Lithic Analysis and Cultural Change
in the Late Pre-Pottery Neolithic of North Syria

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Abstract The late Pre-Pottery Neolithic B (PPNB) represents an important period of transition in North Syria, with the evolution from primitive to more advanced farming communities. The transition took place rather rapidly, involving a range of profound changes in human life-style. This paper examines the changing nature of the stone tool manufacturing behavior in this period. The analysis shows that the change is characterized by the increasing use of locally available raw material and a shift from well-organized blade to more expedient flake technologies. It is argued here that the change in lithic manufacturing was closely related to changing patterns in raw material economy, settlement pattern, and subsistence during the late PPNB. An ethnoarchaeological model suggests that, among those, the shift in subsistence or the decreasing importance of hunting appears to have been a more influential factor for the change in lithic manufacturing behavior.

Key Words: lithic technology, Neolithic, Southwest Asia, settlement pattern, hunter-gatherers

1 INTRODUCTION

The origin of plant domestication and livestock herding in the Near East dates, perhaps, to earlier than the Neolithic while the economy during the first millennia of the Neolithic was characterized by a combination of food production and exploitation of wild food resources. It is generally agreed that the food production economy was considerably developed in the later Pre-Pottery Neolithic (PPNB), and it had become, at least in some areas of North Syria, almost the exclusive means for subsistence by the onset of Pottery Neolithic, at around 6000 B.C. This shift in subsistence from PPNB to Pottery Neolithic was a continuous but rapid one, accompanied by significant changes in wide-ranging aspects of human life, as in technology, settlement pattern, social organization and so on.

This paper is concerned with how lithic tool manufacturing behavior changed between a period of the PPNB and the Pottery Neolithic. Lithic tools are the only artifactual remains available in substantial quantities from both periods, and are useful to monitor cultural changes in a chronological perspective. A trend in current lithic analysis is to relate variability in lithic assemblages to the settlement mobility and subsistence economy of the prehistoric society, largely relying upon models
developed from contemporary ethnoarchaeological research (e.g. Parry and Kelly, 1987; Torrence 1989a; Kelly, 1992). This study adopts this approach to examine how closely changes in lithic manufacturing behavior reflected those in other cultural elements.

Numerous studies have demonstrated that regional variability existed in the Levantine Neolithic cultures (e.g. Moore, 1981; Fujii, 1981; Hours and Copeland, 1982). The study area of this paper is North Syria, which consists of several

Fig. 1. Map showing the Neolithic sites mentioned in the text. 1: Ras Shamra, 2: Jericho, 3: Ain Ghazal, 4: Hayaz Höyük, 5: Kumar Tepe, 6: Abu Hureyra, 7: Assouad, 8: Damishliya, 9: Qdeir 1, 10: Douara Cave II, 11: Seker al-Aheimar, 12: Kashkashok II, 13: Feyda, 14: Ginnig, 15: Umm Dabaghiyah, 16: Bouqras. The northern side of the broken line has more than 250mm precipitation.
geographic units including the Balikh valley, the Khabur basin, the Middle Euphrates valley and oasis basins in the Syrian desert (Fig. 1). The late Neolithic cultures of this area also show a regional variability but represent, in general terms, a more or less similar development at least in the PPNB period (Moore, 1981; J. Cauvin, 1989).

2 THE PPNB AND POTTERY NEOLITHIC OF NORTH SYRIA: A BACKGROUND

2.1 Natural setting

Modern Syria has a Mediterranean climate in a broad sense, characterized by rainy/cold winters and long dry/hot summers. The modern cultural landscape of Syria is divided into four major regions according to differences in rainfall (Wirth 1971: 19–21): the Mediterranean mountains, the arable lowland, the inland steppe, and the desert, the latter two comprising North Syria. The Mediterranean mountains region includes the narrow coastal area and the mountains running north-south. This region enjoys plentiful precipitation of over 600 mm, often reaching to 1000 mm, which feeds dense vegetation and forests. The land developed east of the Mediterranean zone is a narrow and flat plain, with deep valleys and occasional plateaus. The annual rainfall is usually more than 400 mm, so that crop cultivation without irrigation is possible throughout the year. Precipitation in the inland steppic zone reaches about 250 – 400 mm, with which dry-farming is possible although rather vulnerable to annual climatic fluctuations. The inland desert or the steppic plateau constitutes about half of the whole area of modern Syria (Fig. 1). Because of the low rainfall (under 250 mm a year), the land is mainly used for herding sheep and goats, and can be cultivated on a regular basis only with irrigation. More or less sedentary settlements are limited to the oasis basins such as Palmyra and el-Kowm.

