

People and Space in Early Agricultural Villages: Exploring Daily Lives, Community Size, and Architecture in the Late Pre-Pottery Neolithic

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Population growth, or, more specifically, pressure, is often viewed as being critical to the development of food production in the Pre-Pottery Neolithic of the Near East. It is surprising, therefore, to recognize how little detailed archaeological research has explored the rates of population growth and how they might be related to social crowding in early village social environments. Combining archaeological and ethnographic perspectives, this article explores the possible links between demographic change, possible social crowding, and reasons for the “collapse” of large aggregate villages occupied between approximately 8500 to 8000 years before present. Reflection upon the timing, estimated magnitude, and rate of demographic change prompts the researcher to reconsider the perceived links between sedentism, food production, and the emergence of social inequality in the context of early agricultural villages of the south-central Levant. © 2000 Academic Press

Understanding the interrelationships between broader long-term evolutionary social developments and the short-term social context of everyday life is critical to the archaeological and anthropological reconstruction and interpretation of the Pre-Pottery Neolithic of the Near East. While it is widely recognized that the Neolithic was a social process, to a degree previous archaeological attempts at reconstruction have failed to noticeably advance our understanding of the relationships between everyday living conditions and long-term social change, two interpretive dimensions that are complementary. The development of systems of food production before and during the Pre-Pottery Neolithic, for example, can be explored both from the perspective of a critical long-term evolutionary event as well as a short-term event in which community members enacted social strategies to deal with changes in daily living conditions. This study examines some of the possible relationships between the physical and social

conditions of life in early agricultural villages with that of broader long-term changes. Out of necessity I only consider some of the interrelationships between long-term population growth and how these might have resulted in gradual, yet important, changes in the living conditions within early agricultural communities. By extension, I want to consider how human communities might have responded to such changes, reflecting upon select aspects of daily life, such as living conditions, reduction in privacy, and the control of subsistence resources.

In focusing on these topics, I want to address several very important interrelated questions of life in early villages in general and those of the south-central Levantine Pre-Pottery Neolithic in specific. First, what archaeological data can be employed to generate estimates of changes in the size and density of human communities through different periods of the Pre-Pottery Neolithic? Second, how might these demographic conditions have influ-

enced social relations and living conditions within Pre-Pottery Neolithic communities and be connected to the abandonment of these villages about 8000 years ago? Finally, I want to address how this awareness alters our understanding of the possible ways in which demographic change, food production, and emerging social inequality might have been interlinked in the context of early agricultural villages of the south-central Levant. In this context, I explore how the emergence of, and changing arrangements within, social systems may have been linked both physically and psychologically to regional population growth and increased population aggregation at individual settlements.

ANTHROPOLOGICAL INSIGHTS INTO POPULATION AGGREGATION AND CROWDING STRESS

Understanding the relationships between demographic change, food production, and emerging social inequality continues to be a central focus in archaeology and anthropology. Between the 1960s and 1980s a number of anthropologists (e.g., Binford 1968; Boserup 1965; Cohen 1977) directed new attention to the concept that population growth is an important stimulus to economic and social change. While not always explicitly articulated as some form of prime mover by researchers, population growth is often envisioned as one of, if not the, major catalyst in the emergence of food production, more complex social and economic systems, and on a general level, the appearance of social differentiation (Carneiro 1967; Cohen 1977; Flannery 1973; Wright 1971; Young 1972). Under this framework, researchers have examined the connections between demographics and social organization at several scales of analysis, including understanding past population levels at an individual site (e.g., Longacre 1976; Plog et al. 1978)

or, more often, modeling of continental or global demographic changes (e.g., Adams 1978; Binford 1968; Carneiro 1967; Johnson and Earle 1987). In light of the assumed importance of demographic shifts as an underlying foundation for broader economic and social changes, little research has systematically explored the nature of archaeological evidence for demographic change in key geographical and temporal contexts, such as that of the Pre-Pottery Neolithic of the Near East, approximately 10,000 to 8,000 years ago. Previous studies have approached Neolithic demographic changes and the establishment of food production from one of two directions: (a) intuitively arguing that population increases, often viewed as the result of increased sedentism, led to population pressures and, eventually, food production; and/or that (b) the Pre-Pottery Neolithic was characterized by sudden population growth, and researchers often, but not always, do not differentiate between different phases of the Pre-Pottery Neolithic period (e.g., Binford 1968; Bar-Yosef and Meadow 1995; Hershkovitz and Gopher 1990). Given the important role these positions play in modeling social and economic change in the Neolithic of the Near East, it is surprising to note how limited our understanding is of the overall pattern and timing of demographic change and how households and communities might have dealt with such shifts.

In a different, but not unrelated trend in Near Eastern prehistoric archaeology, it is important to recognize that it is only recently that archaeologists have started to explore the nature of, and social/economic processes behind, the emergence and abandonment of village systems in the Pre-Pottery Neolithic period. With a few exceptions, general treatments of the Levantine Pre-Pottery Neolithic often present it as an economic and evolutionary threshold, one in which there is a relative sudden and total adoption of agri-

culture and the appearance of large villages (e.g., Mellaart 1975; Moore 1985). This perception is, in many ways, out of step with recent field research conducted at a number of individual sites that has outlined that the size of settlements, and presumably those of the human communities that existed in the past, increased at different rates in the Pre-Pottery Neolithic and that these lifeways were abandoned at around 8000 years ago (Köhler-Rollefson and Rollefson 1990; Kuijt 1998; Rollefson 1996; Rollefson and Köhler-Rollefson 1989). This general perception of the Neolithic, as usually expressed in general introductory textbooks, also fails to recognize a number of important studies of social process in the Neolithic (e.g., Aurenche and Cauvin 1989; Byrd 1994; Cauvin 1995; Hodder 1990; Thomas 1991; Watson 1990), as well as the important concurrent trends in Neolithic research of the Euphrates and Anatolia (e.g., Hodder 1996; Kozłowski and Kempisty 1990; Le Brun 1981; Rosenberg and Davis 1992; Watkins 1990).

From an anthropological level, researchers have approached the emergence of social relations within early agricultural village communities with the assumption that population pressure is a key explanatory factor, given that (1) changing social arrangements reflect a reaction to problems of organizing subsistence practices and maintaining economic homeostasis; (2) these changes are linked to pressures associated with reduced mobility and more temporally and spatially limited food resources; (3) increased social segmentation and differentiation is usually a by-product of economically based competition between individuals or groups for control of power and authority within communities; and (4) hierarchical social systems, at least those in which there are entrenched dimensions of social differentiation, often emerge from within the social context of population aggrega-

tion. In this context researchers portray population pressure as linked to subsistence resource and economic factors, specifically the relationship between population density and the quantity, location, and availability of subsistence resources. For example, Cohen (1985: 104–105) states that “. . . a number of other specific aspects of social complexity have been, or can be, described as solving problems in the logistics of access to resources . . .” In this light social differentiation emerges as a by-product of population pressure caused/elicited by the competition for scarce resources or development of new means for the economic control and redistribution of them.

At times such discussions also illustrate one of the more problematic aspects of studies of population dynamics and social and economic relations: the conflation of the distinctive variables of population growth, population density, and population “pressure” on resources (see Hassan 1982, Wood 1998 for more detailed discussion). As noted by Wood in his skillful treatment of the topic, researchers often confuse the three concepts, frequently presenting them as synonymous. Population growth can be defined as the change in population size through the birth and death of individuals within a community and migration of people between communities. The rate of this growth, as well as the overall population size, is clearly linked to available food resources on a local and regional level. In light of certain environmental potentials and a specific regime of food procurement and technology, the theoretical maximum number of people who can be supported at one time in a single region is represented as the carrying capacity of the region. Population density refers to the relationship between overall population level and a unit of space, such as that of a valley or residential community. Population pressure, as defined strictly in subsistence terms, is

when overall population levels have outstripped the ability of humans to produce or procure enough food for their needs on a short- or long-term basis, thus overexploiting the carrying capacity of a region. As Hassan (1982) demonstrates, however, one of the major weaknesses of the population pressure concept as applied by original researchers lies in confusing population increase with population pressure.

These are clearly very different concepts, as an increase in population size does not necessarily imply that resources have been depleted or that the survival of human communities is at risk. The adoption of agricultural systems by a community, for example, may well have permitted an increase in population size, but, at the same time, would not have resulted in any increased population pressure. In most cases (e.g., Binford 1968; Boserup 1965) researchers construct demographic models by focusing on population pressure, with inequities between food resources and population growth, and assume that this condition emerges from increases in population growth or density. Needless to say, as pointed out by Wood (1998: 101), in some situations population growth may provide a useful measure of population pressure, but this is a questionable relationship at times, and one that, if nothing else, is frustratingly difficult to quantify.

There are, however, alternative ways to explore the importance of demographic pressure in the context of cultural change: that of population growth and aggregation as a social, rather than subsistence, concern. As noted earlier, researchers have traditionally explored how demographic change and population pressure might be linked to the overall health of individuals, the links between food availability and population size, and their possible relationships with human labor. Approaching the possible impact of demographic change from a different di-

rection, researchers have started to explore how increases in the scale and density of communities required changes in the organization of labor, how changes in community size might have been expressed through the built environment, and how people actually tried to deal with changing social and environmental conditions. On a very broad level Johnson (1982) and Cohen (1985), for example, link the appearance of hierarchical or heterarchical social organizations to population pressure. As changes in social scale in villages require adjustments at the individual, household, and community scale, these changing structures reduce the ability of individuals to process information and deal with kin-members and non-kin of the community. Within many hunter-gatherer and horticultural communities, social arrangements are organized to cross-cut kin and household lines, thereby reducing interpersonal tensions and conflicts over authority (Johnson 1982). The reorganization of these social relationships and authority, therefore, can serve as a situational response to short- and long-term population-related problems.

