hammerstones/pecking stones. As with the formal tools, these objects came from domestic-related deposits, and occurred widely across the site\(^1\). The informal tool categories discussed here include burins, scrapers, notches and denticulates, used and retouched flakes and blades, chamfered-bit tools, and combination tools. Such tools tend to be less regular in form and require less effort to produce with fewer resource material and blank constraints. Most would be best understood as tools within “expedient technologies” in which core reduction is unstandardized and the resultant blanks and tools are variable in form (Parry and Kelly 1987; Nelson 1991).

Although numerous typologies include woodworking tools with bifacial knives as part of the bifacial class (e.g., Gopher 1989b, Garfinkel et al. 2012; Khalaily et al. 2003), they are separated here because they differ in the way they were produced and used. Additionally, bifacial implements used for woodworking are quite different from the flake-and blade-based tool categories. Tools identified as woodworking implements include axes, adzes, axe/adzes, chisels, and picks, and as with the rest of the tool kit, they were used in important tasks in the household lithic economy.

The overview below includes a description of the tool types, followed by the results of analysis for each. Characteristics recorded for each include resource material,
presence of cortex, blank type, dimensional information, presence of retouch and/or use-wear, and evidence of recycling or resharpening.

**BURINS**

Traditionally, burins have long been associated with engraving activities, especially on bone, antler, wood, soft stone, and ivory artifacts (Clark and Thompson 1953; Semenov 1964; Stafford 1977; Odell 1981; Keeley 1982) but research of the past three decades suggests that, as a class, they were multifunctional tools (Stafford 1977; Unger-Hamilton 1988; Finlayson and Betts 1990; Barton et al. 1996). This supposition was tested by Barton et al. (1996:114-120), who examined burins from three late Pleistocene sites in Southwest Asia to consider four possible burin functions: as gravers, as cutting/scraping tools, as cores, and as tangs on hafted artifacts. Their findings suggest that burins served a multitude of functions and that the presence of burination should also be viewed as a reduction technique rather than just as a functional tool class (Barton et al. 1996:121).

**Neolithic Burins**

Most burin analyses presented in Neolithic site reports use types similar to those defined by Crowfoot Payne (1983:688-689) and Gopher (1989b:51). At MPPNB sites, the common pattern is that transverse burins, simple burins (e.g., burins-on-breaks, burins-on-natural sides, angle burins, etc.), and dihedral burins are the most common types, but truncation burins may be present in small numbers (Crowfoot Payne 1983:688-689; Gopher 1989b:57; Simmons et al. 2001:18; Khalaily et al. 2003:28; Garfinkel et al. 2003).
2012:89, 163). During the LPPNB, transverse burins remained common, but truncation burin varieties increased in frequency at some sites (e.g., Wadi Shu‘eib and ‘Ain Ghazal [Rollefson 1995; Simmons et al. 2001:18]). This pattern is by no means universal. At sites such as Basta, dihedral burins were most represented (Nissen et al. 1987:101), and some sites had few burins at all (e.g., el-Hemmeh) (Makarewicz et al. 2006:198-199). By the PN, burins are still present, but much less common at a number of sites including Jericho (Crowfoot Payne 1983:712), Munhata (Gopher 1989b:114-115), and Abu Gosh (Khalaily et al. 2003). In contrast to village sites along the Jordan Valley and the Mediterranean, burins are quite common in desert sites during the PN, with many apparently devoted to burin spall production (Betts 1987, 1992, 1993, 1998). Likewise, they were common at some sites in the highlands of Jordan during the PN (e.g., Wadi Shu‘eib, ‘Ain Ghazal).

**Previous Research at ‘Ain Ghazal**

As indicated above, the burin assemblage at ‘Ain Ghazal was examined and reported on by Rollefson (1988, 1995). In his later analysis, Rollefson (1995:515) divided burins into five major groups and 41 types in an effort to standardize typologies and aid in comparative analyses. His results suggested that transverse burins became less common after the PPNB at ‘Ain Ghazal, and truncation burins became more common. Additionally, he noted that burins generally became larger later in time. To explain these changes, Rollefson (1995:516-517) proposed that the decline in transverse types may reflect a decline in the use of woodland resources. Correspondingly, he argued, the common occurrence of truncation burins later in time could reflect a shift in emphasis to
xeric resources, perhaps associated with the appearance of pastoralism. Although Rollefson (1995) correctly observed that these changes seem to co-occur, he had not yet established the specific resources for which these tools were used.

**Burin Typology and Analysis**

For this analysis, I rely on the major groups identified by Rollefson (1995:515), including simple burins, transverse burins, concave-truncation burins, and dihedral burins, but the range of types considered here is greatly pared down in comparison. This simplified approach was chosen because these larger categories represent the major functional differences among burins.

*Transverse Burins*

Transverse burins have a burination, or burin spall removal scar, across the proximal or distal end of a blade or flake, which creates a pointed “beak” or protrusion. The burin spall removal was often set up with abrupt retouch along one lateral margin. As discussed by Crowfoot Payne (1983:688-689) and Gopher (1989b:36), it can be difficult to distinguish between transverse burins and chamfered-bit tools because of the similarity in their production. For the purposes of this analysis, those pieces with probable use-wear on the “beak” and/or a less acutely angled spall removal are classified as transverse burins (Plate 6.1). The analyzed assemblage includes 244 transverse burins, or 22.9% of the total burin assemblage. With regard to production preferences, blades from naviform cores and to a lesser degree, blades from other core-reduction strategies are common blanks, indicating that blades were the preferred blank choice.
Functionally, transverse burins may have been associated with use on woodland resources (e.g., woodworking?), as suggested by Rollefson (1995), or they could also have been used as tools for engraving or scraping of various materials (Stafford 1977; Unger-Hamilton 1988: 159-160). It is unlikely, however, that they were cores, as the spalls produced from transverse burins are usually curved and short, and of uncertain utility. Additionally, some transverse burin spall removals appear to have been intended to trim blades for hafting purpose (as is seen among specimens in the blade-knife and sickle element assemblage) (also suggested by Unger-Hamilton 1988:160). Thus, it appears that not only do transverse burins lack a common function, some may not have been used as burins at all.

Dihedral Burins

Dihedral burins result from intersecting spall removals creating a V-shape at the proximal or distal end of the blank. This category also includes less symmetrical dihedrals (sometimes called canted dihedrals), which typically involve a convergence of a burin spall removal down one lateral margin and a transverse burin spall removal across the same end (Plate 6.2). The 90 dihedral burins examined here comprise 8.5% of the analyzed burin sample from ‘Ain Ghazal. Platform spalls and blades from both naviform and other blade core technologies were preferred blanks, although several burins were made on flakes.

Functionally, dihedral burins are often associated with engraving on bone, antler, or wood (Stafford 1977; Keeley 1982). Despite, the general ambiguity of burin function (Barton et al. 1996), the form, and the way in which dihedral burins were produced,
Plate 6.1. Transverse burin examples. Note that while most of these are made on blades, at least two are on platform spalls, and one is on a flake.

Plate 6.2. Examples of dihedral burins. Note the use of a platform spall and a flake.
suggest they are likely to have been used as graving or cutting tools, but may also have been made to facilitate hafting. Until more dihedral burins from Neolithic contexts are analyzed for use-wear, the full range of functions will remain unknown.

**Burins-on-Breaks**

Burins-on-breaks are created by burin spall removals that originate from the proximal or distal end of a blank (usually a break or platform) (Plate 6.3). The burin-on-break sample of 214 artifacts comprises 20% of the total burin assemblage, and both blades and flakes served as blanks. With regard to function, burins-on-breaks often appear to have served as cores for burin spall production. In the sample examined here, they rarely had noticeable wear, suggesting they were not used as tools, although they were often made on tools.

**Truncation Burins**

Single-truncation burins are created by a burin spall removal along one lateral margin that originated from a truncated (most often concavely truncated) proximal or distal end of a blank. They represent 14.7% (n=156) of the analyzed burin assemblage. Blades and flakes were both commonly used as blanks, but blades from naviform cores are less represented in this group than among other burin types. Double-truncation burins (n=80) are similar to single-truncation burins except they have spalls removed along two lateral margins originating from a truncated proximal or distal end of a blank. Opposed-truncation burins have spall removals along one or both margins, originating from
truncations on both the proximal and distal ends of a blank, and 84 such burins were identified, or 7.9% of the total assemblage analyzed for this study (Plate 6.4).

With regard to function, Finlayson and Betts (1990) suggested that truncation burin types might have served as cores for spall production rather than as tools. The detached spalls then were fashioned into drill bits and hafted on to drilling implements. However, at many sites, especially the “burin sites” of the later Neolithic, the vast quantity of truncation burins present indicates that many more spalls were produced than were used as drills. To explain this pattern, Finlayson and Betts (1990:20) suggested that appropriate spalls might have been difficult to produce, necessitating many attempts and

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2 Their interpretation is supported by use-wear studies (Barton et al. 1996; Yamada 2000). In fact, Yamada (2000:337-338) examined a sample of truncation burins from ‘Ain Ghazal and found no evidence to suggest they were used as tools.
therefore many cores. An alternative suggestion by Quintero et al. (2004:208-209), linked the changes in burin spall production with the appearance of pastoralism. Specifically, they proposed the increase in truncation burins might have been to produce spalls that served as inserts in combs used to obtain wool from molting sheep. That interpretation is supported by the use of combs to obtain wool from goats in northwestern China (Ryder 1987). Whatever the cause for an increase in truncation burins at some sites in the LPPNB, it is difficult to deny the possibility of its association with the greater visibility of sites in the deserts and with pastoralism.

Combination Burins

Combination burins combine two or more different burin types (e.g., transverse burin and burin-on-break), and they represent only 4.6% (n=49) of the assemblage. Both blades and flakes are common blanks in the assemblage, but blades were used more commonly.

Burinated Tools

Burinated tools are burins created by spall removals from a tool, thereby fashioning a dual or multipurpose tool (e.g., a transverse burin on one end and knife along one lateral margin). Tools of this type may also reflect tool-recycling behavior. Where the latter distinction was possible, it was noted during analysis. This burin type is represented by 116 pieces, or 10.9% of the total assemblage. Blades were the preferred blanks, especially those from naviform cores, but blades from other blade core types were also included.
Plate 6.4. Examples of concave-truncation burins from ‘Ain Ghazal. All subtypes are pictured.

**Burin fragments**

Small fragments exhibiting traces of burination for which type is indeterminate are also present in the burin assemblage. Only 32 (3%) pieces fall into this category.

**Burin Distribution by Period**

*Middle Pre-Pottery Neolithic B*

As shown in Table 6.1, in the MPPNB sample, transverse burins are the most frequent, followed by burins-on-breaks, dihedral burins, and burinated tools. The high
number of transverse burins could indicate an emphasis on woodland resources, but they most likely had multiple uses. Moreover, they may be related functionally to chamfered-bit tools, which also were present in high numbers at this time. The notable presence of burins-on-breaks in the MPPNB burin assemblage indicates a demand for straight spalls (perhaps for drills bits for finer drilling tasks, perhaps bead manufacture?). Finally, the moderately high incidence of dihedral burins, which could have been used for working bone, antler, or wood, suggests these activities occurred on a regular basis in the MPPNB at ‘Ain Ghazal.

There is a relatively high incidence of burinated tools and other evidence of recycling (n=50, or 18%) in the MPPNB assemblage. It is especially noticeable among the burin-on-break type, where 16 pieces show some signs of recycling, mostly in the form of burin spalls removed from knives or sickle elements (where the spall removes the working edge). Another possibility for this pattern of burinating away a dulled working edge could have been to facilitate hafting, if the blade was reversed and reset. Table 6.2 displays information about blank selection by type for the MPPNB and the other major periods. Blades from naviform cores are most frequent in the MPPNB burin assemblage. By-products from naviform core-and-blade production, including blades and platform spalls, are the favored blank types for dihedral, transverse, and combination burin types. In general, blade-based blanks were favored in the MPPNB over flake-based blanks, but beyond the blank production technology, no clear preference for a specific blade or flake

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3 Future use-wear studies may resolve this issue.
Table 6.1. Burin type by period.

<table>
<thead>
<tr>
<th>Type</th>
<th>MPPNB</th>
<th>%</th>
<th>LPPNB</th>
<th>%</th>
<th>PPNC</th>
<th>%</th>
<th>PN</th>
<th>%</th>
<th>Mixed/Trans</th>
<th>%</th>
<th>Total</th>
<th>%</th>
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<tbody>
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<td>Dihedral</td>
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<td>39</td>
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<td>6</td>
<td>5.22%</td>
<td>15</td>
<td>5.51%</td>
<td>4</td>
<td>6.67%</td>
<td>90</td>
<td>8.45%</td>
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<tr>
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<td>148</td>
<td>53.62%</td>
<td>52</td>
<td>15.12%</td>
<td>8</td>
<td>6.96%</td>
<td>19</td>
<td>6.99%</td>
<td>18</td>
<td>30.00%</td>
<td>245</td>
<td>22.91%</td>
</tr>
<tr>
<td>Burin-on-break</td>
<td>54</td>
<td>19.57%</td>
<td>84</td>
<td>24.42%</td>
<td>21</td>
<td>18.26%</td>
<td>49</td>
<td>18.01%</td>
<td>8</td>
<td>13.33%</td>
<td>216</td>
<td>20.09%</td>
</tr>
<tr>
<td>Truncation</td>
<td>10</td>
<td>3.62%</td>
<td>35</td>
<td>10.17%</td>
<td>23</td>
<td>20.00%</td>
<td>78</td>
<td>28.68%</td>
<td>10</td>
<td>16.67%</td>
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<td>0.00%</td>
<td>36</td>
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<td>19</td>
<td>16.52%</td>
<td>22</td>
<td>8.09%</td>
<td>3</td>
<td>5.00%</td>
<td>80</td>
<td>7.51%</td>
</tr>
<tr>
<td>Opposed-truncation</td>
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<td>0.36%</td>
<td>16</td>
<td>4.65%</td>
<td>27</td>
<td>23.48%</td>
<td>34</td>
<td>12.50%</td>
<td>5</td>
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<td>83</td>
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<tr>
<td>Combination burin</td>
<td>7</td>
<td>2.54%</td>
<td>24</td>
<td>6.98%</td>
<td>2</td>
<td>1.74%</td>
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<td>4.78%</td>
<td>3</td>
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<td>49</td>
<td>4.60%</td>
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<tr>
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<td>9.42%</td>
<td>44</td>
<td>12.79%</td>
<td>8</td>
<td>6.96%</td>
<td>32</td>
<td>11.76%</td>
<td>6</td>
<td>10.00%</td>
<td>116</td>
<td>10.89%</td>
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<td>1.45%</td>
<td>14</td>
<td>4.07%</td>
<td>1</td>
<td>0.87%</td>
<td>10</td>
<td>3.68%</td>
<td>3</td>
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<td>100%</td>
<td>344</td>
<td>100%</td>
<td>115</td>
<td>100%</td>
<td>272</td>
<td>100%</td>
<td>60</td>
<td>100%</td>
<td>1067</td>
<td>100%</td>
</tr>
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Table 6.2. Blank choices by burin type and period.

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<th>Type</th>
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<th>Blade</th>
<th>Flake</th>
<th>Other</th>
<th>Naviform</th>
<th>Blade</th>
<th>Flake</th>
<th>Other</th>
<th>Naviform</th>
<th>Blade</th>
<th>Flake</th>
<th>Other</th>
<th>Naviform</th>
<th>Blade</th>
<th>Flake</th>
<th>Other</th>
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<td>3</td>
<td>8</td>
<td>0</td>
<td>16</td>
<td>16</td>
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<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Transverse</td>
<td>94</td>
<td>28</td>
<td>26</td>
<td>0</td>
<td>22</td>
<td>21</td>
<td>9</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>11</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Burin on break</td>
<td>19</td>
<td>12</td>
<td>23</td>
<td>0</td>
<td>23</td>
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<td>12</td>
<td>9</td>
<td>0</td>
<td>5</td>
<td>18</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>Truncation</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>6</td>
<td>16</td>
<td>13</td>
<td>0</td>
<td>1</td>
<td>17</td>
<td>5</td>
<td>0</td>
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<td>41</td>
<td>33</td>
<td>3</td>
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<tr>
<td>Double truncation</td>
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<td>0</td>
<td>0</td>
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<td>19</td>
<td>9</td>
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<td>1</td>
<td>8</td>
<td>10</td>
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<td>0</td>
</tr>
<tr>
<td>Opposed truncation</td>
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<td>0</td>
<td>0</td>
<td>6</td>
<td>7</td>
<td>3</td>
<td>0</td>
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<td>12</td>
<td>15</td>
<td>1</td>
<td>0</td>
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<td>13</td>
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</tr>
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<td>Combination burin</td>
<td>5</td>
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<td>1</td>
<td>0</td>
<td>5</td>
<td>16</td>
<td>3</td>
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<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Combination burin/other tool</td>
<td>13</td>
<td>7</td>
<td>6</td>
<td>0</td>
<td>27</td>
<td>14</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>7</td>
<td>19</td>
<td>6</td>
<td>0</td>
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<td>0</td>
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<td>2</td>
<td>3</td>
</tr>
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<td>71</td>
<td>0</td>
<td>117</td>
<td>147</td>
<td>74</td>
<td>5</td>
<td>10</td>
<td>60</td>
<td>45</td>
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<tr>
<td>Total%</td>
<td>55.4%</td>
<td>18.8%</td>
<td>25.7%</td>
<td>0%</td>
<td>34%</td>
<td>42.7%</td>
<td>21.5%</td>
<td>1.45%</td>
<td>8.7%</td>
<td>32.2%</td>
<td>39.1%</td>
<td>.87%</td>
<td>7%</td>
<td>51.5%</td>
<td>37.1%</td>
<td>.44%</td>
</tr>
</tbody>
</table>
type is apparent. Huweijir flint is the predominant resource material making up about 96.7% (n=267) of the MPPNB burin sample.

Late Pre-Pottery Neolithic B

The LPPNB sample consists of 333 burins, and of these, the burin-on-break type is the most common (Table 6.1), suggesting an emphasis on burin spall production, which is supported by the strong increase in concave-truncation burin types in the LPPNB. The greater demand for spalls could be associated with the larger population of the site engaging in finer drilling activities. However, the increased number of drills made on burin spalls in the borer assemblage does not seem great enough to account for the number of spalls being produced. If, as suggested by Quintero et al. (2004:209), burin spalls served as inserts for combs to extract wool, then the increased presence of burin spalls at LPPNB ‘Ain Ghazal may well serve as a marker for the emerging reliance on the “secondary products” of animals associated with pastoralism.  

Additionally, the increase in truncation burins occurred as transverse burins became less common. As discussed above, it is impossible to ignore the similarity between transverse burins and chamfered-bit tools (also noted by Crowfoot Payne 1983: 688-689) and their similar peak in the MPPNB and subsequent decline in the LPPNB. Most likely, their similar peak and decline resulted because they often were made on blade blanks, which began to decline in quality and availability in the LPPNB. Additionally, they may have been used for manipulation of the same types of resources.

\footnote{Specifically, sheep begin to appear in abundance in the LPPNB (Horwitz et al. 1999)
(perhaps woodland resources, as suggested by Rollefson 1995⁵), and a decline in the use of these resources resulted in a related decline in the representation of both tool types at ‘Ain Ghazal. Clearly, these trends are more complex than previously thought, but it seems reasonable to suggest that a decrease in suitable blades, together with a decline in the resources for which they were used, caused a decline in transverse burins. Use-wear analyses of tools may be useful in clarifying these issues.

Recycling and evidence of reuse are present on 14% (n=48) of the LPPNB assemblage, most frequently seen among burin-on-break varieties (n=15), and burinated tools (n=15). Much of the recycling occurred on blades with use-wear and/or retouch and appears to be opportunistic; essentially, wherever a good spall could be removed, it was reworked. As shown in Table 6.2, blank choice changed somewhat through time. For example, blades from naviform cores comprise less of the LPPNB sample, with blades from other blade core technologies accounting for more of it. Although it is not as frequent as in the MPPNB, Huweijir flint is still the preferred resource material, representing 77.6% (n=267) of the assemblage.

Additionally, it is possible to divide some of the LPPNB burin assemblage into early and later phases, and some differences are apparent between the two. The sample of 118 burins from the early phase shows differences when compared to the sample of 127 from the later phase in both the representation of Huweijir flint, 88.1% (n=104) to 71.7% (n=91), and blades from naviform cores, from 47.5% (n=56) to 29.9% (n=38). With regard to type changes, concave-truncation burins appear to be more common in later

⁵ Although, he did not specify what these resources were beyond possibly wood or animal species, he notes that the decline in transverse burins co-occurs with the decline in the environment surrounding ‘Ain Ghazal.
LPPNB contexts (19 for the earlier LPPNB and 48 for the later LPPNB). As with the formal tool assemblages, these differences indicate that the lithic economy of the site was undergoing major changes in the LPPNB6.

Pre-Pottery Neolithic C

The PPNC sample of 115 examples consists mainly of truncation burins, which together account for over half the sample (Table 6.1), but burins-on-breaks were still present. Clearly, the trends observed in the LPPNB regarding spall demand not only continued, but increased in the PPNC, in spite of the clear decline in the population of the site (Rollefson et al. 1992) and the decline in spalls used as drills. This pattern seems to provide support for arguments that link the increasing presence of certain burin types, including truncation burins, with the increasing importance of pastoralism (Köhler-Rollefson 1988; Simmons et al. 1988; Rollefson 1995:517; Quintero et al. 2004).

Obvious signs of recycling are fewer than in the PPNB periods at 7% (n=8). This change may be due in part to less availability and hence a lower percentage of blades from naviform cores and Huweijir flint, both of which were preferred and more likely to have been reused. The burin types recycled most frequently are burinated tools, with four pieces (3.2%), but the sample is very small. The distribution of blank selection is presented in Table 6.2. It shows that blades from naviform cores are even less frequent in the PPNC, but in total, blade-based burins account for 60.9% of the assemblage, a small majority. Thus, an increase in the use of flakes for tool blanks is evident. In addition, to

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6 A comparison between of burin samples from different excavation areas in the LPPNB, however, revealed few differences.
the changes in blank preference, the use of Huweijir flint is noticeably lower in the PPNC assemblage, accounting for only 46.1% (n=53).

Pottery Neolithic

The Yarmoukian assemblage of 272 burins consists chiefly of truncation burin types, which account for nearly half of the assemblage, and as in the PPNC, burins-on-breaks are common, as are burinated tools. The Yarmoukian burin assemblage indicates a continued demand for spalls. Transverse and dihedral burins are also present in similarly low quantities as those in the PPNC, suggesting that they continued to be used, although in a reduced capacity compared to the earlier periods.

The Yarmoukian sample also appears to have the lowest rate of recycling and reuse at 2.9% (n=8), with burinated tools showing more recycling (n=4). Blank selection is similar to that in the PPNC, but blade-based burins are even less represented, making up 58.5%, and flakes and other blanks comprising 37.1%. Huweijir flint representation is even less, comprising only 48.2% (n=131) of the sample.

Summary of the Burin Assemblage Findings

The burin assemblage shows clear change through time. Transverse burins are most common in the MPPNB and decrease through time. The cause for this decline is unclear, but is most likely related to the gradual decrease in the availability of suitable blades. Although it requires additional research and some clearer evidence of a connection, the decline could also be associated with a change in the availability of woodland resources, as suggested by Rollefson (1995). Dihedral burins are most common
in the PPNB, especially the LPPNB. They may have been used for grooving bone and antler. Their increase may simply reflect an increased population of the site in the LPPNB, only decreasing in number in the PPNC and PN. Concave-truncation burins first became apparent in the LPPNB and increased in later periods, which seems to be associated with the rise of pastoralism and reliance on animal products in the local economy (Köhler-Rollefson 1988; Rollefson 1995; Quintero et al. 2004).

Recycling and related behaviors apparent in the burin assemblage are especially interesting because they appear to be more important in the MPPNB and LPPNB than in the PPNC and Yarmoukian, which is contrary to the expected pattern of increased recycling. This trend may be related to blank choice and resource material availability. That is, Huweijir flint and blades from naviform cores, which are more regular and conducive to easy reuse, were prominent in the PPNB\(^7\), but became less so in later periods.

A regional comparison suggests some general similarities in the changes in burin types, and function through time, but much variation is evident between sites especially starting in the LPPNB (see discussion on page 208). The burin assemblage from the nearby multicomponent site of Wadi Shu‘eib provides perhaps the most informative comparison for understanding the patterns at ‘Ain Ghazal. The investigations of Wadi Shu‘eib are still in their preliminary stages, but what has been found so far in the flaked-stone assemblage indicates some similarities shared commonly across the southern Levant (e.g., transverse burins decrease after the PPNB and truncation burin types

\(^7\) Gopher (1989b) also noticed that tools made of fine blades were often recycled into burins at MPPNB Munhata.
increase). Despite these general similarities, the greater representation of dihedral burins and the somewhat lower number of truncation burins in the later periods at Wadi Shu‘eib, suggests some differences exist between Wadi Shu‘eib and ‘Ain Ghazal. These differences are perhaps associated with the greater emphasis on xeric resources and pastoralism by the inhabitants of ‘Ain Ghazal (Rollefson 1995; Simmons et al. 2001:19).

SCRAPERS

Scrapers are mentioned in most descriptions of site assemblages. Reporting of this tool category, however, is inconsistent, with some writers providing little distinction of types and others that recognize numerous types. Additionally, authors of some sites reports identify types that appear to be present only in their assemblages (Simmons et al. 2001; Al-Nahar 2010). Furthermore, in contrast to some of the formal tool types, little change is evident in the array of scraper types present throughout the Neolithic period. Some reports for multicomponent sites do observe an emphasis on the use of flake blanks later in time (e.g., Gopher 1989b:118; Rollefson et al. 1994:454), but generally, scrapers are not considered a tool type with great temporal sensitivity.

Functionally, scrapers are most commonly associated with hide working, which is supported by ample ethnographic research (e.g., Clark and Kurashina 1981), and use-wear analyses conducted on Neolithic scrapers (Yamada 2000:170; Ibáñez et al. 2007: 156-157). It is likely, however, that scrapers had multiple uses, including the working of

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8 For instance, Peterson (2004:10) mentions only end- and side-scrapers at Khirbet Hammam, Simmons and Najjar (2003:418) mention scrapers only as a functional class at Ghwair, and Galili et al. (1993:141) also mention scrapers only as a functional class at PPNC Atlit-Yam.

plant materials, wood, bone, and softer stone (Unger-Hamilton 1988:127-130; Verhoeven 1999:150; Yamada 2000:170). The minimal change in scraper form and representation suggests they remained important for a variety of tasks throughout the Neolithic period.

**Previous Research at ‘Ain Ghazal**

At ‘Ain Ghazal, Rollefson et al. (1994:447) employed a comprehensive typology for scraping implements. They found that not only were scrapers more likely to be made on flakes than blades in the later periods of occupation, they were also smaller regardless of the scraper group. Concerning retouch, their findings suggested that scrapers changed little over time.

**Scraper Types**

The typology employed here is simplified in comparison to those of Rollefson et al. (1994) and others (Mortensen 1970:29-32; Gopher 1989b:59-61). Instead, it focuses on the location of retouch (e.g., end scraper, side scraper) (such as that recognized by Crowfoot Payne 1983:692) and blank preferences (as was done to a certain extent by Gopher 1989b, and Rollefson et al. 1994).

Scrappers are tools with abrupt retouch (either by pressure or percussion) along a portion of the margin that creates an edge approaching 90 degrees. In some cases, where visible use-wear along a minimally retouched edge appears consistent with use for scraping, the piece is classified as a scraper. The scraper types used for this analysis include end scrapers on flakes and side scrapers on flakes (Plate 6.5), end scrapers on blades and side scrapers on blades (Plate 6.6), combination scrapers (pieces with a
scraper edge along one or both margins and the distal or proximal end), end scrapers and side scrapers on platform spalls, other scrapers (includes combination scrapers and other miscellaneous tools: three tabular scrapers, and two scrapers on flint chunks), and scraper fragments.

As indicated in Table 6.3, end scrapers on flakes, side scrapers on flakes, and combination scrapers (mostly on flakes) are the most common types, and in general, flakes are the most common blanks for scrapers.

**Distribution by Period**

The MPPNB sample is the smallest of all the chronological periods with 115 pieces. As shown in Table 6.3, the most common scrapers in this sample are end scrapers and side scrapers on flakes, and combination scrapers (mostly on flakes). Huweijir flint was the preferred resource material making up 93.9% (n=108) of the assemblage (Table 6.4). Unlike the situation with the formal tools, few clear indications of recycling are present.

End scrapers and side scrapers on flakes, followed by combination scrapers (mostly on flakes), are the frequent types in the LPPNB sample (Table 6.3). Scrapers on blades are present in slightly lower proportions, when compared to the MPPNB. Likewise, the LPPNB assemblage has a much lower representation of Huweijir flint. In fact, a decline in Huweijir flint is evident between the early and late phases of the LPPNB. The earlier LPPNB sample of 43 is represented by 76.7% Huweijir flint and the later LPPNB
Plate 6.5. End scrapers on flakes (A), side scrapers on flakes (B), combination scrapers on flakes (C), and scraper fragments (D).
Plate 6.6. End scrapers on blades (A), side scraper on a blade (B), and combination scraper on a blade (C).

Table 6.3 Scraper types by chronological periods.

<table>
<thead>
<tr>
<th>Scraper Type</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Mixed/ Transition</th>
<th>Total</th>
<th>Total%</th>
</tr>
</thead>
<tbody>
<tr>
<td>End scraper on blade</td>
<td>9 (7.8%)</td>
<td>7 (4.3%)</td>
<td>8 (4.2%)</td>
<td>12 (4.1%)</td>
<td>6 (8.3%)</td>
<td>42</td>
<td>5.1%</td>
</tr>
<tr>
<td>End scraper on flake</td>
<td>26 (22.6%)</td>
<td>55 (33.7%)</td>
<td>61 (32.3%)</td>
<td>50 (17.2%)</td>
<td>19 (26.4%)</td>
<td>211</td>
<td>25.5%</td>
</tr>
<tr>
<td>Side scraper on blade</td>
<td>13 (11.1%)</td>
<td>14 (8.6%)</td>
<td>12 (6.3%)</td>
<td>23 (7.9%)</td>
<td>5 (6.9%)</td>
<td>67</td>
<td>8.1%</td>
</tr>
<tr>
<td>Side scraper on flake</td>
<td>30 (26.1%)</td>
<td>29 (17.8%)</td>
<td>56 (30.1%)</td>
<td>71 (24.5%)</td>
<td>19 (26.4%)</td>
<td>205</td>
<td>24.7%</td>
</tr>
<tr>
<td>End scraper on a platform spall</td>
<td>5 (4.3%)</td>
<td>2 (1.2%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>7</td>
<td>.8%</td>
</tr>
<tr>
<td>Side scraper on platform spall</td>
<td>2 (1.7%)</td>
<td>3 (1.8%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>5</td>
<td>.6%</td>
</tr>
<tr>
<td>Combination scraper</td>
<td>20 (17.4%)</td>
<td>34 (20.9%)</td>
<td>34 (18%)</td>
<td>79 (27.2%)</td>
<td>17 (23.6%)</td>
<td>184</td>
<td>22.2%</td>
</tr>
<tr>
<td>Other scraper</td>
<td>2 (1.7%)</td>
<td>2 (1.2%)</td>
<td>3 (1.6%)</td>
<td>6 (2.1%)</td>
<td>4 (5.6%)</td>
<td>17</td>
<td>2%</td>
</tr>
<tr>
<td>Scraper fragment</td>
<td>8 (7%)</td>
<td>17 (10.4%)</td>
<td>15 (7.9%)</td>
<td>49 (16.9%)</td>
<td>2 (2.8%)</td>
<td>91</td>
<td>11%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>115</strong></td>
<td><strong>163</strong></td>
<td><strong>189</strong></td>
<td><strong>290</strong></td>
<td><strong>72</strong></td>
<td><strong>829</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
sample of 81 by 43.2% Huweijir flint\(^\text{10}\). Recycling and related behaviors are not well represented among the LPPNB scraper assemblage.

The PPNC assemblage continues the trends of the previous periods, with an even greater proportion of flake-based scrapers, which are dominated again by end scrapers, side scrapers, and combination scrapers. Huweijir flint representation is comparable with that seen in the late LPPNB. Recycling and related behaviors are uncommon.

The Yarmoukian sample is the largest of any, and as shown in Table 6.3, end scrapers and side scrapers on flakes, combination scrapers, and scraper fragments are the most common. Additionally, in comparison to the PPNC, the Yarmoukian sample has a greater representation of Huweijir flint, at 55.9% of the assemblage. The increase in Huweijir flint use may be associated with scavenging from earlier deposits, which likely occurred more frequently due to the numerous pits dug in the Yarmoukian period (G.

\(^{10}\) A comparison of scrapers from different excavation areas reveals no significant differences and is not discussed.

---

Table 6.4. Resource material distribution by type and period.

<table>
<thead>
<tr>
<th>Scraper Type</th>
<th>MPPNB H/NH(^a)</th>
<th>LPPNB H/NH</th>
<th>PPNC H/NH</th>
<th>PN H/NH</th>
<th>Total H/NH</th>
</tr>
</thead>
<tbody>
<tr>
<td>End scraper on blade</td>
<td>9/0</td>
<td>6/1</td>
<td>3/5</td>
<td>8/4</td>
<td>26/10</td>
</tr>
<tr>
<td>End scraper on Flake</td>
<td>23/3</td>
<td>36/19</td>
<td>27/34</td>
<td>27/23</td>
<td>113/79</td>
</tr>
<tr>
<td>Side scraper on blade</td>
<td>12/1</td>
<td>10/4</td>
<td>10/2</td>
<td>16/7</td>
<td>48/14</td>
</tr>
<tr>
<td>Side scraper on flake</td>
<td>30/0</td>
<td>12/17</td>
<td>17/39</td>
<td>34/37</td>
<td>93/93</td>
</tr>
<tr>
<td>End scraper on plat. spall</td>
<td>5/0</td>
<td>2/0</td>
<td>0/0</td>
<td>0/0</td>
<td>7/0</td>
</tr>
<tr>
<td>Side scraper on plat. spall</td>
<td>2/0</td>
<td>3/0</td>
<td>0/0</td>
<td>0/0</td>
<td>5/0</td>
</tr>
<tr>
<td>Combination scraper</td>
<td>18/2</td>
<td>15/19</td>
<td>13/21</td>
<td>44/35</td>
<td>90/77</td>
</tr>
<tr>
<td>Other scraper</td>
<td>2/0</td>
<td>1/1</td>
<td>3/0</td>
<td>2/4</td>
<td>8/5</td>
</tr>
<tr>
<td>Scraper frag.</td>
<td>7/1</td>
<td>12/5</td>
<td>12/3</td>
<td>31/18</td>
<td>62/27</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>108/7</strong></td>
<td><strong>97/66</strong></td>
<td><strong>85/104</strong></td>
<td><strong>162/128</strong></td>
<td><strong>452/305</strong></td>
</tr>
<tr>
<td><strong>Percent total</strong></td>
<td><strong>93.9%/6.1%</strong></td>
<td><strong>95.9%/4.1%</strong></td>
<td><strong>45%/55%</strong></td>
<td><strong>55.9%/44.1%</strong></td>
<td><strong>59.7%/40.3%</strong></td>
</tr>
</tbody>
</table>

\(^a\) H=Huweijir flint, NH=Non-Huweijir flints and cherts.
As in the other assemblages, recycling and related behaviors are not well represented in the Yarmoukian.

**Summary of Findings from the Scraper Assemblage**

During all periods, scrapers were produced more often on flakes than on blades, and no preference for a particular blank form is apparent. In accordance with the findings of Rollefson et al. (1994), no clear change in the frequency of certain scraper types is apparent in this analysis. Additionally, their relatively consistent presence through time suggests the activities for which they were used remained important throughout the occupation of the town, which appears to have been the case at other multicomponent sites in the southern Levant (Crowfoot Payne 1983; Gopher 1989b; Simmons et al. 2001).

In the scraper assemblage, most appear to have been made when needed, with little time or effort put into production. Most scrapers were not hafted, as they show little regularity in size and form. Another aspect of the scraper assemblage that shows the expedient nature of these tools is the low incidence of recycling. Moreover, the low incidence of conservation-related behaviors suggests ample access to flake blanks, which were available either as debitage from workshop areas or from household core reduction. Finally, resource material quality does not seem to have been a big consideration, and Huweijir flint decreases in use after the MPPNB, when it generally became less available.
DENTICULATES AND NOTCHES

Both denticulates and notches are recognized in varying quantities in nearly every site report from the Neolithic period of the southern Levant\(^\text{11}\). Despite their ubiquity in site assemblages, little standardization exists in the classification of types. At several sites, numerous notch and denticulate types are distinguished (e.g., at Yiftahel [Garfinkel et al. 2012:90, 163]; Tel ‘Ali [Garfinkel 1994:554-556]; Munhata [Gopher 1989b:63-64]); while at others, only the two types—denticulates and notches—are mentioned (Mortensen 1970:36-38; Galili et al. 1993:141; Gebel and Bienert 1997:242-246; Simmons et al. 2001:10-12; Simmons and Najjar 2003:418; Khalaily et al. 2003:38-40; Peterson 2004:10). Given that these are expedient tools, the lack of standardization in types is not surprising, nor is it entirely necessary, as tools that lack standardization in production and use will also lack standardized features that allow them to be assigned to meaningful types.

Identification of informal tools such as notches and denticulates is further complicated by effects such as trampling. Controlled experiments suggest trampling causes damage that can be misidentified as retouch, and in fact, this “retouch” can be continuous enough to be mistaken as a tool (Flenniken and Haggarty 1979; Gifford-Gonzales 1985; McBrearty et al. 1998). Because, notched and denticulated “tools” are easily created by trample damage (McBrearty et al. 1998:124-25), caution is necessary in

\(^{11}\) For example, Munhata (Gopher 1989b:63,120); Atlit-Yam (Galili et al. 1993:141); Tel ‘Ali (Garfinkel 1994:553); Wadi Shu’eb (Simmons et al. 2001:11); Abu Thuwwab (Kafafi 2001:118); Ghwair (Simmons and Najjar 2003); Khirbet Hammam (Peterson 2004:10); and El-Hemmeh (Makarewicz et al 2006).
the identification of such tools, and in any interpretation of site function based on their presence.