A general picture of palaeoclimates for Neolithic Syria has been provided from palynological studies in the Ghab depression. Van Zeist and Bottema (1982: 282) reconstruct the climatic and vegetational history as follows: “Between 11,000 and 10,000 years B.P. forest vegetations must have expanded rapidly.... During this period the temperature dropped..., which must already have resulted in a rise in humidity, but precipitation itself probably increased too. The pollen evidence suggests that forest vegetations reached their greatest expansion in the period of c. 10,000 – 8,000 B.P. During this period conditions for tree growth were more favorable than during the later stages of the Holocene. It is likely that in the early Holocene humidity reached its highest level, to decrease again to some extent after 8,000 B.P.” To summarize, they suggest that a more humid and cooler climate was enjoyed during the period of PPNB (ca. 7600 to 6000 B.C.) and that this condition began to deteriorate around the onset of Pottery Neolithic (6000 B.C.). A similar picture for North Syria has also been suggested by others (Leroi-Gourhan, 1974,
1981; Sakaguchi, 1978, 1987), although the climatic conditions might well have varied regionally in the Levant.

2.2 Cultural development

The period discussed in this paper is the later Neolithic, i.e. PPNB and the Pottery Neolithic. Various authors have proposed subdivisions of this time range, the ones generally agreed being early (ca. 7600–7200 B.C.), middle (ca. 7200–6600 B.C.), late (ca. 6600–6000 B.C.) and final PPNB (ca. 6000–5500 B.C.) (J. Cauvin, 1989; Rollefson, 1989). The final PPNB is regarded as having occurred in only part of the Levant, and co-existed with the early Pottery Neolithic settlements in other areas. Most of the Pre-Pottery Neolithic settlements in the Syrian desert are probably assignable to this phase (Stordeur, 1989). The end of the Pottery Neolithic or the beginning of the Chalcolithic period has not yet been fully determined in terms of either absolute dates or cultural definition (Akkermans, 1990: 112–13). I employ the more traditional view here that defines the Pottery Neolithic as a period between the Pre-Pottery Neolithic and the Halafian periods, which in North Syria approximately corresponds to the earlier centuries of the 6th millennium B.C.

Many good summaries are now available on the cultural development in a period from the late PPNB to the Pottery Neolithic (e.g. J. Cauvin, 1978; Moore, 1981; Fujii, 1981; Bar-Yosef and Belfer-Cohen, 1989a; Rollefson, 1989; Zarins, 1990). The following is a shorter summary devoted to Syria.

While the origin of both plant and animal domestication in the Levant obviously dates to well before PPNB, it was in the late PPNB and the subsequent periods that their technologies were considerably developed. New tools for harvesting and processing cereals, ovens of the tannor type, and large storage facilities all came into common use in the late PPNB, suggesting the quite developed nature of agriculture in this period (Fujii, 1981: 64). Even primitive irrigation might have been attempted in inland Syria (J. Cauvin, 1978; Moore, 1982). A variety of vessels or containers, including vaisselles blanche and stone bowls were commonly used, particularly from the late PPNB onwards, which probably reflects the increasing need for storing agricultural products.