A second very important dimension of demographic change is that population growth influences other less observable dimensions of household and community relationships, particularly increases in interpersonal tensions and social crowding. Social crowding, as defined by Cohen (1985) and applied here, refers to tensions that occur when hunter-gatherers, horticulturists, or agriculturists remain in large aggregates for a long time. Cohen (1985: 106; cf. Altman 1977) argues that under conditions of population aggregation, animals and humans respond negatively to a number of features in their environment: congestion, loss of control, loss of privacy, and information load. Members of early agricultural communities may have experienced the by-products of social crowding expressed in physical congestion in

housing, resource procurement, or in scheduling conflicts. Similarly, loss of control, or the perception that individuals have lost the ability to achieve some desired end through their own action and decision-making (Altman 1977), may also have been a characteristic of growing communities. Cohen (1985: 106) notes "... *perceived* control may be the most important quality for an organism's psychological and social well-being and the most salient quality affecting its decisions." In order to ensure privacy, or the ability of individuals to retain control over access to other people and resources, or, more likely, restrict access, people may construct physical boundaries to impede movement and access and develop social barriers in interpersonal interaction. While subject to some of the same limitations (when is physical crowding sufficient to result in "pressure"?), both of these approaches may represent complementary perspectives to explore how demographic change is linked to social systems.

PRE-POTTERY NEOLITHIC DEMOGRAPHIC CHANGE

Examining the important dimension of human subsistence resource imbalances, a number of researchers have examined how increased sedentism and the development of new forms of food production may have been linked to increased population growth in the Natufian (c. 12,500–c. 10,500/300 B.P.) and Pre-Pottery Neolithic periods of the south-central Levant (c. 10,500/300–c. 8,000 B.P.) (Bar-Yosef and Belfer-Cohen 1989, 1991; Bar-Yosef and Kislev 1989; Cohen 1977; Smith et al. 1984).¹ The development of food produc-

tion based on several wild and domestic plant species in the Late Natufian and PPNA resulted in several important social changes. Archaeological evidence demonstrates that the appearance of food production corresponds with three critical patterns in the archaeological record: (1) a radical improvement of the predictability and scheduling of plant availability, (2) an increased capacity for food storage, and (3) a growth in the potential maximum size of individual communities in the entire region. The first of these points is important in that increased knowledge and manipulation of the predictability and scheduling of plants ultimately leads to improved control of certain food resources, thereby reducing the susceptibility of communities to environmental fluctuations. In a related fashion, the development of food storage not only serves as a short-term buffer for food stress, but also enhances the management of subsistence resources over the long term. Finally, the development of food production, as exemplified by horticulture and agriculture, increases the potential maximum community size as well as influences a variety of interlinked factors (for example, new weaning foods, de-

Neolithic B periods (EPPNB, MPPNB, and LPPNB), a broad scheme that continues to be employed by archaeologists. Although not defined in Bar-Yosef's original study, it is generally held that Early Pre-Pottery Neolithic B lasted from approximately 9600 to 9300 B.P., followed by the Middle Pre-Pottery Neolithic B (9300–8500 B.P.) and the Late Pre-Pottery Neolithic B (8500–8000 B.P.). Reconsideration of the archaeological evidence for a distinct transitional stage between the PPNA and MPPNB question if there is sufficient evidence to support arguments for an EPPNB phase, alternatively noting that the PPNA may lead directly into what has been termed the MPPNB. In this article I adopt this more conservative scheme, but at the same time continue to employ the original terms Middle Pre-Pottery Neolithic B, lasting from 9300 to 8500 B.P., and the Late Pre-Pottery Neolithic B lasting from 8500 to 8000 B.P. to maintain standardization with previous literature.

¹ The Pre-Pottery Neolithic period of this region, an area encompassing the modern political states of Jordan, Israel, southern Lebanon and Syria, and the Sinai desert of Egypt, was originally subdivided by Bar-Yosef (1981) into the Early, Middle, and Late Pre-Pottery

creased birth spacing, and stable resource economies) (Smith et al. 1984).

In addressing the nature of the possible connections between population growth and changing social arrangements in southern Levantine villages, it is important to address two scales of analysis: extracommunity- (regional) and community- (site) level changes through time. Needless to say, developing accurate estimates for these is highly complex and complicated by issues of changing archaeological visibility of settlements through different periods (such as the PPNA with mud architecture and the PPNB with stone architecture and painted plaster floors) as well as by variations in the location, architectural remains, and size of settlements within an individual cultural-historical period in different environmental regions (Bar-Yosef and Belfer-Cohen 1991; Kuijt 1994). Smaller seasonal PPNB encampments are, for example, more likely to have been totally destroyed and are less likely to be recorded in field surveys than large PPNB villages. If one accepts this proposition, then this results in a classic bad news/good news situation: archaeologists are unlikely to be able to reconstruct the nature of total settlement variability for a single period with any degree of confidence, but have a better chance of understanding the overall change in the size of the largest settlements through time, as they are most likely to be recorded. Thus, drawing upon site size data from a single environmental zone, such as the Mediterranean zone of the south-central Levant, probably provides our best means of understanding regional- and site-level demographic changes through time.

Working on the assumption that the largest settlements provide a relative idea of changing demographic patterns through time, it is informative to compare how the size of the five largest settlements changed through time. Viewed collec-

tively, we witness a pattern of considerable expansion in communities from the period of 11,000 to c. 8,000 B.P., and most notably in the LPPNB (Table 1, Figs. 1 and 2). For example, while the five largest known Late Natufian settlements are each approximately 2,000 m², this figure increased dramatically in the PPNA period, with settlements averaging over 10,000 m². The largest known MPPNB period settlements range in area from 45,000 to 50,000 m², and later post-8,500-B.P. LPPNB settlements such as Basta and 'Ain Ghazal, cover nearly 140,000 m² (Fig. 3). The distribution of Early Neolithic sites by size illustrates a trajectory of a steady increase in the size of largest settlements through time, while remembering that this pattern is not necessarily representative of the total variability in settlement practices. Even if smaller sites were underrepresented in the archaeological record, which is likely to be the case, this does not eliminate the need to explain the emergence of large (between 10 and 14 ha) LPPNB mega villages/towns situated along the Jordanian highlands.

This pattern of expansion provides us with a coarse means of developing a preliminary understanding of the overall comparative magnitude of change in the size of individual Neolithic communities, within different physiographic regions, and sets the stage for exploring how people in these communities coped with shifts in settlement and lifeways during the Neolithic. Although clearly limited due to several methodological issues, ethnographic observations on the relationship between the physical size of agricultural settlements, the number and size of residential structures, and the number of people who live in them provides us with a useful, albeit coarse grained, means of estimating the relative numbers of people living in prehistoric agricultural settlements (Tables 1 and 2). Making any population estimate based on settlement size

TABLE 1
 Estimated Site Area and Possible Correlated Community Levels for the Late Natufian through
 PPNC Periods in the South-Central Levant^a

Period	Site	Approximate depth of cultural deposits	Site area (ha)	Estimated population level ^b	Estimated population level ^c	Mean population level ^d
Late Natufian						
(11,000–10,300 B.P.)	'Ain Mallaha (Ic/b)	<1 m	0.2	18	59	59
	Nahal Oren	<1 m	0.2	18	59	
	Hatoula (4a,b,5)	<1 m	0.2	18	59	
	Saaidé II	<1 m	0.2	18	59	
	Shukbah	<1 m	0.2	18	59	
PPNA						
(10,300–9,300 B.P.)	Jericho	8 m	2.5	225	735	332
	Netiv Hagdud	3 m	1.5	135	441	
	Gilgal I	3 m	1.0	90	294	
	Dhra'	2.5 m	0.45	41	132	
	Nahal Oren	2 m	0.2	18	59	
MPPNB						
(c. 9,300–8,500 B.P.)	'Ain Ghazal	3 m	4.5	405	1323	764
	Tell Aswad	?	4	360	1176	
	Jericho	4 m	2.5	225	735	
	Yiftahel	1.5 m	1.5	135	441	
	Kfar Hahoresh	2 m	0.5	45	147	
LPPNB						
(c. 8,500–8,000 B.P.)	Basta	4 m	14	1260	4116	3293
	'Ain Ghazal	1.5 m	10	900	2940	
	Wadi Shu'eib (?)	4 m	10	900	2940	
	Beisamoun	2 m	10	900	2940	
	Es-Sifiya	3 m	10	900	2940	
	'Ain Jammam	3 m	6–8 (7)	630	2058	
	Ramad I	?	?	?	?	
PPNC/Final PPNB						
(c. 8,000–7,500 B.P.)	'Ain Ghazal	1 m	12	1080	3528	3822
	Basta (?)	?	14 (?)	1260 (?)	4116	
	Ramad II (?)	?	2 (?)	?	?	

^a Based on Byrd (1989); Belfer-Cohen (1991); Kuijt (1995) and references therein.