**Function of Denticulates and Notches**

Compounding the difficulties in identification, the function of notches and denticulates is not always clear, which is not surprising given their generally expedient nature. Work by Yamada (2000:164-165; 175) identified use-wear on both classes from Nahal Issaron, and indicated that notches and some denticulates were used for antler/bone working, but some pieces also contained polishes indicative of hide scraping and woodcutting. He concluded there was some clear change in their use through time at Nahal Issaron, but it was unlikely that this tool category had any specific common function (Yamada 2000:338-339). This conclusion was supported by the work of Verhoeven (1999:151-152), who examined a late Neolithic tool assemblage from Tell Sabi Abyad in Syria for microwear traces of use. Among the analyzed tools were several denticulates and notches, which appear to have use-wear from a variety of different tasks including hide processing, woodworking, perhaps to cut reeds for mats or arrowshafts. In both use-wear examinations, numerous denticulate and notched tools show no detectable traces of use. Nevertheless, these studies demonstrate that notches and denticulates are multipurpose tools used in a variety of tasks that would have occurred on a daily basis.

**Types Used for Analysis**

Beyond a brief mention and basic frequency results in excavation season reports and articles (e.g., Rollefson et al. 1992), no significant research has yet been devoted to
denticulates and notched tools from ‘Ain Ghazal. I present only the two types, denticulates and notches, although I draw some insight from descriptions provided by Mortensen (1970), Crowfoot Payne (1983), and Gopher (1989b). Denticulates are any pieces with an edge characterized by large serrations or “teeth” shaped by percussion, and much less often, abrupt pressure flaking. Notches are tools with abrupt retouch creating a small concavity along a portion of a margin. Some tools classified as notches have two or more such elements along the margins of the flake or blade, which are noted but not given a subtype characterization (e.g., double-notch).

Analysis of Denticulates

As indicated in Table 6.5, denticulates were uncommon in every period (only 34 tools in total) at ‘Ain Ghazal. No use-wear analysis has been conducted on any of denticulate tools, but it seems likely that they had numerous functions, and were made and used when needed. Furthermore, their expedient nature is indicated by the variation in blanks and resource material used. For instance, blanks consisting of blades from naviform cores are only present in the PPNB assemblages, and in general, flakes are more frequent blanks. Accordingly, Huweijir flint is common in the MPPNB and LPPNB sample, and not present in the PPNC or Yarmoukian samples. Furthermore, the casual nature of blank selection and the easy availability of flakes through scavenging or household production likely contributed to the absence of conservation-related behaviors including recycling. Overall, denticulates are expedient in nature with little concern for blank choice or resource material.

12 Although they are most common in the LPPNB, the population was also greatest at that time.
Table 6.5. Denticulate attributes by period

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>Mixed</th>
<th>PN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denticulates</td>
<td>4 (11.8%)</td>
<td>20 (58.8%)</td>
<td>3 (8.8%)</td>
<td>5 (14.7%)</td>
<td>2 (5.9%)</td>
<td>34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource material</th>
<th>Huweijir</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MPPNB</td>
</tr>
<tr>
<td>Huweijir</td>
<td>4 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technology</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>Mixed</th>
<th>PN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naviform</td>
<td>2 (50%)</td>
<td>5 (25%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>7</td>
</tr>
<tr>
<td>Blade</td>
<td>1 (25%)</td>
<td>4 (20%)</td>
<td>0 (0%)</td>
<td>1 (20%)</td>
<td>2 (100%)</td>
<td>8</td>
</tr>
<tr>
<td>Flake</td>
<td>1 (25%)</td>
<td>11 (55%)</td>
<td>2 (66.7%)</td>
<td>3 (60%)</td>
<td>0 (0%)</td>
<td>17</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (33.3%)</td>
<td>1 (20%)</td>
<td>0 (0%)</td>
<td>2</td>
</tr>
</tbody>
</table>

a Distribution of total assemblage by period. b Total and percentage calculated for each chronological period sample.

Analysis of Notches

Although notches are not frequent in any period, they are especially few in the MPPNB and high in the LPPNB, a pattern that may well be an effect of the small sample size (Table 6.6). As with the denticulates, the notches at ‘Ain Ghazal may have been multipurpose tools used for working bone, antler, shell, soft stone, and wood (as spokeshaves\(^{13}\)), activities that would have been consistent throughout the occupation of the site. Generally, at ‘Ain Ghazal, as at other southern Levantine sites\(^{14}\), notches tend to be more common than denticulates.

Among the notch sample, used blades from naviform cores as blanks for production occurs only in the PPNB assemblage. Overall, notches were made mainly on flakes, which likely accounts for the lack of continual reuse or recycling into or from other tools, and suggests little emphasis on conservation. Huweijir flint representation is highest in the MPPNB and reaches its lowest point in the PPNC, increasing some in the

\(^{13}\) Notches may have been useful for the preparation of arrow and dart shafts of phragmites (common to the spring environments found in most villages) or Tamarix (very durable and native to the Near East).

\(^{14}\) For example, Munhata (Gopher 1989b:63,120); Tell ‘Ali (Garfinkel et al. 1993:141); Abu Thuwwab (Kafafi 2001:118); and Wadi Shu’eib (Simmons et al. 2001:11).
Table 6.6. Notch attributes by period.

<table>
<thead>
<tr>
<th>Tool Type(\text{a})</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Mixed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notches</td>
<td>12 (9%)</td>
<td>48 (36.1%)</td>
<td>25 (18.8%)</td>
<td>27 (20.3%)</td>
<td>21 (15.8%)</td>
<td>133 (100%)</td>
</tr>
</tbody>
</table>

| Resource material\(\text{b}\) | |
|-----------------------------|-------|---------------------------------|
| Huweijir                    | 10 (83%) | 34 (70.8%) | 6 (24%) | 12 (44.4%) | 8 (38.1%) | 70 (52.6%) |

| Technology\(\text{b}\) | |
|------------------------|-------|------------------------|
| Naviform               | 2 (16.7%) | 9 (18.8%) | 0 (0%) | 0 (0%) | 0 (0%) | 11 (8.3%) |
| Blade                  | 1 (8.3%) | 9 (18.8%) | 5 (20%) | 4 (14.8%) | 8 (38.1%) | 27 (20.3%) |
| Flake                  | 9 (75%) | 28 (59.3%) | 20 (80%) | 22 (81.5%) | 12 (57%) | 91 (68.4%) |
| Other                  | 0 (0%) | 2 (4.2%) | 0 (0%) | 1 (3.7%) | 1 (4.8%) | 4 (3%) |

\(\text{a}\) Distribution of total assemblage by period. \(\text{b}\) Total and percentage calculated for each chronological period sample.

Yarmoukian. Taken together, it is obvious that few material or blank constraints were important in notch manufacture, conforming to expectations for expedient tools.

RETOUCHED AND USED FLAKES AND BLADES

Numerous tools do not fit into the recognized categories for either formal or informal tools. The largest of these indefinite categories at most sites is that of retouched and used flakes and blades, which is because it is a broad category. At many sites, this category includes knives made on blades and flakes. For instance, Yamada (2000:152-155) examined several retouched blades from PPNB Kfar HaHoresh.

Function of Retouched Pieces

Given the ambiguous nature of retouched and used flake and blade tools, it is unlikely there was any common function among them, and in fact, use-wear studies on such tools suggest they served numerous functions (Unger-Hamilton 1988). For instance, Yamada (2000:152-155) examined several retouched blades from PPNB Kfar HaHoresh.

For instance, several of the following site reports have either no knife category or they only identify bifacial knives: Khalaily et al. (2003) for Abu Gosh; Peterson (2004) for Khirbet Hammam; Garfinkel et al. (2012) for Yiftahel; Galili et al. (1993) for Atlit-Yam; Garfinkel (1994) for Tell ‘Ali.
and based on the presence of coarse scratches argued that the blades were used to cut hard material, which could have been plant, wood, or bone/antler. Two additional blades appear to have been used for processing some kind of mineral material. Additionally, Yamada (2000:172-173) examined 13 retouched blades from Nahal Issaron I, and found that all of them had polish consistent with use on bone/antler and dry hide. Despite the difficulty in classifying these expedient types, such tools would have been necessary on a daily basis and would have been made and used by most inhabitants throughout the occupation of ‘Ain Ghazal.

No previous research has been conducted on retouched and used flakes and blades at ‘Ain Ghazal. Additionally, since they are not well-defined types, the description includes any flake or blade with edge modification consistent with retouch and/or use-wear along a portion of any margin that does not clearly fit into the other known types.

Retouched and Used Pieces

The MPPNB and LPPNB samples comprise the bulk of the used and retouched blade sample of 693 items. This figure may in part result from the larger analyzed sample from these two periods, but blades are also just less common in the PPNC and PN assemblages. As demonstrated in Table 6.7, Blades from other technologies comprise the majority of the blanks in the LPPNB, PPNC, and Yarmoukian samples. Somewhat irregular, triangular, and trapezoidal blades are the most represented forms. But overall, this tool category includes a greater range of blade types than is found among formal
Table 6.7. Resource material and blank technology for used and retouched blades.

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Mixed/ Transitional</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blade tool total</td>
<td>157 (22.7%)</td>
<td>341 (49.2%)</td>
<td>86 (12.4%)</td>
<td>82 (11.8%)</td>
<td>27 (3.9%)</td>
<td>693 (100%)</td>
</tr>
<tr>
<td>Resource material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir total</td>
<td>150 (95.5%)</td>
<td>285 (83.6%)</td>
<td>63 (73.3%)</td>
<td>67 (81.7%)</td>
<td>19 (3.3%)</td>
<td>584 (84.3%)</td>
</tr>
<tr>
<td>Blank type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naviform blades</td>
<td>104 (66.2%)</td>
<td>115 (33.7%)</td>
<td>7 (8%)</td>
<td>17 (20.7%)</td>
<td>4 (14.8%)</td>
<td>247 (35.6%)</td>
</tr>
<tr>
<td>Other blades</td>
<td>53 (33.8%)</td>
<td>225 (66%)</td>
<td>79 (92%)</td>
<td>65 (79.3%)</td>
<td>23 (8.5%)</td>
<td>445 (64.2%)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0%)</td>
<td>1 (0.3%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (0.1%)</td>
</tr>
</tbody>
</table>

*a* Percentage of total assemblage by period. *b* Total and percentage calculated for each chronological period sample. *c* One obsidian pressure blade with use-wear.

tool categories, and includes the consistent use of crested blades, ridge-straightening blades, error-correction blades, and occasional platform spalls. Recycling is infrequent among these tools, further indicating they were opportunistically produced and used, with only two recycled pieces observed from the MPPNB and LPPNB and one piece from the PPNC. Finally, Huweijir flint is the preferred resource material in all assemblages. It was most commonly used in the MPPNB, least commonly used in the PPNC, and somewhat more favored again in the Yarmoukian period. This too is the case for blades from naviform cores.

As indicated in Table 6.8, the LPPNB assemblage includes the greatest number of used and retouched flakes, which likely is a result of both an increased reliance on flake blanks and the larger sample from this period. In general, used and retouched flakes appear more common in the PPNC and Yarmoukian assemblages than used and retouched blades, which coincides with the generally lower representation of blades in

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16 The small increase in Huweijir flint and blades from naviform cores likely is associated with the pit digging that was common during the Yarmoukian period (G. Rollefson, personal communication 2013).
Table 6.8. Distribution of used and retouched flakes by period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Flakes</th>
<th>Huweijir&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPNB</td>
<td>93 (14.6%)</td>
<td>86 (92.5%)</td>
</tr>
<tr>
<td>LPPNB</td>
<td>248 (39%)</td>
<td>137 (55.2%)</td>
</tr>
<tr>
<td>PPNC</td>
<td>161 (25.3%)</td>
<td>55 (34.2%)</td>
</tr>
<tr>
<td>PN</td>
<td>104 (16.3%)</td>
<td>54 (51.9%)</td>
</tr>
<tr>
<td>Mixed/Trans</td>
<td>31 (4.9%)</td>
<td>20 (64.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>637 (100%)</td>
<td>352 (55.3%)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Percentage of Huweijir flint in each chronological period sample and overall.

the later periods (Rollefson 1996a). Huweijir flint is much less frequent, and is found in the highest proportion in the MPPNB assemblage and lowest in the PPNC, increasing somewhat in the Yarmoukian. Overall, however, there is less emphasis on high-quality resource material among used and retouched flakes<sup>17</sup>. When the flake type was identifiable, flakes with single-facet platforms were the most frequent blanks, which coincides with the prominence of these flakes among the debitage assemblage. Additionally, this pattern gives evidence for regular reduction of single- or multiple-platform cores to produce flakes for use as tools in households. Finally, in accordance with the expedient nature of these tools, recycling and related behaviors were infrequent.

**CHAMFERED-BIT TOOLS**

Chamfered-bit tools are known from Upper Paleolithic sites in the Levant (Newcomer 1988), but they are also common in the earlier part of the PPNB period. Crowfoot Payne (1983:694) identified chamfered-bit tools or tranchet-blade tools, as well as spalls from the creation and resharpening of these tools at PPNB Jericho. Similarly,

<sup>17</sup> It is worth comment that the generally greater representation of Huweijir flint among used and retouched blades is primarily because blades (both from naviform core reductions and other strategies) necessitate a higher quality resource material for consistent production, whereas flakes do not.
Gopher (1989b:68-72) noted the presence of chamfered-bit tools and bit spalls at MPPNB Munhata. At PPNB Yiftahel, however, chamfered-bit tools were not designated as their own category, but Garfinkel et al. (2012:89-90) suggested that the transverse burin type may instead be chamfered-bit tools. This reasoning may be why chamfered-bit tools rarely are mentioned in MPPNB site reports\(^\text{18}\). Similarly, few LPPNB and PPNC site reports include specific mentions of chamfered-bit tools\(^\text{19}\). They are present, however, in the Pottery Neolithic layers at the site of Nahal Zehora 1 (Gopher and Orrelle 1989:71), but not at Pottery Neolithic Ashkelon (Perrot and Gopher 1996), Abu Thuwwab (Kafafi 2001:118), Munhata (Gopher 1989b), and Jericho (Crowfoot Payne 1983). Despite the general lack of specific documentation of chamfered-bit tools in many Neolithic site reports, it seems from the limited data that they were more common in the earlier parts of the PPNB, but are also found in small numbers in the late Neolithic.

Newcomer (1988:301) discussed the potential function of chamfered-bit tools as specialized cutting or scraping implements. Crowfoot Payne (1983:694) proposed that visible use-wear along the bit indicated they were used in the same direction as an end scraper. She argued that a scraper edge produced in this way would be sharper, and could be easily resharpened by a second tranchet blow. Moreover, the sharp bevel of the bit supports an adzing or scraping function, and for the production of wooden vessels such as

\(^{18}\) For instance, no mention of chamfered-bit tools is made in the Abu Gosh report, but transverse burins are the most numerous burin type, so it is possible chamfered-bit tools are present but not recognized as such (Khalaily et al. 2003). Additionally, no mention is made of chamfered-bit tools at MPPNB Ghwair (Simmons and Najjar 2003) or in the MPPNB layers at Wadi Shu‘eib (Simmons et al. 2001).

\(^{19}\) LPPNB/PPNC reports lacking mention of chamfered-bit tools include: Nissen et al. (1987) for Basta; Galili et al. (1993) for Atlit-Yam; Garfinkel (1994) for Tel ‘Ali; Mahasneh (1997) for Es-Sifiya; Simmons et al. (2001) for Wadi Shu‘eib; Peterson (2004) for Khirbet Hammam; and Makarewicz et al. (2006) for El-Hemmeh.
bowls and boxes (e.g., the wooden box from Beidha [Mortensen 1980]), a combination of scoring, shredding, and scraping after burning with hot coals would be a practical and efficient production method. Despite the lack of certainty in the function of these tools, it is possible some chamfered-bit tools may have been hafted, as has been identified at Neolithic sites in Europe\textsuperscript{20}. Whether or not they were hafted, the fact that they could be resharpened easily indicates they were tools regularly kept in a working condition for an extended period of time.

**Previous Research and Identification Issues**

No previous research at ‘Ain Ghazal has focused on chamfered-bit tools, so Crowfoot Payne’s (1983:694) and Newcomer’s (1988:299-300) assessments guide the identification of them in this analysis. Chamfered-bit tools are fashioned by the removal of a small tranchet flake across the distal or proximal end of a flake or more often a blade. This removal creates a small beveled bit with an acute edge angle. At ‘Ain Ghazal, the bits of such tools often have use-wear, and show signs of prior bit rejuvenation removals.

As mentioned above, some crossover exists between the categories of transverse burins and chamfered-bit tools. For instance, some tools that appear to be transverse burins have use-wear more consistent with that observed on chamfered-bit tools. Furthermore, the detachment of transverse burin spalls was often achieved in a similar way as chamfered-bit spalls. To further confound matters, transverse burinations occasionally were used to trim knives or sickle elements for hafting. Since distinguishing

\textsuperscript{20} For instance, Bocquet and Noël (1985:34) found evidence that chamfered-bit tools were hafted in wood handles.
tool types by form alone was sometimes uncertain, the presence and positioning of use-wear was used here whenever possible to distinguish between these three categories. Newcomer (1988) and Crowfoot Payne (1983) also discussed these issues.

**Blank Choice and Recycling of Chamfered-Bit Tools**

The total sample of chamfered-bit tools examined here numbers 147 pieces, and as indicated in Table 6.9, they were most common in the MPPNB. Blades are the preferred blanks, and in the PPNB assemblages, blades from naviform cores were favored (Plate 6.7). Specifically, trapezoidal blades from naviform cores are more numerous in the MPPNB (n=42) and the LPPNB (n=12) samples, but this preference is not well expressed among blade blanks from other core-reduction strategies, nor is any particular flake type more common among flake-based blanks. As a result of the blank preferences, Huweijir flint is the preferred resource material across all of the period assemblages.

In general, among chamfered-bit tools, clear indications of recycling into or from other tools are few with only about 3% (n=3) of the MPPNB sample and 3.5% (n=1) of the LPPNB sample demonstrating unmistakable signs of recycling. The PPNC and Yarmoukian samples each have one piece with obvious signs of recycling. Interestingly, the incidence of resharpening appears to have been high, as rejuvenating spalls are well represented in the chamfered-bit spall assemblage (see Table 7.10 in Chapter 7).

---

21 If the use-wear is present mainly on the tip of the burin (the intersection of the lateral margin and the burinated edge), then it was classified as a transverse burin. If the use-wear is along the entire burinated edge (as if it had been used for cutting or scraping), then it was classified as a chamfered-bit tool.
Plate 6.7. Examples of chamfered-bit tools. Bit ends are up. Top right is made on a platform spall, the rest are on blades.

Table 6.9. Chamfered-bit tool attributes by period.

<table>
<thead>
<tr>
<th>Tool Type a</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Mixed/ Transitional</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamfered</td>
<td>104 (70.7%)</td>
<td>27 (18.4%)</td>
<td>5 (3.4%)</td>
<td>6 (4.1%)</td>
<td>5 (3.4%)</td>
<td>147 (100%)</td>
</tr>
<tr>
<td>Resource material b</td>
<td>Huweijir</td>
<td>104 (100%)</td>
<td>23 (85.2%)</td>
<td>5 (100%)</td>
<td>4 (66.7%)</td>
<td>140 (95%)</td>
</tr>
<tr>
<td>Technology b</td>
<td>Naviform</td>
<td>69 (66.3%)</td>
<td>13 (48.1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (20%)</td>
</tr>
<tr>
<td></td>
<td>Blade</td>
<td>19 (18.3%)</td>
<td>7 (25.9%)</td>
<td>4 (80%)</td>
<td>3 (50%)</td>
<td>2 (40%)</td>
</tr>
<tr>
<td></td>
<td>Flake</td>
<td>16 (15.4%)</td>
<td>7 (25.9%)</td>
<td>0 (0%)</td>
<td>3 (50%)</td>
<td>2 (40%)</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (20%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

a Percentage of total assemblage by period. b Total and percentage calculated for each chronological period sample.
Summary of Findings from the Chamfered-Bit Tool Assemblage

While they were relatively abundant during the MPPNB, chamfered-bit tools became less common in the later Neolithic at ‘Ain Ghazal, which accords with the patterns observed at other sites in the southern Levant. This finding suggests a decline in the tasks for which they were commonly used. They may have been some type of scraper/knife implement (as suggested by Newcomer 1988) that was replaced by the other categories of scrapers and knives starting in the LPPNB. It is also possible they were a light woodworking tool, perhaps replaced by chisels, which had durable ground bits and longer use-lives. Alternatively, as suggested above, transverse burins decline in representation at the same time as chamfered-bit tools, perhaps they were used together or they represent variations of the same type of tool. Most likely, they were affected by the same types of constraints, such as blank availability, which certainly had an impact, as most chamfered-bit tools were made on blades from naviform cores in the MPPNB. It is likely that as such blades became less available, chamfered-bit tools (and transverse burins) also declined. But until we more fully understand their function and the tasks for which they were used, other potential causes of their decline are still not entirely clear.

COMBINATION TOOLS

Combination tools, or multiple-task tools are recognized as their own category in a few site reports (e.g., Yiftahel [Garfinkel et al. 2012:168]; Abu Gosh [Khalaily et al. 2003: 35]), but even when they are distinguished as a separate category, little concurrence in what the category includes is apparent. For instance, at Abu Gosh,

22 The decline of chamfered-bit tools, however, is not plainly coincident with an increase in chisels.
multiple-task tools seem to include recycled tools (e.g., sickles recycled as burins) and combination tools (such as scrapers plus another ad hoc tool) (Khalaily et al. 2003:35). At Yiftahel, however, multiple-task tools were separated from recycled tools and included burins plus notches and denticulates, and retouched flakes plus perforators (Garfinkel et al. 2012:168). At ‘Ain Ghazal combination tools include any pieces that appear to have been used for multiple functions (e.g., as both an end scraper and a knife), which is interpreted here to be different from recycling\textsuperscript{23}, where the tool had one function and was then repurposed for another use (e.g., from a sickle element to a projectile point).

At ‘Ain Ghazal, combination tools are present consistently throughout each period (Table 6.10), but they are most frequent in the MPPNB and least frequent in the PPNC assemblages. The latter is most likely an effect of overall sample size. During the PPNB, many of these combination tools included a chamfered-bit tool or burin combined with a knife or scraper. In fact, during the MPPNB, about 51\% of the proximal treatments and 41\% of the distal treatments included a transverse burin spall or chamfered-bit spall removal. This combination of functions was not common in the PPNC or Yarmoukian.

Huweijir flint and blades from naviform cores are best represented in the MPPNB assemblage. In general, blade blanks for combination tools were more frequent than flake blanks in the PPNB periods, which follows the same general pattern found among the other expedient tools.

\textsuperscript{23} A small number of combination tools, however, do show signs of recycling. From the MPPNB four pieces retain signs of probable recycling and one piece each from the LPPNB and PPNC.
Table 6.10. Combination tool attributes by period.

<table>
<thead>
<tr>
<th>Tool Type(^a)</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Mixed/ Transitional</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combination tools</td>
<td>39 (35.8%)</td>
<td>28 (25.7%)</td>
<td>7 (6.4%)</td>
<td>15 (13.8%)</td>
<td>20 (18.3%)</td>
<td>109 (100%)</td>
</tr>
<tr>
<td>Resource material(^b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>36 (92.3%)</td>
<td>21 (75%)</td>
<td>3 (43%)</td>
<td>10 (66.7%)</td>
<td>13 (65%)</td>
<td>83 (76%)</td>
</tr>
<tr>
<td>Technology(^b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naviform</td>
<td>19 (48.7%)</td>
<td>9 (32%)</td>
<td>0 (0%)</td>
<td>3 (20%)</td>
<td>1 (5%)</td>
<td>32 (29.4%)</td>
</tr>
<tr>
<td>Blade</td>
<td>9 (23%)</td>
<td>9 (32%)</td>
<td>1 (14.3%)</td>
<td>3 (20%)</td>
<td>7 (35%)</td>
<td>29 (26.6%)</td>
</tr>
<tr>
<td>Flake</td>
<td>11 (28.2%)</td>
<td>10 (36%)</td>
<td>5 (71.4%)</td>
<td>9 (60%)</td>
<td>11 (55%)</td>
<td>46 (42.2%)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (14.3%)</td>
<td>0 (0%)</td>
<td>1 (5%)</td>
<td>2 (1.8%)</td>
</tr>
</tbody>
</table>

\(^a\) Percentage of total assemblage by period. \(^b\) Total and percentage calculated for each chronological period sample.

WOODWORKING TOOLS

In addition to the informal tools from ‘Ain Ghazal indicative of an array of production activities that occurred at the household level, we know that the inhabitants of Neolithic sites also exploited timber resources. To exploit these resources, Neolithic peoples used a suite of bifacial implements suited for both heavy and light woodworking. In the southern Levant, such woodworking implements, including axes, adzes, chisels, and picks, are well studied (e.g., Quintero 1998; Barkai 1998, 1999, 2001; Yerkes et al. 2003, 2012, 2014; Quintero and Hintzman 2007; Barkai and Yerkes 2008; Barkai 2011; Yerkes and Barkai 2013). They are found in varying quantities at numerous Neolithic sites starting in the PPNA, and their forms changed over time. The major difference between early PPN woodworking tools and those most commonly found in the MPPNB through the Chalcolithic is the treatment of the working end or bit. PPNA woodworking tools have bits shaped by tranchet removals (Cauvin 1968), and by the MPPNB, ground bits are the dominant form (Barkai 2005). Barkai (2005:18-20), who studied this tool
category at numerous sites in the southern Levant, discussed the relative merits of each type of working edge treatment, and suggested numerous explanations for the move from tranchet bits to ground bits. Chief among them is that a ground bit creates a durable, homogenous working edge, better suited for heavy-duty woodworking tasks. Heavy-duty tasks were especially prevalent in the PPNB, after which evidence of lighter woodworking tasks became more common (Quintero and Hintzman 2007; Barkai 2005; Barkai and Yerkes 2008; Barkai 2011; Yerkes et al. 2012, 2014; Yerkes and Barkai 2013).

At ‘Ain Ghazal, Hintzman and Quintero (2004) and Quintero and Hintzman (2007), examined a sample of axes, adzes, chisels, and picks from all periods of occupation. Their sample consisted of 80 axes, 30 adzes, 23 axe/adzes, 16 chisels, and 20 picks. They discussed the production strategies for the different tools and identified the presence of blanks, preforms, production failures, finished, and exhausted woodworking tools in domestic-related deposits from each period of occupation. Based on the changing frequency of certain tool forms, along with clear changes in the architecture and environment around the site, they concluded that the woodworking tool assemblage reflected the diminishing availability of timber resources through time. That is, during the MPPNB and LPPNB, the woodworking tool assemblage appeared oriented towards heavy-duty tasks such as tree felling to provide timber for house construction and fuel for plaster production. By the PPNC, changes in the architecture and environment (Rollefson and Köhler-Rollefson 1989) indicated that timber resources were becoming depleted, which was reflected in the woodworking tool assemblage as an increase in lighter woodworking tools, specifically, adzes and chisels.
Other studies conducted on woodworking assemblages in the southern Levant (Barkai 2005; Barkai and Yerkes 2008; Barkai 2011; Yerkes and Barkai 2013:228) have presented findings similar to those of Quintero (1998b) and Quintero and Hintzman (2007). These studies also recognized that axes appear to be most common during the MPPNB and LPPNB (and at some sites in the PPNC24), when larger rectangular structures with wooden beams, posts, and plastered floors were common. Likewise, they argued that the increase in tree felling during the PPNB may have depleted timber resources faster than they could rejuvenate. Deforestation coupled with climatic changes meant that large timber resources became scarce in the PPNC and PN. The scarcity of such resources in the vicinity of villages resulted in architectural changes and the reduced production or abandonment of the use of plaster on floors or walls (Rollefson and Köhler-Rollefson 1989; Rollefson et al. 1992). The degradation of timber resources also affected woodworking tools—axes declined, and adzes and chisels increased, suggesting a switch to lighter woodworking activities (Barkai and Yerkes 2008; Barkai 2011; Yerkes and Barkai 2013:228). In fact, in a comparison of the frequencies of axes, adzes, and chisels from the PPNA through the Chalcolithic periods, it appears that by the later PPNB, 75% of the bifacial tools were used for heavy work and 25% for carpentry and lighter work. Conversely, by the PN 70% of the bifacial tools were used for carpentry and 30% for heavy work such as tree felling (Barkai 2005, 2011; Barkai and Yerkes 2008; Yerkes et al. 2012, 2014:125-126; Yerkes and Barkai 2013:230).

24 For example, Atlit-Yam had heavy-duty woodworking tools such as axes in proportions similar to those in LPPNB sites, which is likely because it was a new site situated near a relatively undisturbed woodland area (Yerkes et al. 2014:125-126).
Clearly, woodworking tools were an important component of the Neolithic tool kit and were sensitive to changes in other facets of the economy. At sites such as ‘Ain Ghazal, the evidence indicates they were made in households. Furthermore, although they may be time consuming to produce, they do not require a high level of skill (Quintero and Hintzman 2007), so there is little reason to suggest that their production was a specialized industry at most Neolithic sites. However, some sites (Nahal Lavan 109, Nahal Hamearot, and Mesad Mazal) appear to have been devoted to the production of bifacial implements and other artifacts (arrowheads, beads, obsidian items). These sites are interpreted by some to have served production and dispersal of bifacial implements to other sites (Taute 1994; Barkai 2001; Barkai 2005; Schyle 2007).

**Woodworking Tool Types**

The approach used here relies mainly on the work of Quintero (1998) and Quintero and Hintzman (2007), who considered the production stages and use-life trajectories of each individual tool type. Many of the tools examined here were analyzed in their sample; therefore, to achieve comparable results, the analysis here considers the same types and common manufacturing choices. In addition to re-examining the 169 woodworking tools Quintero and Hintzman (2007) analyzed, the analysis here added 28 tools (including five axes, two adzes, 11 axe/adzes, seven chisels, two picks, and a bifacial wedge).

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25 Barkai (1998, 2001, 2005) also discussed the production and use-lives of these tools at Neolithic sites, but replicative work and research conducted on the woodworking tool assemblage at ‘Ain Ghazal had been underway for several years before the presentation of findings by Quintero in 1998.
Most of the resource material used for the production of woodworking tools at ‘Ain Ghazal was nodular, wadi-rolled, or bedded flint or chert varieties present in the immediate site vicinity. Huweijir flint was present, but only as a minor resource material. This pattern of tool stone use is associated with the function of these tools as woodworking implements, which necessitated durable resource materials.

**Axes**

Numerous use-wear studies suggest the primary function for ground-bit axes during the Neolithic was as heavy-duty woodworking tools used to fell trees and split logs (Olausson 1982; Yamada 2000; Yerkes et al. 2003; Barkai 2005; Barkai 2011; Yerkes et al. 2012; Yerkes et al. 2014). Small axes, however, may have been employed for finer work. Additionally, use-breaks denote the character of use (Olausson 1982; Yerkes et al. 2012), as heavy-duty tools incur damage more often and show catastrophic breaks more frequently. Despite abundant evidence of use on many axes, not all axes are considered utilitarian. Barkai (2005:38-39) noted the presence at many sites of extremely long axes and very small axes (votive axes), and argued that both forms are ceremonial in nature, with no evidence of use.

In production, most axes were shaped with bifacial flaking, followed by pecking of edges and pronounced arrises before the bit was ground (Plate 6.8). In plan-view the bit shape is most often rounded, and grinding is oriented either perpendicular or parallel to the bit. They are often thick on the hafted end and have a bit that is centered in cross section and convex in plan view (Quintero and Hintzman 2007:194). Most axes appear to have converging edges in plan view (n=43), but 21 are parallel-sided. The sizes of
complete axes presented in Table 6.11 display a large range in metrical attributes, but the average length of a complete axe is 98.5 mm. This large range in size may be because many axes were repeatedly resharpened, thus getting shorter throughout their use-lives. As with modern axes, they appear mostly to have been hafted with the bit edge parallel to the handle. Nevertheless, it is important to consider that this is not a universal hafting choice. For instance, in New Guinea, axe heads are hafted with the bit perpendicular to the haft (Toth et al. 1992).

**Adzes**

Adzes are considered more versatile tools than axes, and appear to have been used for a wider range of woodworking activities that included light chopping and shaving (Barkai 2005:46-47; Yerkes and Barkai 2013). As with modern adzes, they were hafted with the bit edge perpendicular to the handle, but as suggested for the axes, variation in the positioning of the tool in the haft is entirely possible (Toth et al. 1992). They are generally smaller in size than axes and can have a bit that is asymmetrical in cross section and straight to slightly convex in plan view (Plate 6.9). It is important to recognize that symmetry of the bit in cross section, however, is not a definitive indicator of function, that is, many factors can affect the profile of the bit and these do not affect function (see Quintero and Hintzman 2007:195). Similar to axes, adzes were shaped with bifacial percussion, followed by pecking and grinding of the bit. Replicative work showed that pressure flaking of the intended bit greatly reduced grinding time. Also, final grinding along the bit, rather than perpendicular to it, saved time (Philip J. Wilke, personal communication 2015). Adze bits are most often straight in plan view, but some are
slightly rounded. Where grinding is evident, the directionality is equally divided between parallel to the bit, and perpendicular to the bit. The shape of most adzes in plan view is converging at the edges, but some are parallel-sided. The average length of adzes (83.2 mm) is somewhat less than that of axes, but a wider range in all metrical attributes is apparent, which is expected given their greater versatility (Table 6.11).

### Axe/Adzes

As would be expected, axe/adzes are implements for which the distinction between the two is not clear, and thus, they share features in common with both functional categories Some are classed as axe/adzes because they are ambiguous in form, but in many cases, they are classified here because they are broken or incomplete and distinguishing between the two is impossible. The average length of complete specimens (81.15 mm) is closer to that of adzes, but variation in size is apparent (Table 6.11).

### Chisels

Chisels are generally narrower than axes and adzes and were mainly used for lighter woodworking chores, but some in other site assemblages appear to have other uses
Plate 6.8 Sample of preformed and finished axes from ‘Ain Ghazal.
Plate 6.9 Sample of preformed, finished, and broken adzes from ‘Ain Ghazal. Note the generally straight bit in comparison to axes.
including cutting meat or fresh hide (Barkai 2005:46-47; Yerkes and Barkai 2013:228-229). They were shaped with percussion flaking, followed by pecking, and grinding of the bit (Quintero and Hintzman 2007:195). When the bit is present, it usually is rounded in plan view, but some are pointed (Plate 6.10). Most chisels are parallel-sided. The average length of complete chisels is similar to that of axes, but chisels are much narrower in width, and like all of the other woodworking tools, they display a range of sizes (Table 6.11).

**Picks**

The function of picks is less clear; they may have been used for some woodworking activities, perhaps serving as wedges to split wood, but also likely were used in quarrying activities (Quintero and Hintzman 2007:195-196; Barkai 2005:44). They typically were percussion shaped, often with less effort put into production, and therefore are the least regular in form (Plate 6.11). Additionally, none of the picks reveal much evidence of grinding, so that production stage apparently was not necessary for the manufacture of these tools. Picks are on average longer than axes (120.67 mm), but substantial variation in all of the measurements is apparent (Table 6.11).

Following Quintero and Hintzman’s (2007:196-197) designations, blanks, preforms, finished pieces, and exhausted tools are the production and use-life stages considered in this analysis. Blanks are large, rough bifaces shaped with early-to-mid stage bifacial flaking, but without fine shaping or pecking. Preforms are those pieces that display late-stage bifacial flaking; some display evidence of the pecking of edges and
Plate 6.10 Sample of preformed, finished, and broken chisels from ‘Ain Ghazal.

Plate 6.11. An example of a pick tool. Note the lack of grinding.
arrises, but had not yet been ground. Production failures and breaks are also present, and most often they consist of bending breaks from end shock, or breaks that occur along impurities in the stone. In a few cases, the piece was too irregular or the knapper had made so many mistakes that production was abandoned. Finished woodworking tools have ground bits and appear to have been ready for use or in use. Finally, a woodworking tool is considered exhausted if it appeared no longer functional for its intended task, which may have been from use breaks or extensive use, failed resharpening events, or because its length was so reduced that it would have been difficult to haft securely.

