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Heartland of villages: Reconsidering early urbanism in the southern Levant

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HEARTLAND OF VILLAGES: RECONSIDERING EARLY URBANISM IN THE SOUTHERN LEVANT

by

Steven Edward Falconer

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF ANTHROPOLOGY

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ABSTRACT

Archaeological studies of early civilizations in southwestern Asia concentrate on the evolution of urbanism and the state, and generally assume that cities were the foci of complex societies. However, some early civilizations may represent largely extinct forms of complex, but essentially <u>rural</u>, society. Archaeological concepts of urbanism and urbanization are reviewed and critiqued. Rural communities are defined as agriculturally self-sufficient, while cities have populations too large for independent agricultural subsistence. Ethnographic and historical data are used to propose size classifications for ancient "urban" and "rural" settlements in Mesopotamia and the southern Levant. Survey data show that Mesopotamia is characterized aptly as a "Heartland of Cities," in which urban centers restructured regional settlement systems. The southern Levant is reconsidered as a "Heartland of Villages," in which Bronze Age populations grew, and social complexity developed, primarily in the countryside with little urban influence.

The nature of this "rural complexity" is illuminated by excavated data from Tell el-Hayyat and Tell Abu en-Ni^{c}aj in the Jordan Valley. Ni^{c}aj suggests the importance of sedentary rural agriculture during the otherwise "pastoralized" Early Bronze IV Period. Middle Bronze II temples at Hayyat, a diminutive village site, exemplify social institutions normally interpreted as "urban" in distinctly rural settings. Neutron activation analysis is used to investigate rural pottery manufacture and exchange in the Jordan Valley. A brief

excursus proposes a means of distinguishing trace element signatures of clays from those of non-clay inclusions in archaeological ceramics. This revised method reveals that some villages specialized in fine ware production during the absence of towns in Early Bronze IV, and that fine ware production continued in villages despite the reappearance of towns in Middle Bronze II. Thus, economic and social differentiation had characteristically rural manifestations, and Bronze Age society in the southern Levant should be reconsidered as a distinct and provocative case of "rural complexity" in a "Heartland of Villages."

INTRODUCTION

The title of Robert Adams' book Heartland of Cities captures succinctly the primary focus for archaeological analyses of early civilizations in southwestern Asia: the evolution of urbanized society. Over the millennia following ca. 4000 B.C. the cultural landscapes of Mesopotamia and the southern Levant were marked by the appearance of conspicuously large, often fortified, sedentary settlements. The largest settlements in these regions are interpreted by archaeologists as cities that were differentiated from, but integrated with, smaller surrounding towns, villages and seasonal encampments. Cities are seen as the essential denotata of urbanism, and the development of urbanized social complexity is inferred from their advent and growth. This dissertation proposes that common emphasis on the evolution of urbanism, as prototypified in Mesopotamia, diverts archaeological attention from equally important examples of early complex societies, like those of the southern Levant, that were essentially rural.

The following chapters draw Mesopotamian data from several archaeological surveys of the Tigris-Euphrates alluvial plain below the early Islamic city of Samarra. The Susiana Plain, lying immediately west of the Zagros Mountains which bound this basin, provides data from a periphery of greater Mesopotamia. These surveys document the ebb and flow of human settlement over a span of six millennia.

The southern Levant, as defined here, encompasses Palestine (i.e., approximately the area covered by the West Bank of the Jordan River and the modern nation of Israel) and western Transjordan. Alternatively, this might be labeled in more culturally specific terms as "ancient Canaan." The southern Levant is segregated from surrounding lands according to regional differences in ancient settlement and society. The discussions below focus on sedentary settlement during the Early, Middle and Late Bronze ages (c.a., 3200-1200 B.C.). Through these two millennia, the deserts of eastern Jordan and the Negev were characterized by non-sedentary, apparently pastoral populations that fall, regrettably, outside the scope of this study. To the north, inland Syria had a long history of town and city life with many ties to the southern Levant. However, during the Bronze Age the settlement systems of these two regions followed different trajectories. This dichotomy is most clearly exemplified during the late third millennium B.C. by the simultaneous collapse of town life in the southern Levant and continued florescence of cities in Syria.

The more arbitrary exclusion of the northern Levantine mountains and coastal plain is dictated by limits of regional settlement data analyzed in Chapter 4. These data are derived from excavations and surveys north of the Negev Desert, west of the Jordan River and within the modern northern borders of Israel. In terms of archaeological survey, most of Lebanon is *terra incognita*. Although many of the observations below undoubtedly also pertain to the Bronze Age of the northern Levant, discussion is limited to the more accessible archaeological record of the south.

The characteristics of Bronze Age settlements east of the Jordan River soon can be added more fully to the portrait presented below. Regional coverage is expanded here with a case study of Bronze Age ruralism in the Jordan Valley based on the work of the University of Arizona Tell el-Hayyat Project.

Many of the following discussions center on the varying functions and inter-relations of urban and rural communities. Chapter 1 reviews and critiques archaeological concepts of urbanism and urbanization. These concepts have engendered a normative view of cities as the inevitable prime foci of ancient complex societies. In rebuttal, Chapter 1 argues that need to emphasize the differences, as well as similarities, between various examples of cities and social complexity. The points made in this chapter are crucial if we are to recognize the fundamental contrasts between urban and rural complexity as seen in ancient Mesopotamia and the southern Levant.

Chapter 2 considers how archaeological concepts of urbanism and ruralism can be operationalized. Cities are defined as those ancient communities that had populations too large to provide for their own agricultural subsistence. Rural communities are defined as those smaller agricultural villages that undoubtedly could have subsisted independently. Ethnographic and historic data concerning ancient agriculture (e.g., the productivity of irrigated and rainfed cereal agriculture, the extent of agricultural "sustaining areas") and population densities are used to estimate size classifications that can be used to differentiate ancient "urban" and "rural" settlements in regional surveys of southwestern Asia. These urban and rural definitions are utilized in general overviews of complex society and settlement in ancient Mesopotamia (Chapter 3), and during the Bronze

Age of the southern Levant (Chapter 4).

Settlement patterns in Mesopotamia describe a variety of processes in which cities restructured the countryside by discouraging or promoting rural settlement. For example, during the spectacular Early Dynastic hyperurbanization of southern Mesopotamia, the metropolis of Uruk absorbed the populations of surrounding villages. An alternative expression of Mesopotamian urbanism is found in the Ur III/Isin-Larsa periods when several competing cities broadened their territorial authority by encouraging new subsidiary communities. This form of growth, essentially the converse of Uruk's early urbanization, also reflects the pervasive influence of cities in the development of Mesopotamian civilization. These findings are consistent with characterization of Mesopotamia as an urban "heartland."

A critical review of excavated and survey data from Palestine and Transjordan reveals a number of reasons for reconsidering the nature of Canaanite "urbanism." The cities of the Early and Middle Bronze ages were concentrated in Canaan's peripheries: the Mediterranean coastal plain and the Huleh Basin. However, growth during both periods was most pronounced in Canaan's heartland: the Jordan Valley and the central hill country of Palestine. Villages proliferated precisely in these latter regions that were most distant from cities. Thus, survey data suggest that the apogee of Canaanite civilization may be most intriguing because growth and development occurred primarily in rural communities, often without the participation of cities as agents of change. In striking contrast to Mesopotamia, the structural basis of Canaanite civilization lay more in "rural complexity" than urban pre-eminence and, therefore, normative concepts of urbanism characterize it inadequately.

Chapter 5 outlines the salient results of University of Arizona excavations at Tell el-Hayyat and Tell Abu en-Ni^{c}aj that illuminate several unexpected characteristics of Bronze Age village life in the Jordan Valley. Tell Abu en-Ni^{c}aj exemplifies the importance of sedentary agrarian life during Early Bronze IV, an era normally ascribed to "pastoralized" society and subsistence. Tell el-Hayyat was a small agricultural hamlet occupied from the end of Early Bronze IV through the Middle Bronze Age. Despite its diminutive size, Hayyat revealed a stratified series of four Middle Bronze II "Migdal" or "fortress"-type temples. These temples exemplify a counterintuitive pattern in which Canaanite religious institutions were represented in tiny villages, as well as larger towns and cities.