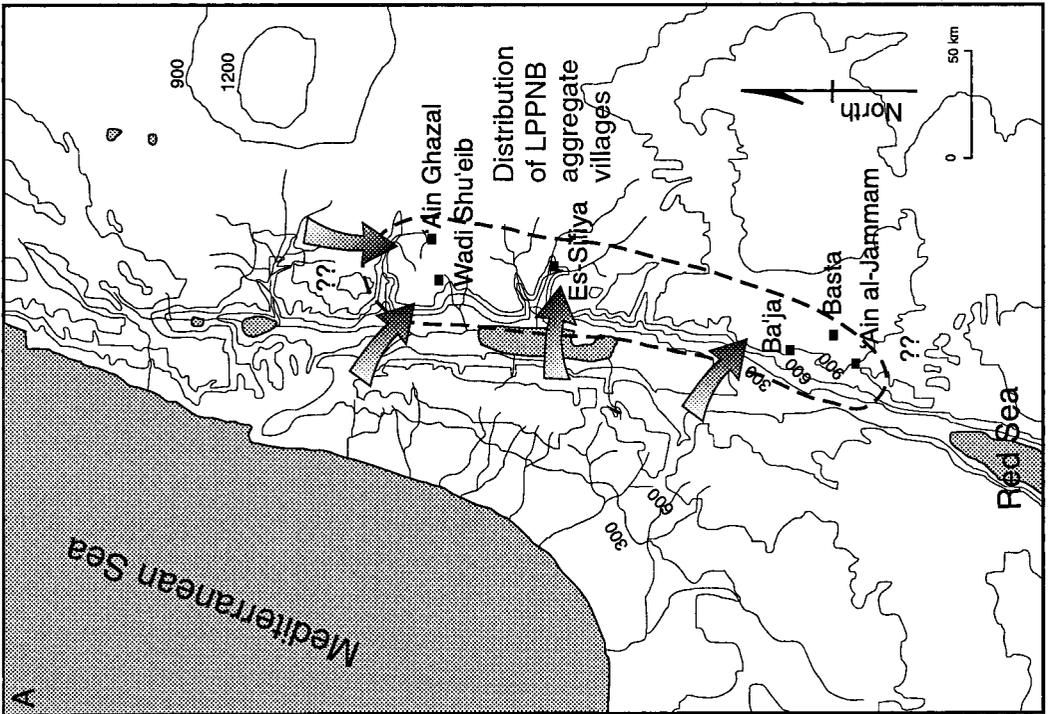
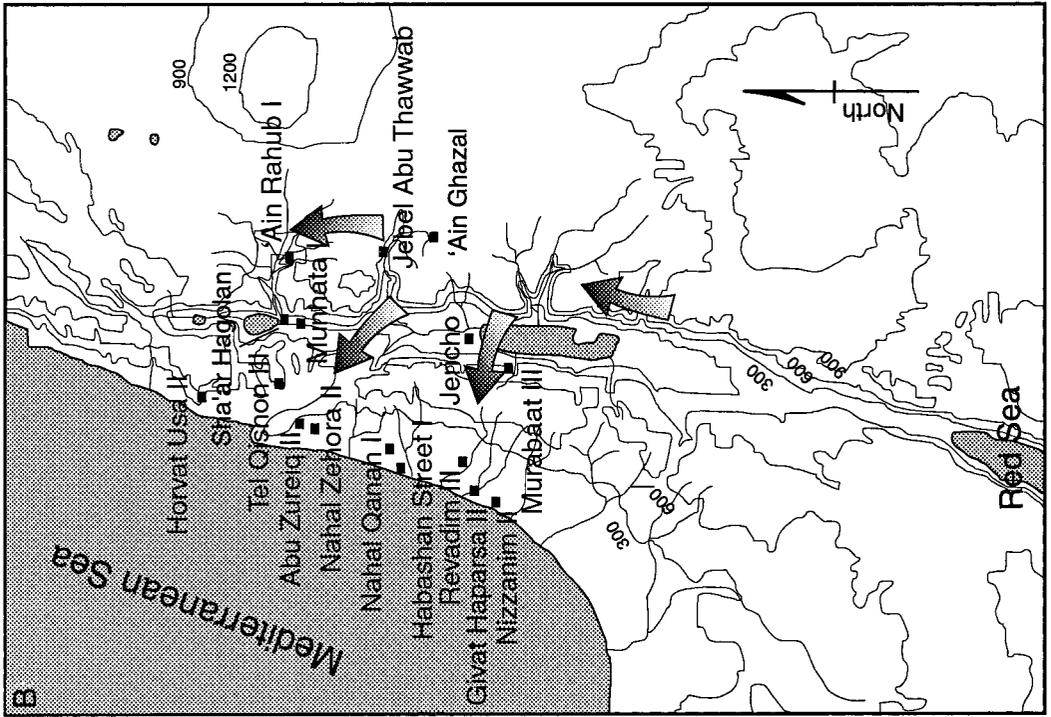
^b Kramer (1982: 162) and Watson (1979: 35–47) estimate that among agriculturists the average number of people living in a 1000-m² village ranges from 83 to 97. This calculation assumes that 90 people lived year-round in a 1-ha settlement, figures rounded up.

^c Based on research on Tell Marib, a modern site in Yemen, van Beek (1982: 64–65) provides an estimate of 286–302 people per hectare. For the purposes of simplicity a mean of 294 has been employed to calculate community population levels with results rounded up.

^d Mean population based on the largest five communities, based on van Beek (1982) estimates.

relies on several critical assumptions: (1) the type and density of structures in excavated areas are representative of the site as a whole, (2) the horizontal extent of cultural materials for each site is representative of the actual extent of the site

while occupied and the occupation density is constant in all areas of the site, and (3) the social and economic systems for sites from different periods are similar enough to 20th-century ethnographic studies to permit comparisons. There is no



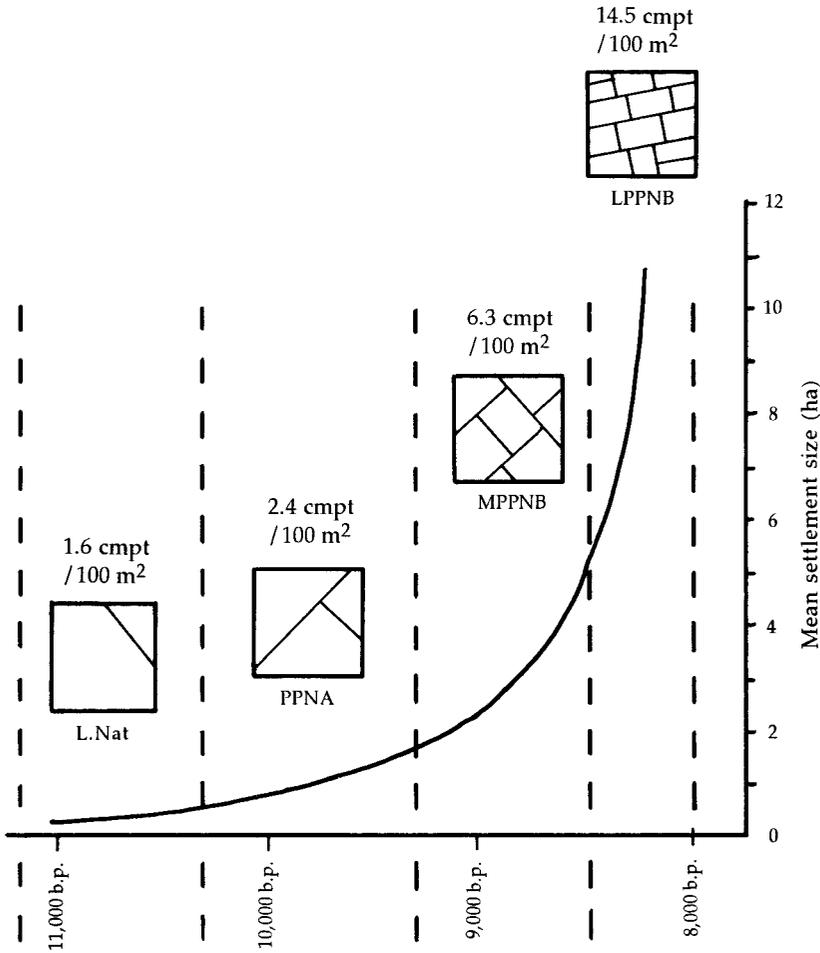


FIG. 2. Increase of total area of the five largest south-central Levantine Late Natufian through LPPNB settlements compared to mean compartmentalization for the same periods.

question that some of these assumptions are tenuous, and, therefore, it is best to employ the resulting data as comparable estimates rather than as straightforward referents for past populations (see Edwards 1989; Fletcher 1986; Hassan 1982;

Hershkovitz and Gopher 1990 for further discussion). Research in western Iran by Kramer (1982: 162), for example, indicates that, on average, 97 adults, children, and infants live within a 1-ha agricultural community. Similar research by Watson

FIG. 1. Population shifts from the Late Pre-Pottery Neolithic B period to the Pottery Neolithic periods. (A) Expansion of existing Middle Pre-Pottery Neolithic B period settlements and founding of large Late Pre-Pottery Neolithic B period villages in southern Levant (c. 8500/8300–8000 B.P.); (B) reduction in size or total abandonment of large Late Pre-Pottery Neolithic B period villages and establishment of new small Pre-Pottery Neolithic C period/Pottery Neolithic (Yarmukian and Jericho IX) villages and hamlets (c. 8000–7000 B.P.).