**Distributional Analysis**

*Middle Pre-Pottery Neolithic B*

As indicated in Table 6.12, axes are the most common implements of this broad grouping in the MPPNB, followed by picks, suggesting an emphasis on heavy woodworking and perhaps quarrying and digging. The presence of preforms, production failures, and discarded specimens in domestic-related contexts indicates they were made and used in households. Recycling and reshaping modification is evident on eight specimens (42%) from MPPNB contexts. Six tools appear to have been recycled as flake cores (4 axes, 2 axe/adzes), one tool is a resharpened adze, and one is an axe reshaped as a chisel (Table 6.12).
Table 6.12. Assemblage attributes by type and period

<table>
<thead>
<tr>
<th>Types by Period</th>
<th>Blank</th>
<th>Preform</th>
<th>Finished Tools</th>
<th>Production Failure</th>
<th>Exhausted/Broken Tools</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPNB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axes</td>
<td>0 (0.0%)</td>
<td>1 (11.1%)</td>
<td>1 (11.1%)</td>
<td>2 (22.2%)</td>
<td>5 (55.6%)</td>
<td>9 (47.9%)</td>
</tr>
<tr>
<td>Adzes</td>
<td>0 (0.0%)</td>
<td>1 (33.3%)</td>
<td>1 (33.3%)</td>
<td>0 (0.0%)</td>
<td>1 (33.3%)</td>
<td>3 (15.8%)</td>
</tr>
<tr>
<td>Axe/Adze</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>2 (100%)</td>
<td>2 (10.5%)</td>
</tr>
<tr>
<td>Chisel</td>
<td>0 (0.0%)</td>
<td>1 (100%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>1 (5.3%)</td>
</tr>
<tr>
<td>Pick</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>4 (100%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>4 (21%)</td>
</tr>
<tr>
<td>Total (%)³</td>
<td>0 (0.0%)</td>
<td>3 (15.8%)</td>
<td>6 (31.6%)</td>
<td>2 (10.5%)</td>
<td>8 (42.1%)</td>
<td>19 (100%)</td>
</tr>
<tr>
<td>LPPNB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axes</td>
<td>1 (4.5%)</td>
<td>5 (22.7%)</td>
<td>7 (31.8%)</td>
<td>0 (0.0%)</td>
<td>9 (41%)</td>
<td>22 (42.3%)</td>
</tr>
<tr>
<td>Adzes</td>
<td>1 (11.1%)</td>
<td>4 (44.4%)</td>
<td>4 (44.4%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>9 (17.3%)</td>
</tr>
<tr>
<td>Axe/Adze</td>
<td>4 (44.4%)</td>
<td>0 (0.0%)</td>
<td>1 (11.1%)</td>
<td>1 (11.1%)</td>
<td>3 (33.3%)</td>
<td>9 (17.3%)</td>
</tr>
<tr>
<td>Chisel</td>
<td>2 (40%)</td>
<td>0 (0.0%)</td>
<td>2 (40%)</td>
<td>0 (0.0%)</td>
<td>1 (20%)</td>
<td>5 (9.6%)</td>
</tr>
<tr>
<td>Pick</td>
<td>1 (14%)</td>
<td>0 (0.0%)</td>
<td>3 (43%)</td>
<td>0 (0.0%)</td>
<td>3 (43%)</td>
<td>7 (13.4%)</td>
</tr>
<tr>
<td>Total (%)³</td>
<td>9 (17.3%)</td>
<td>9 (17.3%)</td>
<td>17 (32.7%)</td>
<td>1 (1.9%)</td>
<td>16 (30.8%)</td>
<td>52 (100%)</td>
</tr>
<tr>
<td>PPNC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axes</td>
<td>1 (7.1%)</td>
<td>3 (21.4%)</td>
<td>4 (28.6%)</td>
<td>2 (14.3%)</td>
<td>4 (28.6%)</td>
<td>14 (41.2%)</td>
</tr>
<tr>
<td>Adzes</td>
<td>0 (0.0%)</td>
<td>1 (25%)</td>
<td>1 (25%)</td>
<td>0 (0.0%)</td>
<td>2 (50%)</td>
<td>4 (11.8%)</td>
</tr>
<tr>
<td>Axe/Adze</td>
<td>2 (28.6%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>5 (71.4%)</td>
<td>7 (20.6%)</td>
</tr>
<tr>
<td>Chisel</td>
<td>0 (0.0%)</td>
<td>1 (33.3%)</td>
<td>0 (0.0%)</td>
<td>1 (33.3%)</td>
<td>1 (33.3%)</td>
<td>3 (8.8%)</td>
</tr>
<tr>
<td>Pick</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>2 (40%)</td>
<td>0 (0.0%)</td>
<td>3 (60%)</td>
<td>5 (14.7%)</td>
</tr>
<tr>
<td>Wedge</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>1 (100%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>1 (2.9%)</td>
</tr>
<tr>
<td>Total (%)³</td>
<td>3 (8.8%)</td>
<td>5 (14.7%)</td>
<td>8 (23.5%)</td>
<td>3 (8.8%)</td>
<td>15 (44.1%)</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>PN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axes</td>
<td>1 (4.5%)</td>
<td>6 (27.3%)</td>
<td>6 (27.3%)</td>
<td>0 (0.0%)</td>
<td>9 (40.9%)</td>
<td>22 (53.7%)</td>
</tr>
<tr>
<td>Adzes</td>
<td>0 (0.0%)</td>
<td>2 (50%)</td>
<td>1 (25%)</td>
<td>0 (0.0%)</td>
<td>1 (25%)</td>
<td>4 (9.7%)</td>
</tr>
<tr>
<td>Axe/Adze</td>
<td>3 (50%)</td>
<td>0 (0.0%)</td>
<td>1 (16.7%)</td>
<td>0 (0.0%)</td>
<td>2 (33.3%)</td>
<td>6 (14.6%)</td>
</tr>
<tr>
<td>Chisel</td>
<td>0 (0.0%)</td>
<td>2 (28.57%)</td>
<td>1 (14.3%)</td>
<td>1 (14.29%)</td>
<td>3 (42.85%)</td>
<td>7 (17%)</td>
</tr>
<tr>
<td>Pick</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>0 (0.0%)</td>
<td>2 (100%)</td>
<td>2 (4.9%)</td>
</tr>
<tr>
<td>Total (%)³</td>
<td>4 (9.8%)</td>
<td>10 (24.4%)</td>
<td>9 (22%)</td>
<td>1 (2.4%)</td>
<td>17 (41.4%)</td>
<td>41 (100%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>16 (10.9%)</td>
<td>27 (18.5%)</td>
<td>40 (27.4%)</td>
<td>7 (4.8%)</td>
<td>56 (38.4%)</td>
<td>146 (100%)</td>
</tr>
</tbody>
</table>

³Much of the sample on which these data are based is from the original paper by Quintero and Hinztman (2007), with additional data from more recent analysis added in.

Table 6.13. Recycled/reshaped tools by type and period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Axes</th>
<th>Adzes</th>
<th>Axe/Adze</th>
<th>Picks</th>
<th>Chisels</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPNB</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>LPPNB</td>
<td>9</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>PPNC</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>PN</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>6</td>
<td>14</td>
<td>0</td>
<td>2</td>
<td>46</td>
</tr>
</tbody>
</table>
Late Pre-Pottery Neolithic B

The LPPNB sample is considerably larger than the MPPNB sample and is comprised mainly of axes (Table 6.12). The type distributions are somewhat similar, except that picks are more common in the MPPNB assemblage, perhaps related to their use in quarrying activities, which may have been more prevalent in the MPPNB when the specialized production of naviform cores was more common. The larger LPPNB sample may be associated with the overall population growth of the site, resulting in a greater number of people engaging in heavy woodworking activities. The LPPNB assemblage also has a better representation of blanks and performs, and the majority of the tools are either finished, or exhausted/broken\(^{26}\), but as in the MPPNB, woodworking implements were made and used by most households. Recycling and reshaping of tools is well represented, and most woodworking tools were recycled as flake cores (n=9) or reshaped as axes (n=5), but two are resharpened adzes, one is a resharpened chisel, and one is an axe/adze reused as a pecking tool. Evidence of recycling or reshaping also was found in the debitage from the LPPNB. Six flakes appear to have removed a ground bit edge from an axe or adze and are indicative of either rejuvenation of the working edge or recycling into something else.

Pre-Pottery Neolithic C

The PPNC sample is smaller than the LPPNB sample, but as with the PPNB assemblages, axes predominate (Table 6.12). Proportionally, fewer adzes and chisels are

\(^{26}\) As was found among MPPNB woodworking tools, most of the exhausted specimens were broken or were damaged in use.
present than in the LPPNB assemblage, which may be associated with the decrease in population. The PPNC assemblage is the only one that has a bifacial wedge tool. The wedge tool was bifacially shaped and the working edge had crushing and flaking from use. Blanks, preforms, and production failures are present. As in the other assemblages, finished and exhausted tools are the most represented use-life stages. Recycling and reshaping are present on 20.6% of the assemblage (Table 6.13). Again, a common recycling trajectory is a tool reused as a flake core (n=3), but three axes and one adze also show signs of having been reworked. As in the LPPNB, the debitage sample includes some evidence of recycling or rejuvenation of woodworking tools in the form of flakes removed from ground bits.

*Pottery Neolithic*

The Yarmoukian sample also is dominated by axes. Adzes and picks are less represented than in previous periods, but chisels are more common, suggesting that while heavy woodworking continued, lighter woodworking increased\(^\text{27}\). The Yarmoukian period also has the highest proportion of preforms, but blanks and tools with manufacturing breaks are present in similar numbers compared to other periods, as are finished and exhausted tools. Additionally, the exhausted implements and evidence of their production are found in domestic contexts, indicating they continued to be made and used in households through the Yarmoukian.

\(^{27}\) A comparison of the average size of complete axes through time shows no clear pattern of change, and therefore, is not discussed.
Recycling and other behaviors consistent with tool conservation, such as resharpening, are common on about 31.7% of the assemblage. Unlike the situation in earlier periods, recycling tools into flake cores is not as well represented, with only three pieces showing this transformation (Table 6.13). Other recycling evidence consists of an axe/adze that was recycled into a burin, and the rest were resharpened tools: one resharpened chisel, two resharpened adzes, five resharpened axes, and one resharpened axe/adze. Perhaps the higher incidence of resharpening accounts for the lower number of woodworking tools recycled as cores in the Yarmoukian.

**Summary of Findings from the Woodworking Assemblage**

Quintero and Hintzman’s (2007) findings suggested that all woodworking tools were produced within individual households for their own use. They also found that axes are the predominant type in each period, indicating that heavy woodcutting continued to occur through the PN. The increase in lighter woodworking implements by the PN, however, suggested a greater emphasis on finer woodworking tasks, such as the production of bowls, boxes, handles, and shafts, than in previous periods. This pattern of change through time is associated with an apparent decline in large timber resources.

The analysis conducted here also found that axes are the most common woodworking tools in the ‘Ain Ghazal assemblage and in each period. Similarly, the changes in the frequency of adzes, chisels, and picks in the PPNC and Yarmoukian seem coincident with changes in woodworking needs through time. Additionally, in accordance with the findings from the Quintero and Hintzman analysis, this analysis provided additional evidence of on-site domestic-related production in the identification of more
preforms, production breaks, and associateddebitage\textsuperscript{28}, much of which came from both interior and exterior deposits that are consistent with debris from activity areas or trash dumps\textsuperscript{29}.

The patterns of change in woodworking implements through time at ‘Ain Ghazal generally accord with what is seen elsewhere in the southern Levantine Neolithic. Axes are the most common type throughout, and chisels increase in number in the PN. The commonality of axes is well attested at many PPN and PN sites\textsuperscript{30}. Additionally, at several PPN and PN sites, chisels are the second most common type\textsuperscript{31}, which is not the case at ‘Ain Ghazal until the PN. At all of these sites, ground-bit tools dominate, although tranchet-bit tools are present in small numbers at several PPN sites\textsuperscript{32}. All of these patterns suggest that some general accordance exists in the changes in woodworking tools through time across much of the southern Levant; however, some variation in production and the representation of certain types is also observable between sites.

\textsuperscript{28} In addition to the two LPPNB deposits with evidence of woodworking tool manufacture described by Quintero and Hintzman (2007:199), an additional MPPNB deposit containing debris consistent with the production of woodworking implements was included in this analysis (see Chapter 8 for more discussion).

\textsuperscript{29} Contextual information for the sample examined by Quintero and Hintzman (2007), as well as the 28 additional tools added in this analysis can be made available upon request.

\textsuperscript{30} For instance, PPNB Beisamoun (Lechevallier 1978); PPNB Yiftahel (Barkai 2005:134); PPNB Kfar HaHoresh (Barkai 2005:142); LPPNB El-Hemmeh (Makarewicz et al. 2006:197, 201); LPPNB Basta (Nissen et al. 1987:101); LPPNB Ba’ja (Gebel and Bienert 1997:242); PPNC Atlit-Yam (Barkai and Galili 2003; Barkai 2005:182); PPNC Ashkelon (Garfinkel and Dag 2001:342); PN Nahal Zehora II (Barkai 2005:199); PN Sha’ar Hagolan (Barkai 2005:189); and at multicomponent Wadi Shu’eib (Simmons et al. 2001:16).

\textsuperscript{31} For example, PPNB Yiftahel (Barkai 2005:134); PPNC Ashkelon (Garfinkel and Dag 2001:342); PPNC Atlit-Yam (Barkai and Galili 2003; Barkai 2005:182); PN Sha’ar Hagolan (Barkai 2005:189); and PN Nahal Zehora II (Barkai 2005:199).

\textsuperscript{32} For example, Jericho (Crowfoot Payne 1983:674); Yiftahel (Garfinkel et al. 2012:88,168); Beidha (Mortensen 1970:41-44); and PPNC Tel Ali (Garfinkel 1994:556).
Tool conservation strategies, including recycling and reworking are common in all periods, but are greatest in the LPPNB and least apparent in the PPNC. Recycling can be related to conservation of resource material in situations where the availability of suitable raw materials is low. It can also be an act of opportunism (Nelson 1991; Amick 2007). At ‘Ain Ghazal the resource material for the production of woodworking tools was readily available in the immediate site area; thus, scarcity is unlikely to have been the motivation for recycling. Opportunism seems to be the most reasonable explanation, as woodworking tools were thick (and sometimes long), and the quality of the resource material was good enough to shape into a tool in the first place, making such tools easy and attractive for recycling or resharpening. Furthermore, reworking and resharpening are common among formal (often hafted) tool types to extend the use-lives of tools that were already properly configured for hafting or for a specific function (e.g., chisels). Therefore, the reworking of woodworking implements at ‘Ain Ghazal and elsewhere (e.g., Barkai 1999, 2005) is not surprising.

HAMMERSTONES/PECKING TOOLS

Hammerstones and pecking tools are artifacts that show evidence of extensive battering from use as flintknapping hammerstones or pecking tools for dressing or finishing of other tools (e.g., milling stones used for grinding such as querns, hand stones, pestles, and axes) (Plate 6.12). They are noted in every Neolithic site assemblage, though

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33 Recycling and/or tool rejuvenation also are indicated in the debitage sample, as both the LPPNB and PPNC have flakes consistent with bit rejuvenation and/or tool recycling.
researchers generally do not distinguish between hammerstones and pecking stones. Abraders also are included in this database, as they often were employed along with hammerstones in reduction activities. Most of the tools come from domestic-related deposits implying that the production activities for which they were used occurred in households.

The entire sample of hammerstones and pecking stones analyzed here consists of 50 artifacts, many of which are pecking tools made from recycled cores. The MPPNB sample consists of 15 hammerstones and pecking stones and of these 10 were made from flake cores. The LPPNB sample is smaller, with two hammerstones/pecking stones, one
hammerstone/abrader, and two abraders. In contrast to the MPPNB, none of these tools was fashioned on cores. The resource materials, however, were also quite diverse, and include Huweijir flint, sandstone, fossil-rich limestone, and bedded flint from the immediate site vicinity.

The PPNC sample comprises 12 artifacts, including 11 hammerstone/pecking stones and one hammerstone tested for core use. Three of the hammerstone/pecking tools were made from flake cores. All of the resource material in the PPNC sample is bedded and wadi-rolled flint or chert present in the immediate site area. The Yarmoukian assemblage includes 11 hammerstone/pecking tools, six of which were fashioned from cores. The stone resources included silicified limestone and bedded or wadi-rolled flint. The remaining seven hammerstones/pecking tools are from mixed contexts.

This assemblage is not large, so the observations here are necessarily preliminary. Nonetheless, recycling was common, as many of the hammerstones and pecking stones were once cores. It is also obvious that the resource materials were more diverse than among other tool categories, but the rough bedded and wadi-rolled flints and cherts available in the immediate site vicinity were the most common. These are generally durable and therefore best suited for use in hammering or pecking. Although some of these tools appear to have been hammerstones for flaking stone, the vast majority appear to have been pecking implements and may well have been used in the production and maintenance of millstone equipment and possibly for pecking arrises in the production of axes and related tools. The apparently low representation of hammerstones suitable for blade-core reduction and flaked-tool manufacturing may indicate that such hammerstones
are more difficult to identify in the archaeological record. Flintknapping hammerstones for these purposes may have been small nodules of flint with heavy cortex to soften the blow. It is also possible that after exhaustion as a hammerstone, they were reduced as cores or otherwise reused for other purposes.

**SUMMARY**

The more informal tool categories including scrapers, denticulates, notches, used and retouched pieces, and combination tools are all of a multifunctional nature, lacking clear association with a specific task. They represent expedient tools produced on a more opportunistic basis, with few indicators of manufacturing preferences for any particular blank type. Due to their expedient nature, however, they reflect some changes in resource material availability. As high-quality tool stone became scarce for flake-core reduction and blank production, people quickly turned to stone resources that were most easily available for continued production of these tools. Additionally, the number of informal tools made on flakes increased through time, which likely is tied to the cessation of the specialized production of naviform cores and blades.

Some exceptions to the informal tool pattern exist, however, and these are tools more often made on blades, including transverse types and chamfered-bit tools. These tools decline in numbers after the MPPNB, and this seems to be at least partially associated with the decline in availability of blades from naviform cores. Along with changes in the accessibility of blades, tool needs may have also changed through time. As suggested by Rollefson (1995), the decline in transverse burins coincided with a shift away from woodland resources to more xeric resources. The coincident decline of
chamfered-bit tools, suggest they also may have been associated with woodland resources, perhaps as tools used for light woodworking.

As transverse burins and chamfered-bit tools declined in number through time, burins-on-breaks remained present in consistent quantities, and concave-truncation burins increased. These patterns may have been associated with the appearance of pastoralism in the southern Levant and a greater need for spalls as inserts in composite tools, such as bead drills and wool combs (Rollefson 1995; Quintero et al. 2004). Dihedral burins decline some in the later periods, but remain present until the PN, suggesting a continued, if somewhat diminished, presence of the tasks for which they were used (most likely working of wood, bone, and antler).

When compared to other southern Levantine sites, many of the informal tool categories are present in relatively consistent numbers through time, but given the unstandardized nature of many of the types and the lack of a common function, variation between sites in the frequency of some of these tool classes is difficult to interpret without use-wear studies. Among the more “formal” of the informal tools, including some burins and chamfered-bit tools, the variation between sites appears meaningful and may have been related to an emphasis on different subsistence activities through time.

Production of woodworking tools did not rely on Huweijir flint, or on products from specialized production, so these items were not impacted by changes in those facets of the lithic economy. Rather, the greatest source of variation in the proportions of axes, adzes, chisels, and picks appears to have been linked to environmental changes and
resource scarcity (in this case timber), a pattern observed broadly in the Neolithic of the southern Levant.

The hammerstone/pecking stone assemblage, though not large, demonstrates that such implements consistently were essential tools through time, indicating also that flaked-stone and millstone production and maintenance occurred in domestic-related contexts throughout the occupation.

Evidence of production, use, discard, and reuse of informal, woodworking, and hammer/pecking tools is widespread in domestic-related deposits, attesting to the fact that these tools were all made and used in individual households throughout the occupation of the town. Additionally, among a few of the informal tool types, a difference in the representation of Huweijir flint between the early and late LPPNB implies that the availability of that flint declined sharply during the course of the LPPNB. Taken with other data in the assemblage, this interpretation supports findings from the formal tool assemblage that some of the patterns commonly associated with the PPNC (Rollefson 1990a) started in the later part of the LPPNB. Clearly, as this analysis demonstrates, these tools were part of daily life, and as such, they reflect the impact of changes in subsistence, tool stone resource availability, and larger changes in the local environment and in settlement organization through time.
Chapter 7

ANALYSIS OF DEBITAGE, TOOL-PRODUCTION DEBRIS, AND CORES

Along with the tool assemblages, this analysis includes flake and blade debitage, tool-production debris, and cores in order to consider more fully the nature of household production and the potential causes for change through time within the tool assemblage. Therefore, this chapter focuses on the analysis of flakes, blades, tool-production debris, and cores from domestic-related deposits across the site.

BLADE AND FLAKE DEBITAGE

In research on the Neolithic of the Levant, blade technology—especially blades and cores of naviform technology—are the focus of much research, and as such are examined with numerous typologies that to varying degrees consider the technological attributes of core reduction (e.g., Wilke and Quintero 1994; Quintero and Wilke 1995; Quintero 1998a, 2010; Nishiaki 2000; Abbes 2003; Barzilai 2010). This focus on blade technology has provided a greater understanding of the role of blades as blanks for formal tool types (Crowfoot Payne 1983; Gopher 1989b; Quintero and Wilke 1995; Nishiaki 2000; Barzilai 2010), and an explanation for the importance and dominance of naviform core technology in much of the southern Levant during the Pre-Pottery Neolithic.

The seeming importance of blades and blade tools, however, has meant that flake-based tools have received less attention, resulting in a misconception that flake tools, often made on the production debitage from naviform technology, were not as important economically, or that they were as frequently used. And while flakes and their quantities
are usually noted in site reports, few lithic analyses in the southern Levant pay attention to the technological attributes and analytical significance of flake debitage. Many writers relegate debitage to aggregate categories such as flakes, chips, chunks, and microflakes (e.g., Lechevallier 1978; Gopher 1989b:20, 86; Kafafi 2001; Simmons et al. 2001; Garfinkel et al. 2012:79). Consideration of technological features of debitage, however, can provide insight into core-reduction strategies, tool production, issues of knapping skill, and the influence of resource material quality and availability (Flenniken 1981; Clark and Bryant 1997; Quintero 2010; Barket 2013). Furthermore, an in-depth debitage analysis along with a consideration of cores and tools is necessary for understanding the influence of socioeconomic changes on the technologies used in everyday tasks. After all, unstandardized flake-core and blade-core reduction, and the flakes and blades produced, provided blanks for much of the tool kit during the Neolithic.

**Previous Research at ‘Ain Ghazal and Recognized Debitage Types**

Wilke and Quintero (1994), Quintero and Wilke (1995), and Quintero (2010) conducted in-depth research on the naviform core-and-blade assemblage from ‘Ain Ghazal. Their research involved the development of a technological typology that identified debitage types produced from the final shaping of the core, blade production, common blade types, error correction, and core maintenance. Their findings suggested that naviform core reduction was a specialized activity during the PPNB, but had ceased by the PPNC at ‘Ain Ghazal. In addition to the naviform core-and-blade assemblage,

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1 An attempt was made to standardize the debitage typologies (Kozłowski and Gebel 1994), but it has not been widely applied (except see Simmons and Najjar [2003] for Ghwair).
Quintero (2010) examined generalized flaked-stone production activities. She found abundant evidence of tool production and core reduction in domestic-related deposits from each period of occupation.

Because of its analytical potential and usefulness, and to remain consistent with the previous research at ‘Ain Ghazal, blade and blade-core production debitage classification in this analysis relied on the typology developed by Wilke and Quintero (1994). For the flake types, I rely on a modified version of the technological typology developed originally by Lithic Analysts, Pullman, Washington, and revised by Wilke (MS 1993). The debitage is organized into the flake and blade categories listed in Table 7.1. Resource material type, presence of cortex, basic dimensions, and, when necessary, stages of production (e.g., early-, middle-, and late-stage biface production) were recorded. The flake debitage categories are designed to distinguish different types of core reduction and stages of tool production and maintenance. Some types of debitage are combined into the “other” category because they do not have a significant presence in or clear association to the deposits analyzed, or analytical importance for this study (including bipolar debitage, eraillures, bulb-removal flakes, and Janus flakes). Debitage categories that are obvious indicators of tool production (e.g., pressure flakes, chamfered-bit spalls, and burin spalls) are grouped with tool-production by-products. Biface-production debitage is a generalized class of debitage, as biface-production flakes can be associated with more than one type of core production/reduction and with tool production.
Table 7.1. Flake and blade debitage categories.

<table>
<thead>
<tr>
<th>Flake Debitage Categories</th>
<th>Blades (and production debris)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely cortical flakes (CC)</td>
<td>Trapezoidal blade/lets (naviform and other technologies)</td>
</tr>
<tr>
<td>Single-facet platform flakes (SFP)</td>
<td>Triangular blade/lets (naviform and other technologies)</td>
</tr>
<tr>
<td>Multiple-facet platform flakes (MFP)</td>
<td>Trapezoidal-to-triangular blade/lets (naviform and other technologies)</td>
</tr>
<tr>
<td>Platform absent flakes (PA)</td>
<td>Platform-isolation and-preparation elements</td>
</tr>
<tr>
<td>Edge-preparation flakes</td>
<td>Error-correction/clean-up blades</td>
</tr>
<tr>
<td>Biface-production flakes (BPF)</td>
<td>Profile-correction blades</td>
</tr>
<tr>
<td>Alternate flakes (Alt)</td>
<td>Ridge-straightening blades</td>
</tr>
<tr>
<td>Axe/Adze bit rejuvenation/recycling</td>
<td>Crested blade/lets (naviform and other technologies)</td>
</tr>
<tr>
<td>Faceting flakes</td>
<td>Initial natural, crested, and faceted platform spalls</td>
</tr>
<tr>
<td>Microflakes</td>
<td>Noninitial corrective plain and faceted platform spalls</td>
</tr>
<tr>
<td>Fragments</td>
<td>Nondiagnostic blade fragments</td>
</tr>
<tr>
<td>Shatter</td>
<td>Other</td>
</tr>
</tbody>
</table>

a. Technological flake debitage types after Wilke (MS 1993)\(^2\).

In order to record the frequency of debitage types and identify if blade production occurred, the blade debitage categories include major blade-blank types and blade production debitage. Many of the major blade-blank types used as tool blanks—triangular, trapezoidal, trapezoidal-to-triangular—are called here intended blades because they represent the intended products from naviform core reduction. Obviously, when ridge-straightening or profile correction blades were suitable for tool production they were used, but among many of the formal tools, there is a clear preference for the regular intended blade products. Blade-core preparation debitage is categorized with the flake debitage because naviform core preparation often required bifacial shaping and generates biface-production flakes. Whenever it was possible to distinguish probable naviform core-preparation debitage from biface-reduction debitage associated with axe/adze production or other bifacial tools (bifacial or tile knives), it was noted in the comments.

\(^2\) After unpublished debitage protocols established by J. Jeffrey Flenniken, Lithic Analysts, Pullman, Washington, used in many technical reports, and later revised by Philip Wilke (MS 1993).
**Flake Debitage Analysis**

Among the identifiable flake types, multiple-facet platform (MFP) flakes are predominant in the PPNB periods, followed by single-facet platform (SFP) flakes. This trend reverses in the PPNC and PN (see Table 7.2). Both types may be indicative of simple flake-core reduction, which appears to have been common throughout the occupation of the town. Biface-production flakes (BPF) are most abundant in the MPPNB and LPPNB, and it is clear from the tool assemblage that bifacial tool production including woodworking tools and knives continued throughout these occupations. Nonetheless, naviform core production debitage very probably accounts for a higher incidence of BPF in the PPNB, and such flakes would have been important blanks for tools.

Resource material representation also changes through time, with Huweijir flint most frequent in the MPPNB, declining some that in the LPPNB (Table 7.3). By the PPNC, Huweijir flint accounts for less than half of the debitage assemblage, and this trend continues into the Yarmoukian. In addition to a decline in the use of Huweijir flint through time, fragmentation of the debitage increased, with only 15% of Huweijir flint flakes complete by the PN (see Figure 7.1). Correspondingly, complete flakes of non-Huweijir flint resources increased through time. Even among complete flakes of Huweijir flint, however, size decreased through time (see Table 7.4). The increase in fragmentation and decline in size of Huweijir flint flakes suggests that flakes of this high-quality

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3 However, MFP flakes may also be generated by flake detachments from biface margins and thus may reflect both bifacial tool production and the bifacial production of naviform cores. Care was taken in the analysis, however, to classify, whenever possible, flakes produced early in the production of bifacial cores and tools as BPF.
Table 7.2. Flake type distribution through time\(^a\).

<table>
<thead>
<tr>
<th>FLAKE CATEGORIES</th>
<th>MPPNB</th>
<th>MPPN/ LPPNB</th>
<th>LPPNB</th>
<th>LPPNB/ PPNC</th>
<th>PPNC</th>
<th>PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC flakes</td>
<td>96</td>
<td>3</td>
<td>229</td>
<td>64</td>
<td>173</td>
<td>111</td>
</tr>
<tr>
<td>SFP flakes</td>
<td>471</td>
<td>14</td>
<td>873</td>
<td>243</td>
<td>915</td>
<td>744</td>
</tr>
<tr>
<td>MFP flakes</td>
<td>536</td>
<td>50</td>
<td>954</td>
<td>253</td>
<td>802</td>
<td>396</td>
</tr>
<tr>
<td>PA flakes</td>
<td>180</td>
<td>5</td>
<td>276</td>
<td>59</td>
<td>259</td>
<td>245</td>
</tr>
<tr>
<td>Edge-preparation</td>
<td>72</td>
<td>0</td>
<td>131</td>
<td>1</td>
<td>63</td>
<td>57</td>
</tr>
<tr>
<td>BPF</td>
<td>112</td>
<td>6</td>
<td>433</td>
<td>9</td>
<td>105</td>
<td>44</td>
</tr>
<tr>
<td>Alternate</td>
<td>28</td>
<td>0</td>
<td>65</td>
<td>2</td>
<td>36</td>
<td>13</td>
</tr>
<tr>
<td>Axe/Adze bit rejuvenation</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Faceting flakes</td>
<td>38</td>
<td>0</td>
<td>48</td>
<td>0</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Microflakes</td>
<td>0</td>
<td>0</td>
<td>1,109</td>
<td>98</td>
<td>495</td>
<td>15</td>
</tr>
<tr>
<td>Fragments</td>
<td>1,058</td>
<td>88</td>
<td>2,103</td>
<td>417</td>
<td>2,175</td>
<td>887</td>
</tr>
<tr>
<td>Shatter</td>
<td>119</td>
<td>11</td>
<td>343</td>
<td>95</td>
<td>257</td>
<td>887</td>
</tr>
<tr>
<td>Other</td>
<td>15</td>
<td>0</td>
<td>12</td>
<td>1</td>
<td>9</td>
<td>47</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,725</strong></td>
<td><strong>177</strong></td>
<td><strong>6,582</strong></td>
<td><strong>1,244</strong></td>
<td><strong>5,298</strong></td>
<td><strong>3,454</strong></td>
</tr>
</tbody>
</table>

\(^a\) Analysis was dependent on what was recovered during screening of deposits during excavation.

Material became more intensively used as availability became scarcer. Likewise, the decrease in average size of complete Huweijir flint flakes suggests that the resource material pieces used to produce flakes also got smaller.

In accordance with the more intensive use of Huweijir flint, evidence of probable scavenging is present in deposits from the MPPNB through the Yarmoukian. In the MPPNB and LPPNB, scavenging may be demonstrated by the presence of technologically inconsistent naviform core-production waste in domestic contexts. Such flakes may have been supplied from specialists’ workshops, but it seems more likely that inhabitants scavenged them from specialist’s discard deposits, as the location of such activities would have been known to community members. During the PPNC and Yarmoukian, the reuse of PPNB structures and spaces meant that inhabitants often dug
Table 7.3. Huweijir flint distribution for flake debitage.

<table>
<thead>
<tr>
<th>Resource Material</th>
<th>MPPNB</th>
<th>MPPNB/LPPNB</th>
<th>LPPNB</th>
<th>LPPNB/PPNC</th>
<th>PPNC</th>
<th>PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huweijir</td>
<td>2,365 (86.8%)</td>
<td>157 (88.7%)</td>
<td>4,102 (62.3%)</td>
<td>559 (44.5%)</td>
<td>2,152 (40.6%)</td>
<td>1,089 (31.5%)</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>360 (13.2%)</td>
<td>20 (11.3%)</td>
<td>2,480 (37.7%)</td>
<td>691 (55.5%)</td>
<td>3,146 (59.4%)</td>
<td>2,365 (68.5%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,725 (100%)</strong></td>
<td><strong>177 (100%)</strong></td>
<td><strong>6,582 (100%)</strong></td>
<td><strong>1,250 (100%)</strong></td>
<td><strong>5,298 (100%)</strong></td>
<td><strong>3,454 (100%)</strong></td>
</tr>
</tbody>
</table>

Figure 7.1. Debitage completeness by major period.

Table 7.4 Flake debitage size distribution by resource material and chronological period.

<table>
<thead>
<tr>
<th>Resource material by period</th>
<th>1-3 cm</th>
<th>3-6 cm</th>
<th>6+ cm</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPNB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>590 (56.7%)</td>
<td>422 (40.58%)</td>
<td>28 (2.69%)</td>
<td>1,040 (100%)</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>78 (51.30%)</td>
<td>66 (42.86%)</td>
<td>10 (6.49%)</td>
<td>154 (100%)</td>
</tr>
<tr>
<td>LPPNB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>860 (58.58%)</td>
<td>587 (39.99%)</td>
<td>21 (1.43%)</td>
<td>1,468 (100%)</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>223 (34.47%)</td>
<td>378 (58.42%)</td>
<td>46 (7.11%)</td>
<td>647 (100%)</td>
</tr>
<tr>
<td>PPNC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>501 (82.40%)</td>
<td>106 (17.43%)</td>
<td>1 (0.16%)</td>
<td>608 (100%)</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>713 (56.70%)</td>
<td>522 (41.50%)</td>
<td>22 (1.75%)</td>
<td>1,257 (100%)</td>
</tr>
<tr>
<td>PN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>381 (71.35%)</td>
<td>152 (28.46%)</td>
<td>1 (0.19%)</td>
<td>534 (100%)</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>411 (53.87%)</td>
<td>349 (45.74%)</td>
<td>3 (0.39%)</td>
<td>763 (100%)</td>
</tr>
</tbody>
</table>
into earlier deposits. These activities likely account for much of the Huweijir flint used in the later periods. The presence of diagnostic PPNB flake types (e.g., those associated with naviform core production) within these later contexts supports the interpretation of scavenging behavior.

**Blade Debitage Analysis**

Huweijir flint and blades from naviform cores (Tables 7.5 and 7.6) are dominant in the MPPNB blade sample. The single most common blade type is the trapezoidal intended blade, but as with the other intended blade types, very few are complete (only 12). In fact, of the 178 intended blades, only 17 are complete or nearly complete. The less regular blade types (e.g., crested, error-correction, profile-correction, and ridge-straightening) are less fragmented and comprised 33.7% of the assemblage of blades from naviform cores. The presence of the less-regular blades, platform spalls, and preparation/isolation elements in domestic contexts suggests these types were kept, curated, and in some instances, used as blanks for tool production. For example, platform spalls were often made into scrapers, burins, or other informal tools. Therefore, the presence of fragmentary intended blades in deposits examined here, and that of many of the other less-regular blade types from naviform core reduction, is more indicative of tool-production activities rather than of blade production.

In addition to the blades and debitage related to naviform core-and-blade technology, some blades originated from other blade-core reduction strategies. Such blades lack traces of bidirectional blade removals on the dorsal surfaces, and have large single-facet or multiple-facet platforms that lack features consistent with platform
preparation and isolation. Additionally, the blades produced from other core-reduction strategies, even those that appear to have been intended blades, tend to be less regular in form, that is, curved, too wide, or too thick. These blades make up 23.8% of the MPPNB identifiable blade debitage types. They include both intended blades and production elements, but they are not numerous enough in any deposits sampled here nor is the debitage assemblage coherent enough to indicate blade production. In fact, no single deposit sampled here contains manufacturing debris that is numerous enough or technologically consistent enough to suggest that blade production of any form occurred. The LPPNB blade debitage sample has a lesser representation of Huweijir flint, but it remained the dominant resource material (Table 7.6). Aside from the changes in representation of certain types, blades and blade-production debitage from naviform cores exhibit much the same pattern as they did in the MPPNB. First, trapezoidal blades are the most frequent blade type, but they are heavily fragmented (only 10 complete). In fact, from the total 221 intended blades, only 19 are complete. As in the MPPNB, intended and less-regular blades and debris appear to be associated with tool production, and are not present in sufficient numbers in any particular locus to suggest that blade production occurred. Additionally, blades from other blade production strategies are a little more common in the LPPNB, but the quantities and types present do not give evidence of production, and are generally more consistent with blank selection or tool production behaviors.

4 Despite its absence in these deposits, generalized blade production clearly occurred in some domestic-related deposits, as indicated by Quintero’s (2010) research and numerous unstandardized blade cores in the core assemblage examined here.
Table 7.5. Blades and production debitage by period.

<table>
<thead>
<tr>
<th>Blade Types</th>
<th>MPPNB</th>
<th>MPPNB/LPPNB</th>
<th>LPPNB</th>
<th>LPPNB/PPNC</th>
<th>PPNC</th>
<th>PN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N°</td>
<td>NN</td>
<td>N</td>
<td>NN</td>
<td>N</td>
<td>NN</td>
</tr>
<tr>
<td>Unspecified</td>
<td>55</td>
<td>42</td>
<td>3</td>
<td>0</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Error-correction</td>
<td>46</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>43</td>
<td>5</td>
</tr>
<tr>
<td>Crested</td>
<td>44</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>42</td>
<td>16</td>
</tr>
<tr>
<td>Platform-preparation/isolation</td>
<td>56</td>
<td>42</td>
<td>2</td>
<td>0</td>
<td>87</td>
<td>16</td>
</tr>
<tr>
<td>Profile-correction</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Ridge-straightening</td>
<td>65</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>43</td>
<td>0</td>
</tr>
<tr>
<td>Trapezoidal-to-triangular</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Triangular</td>
<td>56</td>
<td>36</td>
<td>3</td>
<td>6</td>
<td>96</td>
<td>125</td>
</tr>
<tr>
<td>Platform spalls</td>
<td>43</td>
<td>13</td>
<td>0</td>
<td>1</td>
<td>42</td>
<td>23</td>
</tr>
<tr>
<td>Fragments</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>516</strong></td>
<td><strong>160</strong></td>
<td><strong>24</strong></td>
<td><strong>7</strong></td>
<td><strong>509</strong></td>
<td><strong>267</strong></td>
</tr>
</tbody>
</table>

| Total %                              | 76.3% | 23.7% | 77.4% | 22.6% | 65.6% | 34.4% | 18.9% | 81.1% | 5% | 95% | 5.6% | 94.4% |

N and NN refer to Naviform and Non-naviform.
Table 7.6. Huweijir flint distribution in blade debitage.

<table>
<thead>
<tr>
<th></th>
<th>MPPNB</th>
<th>Total</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huweijir</td>
<td>652</td>
<td></td>
<td>96.40%</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>24</td>
<td></td>
<td>3.60%</td>
</tr>
<tr>
<td>MPPNB/LPPNB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>31</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>0</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>LPPNB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>664</td>
<td></td>
<td>85.60%</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>112</td>
<td></td>
<td>14.40%</td>
</tr>
<tr>
<td>LPPNB/PPNC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>67</td>
<td></td>
<td>70.50%</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>28</td>
<td></td>
<td>29.50%</td>
</tr>
<tr>
<td>PPNC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>237</td>
<td></td>
<td>61.70%</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>147</td>
<td></td>
<td>38.30%</td>
</tr>
<tr>
<td>PN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huweijir</td>
<td>156</td>
<td></td>
<td>67%</td>
</tr>
<tr>
<td>Non-Huweijir</td>
<td>77</td>
<td></td>
<td>33%</td>
</tr>
</tbody>
</table>

The PPNC blade assemblage has an even lower percentage of Huweijir flint (see Table 7.6.), and blades from naviform cores are nearly absent. Consistent with Quintero’s (2010) findings, it appears that specialist production was no longer undertaken and those blades from naviform cores that are present likely were scavenged from older deposits, which accounts for the high degree of fragmentation (only three pieces are complete).

Blades from non-naviform core-reduction strategies comprise much of the PPNC blade assemblage. Among the identified types, intended blade products are common, representing 65% of the assemblage. Blades with single-facet platforms are the most numerous, comprising 32.2% of the assemblage rather than the isolated platform blades that are common from naviform cores. Less-regular blade types and production debris are present also, but no locus sampled here has evidence of in situ blade production. Since such household blade production would have been carried out by nonspecialists,
individual’s knapping for their own use, this pattern implies that people produced blades on an as-needed basis, and cores probably were reduced over several knapping episodes.