Further aspects of village complexity are illuminated by a case study of Bronze Age pottery manufacture and exchange in the Jordan Valley. An excursus in Chapter 6 considers the most appropriate means of distinguishing clay sources in localized neutron activation studies. Neutron activation analysis reveals chemical signatures of clays and non-clay inclusions in archaeological ceramics. It is argued that trace element "noise" can obscure the signatures of distinct potting clays and hinder the inference of clay sources and sites of pottery manufacture. This chapter proposes a revised method of sample preparation that segregates a clay- to silt-size fraction which best represents the clays in a ceramic body, with minimal interference from larger non-clay inclusions.

Chapter 7 presents a neutron activation analysis that applies this revised method to pottery from Tell el-Hayyat, Tell Abu en-Ni^{c}aj and six other towns and villages. The resulting data describe unanticipated patterns of pottery manufacture and distribution. The modest village of Tell Abu en-Ni^{c}aj (2.5 ha) appears to have been a central producer of trickle painted cups during Early Bronze IV, a period that lacked substantial towns altogether. Following the reappearance of towns in Middle Bronze II, rural fine ware manufacturing persisted in the Jordan Valley. Contrary to expectations, Tell el-Hayyat produced carinated bowls and distributed them to much larger communities like Pella (an 8 ha town). Most importantly, these data show that specialized products and services had important rural manifestations, and were not simply aspects of "urbanism" concentrated in towns and cities.

Chapter 8 concludes that the nature of Bronze Age society in the southern Levant can be reconsidered fruitfully on both the broad scale of regional settlement patterns, and with specific reference to the economic and social roles of villages. Canaanite civilization is particularly intriguing because many aspects of growth and differentiation, the hallmarks of social complexity, developed in the countryside. Cities were not the instigators of change, nor the prime foci of civilization. Instead, the Canaanite heritage of the southern Levant merits special attention, not as a scaled-down reiteration of urbanism seen elsewhere, but as a structurally distinct and archaeologically provocative "Heartland of Villages."

CHAPTER 1:
EVOLUTIONARY PERSPECTIVES ON URBANISM AND URBANIZATION

Long-term processes of change in human social organization are generally explained in terms of social evolution. Studies of state-level civilizations have focused on institutionalized, society-wide social and political authority as it became structurally differentiated from antecedent and contemporaneous kin-based authority (e.g., Yoffee 1979: 14-15). The state has been an attractive and controversial object of research because its episodes of rise, growth, and collapse can illuminate abundant differing forms of social and political structure.

The same cannot be said of archaeological approaches to urbanism. Cities are easily presumed to be inherently adaptive responses to the constraints and demands of complex (i.e., state-level) societies. Thus, "urbanism" can be trivialized simply as shorthand for evolving social complexity. Whereas studies of state structures can emphasize diversity, urbanism usually is explained as the product of normative teleological processes. Cities are taken to signify "urbanized" society, and urbanism is seen as a relatively uniform concept, a Platonic essence of sorts.

Cities are expected to be "an essential feature" (Childe 1950: 4) and "the dominant element in the settlement system" (Redman 1978a: 220) of civilizations. However, comparative studies tend to conclude that "urbanism seems to have been much less important to the emergence of the state, and even to the development of civilization in the broadest sense, than social stratification and institutionalization of political authority" (Adams 1966: 9-10). Service insists that "cities were not, [...] either essential to the development of the archaic civilizations or even closely correlated with that development" (1975: xii). Therefore, cities are, at best, merely indirect symptoms of social differentiation and stratification, and "truly urban agglomerations," (i.e., very large, highly differentiated cities), may depend upon the prior, or at least contemporaneous, structural development of the state (Adams 1972a: 735; H. T. Wright 1977: 225; Trigger 1972: 576, 592).

Thus, while urbanism and civilization are conceptually, as well as etymologically, intertwined, they are not isomorphic. While the appropriate definition of "the state" has attracted extensive debate, "urbanism" remains a uniform, intuitively-defined concept (see Trigger 1972: 576) despite its common usage. A comparison of the differing roles of ancient cities in Mesopotamia and the southern Levant requires explicit discussion of what characteristics make some communities "urban."

Urbanism as a Product of Growth and Differentiation

In axiomatic archaeological terms, "urbanism" characterizes the organization of societies in which particularly large settlements are differentiated from, but integrated with, other communities (Redman 1978a: 215). "Urbanization" refers to the process that gives rise to the assumed social, economic, and political primacy of urban communities, "a process whereby an increasingly substantial proportion of the population of a settlement system [comes] either to live in a central place or to be involved in a variety of ways in the activities of a central place" (Clarke 1979: 436; see also Johnson 1980: 255). Diverse expressions of urbanism, though openly acknowledged, are treated too readily as minor variations on a unilineal developmental theme. Urbanism and urbanization rarely have been scrutinized with an emphasis on variability within and between societies. Subsequently, the structural implications of this variability, and of urbanism's oscillating history, have not received archaeological attention commensurate with their potential significance. The fundamental task of this study is to explore the structures of ancient urbanized societies in southwestern Asia as they may be illuminated by their differences and by the diverse interests of their constituent parts. Particular attention will focus on the roles and influences of rural communities in urbanized societies.

The anthropological search for a generalized explanation of urbanism is rooted in Childe's diffusionist argument that city life radiated out from centers of early civilization in Egypt, Mesopotamia, and the Indus Valley (1950: 8). For Childe, urban settlement was the result and symbol of "a new economic stage in the evolution of society" predicated on the production of agricultural surplus that resulted in a dramatic population increase, the specialization of labor, and attendant structural changes in economy and society (Childe 1950: 3-8). Three fundamental dimensions of Childean thought underlie many contemporary applications of "urbanism" as an archaeological concept. Childe emphasized 1) progressive demographic growth to a level that 2) permits urban populations to engage in non-subsistence economic activities which lead, in turn, to 3) specialization of labor, differential accumulation of wealth, and class stratification. Similarly, Clarke (1979: 436) has enumerated three dimensions for defining urban systems as 1) the "large-scale residential population at a site," 2) the "numbers of specialists who do not produce their own food," and 3) the elaboration of political, economic, religious, and military functions at regional centers.

The first aspect of these archaeological formulations holds that urbanism is, most basically, a product of growth. Childe's fundamental structural change occurred at a demographic threshold, "a certain size of settlement and density of population" that provided the economic and political security necessary to encourage sedentary craft specialization and social differentiation (1950: 4, 7-8). Similarly, Weber (1958) maintained that the most significant structural transformation in the advent of urbanized society in Europe was social and economic diversification within and between cities. Both Weber and Childe emphasized that urbanization, as a growth process, entailed a profound change in social structure, not simply an aggregation of disarticulated populations. This fundamental structural change is characterized by social differentiation, in which "the major institutional spheres of society become dissociated from one another" (Eisenstadt 1963: 376).

For Weber, the prime loci of urbanized society are "market settlements" located at exchange points for goods and information, "the inhabitants of which live primarily off trade and commerce rather than agriculture" (1958: 66-67). Despite its europocentric bias, this perspective provides much of the foundation for archaeological conceptions of urbanized societies. For example, Renfrew reiterates Weber's emphasis on exchange in the development of complex polities, and Childe's argument that population growth itself may lead to craft specialization and social differentiation (1984: 94, 108). This is in keeping with the archaeological tenet that the degrees of social, political, and economic diversity in urbanized societies are functions of scale. The differentiation of urban centers from rural communities is presumed to follow from the "large size and diverse inhabitants" of cities that "provide specialized services to those living both in [them] and in areas nearby" (Redman 1978a: 220). Smaller rural settlements, on the other hand, are expected to be economically homogeneous and dedicated to agriculture (Trigger 1972: 577).