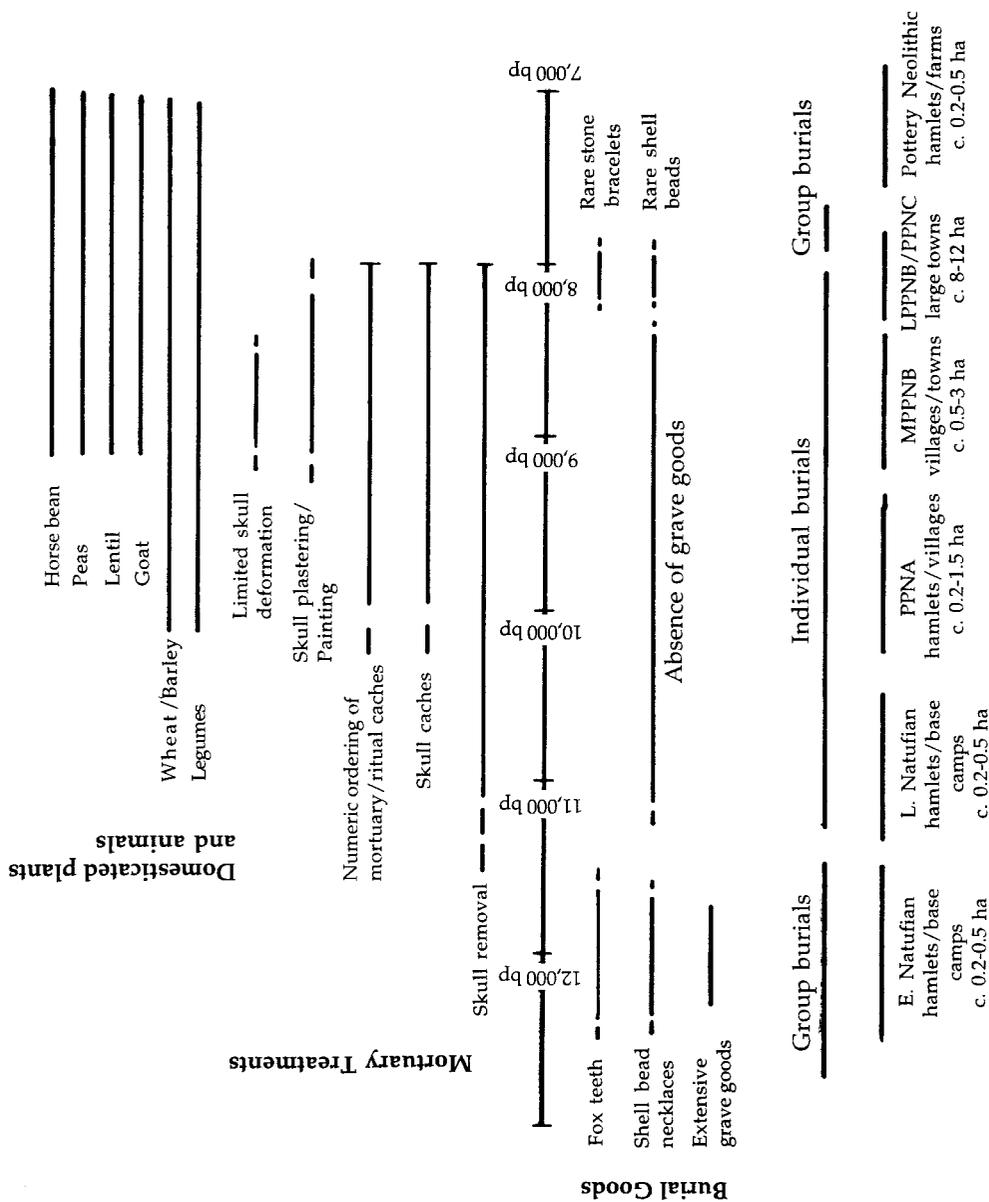


FIG. 3. Changing dimensions of south-central Levantine Natufian and Neolithic mortuary practices, food production, and demographic change.

TABLE 2

Estimated Increases in Site Size, Population Levels, and Compartmentalization for Late Natufian through PPNC Period Settlements in the Mediterranean Zone of the South-Central Levant

Period	Estimated mean site size (ha)	Estimated % increase in site size	Estimated mean population (van Beek 1982)	Estimated mean compartmentalization (mean from Table 3)
Late Natufian (11,000–10,300 B.P.)	0.2	—	59	1.6 compartments/ 100 m ²
PPNA (10,300–9,300 B.P.)	1.0	500%	332	2.4 compartments/ 100 m ²
MPPNB (9,300–8,500 B.P.)	3.0	1500%	764	6.4 compartments/ 100 m ²
LPPNB (8,500–8,000 B.P.)	10.0	5000%	3293	14.5 compartments/ 100 m ²
PPNC (c.8,000–7,750 B.P.)	12.0 (?)	6000% (?)	3822 (?)	unclear

(1982: 35) in Hasanabad provides a mean of 83 people for the same area. Research by van Beek (1982) at Tell Marib, in Yemen, provides considerably higher population estimates with around 294 individuals living within the same 1-ha area. This variability indicates that it is neither practical nor wise to employ such data with the purpose of determining definitive population levels for individual communities; however, I believe that these estimates facilitate comparative studies of demographic shifts for the Neolithic in specific geographical contexts.

While also limited, examination of the amount of roofed-floor area provides a second means of estimating population change within Neolithic communities. Ethnographic studies of roofed-floor area, numbers of structures, and household size suggest that each adult person in a sedentary agricultural and horticultural context generally requires between 9 and 10 m² of floor space (Kramer 1982; Leblanc 1971; Naroll 1962; Watson 1982). If we assume that these behavioral observations offer reasonable correlates for the Late Natufian and Early Neolithic, these estimates predict a pattern of a phenomenal increase in the size of LPPNB aggregate village communities in comparison to the

previous period (Figs. 2 and 4). Although population estimates differ depending upon which ethnographic source one favors, the overall reconstructions that result from these analyses are very similar. Based on these reconstructions the largest Late Natufian communities consisted of fewer than 50 people, while the largest PPNA communities contained several hundred people, living in residential structures over an area of 0.5 to 1.5 ha, such as at Jericho, Netiv Hagdud, Dhra', and Gilgal I. MPPNB settlements expanded to approximately 2–4 ha, with a corresponding increase in the density of residential structures within the settlement, and were occupied by as many as several hundred to over a thousand people. At about 8500 B.P. the size of these already large communities increased dramatically and may well have numbered upward of several thousands of people, living in high-density housing such as that seen at Basta, 'Ain Ghazal, and Es-Sifiya, and covering an area of at least 10 ha (Mahasneh 1995; Nissen et al. 1987; Rollefson et al. 1992). These data illustrate an increase of nearly 5000% in the size of settlements over the 2000-year transition from the Late Natufian to the LPPNB period.

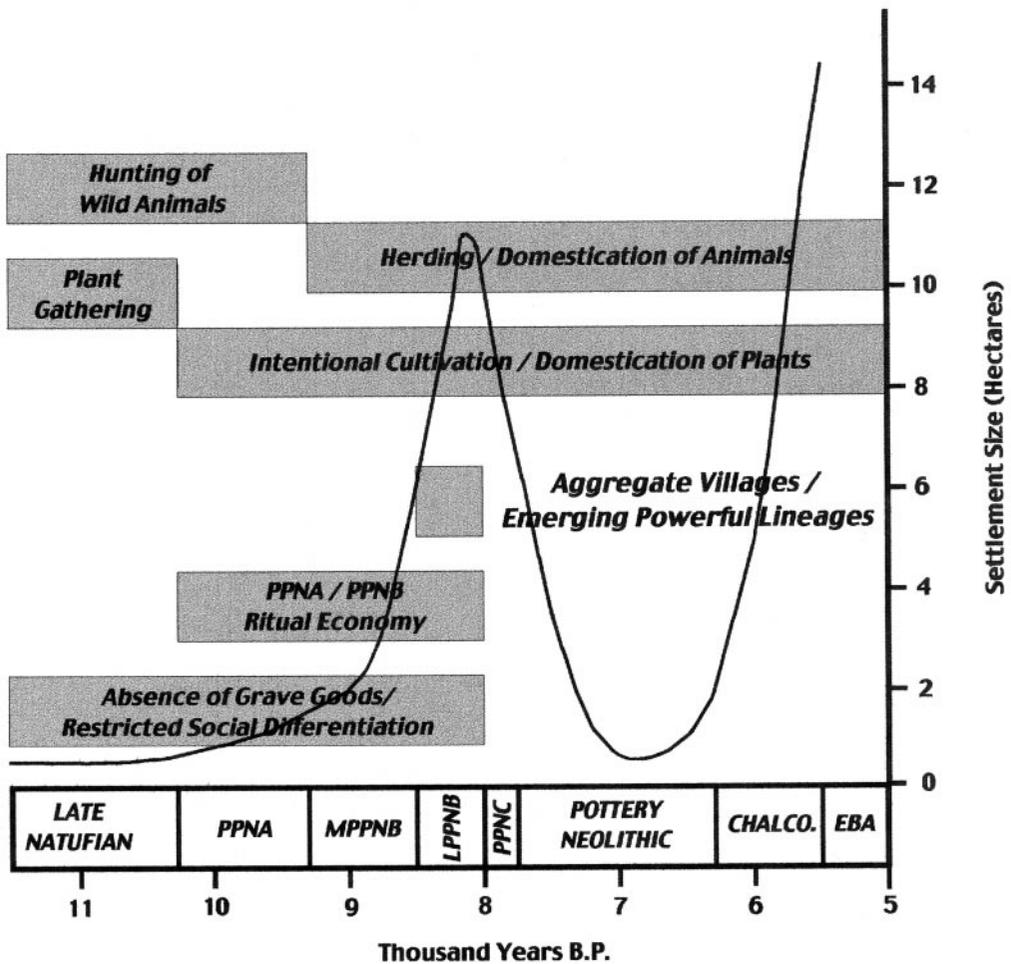


FIG. 4. Changes in south-central Levantine Late Natufian through LPPNB settlements size in relation to Neolithic mortuary practices and food production. Note that the appearance of aggregate LPPNB villages postdates the domestication of most plants and animals by between 1000 and 2000 years.