Recent research suggests that domesticated animals appeared in stages; goat was probably first in the 8th millennium B.C., then sheep and cattle in the 7th, and finally pig at the beginning of the 6th millennium B.C. (Helmer, 1989; Grigson, 1989). Clear evidence of animal domestication in Syria has been known only from later PPNB sites of the 7th millennium B.C. At Tell Abu Hureyra, for instance, animal remains of the earlier PPNB phase were dominated by wild animals, while they were radically replaced by domesticated sheep and goats in later PPNB levels, at around 6300 B.C. (Legge and Rowley-Conwy, 1987). Domesticated sheep and goats also became dominant at other late PPNB sites in Syria like Tell Bouqras (Akkermans
The establishment of herding technology was most likely responsible for the wide distribution of late PPNB settlements in the arid inland environments including oasis basins of Palmyra and el-Kowm (Moore, 1981; J. Cauvin, 1989).

Both agriculture and animal husbandry were already commonly practiced in Syria during the earlier Neolithic. Faunal and floral analysis suggest, however, that the subsistence economy of the earlier Neolithic was dependent not solely on the domesticated resources, but also on wild food resources. As Moore (1980: 252; 1985) states, it is considered that agriculture and stock-raising continued to be combined with hunting and gathering down to about 6000 B.C., after which during the sixth millennium B.C., they became the only sources of subsistence.

Many of the PPNB settlements like Bouqras and Abu Hureyra in North Syria were abandoned at the beginning of the Pottery Neolithic. New settlements were founded, in turn, in the previously ill-exploited lowlands with rather monotonous landscapes such as the Khabur basin (Nishiaki, 1992b) and the Orontes valley (Iwasaki, 1991, 1992). The movement of settlements at this stage is regarded as a result of adjustment in the subsistence economy, caused probably by various factors including the ongoing climatic deterioration and long-lasting human mismanagement of natural resources during the PPNB (Moore, 1985; Köhler-Rollefson and Rollefson, 1990).

The development of food production and settlement systems apparently created a new social environment. There are some indications that a “complex society”, although not ranked, existed in the communities of the period. The elaborated craft workmanship represented by various ornaments and flint artifacts, for example, might suggest that some form of part-time craft specialization existed as early as the PPNB period (Moore, 1981; Rosen, 1989). Stamp seals, considered as a marker showing the ownership of personal belongings, came into popular use in the late PPNB (Tsuneki, 1983). Population growth in the late PPNB is suggested by the widespread settlements throughout the Levant from the Mediterranean coast to the inland desert/steppe. In settlements such as Abu Hureyra and Ras Shamra which became very densely populated, some form of communal organization might have functioned to regulate social problems (Moore, 1981: 450). Objects made of locally unavailable materials, like obsidian and marine shell became popular, suggesting a greater flow of goods through the exchange network in the PPNB than in earlier periods. Ceremony also shows a development in the late PPNB period: “Mother goddess” or clay figurines representing females became popular in the PPNB period (J. Cauvin, 1978; also see Simmons and Rollefson, 1984).

The brief survey of the literature above suggests that the cultural changes in the late PPNB represent a continuity from the earlier periods, but show a rather rapid development. They are all considered as representing a shift toward the more
advanced society and culture that characterize the rest of the period of the Levantine Neolithic. Moore (1982) designated the Neolithic after the outset of the Pottery Neolithic as *Advanced Neolithic*, and the previous one as *Archaic Neolithic*. The boundary between these two periods is set by the advent of the common use of pottery, but in terms of socio-economy and other artifact classes, the late PPNB culture seems to share many elements with the early Pottery Neolithic, and represents an important period of transition from the primitive to the more advanced farming communities. It is highly unlikely that the lithic manufacturing activities of this period, as part of the daily life, did not undergo a change comparable to those profound developments in human life-styles. We shall consider below implications of the lithic analysis in the light of this background.