This concept is based on the importance ascribed to population growth in the appearance of early urbanism. A high population density dependent on intensive agriculture is commonly cited as a precondition for the development of urbanism (e.g., Trigger 1972: 592). Continued population growth, especially when treated as an independent variable (following Boserup 1965), is expected to cause further intensification and socio-economic differentiation (e.g., Young 1972; Athens 1977). An implicit tenet holds that the growing concentration of ancient populations in cities lowered potential per capita agricultural production, possibly by absorbing farming communities into larger non-agricultural cities (Wheatley 1972: 601), and certainly by reducing the amount of agricultural land urbanites could reach and cultivate (Redman

1978b: 343). This view follows the Childean/Weberian tradition in which urban-rural differentiation and interdependence are the expected results when growth reaches a scale large enough that urban populations can no longer be economically self-sufficient, but must persist as part of a differentiated social system in which "cities depend on an external population as suppliers of food and raw materials and as consumers of their goods and services" (Trigger 1972: 581; see also Clarke 1979: 438). Thus, urban economies, as differentiated from rural economies, are quintessentially "those with fully specialized productive activities" (H. T. Wright 1969: 1-2; 1981b: 278).

The argument that growth leads to differentiation also underlies the implicit assumption that a differentiated, urbanized settlement system signifies differentiated social and economic functions. This assumption allows for the expedient archaeological analysis of settlement hierarchies using theory and method borrowed from economic geography. Prominent among these techniques is Central Place Theory. In geographical terms, the hierarchical relations of urbanized societies are epitomized by high order "central places" that offer distinctive goods and services in addition to all the goods and services offered by lower order central places (Christaller 1933). Subsequent theoretical refinement (*e.g.*, Lösch 1944) suggests that central places of the same order are not always hierarchically equivalent (*i.e.*, they do not inevitably exercise the same functions), and that the functions of higher order central places do not necessarily subsume those of smaller central places. However, the essential proposition of economic geographical analysis, as applied in archaeology, has remained consistent: identification of hierarchical scale is the key to inferring social and economic structure.

Modern studies suggest a general correlation of population and functional size of communities (discussion in Johnson 1980: 239). Despite explicit recognition that the scale and structure of ancient hierarchies may not be indicated best by relative population sizes (Wheatley 1972: 620; Johnson 1982: 391), geographical analyses use only slightly distinct conceptions of administrative or "organizational" scale as the basis for inferring economic structure (e.g., Johnson 1982: 392). The identification of scale as the key to inferring structure is operationalized archaeologically by the simplistic, but expedient assumption that site size tends to vary with the number of functions an ancient community performed (see Johnson 1972: 770; Trigger 1972: 577, 579; Wheatley 1972: 609, 620). It is assumed that larger centers in urbanized societies offered a wider range of goods and services, engaged in more business, housed more public institutions, had larger populations, and served larger systems of subsidiary sites, than did smaller communities (Wheatley 1972: 615; Johnson 1980: 246). Thus, urbanized society has been described as the normal product of growth and differentiation. The reasoning behind this axiom is founded in the concept of social adaptation.

Urbanism as Adaptation

By virtue of its material database, archaeology has a long tradition rooted in materialistic interpretation and explanation in which greater "causal weight" is accorded to a society's behavior than to its thoughts, reflections, or justification for its behavior" (Kohl 1981: 89). Archaeological perspectives on urbanism conform readily to the materialist tradition (*e.g.*, as formalized by Christaller 1933), in which economic relations are regarded as autonomous factors in the generation of settlement hierarchies (see Wheatley 1972: 617) and urbanization is explained as economically adaptive behavior.

Urban-rural relations, in particular, are construed as inherently symbiotic *adaptive* responses to the economic pressures of growth and differentiation. The inspiration of this concept is found in Weber's (1958) argument that the advent of urbanized society in Europe represented a new social and economic equilibrium. This emphasis on equilibrium underlies archaeological analyses that treat human behavior as "the dynamics of adaptation" (Binford 1972: 264; see discussion in Kohl 1981: 97).

Recent interpretations of states as political and economic decision-making systems clearly exemplify this adaptationist approach as it is applied to early urbanism as well. These studies hold that economic and political systems adapt to growth by becoming more complex, particularly through the proliferation of "hierarchically specialized levels of administration" (Adams 1984: 85). Societies with "specialized decision-making organizations" are contrasted with those societies in which internal relations "are mediated only by a generalized decision-maker" or "are exclusively self-regulating" (H. T. Wright 1977: 220-221). Institutionalized hierarchical authority, in particular, is portrayed as a systemic adaptation to the administrative pressures of growth: increased information load and increased decision-making demands (Johnson 1973: 160-161).

In general terms, the elaboration of decision-making hierarchies is expected to increase the efficiency, and reduce the costs, of administering the communication and exchange networks that bind stratified societies together. Adaptive decisions encouraging "efficiency maximization" are required, and expected, for the continued coordination and integration of increasingly complex systems (Johnson 1978: 87). This expectation is very much in keeping with Christaller's "marketing principle" which holds that settlements develop in an economic structure that allows for the most efficient performance of work (Johnson 1972: 769). For example, this principle has been reformulated in archaeological assumptions that efficient information flow (at or near "channel capacity") enables efficient decision-making, which, in turn, determines the optimal structure of political and economic hierarchies (Johnson 1972: 770).

An adaptationist perspective holds that collapse results from poor performance within an otherwise adaptive structure. Systems that are not maximally efficient endure marked increases in workload and may eventually collapse, for example through "degraded decision performance" (Johnson 1982: 398; 1978: 98). The possibility of structural maladaptation is accommodated only as the result of excessive adaptive growth, not by virtue of the fragile heterogeneity of social complexity. From the adaptive perspective, the excessive expansion of bureaucracy (Redman 1978b: 343-344), or the development of "hypercoherent" hierarchical decision-making (Flannery 1972), ultimately is seen as the product of "too much of a good thing:" too much growth, differentiation, and integration.

The view that increased social complexity is adaptive, when applied over the long term, holds that any trajectory of change (for example, involving urbanization) is a succession of stable states punctuated by short-term decisions in favor of newly-adaptive stable states (e.g., Redman 1978b: 334, 342). These are necessitated only during atypical external disruptions of adaptive equilibrium (see discussions in Kohl 1981: 95; Yoffee 1979: 23). For example, on the basic level of subsistence, this approach suggests that circumstances of ecology and agricultural technology will determine "an optimal size to which individual cities may grow and still be able to feed themselves" (Trigger 1972: 580; 592). Further urban growth upsets this "optimal" equilibrium, prompting urban dependence on rural communities for subsistence needs. A newly-adaptive equilibrium will be adopted in which urban-rural symbiosis permits the survival of economically dependent cities and their continued ability to grow. Because diversified cities encourage maximum economic efficiency, continued growth will concentrate population and economic activities in cities, which are expected to become manufacturing centers (Blouet 1972: 10-11).

The structure of rural settlement systems is also expected to be determined by a similar adaptive process. Lösch (1944) turned the attention of economic geographers to the countryside, but assumed that rural settlement was uniformly distributed around central places of greater economic importance. The adaptationist approach, as applied via economic geography (*e.g.*, Hudson 1969; Blouet 1972), proposes that agricultural settlements must compete for survival in the countryside, and that this competition molds rural settlement patterns. Hinterlands are caricatured as empty niches that become "colonized" by rural settlement (Hudson 1969: 371; see also Redman 1978b: 337). Subsequent growth leads to population pressure and limited access to natural resources. Economic competition forces the elimination of smaller, less productive communities or their absorption by larger ones (Hudson 1969: 371; Blouet 1972: 7). This scenario is in keeping with Central Place perspectives in which smaller settlements are expected to decline in marketing importance because they do not offer a broad range of goods and services, and, therefore, cannot compete economically (Blouet 1972: 12; Johnson 1980: 246). Eventually, this hypothesized process is expected to cause a decrease in settlement density as the settlement/economic system approaches a "stable" urbanized pattern (Hudson 1969: 367).

The analysis of urbanism as adaptation is founded in an economic appreciation of the history of European urbanization. The historical growth of large, diversified urban centers from smaller settlements with more limited economic functions is assumed to provide a valid analogue for the development of ancient urbanized societies from non-urban ones. When viewed in an adaptive sense, ancient settlement systems are expected to have evolved by having "an increasingly high proportion of the population living within urban areas" (Blouet 1972: 11). Thus, the adaptationist approach implicitly suggests that modern economic ontogeny somehow recapitulates ancient settlement phylogeny. This analytical focus has fostered the urbanocentric misconception stated most succinctly by Spengler (1922 in Wheatley 1971) that "Weltgeschichte ist Stadtgeschichte." The investigation of ancient urbanized societies requires a critical reconsideration of this depiction of complex societies as organic adaptive entities. Recognition of the differing, and often conflicting, needs within urbanized society, is essential for appreciating the multitude of archaeological expressions of urbanism.