The Yarmoukian blade assemblage also contains mostly Huweijir flint, but it is less well represented than it was in the PPNB periods. As in the PPNC, blades from naviform cores are uncommon, and, when they are present, they represent scavenging behavior rather than actual production. Domestic blade production from non-naviform cores, however, continued in the Yarmoukian, although it is less well represented than in the PPNC. As in the other periods, intended blade products (triangular and trapezoidal) are common, comprising 75% of the blade assemblage (n=166). The assemblage also contains less-regular blade types and some debris consistent with blade production, but as in the PPNC sample, it appears none of the deposits sampled here reflect in situ blade production.

**Summary of Debitage Analysis**

The debitage assemblage provides strong evidence that simple flake-core reduction was common in households in the MPPNB, and increased significantly in the later periods in response to the decline and eventual loss of the specialized blade industry. Debitage from the production and/or maintenance of woodworking tools is present in assemblages from all the periods. Similarly, biface production flakes, such as those that would result from the production of bifacial knives, are well represented from the LPPNB on. Interestingly, some biface-production flakes appear consistent with those resulting from naviform core preparation, and these appear to represent flakes scavenged and used for tool production in various households. Huweijir flint declined in availability for flake
production through time, and when it was present in later periods, it was generally smaller in size and more heavily fragmented, implying intensive use.

Though none of the loci here includes evidence of in situ blade production of any form, much can be said about the role of blades in domestic-related production activities, and meaningful changes occur through time. First, the strong representation of intended blade products and their high degree of fragmentation in the deposits analyzed here is consistent with their preference in blank selection and tool manufacturing. Second, specialist-produced blades from naviform cores declined noticeably in the post-PPNB periods, a trend that began in the LPPNB. Overall, as noticed by Rollefson (1996a), blades declined in representation through time as flakes increased. Finally, use of Huweijir flint declined through time, but despite the decline, it remained the preferred resource material for blades throughout all the periods.

**TOOL PRODUCTION DEBRIS**

During the course of the debitage and tool analysis, certain artifacts that appeared to demonstrate tool production were set aside for a separate study. These artifacts are grouped into production by-products, tool blanks, and tool-production failures (Plate 7.1). Table 7.7 shows the distribution of tool-production debris types through time at ‘Ain Ghazal. As with the tools, the tool-production debris derives mainly from domestic-related deposits. Furthermore, the presence of tool-production debris was crucial in identifying loci that contained evidence of tool production, and much of the tool-production debris identified here is also discussed in Chapter 8, along with the tools, debitage, and cores that came from the same loci.
Table 7.7. Distribution of tool production debris by chronological period.

<table>
<thead>
<tr>
<th>Tool production debris</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production by-products</td>
<td>382</td>
<td>506</td>
<td>174</td>
<td>122</td>
<td>1,184</td>
</tr>
<tr>
<td>Burin spalls</td>
<td>92</td>
<td>299</td>
<td>147</td>
<td>50</td>
<td>588</td>
</tr>
<tr>
<td>Chamfered-bit spalls</td>
<td>32</td>
<td>41</td>
<td>6</td>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>Tool blanks</td>
<td>95</td>
<td>70</td>
<td>10</td>
<td>15</td>
<td>190</td>
</tr>
<tr>
<td>Production Failures</td>
<td>29</td>
<td>31</td>
<td>9</td>
<td>5</td>
<td>74</td>
</tr>
<tr>
<td>Total</td>
<td>630</td>
<td>947</td>
<td>346</td>
<td>193</td>
<td>2,116</td>
</tr>
</tbody>
</table>

\(^a\) Total does not include tool production debris from transitional contexts and mixed or unknown contexts.

**Background of Research**

Debitage from tool production has been identified at numerous sites in the Levant\(^5\). Yet, few studies explicitly discuss what was entailed in tool production and the contexts in which it occurred (except see Quintero [2010] for blade-and flake-tool production, Quintero and Hintzman [2007] for woodworking tools, and Barkai [2005] for woodworking tools). Identifying the nature and context of tool production is important for understanding what people made and used on a daily basis, and where these activities occurred. Furthermore, at sites with specialized production of naviform cores and blades, an examination of non-specialized household-level production also provides insight into the role of the specialized economy in the PPNB, and the impact of its loss in the post-PPNB.

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\(^5\) For example, Barzilai (2010:48) identified burin spalls in workshop deposits at Yiftahel; Crowfoot Payne (1983:694) identified chamfered-bit spalls at Jericho; Gopher (1989b: 22, 24) identified “scraper spalls” and burin spalls at Munhata; “side-blow blade flakes” are also noted as evidence of sizing blades for hafting (Nishiaki 2000:201-202; Khalaily et al. 2003; Vardi and Gilead 2011); finally, a tool production locus was identified at Basta (Gebel 1996), and axe production has been identified at numerous sites (Barkai 2005).
Plate 7.1. Examples of tool-production debitage including production by-products (A), chamfered-bit spalls (B), a tool blank (C), and a probable projectile point production failure (D). Scale here and throughout in centimeters.

**Identified Types of Tool-Production Debris**

the identification of small blade segments left from trimming blades for hafting. Finally, the recognition of tool blanks and production failures draws heavily from Quintero’s (1998a, 2010) work on domestic-related deposits at ‘Ain Ghazal.

**Blade and flake production by-products**

Blade and flake production by-products are items of debitage that result from tool production. They often show attributes from their creation, such as intentional truncation, including dorsal breaks, ventral breaks, anvil breaks, and perverse fractures (Quintero 2010:127-130). Blade fragments comprise much of the by-product assemblage, but flake fragments are represented in small numbers. The most likely cause for this discrepancy is that blades were more likely to be sectioned for tool production to facilitate hafting (see discussions of “side-blow blade flakes” in Nishiaki [1996] and Vardi and Gilead [2011]), and are therefore easier to identify. The presence of retouch or usewear that was interrupted by intentional sectioning was noted and understood here to indicate tool recycling and/or resizing behavior.

Based on the chronological distribution of blade and flake production by-products (Table 7.8), the MPPNB and LPPNB samples are the most numerous. Likewise, they are comprised mainly of blade segments, and the majority of these were from naviform cores in the PPNB periods (Table 7.9). Thus, the smaller PPNC and PN assemblages are due to the difficulty of identifying production by-products from flake tools, which are more common in the post-PPNB assemblages. By the PPNC and Yarmoukian, debitage from sectioning blade blanks from naviform cores was much less common and blades from other technologies make up much of the sample. Sections of blades from naviform cores
Table 7.8. Distribution of blade and flake production by-products.

<table>
<thead>
<tr>
<th>Period</th>
<th>Total</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPNB</td>
<td>382</td>
<td>30.4%</td>
</tr>
<tr>
<td>MPPNB/LPPNB</td>
<td>17</td>
<td>1.35%</td>
</tr>
<tr>
<td>LPPNB</td>
<td>506</td>
<td>40.2%</td>
</tr>
<tr>
<td>LPPNB/PPNC</td>
<td>55</td>
<td>4.37%</td>
</tr>
<tr>
<td>PPNC</td>
<td>174</td>
<td>13.8%</td>
</tr>
<tr>
<td>PN</td>
<td>122</td>
<td>9.7%</td>
</tr>
<tr>
<td>Mixed</td>
<td>2</td>
<td>0.16%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,258</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 7.9. Production by-product characteristics.

<table>
<thead>
<tr>
<th>Period</th>
<th>Huweijir</th>
<th>Naviform</th>
<th>Retouched/used</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPNB</td>
<td>380 (99.5%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>346 (90.6%)</td>
<td>84 (21.9%)</td>
</tr>
<tr>
<td>MPPNB/LPPNB</td>
<td>17 (100%)</td>
<td>17 (100%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>LPPNB</td>
<td>456 (95.8%)</td>
<td>403 (84.66%)</td>
<td>116 (24.37%)</td>
</tr>
<tr>
<td>LPPNB/PPNC</td>
<td>50 (90.9%)</td>
<td>17 (34%)</td>
<td>11 (20%)</td>
</tr>
<tr>
<td>PPNC</td>
<td>154 (88.5%)</td>
<td>38 (21.8%)</td>
<td>25 (14.37%)</td>
</tr>
<tr>
<td>PN</td>
<td>96 (78.7%)</td>
<td>18 (14.75%)</td>
<td>18 (14.75%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,153 (91.65%)</td>
<td>839 (66.67%)</td>
<td>254 (20.2%)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Percentage calculated for each period’s assemblage.

<sup>b</sup> The blade segments are often very small, so it can be difficult to determine the blade technology, but these pieces maintain characteristics consistent with naviform technology.

found in post-PPNB contexts likely were produced from scavenged blades or blade-based tools from PPNB deposits.

In addition to the scavenging of blades from naviform cores in the later periods, some tool-production by-products display retouch and usewear interrupted by intentional breaks. The presence of such features in all periods suggests resizing and repurposing of blades was common throughout the occupation of the site (Table 7.9). In accordance with this evidence, numerous sickle elements, knives on blades, and a few flake tools retain traces of having been resized during the course of their use lives. Most of the resizing
occurred to modify blade segments for replacement in hafts, suggesting that people made an effort to conserve and maintain suitable blanks (even in the MPPNB, when regular blades were numerous). Finally, the frequency of Huweijir flint is high throughout the tool-production debitage sample and across all periods (Table 7.9), although it declines somewhat in the PPNC and Yarmoukian.

*Burin spalls and chamfered-bit spalls*

Burin spalls and chamfered-bit spalls also serve as evidence of tool production, and like the other production by-products, they are common in domestic-related contexts. Despite their consideration together here, several differences between the two are apparent and are discussed below.

Burin spalls were produced for a variety of reasons including to trim a blade blank, flake blank, or tool; to create a burin tool; to rejuvenate a working edge or bit of a tool; and as tool blanks themselves (e.g., for drill bits). In general, burin spalls for trimming a blade or flake or producing a burin tool (mostly transverse or dihedral burins) were more common in the MPPNB, when these burins were also more common. It was only after the MPPNB, that burin spalls were primarily the intended product rather than primarily a by-product of trimming or burin production (Plate 7.2). Accordingly, the increase in burin spalls as products coincides with an increase in truncation burins, which served as cores for burin spalls, as shown, for example by Finlayson and Betts (1990). Some of the spalls produced at ‘Ain Ghazal were definitely used as drills; in fact, 57 of the drills examined here were made on burin spalls. Considering the numerous burins that
served as cores and the large spall assemblage, however, it seems that the large quantities produced were intended for use as more than just drills. As suggested by Rollefson (1995), the growth in spall production through time appears to have been synchronous with an increasing emphasis on xeric resources, although he did not specify the role they may have played. As note earlier, Quintero et al. (2004), however, proposed that the spalls may have been used as comb teeth inserts for harvesting wool, which would have been among the secondary products exploited by Neolithic peoples practicing pastoralism.

Distinguishing between burin spalls detached during burin production and those detached from burin cores is not always straightforward. Additionally, some burin spalls are fragmentary, making such a distinction difficult; as a result, the sample of spalls that
can be associated with burin production versus spall production is small. An examination of these different types of spalls, however, shows some clear change through time. From the MPPNB sample, only 57 burin spalls were assignable to one of these two trajectories, and it seems that spalls from truncation burins and burins-on-breaks were a little more common, with 36 such spalls, while the other 21 appear associated with burin production. From the LPPNB sample, 138 spalls are assignable to one of the two trajectories, and it is clear that burin spall production is much more common, with about 117 spalls from truncation burins or burins-on-breaks. Production of transverse and dihedral burins continued, and 21 spalls appear to be associated with their production. From the PPNC sample 63 spalls were assignable to one of these two trajectories. Of these, 61 spalls appear to have been removed with the intent of producing spalls, while only two of the spalls appear to have been the result of burin production. From the identifiable Yarmoukian sample, 29 spalls appear to have been products from burin spall production, and none of the spalls appear to be associated with the production of burin tools.

As discussed above and shown in Tables 7.10 and 7.11, spalls from burin “cores” are more numerous than spalls from the production of burin tools and chamfered-bit spalls across all the periods. Despite the predominance of burin spall products, spalls resulting from the production of burins were greatest in the MPPNB, when transverse and dihedral burins were common, decreasing in occurrence thereafter. Additional characteristics from the burin spall assemblage are presented in Table 7.11. One interesting pattern is the variation in representation of initial (triangular) and noninitial
Table 7.10. Distribution of burin and chamfered-bit spalls by period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Burin</th>
<th>Chamfered-bit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPPNB</td>
<td>92 (74.2%)</td>
<td>32 (25.8%)</td>
<td>124 (100%)</td>
</tr>
<tr>
<td>MPPNB/LPPNB</td>
<td>2 (100%)</td>
<td>0 (0%)</td>
<td>2 (100%)</td>
</tr>
<tr>
<td>LPPNB</td>
<td>299 (87.9%)</td>
<td>41 (12.1%)</td>
<td>340 (100%)</td>
</tr>
<tr>
<td>LPPNB/PPNC</td>
<td>12 (92.3%)</td>
<td>1 (7.7%)</td>
<td>13 (100%)</td>
</tr>
<tr>
<td>PPNC</td>
<td>147 (96.1%)</td>
<td>6 (3.9%)</td>
<td>153 (100%)</td>
</tr>
<tr>
<td>PN</td>
<td>50 (98%)</td>
<td>1 (2%)</td>
<td>51 (100%)</td>
</tr>
<tr>
<td>Mixed/unknown</td>
<td>16 (94.1%)</td>
<td>1 (5.9%)</td>
<td>17 (100%)</td>
</tr>
<tr>
<td>Total</td>
<td>618 (88.3%)</td>
<td>82 (11.7%)</td>
<td>700 (100%)</td>
</tr>
</tbody>
</table>

Table 7.11. Spall characteristics by major period.

<table>
<thead>
<tr>
<th>Complete Spalls</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burin spall products</td>
<td>34 (37%)</td>
<td>88 (29.4%)</td>
<td>35 (23.8%)</td>
<td>17 (34%)</td>
<td>174 (29.6%)</td>
</tr>
<tr>
<td>Burin-production spalls</td>
<td>21 (22.8%)</td>
<td>15 (5%)</td>
<td>1 (0.7%)</td>
<td>0</td>
<td>37 (6.3%)</td>
</tr>
<tr>
<td>Indeterminate burin spalls</td>
<td>21 (22.8%)</td>
<td>52 (17.4%)</td>
<td>15 (10.2%)</td>
<td>5 (10%)</td>
<td>93 (15.8%)</td>
</tr>
<tr>
<td>Chamfered-bit spalls</td>
<td>31 (96.9%)</td>
<td>39 (95.1%)</td>
<td>4 (66.7%)</td>
<td>1 (100%)</td>
<td>75 (93.8%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initial Spalls</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burin spall products</td>
<td>12 (13%)</td>
<td>46 (15.4%)</td>
<td>27 (18.4%)</td>
<td>15 (30%)</td>
<td>100 (17%)</td>
</tr>
<tr>
<td>Burin-production spalls</td>
<td>16 (17.4%)</td>
<td>10 (3.3%)</td>
<td>1 (0.7%)</td>
<td>0</td>
<td>27 (4.6%)</td>
</tr>
<tr>
<td>Indeterminate burin spalls</td>
<td>15 (16.3%)</td>
<td>93 (31.1%)</td>
<td>50 (34%)</td>
<td>13 (26%)</td>
<td>171 (29.1%)</td>
</tr>
<tr>
<td>Chamfered-bit spalls</td>
<td>14 (43.8%)</td>
<td>4 (9.8%)</td>
<td>1 (16.7%)</td>
<td>0 (0%)</td>
<td>19 (23.8%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noninitial Spalls</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burin spall products</td>
<td>24 (26.1%)</td>
<td>73 (24.4%)</td>
<td>34 (23.1%)</td>
<td>15 (30%)</td>
<td>146 (24.8%)</td>
</tr>
<tr>
<td>Burin-production spalls</td>
<td>5 (5.4%)</td>
<td>11 (3.7%)</td>
<td>1 (0.68%)</td>
<td>0</td>
<td>17 (2.9%)</td>
</tr>
<tr>
<td>Indeterminate spalls</td>
<td>20 (21.7%)</td>
<td>66 (22.1%)</td>
<td>34 (23.1%)</td>
<td>7 (14%)</td>
<td>127 (21.6%)</td>
</tr>
<tr>
<td>Chamfered-bit spalls</td>
<td>18 (56.3%)</td>
<td>37 (90.2%)</td>
<td>5 (83.3%)</td>
<td>1 (100%)</td>
<td>61 (76.2%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Huweijir Resource Material</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burin spall products</td>
<td>36 (100%)</td>
<td>88 (75.2%)</td>
<td>37 (60.7%)</td>
<td>23 (76.7%)</td>
<td>184 (75.7%)</td>
</tr>
<tr>
<td>Burin-production spalls</td>
<td>21 (100%)</td>
<td>21 (100%)</td>
<td>2 (100%)</td>
<td>0</td>
<td>44 (100%)</td>
</tr>
<tr>
<td>Indeterminate spalls</td>
<td>35 (100%)</td>
<td>135 (84.9%)</td>
<td>41 (48.8%)</td>
<td>14 (70%)</td>
<td>225 (67%)</td>
</tr>
<tr>
<td>Chamfered-bit spalls</td>
<td>32 (100%)</td>
<td>35 (100%)</td>
<td>5 (83.3%)</td>
<td>0 (0%)</td>
<td>72 (90%)</td>
</tr>
</tbody>
</table>

\(^a\) Total percent expressed here is from the major periods only. The total and the percentage were not calculated for the MPPNB/LPPNB, LPPNB/PPNC and mixed/unknown contexts.
(trapezoidal) spalls among the different types through time\(^6\). For instance, among burin spall products, noninitial spalls were more common in each period, while among spalls from burin-tool production, initial spalls were more common in the MPPNB and noninitial spalls were more common in the LPPNB. Indeterminate spalls also show variation from one period to the next in the representation of initial versus noninitial spalls. The meaning of these fluctuations (if any exists) is not clear, but the pattern of a greater number of noninitial spalls among burin spall products accords well with the presence of numerous repeatedly used truncation burins in the burin assemblage from the LPPNB and later periods.

With regard to completeness, the greatest percentage of complete burin spalls came from the MPPNB. This pattern is consistent with the greater numbers of spalls produced from transversal blows, which are less likely to break upon removal, perhaps due to their greater thickness. Burin spalls created from burins-on-breaks or truncation burins that are complete often appear unsuitable for production as drills or for use as inserts; they are irregular in form, with hinge terminations, coming off too thick or too thin, or overshooting. Additionally, about 25% of the burin spalls examined in this analysis removed a retouched or used edge, while others may have been retouched to create a pronounced straight edge for easy removal of the spall. An examination of resource material use among the different types of burin spalls shows a decline in the representation of Huweijir flint through time among spall products and indeterminate

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\(^6\) The assumption that triangular spalls are initial and trapezoidal spalls are noninitial is generally the case, but it must be considered that due to variation in the blanks used, some initial spalls may not be triangular and some noninitial spalls may not be trapezoidal.
spalls. Among spalls resulting from the production of burin tools, Huweijir flint was the only flint used, which accords well with the findings from the burin assemblage.

In contrast to the different roles of burin spalls, chamfered-bit spalls result from the creation or rejuvenation of a chamfered-bit tool edge. Chamfered-bit spalls are most common in the MPPNB and LPPNB, but make up a larger percentage of the MPPNB assemblage, which accords with the greater representation of chamfered-bit tools during the MPPNB\(^7\). The decline in chamfered-bit spalls after the MPPNB coincides with a decline in chamfered-bit tools. Additionally, the decline in chamfered-bit spalls and tools parallels that of transverse burins and the spalls associated with their production. Both of these trends likely reflect the decline in blades from naviform cores, as both of these tools tended to be made on these blade blanks.

As indicated in Table 7.10, chamfered-bit spalls are more often nonintial, especially after the MPPNB. About half of the chamfered-bit spalls included in this analysis show the removal of a retouched or used edge, suggesting bit rejuvenation was common. Finally, Huweijir flint is present in greater numbers in the chamfered-bit spall assemblage, but these artifacts are also more common in the PPNB when Huweijir flint was more often used for blade tools.

Burin spalls and chamfered-bit spalls may have been discussed together here, but they clearly were impacted by changes in different tool categories through time. Despite these differences, both are indicative of tool production and both are found in domestic-
related deposits throughout the occupation of the town. Thus, they give evidence for
domestic production of their respective tools.

Tool blanks

Based on the previous work of Mortensen (1970, 1988), Gopher (1989b), Karnes
and Quintero (2007), and Quintero (2010), and the attention to blank choice in this
analysis of the formal and informal tool assemblage, it is clear that particular blade types
served as blanks for the formal blade tool varieties. Undoubtedly, some ambiguity exists
in this category, but patterned blank choices are apparent in many tool collections and
these choices guide the recognition of unaltered or minimally altered tool blanks in lithic
assemblages. Specifically, for example, intended trapezoidal, triangular, and trapezoidal-
to-triangular blades, from naviform cores, were the preferred blanks for sickle blades,
blade-based knives (K3), and projectile points. Thus, in this analysis, tool blanks are
blade or flake blanks with partial retouch or intentionally snapped ends indicative of
partial manufacture, and/or they are of the same type and configuration as blanks
commonly preferred for particular tool forms (e.g., trapezoidal blades for sickle elements,
and triangular blades for projectile points) based on analyses of tool collections.

Formal blade-based tools are numerous in the MPPNB and LPPNB assemblages,
and the blanks on which they were made are easy to identify. During the PPNB, the
majority of those blanks are blades from naviform cores supplied by specialist knappers.
As shown in Table 7.12, trapezoidal blades most often were chosen for manufacture into
hafted cutting implements such as sickle elements or blade-based knives (also noted by
Karnes and Quintero 2007; and Quintero 2010). Additionally, trapezoidal blades are also
more likely to have been intentionally sectioned or shaped to a specific length, so that 62.4% of the blade blanks are missing one or both ends. Blanks that appear most consistent with projectile point manufacture often are triangular blades\(^8\), and they are likely to be complete, with 57% of the triangular blade blanks complete or nearly complete (plates 7.1, 7.3, 7.4). Trapezoidal-to-triangular blade blanks are less common in the blade assemblage overall, but appear nearly equally suitable for projectile points or cutting implements. Determination of their intended production trajectory as cutting implements or projectile points often relied on whether or not the blank was complete (about 40% of the trapezoidal-to-triangular blanks are complete or nearly so), and on patterns of retouch used to shape blade edges and hafting areas (plate 7.3). Additionally, some blanks appear as though they could have been manufactured into several different tool types; these are classed with the multiple potential types. Flakes only begin to serve as blanks for formal tools such as projectile points and sickle elements in the PPNC and Yarmoukian (see plate 7.5), and the majority of these were identified as tool blanks based on signs of partial manufacture (about 40% of PPNC and 73.3% of PN tool blanks have some retouch)\(^9\).

As indicated in table 7.14, blade blanks from naviform cores were most represented in the MPPNB and LPPNB, but flake blanks do increase somewhat through

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\(^8\) Blades with a trapezoidal-to-triangular configuration were also commonly used for projectile points. But, in fact, analysis of the projectile point assemblage demonstrates that any finely made blade that tapers to a point on the distal end would have been suitable for production into projectile points (for example, see Mortensen 1988).

\(^9\) The rates of retouch consistent with partial manufacture of flake blanks are lower than in the later periods, but overall similar between the MPPNB and the LPPNB, at 31.6% and 31.4%, respectively.
Plate 7.3. Examples of projectile point blanks. The first blank has a partially formed base or haft element, and the other blank has retouch along the distal end. Note that both are made on fine blades from naviform cores.

Table 7.12. Chronological distribution of tool blanks by probable associated tool types.

<table>
<thead>
<tr>
<th>Tool blank suitability</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sickle element/knife-on-blade</td>
<td>74</td>
<td>48</td>
<td>5</td>
<td>3</td>
<td>130</td>
</tr>
<tr>
<td>Projectile point</td>
<td>17</td>
<td>12</td>
<td>2</td>
<td>9</td>
<td>40</td>
</tr>
<tr>
<td>Multiple potential types</td>
<td>4</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>95</strong></td>
<td><strong>70</strong></td>
<td><strong>10</strong></td>
<td><strong>15</strong></td>
<td><strong>190</strong></td>
</tr>
</tbody>
</table>

*a* Presented for formal tools only, as informal tools generally do not show consistent use of specific blanks.

*b* Blanks suitable for manufacture into projectile points, cutting implements, borer, chamfered-bit tools, and transverse burins.

*c* Total does not include two tool blanks from transitional MPPNB/LPPNB, three from transitional LPPNB/PPNC, and eight from mixed contexts.
Table 7.13. Probable intended tool type based on blade type.

<table>
<thead>
<tr>
<th>Blank type</th>
<th>Sickle element/knife-on-blade</th>
<th>Projectile point</th>
<th>Multiple potential types</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trapezoidal blade</td>
<td>82</td>
<td>8</td>
<td>11</td>
<td>101</td>
</tr>
<tr>
<td>Triangular blade</td>
<td>20</td>
<td>15</td>
<td>14</td>
<td>49</td>
</tr>
<tr>
<td>Trapezoidal-to-triangular blade</td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Ridge-straightening blade</td>
<td>13</td>
<td>0</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Other blades</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Flakes</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>134</strong></td>
<td><strong>33</strong></td>
<td><strong>36</strong></td>
<td><strong>203</strong></td>
</tr>
</tbody>
</table>

- The blanks in this category appear suitable for manufacture into any of the formal tool types.
- This total includes 2 tool blanks from MPPNB/LPPNB, 3 from LPPNB/PPNC, and 8 from mixed contexts.

Table 7.14. Tool blank characteristics by period.

<table>
<thead>
<tr>
<th>Core-reduction strategy</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naviform</td>
<td>93 (97.9%)</td>
<td>65 (92.9%)</td>
<td>4 (40%)</td>
<td>3 (20%)</td>
<td>175</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource material</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huweijir</td>
<td>95 (100%)</td>
<td>69 (98.6%)</td>
<td>7 (70%)</td>
<td>13 (86.7%)</td>
<td>196</td>
</tr>
</tbody>
</table>

- Numbers and percentages reflect proportion for each chronological period’s assemblage.

Blades from naviform cores recovered from the post-PPNB contexts appear to have been scavenged and sometimes retain signs of prior use. Associated with the decrease in blade blanks from naviform cores, there was a noticeable decline in the size of complete blade blanks, with the average length in the MPPNB at 69.7 mm, which declined to 36.7 mm in the Yarmoukian. Predictably, Huweijir flint was the preferred resource material for tool blanks throughout, declining some through time; in fact, it is at its lowest in the PPNC and rebounds somewhat in the PN\(^\text{10}\).

\(^{10}\) Similar to the resource material patterns seen among informal tools, this pattern is perhaps related to the common practice of Yarmoukian pit digging into older deposits.
Plate 7.4. Projectile point tool blanks (top row), projectile point production failures (middle row), and used projectile points (bottom row). Most are from the late MPPNB and LPPNB, and exhibit noticeable differences in the regularity of blanks when compared to those from the post-PPNB periods (see Plate 7.5).
Plate 7.5. Projectile point blanks and preforms from the PPNC and PN (A and B), and a PN projectile point production failure (C). Note that one tool blank, one preform, and the production failure are flake blanks.

Production failures

A production failure is a blank or tool that was broken before it was finished. Based on replicative work conducted by others (e.g., Quintero and Hintzman 2007; Quintero 2010) and the replications undertaken as part of this research, it was possible to identify the probable intended tool of some of the production failures (especially, bifaces and projectile points). Thus, it was easier to identify these failures in the archaeological
record, even at early stages of production. The most common projectile point failures were bending breaks or perverse fractures in the tang or medial portion of the point (see Table 7.15, and Plate 7.4). Bifacial tools, likely intended to be knives, also most often broke in bending breaks or perverse fractures, and care was taken to examine the edges and identify the presence of any dulling from use. If such traces were not apparent, the biface fragment was categorized as a production break. Many of these production breaks occurred in the mid-to-late stage of reduction.

In addition to the clearly identified failure types, several specimens broke while being trimmed or possibly recycled as burins. A number of these burination failures appear to be transverse spall removal attempts that overshot and removed a large portion of the opposing margin. Finally, when the production aim was not clear (which was the case for some flake tools and blade tools), but the piece exhibited a bending break or perverse fracture interrupting a retouched edge lacking apparent dulling from use, it was included in the production failure assemblage.

Production failures were most common in the PPNB (see Table 7.15), probably because they are easier to identify on the blade-based formal tools, and because the PPNB samples are larger. The majority of the identified MPPNB production failures are projectile points that broke during manufacture. Projectile point production failures are also common in the LPPNB. In contrast to the MPPNB, however, a number of bifacial tools broke in production. The PPNC assemblage has fewer projectile point and biface production failures, but it is also much smaller than the previous assemblages. The PN
Table 7.15. Production failures by period\textsuperscript{11}.

<table>
<thead>
<tr>
<th>Production Failures</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile point</td>
<td>13</td>
<td>10</td>
<td>1</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Sickle element/ Knife-on-blade</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Burination failures</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Bifacial knives\textsuperscript{a}</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Production goal unclear\textsuperscript{b}</td>
<td>10</td>
<td>9</td>
<td>4</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>29</strong></td>
<td><strong>31</strong></td>
<td><strong>9</strong></td>
<td><strong>5</strong></td>
<td><strong>74</strong></td>
</tr>
</tbody>
</table>

\textsuperscript{a} One probable bifacial knife production break not included here is from transitional LPPNB/PPNC context.

\textsuperscript{b} A number of production failures were identified by perverse fractures or bending breaks that interrupt retouch, despite not having a clear production aim.

The assemblage is the smallest, comprised of projectile point production failures, and failures on pieces for which the production aim was not clear.

For comparative purposes with the tool assemblage, the blanks representing production failures from each period of occupation are presented in Table 7.16. Blades from naviform cores are common in the PPNB, but blades from other core-reduction strategies and flakes are also present. The PPNC and PN samples are small in comparison to the PPNB, but blades from naviform cores are still present (and clearly scavenged), as are blades from other core-reduction strategies and flakes. Finally, Huweijir flint is predominant, comprising 88% of the production failure assemblage, but it does decline some through time, reaching its lowest representation in the PPNC, at 66.7%.

**Summary of Tool-Production Debris Analysis**

Identifying the remains of tool production is important for understanding how and where past people created, used, and maintained their tools. Also important are

\textsuperscript{11} This table does not include production failures from the creation of woodworking tools. They are here included with the woodworking tool assemblage attributes in Table 6.12, as they were originally identified and presented with the rest of the woodworking tool assemblage in the paper by Quintero and Hintzman (2007).
identifications of common by-products, production choices, and mishaps. With the exception of burin spalls and chamfered-bit spalls, and production failures resulting from over-exuberant spall removals, much of the tool-production debris assemblage is associated with formal tool manufacture. This pattern results because formal tool production more often involved standardized blanks (especially in the PPNB, when more of the blanks were blades from naviform cores) that during manufacture produced regular by-products that are easier to identify.

Overall, tool-productiondebitage was widespread in the deposits, indicating tool manufacture was a common activity undertaken by ordinary inhabitants of ‘Ain Ghazal. Blades produced from naviform cores served as the basis for formal tool production in domestic contexts during the PPNB, and are most common in the MPPNB among tool production by-products and tool blanks. Preferred blanks for tools were triangular and
trapezoidal intended blades from naviform cores, which is consistent with the formal tool assemblage findings. These blades decline in frequency during the subsequent periods of site occupation, but are present in greater proportions throughout among the formal tools and their associated tool-production debris than among informal tools. This pattern suggests that people preferred these blanks for formal tool production (even after specialized production ceased), perhaps due to the general ease with which such standardized blanks could be manufactured into an array of tools.

Among tool-production by-products associated with informal tools, the findings from the burin spall and chamfered-bit spall assemblages accord well with the patterns seen in the burin and chamfered-bit tool assemblages, and they suggest that such tools were commonly produced and maintained in households. Finally, associated with the consistent use of blades from naviform cores, Huweijir flint remained the most commonly used resource material, although it did decline some through time.

**CORE ASSEMBLAGE**

Commonly used blade core typologies include those by Quintero (1998a, 2010), Nishiaki (2000), and Barzilai (2010). One of the most common types of blade cores at many PPNB sites is the naviform or opposed-platform, “boat-shaped” core\(^\text{12}\), but the percentage of naviform cores varies significantly from site to site in the Levant (e.g., Garfinkel et al. 2012:78, Table 3.3). Despite varied representation among sites, naviform cores and blades detached from them tend to be most common during the PPN.

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Additionally, because naviform core reduction appears to have been a specialized industry at several sites, including Yiftahel (Barzilai 2010; Garfinkel et al. 2012), ‘Ain Ghazal (Quintero and Wilke 1995; Quintero 2010), Basta (Gebel 1996), and probably Wadi Shu’eib (Simmons et al. 2001) and Abu as-Suwwan (Al-Nahar 2010), naviform cores are more often thoroughly studied and illustrated in reports. Other types of blade cores, however, were reduced in many sites, especially from the post-PPNB periods.

As with the flakedebitage, flake cores are less often the subjects of detailed discussion, but some basic types appear in most typologies, including single-platform cores, multiple-platform cores (sometimes called irregular cores, such as in Mortensen [1970]; and Nissen et al. [1987]), and discoidal cores. Other common core types include bidirectional (both change-of-orientation and opposed-platform) blade cores and flake cores (Crowfoot Payne 1983; Gopher 1989b; Garfinkel 1994; Khalaily et al. 2003; Matskevich 2011).

One major goal of examining cores at any site is to identify changes through time in core-reduction strategies. Such information is crucial for understanding changes in other aspects of the flaked-stone tool assemblage. For instance, changes in common core-reduction strategies are linked to changes in blank use for tool production. Furthermore, they are sensitive to resource material availability and quality. Given their sensitivity, it is not surprising that core-reduction strategies show some change through time in the southern Levantine Neolithic. Specifically, naviform core reduction and its blade products became much less common in sites after the PPNB (Crowfoot Payne 1983; Gopher 1989b; Barzilai 2010; Quintero 2010). During the PPNC and PN, blade cores

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remained in use, but they were no longer the standardized naviform cores. Flake cores are present at sites throughout the Neolithic, and at many sites, they are the most common core form, even in the PPNB\textsuperscript{13}. Core-reduction strategies for most unstandardized blade cores and flake cores, however, remained consistent through time, with single-platform cores, multiple-platform cores, and bidirectional cores generally the most common\textsuperscript{14}.

**Previous Research at ‘Ain Ghazal and Core Typology**

At ‘Ain Ghazal, Quintero (2010) considered a large sample of blade and flake core types present in domestic-related deposits during each period of occupation. She identified numerous flake-core types including single-platform, multi-platform, bidirectional, discoidal, opposed-platform, and bipolar cores. The blade core types included naviform, single-platform, opposed-platform, bidirectional, remnant, and microblade (Quintero 2010:101). Her findings suggested that naviform cores were the predominant type in the MPPNB, but from the LPPNB through the PN, flake cores were the most represented core types.

The analysis here does not include naviform cores, except when they were recycled as another type of blade core or flake core. The focus of this research is on household-level production; thus, the cores considered here are those found in domestic-related deposits (Table7.17), and are comprised of various types of unstandarized flake cores.

\textsuperscript{13} As noted by Mortensen (1970:4) at Beidha; Gopher (1989b:15-19) at Munhata; Khalaily et al. (2003:26) at Abu Gosh; Peterson (2004) at Khirbet Hammam; and Jensen et al. (2005:126) at Shakarat Msaeid).

\textsuperscript{14} As noted by Gopher (1989b:84) at PN Munhata; Garfinkel (1994:547) at PPNC Tell Ali; Khalaily et al. (2003) at PN Abu Gosh; Quintero (2010) at PPNC and PN ‘Ain Ghazal; Matskevich (2011:230-231) at PN Sha’ar Hagolan).
cores and blade/let cores. In an effort to maintain continuity with the previous core analysis, I draw heavily from Quintero’s (2010) core typology.

**Blade Core Types**

Single-platform blade/let cores have blade removals from one primary striking platform. They have removal faces that range from narrow to broad and some are worked in the round. Single-platform blade/let cores are the most common non-naviform blade core type in the ‘Ain Ghazal assemblage (Table 7.17 and Plate 7.6).

The bidirectional blade-core category includes opposed-platform cores (excluding naviform), which have blade/lets removed from two opposing platforms, and other bidirectional blade-core reduction strategies (all forms without an opposed platform). The analyzed assemblage includes 38 such blade/let cores (Plate 7.7).

Combination bladeflake cores and blade/let core fragments comprise the remaining blade-core types (Table 7.17). Combination bladeflake cores are any cores that have what appear to be contemporaneous removals of both blades and flakes as products. Blade/let core fragments lack diagnostic features that allow classification into the other core types.

**Flake Core Types**

Single-platform flake cores are those with flakes removed from one striking platform. They range from large minimally reduced cores on lower-quality resource
material to small cores on higher-quality material (including Huweijir flint). They tend to have broad removal faces, and some of the smaller cores are worked in the round (Plate 7.8). As shown in Table 7.17, single-platform flake cores are the most common flake core type in the ‘Ain Ghazal assemblage with 337 examples.
Table 7.17. Core assemblage characteristics.

<table>
<thead>
<tr>
<th>Core Type</th>
<th>Totalb</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blade cores</strong></td>
<td></td>
</tr>
<tr>
<td>Single platform</td>
<td>126 (11%)</td>
</tr>
<tr>
<td>Bidirectionala</td>
<td>38 (3.3%)</td>
</tr>
<tr>
<td>Core fragments</td>
<td>13 (1.1%)</td>
</tr>
<tr>
<td>Unknown/other</td>
<td>1 (.09%)</td>
</tr>
<tr>
<td><strong>Flake cores</strong></td>
<td></td>
</tr>
<tr>
<td>Single platform</td>
<td>337 (29.5%)</td>
</tr>
<tr>
<td>Multiple platform</td>
<td>267 (23.3%)</td>
</tr>
<tr>
<td>Bidirectional</td>
<td>166 (14.5%)</td>
</tr>
<tr>
<td>Core fragments</td>
<td>70 (6.1%)</td>
</tr>
<tr>
<td>Discoidal</td>
<td>67 (5.9%)</td>
</tr>
<tr>
<td>Tested piece</td>
<td>16 (1.4%)</td>
</tr>
<tr>
<td>Bifacial</td>
<td>13 (1.1%)</td>
</tr>
<tr>
<td>Unknown/other</td>
<td>4 (.35%)</td>
</tr>
<tr>
<td><strong>Mixed cores</strong></td>
<td>16 (1.4%)</td>
</tr>
<tr>
<td><strong>Bipolar</strong></td>
<td>10 (.87%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,144 (99.9%)</td>
</tr>
</tbody>
</table>

a Includes all varieties of non-naviform bidirectional cores (e.g., opposed-platform, change-of-orientation).
b Total includes cores from transitional, unknown, and mixed contexts.