The extent to which this increase in the size of settlements reflects regional population growth or population aggregation at individual sites remains unclear. This reconstruction of regional Neolithic demographics is probably a conflation of two interrelated processes: (1) gradual and steady regional population growth through the Neolithic period; and (2) population aggregation in large and important settlements, like Basta and 'Ain Ghazal, for ritual, political, and economic

reasons (Rollefson 1987). Based on figures for the total settlement area for the period of c. 11,000 to 8,000 B.P., it can be argued that population levels increased gradually up to, and probably including, the PPNA. In the LPPNB, and perhaps more specifically for the period between c. 8,300 and 8,000 B.P., human communities increased at a much greater rate during and immediately after the widespread introduction of domesticated plants and animals in the south-central Levant (Figs. 3 and 4). With-

out future field research on the distribution of different-sized settlements and changes in the density of residential housing through time it is not possible to estimate the extent to which increased settlement area is due to regional population growth rather than to population aggregation. At the same time, based on these comparative estimates it is clear that the demographic changes must have influenced social structures in these communities.

LPPNB COMMUNITIES: SOCIAL CROWDING AND RELATIONS

While questions remain as to the degree to which regional population levels increased through the PPNB, current evidence indicates that individual communities increased significantly and leads us to examine some of the short-term aspects to this transition: what kinds of strategies did people employ to deal with these changes, and how did these changes alter daily life and living conditions of people in these communities? Specifically, what evidence do we have for how people may have coped with increased population pressure, aggregation, and social crowding in daily life, and how might this be related to the eventual abandonment of agricultural villages at around 8000 B.P. at the end of the Late Pre-Pottery Neolithic B period of the south-central Levant? In the LPPNB of the south-central Levant there appears to have been considerable variability in economic orientation, subsistence systems, and the size and permanence of settlements in different environmental areas (see Bar-Yosef and Meadow 1995; Byrd 1992; Garrard et al. 1994). In desertic areas, for example, we find settlements comprised of round or oval stone structures covering a relatively small area, inhabited by people combining the hunting of wild game and agriculture as a subsistence strategy. In other

areas, such as in or to the west of the Jordan Valley, LPPNB communities were considerably larger (covering c. 2.5 ha), with rectangular architecture and food production based on domesticated plants and animals (Bar-Yosef and Meadow 1995). Along the eastern side of the Jordan Valley, we find a very different settlement type, including the emergence of large LPPNB communities of several thousand people living in tightly packed residential structures covering an area between 10 and 14 ha (Fig. 1). These LPPNB communities, including the settlements of Basta, 'Ain al-Jammam, 'Ain Ghazal, and Es-Sifiya, were situated along the ecological ecotones of the Jordanian highlands, an area that receives considerable rainfall even today (see Bisheh et al. 1993; Nissen et al. 1987; Rollefson et al. 1992). Although the environmental, demographic, and social reasons for the emergence and eventual collapse of these villages is still poorly understood, these large LPPNB communities can be envisioned as aggregate villages, resulting from regional population increases as well as the aggregation of members from earlier MPPNB communities. While it is not entirely clear how these large LPPNB communities were linked to each other, or for that matter with other smaller LPPNB communities situated in desertic environments or within the Mediterranean zone, recent field research illustrates that the relative scale of these communities embodied a distinctly different lifestyle from other types of earlier, contemporaneous, and later settlements.

LPPNB Compartmentalization and Two-Story Architectural Systems

Two of the more visible strategies that LPPNB community members adopted in response to increased population levels and control of food resources involved the development of two-story architecture

TABLE 3
Estimated Compartmentalization for Late Natufian through LPPNB Settlements
in the South-Central Levant

Period	Site/area	Site size (ha)	Total exc. area (m ²)	No. of structures/compts.	Estimated mean compts./100m ²	Estimated mean compts.
Late Natufian (11,000–10,300 B.P.)	'Ain Mallaha					
	Nieueu I	0.2	240	c.4/4	1.7	LNat = 1.6
	Jericho	c.0.2	65	1/1	1.5	
SQ E I,II,V Phase II						
PPNA (10,300–9,300 B.P.)	Netiv Hagdud Upper area	1.5	500	10/11	2.2	PPNA = 2.4
	Jericho	2.5	75	2/2	2.6	
	Sq E I,II,III Phase IV xvi					
	Jericho	2.5	90	2/2	2.2	
	Sq M I Phase VIII xxxix					
	Jericho	2.5	90	2/2	2.2	
MPPNB (9,300–8,500 B.P.)	Nahal Oren	0.5	500	13/13	2.6	MPPNB = 6.4
	'Ain Ghazal (Central field)	4.0	200	5/c.15	7.5	
	Jericho	2.5	95	2/5	5.3	
	Sq M I Phase XV lxxviii					
	Jericho	2.5	92	3/5	5.4	
	Tr III Phase IX xxi					
	Jericho	2.5	80	2/5	6.3	
	Tr I Phase XVIa xxviii					
	Jericho	2.5	70	3/5	7.1	
	Sq E I, II, III Phase X xlii					
LPPNB (8,500–8,000 B.P.)	Jericho	2.5	112	3/7	6.3	LPPNB = 14.5
	Tr I Phase XXI					
	Basta (Area A)	14.0	240	Unknown/32	13.3	
	Basta (Area B)	14.0	108	Unknown/22	15.7	

and the compartmentalization of buildings. Drawing on architectural data from 'Ain Ghazal and Beidha, Banning and Byrd (1987, 1989), among others, note that the later phases of the PPNB period are characterized by a greater subdivision of structures. Placing these observations in a broader regional and more detailed temporal framework, examination of the mean number of compartments in a 100-m² area illustrates a significant increase in compartmentalization of residential structures from the Late Natufian

through to the LPPNB aggregate villages (Table 3, Fig. 2). In the Late Natufian, for example, available data indicate that there were approximately 1.6 compartments per 100 m², and by the PPNA this figure increased marginally to 2.4. By the MPPNB, however, we see a substantial increase in compartmentalization, with an average of 6.3 compartments per 100 m². This trend continued into the LPPNB. Recent excavations at several settlements, including Basta, 'Ain al-Jammam, and Es-Sifiya, document a dramatic increase in this pat-