Reconsidering Urbanism as Adaptation

The archaeological perspectives discussed above emphasize long-term growth of societies and the resulting need for more effective, increasingly complex socio-political structure. It is the purpose of the following discussion to illustrate that this generalized conception is, in fact, predicated on the assumption that early urbanism was a functionally successful, optimal adaptive response to evolutionary stress. This functionalist mode of explanation depends on the inappropriate application of biological concepts of adaptation to the environment. The adaptationist approach to urbanism risks tautological difficulties in assuming urbanism to be adaptive, then attempting to explain urbanism by seeking the ways in which it was adaptive. The explanatory fallacy of this "progressive *ad hoc* optimization" (Lewontin 1979; Wenke 1981: 91) may be seen in two fundamental dimensions: it is assumed 1) that there *is* an optimal adaptive route to urbanism for any given situation, or for urbanism generally, and 2) that there *is* an optimal adaptive strategy that best serves the entire system under consideration. To avoid these normative expectations it is imperative to emphasize differing expressions of urbanism and social complexity. Ultimately we should consider "why urbanism appeared at all, and why it took such variable form" (Wenke 1981: 115).

Differing Adaptive Interests Within Urbanized Societies

It is particularly important to note that explanation of urbanism as an adaptive strategy risks the assumption that the policies of higher order authorities were beneficial for, or at least accommodated by the balance of society. Differentiation within society, the structural basis of social complexity, is not simply adaptive a priori. Furthermore, the immediate goal of social and economic systems, and their constituent subsystems, is not adaptation, but survival, and the means to survival are highly variable, or "inspecific", for different systems and subsystems (Rappaport 1977: 79). The variety of interests and means of survival within complex societies is a perennial source of internal conflict that institutionalized authority struggles to mediate for the perpetuation of the overall system (Yoffee 1979: 27).

"Adaptive" responses may vary considerably, such that the same behavior can be seen as adaptive or maladaptive depending on the context or the participants involved (Whyte 1977: 75; Rappaport 1977: 82-83). Therefore, in contrast to the adaptive perspective above, the varied and contradictory interests within stratified societies may be seen as the major driving force of social change (e.g., Diakonoff 1972). In systemic terms this argument holds that the constituent subsystems within socio-political hierarchies have such diverse interests that hierarchical behavior (*e.g.*, decision-making) cannot be assumed to enhance the maintenance and perpetuation of the overall system (Adams 1984: 89). Stability or equilibrium can be expected in complex social systems only in fleeting instances when a fragile balance is maintained between the needs of local autonomy and the demands of central authorities (Eisenstadt 1963; Yoffee 1979). With regard to urbanism in particular, it is important to consider cities as inherently divided and divisive, surrounded by "walls of inclusion as well as exclusion," with unavoidable tensions between and within urban institutions over access to resources and authority (Adams 1984: 112).

The essential concept of this discussion, differentiation, refers to "the unequal arrangement of goods and services within and among social groups" (Yoffee 1979: 28). Social and political differentiation within urbanized societies can be interpreted most pointedly as maldistributions of wealth and authority such that the interests of society were progressively subjugated to the self-interests of society's upper echelons (Diakonoff 1972).

The fundamental significance of variability within society is that the behaviors of various individuals and institutions must be viewed as adaptive only in a limited self-interested sense that is often counterproductive for the perpetuations of the social system as a whole. Ruling elites, for example, were primarily "adept at finding ways to rationalize their imposition of arbitrary authority in pursuit of their own self-interest" (Adams 1984: 88; see also Gilman 1981).

Institutionalized authority provided only mixed blessings (e.g., military protection and economic advantages vs. greater tax and corvee labor obligations) for commoners tied to cities "only under varying degrees of duress" (Adams 1972a: 743; 1974: 8; Diakonoff 1975: 123-124).

The self interest of institutionalized authorities inspired compensatory strategies at the lower end of the social hierarchy that illustrate the conflicting needs within stratified society. For example, increased pastoralism was adaptive for rural populations, but disintegrative for the political system as a whole, for the same reason: non-sedentary populations are more difficult for the authorities to control and tax (Adams 1974: 3). In fundamental marketing terms, the conflict inherent in social heterogeneity is illustrated further by the contradictory interests of consumers, who desire multiple producers and low prices, and suppliers, who strive for minimal competition and high prices (Wallerstein 1976: 348).

Just as the interests of different socio-economic strata are often opposing, the interests of various cities, and of cities and their rural neighbors may conflict fundamentally. For example, Hoselitz's (1955) unorthodox view of historic urbanism emphasizes the diametric influences of "generative" vs. "parasitic" cities. Generative cities foster regional economic growth, as expected by the adaptationist approach to urbanism. On the other hand, the economic demands of parasitic cities (e.g., colonial administrative centers) are dictated by the needs of larger economic or political systems (e.g., colonial empires). Therefore, parasitic cities sap regional growth through the "excessive depletion of natural resources, and the exploitation of peasants and other primary producers" (Hoselitz 1955: 280).

This contradictory tension was reflected similarly in ancient urbanized society by the distinct and separate interests of city and countryside ("die Scheidung von Stadt und Land," Marx 1968: 373). Villages "were at all times at risk of being more or less forcibly incorporated into larger [urban] estates and otherwise losing their corporate character" (Adams 1982: 11; see also Diakonoff 1975: 127). If these separate interests were not balanced then disintegration was the likely result (Yoffee 1979: 21). The implication of this anti-adaptationist approach is that the most provocative archaeological challenge "is to reconstruct the conflicting needs and strategies of groups within complex societies," rather than assuming "that society as a whole was passively adapting to its environment and/or technological base" (Kohl 1981: 109).

"Stability" and "Resilience"

This counterintuitive view of urbanism is formulated most systematically in Adams's interpretation of the oscillations of urbanization and deurbanization in ancient Mesopotamia and his discussion of "stability" and "resilience" (see especially Adams 1978). Adams emphasizes the inherent uncertainty of agriculture in the Tigris-Euphrates Basin as the basis for understanding the fluctuations of ancient Mesopotamian urbanism. In this context, "stable" economic strategies encourage optimizing behavior through the intensive, maximizing use of resources, as might be anticipated from an adaptationist perspective. Stable systems are expected to endure temporary disturbances and subsequently return to a maximizing equilibrium.

Maximizing strategies provide short-term optimization and equilibrium, through agricultural intensification and urbanization, for example (Adams 1978). Over the short term, "Mesopotamian cities can be viewed as an adaptation to [the] perennial problem of periodic unpredictable shortages" (Adams 1981: 243-244). However, maximizing strategies do not allow for substantial readjustments in the face of chronic stresses on subsistence, like those endemic to Mesopotamia. The significance of this point rests on the proposition that social organization and hierarchical behavior are inspired by the desire for survival, rather than adaptation.

Adams argues convincingly that the probability of survival, particularly over the long term, is enhanced for economic systems that are "resilient" in the face of fluctuations, and are not based on maximizing adaptive strategies. Contrary to adaptationist assumptions of equilibrium, resilient systems "adapt qualitatively as well as quantitatively to profound, unexpected, continuing perturbations (Adams 1978: 329). Therefore, "extensive, periodically shifting agriculture with a large component of husbandry is and has always been the system best adapted to Mesopotamian conditions" (Adams 1974: 5). Given its decreased resilience, pronounced urbanization cannot be viewed as necessarily desirable (Clarke 1979: 440; Adams 1984: 110-112). Near Eastern cities, both ancient and modern, must be considered inherently unstable, socio-economically "artificial" structures that must be explained as one limited, but conspicuous, aspect of highly diversified urbanized societies (Adams 1969: 188-190; 1972a: 743; Clarke 1979: 438-439). The larger cross-cultural ramifications of this essential point may be illustrated by returning to the basic concepts of adaptation and social evolution.

Reconsidering Urbanization as Social Evolution

Archaeological emphasis on processes of growth and increased complexity risk the implicit acceptance of the doctrine of social progress, which originally spurred materialism and social evolutionary thought in the nineteenth century (see discussions in Kohl 1981; Clarke 1979). The argument that more complex social systems supersede less complex ones assumes an inappropriate directional focus if we overlook the theoretical fundamental that evolution, be it biological or social, is not a progressive process toward an ultimate end.