Multiple-platform flake cores display flake removals from multiple striking platforms. The larger cores of this type are usually irregular in size and form and are often made on lower-quality flint and chert types available in the immediate site area. Small and exhausted multiple-platform cores are almost spherical by the time they are discarded and are often made from Huweijir flint or other high-quality resource material (Plate 7.9). As a group, multiple-platform cores are well represented by 267 examples.

As with the blade cores, bidirectional flake cores include those with opposed platforms and cores of other orientations with evidence of bidirectional removals (Plate 7.10). As shown in Table 7.17, they are the third most common flake-core type in the 'Ain Ghazal assemblage.
Discoidal cores are flake cores worked on two faces from striking platforms along a common margin, mostly bifacially, in the round. They tend to be irregular in form, ranging from circular to subcircular in plan view (Plate 7.11). They often are made on chert and flint available in the immediate site area of varying quality, although some are on higher-quality flints, and these tend to be more heavily reduced. The assemblage contains 67 discoidal cores.

Bifacial flake cores have flake removals from both faces, but are not clearly discoidal in shape. Although an array of bifacially shaped tools (e.g., woodworking tools,
Plate 7.8. Single-platform flake cores. Note that the majority of these cores are made of lower quality bedded flint and chert varieties. The two cores of Huweijir flint pictured here are also the smallest.

Plate 7.9. Multiple-platform flake cores. Note the very small heavily reduced cores, many of which are of Huweijir flint.
Plate 7.10. Bidirectional flake cores (the arrows show the direction of removals). Note the smaller size of the two cores made of Huweijir flint (upper right).

Plate 7.11. Discoidal flake cores. Note that many of the smallest cores are of high-quality flint.
bifacial knives, etc.) and in some cases bifacially shaped cores (e.g., naviform blade cores) are present in the assemblage, the pieces designated as bifacial cores here are less regular in form and flake removals were not intended to shape or thin the piece, but rather to obtain flakes for production into a variety of informal tools. Bifacial flake cores are infrequent in the ‘Ain Ghazal assemblage represented by only 13 examples (Table 7.17.).

Bipolar cores (often called pièces esquillées) result from hammer-and-anvil techniques of splitting small flint pieces. The shearing forces that enable this technique can create “wedge-like” segments and fragments with evidence of impact on opposite ends (Plate 7.12). Bipolar reduction is, in general, uncommon; it is most often employed in situations where resource material is scarce or where the available resource material is small and not easily exploited in any other manner. As indicated in Table 7.17, cores created by the bipolar technique are rare in the assemblage.

The remaining flake core types include tested pieces, which have only one or two flake removals, and flake core fragments.

Unlike much of the tool assemblage, the most common resource materials are wadi-rolled, nodular, and bedded flint and chert varieties of variable quality available in the immediate site vicinity. Huweijir flint is not the most common resource material in the core assemblage, accounting for less than half of it (Table 7.19). However, Huweijir flint is slightly more common among the blade core types than among the major flake core types. Most cores examined here were percussion reduced and exhibit no clear standardization in the quality or consistency of reduction similar to that seen in naviform
core reduction. Flake cores make up the majority of the sample, which accounts for the greater variety in resource material, as they generally do not require the high-quality homogenous resource materials typically employed for blades. Beyond these overall characteristics, some differences in type, degree of exhaustion, recycling, and differences in size over time are discussed in the following section.

**Distributional Studies**

*Middle Pre-Pottery Neolithic B core assemblage*

The MPPNB assemblage of cores from domestic-related contexts consists mostly of flake cores (see Tables 7.18 and 7.19). The most frequently represented flake core types are multiple-platform followed by single-platform. Single-platform blade/let cores are the most common blade-core type, with only two bidirectional blade cores (both opposed-platform) present in the assemblage.
Recycling behavior is present in 16.4% (n=18) of the MPPNB core assemblage, and most often takes the form of exhausted blade cores recycled into flake cores. In addition to the resource conservation indicated by recycling, 18.2% (n=20) of the cores appear exhausted. Accordingly, a comparison of core size through time shows that although complete MPPNB blade and flake cores are on average the largest (Table 7.20), those of wadi-rolled and bedded flint and chert tend to be larger than those of Huweijir flint, suggesting that Huweijir flint cores were more often made on small clasts or nodule fragments and were intensively reduced. In fact, the MPPNB assemblage contains numerous multiple-platform flake cores of Huweijir flint that were so heavy reduced, they were almost small round spheres of flint by the time they were discarded (Plate 7.9). As indicated in Table 7.19, Huweijir flint is the most used resource material in the MPPNB, but non-Huweijir flint varieties are well represented too, especially among flake cores.

Late Pre-Pottery Neolithic B core assemblage

Flake cores also comprise much of the LPPNB assemblage, but in comparison to the MPPNB assemblage, blade cores make up a slightly greater percentage. Overall, however, the LPPNB assemblage has a similar distribution by core type as the MPPNB, with multiple-platform flake cores the most represented. The blade cores are similarly distributed with single-platform blade/let cores the most frequent type, followed by bidirectional blade/let cores (five are opposed-platform bidirectional). Only 6% of the LPPNB core assemblage retains signs of recycling, and as in the MPPNB, it is often exhausted blade cores recycled into flake cores. The lower apparent rate of
Table 7.18. Chronological distribution of core types\textsuperscript{a}.

<table>
<thead>
<tr>
<th>Core Type</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blade cores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single platform</td>
<td>9</td>
<td>11</td>
<td>22</td>
<td>48</td>
<td>90</td>
</tr>
<tr>
<td>Bidirectional</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>Core fragments</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Unknown/other</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Flake cores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single platform</td>
<td>17</td>
<td>24</td>
<td>82</td>
<td>155</td>
<td>278</td>
</tr>
<tr>
<td>Multiple platform</td>
<td>41</td>
<td>28</td>
<td>60</td>
<td>87</td>
<td>216</td>
</tr>
<tr>
<td>Bidirectional</td>
<td>11</td>
<td>11</td>
<td>42</td>
<td>57</td>
<td>121</td>
</tr>
<tr>
<td>Discoidal</td>
<td>7</td>
<td>3</td>
<td>19</td>
<td>28</td>
<td>57</td>
</tr>
<tr>
<td>Core fragments</td>
<td>7</td>
<td>3</td>
<td>13</td>
<td>31</td>
<td>54</td>
</tr>
<tr>
<td>Bifacial</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Tested piece</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Unknown/other</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td><strong>Mixed cores\textsuperscript{b}</strong></td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td><strong>Bipolar</strong></td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>108</td>
<td>99</td>
<td>269</td>
<td>434</td>
<td>910</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Twelve cores from transitional LPPNB/PPNC contexts, one from a transitional MPPNB/LPPNB context, and 221 cores from mixed/unknown contexts not included in the chronological distribution.

\textsuperscript{b} Represents combination blade/flake cores.

Table 7.19. Resource material distribution by core type\textsuperscript{a} and phase.

<table>
<thead>
<tr>
<th>Core Type</th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
<th>Total</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blade cores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single platform</td>
<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
<td>48/42</td>
<td>53.3%/46.7%</td>
</tr>
<tr>
<td>Bidirectional</td>
<td>7/2</td>
<td>6/5</td>
<td>15/7</td>
<td>20/28</td>
<td>25/3</td>
<td>89.3%/10.7%</td>
</tr>
<tr>
<td><strong>Flake cores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single platform</td>
<td>14/3</td>
<td>10/14</td>
<td>24/58</td>
<td>45/110</td>
<td>93/185</td>
<td>33.5%/66.3%</td>
</tr>
<tr>
<td>Multiple platform</td>
<td>27/14</td>
<td>19/9</td>
<td>25/35</td>
<td>43/44</td>
<td>114/102</td>
<td>52.7%/47.2%</td>
</tr>
<tr>
<td>Bidirectional</td>
<td>6/5</td>
<td>9/2</td>
<td>16/25</td>
<td>17/40</td>
<td>48/72</td>
<td>40%/60%</td>
</tr>
<tr>
<td>Discoidal</td>
<td>5/2</td>
<td>1/2</td>
<td>6/13</td>
<td>15/13</td>
<td>27/30</td>
<td>47.4%/52.6%</td>
</tr>
<tr>
<td>Bifacial</td>
<td>4/0</td>
<td>2/2</td>
<td>1/2</td>
<td>0/2</td>
<td>7/6</td>
<td>53.8%/46.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>65/26</td>
<td>53/34</td>
<td>99/140</td>
<td>145/240</td>
<td>362/440</td>
<td>45.1%/54.9%</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Excludes combination blade/flake cores, bipolar cores, unknown/other, tested pieces, and core fragments.

\textsuperscript{b} H signifies Huweijir flint and NH is non-Huweijir, which includes wadi-rolled, nodular, and bedded flint and chert available in the immediate site vicinity.
Table 7.20. Average size of cores by resource material type.

<table>
<thead>
<tr>
<th></th>
<th>MPPNB</th>
<th>LPPNB</th>
<th>PPNC</th>
<th>PN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Huweijir</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>59.0 mm</td>
<td>39.9 mm</td>
<td>35.7 mm</td>
<td>31.7 mm</td>
</tr>
<tr>
<td>Width</td>
<td>42.4 mm</td>
<td>30.9 mm</td>
<td>29.7 mm</td>
<td>27.9 mm</td>
</tr>
<tr>
<td>Thickness</td>
<td>28.9 mm</td>
<td>23.6 mm</td>
<td>21.2 mm</td>
<td>21.1 mm</td>
</tr>
<tr>
<td><strong>Non-Huweijir</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>56.2 mm</td>
<td>51.7 mm</td>
<td>47.7 mm</td>
<td>40.6 mm</td>
</tr>
<tr>
<td>Width</td>
<td>56.3 mm</td>
<td>46.1 mm</td>
<td>48.8 mm</td>
<td>40.5 mm</td>
</tr>
<tr>
<td>Thickness</td>
<td>41.0 mm</td>
<td>32.9 mm</td>
<td>37.8 mm</td>
<td>33.8 mm</td>
</tr>
</tbody>
</table>

recycling, when compared to the MPPNB, could be due in part to the greater representation of exhausted cores (37%), which are less likely to retain traces that would indicate recycling. The greater rate of exhaustion is also evident in the generally smaller sizes of cores, whether made from Huweijir flint or from wadi-rolled and bedded chert and flint (see Table 7.20).

Among the major core types of the LPPNB, Huweijir flint is less common and non-Huweijir flint is more common. This pattern is especially clear among single-platform flake cores, of which more are of low-quality bedded chert and flint than of Huweijir flint. In contrast, multiple-platform flake cores, which are more likely to be reduced to the point of exhaustion, are also more likely to be of Huweijir flint.

*Pre-Pottery Neolithic C core assemblage*

The cessation of naviform core reduction during the LPPNB may account for the larger number of unstandardized PPNC cores. The resultant reduction in blanks for tools from specialist producers meant that the inhabitants were responsible for producing all of their own tool blanks. Accordingly, core reduction in household contexts increased
noticeably. As in the PPNB, however, flake cores are the most common types in the assemblage (Table 7.18) and the most common blade/let core types were single-platform cores followed by bidirectional cores (10 are opposed-platform cores). Despite this general similarity, the distribution of flake core types in Table 7.18 shows that some differences exist between the PPNC and the PPNB periods. The greatest difference in the PPNC from the PPNB periods is the predominance of single-platform flake cores. This shift in representation of core types may be associated with a decrease in the availability of Huweijir flint, as cores of high-quality resource material tended to be more heavily reduced, often as multiple-platform flake cores. Conversely, poor-quality resource material is easier to reduce from a single platform.

The rate of core recycling in the PPNC assemblage is similar to that in the LPPNB, at 5.2% (n=14). Most often, these recycled cores are flake cores made from exhausted blade cores. The representation of exhausted cores in the PPNC assemblage is greater, however, with 43.1% (n=116) of the cores no longer in working order. The high rate of exhaustion could be the reason for a generally lower representation of recycling, and it most certainly contributed to the somewhat smaller sizes of Huweijir flint cores in the PPNC (see Table 7.20). As in the previous periods, Huweijir flint remained common among blade cores, but was noticeably less commonly used for flake cores. Single-platform flake cores are especially often of non-Huweijir flint. Multiple-platform flake cores have a greater number of non-Huweijir flint cores than in previous periods, but Huweijir flint remains more common among this core type than any of the other flake-core types.
Yarmoukian core assemblage

The core assemblage of the Pottery Neolithic is the largest of all the periods. When compared to the PPNC, the PN shows few differences in the major core types. Single-platform flake cores are the most common core type, followed by multiple-platform flake cores. The most common blade/let core types are consistent with the previous periods, that is, single-platform cores followed by bidirectional cores (six are opposed-platform).

When compared to the previous periods, the rate of recycling is even lower in the Yarmoukian at 2.78% (n=12), accompanied by a greater representation of exhausted cores (50%, n=216). The high rate of exhaustion is also evident in the size distribution presented in Table 7.20, with PN cores on average among the smallest. Huweijir flint is at its lowest representation in the PN, even among blade cores. Among flake cores, wadi-rolled and bedded chert and flint varieties are the most common resource materials, which is especially evident among bidirectional and single-platform flake cores. Multiple-platform flake cores continue to have a greater representation of Huweijir flint than most of the other core types. Interestingly, discoidal cores have a greater representation of Huweijir flint in the PN than in the previous periods, except the MPPNB. This anomalous pattern is difficult to explain, but could be due to the common practice of pit digging by townspeople in the Yarmoukian.

Summary of Core Analysis

As was found by Quintero (2010), the majority of household core reduction involved producing flakes, and to a lesser degree blades from non-naviform cores. Blade
cores are at the lowest representation in domestic-related deposits in the MPPNB, but, in general, all cores are less common in the PPNB periods. These trends are expected given the ready availability of blade blanks for tools produced from naviform cores in these times. After naviform core-and-blade production ceased, blade- and flake-core reduction in households increased as people took on the responsibility of supplying their own tool blank needs.

The most recognizable change in core type distribution through time is the increasing representation of single-platform flake cores, which became predominant in the PPNC and Yarmoukian periods. This increase in single-platform flake cores may be linked to the lesser availability of high-quality Huweijir flint after the LPPNB. That is, the single-platform flake cores examined here often are of lower-quality flint, which was easily available in the immediate site area, and because of the tool stone quality of many of these cores, they were not as easy to heavily reduce. Furthermore, the larger flake products from these cores (and other core types of lesser-quality flint and chert) often were made into heavy-duty flake tools such as scrapers or denticulates\textsuperscript{15}. Thus, it seems the lower quality flint was chosen in part because of its easy availability and because such tool stone is often more durable and useful for heavy-duty tools.

Conversely, multiple-platform flake cores, which are more often of high-quality flint (both from Wadi Huweijir and high-quality wadi-rolled flints), are more fully exhausted. This pattern suggests cores of high-quality resource material were easier to reduce, and therefore more likely to be reduced to the point of exhaustion, which often

\textsuperscript{15} This pattern was observed by Quintero (2010:111).
was achieved by using multiple platforms. Furthermore, it accords well with the evidence from the flake debitage, which shows a decline in the size of flakes of Huweijir flint through time. Additionally, it seems the higher-quality flint was preferred for tools that required a sharp edge or for those that were hafted and more likely to have long use-lives. Tool blanks supplied by such core reduction were used for both formal and informal tools, and the smallest flakes, produced late in reduction, may have been used as expedient cutting tools or scrapers with very little modification (many of which, likely fall into the retouched and used flake category).

Other changes through time are evident in the rates of recycling and exhaustion. Obvious recycling of exhausted blade cores to another core type is most identifiable in the MPPNB. It seems in the MPPNB, cores were not as often reduced to exhaustion and thus retained some traces of the previous reduction trajectory. The representation of recycled cores decreases after the MPPNB. Concomitantly, the rate of exhaustion increases steadily through time, and is always greater among Huweijir flint cores. Likewise, core size is generally larger in the MPPNB and decreases through time. Among cores of Huweijir flint, this decline in size through time can be attributed to the more intensive use of this resource material as it became less readily available in later periods.

Additionally, given the comparatively lower number of cores made from Huweijir flint, it does not seem that individuals or small groups regularly mined it for their own needs or had unlimited access to it; rather, as argued by Quintero (1996, 2010), mining efforts were dangerous and difficult, and related primarily to the specialized production...

16 Projectile points and sickle elements in the post-PPNB periods were both sometimes made on flakes, and flakes served as blanks for borers and knives throughout the occupation span.
of naviform cores-and-blades, so that its acquisition was controlled. Accordingly, it seems reasonable to suggest that in the MPPNB and the early portion of the LPPNB, most townspeople relied on what Huweijir flint was available as discard from the specialists’ workshops on the site. Perhaps acquiring resource material rejected by the specialist stone workers, such as broken fragments and exhausted cores. In the later periods, they scavenged flint from old site deposits.

**LPPNB ASSEMBLAGE VARIATION**

As was evident among the formal and informal tool assemblages, some of the LPPNB deposits can be associated with an early and a late phase, and some differences in the representation of Huweijir flint and blades from naviform cores are apparent between these phases. In addition to phase differences, some variation is apparent among materials recovered from the different excavation areas during the LPPNB\(^\text{17}\). The following discussion examines these patterns among the debitage, tool-production debris, and core assemblages.

**Assemblage Variation between the Early and Late Phases of the LPPNB**

An examination of flakes, blades, and tool-production debris\(^\text{18}\) from the early and late LPPNB phases suggests some changes occurred during the LPPNB in the representation of blades from naviform cores and the use of Huweijir flint. Specifically, among production by-products, blade blanks from naviform cores are more frequent in

\(^{17}\) It is difficult to say to what extent these deposits are contemporaneous beyond being associated with a phase of the LPPNB.

\(^{18}\) Chamfered-bit spalls and production failures are not included here because either the sample was too small to draw meaningful conclusions from or because few differences between the samples from each phase were apparent.
the early LPPNB (sample of 339), at 90.9%, and decreases to 82.7% in the later LPPNB (sample of 81)\(^{19}\). Among tool blanks, a discernable drop in the proportion of blanks from naviform technology is evident, from 100% in the early LPPNB assemblage (total sample is n=45) to 86.4% in the later LPPNB assemblage (total sample is n=22). Regarding differences in the representation of Huweijir flint, among the LPPNB flake debitage assemblage, Huweijir flint comprised 86.23% of the resource material from early LPPNB deposits (sample size n=1,409) and only 41.66% from later LPPNB phase (sample size n=1,613). Similarly, among the blade assemblage from the LPPNB, those samples from early LPPNB loci (sample size n=406) have a percentage of Huweijir that is much closer to that of the MPPNB, at 96.07%, while those recovered from later LPPNB loci (sample size n=226) are somewhat lower, at 90.27%\(^{20}\). The burin spall assemblage also shows a few clear differences, especially in the representation of Huweijir resource material. From the earlier LPPNB sample of 108, 92.6% of the resource material is Huweijir flint, compared to 66.4% from the later LPPNB sample of 128. Unfortunately, the cores assignable to the different LPPNB phases are not numerous enough to make meaningful comparisons.

The differences among the debitage and tool-production debris assemblages between the early and late phases supports the findings from the formal tools and some of the informal tools, suggesting that many of the changes in the flaked-stone assemblage

\(^{19}\) No difference in the representation of Huweijir flint between the phases is apparent for tool-production by-products.

\(^{20}\) No major differences in the representation of blades from naviform cores are apparent between the phases.
associated with the loss of naviform core-and-blade specialization began during the course of the later LPPNB.

**Intrasite Assemblage Variation in the LPPNB**

Variation between different excavation areas during the LPPNB is evident in nearly all of the assemblages examined here\(^\text{21}\). For example, when the LPPNB blade samples from some of the major excavation areas are compared (specifically, the East Field and North Field), some variation is noticeable. The East Field samples (sample size \(n=599\)), including both early and late phases, have a strong representation of both Huweijir flint and blades from naviform cores, at 93.49% and 75.13%, respectively. In contrast, the North Field sample (\(n=136\)) is very different, regardless of phasing, with only about 46.32% of the sample comprised of Huweijir flint and 10.29% blades from naviform cores.

Similarly, the flake assemblage from the East Field (\(n=2,439\)) has the highest percentage of Huweijir flint, at 73.3% (a trend that appears to be the case for both early and late deposits in this area—see also LPPNB selected loci in chapter 8). The debitage sample from the North Field (\(n=906\)) has a much lower percentage of Huweijir flint, at 37.31%.

Among tool-production debris, only production by-products show variation between major excavation areas, specifically, the East Field and North Field. From the East Field deposits (early and late phases combined), about 89.5% of the blade-sectioning

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\(^{21}\) The LPPNB burin and chamfered-bit spall assemblages, the tool blank assemblage, and the production failure assemblage, however, showed few significant differences between excavation areas and are not discussed.
by-products appear to be from naviform cores and about 99.52% of the resource material is Huweijir flint. The North Field has a lower representation of blades from naviform cores at about 47.6% and only about 69.49% of the tool stone is Huweijir flint.

Unfortunately, the core assemblage in both the Central Field and the outlier square 3300, yielded only small samples of LPPNB cores (13 and 12, respectively) and comparison between them was not informative. The East Field sample (n=50) and North Field sample (n=23), however, were a little larger, but a comparison between them showed only minor differences in resource material use. Few differences are apparent in the types of cores represented in each area; single-platform cores (n=13) are a little more common in the East Field than are multiple-platform cores (n=8), conversely, in the North Field, multiple-platform cores (n=8) are a little more common than single-platform cores (n=5). Additionally, in general, the East Field has a greater diversity of core types, but this may be due to the larger sample.

As suggested for the formal tool assemblage, the greater percentage of Huweijir flint in the East Field deposits may be due to the presence of a later MPPNB naviform core-and-blade production workshop, which may have served as an additional source of Huweijir flint and blades and flakes, etc., from naviform core reductions in this area of the town during the LPPNB. Additionally, it is possible that these differences in representation result from differential access between households to products anddebitage from naviform core production.

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22 For instance, the percentage of Huweijir flint (69.23% and 63.27%) was only a little different.
SUMMARY

Changes in the flake and blade debitage assemblages reflect the technological and economic changes apparent in other aspects of household tool production. In the MPPNB, blades from naviform cores supplied blanks for the production of many formal and informal tools. Nonetheless, flake-core reduction strategies intended to produce blanks for tools, and to a lesser extent other blade core reduction strategies, were also important, although to a lesser extent than in the later periods. Likewise, because of the greater reliance on blades that were created by specialist craftspeople, use of Huweijir flint was also most common in the PPNB. Overall, the debitage data demonstrates a certain degree of continuity with the other assemblages. Tool-production debris reflects changes in projectile point and sickle element assemblages through time. Also, biface production flakes from tabular flint commonly used for bifacial knives increased noticeably in the LPPNB, which coincides with the findings from the knife assemblage and suggests they were important tools that were made and maintained in most households. Similarly, evidence of the manufacture and maintenance of woodworking tools is present in domestic-related deposits throughout the occupation. Finally, the debitage assemblage includes evidence of other, nonproduction activities, such as scavenging of flakes and blades from naviform cores, which appears to have been commonplace throughout the later occupations of the site.

An additional result of this careful debitage analysis was the identification of tool production debitage. The presence of this debitage in household contexts provides strong evidence that the majority of townspeople made and maintained their own tools for use in
a variety of production activities that occurred in individual households. In addition to clarifying the context and extent of tool production, trends such as the decline in chamfered-bit tools and spalls and the increase in the production of burin spalls for tool blanks may be associated with changes in subsistence choices and resource availability starting in the LPPNB.

An analysis of the core assemblage provides support for the findings from the flake and blade debitage assemblages that unstandardized flake core, and blade core, reduction was commonplace in households throughout the occupation of the town. Furthermore, flake-core reductions became more commonplace after products from naviform cores were no longer widely available. Similarly, a preference for high-quality flint for some tool types was evident in the more concentrated use and smaller discard size of flake cores made of Huweijir flint.

Finally, as with the formal tool assemblage, evidence from the debitage, tool production debris, and core assemblages, suggest that some of the changes commonly associated with the PPNC may have started in the later portion of the LPPNB. Moreover, evidence from diverse excavation areas suggests that blade products from naviform core technology were not equally available across the site during the LPPNB.
Chapter 8

PRODUCTION AND MAINTENANCE OF FLINT TOOLS AT ‘AIN GHAZAL: EVIDENCE FROM HOUSEHOLD WORK AND WASTE CONTEXTS

NEOLITHIC ECONOMIES AND THE FLAKED-STONE TOOL KIT

Neolithic economies depended on flaked-stone tools to carry out a variety of daily tasks, which is demonstrated by the large flaked-stone assemblages at many sites, the diversity of formal and informal tool types, and the abundant evidence of different core-reduction strategies. These different tool types and core-reduction strategies show changes through time along with changes in subsistence, resource availability, and socioeconomic structure. As made clear in this research, and in that of others, the tool kit at most Neolithic sites was diverse, designed to carry out an array of tasks that were part of the day-to-day existence of Neolithic people. Building on the findings from the three previous chapters, these probable tasks, the flaked-stone tools used to carry them out, and the patterns from specific contexts associated with the production, maintenance, retooling, and discard of these tools, are the focus of this chapter.

The Tasks and Tools of Daily Life

The following discussion of common pursuits in the life of Neolithic peoples involves some speculation, and it by no means encompasses the totality of activities carried out on a daily basis. Nonetheless, it is important to consider what some of these tasks may have been and the tools used to carry them out. To that end, this section considers some tasks and tools associated with hunting, harvesting, bead production, hide working, bone/antler working, and woodworking.
Hunting

Despite the often-cited reliance on domesticated plants and animals associated with the Neolithic period, hunting remained an important aspect of Neolithic subsistence. Evidence from the faunal assemblage at ‘Ain Ghazal suggests that the hunting of wild animals including gazelle, and less often wild cattle and wild boar (Rollefson 1985:90-98; Köhler-Rollefson et al. 1988:423) was common in the MPPNB. After the MPPNB, domesticated animals became increasingly common, coming to dominate faunal assemblages by the PN. Despite the greater reliance on domesticated animals in the later periods at ‘Ain Ghazal, the presence of gazelle and onager in the faunal assemblage provides evidence that hunting continued into the post-PPNB periods (Köhler-Rollefson et al. 1988; Rollefson and Simmons 1988:417; von den Driesch and Wodke 1999).

Although hunting may not have been a daily activity, it was a frequent activity that occurred in the surrounding environs and further afield. Production and maintenance of the equipment used for hunting, including projectile points, shafts\(^1\), dart throwers (atlatls), and bows would have been among the regular tasks undertaken in most households. As discussed in Chapter 5, the projectile points were shaped by pressure retouch and often were made on standardized blades from naviform cores in the PPNB. After the LPPNB, inhabitants obtained suitable tool blanks by scavenging old blades and tools, and by producing their own unstandardized blade or flake blanks. The perishable

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\(^1\) Dart and arrow shafts may have been made from tamarisk (*Tamarix* sp.) or reeds (*Phragmites* sp.) The presence of basalt shaft straighteners, found in PPNB and PN contexts at ‘Ain Ghazal (Rollefson 1984; Rollefson and Simmons 1985, 1986; Rollefson et al. 1989; Kafafi and Rollefson 1995) attests to the use of reed shafts, which may have also been used for hafted drill shafts (Wilke and Quintero 2009).
shafts, dart throwers, and bows that were a part of these projectile weapon systems\textsuperscript{2} may have been shaped with light woodworking tools, including notches, chisels, transverse and dihedral burins, and possibly chamfered-bit tools\textsuperscript{3}.

In addition to the production and maintenance of hunting weaponry, hunted animals supplied numerous products, the processing of which would have been common activities at ‘Ain Ghazal and other Neolithic sites. For instance, hunted animals would have supplied sinew for hafting (and sewing) and feathers for fletching and decoration. In addition, their hides would have been processed using scrapers to create clothing, bags, containers, etc. Butchery of carcasses may have been carried out with both hafted and hand-held knives, and importantly also with sharp flakes. Bones\textsuperscript{4}, antlers, and horns also would have been fashioned into tools, using implements such as burins (transverse and dihedral), denticulates, and other expedient flake and blade tools.

\textit{Harvesting}

Another emphasized feature of Neolithic subsistence is the domestication of plants and the use of cereal crops. According to a recent synthesis of analytical studies of Neolithic plant remains, during the MPPNB and into the LPPNB, people cultivated and used both wild and domestic cereals (e.g., Neef 1997; Asouti and Fuller 2012). At ‘Ain

\footnotesize
\textsuperscript{2} As discussed in Chapter 5, changes in the lithic economy at ‘Ain Ghazal impacted projectile point morphology, but such developments may also reflect technological change. Although the relationship is hardly straightforward, it seems likely that both the dart thrower (atlatl) and dart, and bow and arrow continued to be used throughout the Neolithic, with perhaps greater emphasis on the bow and arrow later in time (e.g., Eighmey 1992; Gopher 1994).

\textsuperscript{3} Except for chamfered-bit tools, which have not been studied for that function, use-wear studies support the use of these tools in woodworking (Stafford 1977; Keeley 1982; Unger-Hamilton 1988; Yamada 2000; Yerkes and Barkai 2013:228-229).

\textsuperscript{4} Worked bone is well represented in the ‘Ain Ghazal assemblage and many of the tools appear to have been associated with weaving, sewing, and possibly leatherwork (Rollefson 1984; Rollefson and Simmons 1985, 1986; Rollefson et al. 1992).
Ghazal, these crops included domesticated wheat, barley, peas, lentils, and chickpeas, along with wild species such as figs, almonds, pistachios, and various weeds (Rollefson et al. 1985:96-104; Rollefson et al. 1992:453). These crops would have been planted in the areas near the town so they could be protected, and it is easy to imagine that individuals from most households would have taken part in the planting, care, and harvesting of them. While we have a botanical record for ‘Ain Ghazal and many other sites supporting the cultivation and use of cereal crops, indirect evidence of these activities is provided by sickle elements and reaping knives (both glossed and unglossed). Functional studies suggest that they were used in the harvesting of both wild and domesticated cereal crops, as well as other plants such as reeds (Unger-Hamilton 1988, 1989; Quintero et al. 1997; Yamada 2000)

Producing sickles involved crafting the haft, which, taking into account the hafted sickles that have been found (e.g., Bar-Yosef and Alon 1988:17; Khalaily et al. 2005), may have been made of antler, horn, bone, or wood. Shaping the sickle may have involved the use of a variety of tools, including gravers (transverse and dihedral burins), chisels, and perhaps chamfered-bit tools (see note 3). The cutting edge was achieved by embedding flint blades or flakes in the handle with mastic. During the PPNB, sickle elements often were blade segments (Lechevallier 1978; Crowfoot Payne 1983; Gopher 1989; Olszewski 1994; Quintero et al. 1997; Simmons et al. 2001; Khalaily et al.

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5 For instance, experimental research demonstrated that attributes of the ‘Ain Ghazal sickle element assemblage provide insight into harvesting strategies. Specifically, the high incidence of heavy sickle gloss in the MPPNB suggests inhabitants harvested cereals before they were fully ripe, indicating the cultigens may not have been fully domesticated. Likewise, the lower incidence of gloss in later periods indicates that the harvested grasses were ripe and likely to have been fully domesticated (Quintero et al. 1997:282).
2003:32; Garfinkel et al. 2012), and at some sites, specialists supplied the blade blanks. In the post-PPNB, irregular blade and flake blanks were more commonly used and so was the use of retouch to shape elements for fitting into the haft. Many members of a household would have used such implements frequently, and thus production, and especially maintenance, of these tools would have been commonplace tasks throughout the occupation of the town.

*Other cutting tasks*

Perhaps one of the most common activities undertaken on a daily basis in and around the household (and further afield) would have been cutting. Most meat processing, leather working, and much plant processing involved the use of cutting implements. The list of activities that would routinely have necessitated the use of a knife is perhaps longer than compiling a list of activities that did not involve the use of one. Because cutting was involved in the processing and other modification of many different materials, some knives were hafted and others were hand-held, many were expediently made and as such, knives as a functional category exhibit much variation, which may account for why they are not commonly described in detail in publications on site assemblages in the southern Levant6 (e.g., Simmons and Najjar 2003; Garfinkel et al. 2012; Khalaily et al. 2003).

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6 Use-wear studies on used/retouched blades suggest they were employed on a variety of materials including bone/antler, woods, plants, etc. (Yamada 2000). Such diversity of use is indicated at ‘Ain Ghazal. Numerous flake and blade knives have some form of residue or sheen from use, and at least one of the examined blade-based knives was used to cut or saw ochre and has a noticeable deposit of ochre along with obvious dulling of the cutting edge. More use-wear research on this tool category is necessary at ‘Ain Ghazal to understand more fully the range of function these implements served.
As presented in Chapter 5, the common knife types at ‘Ain Ghazal include knives on blades, bifacial knives, tabular bifacial knives (including tile knives), and knives on flakes. The effort involved in the production of cutting implements varied greatly among types. Flake-knives could be produced as simply as removing a flake from a core and using it\(^7\). The blade knives were most often made on standardized blades from naviform cores (especially in the PPNB), but others were made on less regular blades, including those from other core-reduction strategies. Some of the blade knives may have been hand-held, but others have tangs indicating that they were hafted, and many more (especially blade segments) would have been more useful if hafted. For the hafted blade-based knives, the handles are likely to have been made of similar materials (bone, antler, wood) as those used for sickles, and they would have involved a similar production process and tool kit. In contrast to blade and flake knives, bifacial knives are more time-consuming to produce, and although some may have been hafted, they are easily used without being hafted. Additionally, bifacial knives can be resharpened repeatedly; thus, they represent tools with longer use-lives.

Given the commonality of tasks that involved cutting, the necessity and the frequency of the use of knives changed little through time. Thus, as discussed earlier, the majority of changes evident in the knife assemblage examined in this research are likely to be associated with changes in the common core-reduction strategies that supplied tool blanks. At ‘Ain Ghazal, blades from naviform cores became less common through time and flakes produced through simple flake-core reduction, while always present, became

\(^7\) The numerous exhausted flake cores found in household contexts suggests these cores may have yielded many such small flake knives, even in the PPNB.
more common. Additionally, starting in the LPPNB, bifacial and tabular knives became more common, and remained in use through the PN.

**Drilling, boring, and perforating**

Hide working, bead and pendant production, bone/antler working, basketry, and some woodworking all involved drilling, boring, or perforating (e.g., Keeley 1983; Unger-Hamilton 1988; Yamada 2000; Coskunsu 2008). Such tasks would have occurred frequently, and unlike hunting or harvesting, they would have been carried out in or around households. As discussed in Chapter 5, the hole-making implements necessary to carry out these activities are generally referred to as borers, perforators, or drills, and they encompass a variety of tools of different configurations (some hafted and others handheld) and sizes. This diversity suggests that tools for perforation were involved in a number of different production tasks on a variety of materials.  

Perforators and more generalized boring implements likely were involved in a variety of tasks including leather working, bone or antler working, and woodworking. Fine boring implements, such as drills, appear most clearly associated with bead production at Neolithic sites. Drills were usually made on blades, bladelets (such as at Al-Basit [Rollefson 2002]), and burin spalls, which became commonplace in the LPPNB. At some sites, however, the quantity of truncation burins suggests the number of spalls

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8 For instance, at ‘Ain Ghazal beads and pendants of both hard and soft stones (e.g., carnelian and greenstone) are present, as well as shell and bone beads, and some bone implements that appear to have been perforated (Rollefson and Simmons 1984; Rollefson et al. 1994). Furthermore, if Quintero et al. (2004) are correct about the use of burin spalls as teeth in combs used to harvest wool, holes to receive such spalls would have had to be drilled.

produced seems to far exceed those used for drills (Finlayson and Betts 1990; Yamada 2000; Quintero et al. 2004). As discussed in previous chapters, this preponderance of burins at some sites suggests the spalls produced served functions other than drilling (cf. Quintero et al. 2004).

Several boring tool types appear to have been hafted specimens (B7, B8, B10, B12, B15, and some smaller B3, B4, and B5 type borers). Although the haft or shaft portions of these implements did not preserve, they likely were reed or wood shafts (see footnote 1 above), which may have been rotated by hand or used with a bow. Such shafts would have been prepared easily with notches, scrapers, and knives. The bits of hafted drilling implements often consisted of blade/let fragments or burin spalls. Hand-held borers and perforators were made on both blades and flakes, the latter of which became more common in the post-PPNB periods. Although some fluctuations among borer types associated with finer drilling tasks is evident, it appears such tasks remained commonplace in households throughout the occupation.

*Woodworking*

Timber exploitation and woodworking were also common tasks in the Neolithic. Axes used for woodcutting are well represented in most site assemblages (Barkai 2005). The timbers were cut from the woodlands (mainly oak in the case of ‘Ain Ghazal [Simmons et al. 1988:37]) surrounding the settlement and were used for house construction and also as fuel in plaster production and hearths (Garfinkel 1987; Rollefson

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10 Use-wear studies suggest such a distinction is possible (e.g., Ibáñez et al. 2007), but no such studies have been conducted at ‘Ain Ghazal.
1990; Rollefson and Pine 2009). People would have used adzes, which are not as heavy-duty as axes, for finer trimming and shaping of large timbers, among other tasks (Barkai 2005:46-47; Yerkes and Barkai 2013). Some of the smaller branches and logs were surely used to produce an array of wooden tools, including sickle and knife handles, shafts, bows, and spear throwers for projectile weapons, handles for woodworking implements, and other items such as containers, bowls, and boxes (recall that the remains of a wooden box filled with blades and weapon points was identified at Beidha [Mortensen 1980]).

These finer woodworking tasks likely were undertaken in households and may have involved the use of chisels, scrapers, notches, and perhaps chamfered-bit tools for fine shaving and shaping. Such woodworking tasks may have been made much easier through the use of controlled burning\footnote{Modern replicative work to create a dugout canoe employed burning, controlled in its extent by mud to protect the wood surrounding the hollowed-out interior of the craft. This work conducted by James Dina and detailed in a five-part collection of videos available on YouTube (on the LivingStoneAge channel) demonstrates how the use of burning makes the process much easier and minimized the use of stone tools. A 1996 article in the Bulletin of Primitive Technology, no.12, called “The Dugout Canoe” also detailed the process of production.}; the resultant charring easily could be scraped away, requiring minimal carving. As with the other tools, evidence from household deposits across the site and through time, suggests that the entire woodworking tool kit at ‘Ain Ghazal was produced in ordinary individual households (Quintero and Hintzman 2007).