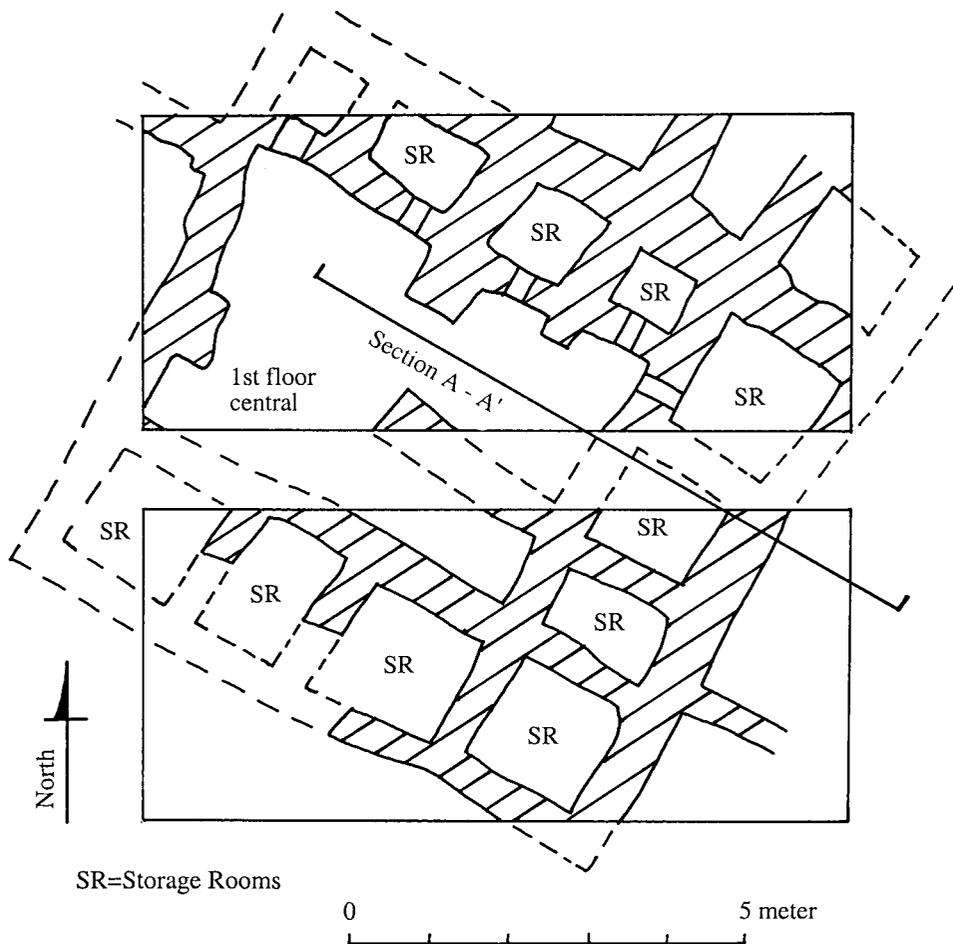


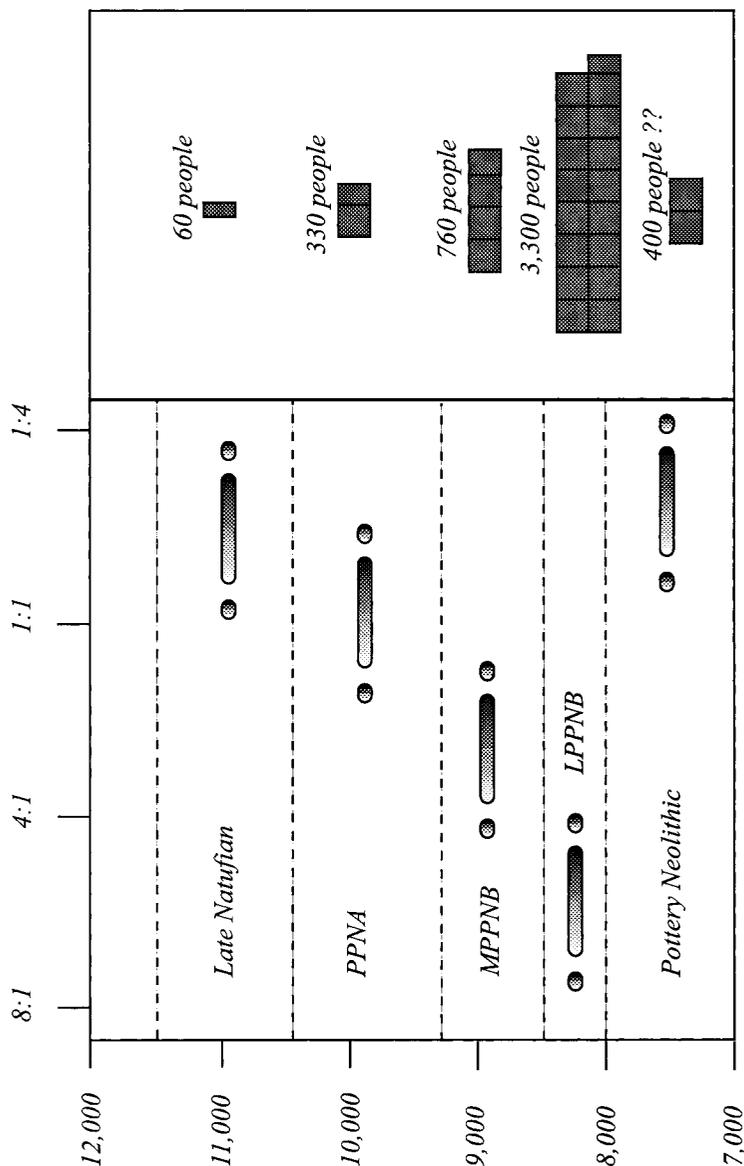
FIG. 5. Plan view of exposed LPPNB (c. 8200 B.P.) building at Area B, Basta, Jordan. Note first floor central room, 1 × 1.5-m storage rooms along outer edges, and access openings connecting central room and storage rooms. Profile of excavated interior walls (section A-A') is seen in Fig. 7 (after Nissen et al. 1987: Fig. 7).

tern, with an average of 14.5 compartments per 100 m² (Fig. 5) and with reduced space between buildings as well (Fig. 6). This suggests that as the size of the community grew, PPNB peoples continually subdivided the space in their dwellings: perhaps this compartmentalization reflects the increased stress of social crowding and desire to delineate space for privacy, or growing emphasis on personal goods and ownership, or, most likely, a combination of these and other factors.

Significantly, this LPPNB trend toward increasing segmentation of space was accompanied by another important development: the development of two-story buildings. One of the most obvious differences between LPPNB aggregate villages and contemporary smaller settlements in desertic areas, as well as earlier MPPNB communities, was the development of architectural systems that employed two-story structures. Two-story architecture, combined with the high overall density of buildings within LPPNB communities,

Residential density: Estimated ratio of area with buildings to open space

Estimated Community Size



• 'Ain Mallaha, Hatoula

• Jericho, Tell Aswad,
Netiv Hagdud, Gilgal I,
Dhra', Nahal Oren

• Jericho, Kfar Hahoresht,
'Ain Ghazal, Yiftahel

• Basta, 'Ain Ghazal,
Wadi Shu'eib, Es-Sifiya,
'Ain Jammam, Ramad I

• Ramad, Beisanoun,
Abu Gosh

FIG. 6. Estimated changes in community size to density of housing for open air Late Natufian through Pottery Neolithic settlements located in the Mediterranean vegetative zone of the south-central Levant.

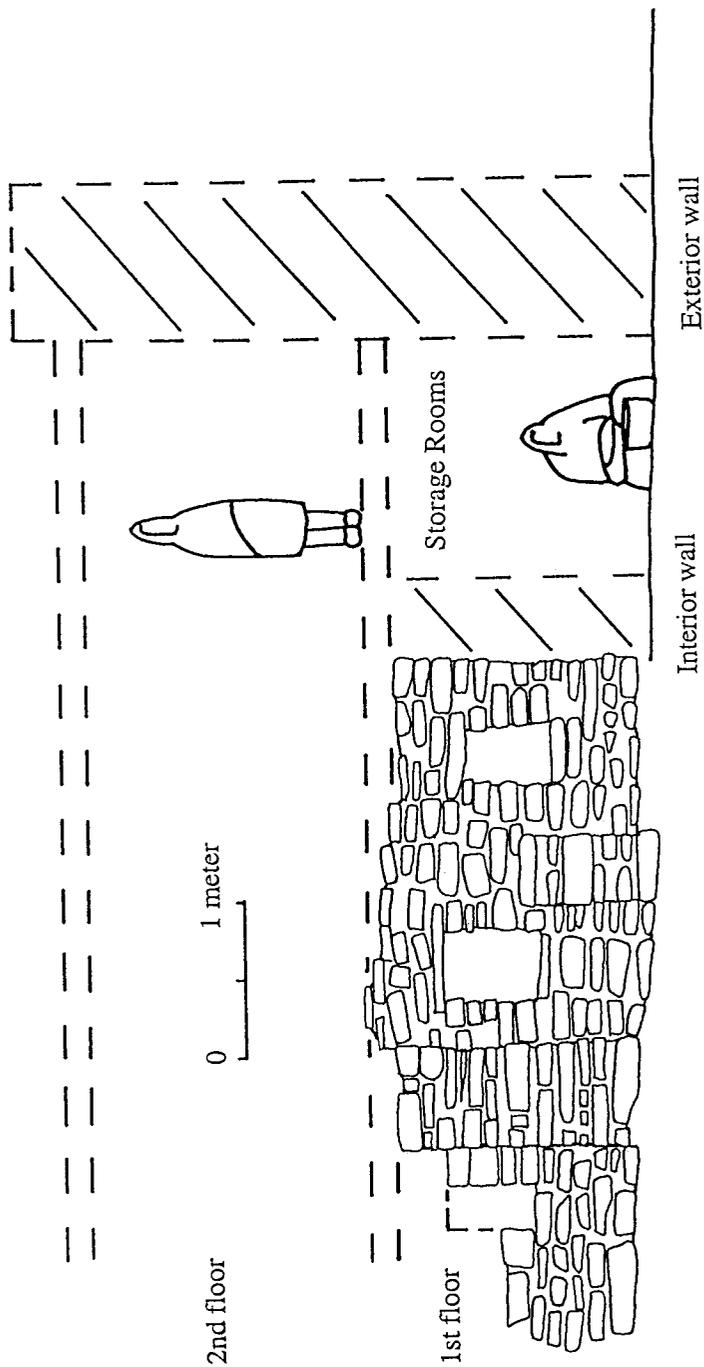
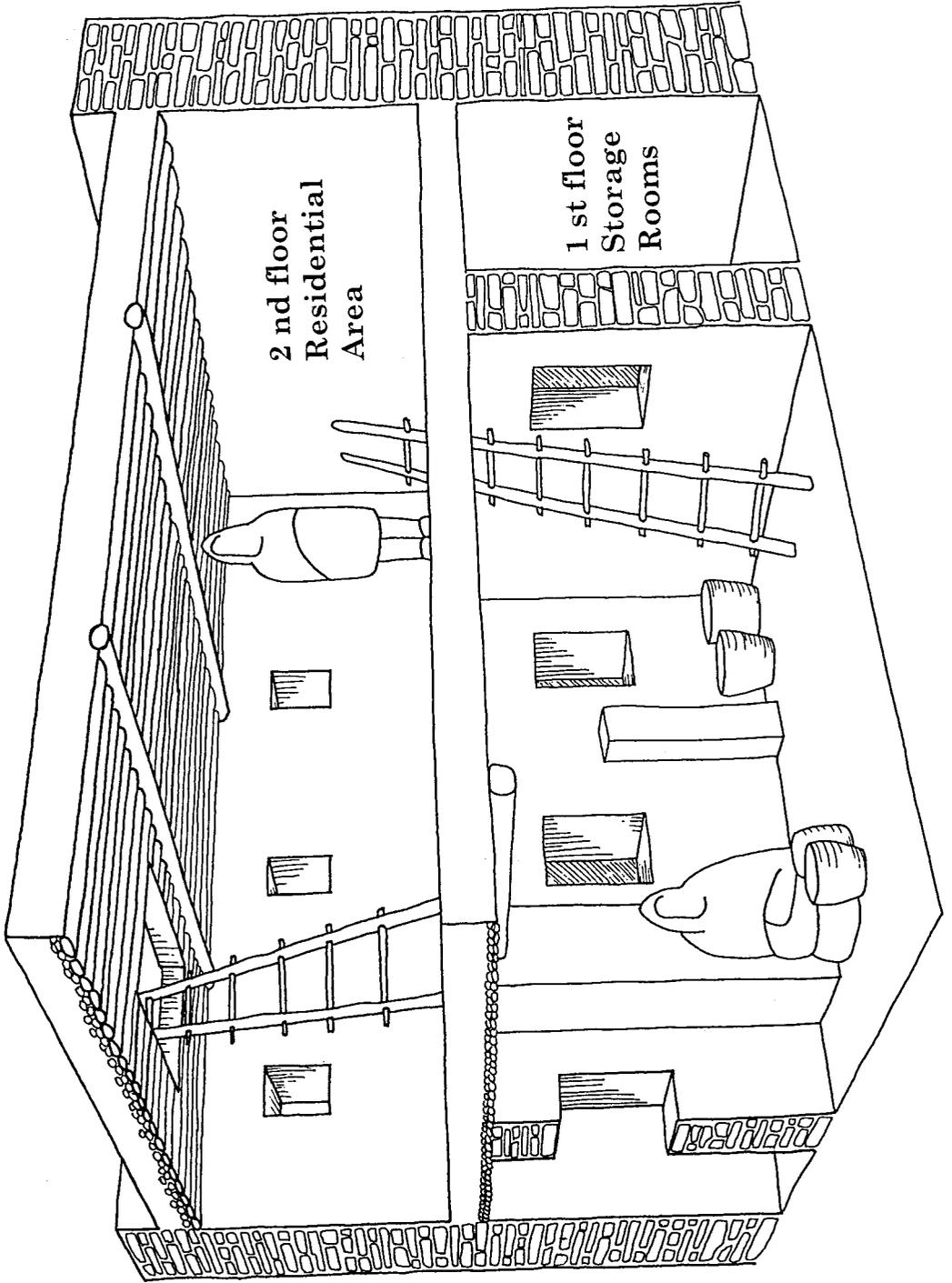