The prevalence of the adaptive perspective, and gradualistic theory emphasizing smooth growth trajectories, have rendered archaeology susceptible to a fundamental teleological bias in its investigation of ancient urbanism. This bias may be seen in a pervasive "developmentalism" that assumes all societies have developed, and continue to develop, over time (Wallerstein 1976). In this manner, evolutionary theory may be misappropriated in the study of urbanism by assuming that the prehistory of urbanism is directional and progressive.

Urbanized societies, when conceived as economically adaptive systems, are expected to develop toward a "preferred state" (see discussion in Whyte 1977: 74). Wheatley (1972: 605) notes the common assumption that urbanization is the expected form of systemic growth precisely because it provides an "adaptive" means to the presumably preferred state of continued growth and differentiation. Thus, urbanism in antiquity can be viewed erroneously as an inevitable and progressive approximation of historical urbanism (see discussion in Adams 1966: 10; Clarke 1979: 435). The most fundamental explanatory dilemma can, too easily, be trivialized to the question of merely why many societies resisted this development (Wallerstein 1976: 344). To avoid this teleology, archaeology can accept the more provocative challenge that explanatory models for modern urbanism may be inapplicable to ancient society, and that ancient urban forms represent "largely extinct patterns of activity" to be explained on their own terms (Clarke 1979: 435). Toward this end archaeology must consider alternative models of early urbanism not based on homeostatic adaptation, and without assuming or predicting a normal trajectory of development (see discussion in Yoffee 1979: 26).

The most obvious corollary to implicit developmentalism is that episodes of collapse (e.g., of urbanism) violate expected long-term equilibrium, and therefore are the phenomena in greatest need of explanation. As a case in point, the rich, but distinctly urbanocentric, documentary evidence from Mesopotamia has promoted the assumption that dynastic continuity and substantial urbanism were normal. To borrow Adams' phraseology (1978: 333), even if urbanism is recognized as an oscillating phenomenon, archaeological explanatory attention has focused overwhelmingly on the "troughs" of resilience and apparent collapse, while the "peaks" of maximizing consolidation have been taken for granted.

One means of escaping the teleological trap may be found in the venerable cross-cultural comparative approach to anthropological analysis. Comparative analysis was essential to diffusionist attempts to identify the origins of cities exemplified by Childe (1950). Building on Childe's approach, while avoiding its diffusionist and trait-listing pitfalls, Fried (1967) and Service (1975) formally defined "pristine" (or "primary") and "secondary" social evolutionary developments. Pristine social forms represented "the first manifestation of a new development among adjacent societies," and arose exclusively from indigenous factors (Service 1975: 20).

Secondary situations, on the other hand, are "set in motion not by indigenous forces but to some extent by pressures released by outside influences, specifically from other societies which had already developed more advanced patterns of economic organization, stratification, and government" (Fried 1967: 198). The important point in this line of thought is the emphasis on variability, specifically on the distinction between "voluntary states and externally imposed or inspired ones" (Adams 1966: 21).

The distinction of primary and secondary cases of urbanism provides a generalizing cross-cultural means of emphasizing variability in urbanized social structures. However, even this basic insight may be squandered if urbanism is assumed to be a unilineal evolutionary product that found variable expression simply by virtue of differing historical or (ecological) circumstances. This normalizing assumption risks the neo-diffusionist misapprehension that secondary instances of urbanism were simply derivative or scaled-down versions of earlier pristine forms (see Trigger 1972: 575; Renfrew 1984: 114).

The greatest danger of developmentalism is that it encourages unilineal evolutionary explanation of urbanism. Childe's "urban revolution" terminology emphasizes the growth of cities as the core of civilization, potentially giving rise to "an implicit, and therefore dangerous, assumption of the unity of all urban phenomena" (Adams 1966: 10). While the historical retrospectives of Childe and Weber did not propose a generic form of urbanism, their formulations provide much of the implicit foundation for normative explanations of urbanization as nucleation (e.g. see Service 1975: 281). One body of implicitly unilineal theory in this tradition seeks to explain urbanization using a kind of demographic determinism in which population pressure and subsequent limited access to natural resources are invoked as systemic stresses to which urbanization is an evolutionary response (e.g., Young 1972; Athens 1977; Redman 1978b; but cf., Cowgill 1975; Hassan 1978). Despite explicit arguments that urbanism is not the same in all places, at all times (e.g., Wheatley 1972: 601; Adams 1972a: 738-739), emphasis on the fundamental similarities of various early urbanized societies has produced an implicitly normalizing perspective, rather than a generalizing one.

Archaeological analysis of urbanism has concentrated on pristine case studies (e.g., Adams 1966; H. T. Wright and Johnson 1975). Citing the absence of appropriate historically or ethnographically observable cases, Fried finds it ironic that studies of civilization and urbanization concentrate on pristine situations, to the exclusion of more readily accessible secondary developments (1967: 242). The unilineal and teleological pitfalls of explaining early urbanism can be avoided most readily by contrasting fundamentally different cases (e.g., Flannery and Marcus 1983).

As discussed earlier, archaeological analyses also tend to neglect the diversity of components and interests in urbanized society and settlement. Consistently urbanocentric historical data concentrate attention on cities themselves as the epitome of urbanism. However, cities can be understood only as they are related to, but differentiated from, their hinterlands (Adams 1966: 18). Given the urban bias of excavated evidence from southwestern Asia, it is particularly important to distinguish the varied interests of rural populations "on whom the whole urban edifice of power, privilege, tradition, and ceremony ultimately depended" (Adams 1978: 333). Therefore, it may be most productive in the future to focus on differences, rather than similarities, between the varying manifestations of urbanism, ruralism and social complexity.

Summary

Urbanism has been analyzed most commonly as an adaptive evolutionary response to growth. Cities are seen as diversified, rural villages as comparatively homogeneous. The degree of this urban-rural distinction, and the resulting complexity of an ancient society ultimately are seen as functions of scale. The activities performed by big cities, past and present, are assumed necessary to hold complex societies together.

In rebuttal, this chapter argues the need to emphasize variability and thereby avoid normative interpretations of urbanism. Adaptation, as currently applied, is an inappropriate interpretive concept for this purpose because it too commonly obscures the varying, often conflicting, interests within complex societies. Further, while it is necessary to consider how cities influence settlement and behavior, it is equally important to investigate what elements of complex societies were "resilient," and how these aspects of complexity survived perturbation. Finally, we must recognize that some expressions of ancient complexity did not conform to modern analogues of urbanism.

Thus, the superficially comparable, but structurally distinct, archaeological records for early cities and urbanism in Mesopotamia and the southern Levant are contrasted in this dissertation. Mesopotamia exemplifies a region of characteristically urban-based development from which archaeologists in the southern Levant have drawn inappropriate parallels. By emphasizing its very different development of cities and villages, and manifestations of rural complexity, the rural heartland of Bronze Age society in the southern Levant may be illuminated.

CHAPTER 2:
ARCHAEOLOGICAL INFERENCE OF URBAN AND RURAL SETTLEMENT

The discussion in chapter 1 maintains that urbanism is a form of social organization in which particularly large communities are economically differentiated from, but incorporated with, smaller communities. Therefore, while cities may be the pre-eminent settlements in urbanized societies, they do not embody urbanism independently. As David Clarke argued (1979: 438) "urbanization is the emergence of site systems with urban elements and we must study and classify the development process of these systems as a whole and not just their most conspicuous urban nuclei." Thus, contra Spengler, the study of urbanism cannot simply be reduced to the study of cities. Cities cannot be analyzed apart from their relationship to the countryside. Therefore, insights on ancient urbanism require an understanding of ancient ruralism.

From this perspective, archaeological analyses of ancient urbanism must be able to identify "urban" sites, segregate them from "rural" sites, and specify some aspect of their urban-rural interrelations. In practice, urbanized and non-urbanized settlement patterns have been distinguished archaeologically using unjustified thresholds of urban site size or relativistic measures of site size hierarchies (see discussion below). The economic characteristics that qualify settlements of a certain size as "urban," or settlement systems of a certain complexity as "urbanized," are largely unspecified.