### 3 Changes in Tool Manufacturing Behavior

Although recent investigations have revealed numerous late Pre-Pottery and Pottery Neolithic sites in North Syria, unfortunately their lithic assemblages have rarely been adequately published. Detailed analyses have been only made at Douara Cave II, Damishliyya and Kashkashok II (Nishiaki, 1991, 1992a), and at Qdeir 1 (Calley, 1986) and Bouqras (Roodenberg, 1986) in Syria. Surface collections from some sites such as Assouad and Seker al-Aheimar were also examined (Nishiaki, 1992b), but quantitative analysis is as yet incomplete. The available data base is so small that descriptions of relevant sites in the neighboring regions, such as Umm Dabaghiyah (Mortensen, 1982) and Ginning (Campbell and Baird, 1990) in the Iraqi Jazira, Hayaz Höyük and Kumar Tepe (Roodenberg, 1989) on the Turkish Euphrates, and Ain Ghazal (Rollefson, 1990) and Jericho (Crowfoot-Payne, 1983) in Palestine, will also be referred to when appropriate in the following discussion.

As a result of the comparison between flaked stone assemblages belonging to different periods, significant changes in lithic manufacturing from the late PPNB to the Pottery Neolithic were found in two general aspects: raw material use and tool production technology.

#### 3.1 Raw material use

The dominant raw material for flaked stone tools throughout the Syrian Neolithic was flint, a siliceous rock mineral. Flints found at Neolithic sites are usually in a variety of colors, textures and surface conditions, which may reflect differences in preservation conditions or source areas. Based mainly on naked eye observations, numerous lithic analysts have noted that flints in late Neolithic assemblages of Syria are divisible into at least two groups, i.e. fine- and coarse-grained flints, and that those flints were processed differently at the sites. This empirical division of flint has been supported in part by mineralogical analysis (Nishiaki, 1992a: 91–4). Blades and blade tools were manufactured on fine-grained flint clearly more often than on
coarse-grained flint. The blade tools characteristically include well-made tools such as tanged points and burins (Fig. 4: 5), and cores made of the fine-grained flints are often absent, or when present highly exhausted. These observations led many authors to suggest that the fine-grained flints were brought in mainly from non-local sources, while most of the coarse-grained ones were procured in the vicinity of the site (e.g. Mortensen, 1982: 210; Roodenberg, 1986: 6; Campbell and Baird, 1990: 72; Nishiaki, 1991: 41).

The relative use of each group of flint apparently changed through time. Fine-grained flint was more popularly utilized in the earlier PPNB, but was rapidly replaced through the later PPNB by coarse-grained flint, which eventually became a major raw material at the Pottery Neolithic settlements. The common use of coarse-grained flint pebbles at Pottery Neolithic settlements is particularly remarkable. A major factor contributing to the use of flint must have included its availability and distance from the source area(s). Nevertheless, the time-vecored change in its use is substantiated by analysis at sites with a stratified Neolithic sequence. Quantitative data is available from Roodenberg’s (1986) analysis at Bouqras, a late PPNB to early Pottery Neolithic settlement with radiocarbon dates of ca. 6300 to 5900 B.C. As shown in Fig. 2, the use of fine-grained flints quickly dropped from PPNB to Pottery Neolithic levels (1 and 2). A survey shows that the coarse-grained flint common in the Pottery Neolithic levels is abundantly available in the form of river pebbles near the settlement, while the nearest source for the fine-grained one is found only about 30 km away (Roodenberg, 1986: 6). A comparable result has been obtained, though less clearly, at Damishliya, also a site bridging the late PPNB and early Pottery Neolithic (Akkermans, 1988). The very dark brown fine-grained flint, which constitutes nearly 20% of the total flint in the late PPNB levels, gradually decreased, so that in the Pottery Neolithic levels, less than 10% of flint artifacts were made of this flint (Nishiaki, 1992a). The survey conducted by Akkermans (1990: 36; p.c.) located a source for the coarse-grained flint near the site, but as yet none for the fine-grained one.