FIG. 7. Profile of exposed standing wall of two-story LPPNB (c. 8200 B.P.) building in Area B, Basta, Jordan (section A-A). View from first-floor central room looking northeast, of open entrances to storage rooms (after Nissen et al. 1987: Fig. 8b).



subdivision of buildings, and the huge increase in the total area of LPPNB settlements, is likely to be linked to the existence of social crowding in these communities or the development of storage areas inside of residences. As noted earlier, excavations at MPPNB Beidha uncovered evidence for a lower building foundation upon which the main residential area was constructed (Byrd 1994; Byrd and Banning 1988). This lower level was employed for storage or perhaps even as cramped work areas. This pattern clearly changes with the LPPNB, with the construction of two-story buildings at select large settlements, such as Basta, Es-Sifiya, 'Ain al-Jammam, and possibly Ghwair I (Najjar 1994). At Basta, for example, there is evidence for past existence of two-story buildings, with the first floor being organized so as to surround an enclosed central room, probably accessed from above, with small (between 1×1 and 1.5×1.5 m) storage areas (Figs. 7 and 8). In contrast, the second floor probably served as the major residential area and was supported by a large wooden beam placed on large 1.5- to 2.0-m-high pillars of fitted rectangular fieldstones.

The construction of multiple building levels holds immense implications for exploration of demography, social crowding and population pressure, for this clearly reflects a strategy to deal with changing social conditions within these communities. First, the archaeological evidence suggests that LPPNB community members expanded space vertically to facilitate the creation of specialized activity areas, such as food storage downstairs and/or upstairs residential areas, as well as to increase control of access to select areas. Second, a community's expansion of us-

able space upward would have resulted in an increased density of residential housing, a higher capacity for housing people, and a reduction in sanitation conditions. Finally, it is possible that household members recognized the functional need for the creation of shaded, cool storage areas in settlements located along the desert margins. Whatever the ultimate reason(s), the existence of multiple levels of rooms at large LPPNB settlements raises the clear possibility that a greater number of people lived within these communities than is reflected by mean site areas and, just as importantly, that the density is even greater than previously recognized. It is also clear that widespread adoption of two-story buildings indicates a broad cultural choice, one that apparently reflects both how people coped with increased social crowding in communities and the development of dedicated storage areas situated inside of buildings.

Admittedly, it is very difficult to substantiate through material means the scale and influence of social crowding, let alone social crowding within communities, whether in the past or the present. While the challenge for all archaeologists is to develop inventive means of interpreting past societies through material culture, the built environment, and the residue of behaviors, we are commonly forced to rely upon qualitative and relativistic data sources rather than quantitative materials. For example, it is clear that the general increase in depth of cultural deposits at PPNA, MPPNB, and LPPNB agricultural villages occurs simultaneously with an increase in settlement area. The volume of sediment produced by cultural activities at LPPNB Basta, probably occupied for around 200 years, is staggeringly different from the 1000+ years of Early and Late Natufian oc-

FIG. 8. Architectural reconstruction of two-story LPPNB (c. 8200 B.P.) building at Area B, Basta, Jordan, based on excavated architectural remains. Note storage rooms surrounding first-floor central room and the open second floor area, which likely served as the residential area.

cupation at 'Ain Mallaha. 'Ain Mallaha, which is among the largest known Levantine Natufian open-air sites with architecture, resulted in approximately 3,000 m³ of cultural deposits (2,000-m² area and 1.5-m deep deposits). Conversely, the LPPNB occupation at Basta resulted in approximately 420,000 m³ of cultural deposits (140,000-m² area and approximately 3-m deep deposits) over a much shorter period of time. Even if we assume that later Neolithic occupations created more archaeological debris per capita due to different architectural techniques or that this pattern is the result of different settlement processes and use of materials for architecture, this trend reflects an increase in human activities that is both intuitively impressive and, at the same time, frustratingly difficult to quantify. Returning back to our case study once again, one can intuitively argue that increased volume of cultural materials in LPPNB settlements reflects an even greater population increase than that presented by settlement area alone. It is, needless to say, very difficult to quantitatively assess the magnitude of this relationship and, more importantly, for archaeologists to understand the causes and implications of such human behavior. Regardless of these difficulties, consideration of the nature of long-term changes in community size, the built environment, and some of the possible strategies that villagers enacted to deal with reduced privacy, increased crowding, and changes in access to resources help us to understand how material culture and cultural practices were employed in the Pre-Pottery Neolithic to offset changing living conditions.

NEOLITHIC DEMOGRAPHIC CHANGES, SOCIAL RELATIONS, AND THE "ABANDONMENT" OF LPPNB COMMUNITIES

It is important to note that many, if not most, of the large LPPNB village commu-

nities in the south-central Levant were abandoned at some point between 8000 and 7750 B.P., with new, and usually smaller, hamlets founded at the beginning of the Pottery Neolithic. In a few rare cases, such as Sha'ar ha Golan, communities may have covered upward of 1.5 ha, albeit with only limited density of architecture. The regional pattern of sharply reduced size of communities in the Pottery Neolithic compared to the Pre-Pottery Neolithic has been noted across the south-central Levant and has led many researchers to explore how aspects of environmental change and ecological degradation might be interrelated (see Bar-Yosef and Belfer-Cohen 1991; Köhler-Rollefson and Rollefson 1990; Rollefson 1996 for further discussion). I believe that, in combination with these factors, it is important for us to examine some of the ways in which the abandonment of these villages was linked to other social conditions. Specifically, in this section I explore how long-term demographic changes and short-term, daily, social relations within communities were interrelated, and ultimately how these might be linked to the abandonment of large regional communities. In addressing the first of these issues, let us return to the question of what forces might have initially brought people together in these village communities. In brief, I believe that the significant increase in the scale of certain LPPNB communities reflects several interrelated processes, including the development and maintenance of elaborate public mortuary rituals enacted by members of larger communities, which attracted members of households living in adjacent settlements; the simultaneous reinforcement of the authority of select ritual practitioners who organized and enacted these rituals; and the emergence of powerful lineages and Houses within larger communities (Kuijt 1995). Following Rollefson (1987) and Rollefson and Köhler-Rollefson (1989), I

suggest that in the south-central Levantine Pre-Pottery Neolithic periods we find compelling evidence for regional social and economic centers in the Near East. As outlined elsewhere (Kuijt 1995, 1996), the public nature of PPNB household and community mortuary and ritual practices within these large settlements may well have increasingly encouraged lineages to merge with other residential groups with whom they shared some preexisting social, economic, or ritual bonds (such as kinship). It is important to note, however, that the emergence of more powerful lineages through alliance did not result in the expression of social differentiation indicative of positions of leadership other than perhaps that of representative leadership from multiple households. The actual and figurative consolidation of related, although previously separate lineages, would have also created new stressful conditions at the community and lineage level. Increased social crowding within buildings and conflicts between individual lineages over rights and obligations and possibly even with competing ritual organizations may have played competing roles in shaping social arrangements within PPNB Neolithic communities. With this perspective we must recognize that people in Neolithic villages, at the household, lineage, and community levels, dynamically crafted social relationships in certain ways to respond to specific demographic dimensions.

In this light the relinquishing of LPPNB lifeways, particularly the abandonment of these large aggregate villages between 8000 and 7750 B.P., may well have been related to changes within a broader set of ritualistic and social beliefs, in combination with regional environmental changes and local environmental degradation. In particular, I would emphasize four possible interrelated social processes of change, including (1) the inherent limitations of LPPNB social organization to cope

with increasing population aggregation, conditions of social crowding, and scalar stress (Johnson 1982); (2) the influence of scalar stress in diminishing the ability of House, ritual, and economic leaders to effectively manage and organize all segments of the community; (3) the emergence of politically, economically, and socially more powerful Houses or lineages characterized by greater access and control of some resources and privileges; and (4) the overall effect of the complex interplay between these factors in challenging the fundamental rationale for the existence of this ritual system and the group of people who controlled it.