This chapter proposes that ancient urban and rural communities can be defined and segregated by a measure of their ability (or lack thereof) to provide for their own agricultural subsistence. Urban settlements, as defined here, are too large to be agriculturally self-sufficient. This definition denotes certain economic interrelations (*i.e.*, the agricultural dependence of urban settlements on rural settlements) as the basis for analyzing *systems* of urban and rural settlement.

Systemic perspectives on early urbanism are particularly appropriate for southwestern Asia, where large mounded *tell* sites dominate the archaeological landscape. The documentary and excavated data from which we infer the structure of ancient urbanism in this region are drawn overwhelmingly from these *tells* and the ancient towns and cities they represent. This chapter provides definitions of both urban and *rural* site size categories, with which this urbanocentrism can be tempered. These definitions, which caution against identifying any relatively large site as a "city", are applied in chapters 3 and 4 to the archaeological records of Mesopotamia and the southern Levant. With equal attention to both urban and rural settlement, these chapters illustrate basic contrasts in the appearance and development of early urbanism in these regions.

Misidentifying Urbanism: Settlement Hierarchies and Arbitrary Thresholds

Regional analyses in archaeology generally assume that patterns of settlement are, in some sense, a material reflection of the social, economic, and/or political systems of their inhabitants, and that the structure of these systems can be inferred from mathematical descriptions of settlement patterns. An operational dilemma arises from these assumptions: how can even the most basic characteristics of social complexity (e.g., hierarchical organization) be inferred from settlement characteristics measurable on survey (e.g., site size)?

In the case of urbanized societies, differing community sizes are expected to reflect differences in the economic or political functions performed by their inhabitants (Johnson 1972: 770; 1980a: 239). On a regional scale, hierarchical structure is inferred most commonly from discontinuous site size distributions. Specifically, modal settlement sizes are assumed to reflect hierarchical strata in the economic or political system under study (e.g., Renfrew 1984: 56-57).

In this tradition Wright and Johnson argue that ancient "states" are manifested in settlement hierarchies with three or more decision-making tiers (H. T. Wright and Johnson 1975: 267; H. T. Wright 1977: 220-222). When applied uncritically, this definition fosters the doctrinaire assumption that "the number of hierarchical levels are [sic] the basic structural criterion for understanding the development of complex societies" (Cordy 1983). This approach provides a relative measure of social complexity that can be applied anywhere, but which illuminates little. It is assumed that any n-tiered settlement hierarchy is equivalent to any other n-tiered hierarchy, regardless of the range of settlement sizes represented. Thus, the Micronesian island of Kosrae with a total population of 3000-7000 (ca. A.D. 1400) can be classified misleadingly as a "state" (Cordy 1983; Cordy and Ueki 1983) and compared, for example, to ancient Mesopotamia, which had numerous cities with tens of thousands of inhabitants, without regard to differences in political systems, or even "decision-making" relationships within or between hierarchical strata.

Relative measures render "the state" a uniform, essentially taxonomic, concept. Subsequently, the analysis of social complexity becomes simply an exercise in classification (e.g., Isbell and Schreiber 1978) based on the enumeration of hierarchical site size classes. Other indications of social complexity (or simplicity) are subordinated. This approach permits Cordy to hypothesize prehistoric states in Micronesia (Kosrae) and Polynesia (Hawaii, Tonga, Tahiti, Samoa) despite abundant contradictory evidence for "non-complexity:" undifferentiated access to resources, non-intensive agriculture, dispersed non-urban settlement, and kin-based social and political organization (1981: 35, 182; 1983; Cordy and Ueki 1983). The largest settlement noted, on the island of Leluh in Kosrae's northeastern bay, had a maximum population of only 1500 with a very sparse density of 18-25 persons per hectare (Cordy and Ueki 1983; cf. discussions of urban site sizes and densities below).

Similar difficulties plague the definition of "urban" vs. "rural" communities based on settlement hierarchies. The sizes at which these sites are segregated can vary considerably between regions. For example, in Mesopotamia, Early Uruk period "large centers" are defined as greater than 9.5 hectares in the Susiana survey area (Johnson 1973: 79, fig. 10), but larger than 12 hectares in the Warka survey area (Johnson 1980: 240-241). Similarly, settlement hierarchies may change through time, and entire size classes may appear and disappear, as site size distributions change. Johnson's Susiana survey (1973: fig. 10) again provides illustrations. The lower size limit for large centers decreases from 9.5 to 8 hectares in the Middle Uruk data, and to 6 hectares in Late Uruk. The size class "large villages," absent in Early Uruk, appears as a new mode in the distribution of Middle Uruk site sizes. Subsequently, in the Late Uruk period, this size class disappears altogether from the settlement hierarchy.

Hierarchical measures of urbanism are assumed to be insightful because they can be applied to settlement systems of different scales. However, they can be equally illusory because they gloss over those differences of scale that may be important. Indeed, if the very essence of urbanized society is simply political and economic differentiation, the identification of an urban threshold of size or complexity may prove a very quixotic task. Nonetheless, if urbanism <u>is</u> a product of population growth, settlements must, at some point, cross a size threshold beyond which they can be considered urban.

Few attempts have been made to infer a critical size above which a settlement might be considered "urban," or below which it can be dubbed "rural." Arbitrary size definitions are exemplified by Adams's (1981: 75) intuitive urban/rural "bifurcation" "in the neighborhood of 10 hectares" for Mesopotamia's Uruk Period and Pfeiffer's (1977: 157) "rough index of an urban center" at the "125-or-more-acre [approx. 50 hectares] level." Using a large cross-cultural database, Fletcher (1977: 106, fig. 4.1; 1981: 15, 19) identifies the threshold (termed an "area front") separating non-industrial "small-scale agricultural settlements" and "agricultural urban settlements" between approximately

100 and 300 acres [40-120 hectares.]

All of these definitions of urbanism, whether based on settlement hierarchies or arbitrary size thresholds, share a pair of basic flaws. First, the characteristics that make a settlement "urban" are not specified. Urban places are simply larger than rural places. Fletcher's urban "area front" is not arbitrary, but exemplifies this problem well. A size threshold between settlements previously classified as "urban" or "rural" is described, but not explained. This threshold is, in some unquantified manner, indicative of the increased communication costs and noise that result from population growth (Fletcher 1977: 116). However, the significance of an area front of approximately 80 hectares, as opposed to 8 or 800 hectares, is never discussed.

Secondly, uniform size thresholds and relative hierarchical measures are inappropriate for cross-cultural comparisons, because both approaches implicitly neglect potentially significant differences in social and natural environments. The result, in either case, is uncritical and excessive generalization. As noted above, a three-tier settlement hierarchy qualifies as a "state" regardless of setting, scale, or other contradictory evidence. Similarly, Fletcher (1977: 118) exemplifies an extreme universalist perspective in which all settlement data, whether from !Kung campsites or modern Hong Kong, are assumed to be comparable and, for example, equally illustrative of the "planet-wide" ceiling for human population density. These approaches ultimately fail because they are indiscriminate. Uniform thresholds are inflexible, and relative measures are rendered meaningless by their universal application.

Redefining Urbanism Based on Agricultural Subsistence

In practice, urban size thresholds, even those on a less metaphysical plane, remain largely uninvestigated. Thus, the task of empirically defining urbanized settlement systems has been abdicated to the relative analysis of settlement hierarchies. The following comparative analysis of ancient urbanism redresses the lack of explicit definition that characterizes these relative studies, and proposes alternative urban size "thresholds" and rural size "ceilings" for ancient settlements in southwestern Asia.

This approach returns to the fundamental appreciation of urbanism as differentiated social organization, and urbanized settlement systems, therefore, as differentiated and interdependent. As originally argued by Childe and Weber (see discussion in Chapter 1), economic interdependence is necessitated when some communities expand beyond their ability to be self-sustaining. Therefore, in response to the previously-stated dilemma of inferring social relations from archaeological survey data, working definitions of urban and rural are proposed.