On the Upper Euphrates, Roodenberg (1989: 92, 97) finds that “excellent fine-grained” flint was used at the late PPNB site of Hayaz Höyük, while the vast majority of the raw material used at Kumar Tepe, a nearby Pottery Neolithic site, consists of small “somewhat coarse-grained” flint pebbles. Further south, Rollefson (1990: 123) comments on the use of flint at the Neolithic settlement of Ain Ghazal in the Jordanian steppe. According to him, “excellent pink-purple colored” flint was typical of the PPNB occupations and the use of poor quality flint became increasingly popular in the later period, the trend being most conspicuous in the Pottery Neolithic (Yarmoukian) phase. This data could suggest that the decreasing use of fine-grained flint from the late PPNB on was a quite widespread phenomenon in the Levant, at least at non-quarry sites.
Another important change is manifested in the manner of transportation and storage of flint. It seems that in the PPNB period flint was usually transported as core-preforms or half-finished cores. An analysis of the core reduction trajectory at Douara II, a final PPNB cave site in the Syrian desert, indicates that flint was brought into the cave in the form of bifaces, or core-preforms to be exploited using the Naviform method (see below; Fig. 4: 1). The same behavioral pattern has also been pointed out at Qdeir 1, an open-air site in the el-Kowm oasis, by Calley (1986: 54). At Jericho, in Palestine, Crowfoot-Payne (1983: 672) too mentions a similar phenomenon. In the Pottery Neolithic period, on the other hand, a considerably different pattern became popular. Analyses of lithic assemblages from Kashkashok II and Damishliyya show that flint was mostly brought into, and stock-piled within the sites, in the form of unworked pebbles (Nishiaki, 1992a). A number of unworked or semi-flaked flint pieces (Fig. 4: 6) have been recovered at these sites.

![Fig. 2. Flint use at Bouqras by levels (Data compiled from figs. 9A – 9C in Roodenberg, 1986). CG: Coarse-grained flint; FG: Fine-grained flint. Insufficient samples from Levels 4 and 9.](image1)

![Fig. 3. Blank production at Bouqras by levels (Data compiled from figs. 9A – 9C in Roodenberg, 1986). Insufficient samples from Levels 4 and 9.](image2)
Fig. 4. Flint artifacts of the Neolithic of Syria. 1–4: Douara Cave II (PPNB, all made of fine-grained flint); 5–9: Tell Kashkashok II (Pottery Neolithic, 5: fine-grained flint, 6–9: coarse-grained flint).
3.2 Technology

Changes in lithic technology are recognized in a variety of elements including tool types and retouch techniques. The most impressive change is, however, seen in blank production technology. The most diagnostic technology of the PPNB period is the Naviform method, a blade production method using an elongated double-ended core (Fig. 4: 2). As reconstructed by Suzuki and Akazawa (1971), the Naviform method is characterized by a series of core preparation stages that must have required considerable skill as well as specific knowledge. This technology was employed very widely in the PPNB Levant, but was virtually suddenly abandoned in many areas at the end of this period. The technology popular from the late PPNB onwards was that of flake production using rather amorphous, unstandardized cores (Fig. 4: 6, 7). These cores show, in contrast to Naviform cores, almost no systematic preparation prior to blank production. The shift toward flake production seems to have occurred quite rapidly as documented in stratified assemblages again from Tell Bouqras. According to analysis by Roodenberg (1986), blades constitute about 60% of debitage assemblages from the PPNB levels, while they decrease to 20% in the Pottery Neolithic levels (Fig. 3). The change from specialized blade to amorphous flake production in the late PPNB is also reported at other contemporaneous sites including Ain Ghazal (Rollefson, 1990) and those on the upper Euphrates (Roodenberg, 1989).

The change in blank production technology was accompanied by one in the resultant tool morphology and diversity. The tools in the earlier PPNB are represented by tanged-points, end-scrapers and burins manufactured on blades (Fig. 4: 3, 4), while in the late PPNB and the Pottery Neolithic, they were mostly replaced by amorphous flake tools such as denticulates, notches and “retouched flakes” (Fig. 4: 8, 9). The blade tools common in the earlier PPNB appear to be comparable to “curated tools” defined by Binford (1979), and the flake tools of the later periods to “expedient tools”.