Although the timbers and wooden implements are not commonly preserved, changes in housing construction (e.g., a more subdivided layout) suggest that the sizes of timbers used for construction steadily declined starting in the MPPNB at ‘Ain Ghazal (Rollefson and Köhler-Rollefson 1989). As discussed above, similar evidence is present at PPNB sites across the southern Levant (Barkai and Yerkes 2008; Barkai 2011; Yerkes 2011).
and Barkai 2013). The flaked-stone assemblage at ‘Ain Ghazal and at other sites reflects this change as a decline in the number of axes and an increased emphasis on more versatile or lighter woodworking tools such as adzes and chisels (Quintero and Hintzman 2007; Barkai 2005; Barkai and Yerkes 2008; Barkai 2011; Yerkes et al. 2012; Yerkes and Barkai 2013; Yerkes et al. 2014).

*Multifunctional tools of the Neolithic*

As suggested in the preceding tool descriptions, on a daily basis informal tools were employed in a diverse array of tasks by townspeople. For example, use-wear studies have linked scrapers, notches, denticulates, and used and retouched flakes and blades to the working of numerous materials including hide, wood, bone/antler, plant materials, and even stone\(^{12}\) (Unger-Hamilton 1988; Verhoeven 1999; Yamada 2000; Ibáñez et al. 2007). Clearly, tools such as these were expediently produced and used, and are unlikely to have been hafted, as few exhibit the kind of shaping or extensive retouch associated with the maintenance of hafted tools. That is, most of these informal tools were manufactured on unstandardized blade and flake blanks produced in most households.

Conversely, although burins and chamfered-bit tools are classified as informal tools, they have characteristics suggesting they are not purely expedient. In fact, some types of burins may have been associated with specific tasks or they have a specific role in the production of other implements. For instance, it has long been recognized that

\(^{12}\) Additionally, although the combination tools have not been specifically examined for use-wear, they have clear attributes associated with multifunctionality (e.g., more than one type of working edge).
engraving of bone, antler, wood, and perhaps even soft stone may have been achieved with dihedral burins and some transverse burins (Clark and Thompson 1953; Semenov 1964; Stafford 1977; Odell 1981; Keeley 1982; Unger-Hamilton 1988; Finlayson and Betts 1990; Barton et al. 1996). Neither of these tool types appears to have been hafted, so the only production necessary was that of the implement itself. These burin spall cores, especially concave-truncation burins, were often made on large flakes and blades produced in core reduction that occurred in most households.

The function of chamfered-bit tools is not well known, nor are they commonly mentioned in Neolithic site reports. As discussed in Chapter 6, they are argued to have been some type of cutting or scraping implement (Crowfoot Payne 1983; Newcomer 1988), which potentially could have been used in a wide variety of tasks, such as hide working, woodworking, or basketry and other textile production. They may have been hafted, but it seems likely they were hand-held, as none show features consistent with hafting. Most are made on blades, many of which were from naviform cores, and they were most common in the MPPNB, declining in representation in the LPPNB.

CONTEXT OF PRODUCTION, MAINTENANCE, AND RETOOILING

Composite Tools and Retooling Patterns

Clearly, both composite and simple hand-held tools were important for tasks carried out on a daily basis during the Neolithic. Many of these tasks occurred in or

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13 Textiles including cordage, coiled baskets, and woven fabrics are well represented at sites such as Nahal Hemar, demonstrating such crafts were well established by the Neolithic period (Schick 1986). Additionally, use-wear analyses and ethnographic research conducted by Ibáñez et al. (2007:159) identified blades with wear that may have resulted from the use of processing plant materials for textile production, indicating used blades and blade tools such chamfered-bit tools may have been employed in a similar manner.
around households, or at some distance from the site, and the patterns of production, maintenance, and retooling would have been affected by the context of use and the practice of hafting. As suggested by Keeley (1982:799-802), retooling, or replacing the hafted lithic component of a tool haft, often occurred in locations removed from their place of use; as such, the presence of broken, discarded, and damaged tools cannot unequivocally be viewed as an activity area. Specifically, retooling of composite implements tends to occur in locations where the necessary tools, space, and materials are easily available, which at Neolithic settlements such as ‘Ain Ghazal would have been the household area. Conversely, hand-held tools are likely to have been made and discarded near where they were used (Keeley 1982:802). Thus, many of the hand-held tools likely were produced and discarded along with the production, maintenance, and retooling of composite tools. So, although some of the common tasks occurred at locations farther away from the town (for example, hunting, harvesting, woodcutting, and pastoral activities), the implements used for them likely were replaced and maintained by the members from individual households who used them. Given this pattern of repair of functionally different tool types, the resultant concentration of lithic debris will show clear typological and functional variation (Keeley 1982:802), and at Neolithic settlements, such deposits should be commonplace.

**Context of Core Reduction and Tool Production**

In the southern Levant, there is abundant evidence from excavation of town and village sites of discrete work areas and debris dumps representative of food production, plaster production, core reduction and tool production, sandstone ring production, and
other industrial endeavors. Specifically, in relation to flaked-stone reduction, numerous site reports have mentioned the presence of loci that appear to have been locations where core reduction and tool production occurred (both specialized and generalized) or the remains of such activities were discarded.

It seems that at most Neolithic sites in the southern Levant, core reduction and tool production that occurred at the settlement took place in households, and thus, the deposits are distributed broadly across the site. At some PPNB towns and villages, however, discrete workshop deposits containing the remains of standardized blades of high-quality flint, indicate such industries were produced by a few skilled, specialist craftspersons. At these sites with specialization, tool production and much core reduction also continued to occur in households, but some variation in the extent of specialization and household lithic production is apparent.

Unfortunately, little detailed research has been devoted to identifying the material signatures of domestic-related production at Neolithic sites with a specialized aspect to their lithic economy. The most detailed analyses on generalized production that occurred

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15 For instance, Gebel (1996) for Basta; Simmons et al. (2001) for Wadi Shu‘eib; Davidzon and Goring-Morris for Kfar HaHoresh (2007); Barzilai for several sites (2010); and Garfinkel et al. (2012) for Yiftahel.

16 For instance, Gebel (1996), Barzilai (2010), and Khalaily et al. (2013) suggest that specialized industries at Basta and Yiftahel encompassed naviform core-and-blade production, as well as the production of some formal tools (some projectile point types). At both sites tool production in households is described as ad hoc in nature. At ‘Ain Ghazal, however, research (Quintero and Wilke 1995; Quintero 2010; Barket 2013) indicates that during the PPNB, standardized blade blanks were obtained from workshops and used in individual households for the production of flaked-stone tools and tool elements. Additionally, flake- and blade-core reduction and tool production from the resultant blanks continued to occur in households.
in households have been carried out at ‘Ain Ghazal. Quintero and Hintzman (2007),
Quintero (2010), and Barket (2013) identified primary and secondary waste deposits
associated with the production of woodworking tools, formal and informal blade and
flake tools, and core reduction. Specifically, Quintero (2010:127-130) identified
deposits from each period of occupation characteristic of the type of production that
occurred in most households. The deposits contained evidence of unstandardized flake
and blade core reduction to produce blanks, and broken and exhausted tools discarded in
the process of retooling, as well as tool blanks, preforms, and production breaks for an
array of tool types. Therefore, it seems reasonable to suggest that such deposits document
flaked-stone production by ordinary people in their households at ‘Ain Ghazal, and that
such patterns apply to other southern Levantine sites.

**Skill and Generalized Production**

In addition to identifying the character of deposits with evidence of generalized
core reduction and/or tool production, it is important to consider the skill level involved
in their production. As discussed in Chapter 4, skill is often addressed in reference to
specialized production; however, it is a consideration for any type of production, and
therefore requires discussion here for core reduction and tool production at ‘Ain Ghazal.

The understanding of the skill necessary to reduce unstandardized flake and
blade(let) cores and the tools widely occurring in domestic-related deposits, draws from
my personal experience as a stone worker and information from the skilled stone workers

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17 The description of what is considered tool-production debitage is detailed in Chapter 7.
who instructed me and many other students (P.J. Wilke and L.A. Quintero). Within the first few weeks of learning, most of my classmates and I were able to produce unstandardized flake cores and flake tools on a variety of raw materials. Simple single-platform blade(let) cores of various sizes took perhaps a few months for most of the students to pick up. Pressure flaking took more time and practice, but most were able to produce pressure-flake tools and projectile points within several months.

Beyond my experience as a stone worker, archaeological and ethnographic evidence provides support for the contention that most tool production at settlements such as ‘Ain Ghazal could have been carried out by many of the inhabitants. Although numerous examples can be found in archaeological literature, only a few are necessary to illustrate the point. For instance, drawing on replicative experimentation, archaeological evidence, and ethnographic evidence, Whittaker (1987:475) examined arrow points from Grasshopper Pueblo, Arizona, and determined that not only was it possible to identify individual producers, but that based on the range of variation in the production of these tools (from clumsily made to superbly made), many knappers must have been active at the pueblo. Based on these observations, Whittaker concluded there was no clear evidence of part-time specialization in the production of projectile points, an assertion supported by the ethnographic record, which suggested that most people learned all the common production and processing activities associated with their gender. This situation likely was the norm at most pueblos prior to European contact and the circumstances at

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18 Most of the students in the class were between the ages of 20 and 35, and while this may be later than was common among prehistoric peoples, it is not likely that people were taught flintknapping at very young ages even in prehistory (see discussion in Ferguson 2008:61-63).
‘Ain Ghazal and many other sites the world over were surely very similar. In a similar manner, Bamforth and Hicks (2008), who conducted research on Paleoindian sites in southwestern Nebraska, suggested that if no complex organization was in place that caused a separation between tool-makers and tool-users, then the minimal skill involved in creating a functional stone tool makes it likely that tool makers and users were the same people (Bamforth and Hicks 2008:150). While they may be discussing this issue in the context of Paleoindian groups, theirs is an argument that is nonetheless relevant to many situations.

Although the above examples draw from different locations and time periods, there is no reason to believe that most of the tool production that occurred at Neolithic villages and towns in the southern Levant was any different, even at those few sites with evidence of part-time specialization. It is with all of this information in mind that the following discussion explores the difficulty of core reduction and tool production at ‘Ain Ghazal.

Cores

Flake cores would have been easy to reduce, even for poorly skilled knappers. Moreover, the flint used for many of the cores was obtainable from the immediate site area, easily within reach of anyone in need of tool stone. The resource material ranged from low-quality bedded flints and cherts to higher-quality wadi-rolled flints. Some flint from Wadi Huweijir was used for cores throughout the occupation span, although evidence suggests it likely was acquired from deposits containing the remains of naviform core-and-blade production in the PPNB, and in the PPNC and PN from
scavenging in earlier deposits. Without a doubt, the higher quality resource materials were easier to reduce and many cores of these materials are heavily reduced. The lower quality materials, which often have inclusions, flaws, and texture differences, would have been more difficult to reduce, but almost anyone who knew how to remove a flake could have removed a few flakes as needed from cores of this material, even if they did not reduce the cores to exhaustion.

Blade cores are much more difficult to both produce and reduce, requiring more preparation, shaping, platform tending, maintenance, and error-correction measures, but the single-directional and bidirectional blade/let cores present in domestic deposits at ‘Ain Ghazal were much less regular in form and smaller than naviform cores, and they produced fewer and less-regular blanks. Thus, although they may have been more difficult to reduce than flake cores, their reduction required far less expertise than naviform blade production, which would have been within the ability of many knappers.

Tool production

Tool production and maintenance would have been common tasks in households, and most of it could have been carried out with relative ease. In the PPNB, much of the formal tool production and some informal tool production was based on blades from naviform cores. Therefore, most formal and informal tool production was relatively easy and involved little beyond sectioning blades to size for hafting; a modest amount of light flaking (percussion and pressure) to modify edges; and perhaps burinations to produce
chamfered-bit tools or burins spalls, and trim blades\textsuperscript{19}. Some post-PPNB tool production, however, may have been more challenging because it relied on less regular blank types on a variety of resource materials from unstandardized core reductions. Scavenging of flakes, blades, and tools from earlier periods was also common in the PPNC and Yarmoukian. The combined effect of reworking scavenged blanks and tools and working with less regular blanks meant that PPNC and Yarmoukian flint workers more often used invasive systematic and nonsystematic pressure retouch to shape their tools. This pattern is especially evident among formal tools, which are often so extensively retouched that the blank is indeterminate. Despite the greater effort involved in this later tool production, most knappers would have been capable of producing such tools.

During the PPNB, however, the manufacture of some formal tools appears to have been more standardized, including that of some of the projectile points, specifically, those with diagonal parallel (Abu Gosh) pressure treatment of the haft element. Such types are sometimes claimed to be examples of specialized production (e.g., Barzilai 2010; Khalaily et al. 2013)\textsuperscript{20}. Nevertheless, the factors that contribute to their regularity are attributable to much more than just skill. As established throughout this analysis, blank choice was a major factor in the manufacture of many of the formal tools, with projectile points produced on fine blades with a trapezoidal, triangular, or trapezoidal-to-triangular

\textsuperscript{19}Such tool production would have required very little training, for example, ethnoarchaeological research among the Lancandon Maya, who maintained an industry of bow and arrow production for tourists, indicated that almost any adolescent or adult was capable of retouching blades into arrowheads. So, although not everyone could produce the blades skillfully, the simple retouching involved in the production of arrowheads required no special skill or even much training (Clark 1991).

\textsuperscript{20}Some of the points produced in the PPNC and PN were beautifully crafted and symmetrical. Despite this, it is generally accepted that the production of such points was not the work of specialists (except see Matskevich 2011).
dorsal ridge structure. Since standardized blanks make the task of tool production easier and most people would have had the requisite knowledge necessary to manufacture most of the formal tool forms, some with more ability, interest, and time available to spend honing their skills, it stands to reason that many people were capable of creating finely retouched symmetrical projectile points. Moreover, the quality of production among the different point varieties, and even those with systematic pressure flaking of the haft show variability in production quality that is more consistent with individual style and skill differences (Whittaker 1987:475), suggesting many different producers.

As mentioned previously, other factors too may have influenced projectile point morphology including the hafting techniques (Burian et al.1976; Eighmey 1992). For instance, Eighmey (1992) examined a sample of projectile points from ‘Ain Ghazal and considered the idea that hafting method was a major influence on point morphology. He surmised that the hafting method was governed by characteristics such as point thickness, weight, overall basal shape, and expediency. Point types with bifacially retouched tangs (e.g., Jericho) were shaped for hafting in slots or sockets. Untanged points or points with unifacial retouch on the tang (e.g. some Byblos and Amuq varieties), however, were well suited for an asymmetrical or beveled haft (Eighmey 1992:124). Also, as discussed in detail in Chapter 5, projectile point size and form were affected by the weapon system(s) in use at the time. The finished form, therefore, was influenced by numerous factors including the standardized tool blank, the hafting requirements, skill, effort, time available for production, personal style, design requirements associated with a particular weapon system, as well as culturally influenced preferences.
In contrast to blade- and flake-based tools, bifacial tools such as axes, adzes, and chisels would have been time consuming but not very difficult to produce (Quintero and Hintzman 2007). Similarly, bifacial knives, tabular knives, and tile knives are not difficult to make, especially those made on thin, tabular pieces of flint. In sum, unstandardized blade-and flake-core reduction, blade-and flake-tool production, and bifacial production could have been carried out by many community members throughout the occupation of ‘Ain Ghazal.

LOCUS OF CORE REDUCTION AND TOOL PRODUCTION

The analysis of the artifact assemblage reviews evidence of core reduction, bifacial tool manufacture, and formal and informal blade-based and flake-based tool production, occurring widespread in deposits across the site, all of which implies these activities were common in most households. This evidence alone provides a strong argument that along with other common production tasks, tool production occurred in households throughout the occupation of ‘Ain Ghazal. Contextual evidence from individual loci identified as domestic-related contexts, however, provides a more detailed account of the characteristics and extent of household production, as well as certain socioeconomic changes that influenced it throughout the lengthy site occupation. Therefore, the remainder of this chapter examines domestic-related deposits from each period of occupation thought to contain the remains of core reduction and/or tool manufacture and maintenance activities.

The loci presented below in Table 8.1 were drawn from a detailed examination of the contents of 171 loci and 35 squares from most of the major excavation areas (Central
Field, East Field, North Field, and West Field) and all periods of occupation. The context descriptions derive from excavation notes and chronological associations. These loci are all interpreted to be domestic-related, and were determined by excavators to be intact with internal integrity, that is, they do not appear to have been impacted by post depositional processes including later digging. In order to identify the extent of lithic reduction or production activities that occurred at each locus, the archaeological assemblages were compared to expected patterns of reduction debitage as determined by previous research and replicative work.

**Identifying Primary and Secondary Contexts**

Determining whether a deposit was primary or secondary in nature involved several considerations, including the technological consistency of the debitage assemblage, the presence of microdebitage\(^{21}\) (Schiffer 1982; Clark 1991), and the context of the deposit. Those deposits considered to be primary at ‘Ain Ghazal, that is, representing the location at which the flintworking activity occurred, are expected to contain technologically consistent debitage and tool stone types\(^{22}\), as well as small flakes\(^{23}\). Although flake tool production could have occurred within dwellings at ‘Ain

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\(^{21}\) Microdebitage refers to the very small fragments, ranging in size from less than one centimeter all the way down to sizes detectable only with microscopy that result from knapping stone.

\(^{22}\) The expectations for technological consistency associated with these different activities are outlined in Chapter 4.

\(^{23}\) Most of the small microdebitage would have passed through the screens used during excavation, which had a gauge of ¼”, so identification of primary reduction locations mainly relies on technological consistency and context, though a preponderance of small flakes, called here microflakes, may lend support to such interpretations.
Table 8.1. Description of locus contexts.

<table>
<thead>
<tr>
<th>Year</th>
<th>Square</th>
<th>Locus</th>
<th>Context Description</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>3075</td>
<td>005</td>
<td>Fire pit with white ashy fill related to floor 008 (undisturbed interior).</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1983</td>
<td>3075</td>
<td>015</td>
<td>Fill related to plaster floor 016. Includes collapse associated robbing of wall stone.</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1983</td>
<td>3076</td>
<td>018</td>
<td>Clayey layer with abundant artifacts along wall (026) of dwelling.</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1983</td>
<td>3077</td>
<td>015</td>
<td>Dump, trash above clay surface 028 (exterior?).</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1983</td>
<td>3077</td>
<td>024</td>
<td>Eroded upper floor surface and underlying fill (interior).</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1983</td>
<td>3078</td>
<td>056</td>
<td>Clayey fill above floor 063, laid down for terrace wall.</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1983</td>
<td>3078</td>
<td>059</td>
<td>Ashy pit fill (exterior?).</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1983</td>
<td>3082</td>
<td>016</td>
<td>Compact fill with stones, bones, and flints. Between walls 1, 2, and 3 (interior).</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1983</td>
<td>3082</td>
<td>024</td>
<td>Compact dirt with flints, bones, and charcoal below locus 016.</td>
<td>MPPNB</td>
</tr>
<tr>
<td>1995</td>
<td>F14</td>
<td>003</td>
<td>Mixed stony layer.</td>
<td>LPPNB</td>
</tr>
<tr>
<td>1995</td>
<td>F14</td>
<td>034</td>
<td>One in a series of stone layers below floor (interior).</td>
<td>LPPNB</td>
</tr>
<tr>
<td>1996</td>
<td>E14</td>
<td>042</td>
<td>Possible chipping floor in loose stony layer under locus 041 (compactsediment) and over locus 060 (compact surface). Seems to be an exterior dump deposit.</td>
<td>LPPNB</td>
</tr>
<tr>
<td>1996</td>
<td>E14</td>
<td>047</td>
<td>Exterior fill /dump. Under locus 020 (compactsediment) and over locus 026 (dump).</td>
<td>LPPNB</td>
</tr>
<tr>
<td>1996</td>
<td>E14</td>
<td>051</td>
<td>Sandy-gravelly fill (exterior).</td>
<td>LPPNB</td>
</tr>
<tr>
<td>1995</td>
<td>5918</td>
<td>008</td>
<td>Compact muddy surface-exterior (possibly an industrial area).</td>
<td>LPPNB</td>
</tr>
<tr>
<td>2012</td>
<td>WF</td>
<td>F2</td>
<td>Open-air dump feature with a probable chipping station represented (6891±112 Cal BC)</td>
<td>LPPNB</td>
</tr>
<tr>
<td>1989</td>
<td>3300</td>
<td>025</td>
<td>Rubby fill in pit 043, which cut into floor 031 (Interior).</td>
<td>LB/Cb</td>
</tr>
<tr>
<td>1989</td>
<td>3300</td>
<td>022</td>
<td>Fill deposit that is part of a series of fill deposits.</td>
<td>LB/Cb</td>
</tr>
<tr>
<td>1996</td>
<td>5316</td>
<td>003</td>
<td>Stony layer mostly contains head size stones.</td>
<td>PPNC</td>
</tr>
<tr>
<td>1989</td>
<td>3300</td>
<td>006</td>
<td>Fill under floor (005) (interior).</td>
<td>PPNC</td>
</tr>
<tr>
<td>1989</td>
<td>3300</td>
<td>010</td>
<td>Fill under 006 (layer of fill) and above fire pit (not pit fill) (interior).</td>
<td>PPNC</td>
</tr>
<tr>
<td>1994</td>
<td>5516</td>
<td>009</td>
<td>Fill over locus 003 (canal) (no additional info).</td>
<td>PPNC</td>
</tr>
<tr>
<td>1994</td>
<td>5516</td>
<td>013</td>
<td>Fill over a row of stones (no additional info).</td>
<td>PPNC</td>
</tr>
<tr>
<td>1994</td>
<td>5516</td>
<td>014</td>
<td>Fill under 010 (damaged Huwwar floor) (interior).</td>
<td>PPNC</td>
</tr>
<tr>
<td>1994</td>
<td>5516</td>
<td>022</td>
<td>Fill under 009 (fill) and 018 (stone feature).</td>
<td>PPNC</td>
</tr>
<tr>
<td>1994</td>
<td>4076</td>
<td>014</td>
<td>Surface fill under locus 009 (fill), 010 (fill) and over 016 surface (interior).</td>
<td>PN</td>
</tr>
<tr>
<td>1994</td>
<td>4076</td>
<td>016</td>
<td>Domestic surface across most of square with postholes (interior).</td>
<td>PN</td>
</tr>
<tr>
<td>1994</td>
<td>4076</td>
<td>019</td>
<td>Pit under surface 016 (interior?).</td>
<td>PN</td>
</tr>
<tr>
<td>1994</td>
<td>4075</td>
<td>024</td>
<td>The 7th surface above stone pavement and surface. Part of a series of compact surfaces.</td>
<td>PN</td>
</tr>
<tr>
<td>1994</td>
<td>4075</td>
<td>012</td>
<td>5th Surface in a series of compact surfaces (interior?).</td>
<td>PN</td>
</tr>
<tr>
<td>1996</td>
<td>4073</td>
<td>023</td>
<td>Compact surface, store room/curved niche extending south to activity area.</td>
<td>PN</td>
</tr>
</tbody>
</table>

\(a\) Several of the loci presented here were reported on earlier in Barket (2013). The previously published loci that are included in this discussion either have added information from further analysis or they represent interpretively significant behaviors.

\(b\) LB/C is short for the transitional LPPNB/PPNC.
Ghazal\textsuperscript{24}, it seems likely that much of it, along with heavier-duty production activities (e.g., core reduction and biface production) occurred outdoors in open areas such as courtyards. Shafer and Hester (1986); Healan (1992); Webb and Hirth (2000) all note the tendency for messy production activities to occur in exterior work spaces. These behaviors also have been suggested for much of the flint knapping activities at both Basta and Yiftahel (Gebel 1996; Garfinkel et al. 2012), and for naviform core production and reduction at ‘Ain Ghazal (Quintero 2010). Primary deposits with evidence of generalized stone working, such as core production and reduction, and tool production, are referred to as “chipping floors” (cf. Quintero 2010). “Chipping floor” deposits are less common than debris dumps because in relatively densely packed settlements, such as was common in much of Neolithic of the Near East, limited space for undertaking such messy tasks would have encouraged the disposal of debris (Schiffer 1987; Clark 1986, 1991). At ‘Ain Ghazal, many of the domestic activities occurred in and around the households throughout much of the occupation. The clearest evidence for probable communal outdoor activity areas occurs in LPPNB contexts, and such areas are most apparent in the East Field (Banning 2004:222-227).

Deposits identified by context and content as secondary in nature may include the remains of several reduction and production events and little or no small flakes and fragments. The secondary deposits identified here include both interior and exterior dumps and fills. As discussed earlier, these deposits are expected to reflect activities that

\textsuperscript{24} Deposits that contain only debris representative of tool-production activities (especially flake-based and blade-based tools) are harder to characterize as primary or secondary because little microdebitage is created in tool production. Therefore, the context of the deposit in this situation plays a large role in the interpretation.
occurred within or near the household in which they were found or from the immediately surrounding households because people were unlikely to have traveled far to dump their trash or procure fill for construction (cf. Andrieu 2013). Moreover, if core reduction or tool production occurred, much of the debris represented is expected to be consistent with these technologies, even if the entire reduction sequence is not present.

**Middle Pre-Pottery Neolithic B Loci**

In total, 81 loci from 12 squares were examined. Of these, several deposits (see Tables 8.2 to 8.4) appear to have coherent flaked-stone assemblages that reflect core-reduction and tool-production activities. The contents of each of these deposits are discussed in detail below.

**Locus 005, Square 3075**

Locus 005 in Square 3075 was part of an interior fire-pit complex associated with a house floor (Locus 008). One of the pits contained a large concentration of flint, and the surrounding area appeared to be undisturbed. The debitage associated with this locus apparently was dumped in the fire pit and covered with dirt, then covered over by a plaster floor (locus 008). The context indicates that it was not a primary deposit, however, given the nature and coherency of the debitage reflecting early-to-mid-stage biface production that is apparent in both the flake types (alternate flakes, edge-preparation elements, and biface-production flakes) and the nature of the tool stone (about 87% is locally available bedded chert), the locus very likely represents a secondary deposition of a single production event that created a woodworking tool
(Barket 2013). A few flake tools, blade tools, and tool-production by-products were also part of this deposit, suggesting that some additional tool manufacturing and retooling occurred along with the production of the bifacial tool.

*Locus 015 and Locus 018, Square 3076*

Locus 015 in square 3076 was an exterior deposit interpreted to be a trash dump or fill material from surrounding households. Locus 018 occurred in an exterior clayey layer with a large number of artifacts. Based on the sparse flake and blade debitage in both of these deposits, core reduction and blade production did not occur. Tool production is indicated, however, in both loci by the presence of tool-production by-products, tool blanks, and tool-production failures. The tool-production by-products consist mainly of intentionally sectioned blades, a burin spall, and chamfered-bit spalls. The pieces identified as tool blanks were suitable for production into knives or sickle elements and projectile points. Additionally, two production failures from locus 018 appear to be fragments of projectile points. Furthermore, the tools from both loci give evidence for retooling activities (cf. Keeley 1982), as indicated by broken projectile points (a few with impact damage). The deposits also contained used and broken knives, sickle blades, borers, drills (none on spalls), burins (mostly dihedral and transverse), chamfered-bit tools, and other informal tools. In general, the presence and types of tools in this deposit are consistent with the tool-production debris.
Table 8.2. MPPNB debitage and tools by locus.

<table>
<thead>
<tr>
<th>CORES, TOOL PRODUCTION &amp; TOOLS</th>
<th>3075 (005)</th>
<th>3075 (015)</th>
<th>3076 (015)</th>
<th>3076 (018)</th>
<th>3078 (056)</th>
<th>3078 (059)</th>
<th>3082 (016)</th>
<th>3082 (024)</th>
<th>3077* (024)</th>
<th>3077* (015)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H/NH²</td>
<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
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<td>H/NH</td>
<td>H/NH</td>
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<td>38/0</td>
<td>56/1</td>
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<td>Informal tools</td>
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<td>5/0</td>
<td>7/0</td>
<td>20/1</td>
<td>36/1</td>
<td>13/0</td>
<td>50/0</td>
<td>9/0</td>
<td>24/1</td>
<td>40/1</td>
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<td>62/0</td>
<td>19/0</td>
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<td>1/0</td>
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<td>0/0</td>
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**BLADE DEBITAGE**

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<th>3076 (015)</th>
<th>3076 (018)</th>
<th>3078 (056)</th>
<th>3078 (059)</th>
<th>3082 (016)</th>
<th>3082 (024)</th>
<th>3077* (024)</th>
<th>3077* (015)</th>
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<td>10/0</td>
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<td>0/0</td>
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<td>0/0</td>
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<td>3/0</td>
<td>1/0</td>
<td>3/0</td>
<td>4/0</td>
<td>9/0</td>
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<td>Crested blades</td>
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<td>14/0</td>
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**FLAKE DEBITAGE**

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<th>3075 (015)</th>
<th>3076 (015)</th>
<th>3076 (018)</th>
<th>3078 (056)</th>
<th>3078 (059)</th>
<th>3082 (016)</th>
<th>3082 (024)</th>
<th>3077* (024)</th>
<th>3077* (015)</th>
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<td>8/0</td>
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<td>1/0</td>
<td>6/1</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Single-facet platform</td>
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<td>3/6</td>
<td>2/1</td>
<td>9/3</td>
<td>29/4</td>
<td>14/0</td>
<td>12/1</td>
<td>41/0</td>
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<td>0/0</td>
</tr>
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<td>Multiple-facet platform</td>
<td>1/23</td>
<td>5/3</td>
<td>2/0</td>
<td>2/0</td>
<td>26/1</td>
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<td>16/1</td>
<td>35/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Platform absent</td>
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<td>9/1</td>
<td>1/0</td>
<td>1/0</td>
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<td>6/0</td>
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<td>38/8</td>
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<td>235/6</td>
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<td>109/3</td>
</tr>
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</table>

a These data are from the tool assemblage and attest to tool-production activities at these loci. The complete debitage assemblages were not available for this analysis.
b H=Huweijir flint and NH=non-Huweijir or the local bedded, wadi rolled, and tabular flint and chert.
c Although these flake types can be associated with the early stages of bifacial reduction, the flakes assigned to these categories either appear associated with early stage reduction that cannot easily be assigned to any specific reduction strategy or they appear more consistent with the reduction of flake cores.
Table 8.3. MPPNB formal and informal tools.

<table>
<thead>
<tr>
<th>Formal Tools</th>
<th>3075 (005)</th>
<th>3075 (015)</th>
<th>3076 (015)</th>
<th>3076 (018)</th>
<th>3078 (056)</th>
<th>3078 (059)</th>
<th>3082 (016)</th>
<th>3082 (024)</th>
<th>3077 (024)</th>
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<td>16</td>
</tr>
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<td>Sickle blades</td>
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<td>11</td>
<td>8</td>
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<td>17</td>
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<td>19</td>
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<table>
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<th>Informal Tools</th>
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<td>3</td>
<td>15</td>
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<td>3</td>
<td>7</td>
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<td>0</td>
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<td>0</td>
<td>3</td>
<td>4</td>
<td>11</td>
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<tr>
<td><strong>Total</strong></td>
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<td>14</td>
<td>47</td>
<td>51</td>
<td>76</td>
<td>23</td>
<td>110</td>
<td>23</td>
<td>63</td>
<td>98</td>
<td>517</td>
</tr>
</tbody>
</table>

Table 8.4. MPPNB tools and blades from naviform cores.

<table>
<thead>
<tr>
<th>NAVIFORM</th>
<th>3075 (005)</th>
<th>3075 (015)</th>
<th>3076 (015)</th>
<th>3076 (018)</th>
<th>3078 (056)</th>
<th>3078 (059)</th>
<th>3082 (016)</th>
<th>3082 (024)</th>
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<td></td>
<td></td>
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<td>2</td>
<td>2</td>
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<td>8</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
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<td>3</td>
<td>4</td>
<td>2</td>
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<td>16</td>
</tr>
<tr>
<td>Sickle blades</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>11</td>
<td>8</td>
<td>3</td>
<td>17</td>
<td>2</td>
<td>9</td>
<td>13</td>
<td>77</td>
</tr>
<tr>
<td>Knives</td>
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<td>5</td>
<td>25</td>
<td>13</td>
<td>25</td>
<td>5</td>
<td>37</td>
<td>10</td>
<td>23</td>
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<td>181</td>
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<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
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<td>9</td>
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<tr>
<td>Drills</td>
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<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7</td>
<td>40</td>
<td>62</td>
<td>47</td>
<td>118</td>
<td>60</td>
<td>169</td>
<td>55</td>
<td>55</td>
<td>62</td>
<td>674</td>
</tr>
</tbody>
</table>

Locus 056, Square 3078; Locus 024, Square 3082; and Locus 015, Square 3075

Locus 056 in square 3078 was a fill layer above a house floor. The same pertains to locus 024 in square 3082, which was an interior fill deposit, one of a series of such deposits over a plaster floor in a house. Locus 015 in square 3075 appears to have been a
fill layer associated with a plaster floor, suggesting it too was a secondary deposit in an interior context. Given the context of these deposits and the lack of small flakes and fragments, they are all considered to be secondary deposits and are discussed together because of the similarity of their contents. The flake assemblages contain flake types (flakes with single-facet platforms and multiple-facet platforms) that are consistent with flake core reduction, but that does not appear to have been a common activity. In fact, locus 015 in square 3075 has several flakes of a variety of resource materials (including one piece of opal, four flakes of high-quality banded non-Huweijir flint), which may represent a collection of flakes produced from a number of Huweijir flint), which may represent a collection of flakes produced from a number of chipping episodes. The blade assemblages from each of these loci do not have any clear indications of blade production; that is, the blade quantities, fragmentation, and types (mostly intended blade products) are more consistent with blades selected from somewhere else for tool production. Tool production and maintenance activities are indicated by the presence of production by-products, which include sectioned blade segments, burin spalls\textsuperscript{25}, and chamfered-bit spalls. Several blade segments (n=11) have evidence of retouch or use-wear, interrupted by intentional sectioning, suggesting that recycling, resizing, and retooling activities also occurred. Additionally, each locus contained tool blanks (all suitable as cutting implements) and manufacturing failures. From locus 056, two of the projectile points appear to be production failures broken before completion. Overall, the production debris from these deposits is consistent with the discarded tools (cutting

\textsuperscript{25} Most of the spalls seem to be associated with burin-tool production as many of the spalls reflect transverse detachment, most of the burins are dihedral and transverse, and none of the borers or drills are on spalls.
implements, projectile points, burins, scrapers, chamfered-bit tools, and other used implements), most of which were broken or have evidence of use and/or reuse.

*Locus 059, Square 3078*

Locus 059 in square 3078 appears to have been a secondary trash deposit. Based on the flake and blade debitage, core reduction of any kind is not well represented. This deposit, like most of the others, appears to have been associated with tool production, maintenance, and retooling, including tool production by-products, tool blanks, and production failures, as well as discarded used and broken formal and informal tools. However, unlike the other deposits, it contained several pieces that may reflect the mark of novice knappers, or perhaps the remains of a bad knapping day. At least two of the chamfered-bit tools show several attempts to remove spalls, resulting in stacked step terminations and crushing of the bit. Three additional pieces display knapping mistakes and irregular flaking, but have little evidence of use, implying they never were functional tools.

*Locus 016, Square 3082*

Locus 016 was an interior fill deposit between walls. It appears to have been one of a series of fill or trash features above a plaster floor. Based on the context and content, it most likely was a secondary deposit. Core reduction of any kind is not well represented. Among the debitage from this locus are some Huweijir flint flakes that appear to be core-preparation flakes consistent with those resulting from naviform core production.

---

26 Two discarded projectile points from locus 056 have impact damage and evidence of reuse as knives or sickle elements before they were discarded.
preparation. When compared to the rest of the flake debitage, these items are technologically inconsistent, suggesting they may have been scavenged or otherwise obtained from a naviform core-production workshop locality. The blade assemblage is large, but is more consistent with tool manufacture than with blade production. It contains fragmentary intended blades and less regular blade forms that may represent potential tool blanks left behind during tool production.

Tool-production by-products are numerous in this deposit, including 62 blade fragments, 20 burin spalls, and five chamfered-bit spalls. The tool blanks include eight blades, mostly suitable for cutting implements, but at least one is suitable for flaking into a projectile point. Four production failures also were recovered, three of which appear to be projectile points broken before completion. Retooling is strongly implied by the tool assemblage, as all three of the projectile points are broken, two with impact damage. The sickle blades, knives, and borers all show some evidence indicative of recycling or resizing. Additionally, transverse and dihedral burins are the most numerous types and chamfered-bit tools are present, which is consistent with the numerous burin spalls and chamfered-bit spalls. In sum, the entire assemblage from this context is technologically consistent with tool production, retooling, and maintenance activities.

*Locus 024 and Locus 015, Square 3077*

Locus 024 in square 3077 was an eroded house floor surface and underlying fill, suggesting it was a secondary context. Locus 015 appears to have been a trash dump on a clay surface. The complete debitage assemblage was not available for these loci; nonetheless, tools and a sample of associated debitage were studied and they each reflect
tool-production activities. The artifacts include tool-production by-products consisting of segments of blades from naviform cores, burin spalls, and chamfered-bit spalls. The deposits also contained tool blanks suitable for use as sickle elements or knives, and tool-production failures, four of which appear to be projectile points broken before completion (three from locus 024). In both of these deposits, the tool-production debris is consistent with the presence of discarded tools, many of which are broken or have evidence of recycling, reworking, or resizing, reflecting retooling and maintenance activities. Although these are only samples of the contents of these deposits, the available data are strong evidence that tool manufacturing and maintenance occurred in these loci.

**Summary of MPPNB Loci**

Among the MPPNB loci discussed here, none have an abundance ofdebitage reflecting a focus on core reduction. The blade assemblages from all these loci give strong evidence for tool production and maintenance, with numerous blades and by-products from naviform cores (86.5% of the blades from the MPPNB selected loci).

Also, the majority of the intended blades or blade products intended as tool blanks from these samples are fragmentary, suggesting their presence in these deposits is a result of tool-production activities rather than blade production. Additionally, complete pieces are more common among the less-regular blade debitage forms from naviform cores (e.g., ridge-straightening blades, error-correction blades, platform spalls, etc.), and among blades from other blade core types that were less desirable tool blanks. Despite the lack of evidence for nonspecialized blade production in any of these deposits, it is clear that it did occur, even if rarely, in some domestic-related contexts (see Quintero 2010).
Huweijir flint is the predominant resource material, except in locus 005, square 3075, which contained lithics associated with the manufacture of woodworking tools (Barket 2013). If locus 005 is excluded from the sample, the percentage of Huweijir flint in the flake debitage is 86.5%, and it is 98% among the blade debitage. In addition to the general importance of Huweijir flint among the debitage, the two prominent flake types are flakes with multiple-facet platforms and flakes with single-facet platforms, probably associated with flake core reduction occurring in the households during the MPPNB.