"Urban" settlements are defined as those whose populations exceed the bounds of agricultural self-sufficiency. Conversely, the populations of "rural" settlements are agriculturally self-sufficient. These definitions directly address the agrarian basis of the economic differentiation and interdependence between settlements that characterized early urbanized societies. Different ceilings and thresholds are tailored for regions of rainfed agriculture (e.g., the southern Levant), and for regions in which irrigation was predominant (e.g., lower Mesopotamia). The following discussion does not attempt to specify the agricultural potential of any given site or survey region. Rather, it provides generalized regional assessments of agriculture and settlement with which settlement patterns in ancient Mesopotamia and the southern Levant may be compared.

Agricultural Sustaining Areas

A basic constraint on the economic independence of ancient, as well as modern, communities is the ability of their inhabitants to feed themselves. Subsistence agriculture occurs primarily in community "sustaining areas" (i.e., in the arable lands immediately surrounding each settlement). This discussion considers the size at which a community population exceeds the agricultural base of its sustaining area, and requires the aid of subsidiary villages to meet its subsistence needs. In other words, at what size is a settlement "urban" and, by virtue of that size, part of an interdependent urbanized settlement system?

One related approach to subsistence, falling under the rubric of "site catchment analysis," has been applied, with limited success, to archaeological case studies of pre-agricultural and agricultural settlements (see review in Roper 1979). These analyses estimate the maximum number of inhabitants at any given site from assessments of the resources available, and the economic activities performed, in the "catchment" surrounding that site. Such estimations (e.g., Vita-Finza and Higgs 1970; Rossman 1976) implicitly utilize the all-encompassing biological concept of "carrying capacity," and can easily exceed the more modest intent of locational models in the tradition of von Thünen (1826), simply to describe the spatial organization of subsistence behavior (Sallade and Braun 1982: 19). Noting the difficulties in archaeological applications of carrying capacity, Kramer (1980: 328; 1982: 190) argues that ethnographic data on agricultural sustaining areas can be used effectively for more limited purposes (see also Glassow 1978: 36-40; Hassan 1978: 73-74). The broader difficulties inherent in the concept and measurement of carrying capacity can be avoided by simply questioning "the extent to which growth in [early] administrative centers ... might have necessitated an increased reliance on surplus produced by surrounding villages" (Kramer 1982: 241 citing Johnson n.d.).

This inquiry proceeds conversely to site catchment analysis by first estimating the population at a given site, then calculating the agricultural hectarage necessary to support that population, and finally considering whether that hectarage can be accommodated within a reasonably accessible agricultural sustaining area. The modest goal is simply to estimate the settlement size range denoted by the definition of urban sites proposed here.

Sustaining areas can be estimated according to the equation:

$$s = K p,$$

where (s) is a site's sustaining area, (p) is the site's population, and (K) is a constant, in this case the area of arable land required for agricultural subsistence per capita (cf., Renfrew 1984: 90; Hassan 1978: 66-67). Following the descriptive concept of von Thünen, agricultural behavior is measured in an idealized circular sustaining area surrounding a settlement. This sustaining area can expand until its radius approaches the maximum distance farmers are willing to travel to their fields (Kramer 1982: 246).

This approach follows the fundamental assumption of village ethnoarchaeology that modern "traditional" communities provide the best available demographic and economic analogues to the villages and towns of antiquity. Calculation of sustaining areas for ancient urban and rural settlements is particularly reliant on ethnographic data drawn from agricultural villages in southwestern Asia. Ethnographic documentary evidence illuminates three characteristics needed to calculate the populations and sustaining areas of ancient communities: population density, agricultural land required per capita, and maximum agricultural commuting distance.

Archaeological Population Estimates

Village ethnographies suggest that measurements of storage space, roofed dwelling space, and the number of domestic compounds correlate most closely with settlement population size (Kramer 1980: 330; 1982: 157). Household composition of 5 to 6 persons is strikingly consistent in ethnographic literature on southwestern Asia (see Table 1). Unfortunately, this household population figure is applicable archaeologically only to sites that reveal architectural remains at the surface, or through extensive excavation. Therefore, demographic

Table 1. Ethnographic population density coefficients based on mean household size.

Pop./ Hshld.	Study Area	References
4.4	village of Hasanabad, Kurdistan, Iran (1959-60)	Watson 1978: 132
4.4	"old" city of Acre, Israel	Kesten 1962 Shiloh 1980: 26
4.67	village of Yassih yuk, Turkey	Watson 1978: 137
5.0	Sudan, national average (1955-56)	Farrag 1963 Gulick 1969: Table 1
5.0-5.5	Palestine, regional average, British Mandate period	Grannott 1952: 188
5.2	922 villages in Kangavar Area, Iran (1975)	Kramer 1982: Table 5.1
5.5	13 Lebanese villages	Churchill 1954 Gulick 1969: Table 1
5.5	village of Asvan, Turkey (1970)	Hillman 1973b: 228
5.65	Iraq, national average (1957)	Madfai 1963 Gulick 1969: Table 1
5.8	2 Turkish villages	Stirling 1966 Gulick 1969: Table 1
5.9-7.6	villages in Hilla-Diwaniya Area, Iraq (1957-59)	Poyck 1962: 35
6.0	Lebanese village	Gulick 1955 Gulick 1969: Table 1
6.1	5 villages in Ramle and Lydda districts, Palestine (1944)	Grannott 1952: 200

Table 1. (Continued)

Pop./ Hshld.	Study Area	References
6.6	8 Lebanese villages	Gorton *et al.* 1953 Gulick 1969: Table 1
7.6	village of Kufr al-Ma, Ajlun district, Jordan (1959-60, 1965-67)	Antoun 1972 Kramer 1980: 323

inferences from the archaeological surveys of southwestern Asia generally rely on site area as a measure of ancient population size.

Most commonly, site area (a) is multiplied by a simple fixed coefficient of mean population per unit area (k) to produce a population estimate (p) for any given site:

$$p = k\ a.$$

The use of a fixed coefficient follows the assumption that "site area and population covary in direct proportion" (Adams and Nissen 1972: 28-30).

Unlike the consistency of village household sizes, ethnographic and historic correlations of population and settlement size vary widely from less than 100 to more than 1000 inhabitants per hectare (see Table 2). Population densities of greater than 250 per hectare are reported for the "old" quarters of large, modern cities, while ethnographic village studies suggest sparser densities. The resulting archaeological dilemma is two-fold: 1) can we reduce the wide range of suggested densities for the sake of operational expediency, without 2) excessively homogenizing variable population densities and the structural implications of that variability? Critical review of the data in Table 2 suggests that this dilemma can be resolved sufficiently for the purposes of estimating sustaining areas.

Archaeologically Appropriate Density Coefficients

We may begin by reconsidering population densities reported at both extremes. Spooner (1977) reports very low population densities for 13 villages on the fringe of the arid, high elevation Tauran Plain,

Table 2. Ethnographic and archaeological population density coefficients based on site size. (one hectare = 10,000 square meters)

Pop. /Ha.	Study Area	References
56	13 villages on Tauran Plain, Iran	Spooner 1977 Kramer 1980: 324
80-86	village of Hasanabad, Iran (1959-60)	Watson 1978: 132
96	27 towns and cities, Zagros area, Iran and Iraq (1966 census)	Kramer 1982: Table 5.6
97	40 villages in Aliabad Area, Iran (1975)	Kramer 1982: 158
107	30 villages in Kangavar Area, Iran (1975)	Kramer 1980: 324
125	Marsh Arabs, Iraq; also secondary citation of Gremliza (1962)	Adams and Nissen 1972: 28-30 Adams 1982: 69
147	110 villages, Marv Dasht, Iran (1965-66) (cartographic and census data)	Sumner 1972; 1979: 165 Kramer 1980: 324
150-200	Iron Age Jerusalem	Stager 1975: 242-244 Shiloh 1980: 26-27
158	19 towns and cities, Zagros area, (cartographic data) (1966)	Kramer 1982: Table 5.6
159-267	secondary citation of Gremliza (1962)	Wenke 1975-76 Kramer 1982: 264
181	village of Kufr al-Ma, Ajlun District, Jordan (1959-60, 1965-67)	Antoun 1972 Kramer 1980: 323
200	secondary citation of Gremliza (1962)	Kramer 1980: 324 Johnson 1980: 239
200	Iranian towns and villages in Susiana (223/ha.) and in Kuran Basin (137/ha.) 216/ha. in "old" Baghdad, Iraq	Adams 1965: 41 Wright 1969: 22, 39 Hassan 1981: 66