4 INTERPRETATION

The changes described above can be summarized as from fine- to coarse-grained flint in raw material use, from blade to flake in blank production, and from standardized to non-standardized tools in tool manufacture. Consequently, the flint industries of the late PPNB and the Pottery Neolithic may be described as “banal”, “impoverished”, or “of poor workmanship” in the literature. Under the current agreement that the use of blade production technology is a significant advance in lithic technology, the flake technologies popular after the late PPNB period may appear to be culturally backward. However, the shift should not necessarily be regarded as a backward movement, but could have been a cultural choice. In effect, a similar set of changes in stone tool manufacturing behavior, often including those
in raw material use and tool morphology, in the early Holocene context was not confined to the Neolithic of Syria or the Levant, but was also the case almost everywhere in the world, as in Europe, Japan, and the Americas (e.g. Parry and Kelly, 1987; Sato, 1992; Myers, 1989). A more positive explanation is therefore needed for this phenomenon.

One of the most intriguing interpretations has been offered by Parry and Kelly (1987; also see Patterson, 1987) to explain the position in North America. After examining the technological change in the post-Archaic industries, they suggest that the shift might have been a response to decreased mobility. They argue that the shift was a result of a “tradeoff” between the costs of transporting raw material and tools, which were higher for the flake than for the blade production technologies, and the costs of manufacture and use of tools, which were higher for the blade technology. For more highly mobile societies, the blade technology must have had advantages over flake production. It is logistically ineffective for a highly mobile society to transport a lot of stone raw material around the landscape because of the high transportation cost (Shott, 1986). Thus the use of a technology which enables the production of more durable/reusable, curated tools, even if it is time and labour intensive, is more effective. For more sedentary societies, on the other hand, raw material economy was less important. Raw material was brought into and stored at the settlement in the form of unworked pebbles. Under such circumstances, simple flake production technology was preferred over labour and time consuming blade production. Reuse and maintenance of stone tools were achieved simply by making new flake tools rather than curating the broken or exhausted ones.

Parry and Kelly’s characterization of the shift in raw material use, blank production and tool manufacturing seems to fit well with that from the earlier to the late PPNB in Syria. Accordingly, it seems useful to examine whether or not their explanation for the shift is also applicable to our data. Parry and Kelly found that the shift to sedentism, or a reduction in residential mobility was correlated with a shift to an emphasis on amorphous flake technologies in North America. A roughly similar observation has also been made for the transition from the Palaeolithic to the Mesolithic Jomon in Japan (Sato, 1992). In the Neolithic of Syria, however, a significant step in sedentization apparently occurred well before the PPNB. The settlement mobility generally includes two types: residential mobility, where an entire community moves through a seasonal round, and logistical mobility in which only select individuals are sent to procure distant resources (Lurie, 1989: 48). Available evidence concerning the architecture, plant and animal remains indicates that the shift from residential mobility to logistical mobility occurred as early as the Epi-Palaeolithic, and a year-round occupation at a single settlement was established in Syria by the onset of the Neolithic (Henry, 1989; Bar-Yosef and Belfer-Cohen, 1989b; Mortensen, 1982; Legge and Rowley-Conwy, 1987).
Flint analyses also point to the logistical mobility system in the Neolithic period. According to Morrow and Jefferies (1989), a theoretical model can be formulated for lithic assemblages to distinguish procurement through special-purpose trips (logistical mobility) from that through embedded seasonal trips (residential mobility). They postulate that raw material procured by logistic trips is so expensive that it should have been processed differently from the local material at the site, while the material obtained through an embedded regular procurement system was not so valued and would have been processed and utilized in the same way as locally available raw material. Our supposedly non-local, fine-grained flints in Neolithic assemblages from Syria were processed differently from the coarse-grained flints (Fig. 4: 6–9): they were almost exclusively used for blade production, highly reduced to an exhausted form, and mainly converted to curated tools (Fig. 4: 5). These features all suggest the precious nature of the fine-grained flints or the considerable cost spent in their procurement. The fine-grained flints, accordingly, appear to have been procured during the PPNB largely through a logistic settlement system, unless an undetectable trade network operated.