While none of these loci reflect a focus on core reduction, some minor flake core reduction did occur. The generally low occurrence of core reduction (both flake and blade) in domestic contexts during the MPPNB is related to the apparently readily available blades from naviform cores reduced by specialists that satisfied a large portion of the tool needs of the community. This observation is supported by the fact that among tool blanks and production failures, blades from naviform cores make up 97% and 80% of the sample, respectively. Likewise, blades from naviform cores make up 93.5% of the blanks used for formal tools among the MPPNB loci discussed here, thus mirroring the larger tool assemblage. Despite the predominance of blade blanks among formal tools, flakes produced in most households frequently were used to supply blanks for informal tools even in the MPPNB.

The most common activities represented in these MPPNB deposits include tool production, maintenance, and retooling, as indicated by numerous small blade segments, burin spalls, chamfered-bit spalls, tool blanks, and production failures. Moreover, all of these indications of tool production and maintenance are consistent with the discarded
tools. For instance, by discarded used or broken points, along with tool blanks and projectile point production failures indicate retooling of these weapon elements. The replacement of knives and sickle blades is indicated by the numerous small blade segments and suitable tool blanks. Informal tool production is also indicated by the presence of chamfered-bit spalls, as well as discarded, used, and broken chamfered-bit tools. Additionally, the discarded burins include numerous transverse, dihedral, and burin-on-break types, which agree with the spall assemblage, much of which appears oriented towards burin production. In sum, all of the deposits examined here contain evidence that suggests tool production, maintenance, and retooling were the primary activities.

**Late Pre-Pottery Neolithic B Loci**

The LPPNB loci discussed here were chosen from a larger sample of 36 loci from 11 squares that were evaluated for this analysis. The loci discussed here are considered representative of the larger sample and were selected because they include technologically consistent evidence of core reduction and/or tool production and maintenance activities. Tables 8.5 to 8.7 provide a summary of the contents of the LPPNB selected loci and the descriptions below detail the activities represented in each of these deposits.

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27 Some spalls appear to have been from burins-on-breaks and concave truncation-burins, that is, they appear to be the intended product, but none of the borers or drills in the MPPNB were made on burin spalls.
Table 8.5. LPPNB debitage and tools by locus.

<table>
<thead>
<tr>
<th>CORES, TOOL PRODUCTION &amp; TOOLS</th>
<th>F14 (003)</th>
<th>F14 (034)</th>
<th>E14 (042)</th>
<th>E14 (047)</th>
<th>E14 (051)</th>
<th>5918 (008)</th>
<th>3300 (025)</th>
<th>3300 (022)</th>
<th>WF (feat.2)</th>
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<tbody>
<tr>
<td>FLAKE DEBITAGE</td>
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<td>30/1</td>
<td>250/7</td>
<td>104/8</td>
<td>22/5</td>
<td>29/41</td>
<td>13/11</td>
<td>36/9</td>
<td>41/0</td>
</tr>
<tr>
<td>Completely cortical</td>
<td>9/19</td>
<td>9/6</td>
<td>30/4</td>
<td>25/8</td>
<td>3/1</td>
<td>5/7</td>
<td>2/10</td>
<td>7/11</td>
<td>0/58</td>
</tr>
<tr>
<td>Single-face platform^b</td>
<td>25/74</td>
<td>18/11</td>
<td>152/15</td>
<td>154/58</td>
<td>32/4</td>
<td>25/82</td>
<td>20/33</td>
<td>39/64</td>
<td>12/7</td>
</tr>
<tr>
<td>Multiple-face platform^b</td>
<td>28/32</td>
<td>36/10</td>
<td>298/10</td>
<td>238/10</td>
<td>44/8</td>
<td>25/30</td>
<td>10/50</td>
<td>52/17</td>
<td>29/0</td>
</tr>
<tr>
<td>Platform absent^b</td>
<td>9/22</td>
<td>2/3</td>
<td>39/1</td>
<td>47/28</td>
<td>0/0</td>
<td>9/30</td>
<td>5/6</td>
<td>19/11</td>
<td>9/23</td>
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<td>10/3</td>
<td>0/0</td>
<td>12/10</td>
<td>0/0</td>
<td>1/0</td>
<td>0/53</td>
</tr>
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<td>6/2</td>
<td>25/0</td>
<td>29/52</td>
<td>0/2</td>
<td>8/13</td>
<td>0/3</td>
<td>0/1</td>
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</tr>
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<td>6/3</td>
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<td>3/6</td>
<td>0/0</td>
<td>0/1</td>
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<td>0/1</td>
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<td>0/0</td>
<td>0/0</td>
<td>9/0</td>
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<td>15/0</td>
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<td>0/0</td>
<td>11/10</td>
<td>28/5</td>
<td>0/25</td>
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<td>495/30</td>
<td>405/100</td>
<td>76/14</td>
<td>61/100</td>
<td>50/59</td>
<td>69/80</td>
<td>29/103</td>
</tr>
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<td>13/31</td>
<td>10/11</td>
<td>10/11</td>
<td>4/2</td>
<td>0/0</td>
<td>3/3</td>
<td>16/15</td>
<td>6/0</td>
</tr>
<tr>
<td>Total</td>
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<td>118/84</td>
<td>2054/168</td>
<td>948/277</td>
<td>160/29</td>
<td>149/279</td>
<td>101/202</td>
<td>231/205</td>
<td>103/494</td>
</tr>
</tbody>
</table>

^a H refers to Huweijir flint and NH refers to non-Huweijir, which is a catchall category for the locally available bedded, wadi rolled, and tabular flint and chert.

^b Although these flake types can be associated with the early stages of bifacial reduction, the flakes assigned to these categories either appear associated with early-stage reduction that cannot easily be assigned to any specific reduction strategy or they appear more consistent with the reduction of flake cores.
Table 8.6. LPPNB formal and informal tools.

<table>
<thead>
<tr>
<th>Formal Tools</th>
<th>F14 (003)</th>
<th>F14 (034)</th>
<th>E14 (042)</th>
<th>E14 (047)</th>
<th>E14 (051)</th>
<th>5918 (008)</th>
<th>3300 (025)</th>
<th>3300 (022)</th>
<th>West Field Feature 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile points</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>12</td>
<td>2</td>
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<td>0</td>
<td>2</td>
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<td>30</td>
</tr>
<tr>
<td>Sickle blades</td>
<td>1</td>
<td>0</td>
<td>49</td>
<td>25</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>Knives</td>
<td>6</td>
<td>6</td>
<td>55</td>
<td>30</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>2</td>
<td>115</td>
</tr>
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<td>4</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Drills</td>
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<td>0</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
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<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

Informal Tools

| Burins             | 1         | 4         | 23        | 12        | 3         | 1          | 0          | 1          | 1                     | 46    |
| Scrapers           | 3         | 0         | 4         | 5         | 3         | 1          | 0          | 0          | 0                     | 16    |
| Chamfered-bit      | 0         | 0         | 1         | 1         | 0         | 0          | 0          | 0          | 0                     | 2     |
| Notches/Denticulates| 2        | 0         | 6         | 4         | 0         | 1          | 0          | 0          | 0                     | 13    |
| Used/retouched pieces | 6       | 2         | 34        | 56        | 7         | 0          | 3          | 8          | 0                     | 116   |
| Other informal     | 2         | 1         | 3         | 0         | 0         | 0          | 0          | 0          | 0                     | 6     |
| Total              | 24        | 15        | 194       | 150       | 31        | 11         | 4          | 21         | 3                     | 454   |

Table 8.7. LPPNB tools and blades from naviform cores.

<table>
<thead>
<tr>
<th>Naviform Total</th>
<th>F14 (003)</th>
<th>F14 (034)</th>
<th>E14 (042)</th>
<th>E14 (047)</th>
<th>E14 (051)</th>
<th>5918 (008)</th>
<th>3300 (025)</th>
<th>3300 (022)</th>
<th>West Field feature 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blades</td>
<td>18</td>
<td>23</td>
<td>232</td>
<td>82</td>
<td>12</td>
<td>6</td>
<td>3</td>
<td>24</td>
<td>36</td>
<td>436</td>
</tr>
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<td>Tool-Production Debris</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production By-Products</td>
<td>15</td>
<td>14</td>
<td>198</td>
<td>43</td>
<td>10</td>
<td>11</td>
<td>3</td>
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<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
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<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
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<td></td>
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<td>12</td>
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<td>0</td>
<td>0</td>
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<td>19</td>
<td>11</td>
<td>1</td>
<td>0</td>
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<td>48</td>
<td>21</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>2</td>
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<tr>
<td>Borers</td>
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<td>0</td>
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<td>0</td>
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</tr>
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<td>Total</td>
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<td>52</td>
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<td>19</td>
<td>7</td>
<td>47</td>
<td>38</td>
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Square E14, Locus 042

Square E14 locus 042 appears to contain the remains of a domestic chipping floor with tool production. It occurred in a loose, stony layer under compacted sediment (locus 041) and over another compact surface (locus 060), between a dump deposit (locus 032)
and adjacent to the lower courses of a wall (locus 019). It is an exterior deposit and is one of many apparent domestic dump deposits in this area. Based on the contextual information and the presence of microflakes in the deposit, locus 042 was a secondary deposition of material from a well-cleaned flintknapping activity surface. Only three flake cores were recovered from the deposit, but microflakes and numerous flake fragments, indicate that some flake-core reduction is represented. The blade assemblage is not indicative of core reduction, as many of the blades and blade production by-products are from naviform cores, and no supporting reduction debitage or cores indicative of a primary reduction locus of naviform core-and-blade production is present. Instead, the blade assemblage appears consistent with tool production, that is, it includes many fragmentary intended blades from naviform cores. The remaining blades (n=25) from other blade core-reduction strategies do not constitute an entire technologically consistent reduction sequence either.

Other evidence of tool production comes from the tool-production debris assemblage. Blade- and flake-production by-products are numerous and mostly from naviform core technology (see Table 8.7). Evidence of tool maintenance or possibly recycling is clear, with about 30 pieces of production debitage retaining traces of retouch or use-wear interrupted by sectioning breaks or truncations intended to resize the tools for hafting. In addition to flakes and blade fragments, about 30 pressure flakes are present in the sample, and some appear to be from diagonal, parallel pressure retouch, probably associated with bifacial tool production. Other production by-products include burin
spalls and a few chamfered-bit spalls. Additional evidence for tool production comes from 12 probable blade-tool blanks. Most appear suitable for use or for manufacturing into cutting implements, but two are adequate blanks for projectile points. Of the seven examples of tool-production failures, one appears to be a projectile point broken before completion. The tool assemblage also reflects maintenance and retooling at this locus, as the tool types are consistent with the production debitage, and a number of broken or extensively used specimens (e.g., all of the projectile points, a discarded axe and an axe/adze bit rejuvenation flake, and 8 sickle blade segments with evidence of recycling or resizing).

*Locus 047, Square E14*

Locus 047 in square E14 probably also was an exterior trash deposit. It is similar in function to locus 042 in square E14, as it appears to have been a secondary deposition of a well-cleaned flintknapping area. In general, the flake assemblage including microflakes and fragments suggests that at least some core reduction occurred. The high number of biface-production flakes also indicates that bifaces were produced. The fact that all of the biface-production flakes are of the brown tabular flint (most containing cortex), implies that the flintknapping was associated with the production of a thin biface, possibly a cortical knife, rather than a woodworking tool or core. The blade assemblage is comprised mainly of blades and blade-production debitage from naviform core reduction, but there is not a complete reduction assemblage for blade production of any form.

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28 The burin spalls are associated with both burin production and the production of spalls for tool blanks, as the burin assemblage includes dihedral, transverse, burin-on-break, and concave-truncation burins. However, none of the drills are on spalls.
Furthermore, the intended blade blanks are fragmentary, and indicative of alteration for tool production.

Additionally, locus 047 also contained tool-production debris and tools that show tool production and maintenance. For example, all of the projectile points in this locus assemblage are broken (seven with impact damage) and in need of replacement or repair. Several of the tool blanks appear suitable for making projectile points, and at least one projectile point was broken during production. Moreover, eight sickle blades and three knives show signs of previous instances of resizing, which is consistent with the nine blade and flake by-products that have retouch or use-wear that was interrupted by an intentional break. Finally, the burin spalls are consistent with both the production of burins, including both dihedral and transverse burins, and the production of spalls from burins-on-breaks and from concave truncation burins. None of the spalls, however, were used as drills. In sum, the tool-production debris is consistent with the kinds of tools present in the deposit, supporting the interpretation that it is a waste dump from tool production, and from flake-core reduction activities.

*Locus 051, Square E14*

Locus 051 was an exterior fill deposit. The lack of microflakes and other reduction debris suggests that core reduction did not occur there, but the fragmentary blade assemblage and the presence of tool-production debris indicates tool production did occur. The blade- and flake-tool production by-products include 20 blade segments, two of which have evidence of retouch or use-wear that was interrupted by an intentional sectioning. Additionally, one flake tool appears to have broken in production. The tool
assemblage also reflects retooling and maintenance activities, as several of the discarded tools are broken and/or show evidence of use and sometimes recycling. In sum, this assemblage is a secondary deposit containing the remains of tool production and maintenance activities.

*Locus 003 and Locus 034, Square F14, and Locus 008, Square 5918*

Loci 003 and 034 in square F14 both appear to have been fill or dump deposits in the East Field. Locus 008 in Square 5918 was an exterior dump deposit in the North Field, perhaps associated with an industrial area. Based on the contexts of these deposits, and the lack of small debitage, it is clear they were secondary in nature. Interestingly, when these loci are compared to the LPPNB loci in square E14, Huweijir flint is less well represented, and in locus 003 in square F14 and locus 008 in square 5918, it accounts for less than half the flake assemblage (35.4% and 34.8%, respectively). Fragments of tool-quality blades are prevalent in the blade assemblages in all three deposits, which is more consistent with tool manufacture than with blade production. Tool production by-products also reflect tool maintenance as well as production activities with blade fragments in each assemblage retaining traces of retouch or use-wear interrupted by an intentional break. Locus 034 includes one production failure that appears to be a projectile point broken before completion. From locus 008, the production failures include a probable flake tool, and a biface lacking use-wear and broken in a

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29 Excavation notes suggest some of these “industrial” areas are associated chalk extraction to produce *huwwar*, a chalk-mud plaster, while for others the exact function is not clear.

30 Intentionally sectioned blade fragments with evidence of use-wear or retouch include one blade from locus 008, five from locus 003, and seven from locus 034.
bending break. Additionally, two of the woodworking tools, an axe/adze, and a chisel appear to have broken in production. The tool assemblage provides evidence of retooling and recycling, as indicated by projectile points that were broken, reworked, or altered for another use before they were finally discarded. Taken together, all of these assemblages appear to be secondary deposits resulting from tool production, maintenance, and retooling.

*West Field Feature 2*

Feature 2 is a probable chipping floor deposit located high up the hill in the West Field of the site. The debitage presented in Table 8.5 comes from a large deposit in this feature that was only partially excavated. This deposit appears to be a primary deposition, an interpretation supported by the completeness of the reduction assemblages contained therein, (that is, their technological consistency), and the fact that the debitage from different production activities was not heavily intermixed. The majority of the debitage is not of Huweijir flint. It appears to be mainly high quality, thin, tabular flint, which is brown to dark brown with tiny white inclusions throughout. At least one reduction sequence consists of very thin tabular flint often used for cortical “tile” knives. A second sequence appears to be from a thicker tabular piece of the same type of flint (except with a pinkish hue).

It appears that the production aim for the bifaces was not to create woodworking tools, as none of the flakes show pronounced curvature, which would be consistent with bifacial shaping to create a thicker tool. Also, much of the biface production debitage is small in size, and cortex is often present on the distal portion of the dorsal surfaces of
flakes, even on pieces considered later-stage, suggesting that thin tabular bifaces were the intended products. This interpretation is further supported by the discovery in the deposit of a fragment of a thin, tabular biface broken in production. Additionally, based on the number of Janus flake negatives and margin collapses on biface-production flakes, it appears these bifaces were shaped with stone percussors.\footnote{Although organic percussors can produce these features, the commonness of the features in this assemblage appears more consistent with the use of stone percussors (but not necessarily hard stone).}

Among the Huweijir flint debitage, some probable naviform core-production flakes are present, but a complete reduction sequence is not. Thus, these flakes may represent flakes saved from previous reductions or scavenged from naviform core-production discard piles. It is also possible that further excavation will provide additional evidence of other core reductions and tool production.

The blade assemblage from West Field feature 2 consists strictly of Huweijir flint, and is composed mostly of blades and blade production elements ($n=36$) from naviform core reduction. However, the assemblage is not complete enough to be technologically consistent with a blade production locus. In fact, few of the intended blade products are complete, which suggests that the locus reflects tool production. So far, the small assemblage contains no blade or flake production by-products, but it is expected that further excavation will reveal the presence of additional tool-production debris. In sum, this deposit appears to represent a domestic-related chipping floor with clear evidence for biface production.
Locus 022 and Locus 025, Square 3300

Locus 022 in square 3300 was a fill deposit (part of a series of fill deposits), and locus 025 was fill in a pit cut into a house floor. Based on the chronological associations determined during excavation of these deposits, both are considered to be LPPNB/PPNC and thus represent transitional deposits. Based on the contextual information, they both appear to be waste dumps of tool-production debris. Both contain a fair number of flakes and a small number of microflakes, suggesting that these may be the remains of a well-cleaned flintworking area. Despite the presence of some flake-core reduction and two discarded bladelet cores, no good evidence of blade production is apparent. Both deposits do contain tool-production debris, including production by-products, burin spalls, and tool blanks. Similarly, tool maintenance activities are indicated by discarded blade segments with traces of retouch or use-wear (six artifacts from locus 022). Additionally, the presence of used and broken, discarded tools, suggests that retooling activities also occurred at these loci.

Summary of LPPNB Loci

Taken together, the trends present in the LPPNB loci are generally consistent with the overall trends for resource material use and blank preference in the larger LPPNB sample; that is, all of them appear to be associated with households and all have evidence of tool production, maintenance, and retooling. At least three of the LPPNB loci discussed here, however, represent fairly rich deposits. Two of these rich loci appear to be dumps from well-cleaned deposits of flake-core reduction and tool manufacturing
(loci 042 and 047 in square E14). The other locus is a sample from a primary chipping floor deposit (WF Feature 2).

The evidence for tool production, maintenance, and retooling consists of intentionally broken blade segments, tool blanks, and failures consistent with the production, maintenance, and replacement of projectile points, knives, and sickle elements. Informal tool production is represented by burin spalls and some chamfered-bit spalls (although in much fewer numbers than in the MPPNB). The burin spalls appear in line with the production of both dihedral and transverse burins in the tool assemblage for these loci, but some burins appear to have been devoted to spall production, which is also represented in the spall collection. In addition, at least two of the loci (022 and 025 in square 3300) are considered transitional between the LPPNB and the PPNC, and they exhibit a generally lower proportion of Huweijir flint and blades from naviform core reductions (see Table 8.7). Both trends became even more pronounced throughout the PPNC and Yarmoukian.

Generally, in the LPPNB Huweijir flint is less common overall at 59.7%, and blades from naviform cores are also less common, comprising only 67.28% of all blades in the LPPNB loci. Blades from naviform cores are well represented among tool-production debris and formal tools, however, indicating they continued to be preferred for use as tools, and for fabricating into other tools (see Table 8.7). Finally, the prominence of flakes with multiple-facet platforms and single-facet platforms from flake-core reduction in most of the deposits follows with the overall trend of increased flake-core reduction, as represented in the total assemblage.
In contrast to the MPPNB, great variation in the representation of Huweijir flint across time and space is apparent among the LPPNB loci (Table 8.5). For example, later phases of the LPPNB, as seen at locus 003 in square F14, and locus 047 in square E14, have Huweijir flint representations of 41.2% and 90.3%, respectively. In the same vein, significant variation exists in deposits from the early LPPNB, including locus 034 in square F14, locus 042 in square E14, and locus 051 in square E14, which have Huweijir flint percentages of 68.8%, 93.8%, and 86.4%, respectively. In the LPPNB/PPNC deposits, locus 022 and locus 025 in square 3300, also show marked differences in the percentage of Huweijir flint at 60% and 36.4%. However, if these loci are examined based on their location at the site, then both of the East Field squares, F14 and E14, seem to have a generally higher percentage of Huweijir flint regardless of phase, when compared to units from Central Field, North Field, and square 3300. As discussed in previous chapters, this pattern of variation in Huweijir flint representation and blades from naviform cores may be due to the presence of late MPPNB naviform core-reduction workshop deposits in the East Field.

**Pre-Pottery Neolithic C Loci**

The PPNC loci were drawn from a larger sample of 31 such deposits from seven squares. The deposits discussed in detail below contain technologically consistent assemblages of core reduction and/or tool production and maintenance activities. One deposit, square 5316, locus 003, was included based on findings from the tool

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32 WF Feature 2 is not included because it was only partially excavated. Further excavations may change the representation of both Huweijir Flint and naviform technology.
assemblage, and flake and bladedebitage were not available to be examined as part of the sampling. Additionally, the tools from the other loci are a representative sample rather than a total sample from these deposits. The details of the flaked stone assemblages of each of these loci are presented in Tables 8.8, 8.9, and 8.10, and are discussed below.

*Locus 003, Square 5316*

Locus 003 in square 5316 appears to have been a stony layer (exterior?) with abundant artifacts, possibly representing a lithic dump deposit. The flake and blade debitage from this locus was not sampled, but based on the tools recovered during the initial sorting after excavation, the deposit contains evidence of tool production. In addition, the recovered cores (n=8) suggest that core reduction may have occurred at this locus. Burin spalls (n=44) are numerous, and most are consistent with those produced from concave-truncation burins or burins-on-breaks. The large number of concave-truncation burins in the deposit (n=24) probably served as the cores for the production of these spalls. Only one borer, however, was recovered and it was not fashioned on a spall. Additionally, other tools in the assemblage provide evidence of tool production, maintenance, recycling, and retooling. At least two of the projectile points appear to be unfinished point preforms. Additionally, two woodworking tools (both axe/adzes), appear to have broken during production. Evidence of reuse and/or maintenance was noted in the sickle blade and knife assemblages, both of which include artifacts indicative of recycling and/or resizing. In general, the available evidence for this deposit indicates tool production, maintenance, and retooling are represented, along with some probable unstandardized blade/let-and flake-core reduction.
Table 8.8. PPNC debitage and tools by locus.

<table>
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<tr>
<th>CORES, TOOL PRODUCTION &amp; TOOLS</th>
<th>5316 (003)</th>
<th>3300 (006)</th>
<th>3300 (010)</th>
<th>5516 (009)</th>
<th>5516 (013)</th>
<th>5516 (014)</th>
<th>5516 (022)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>H/NH⁵</td>
<td>H/NH</td>
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<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
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<td>0/1</td>
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<td>1/1</td>
</tr>
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<td>Informal tools</td>
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<td>3/1</td>
<td>2/3</td>
<td>8/1</td>
<td>5/0</td>
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<td>0/0</td>
<td>0/0</td>
<td>0/1</td>
<td>0/0</td>
</tr>
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<td>Production by-products</td>
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<td>11/0</td>
<td>7/2</td>
<td>7/0</td>
<td>4/0</td>
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<td>Burin spalls</td>
<td>19/25</td>
<td>4/7</td>
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<td>2/2</td>
<td>0/0</td>
<td>4/1</td>
<td>1/0</td>
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<td><strong>Total</strong></td>
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<td><strong>33/25</strong></td>
<td><strong>18/9</strong></td>
<td><strong>19/7</strong></td>
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**BLADE DEBITAGE**

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<td>0/2</td>
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<td>4/2</td>
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<td>Noninitial platform spalls</td>
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<td><strong>Total</strong></td>
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<td><strong>27/11</strong></td>
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**FLAKE DEBITAGE**

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<td>Single-facet platform⁵</td>
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<td>Multiple-facet platform⁵</td>
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<td>9/17</td>
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</tr>
<tr>
<td>Faceting flakes</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>1/0</td>
<td>1/0</td>
<td>0/0</td>
<td></td>
</tr>
<tr>
<td>Microflakes</td>
<td>0/0</td>
<td>127/31</td>
<td>10/4</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td></td>
</tr>
<tr>
<td>Fragments</td>
<td>1/0</td>
<td>151/151</td>
<td>90/131</td>
<td>32/30</td>
<td>59/80</td>
<td>29/82</td>
<td>13/45</td>
<td></td>
</tr>
<tr>
<td>Shatter</td>
<td>0/0</td>
<td>12/20</td>
<td>0/14</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4/0</strong></td>
<td><strong>398/406</strong></td>
<td><strong>190/308</strong></td>
<td><strong>63/86</strong></td>
<td><strong>107/172</strong></td>
<td><strong>68/157</strong></td>
<td><strong>35/90</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Overall Total</strong></td>
<td><strong>99/114</strong></td>
<td><strong>456/448</strong></td>
<td><strong>235/328</strong></td>
<td><strong>95/103</strong></td>
<td><strong>132/188</strong></td>
<td><strong>105/168</strong></td>
<td><strong>60/95</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

a Debitage not sampled for this locus.
b H = Huweijir flint and NH = non-Huweijir or locally available bedded, wadi-rolled, and tabular flint and chert.
c Although these flake types can be associated with the early stages of bifacial reduction, the flakes assigned to these categories either appear associated with early-stage reduction that cannot easily be assigned to any specific reduction strategy or they appear more consistent with the reduction of flake cores.
Table 8.9. PPNC formal and informal tools.

<table>
<thead>
<tr>
<th>Formal Tools</th>
<th>5316 (003)</th>
<th>3300 (006)</th>
<th>3300 (010)</th>
<th>5516 (009)</th>
<th>5516 (013)</th>
<th>5516 (014)</th>
<th>5516 (022)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile points</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Sickle blades</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Knives</td>
<td>27</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td>Borers</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Drills</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Woodworking tools</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Informal Tools</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Burins</td>
<td>27</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Scrapers</td>
<td>23</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>34</td>
</tr>
<tr>
<td>Chamfered-bit</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Notches/Denticulates</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Used/re touched pieces</td>
<td>38</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>57</td>
</tr>
<tr>
<td>Other informal</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>153</td>
<td>16</td>
<td>9</td>
<td>5</td>
<td>9</td>
<td>9</td>
<td>7</td>
<td>208</td>
</tr>
</tbody>
</table>

Table 8.10. PPNC tools and blades from naviform cores.

<table>
<thead>
<tr>
<th>Naviform</th>
<th>5316 (003)</th>
<th>3300 (006)</th>
<th>3300 (010)</th>
<th>5516 (009)</th>
<th>5516 (013)</th>
<th>5516 (014)</th>
<th>5516 (022)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blades</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Tool-Production Debris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production by-products</td>
<td>0</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Tool blanks</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Production failures</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Formal Tools</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile points</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Sickle elements</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Knives</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Borers</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Drills</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>14</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>30</td>
</tr>
</tbody>
</table>

Locus 006 and Locus 010, Square 3300

Locus 006 was an interior fill deposit under a floor. The context suggests that this is a secondary deposit, although the presence of a few microflakes, numerous flake fragments, and two cores, indicates it was a dump deposit that originated from a well-cleaned activity area. Likewise, locus 010 was an interior fill layer underlying locus 006.
As with locus 006, this deposit contained cores and flake debitage, including small flake fragments. It too was likely to have been from a well-cleaned activity area. Both loci have some evidence of flake core reduction, but no convincing evidence of blade production is apparent. Evidence of tool production and maintenance activities is indicated by numerous tool-production by-products and burin spalls (although, no burins or drills were recorded in this sampling). Evidence of tool resizing or maintenance is also represented, with five blade segments (from locus 006) retaining evidence of retouch or use-wear interrupted by intentional sectioning. Additionally, locus 006 contained one tool blank (a trapezoidal blade from a naviform core) suitable for use as a knife or sickle blade. The presence of blades from reduction of naviform cores in the PPNC, after they were no longer being produced, is best explained by scavenging, which apparently occurred throughout the PPNC and also involved recycling PPNB tools and cores. The tool assemblage also includes evidence of retooling as indicated by a discarded, impact-damaged projectile point (a scavenged Byblos point with Abu Gosh retouch), and a used and discarded sickle element and knife blade fragments from both loci.

*Locus 009, Locus 013, Locus 014, and Locus 022, Square 5516*

All of these loci were fill deposits that contained waste from tool production. The lack of small debitage, and the context of each deposit, suggests that they were all of a secondary nature. As with the other selected loci, flake cores and bladelet cores were found in each locus, but based on the debitage sample, core reduction does not appear to have occurred in any of them. All have tool-production by-products and loci 009, 014, and 022 also have burin spalls consistent with those produced from concave-truncation
burins, although this sample did not contain many burins or spalls fashioned into drills. Tool blanks are less common; only locus 014 has a clear tool blank (a trapezoidal blade from a naviform core) probably intended as a sickle blade. Loci 013 and 014 have probable production breaks (one on a blade and one on a flake, both broken in bending breaks with no clear use-wear), but the intended product was not clear. The tools also display evidence of retooling, maintenance, and recycling activities. For example, the projectile points from locus 013 are all discarded and broken, as are the bifacial knives from loci 013 and 022, suggesting their replacement through retooling. Additionally, the axe/adze tool from locus 009 has signs of reshaping or recycling, and other evidence for recycling or maintenance of a woodworking tool is indicated by a bit rejuvenation flake in locus 014.

**Summary of PPNC Loci**

Despite the limited sampling, the tool-production debris and tool assemblages from the PPNC loci attest to tool production, maintenance, and retooling activities, a pattern that is likely to be the same even in a larger sample. As in the PPNB, these activities are represented by blade and flake production by-products, tool blanks, and production failures consistent with the discarded, used and broken cutting implements and projectile points. Additionally, burin spalls from concave-truncation burins are more common (although, few burins were represented in this sample), and chamfered-bit spalls and tools are absent, according well with the findings from the overall PPNC assemblage. The tool assemblage does show differences from that of the PPNB, the most apparent of which is the smaller proportion of formal tools and the generally greater representation of
informal tools. This situation also is consistent with findings from the larger assemblage and indicates an emphasis on expedient tool use during the PPNC.

In contrast to the PPNB periods, flake cores are much more common in the PPNC loci. This trend is consistent with the findings from the larger analyzed core assemblage, which clearly shows an increase in reliance on flake cores in the later periods coincident with the cessation of specialized naviform core-and-blade production. Blades from naviform cores are also much less common and those that are present most likely were scavenged from earlier deposits. As indicated in Table 8.10, blades from naviform core technology are most common among formal tools and their production by-products, which is consistent with the overall findings from the formal tool and tool production samples. Finally, as with the trend that started in the LPPNB, Huweijir flint is less common in all PPNC loci.

Yarmoukian Loci

From the Pottery Neolithic, the flaked-stone contents of 17 loci in five squares were examined, and from these, six loci contained evidence of core reduction and/or tool production and maintenance activities. As in the PPNC, one locus (023 in square 4073) was included based on findings from the tool assemblage alone because the debitage for this context was not analyzed due to time constraints. Additionally, the tool assemblages for the other five loci are representative samples, but are considered here to be indicative of the tool production and discard activities that were commonplace in the PN. The details of each of the loci are presented in Tables 8.11, 8.12, and 8.13.
Table 8.11. Yarmoukian debitage and tools by locus

<table>
<thead>
<tr>
<th>CORES, TOOL PRODUCTION &amp; TOOLS</th>
<th>4076 (014)</th>
<th>4076 (016)</th>
<th>4076 (019)</th>
<th>4075 (024)</th>
<th>4075 (012)</th>
<th>4073 (023)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H/NH(^a)</td>
<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
<td>H/NH</td>
</tr>
<tr>
<td>Formal tools</td>
<td>3/0</td>
<td>6/0</td>
<td>2/0</td>
<td>2/2</td>
<td>7/3</td>
<td>14/1</td>
</tr>
<tr>
<td>Informal tools</td>
<td>4/0</td>
<td>2/3</td>
<td>3/2</td>
<td>6/2</td>
<td>25/10</td>
<td>30/14</td>
</tr>
<tr>
<td>Hammer/pecking stone</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/1</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Production by-products</td>
<td>10/4</td>
<td>27/4</td>
<td>7/2</td>
<td>15/10</td>
<td>18/9</td>
<td>0/0</td>
</tr>
<tr>
<td>Burn in spills</td>
<td>2/1</td>
<td>7/0</td>
<td>0/0</td>
<td>0/0</td>
<td>2/2</td>
<td>3/1</td>
</tr>
<tr>
<td>Tool blanks</td>
<td>0</td>
<td>7/0</td>
<td>0/0</td>
<td>0/1</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Production failures</td>
<td>0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Flake cores</td>
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<td>0/0</td>
<td>2/1</td>
<td>3/1</td>
<td>1/2</td>
</tr>
<tr>
<td>Blade/let cores</td>
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<td>0/0</td>
<td>0/0</td>
<td>0/1</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>19/5</td>
<td>49/7</td>
<td>12/4</td>
<td>25/18</td>
<td>55/25</td>
<td>48/18</td>
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</tbody>
</table>

**BLADE DEBITAGE**

<table>
<thead>
<tr>
<th></th>
<th>4076 (014)</th>
<th>4076 (016)</th>
<th>4076 (019)</th>
<th>4075 (024)</th>
<th>4075 (012)</th>
<th>4073 (023)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trapezoidal</td>
<td>2/0</td>
<td>17/8</td>
<td>4/0</td>
<td>8/4</td>
<td>9/8</td>
<td>0/0</td>
</tr>
<tr>
<td>Triangular</td>
<td>3/4</td>
<td>17/7</td>
<td>2/0</td>
<td>13/3</td>
<td>5/13</td>
<td>0/0</td>
</tr>
<tr>
<td>Trapezoidal-to-triangular</td>
<td>0/0</td>
<td>2/0</td>
<td>0/1</td>
<td>1/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Platform-isolation/preparation</td>
<td>0/0</td>
<td>8/0</td>
<td>0/0</td>
<td>0/0</td>
<td>5/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Error correction/cleanup</td>
<td>1/0</td>
<td>3/2</td>
<td>0/1</td>
<td>0/0</td>
<td>2/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Profile-correction</td>
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<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Crested blades</td>
<td>0/0</td>
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<td>0/1</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Initial platform spalls</td>
<td>0/0</td>
<td>1/0</td>
<td>0/0</td>
<td>3/2</td>
<td>0/0</td>
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</tr>
<tr>
<td>Noninitial platform spalls</td>
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<td>1/0</td>
<td>1/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8/4</td>
<td>53/18</td>
<td>7/3</td>
<td>25/9</td>
<td>21/21</td>
<td>1/0</td>
</tr>
</tbody>
</table>

**FLAKE DEBITAGE**

<table>
<thead>
<tr>
<th></th>
<th>4076 (014)</th>
<th>4076 (016)</th>
<th>4076 (019)</th>
<th>4075 (024)</th>
<th>4075 (012)</th>
<th>4073 (023)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely cortical</td>
<td>2/11</td>
<td>11/21</td>
<td>0/8</td>
<td>4/10</td>
<td>0/13</td>
<td>0/0</td>
</tr>
<tr>
<td>Single-facet platform(^c)</td>
<td>6/25</td>
<td>74/128</td>
<td>7/25</td>
<td>45/70</td>
<td>81/78</td>
<td>0/0</td>
</tr>
<tr>
<td>Multiple-facet platform(^c)</td>
<td>16/38</td>
<td>45/85</td>
<td>7/14</td>
<td>18/23</td>
<td>28/28</td>
<td>0/0</td>
</tr>
<tr>
<td>Platform absent(^c)</td>
<td>4/8</td>
<td>24/29</td>
<td>0/8</td>
<td>16/11</td>
<td>61/83</td>
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</tr>
<tr>
<td>Edge-preparation</td>
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<td>0/0</td>
<td>17/8</td>
<td>19/13</td>
<td>0/0</td>
</tr>
<tr>
<td>Biface production flakes</td>
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<td>0/0</td>
<td>0/0</td>
<td>12/11</td>
<td>13/7</td>
<td>0/0</td>
</tr>
<tr>
<td>Alternate flakes</td>
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<td>0/0</td>
<td>0/0</td>
<td>2/3</td>
<td>5/3</td>
<td>0/0</td>
</tr>
<tr>
<td>Faceting flakes</td>
<td>0/0</td>
<td>1/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/2</td>
<td>0/0</td>
</tr>
<tr>
<td>Microflakes</td>
<td>4/5</td>
<td>4/2</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td>Fragments</td>
<td>29/61</td>
<td>108/177</td>
<td>5/37</td>
<td>0/0</td>
<td>77/82</td>
<td>0/0</td>
</tr>
<tr>
<td>Shatter</td>
<td>0/158</td>
<td>61/247</td>
<td>0/37</td>
<td>0/0</td>
<td>0/0</td>
<td>0/0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>61/306</td>
<td>328/689</td>
<td>19/129</td>
<td>114/136</td>
<td>284/309</td>
<td>0/0</td>
</tr>
</tbody>
</table>

**Overall Total**

|                  | 88/315     | 430/714    | 38/136     | 164/163    | 360/355    | 48/18      |

\(^a\) Debitage not sampled for this locus.

\(^b\) H = Huweijir flint and NH = non-Huweijir or the locally available bedded, wadi-rolled, and tabular flint and chert.

\(^c\) Although these flake types can be associated with the early stages of bifacial reduction, the flakes assigned to these categories either appear associated with early-stage reduction that cannot easily be assigned to any specific reduction strategy or they appear more consistent with the reduction of flake cores.
Table 8.12. Yarmoukian formal and informal tools.

<table>
<thead>
<tr>
<th>Formal Tools</th>
<th>4076 (014)</th>
<th>4076 (016)</th>
<th>4076 (019)</th>
<th>4075 (024)</th>
<th>4075 (012)</th>
<th>4073 (023)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile points</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Sickle blades</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Knives</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Borers</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Drills</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Woodworking tools</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Informal Tools</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Burins</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Scrapers</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Chamfered-bit</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Notches/Denticulates</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Used/retouched pieces</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>18</td>
<td>31</td>
<td>56</td>
</tr>
<tr>
<td>Other informal</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

| Total                 | 7          | 11         | 7          | 12         | 45         | 58         | 140   |

Table 8.13. Yarmoukian tools and blades from naviform cores.