Potentially, the increases in the scale and density of these LPPNB communities would have also challenged existing social structures for organizing labor at certain periods of the year, as well as created a greater need for competing and cooperating hierarchical structures for sharing information and materials. As outlined earlier, available architectural and settlement data illustrate a progressive growth in crowding stress within LPPNB Neolithic Houses, lineages, and communities, creating social congestion, perceived loss of control over one's immediate environment, and an overall reduction in privacy, all of which encourage people to segment their physical space (Altman 1977; Rappoport 1975). If architectural segmentation were only partially linked to food storage and the construction of two-story buildings, then it is clearly possible that LPPNB compartmentalization may have also served as a strategy to control/limit access to certain areas. People would have constructed physical barriers to physically and socially further define stages along the continuum of more public to more private space. The LPPNB compartmentalization seen at Basta, for example, reflects on some level the decision by community or House members to create additional residential space, more physi-

cal and social barriers, and a greater capacity for storage. As such, people's and community's conceptualizations of privacy and access may have been fundamentally redefined and, by extension, the changes in the built environment influenced and reshaped the creation of social, economic, and political relationships within and between Houses, lineages, and MPPNB and LPPNB communities. If we assume, like Banning and Byrd (1987, 1989), that the segmentation of MPPNB and LPPNB architecture reflects social forces, such as crowding and attempts for greater privacy and to control access to space within Houses, then it must also be recognized that ultimately this strategy was inherently limited as a long-term solution. Specifically, there are clear physical limitations as to how close buildings can be constructed and still maintain street access and the degree to which compartmentalization can occur within residences. Archaeological evidence indicates that population growth in the LPPNB expanded beyond this threshold, when it was no longer possible for community members to continue segmenting space in structures (Fig. 5).

Shifting patterns of mortuary activity and ritual in the LPPNB may also reflect these fundamental changes in social structures. I believe that the emergence of more powerful lineages, as well as increased social stresses related to crowding and information exchange, limited the practical ability for the community to participate in communal rituals. For instance those rituals that were practiced would have had a reduced effect on the community due to increases in scale and/or resistance to increasing social segmentation. When ritual and mortuary ceremonies are conducted less frequently and less effectively, the entire foundation for social cohesion may be weakened. Not only is the rationale for community practices weakened, or even worse dismantled, but so is

the physical means of reiterating these ideological and moral messages on a regular basis.

Furthermore, if one accepts that some form of ritual/economic elite oversaw LPPNB ritual and mortuary practices while also adjudicating interfamily disputes, organizing communal labor, and serving as the main community source for the distribution of information (see Kuijt 1996), then it follows that the erosion of ritual and mortuary practices were tied to a decrease of support for this ritual elite, the very reasons for population aggregation, and the attractiveness of living in large ritual centers. In short, the social cohesive force holding LPPNB communities together would have dissolved, as would the motivations for individual members, Houses, and lineages to voluntarily relinquish their various rights and privileges. With the weakening or removal of the overall ideological structure upon which this culture of village life was based, ritual systems no longer were able to maintain group solidarity as seen in the MPPNB. Moreover, the promotion or recognition of some individuals or families over others, thereby providing them with greater access to resources and privileges, would have undermined the entire system of egalitarian/communal values and beliefs seen as early as the MPPNB. Without voluntary participation and belief in the ritual systems and worldview by all community members, and in the face of regional environmental changes and degradation of conditions around settlements, there would have been few, if any, factors to attract individuals or families to large agricultural centers and little in the way of social, economic, or ritual reasons to keep disgruntled community members from leaving the settlement for other areas.

In this light, the "collapse" of the LPPNB lifeways can be visualized as a dispersal of people from a number of large population aggregation centers, such as

'Ain Ghazal or Basta, to an increasing number of small hamlets or villages scattered across the south-central Levant. Important dimensions in this settlement shift probably included degrading environmental conditions and the overexploitation of local resources (Rollefson 1996; Rollefson and Köhler-Rollefson 1989). Ultimately, however, the argument I offer suggests that the cessation of LPPNB mortuary and ritual practices at around 8000 B.P. proved to be an equally important factor: the system of social beliefs that created these communities in the MPPNB/LPPNB was unable to deal with the new realities of village life requiring greater social segmentation and people living in increasingly compressed physical conditions. In many ways, therefore, the emergence of economic and social elites, and eventual consolidation of power in the hands of a few individuals by the end of the LPPNB, may have been major elements in the process of fragmentation of these large aggregate LPPNB communities.

REFLECTIONS ON DEMOGRAPHIC CHANGE, THE EMERGENCE OF SOCIAL DIFFERENTIATION, AND FOOD PRODUCTION

A number of recent studies by archaeologists and anthropologists devote increased attention to the social dimensions of the emergence of food production in particular and the Neolithic in general (Bar-Yosef and Meadow 1995; Byrd 1994; Hayden 1995; Watson 1995). These works illustrate that only limited attention has been afforded to anthropological issues of changing social complexity, the organization of labor in these communities, the strategies employed by community members in the face of drastically changing economic conditions, and shifts in the control of resources and the built environment. Ultimately it is through a consider-

ation of how these issues, as well as better understood topics, are interwoven in past social contexts that anthropologists and archaeologists are able to reflect upon the human dimensions of the Neolithic, identifying household and community concerns, and how these might be linked to how people coped with profoundly significant economic, environmental, and social changes.

As noted earlier, one conclusion that can be drawn from examination of changes in the largest Natufian and Pre-Pottery Neolithic settlements is that PPNB communities reflect both regional population growth as well as community level population aggregation for ritual and economic reasons. Often anthropologists and archaeologists have envisioned population aggregation/growth/pressure as leading to the development of new social arrangements along hierarchical lines, largely for economic reasons (e.g., Earle 1987; Johnson and Earle 1982). From this perspective we would anticipate that the south-central Levantine LPPNB, with evidence for a dramatic increase in the size of individual settlements, centralization in certain large regional settlements, and increased crowding stress, would provide material evidence for enormous increases in social segmentation, perhaps through the development of a clear, and firmly entrenched, hierarchical division of authority and power. On the basis of analogies from other cultures, representative of different periods of time and geographical areas, one can argue that the combination of dramatic economic changes associated with food production and population aggregation in regional centers in the LPPNB would have created a social context in which certain individuals consolidated power and authority within the Neolithic communities and perhaps even in the development of hereditary authority. Paradoxically, the material evidence suggests a very different story. If anything, available

archaeological data for approximately 500 years of the MPPNB and LPPNB indicate that in the face of increased population expansion and social stress at the lineage and community level, Neolithic community members (1) continued to limit displays of social differentiation in mortuary practices and residential architecture (see Kuijt 1996) and (2) abandoned their large settlements at c. 8000 B.P., disrupting the social and economic foundation of the LPPNB social structure and the lifeways to move to small hamlets, which exhibit very little evidence supporting social differentiation or hierarchical structures.

This paradox between expectations of anthropological models and archaeological data leaves us with several thorny questions. Most importantly, if these large LPPNB villages emerged through population aggregation due to the need for increased centralization of labor, the development of powerful Houses through kin and economic units, and the development of regional economic and ritual centers, then why do we not see the emergence of some form of centralized leadership? This is a difficult question, the answer to which probably reflects how power and authority may have been shared in LPPNB communities. Specifically, if LPPNB aggregate village communities were organized along lineage lines, then any system of shared power and authority between Houses would have been highly competitive and prohibited the consolidation of authority by a single lineage, let alone individuals. Thus, it may well be that the social rules for limiting the authority and power of individuals and Houses in these LPPNB aggregate villages were stronger, apparently much stronger, than the ability of individuals and Houses to consolidate power and authority in the hands of the few over the many. Simply put, it appears that communities at the end of the Pre-Pottery Neolithic period were un-

able to develop new means of organizing positions of leadership in the face of rapid changes in economic systems, environmental conditions, and the almost-exponential aggregation of people into LPPNB communities. From this perspective, then, the abandonment of LPPNB aggregate village communities along the Jordanian Highlands can be seen as a failed experiment in balancing antiquated systems of shared social power with the need for developing new means of organizing and directing increasingly large urban communities with competing House leaders.

Viewed from a broader perspective, this reconstruction of the nature and timing of demographic change in the south-central Levantine Pre-Pottery Neolithic provides us with some important insights into several current anthropological/archaeological debates. First, data on changing settlement size as well as the overall pattern of community growth indicates that regional population growth and aggregation in select communities occurs at least 500 years after the domestication of many, if not most, plants and animals (see Bar-Yosef and Meadow 1995). While this is hardly unexpected, it does suggest that archaeologists should reexamine the degree to which the development of food production and the domestication of plants and animals should be viewed as causally linked to population growth within the context of early agricultural village life. Second, this and other studies indicate that while new community-shared forms of leadership and social differentiation developed in the MPPNB and LPPNB (probably House based and focused on the maintenance and administration of ritual practices and community labor), early forms of food production and population growth facilitated the emergence of individual powerful rulers who continued to accrue power and authority over others. As noted elsewhere (Kuijt 1995, 1996), considerable archaeological evidence suggests

that PPNB communities intentionally limited the accumulation of differential authority by individuals through the prohibition of the inclusion of grave goods or the use of differential residential architecture, both of which can reflect mechanisms to express differences in status through material culture. It appears that while some differential power and authority was accumulated by ritual or economic elites within MPPNB communities, available mortuary and architectural evidence indicates that it is only in the late LPPNB (c. 8300–8000 B.P.), some 500 years after almost all domesticated plants appeared, that we see extensive mortuary goods and differential treatment of the dead. Just as importantly, the abandonment of PPNB lifeways around 8000 B.P. and the transition to small Pottery Neolithic hamlets containing fewer than a hundred people, reflects a process of decentralization and social fragmentation rather than successful centralization of power and authority by individuals. Thus, when powerful individual leaders did emerge in the LPPNB they were unable to consolidate authority within these communities and perhaps were instrumental in the social fragmentation that occurred within prehistory's earliest known agricultural villages. This suggests that, at least in the case of the Near Eastern Pre-Pottery Neolithic, communities dealt with the new challenges of emerging systems of food production, food surpluses, labor needs, and increased social crowding and population aggregation by continuing existing, and developing new, social mechanisms for maintaining communities through the reiteration of social-leveling mechanisms. Collectively understanding how communities, Houses, and individuals, both intentionally and unintentionally, reacted to changing demographic conditions provides new insights into the Neolithic and helps anthropologists and archaeologists better understand the social side to this critical social, evolutionary, and subsistence transition.

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