The shift in lithic technology seems thus not to be due simply to a change of the settlement system. Lithic analyses indicate, however, a possible increase of sedentism within the logistical mobility system during the late PPNB: flint industries of the period after the late PPNB display more area-diagnostic characteristics than before. The more or less uniform nature of the PPNB culture, possibly a result of communication through more frequent hunting trips, is now replaced by increasing localization. An example is seen among others in the typology of harvesting tools, which became more diversified probably due to increasingly heavy reliance on agriculture. Simple sickle blades, made on large blades produced from Naviform cores during the earlier PPNB, were no longer popular in the late PPNB and Pottery Neolithic. Rather they were replaced by supposedly more effective sickle elements, which include localized morphological types and hafting methods; they were either backed flakes in central-northern Syria, small blade segments with denticulate in West Syria, or imported obsidian blades in the northeastern area (Nishiaki, 1992c).

One may consider that the flowering of regional traditions in lithic technology was a result of population growth and increased sedentism. In addition, hunting tools and animal remains became less popular in late PPNB records, suggesting less frequent hunting trips, hence a decreased mobility during this period. As discussed by Köhler-Rollefson (1988) and below, however, mobility may have increased in the late PPNB and the subsequent periods due to the introduction of another subsistence means, livestock herding. In addition, ethnographic cross-cultural studies have suggested that population growth and development of settlements, like those typical of the PPNB, often lead to resource depletion; communities tend to travel greater distances and spend more time hunting despite the decline in hunting
returns (Speth and Scott, 1989; Köhler-Rollefson and Rollefson, 1990). From this one may argue that the logistic mobility system was likely to have been maintained during the late PPNB and Pottery Neolithic period at least to some extent.

Mobility/sedentism, therefore, can not be viewed as an exclusive factor affecting the change in lithic manufacturing behavior in late Neolithic Syria. Consideration of other possibilities should also be useful. Here I would like to focus my attention on the shift in subsistence, for lithic manufacture was usually undertaken to meet the demands of subsistence activities. Ethnoarchaeological analyses by R. Torrence and others (Torrence, 1983, 1989b; Zvelebil, 1984; Myers, 1989) have developed a model on the relationship between technological complexities and the nature of food resources. Using data collected by Oswalt (1976), Torrence (1983) showed a strong correlation between those two. For societies whose subsistence is largely based on exploiting mobile and seasonal resources (i.e. wild animals), the effective use of time in procurement, manufacture, and maintenance of tools, and in the search and pursuit of resources is essential in survival strategies. Such communities prepare more specialized tools with more complicated technologies in anticipation of future needs. However, in societies dependent on stationary foods such as plants, time stress is not particularly strong; the use of complex food-getting and tool-manufacturing technologies is unnecessary so that rather expedient technologies are preferred.

This model, developed through ethnoarchaeological research, is quite instructive in explaining archaeological data from North Syria. The shift from the more specialized blade technology and blade tools of the earlier PPNB to the expedient flake technology and miscellaneous less curated flake tools of the late PPNB and the Pottery Neolithic does indeed seem to coincide with the abandonment of extensive exploitation of wild animal resources. The change in animal exploitation has been brilliantly illustrated at Abu Hureyra. Legge and Rowley-Conwy (1987) show that in the earlier Neolithic periods gazelles, which were perhaps slaughtered seasonally, provided 80% of the total bones, while they decreased rapidly at around 6300 B.C. until they constituted only about 20%; conversely, bones of domesticated sheep and goats increased up to 80% in the later period. They suggest that the cessation of mass killing of gazelles by the inhabitants of Abu Hureyra was probably a response to the spread of “desert kites” in the south, where other communities particularly adapted to the arid environments began gazelle hunting on a greater scale.

Whether or not this interpretation for the cause of the subsistence shift at Abu Hureyra is appropriate, it is generally accepted that herding technology was introduced into North Syria during the late PPNB, and apparently replaced, at least to some extent, the role of hunting. Hunting and herding animals provide protein and can be accommodated in the same logistical mobility system, but they differ
completely in nature. Hunting animals such as gazelles that migrate seasonally is
an activity yielding a strong time-stress, in which structured technologies are needed
to effectively budget time and avoid risks (Torrence, 1983; Myers, 1989). The
Naviform cores of PPNB require considerable time and labour in manufacture, but
once the characteristic core preparation was completed, their larger size and proper
form allows, whenever needed, the production of consistently large and narrow
blades, which would have been particularly suitable for manufacturing hunting and
butchering tools. The decrease in demand for these tools due to the introduction of
livestock herding, may have been an important factor discouraging the popular use
of the Naviform blade production method.