<table>
<thead>
<tr>
<th>Naviform</th>
<th>4076 (014)</th>
<th>4076 (016)</th>
<th>4076 (019)</th>
<th>4075 (024)</th>
<th>4075 (012)</th>
<th>4073 (023)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blades</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tool-Production Debris</th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production by-products</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>6</td>
<td>3</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Tool blanks</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Production failures</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Formal Tools</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile points</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Sickle Elements</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Knives</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Borers</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Drills</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

| Total                  | 2          | 11         | 2          | 8          | 7          | 1          | 31    |

Locus 019, Square 4076, and Locus 012 and Locus 024, Square 4075

Locus 019 in square 4076 was a pit under an activity surface (locus 016). Loci 012 and 024 in square 4075 were both compacted surfaces in a series of possibly interior
compact surfaces or floors\textsuperscript{33}. Based on the flake debitage, locus 019 in square 4076 and loci 012 and 024 in square 4075 contain little evidence of core reduction. None of the deposits shows evidence of blade production. All three have tool-production by-product, but, only locus 012 has burin spalls and only locus 024 has an obvious tool blank. Evidence of extensive use and reuse of tools is present among the discarded items in all three deposits, especially among the formal tool types (extensively retouched projectile points and sickle blades). Additionally, all three locus samples included at least one scavenged Byblos point (all are broken) and locus 012 contained three exhausted or nearly exhausted Nizzanim points. Among informal tools, burins are dominated by truncation burin types devoted to spall production. Truncation burins then are more correctly considered cores for the production of spalls, which are intended as tool blanks, although, none of the borers or drills sampled from these loci were made on spalls. Finally, in each of the loci, formal tools are less common than informal tools. In general, these deposits are consistent with secondary waste dumps from tool-production activities.

\textit{Locus 023, Square 4073}

Locus 023 in square 4073 was a domestic activity surface associated with a possible storage room. Debitage and blades were not sampled for this locus, but cores were present, suggesting core reduction may have occurred. Because debitage was not sampled, the only tool-production by-products are four burin spalls of the kind produced by truncation burins, which are the most common type of burin in this sample.

\textsuperscript{33} They were not clearly designated as living surfaces by excavators, so they could have been compacted fill layers.
Furthermore, two of the drills in this sample were made on burin spalls. Additionally, the other formal tools display evidence of maintenance and retooling. The projectile points, for instance, include one scavenged Byblos point, one nearly exhausted Ha-Parsa point, and a heavily retouched point fragment. From the sickle element assemblage, two blades have evidence of resizing during their use lives. Finally, some of the knives are fragmentary and probably represent discards, and the single woodworking tool (an axe) has extensive use damage. All of these artifacts suggest that tool production, maintenance, and retooling activities occurred at this locus.

*Locus 014, Square 4076*

Locus 014 appears to have been one of a series of fill deposits associated with interior activity surfaces. Although the flake debitage contains abundant fragments, some of which are small enough to be considered microflakes, the content and character of the assemblage indicates that the deposit is trash from a well-swept flintknapping area. The debitage assemblage contains evidence that some flake-core reduction may have occurred, but there is no evidence of blade production. Blades that are present most likely are discards from tool production. This interpretation is supported by the presence of flake-tool and blade-tool production by-products (for example, three blanks with retouch interrupted by an intentional break), by three burin spalls from concave-truncation burins, and by one Ha-Parsa point that broke very late in production. The tool sample also contains used and discarded, broken examples, including two projectile points and a drill on a burin spall, which supports the interpretation that tool production and retooling and maintenance activities are represented in this deposit, along with some core reduction.
**Locus 016, square 4076**

Locus 016 is interpreted to have been a domestic activity surface that covered much of the square. Flakedebitage is abundant in the sample and flake fragmentation is common, although microflakes are uncommon. The blade assemblage is more numerous and varied in blade types than the other deposits sampled here, but blade production still does not appear to have occurred. Clear evidence of tool production, however, is indicated by the numerous flake-tool and blade-tool production by-products, by burin spalls from truncation burins 34, and by seven blade-tool blanks (five of which appear suitable for modification into projectile points, and two suitable as cutting tools). The discarded tools retain evidence of extensive use and sometimes recycling, traits consistent with retooling. For instance, from the projectile point assemblage, a Byblos point appears to have been scavenged from earlier deposits, and was retouched and recycled as a cutting implement before its final discard. In sum, this locus contained evidence of core reduction, and tool production, maintenance, and retooling activities.

**Summary of Yarmoukian Loci**

The PN loci samples present a typical example of Yarmoukian tool-production and core-reduction activities. Tool production, maintenance, and retooling are indicated by blade and flake production by-products that are consistent with tool blanks, tool-production failures, and with discarded used and broken knives, sickle elements, and projectile points. Additionally, as is represented in the overall findings for the PN, spalls from concave-truncation burins are common, as are concave truncation burins.

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34 No drills on spalls, however, were present in this sample.
themselves. And, while some of the drills in this sample were made on spalls, it seems many of them had other roles. Although the tools from these deposits represent only a sample, the patterns indicated in these samples are considered here to be representative, and are consistent with findings from the entire assemblage. As in the PPNC, formal tools are less common than informal tools (see Table 8.12) and they tend to be heavily retouched, indicating more intensive reworking. Blades from naviform cores are also less prevalent, and while they are not present in any of the blade debitage assemblages, they are nonetheless found among tool-production debris and formal tools. This pattern supports the interpretation that they were scavenged from earlier deposits and reused or remanufactured into one of the formal tool forms.

A few of the PN loci have some evidence of flake-core reduction, and as in the other periods, flakes with multiple-facet platforms and single-facet platforms from flake-core reductions dominate among identifiable debitage types. As in the PPNC sample, flake cores are more numerous than in earlier periods, and none of the loci has evidence of blade production. Additionally, when compared to the PPNB, Huweijir flint is less well represented (40% overall). It is generally lowest among the flake debitage and highest among blades and tools. This pattern suggests that flake and blade blanks of Huweijir flint were preferred for tool production. In fact, abundant evidence of scavenging of flakes and blades from naviform cores, PPNB tools, and cores indicates that much of the Huweijir flint present in Yarmoukian contexts may have been obtained in this way.
**Summary of Locus Analysis**

All of the deposits from the MPPNB loci are domestic debris from household-level activities. None is consistent with the assemblage patterns expected if specialized production of tools had occurred. Instead, they contain abundant evidence for the production of the entire formal and informal tool kit (including projectile points with diagonal parallel pressure retouch) by the household occupants. Variation in the quality of production of tools, including possible novice pieces, falls in line with the view that most community members engaged in tool production to carry out the daily tasks common to most households. Additionally, it is clear from these loci that much of the formal tool assemblage was manufactured on blades from naviform cores, procured from specialist craftspeople. Despite the commonality of these blade blanks, tool production data attest to the fact that unstandardized blade/let-core and flake-core reduction occurred frequently, and many of the flakes and blade/lets produced served as blanks for informal tools.

As in the MPPNB, the LPPNB loci are representative of typical deposits containing domestic debris from household activities, and although some deposits are quite rich (loci 042 and 047 in square E14 and West Field Feature 2), the contents of none of them are consistent with patterns expected for specialization in tool production. In fact, while the production activities still included the entire formal and informal tool kit, they exhibit a range in the quality of production. Given this pattern, it is clear that LPPNB households or equivalent domestic units produced their own tools. Specialist-produced blade blanks from naviform cores, however, appear to have become less
important through time. And, with this change, unstandardized core reduction increased, Huweijir flint became less predominant, and the production of some tool forms began to include a wider variety of resource materials and blank types. The evolution is hardly straightforward, however, as variation is evident between samples from early- and late-phase deposits and between deposits from different areas.

The PPNC locus assemblages represent domestic-related activities including core reduction and tool production, maintenance, and retooling. None of the production activities that occurred in households during the PPNC reflect or required the work of specialists. In response to the loss of naviform core-and-blade production, townspeople produced the majority of their tool blanks, primarily flakes, on their own, and as a result, flake cores are more common, as are informal tool technologies in these assemblages. PPNC inhabitants also scavenged tool blanks from older deposits, and they more intensively retouched and reused tools of high-quality flint such as that from the nearby Huweijir mines. Continuing with trends evident from the later LPPNB and transitional LPPNB/PPNC deposits, Huweijir flint is less common among both blades and flakes in the PPNC assemblages, but is still high among formal tools and tool-production debris.

Finally, the Yarmoukian also contains typical deposits of domestic-related flake core and tool-production activities. None conforms to the patterns expected in specialized production of tool blanks or tools. Instead, as in the PPNC, Yarmoukian inhabitants were responsible for most of their own blank production, which is supported by the large flake core assemblage and the greater prevalence of informal tools. Additionally, tool production activities are widespread, show variation in production quality, and include
the entire tool kit. The continued presence of scavenged tools and blades from naviform core technology found in the Yarmoukian deposits, suggests that when they were found, they were preferred for tool production. Informal tools, however, were much more common than in the previous periods and were made on a diverse array of locally available resource materials of variable quality.

In sum, none of these locus assemblages described here contains debris consistent with the specialized production of a single tool type at either the community or household level at ‘Ain Ghazal. They all show a diversity of reduction and production activities, and varying levels of skill and effort. Together they provide an understanding of the range of flaked-stone production activities represented in typical domestic-related deposits. Additionally, the wide array of tools found in these deposits attests to the variety of daily tasks undertaken near the household and further afield by townspeople throughout the occupation of ‘Ain Ghazal. The findings from the loci discussed here accord well with the overall findings from the larger assemblage for each period of occupation.

The overarching trends and what they indicate about changes in the lithic economy through time are summarized in the next chapter.
Chapter 9

SUMMARY

As the previous chapters demonstrate, the characterization of the nature of flaked-stone tool production in households at ‘Ain Ghazal involved the examination of several lines of evidence: context and content of the deposits, tool-production constraints, and resource material use. The findings for each of the variables are presented by assemblage in Chapters 5 through 7, and Chapter 8 addressed the role of these tools in daily life and the nature and character of flaked-stone production from specific household deposits. This chapter presents a summary of the findings for each line of evidence and what this analysis indicates about household-level production through time at ‘Ain Ghazal. Additionally, this chapter compares ‘Ain Ghazal with other sites that had dual economies and discusses what these findings imply about variation in lithic economies on a regional scale.

THE CONTEXT AND CHARACTER OF FLAKED-STONE PRODUCTION

Context and Content of the Deposits

In order to examine the broad range of flaked-stone production activities that occurred in households at ‘Ain Ghazal, interior and exterior residential deposits representing loci of flaked-stone reduction, domestic debris dumps, and fills previously detailed in Chapter 8 are evaluated here. It is expected that such deposits were widespread and would include a diverse array of core-reduction and tool-production activities. The analysis conducted here suggests that the contents of these deposits and
their ubiquitous presence across the site and through time reflect the everyday activities that occurred in most households.

Specifically, several of the locus assemblages from each period contain coherent evidence of flake-core reduction. That is, diverse types of flake cores were found along with abundant flakes with multiple-facet platforms and single-facet platforms of the same flint, all of which suggests some degree of technological consistency in flake blank production. Compared to flake-core reduction, blade production was not represented in any of the locus assemblages, but a small amount of non-naviform blade-core reduction was noted in the household assemblages in Quintero’s (2010) research. It is entirely possible that such blade/let cores were reduced during ad hoc knapping events at different locations in an expedient manner, reducing the visibility of the behavior in any given individual deposits.

In addition to core reduction, evidence of tool production and retooling is widespread in the examined deposits across all areas and periods of the site occupation, and is suggested by the following conspicuous material indicators:

1. Evidence of formal tool production indicated by blade segments, diverse tool blanks and preforms, and production failures, and maintenance and retooling of cutting implements (e.g., knives and sickle blades) and other tools, such as projectile points, reflected by discarded, used, and retouched tools consistent with the retooling of these implements.
2. Evidence of informal tool production indicated by the presence of numerous burin spalls and burin types, both of which changed through time\(^1\); and by the presence of chamfered-bit spalls, and discarded chamfered-bit tools, both of which became less common after the MPPNB.

3. Evidence of the production and maintenance of woodworking tools indicated by debitage, blanks, preforms, and production failures along with functional tools, and discarded exhausted and broken woodworking implements.

In sum, the technological nature of the debitage, cores, and tools from the household contexts analyzed here provide a coherent body of evidence, and reflect a diversity of tool production and tool maintenance activities reflecting a generalized tool-production economy. This industrial organization was an enduring, and essential aspect of the economy for the duration of the occupation.

**Tool Production Constraints**

As demonstrated by the widespread evidence of core reduction and tool production across the site, it is clear that many people in the community possessed the knowledge and ability to knap and create flaked-stone products. This situation was the case even during the PPNB when standardized blade blanks from specialist production served as the basis for much of the tool kit. Further, none of the loci examined here contained production debris apparently devoted to one particular tool type that might reflect specialized tool production. Moreover, none of the loci of workshop debitage from loci

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\(^1\) That is, spalls from burin production are more common in MPPNB assemblages, in which dihedral and transverse burins also are more common. Similarly, as truncation burin types become more common starting in the LPPNB, so do the spalls produced from these types of burins.
naviform core-and-blade production (described by Quintero 2010) has abundant enough evidence of tool manufacture to indicate that this was a major activity undertaken by specialists. As with many of the other manufacturing activities (e.g., basketry, woodworking, millstone production, etc.), among those who knapped stone, some individuals likely had more natural ability or more interest. Such variability in skill is reflected in tools that show a range in the quality of production (Whittaker 1987; Finlay 2008; Olausson 2008), which is the case at ‘Ain Ghazal. Essentially, at ‘Ain Ghazal there is no evidence that craft specialists consistently produced and supplied tools for the rest of the community during any period of occupation.

**Tool Stone Choices and Their Subsistence Significance**

Two major tool stone resources were used at ‘Ain Ghazal for the production of flaked-stone tools, local bedded and wadi-rolled cherts and flints of lower quality, and high-quality flint mined from the Amman Silicified Limestone formation primarily obtained in the nearby Wadi Huweijir. Consistent with the expectations for household-level production, both flint types are present in domestic-related deposits associated with core reduction and tool production. The degree to which certain resource materials are used among the tool assemblage provides insight into the interrelationship between the household and specialized economy, tool stone preferences, and changes in resource availability through time. The following discussion reviews their use through time among different assemblages associated with household production.

The flake debitage suggests that Huweijir flint was common in the MPPNB and declined sharply thereafter. Coinciding with this decline, brown tabular flint associated
with bifacial knife production, and wadi-rolled and bedded flint and chert from flake-core reduction, became more common. Additionally, some deposits contained technologically inconsistent core-shaping elements from the preparation of naviform cores, suggesting townspeople also scavenged from ancient workshop dump deposits at the site.

The pattern among the blade assemblage during the PPNB was different from that among the flake debitage, as blades from naviform cores were widely disseminated to households to meet tool needs. As a result, Huweijir flint was the most-used tool stone for blades during these periods. During the LPPNB, blanks produced by specialists declined in quality (Quintero 2010), and availability became variable across the settlement. In response to these changes, inhabitants scavenged blades from earlier deposits or made their own tool blanks through blade- and-flake core reduction. Accordingly, the proportion of blades from other non-naviform technologies increased, as did the proportion of lower-quality flint and chert in the lithic assemblages.

Among routinely hafted tools (such as projectile points, sickle elements, and blade-based knives) and tool production debris, products from naviform core reductions, and therefore Huweijir flint, remained well represented even into the post-PPNB periods when inhabitants were responsible for making their own tool blanks. Their continued presence was achieved through scavenging old blades and tools of Huweijir flint from earlier deposits as these were exposed during construction activities. Among formal tool types that were not as reliant on regularized blanks, more variation is apparent in the resource material used. For instance, flake-based knives (K4) were more commonly made of Huweijir flint in the MPPNB, but use of that material declined significantly in the
post-PPNB periods, replaced by other locally available flints and cherts. As with some of the knife types, blanks for borers are more varied. Additionally, among borers, Huweijir flint is most commonly used among blade-based types; among flake-based types resource material use is more varied, consistent with the patterns observed for other flake-based tools.

The bifacial knives (K1 and K2), which became more frequent in LPPNB and later deposits, often were made on nodular or bedded flint and chert, or on thin brown tabular flint, demonstrating that Huweijir flint was neither preferred nor necessary for the manufacture of these tool forms. Similarly, woodworking implements did not require Huweijir flint for their production, and in fact the preferred resource materials, chosen for their durability, were the locally available nodular and bedded flint and chert varieties (as also observed by Quintero and Hintzman 2007).

Among the informal tools, Huweijir flint was most commonly used in the MPPNB and began to decline in the LPPNB, replaced by wadi-rolled or bedded chert and flint. Even in the MPPNB assemblage, however, lesser-quality flints and cherts were generally used for scrapers, notches, and denticulates, retouched pieces, and combination tools, many of which are made on flake blanks produced in households. The most obvious exception to this pattern is chamfered-bit tools and transverse burins. Both categories were more often made on blades from naviform cores than were the other informal tools, but both are also rare in post-PPNB deposits.

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2 In fact, tabular and tile knives (so called because they were manufactured mostly on thin tabular flint) never used the thicker, nodular, Huweijir flint.
In domestic-related deposits that contain the remains of generalized flake-core reduction, some lower-quality flint and chert varieties are present, and these came to dominate in the post-PPNB periods. Even in the PPNB, however, bedded chert and flint varieties comprised much of the core assemblage because this was the flint most easily available to townspeople; individuals do not appear to have mined their own flint from Wadi Huweijir. As suggested by Quintero (1996, 2010:54), the mining of Huweijir flint seems to have been nearly exclusively associated with the naviform core-and-blade industry. Therefore, it appears that many of the cores found in deposits representing the household production were either recycled from discarded naviform cores or they consist of rejected irregular, sometimes internally flawed, Huweijir flint chunks. This pattern suggests that inhabitants may have opportunistically scavenged cores and rejected resource material along with other production debris from deposits left by specialist producers.

Among several tool forms and debris from tool production (spalls, tool blanks, production failures, knives, scrapers, notches, used and retouched flakes and blades, core tools, chamfered-bit tools, and combination tools), the representation of Huweijir flint reached its lowest point in the PPNC, but it became somewhat more common in the Yarmoukian. This trend may reflect the digging of numerous pits during the Yarmoukian period all over the site (Rollefson, personal communication 2013).

In sum, based on the findings from the entire assemblage, resource material representation in the deposits sampled here is more consistent with generalized than with specialized tool production.
Summary of the Context and Character of Flaked-Stone Production at ‘Ain Ghazal

Given the findings regarding context and content of the deposits, resource material preference through time, and skill involved in most production activities, it is clear that tool production and other flake- and blade/let-core reduction was not the work of specialists and occurred in most households at ‘Ain Ghazal. Undoubtedly, household-level flaked-stone production was affected by the presence of the specialized blade-production component of the lithic economy, and it had a lasting influence on production choices into the PPNC and Yarmoukian. Examination of several lines of evidence clarifies some of the choices through time associated with changes in resource use, daily tasks, and the lithic economy, which are summarized for the PPNB and later periods below.

EVIDENCE OF A DUAL ECONOMY AND ITS EVOLUTION

Middle Pre-Pottery Neolithic B

The lithic tool kit of the Neolithic suggests that the Neolithic townspeople of ‘Ain Ghazal frequently engaged in hunting, butchery, harvesting of cereals and other plant foods, construction of structures, production of beads and other adornments, bone/antler working, woodworking, leather/hide working, and surely much more. Discarded implements associated with these activities in household deposits, along with debris indicative of their production, maintenance, and replacement indicates that MPPNB people attended to their own tool needs on a routine basis. This pattern for the context of tool production seems to accord well with arguments regarding Neolithic socioeconomic
organization based on residential architecture in the MPPNB that each household served as the basic unit for production and consumption activities (Rollefson 1997, 2004, 2010; Banning 2004).

Beyond providing insight into the common tasks of Neolithic peoples, the patterns of tool production offer an understanding of the organization of the lithic economy through time. During the MPPNB the economy was a duality in which standardized blades from naviform cores served as the basis for the formal and some of the informal tool kit. In addition, MPPNB townspeople also reduced unstandardized flake cores (and some blade/let cores) to provide blanks for their numerous flake-based tools. Although they could, and frequently did, produce their own tool blanks, the ease of producing blade-based tools on blades from naviform cores meant that townspeople preferred to use such blade blanks for much of their formal-tool production. The preference is also demonstrated in the low numbers of cores found in MPPNB deposits. Additionally, recycling and reuse are evident mainly among formal hafted tools (e.g., projectile points and cutting implements), which indicates that at least intended blades were considered valuable and worth conserving. This pattern suggests that most households or domestic units engaged in regular exchange with specialist blade-producers.

Late Pre-Pottery Neolithic B

The LPPNB shows some significant socioeconomic differences from the MPPNB period. Changes likely to have impacted the flaked-stone tool assemblage and common daily production tasks include population aggregation, changes in residential unit configuration, increased use of domesticates, and the beginnings of a seasonal fluctuation
in population associated with goat and sheep herding (Köhler-Rollefson 1992; Rollefson 1997, 2004; Quintero et al. 2004). Along with these transformations in settlement size and organization, were changes in the flaked-stone tool assemblage, including in the frequency of certain tool types. Some of these differences appear associated with changes in tool production choices and others are linked to changes in the tasks common to daily life. For instance, although differences in the frequency of certain projectile point types are apparent, hunting remained a common activity even as exploitation of domesticates became more prevalent. Cutting implements such as sickle elements and knives remain common in the assemblage, suggesting that harvesting and plant and animal processing were common daily tasks. In contrast to the MPPNB, bifacial and tile knives are much more common, perhaps favored for their longer use-life, ease of resharpening, and practicality of holding in the hand. Additionally, the greater numbers of concave-truncation burins and their resultant spalls appears associated with the start of pastoralism. Overall, informal expedient and multipurpose tools were perhaps a little more common in the LPPNB, which accords with evidence suggesting unstandardized core reduction by households supplied more of the blanks used for tools than in the previous MPPNB.

In contrast to the MPPNB, obvious changes in the lithic economy apparently occurred within the LPPNB. The dual economy was still operating, and households still commonly used products from naviform technology in tool production. Quintero (2010:143) observed, however, that naviform cores and blades appear less regularized in form in the LPPNB, implying changes to the specialized economy. Further, among those deposits that could be associated with an early or late phase of the LPPNB, differences
exist in the proportion of Huweijir flint and blades from naviform cores. As detailed in
the previous chapters, these differences suggest declining access to products from
naviform cores began during the LPPNB, rather than at the end of this period.

The variation evident in the domestic-related lithic deposits sampled here also
seems consistent with some changes in the location of domestic activities within the town.
In fact, publicly accessed activity areas, represented by external courtyards with single
leaf walls (walls of one-half brick thickness) and outdoor hearths are present (identified
in the East Field excavations, as suggested by Banning [2004]). Flintknapping activities
occurred in such places, as noted in Chapter 8. Storage and distribution of goods appear
to have remained under the control of households (Rollefson 1997, 2004, 2010; Banning
2004), so perhaps these courtyard knapping deposits represent the remains of collective
activity areas for the surrounding households. Altogether, whatever the exact cause, the
changes in the lithic economy during the LPPNB reflected a greater emphasis on the
household as a productive unit for all flaked-stone needs and less reliance on products
from naviform technology.

Pre-Pottery Neolithic C

Since naviform core-and-blade production ceased during the later part of the
LPPNB (Quintero 2010), PPNC households were completely responsible for producing
their own tool blanks, mostly from flakes or scavenging blades and tools from older
deposits. As a result, flake-core reduction increased markedly, and more of these cores
were made on lower-quality flints and cherts available in the immediate site area.
This shift in the lithic economy affected tool production in households such that informal tools on a variety of lower-quality resource materials became numerous, and formal tools still made on high-quality flint were both more heavily retouched and smaller. The tasks indicated by the presence of these tools, however, show continuity with the previous PPNB. For instance, projectile points remained present and were still apparently used in the same manner, suggesting that hunting continued. Along with hunting, harvesting of cereals continued, as did bead and pendant production, and, as in the LPPNB, concave-truncation burins and burin spalls continued to be common. Assemblage character changes among the woodworking assemblage, however, hint at an increased emphasis on lighter woodworking activities (Quintero and Hintzman 2007) associated with the decline of timber resources in the vicinity of the town.

It is obvious from the research presented here, and from that by Quintero (2010), that PPNC households remained the primary unit for production and consumption of flaked-stone implements. This view is supported by the nature of storage and distribution, which appears to have remained under the control of households (Banning 2004). The composition of the PPNC household unit, however, seems a little less clear than during the PPNB, as differences are evident between residential structures, with some apparent subdivision of the settlement (as seen in the “great wall”), and the possibility that at least a portion of the inhabitants may have been present for only part of the year (Köhler-Rollefson 1992). With regard to tool manufacture and chipping activities, however, few differences between households are evident in the deposits sampled here. They appear similar across all of the excavation areas.
Yarmoukian

Flaked-stone technology during the Yarmoukian period, as during the PPNC, involved households that produced and obtained their own tool blanks and tools. Flake cores are even more common in the Yarmoukian assemblages, and also flake-based tools are the mainstay of the lithic economy. Huweijir flint was less commonly used than in the PPNB assemblages, but when found, it was intensively used, as were products from naviform technology. Additionally, since scavenging from older town deposits occurred more frequently in the Yarmoukian period there is a greater representation of Huweijir flint among some tools. This pattern is certainly associated with the higher number of pits dug by Yarmoukian inhabitants.

The findings from the tool assemblage reflect a great deal of continuity with the previous periods in the tasks carried out in households throughout the town. Perhaps the biggest differences can be observed among the projectile points and sickle elements. For instance, in contrast to the earlier periods, small projectile points are common, which may be associated with the more intensive use of suitable blanks along with an increasing use of bow and arrow weaponry. Additionally, sickle elements exhibit more retouch and some are deeply serrated. This degree of retouch is related to using less regular and scavenged blanks, but the deep serrations appear associated with an increasing exploitation of tough-stalked plants (Unger-Hamilton 1988; Quintero et al. 1997).

As in the previous periods, production of tools and consumption of resources occurred in the households, which maintained control of their own storage facilities and distribution of subsistence goods (Banning 2004:226-227). Additionally, although the
settlement remained somewhat subdivided (indicated by the maintenance of a central dividing feature, the “great wall”), and some variation in residential structures is apparent, a comparison of artifacts sampled from deposits in different excavation squares show few notable differences.

**Summary of the Lithic Economy at ‘Ain Ghazal**

Distributional analyses through time at ‘Ain Ghazal demonstrate that household production of flaked-stone tools was focused primarily on the coresidential unit, and that changes in the lithic economy, tool types, and tool frequencies through time, coincide with other subsistence and economic transformations. Whether or not these same economic patterns can be observed at other similar sites can only be addressed in a preliminary manner here, but it is worth exploring to identify the sources of possible similarities or variability. The following section is devoted to just such an endeavor and it provides some fruitful directions for future research.

**SITUATING ‘AIN GHAZAL IN THE BROADER TRENDS OF THE SOUTHERN LEVANTINE NEOLITHIC**

It is standard practice for excavation reports to compare tool types, styles, and frequencies between sites, and comprehensive comparative analyses, such as those by Ali (2010) and Barzilai (2010), did this on a regional level. While this type of analysis is informative concerning similarities and differences with respect to the flaked-stone tool kit and inferred associated tasks, they are divorced from a full consideration of socioeconomic factors that influence production choices and the organization of economies through time. As indicated in the analysis conducted here, the easy access to
blades from naviform cores during the earlier part of the PPNB at ‘Ain Ghazal strongly
determined tool-production strategies. Its decline by the PPNC greatly altered the choices
and options available to the townspeople for tool production, until the site was abandoned
in the PN. Consequently, the following discussion focuses primarily on those sites that
are contemporaneous with ‘Ain Ghazal (especially Basta, Yiftahel, with some discussion
of Wadi Shu’eib, and Abu as-Suwwan) and that display similarities in the composition of
the PPNB lithic economy.

The focus on only a few sites here is not intended to ignore the fact that sites
without evidence of obvious or consistent specialized production of naviform technology
may have had complex and variable lithic economies, or that other specialized industries
may have existed at different types of settlements (Rollefson and Parker 2002; Fabiano et
al. 2004; Hermansen and Gebel 2004; Wright et al. 2008). Beyond the few sites with a
dual-economic structure of the flaked-stone economy, naviform core-and-blade
technology was present at many MPPNB and LPPNB sites, but was not necessarily a
specialized industry, and instead apparently was carried out by many community
members3. Moreover, several PPNB communities appear to display little naviform core
technology at all4. Even those PPNB settlements that appear to have received occasional
blade products and tools from villages with specialized production of naviform cores and

(Clegg 2001; Henry et al. 2003; Simmons and Najjar 2003; Bocquentin et al. 2007; Jensen 2007; Wilke et
al. 2007).
4 For instance, El-Hemmeh (Makarewicz et al. 2006), Khirbet Hammam (Peterson 2004), Ba’ja, and Es-
Sifiya (Gebel and Bienert 1997; Peterson 2004; Purschwitz 2013).
blades\textsuperscript{5} do not display the same dual economic pattern that is evident at ‘Ain Ghazal and other sites with specialization during the PPNB. Thus, focusing on those sites that are most comparable to ‘Ain Ghazal with regard to flaked-stone production is likely to be the most informative about potential factors influencing variations in the lithic economy through time.

Chapter 3 provides a discussion of what has been published about specialized and generalized production at Basta, Yiftahel, Wadi Shu‘eib, and Abu as-Suwwan\textsuperscript{6}. Each of these sites has tool types that place them in regional and chronological associations with one another. Differences exist in the proportions of particular tool types (see Chapters 5 and 6 for discussion of these differences), however, which may suggest some variation in the frequency of certain tasks or the use of certain diverse resources among these sites. Settlement sizes and duration of occupation also are factors. Yiftahel is an MPPNB site that may have been occupied for 100 to 200 years (Garfinkel et al. 2012:10-11). It is estimated to have been about 4 hectares in size. In contrast to Yiftahel, Basta is an LPPNB megasite, occupied for much of the LPPNB, and reaching a maximum extent of about 10 to 14 hectares (Nissen et al. 1987). Both Abu as-Suwwan and Wadi Shu‘eib are multicomponent sites occupied from the MPPNB to the PN, and thus are likely to be most comparable to the patterns at ‘Ain Ghazal. Unfortunately, they have only preliminary investigations (Wadi Shu‘eib) or are still in the process of being analyzed.

\textsuperscript{5} For example, Kfar HaHoresh (Goring-Morris 1994; Barzilai and Goring-Morris 2010), Abu Gosh (Khalaily and Marder 2003; Marder et al. 2011), Mishmar Haemeq (Barzilai and Getzov 2008; Barzilai 2010), and ‘Ayn Abu Nukhayla (Nowell et al. 2014).

\textsuperscript{6} The possible dual-economy at Atlit-Yam (Galili et al. 1993; Barzilai 2010) is not included in the comparison because it occurred during the PPNC, when, at ‘Ain Ghazal, specialization of naviform core and blade technology no longer persisted, and because clear evidence for this economy is not strong.
(Abu as-Suwwan), so little can be said about the comparability in scale, scope, and longevity of the specialized lithic economy. Likewise, household production at these sites is not yet well understood, even if commonalities in tool types and tool production suggest similarities to ‘Ain Ghazal in common tasks and in their lithic economies. Consequently, the following discussion focuses mainly on the structure of the dual economies at Basta and Yiftahel in comparison to ‘Ain Ghazal.

As discussed earlier, a comparison of the findings from ‘Ain Ghazal with what is known from Yiftahel and Basta shows some obvious similarities because of the presence of specialized naviform core-and-blade production. This likeness includes the existence of workshop deposits and a reliance on one or a few types of resource materials at all three of the sites. Additionally, one feature shared in common between MPPNB ‘Ain Ghazal and MPPNB Yiftahel was continuity in the organization of the specialized industry, which showed little change at both sites during the MPPNB. This continuity may result from the smaller population size and the relatively steady rate of population growth at each site during the MPPNB, thus resulting in greater economic stability throughout the period.

Some differences in the scale and scope of the specialized industries between the three sites, however, are apparent. MPPNB Yiftahel and LPPNB Basta both seem to have had specialized production of naviform cores and blades and some formal tool forms, with a scale of production that served more than just the immediate community (Barzilai 2010; Garfinkel et al. 2012; Gebel 1996). In contrast, at ‘Ain Ghazal the patterns

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7 Evidence from Wadi Shu’eib suggests similarities in household production based on scavenging (projectile points) and similar changes in blank choice through time (Simmons et al. 2001).
observed for specialization of naviform production by Quintero and Wilke (1995) and Quintero (2010) are more indicative of part-time specialization that was primarily intended to serve the community and did not involve the consistent manufacture of blades or tools for trade during the MPPNB or LPPNB. Additionally, there were apparent changes in specialized industry at ‘Ain Ghazal from the MPPNB to the LPPNB. Most notably, naviform core-and-blade production became less standardized and declined in the LPPNB. This pattern is different from that at LPPNB Basta, which appears to show little change in the lithic economy until the end of the LPPNB when the site was abandoned. Surely, the long and continuous occupation at ‘Ain Ghazal accounts for some of these differences with Basta, as the alterations apparent in the lithic economy at ‘Ain Ghazal appear associated with the major changes in population, site size, and residential units that mark the beginning of the LPPNB.

In addition to the dissimilarities resulting from variation in the occupation spans of the three sites, differences in the scope and scale of the specialized industry may account for some of the variation observed in the household production economy between the sites. For instance, no deposits yet examined at ‘Ain Ghazal appear to have been devoted solely to the production of one tool type. Even the blade cache (82 blades) discovered under the floor of an MPPNB household had blanks suitable for both projectile points and cutting implements, and was interpreted by Karnes and Quintero (2007) to be a household cache stored for future use. Conversely, at Yiftahel, the discovery of two large caches (over 100 items) that are thought to be associated with the production of projectile points, found along with accessories for manufacture, including a
limestone anvil and cortical flakes with bitumen residues, prompted researchers to propose they represent specialized production of tool forms such as projectile points. And, although they provide no productivity estimates, Khalaily et al. (2013:227-228) proposed that the scale of the specialized tool production was intended to meet the needs of the community and likely surrounding communities. However, while these do represent large caches, it is problematic to equate their size and their apparent concentration on projectile point production with specialization. After all, a similar type of cache\(^8\) was recovered at Beidha (Mortensen 1988), a site at which no apparent evidence of specialized production of naviform technology or tools has been found. This is not to say that specialized production of projectile points at Yiftahel is not a possibility, just that more evidence is necessary to support such a conclusion. Similarly, at Basta, Gebel (1996:269) described a “workshop” deposit (Area C, Square 208, Locus 7) that may reflect the production of several different types of tools, but whether it was production on a scale abundant enough to suggest it may have been for trade was not clearly stated. Finally, it also seems that at MPPNB Yiftahel (Garfinkel et al. 2012) and LPPNB Basta (Gebel 1996:268), the household lithic economy involved some core reduction and the production of tools on flakes, but not necessarily all of the formal tool types. In contrast, both MPPNB and LPPNB household production at ‘Ain Ghazal involved the creation of the entire tool kit.

Along with variation in the specialized industry at ‘Ain Ghazal, some differences are evident in access to naviform products and Huweijir flint usage during the LPPNB

\(^8\) The cache contained 115 pieces, including 11 projectile points and numerous blade blanks intended mostly for the production of projectile points. It was interpreted by Mortensen to be a cache of blanks and tools for personal use, that is, for producing tools when time and opportunity allowed or when the need arose (Mortensen 1988:199-200).
(but not the MPPNB). As addressed in the previous section, this variation between deposits and phases is associated with changes in the specialized economy that affected the relative importance of the generalized economy to the community. Such variation is not reported at Basta, which likely is a result of the particular dynamics of the lithic economy at that site, and the shorter exclusively LPPNB occupation span.

Despite the differences evident in some aspects of the dual economy at each of these sites, ‘Ain Ghazal and Yiftahel do have some similarities in behaviors of opportunism in stone tool use. For instance, PPNB inhabitants at both sites scavenged for, or otherwise acquired, discarded naviform core production and maintenance by-products, flawed or irregular resource material chunks, and exhausted naviform cores (Marder et al. 2011:424; Garfinkel et al. 2012). In contrast to Yiftahel, however, ‘Ain Ghazal seems to have evidence of recycling and reuse among all the formal and some of the informal tools. This finding could indicate greater conservation of flint material at ‘Ain Ghazal, or it may be an artifact of the way each analysis reported, defined, and recognized such behaviors.

**Summary of Variation in Site Economies**

Overall, while these sites appear to have specialized lithic economies and parallel nonspecialized household-level production during the PPNB, these entities vary enormously in scope. Moreover, the long occupation span of ‘Ain Ghazal made clear that many of the patterns in household-level production evident in the LPPNB, PPNC, and PN were affected by changes in and the eventual loss of the specialized economy, along with concomitant changes in subsistence and the exploitation of certain resources. Although

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9 Such behaviors are likely present and identified at Basta, but they have yet to be reported.
much change is evident in household lithic production, continuity is also apparent in production choices and common tool forms, suggesting daily tasks remained similar despite changing conditions. This stability is no doubt related to the continual presence of the generalized household lithic economy throughout the duration of the town’s existence.

All of this demonstrates the importance of understanding the unique socioeconomic history of each site. Taken together, the findings here suggest that, as with other production economies, architecture, subsistence, etc., the manner by which ancient peoples organized their lithic economies to produce the necessary tools used in a variety of daily tasks may have been localized to a small region or even settlement. This pattern of variation is more in line with polycentric and other similar arguments (Gebel 2004a, 2004b; Hermansen 2004; Asouti 2006; Finlayson 2013) that recognize the diversity in the timing and extent of behaviors and practices considered typical of the Neolithic. A comparison of such site-level analyses can help us to understand better the genesis and function of variation during the Neolithic, as well as the character of interaction between individual communities in a region and how these interactions affected change on the level of the community, region, and even supraregion.

**FINAL THOUGHTS**

During the Neolithic, lithic tools were part of everyday tasks and interactions and thus provide sensitive indicators of socioeconomic changes. This fact is exemplified in this analysis of household-level flaked-stone production at ‘Ain Ghazal, which

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10 However, Asouti (2006) did not consider her approach polycentric; instead, she emphasized regional diversity, with localized practices aimed at reinforcing group and community identity.
demonstrated that employing a technological analytical approach reveals many of the factors that influenced the choices ancient people made with regard to their tool kits. Further, such an approach can demonstrate that the way people responded to and dealt with change was shaped by the particular socioeconomic environment with which they interacted, which in the southern Levantine Neolithic created a pattern of regional variation.
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