The decrease in the use of supposedly non-local, fine-grained flint in this period
may also be explained similarly rather than by viewing it as a direct response to
the changing settlement pattern. According to ethnographic studies of contemporary
material procurement is very often incorporated or “embedded” into other activities
so as to save time; procurement of lithic raw material during the Neolithic times
might also have been accomplished in a similar way. Although it is generally agreed
that as sedentism increases the opportunities to obtain raw material at distances
decrease (Lurie, 1989: 53) and hunting trips might have been less frequent in the
late PPNB, trips to move livestock would have created opportunities to obtain exotic
materials. Nevertheless, the procurement of non-local, fine-grained flint declined
significantly after the late PPNB, for which one of the appropriate explanations
seems to be the lessening demand for that kind of flint. General characteristics of
what many authors call “fine-grained flint” in North Syria are with fine texture, large
size and in many cases a tabular form. This type of flint in fact must have been
desirable for the Naviform method. It appears that procurement of this flint from
distant sources was made mainly for the purpose of blade production using the
Naviform method; when the demand for larger blades decreased at the end of PPNB
procurement also decreased.

The above discussion suggests that one of the key factors affecting the change
in lithic manufacture appears to have been the cessation of extensive hunting of wild
animals. The relationship between mobility and raw material economy, as proposed
by Parry and Kelly, should not be excluded as a possible factor, however. Instead,
it would serve to account for the technological characteristics of the “final PPNB”
in inland Syria. The changes in lithic technology described above did not occur
simultaneously or in the same way throughout Syria. In the inland zone such as the
el-Kowm and the Palmyra basins, the earlier blade technology survived into the 6th
millennium B.C. The Naviform blade production method was still employed by
societies adapted to arid steppic environments (Stordeur, 1989), while in other
regions it had already been replaced by the expedient flake technology. The sites
in the inland zone are rarely represented by huge mounds like those in the less harsh regions, but are usually either open-air stations or cave dwellings. The settlement pattern of the communities who occupied those sites, whether belonging to an independent society or offshoots of a larger base village, was probably more mobile (residential mobility) than that of village people (Zarins, 1990). The blade technologies utilized at the inland 6th millennium B.C. sites of Douara Cave II and Qdeir I are remarkably similar to those of the earlier PPNB (Nishiaki, 1992a; Calley, 1986). A notable difference is found only in typological aspects: tanged-points are rarer at the inland late sites. The striking conservatism in technology is perhaps an example illustrating the adaptive advantage of the blade technology in the mobile settlement system, while the typological difference seems to reflect the shift in subsistence, from an emphasis on hunting to herding at this stage.

5 CONCLUSION

This paper has attempted to show how lithic manufacturing behavior changed in the late PPNB, and how the change might be interpreted in the context of the overall behavioral change in this period. The change in lithic manufacturing can perhaps be viewed as a response to changing patterns in raw material economy, social organization, and so on, of which only those on settlement pattern and subsistence were discussed in detail in this paper. It is suggested here that the shift in subsistence, or the abandonment of extensive exploitation of wild animals through hunting, appears to have been a more influential factor for the change, since it must have created the need for restructuring the overall technologies including those of time-budgeting as well as lithic manufacturing.

Needless to say, however, much still remains to be done. One of the particularly important tasks, which is presently incomplete due to the lack of adequate data, is to examine closely the correlation between changes in lithic manufacturing and other activities which may be seen at stratified sites with a long occupational sequence. Since lithic manufacturing activities probably comprised an important part of the Neolithic cultural system, analysis of lithic remains in the context of the entire changing system will lead to a better understanding of the profound cultural changes that the Neolithic communities of Syria witnessed in the late PPNB period.

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