Table 2. (Continued)

Pop. /Ha.	Study Area	References
200-250	Early Bronze Age Arad, Israel	Marfoe 1980: 320
231	53 villages in Dez River area, Khuzistan, Iran	Gremliza 1962 Adams and Nissen 1972: 29 Broshi and Gophna 1986: 73
250	secondary citations of Gremliza (1962), Shiloh (1980), Marfoe (1980)	Broshi and Gophna 1984: 42; 1986: 74
250-292	Iron Age Beit Mirsim, Far[c]ah (N), Masos, recalculated at 5/household	see discussion in Chapter 2
281	"old" Acre recalculated using total city area	see discussion in Chapter 2
286-302	village of Marib, N. Yemen (cartographic data) (after 1962)	Van Beek 1982: 64-66
300	Bronze Age Aegean settlements	Renfrew 1972: 251, 394 Hassan 1978: 58
300-338	Iron Age Beit Mirsim, Far[c]ah (N), Masos, recalculated at 6/household	see discussion in Chapter 2
365	15 towns and cities, southern Iraq (ca. 1908)	Adams 1981: 350 Kramer 1982: Table 5.4
370-1140	Ancient Jerusalem, Palestine (changing through time) (water resource data)	Wilkinson 1974: 50 Shiloh 1980: 26-27
395	modern Damascus, Aleppo, Syria	Frankfort 1950 Hassan 1978: 58; 1981: 66
400-467	Iron Age Beit Mirsim, Far[c]ah (N), Masos, calculated at 8/household	Shiloh 1980: 29

Table 2. (Continued)

Pop. /Ha.	Study Area	References
400-500	"old" cities of Jerusalem, Acre, Damascus, Aleppo, Tripoli, Erbil; also secondary citation of Shiloh (1980)	Broshi 1975: 6; 1978; 1979: 1 Broshi and Gophna 1984: 41
494-526	modern Irbil, Iraq	Braidwood and Reed 1957: 29 Hassan 1978: 58; 1981: 66 Van Beek 1982: 65
503	"old" Acre, calculated using habitation space only	Shiloh 1980: 26
1000	Jerusalem, Roman period	Byatt 1973: 57 Shiloh 1980: 26

Iran. Near-desert conditions and a heavy emphasis on pastoralism (Kramer 1980: 324) result in a mean density coefficient substantially below coefficients reported from other ethnographically described farming villages in southwestern Asia.

At the other extreme, Shiloh's (1980: 26) suggestion of an "optimal" density of 400-500 persons per hectare "rarely exceeded" in antiquity merits special attention because of its common citation (Braidwood and Reed 1957: 29; Broshi 1979: 1; Broshi and Gophna 1984; 1986). This optimum is suspect in general terms because population densities at some maximum level (that Shiloh assumes is "optimal") are neither inevitable, nor necessarily adaptive (see discussion in Chapter 1), and in specific terms because Shiloh's density coefficients are calculated inappropriately.

Shiloh's calculations for the 25 hectare "old" city of Acre divide total population by 14 hectares of habitation space, thereby ignoring Acre's 11 hectares of "public" non-residential space (Kesten 1962; Shiloh 1980: 26). Recalculation of this density using Acre's _total site area_ (the measurement that would be available if Acre were a _tell_) produces a more justified, and greatly reduced, coefficient of 281 persons per hectare (see Table 2).

Shiloh's population estimates for three "provincial towns" in the southern Levant (Tell Beit Mirsim, Tell Far^cah [N], and Tell Masos) occupied during the Iron Age (_ca_. 1200-587 B.C.) are based on excavated exposures of houses from which the total number of households in each settlement is extrapolated. Site populations are calculated by multiplying the number of households by an arbitrary figure of eight members per household, despite abundant contradictory ethnographic evidence (see Table 1). In turn, these estimates are divided by the size of each site, producing density coefficients in the "optimal" range of 400-500 persons per hectare (Shiloh 1980: 29). Recalculations using 5 or 6 persons per household produce revised density coefficients of 250-338 persons per hectare (see Table 2). In sum, Shiloh's "optimal" urban densities provide an inflated and misleading demographic precedent for the archaeology of the southern Levant.

Aside from Shiloh's coefficients, population densities in excess of 250 persons per hectare are reported from approximately 20 modern communities, including large cities (Adams 1981: 350), and a small sample of "old" quarters in modern cities (Damascus, Aleppo, Tripoli, and Irbil). Extravagant guesses for ancient Jerusalem also have been offered (Wilkinson 1974: 50; Byatt 1973: 57).

A much broader array of ethnographic, cartographic, and census analyses considers more than 250 communities ranging in sizes more comparable to those of *tell* sites in southwestern Asia (see Table 3). This literature reports density coefficients generally under 250 persons per hectare that are more appropriate for archaeological application in this region. Sumner (1972; 1979), Watson (1978), and especially Kramer (*e.g.*, 1980; 1982), document village population densities ranging between approximately 100 and 150 persons per hectare. Gremliza's (1962) study of villages in the Dez River Pilot Area is cited frequently for density coefficients ranging from 125 persons per hectare (Adams and Nissen 1972; Adams 1981) to 250 persons

Table 3. Size characteristics of selected regional ethnographic studies.

Study Area	No. of Communities	Size Range (ha.)	Pop. Range	References
Dez River Area, Khuzistan, Iran	55	0.24-3.1	60-693	Gremliza 1962 Johnson 1980: fig. 2 Kramer 1982: Table 5.4
Aliabad Area, western Iran	41	0.5-13.7	38-1806	Kramer 1982: Table 5.2
Western Iran	185	0.2-200	n.a.	Schacht 1981a; Schacht 1981b: 130
South Central Iraq	15	14.5-372	1000-200,000	Adams 1981: 350 Kramer 1982: Table 5.4
Zagros Area, Iran and Iraq (1966 census)	27	100-2200	3918-187,930	Kramer 1982: Table 5.6
Zagros Area, Iran and Iraq (cartographic data)	19	22-1021	3918-187,930	Kramer 1982: Table 5.6

per hectare (Broshi and Gophna 1984; 1986). Kramer (1980: 322) notes that a fixed coefficient of 200 persons per hectare is used most commonly in settlement studies of ancient Mesopotamia (e.g., Adams 1965; H. T. Wright 1969; Johnson 1980). However, in light of several studies showing that settlement size and population density covary, fixed estimators are increasingly recognized as inadequate (e.g., Johnson 1972: 770; Hassan 1978: 59; Sumner 1979: 172), but remain in common use because they are expedient.

Variable Densities and their Structural Implications

Population densities may vary for several reasons, including settlement age (Sweet 1974: 48; Jacobs 1979: 188; Sumner 1979: 167; Kramer 1982: 168) and town walls that constrain architectural expansion (Wenke 1975-76; Jacobs 1979: 178; Sumner 1979: 167). Archaeological interpretations commonly expect that population density rises with increased settlement size (e.g., H. T. Wright 1969; Sumner 1979: 166-168; Broshi 1979: 1; Johnson 1980: 239; van Beek 1982: 66; Kramer 1982: 178-179). This demographic argument coincides with the assumption that larger community size signifies a greater concentration of economic and political functions. Modern town and city data compiled by Adams (1981: 350) and Kramer (1982: Table 5.6) seem to corroborate this assumption. However, it is significant that the sizes of these communities are comparable only to the largest tell sites of southwestern Asia.

Two ethnographic studies of smaller towns and villages (Gremliza 1962; Schacht 1981a) suggest that, at the lower end of the settlement spectrum, population density decreases as settlement size increases (also see Aurenche 1981). This relationship is described mathematically by a linear regression:

$$p = m + k a$$

in which (p) is site population, (k) is mean population per unit area, (a) is site area, and (m) is the expected population size as mean settlement area approaches zero.

Upon segregating Gremliza's data into three settlement size classes, Wenke (1975/1976: 75 ff.) notes that the largest size class has the lowest population density (159 persons per hectare), and the smallest size class has the highest density (267 persons per hectare). Johnson's analysis (1980: 239-240, fig. 2) describes this trend in Gremliza's (1962) data with the linear regression:

$$p = 57 + 146 a.$$

Schacht (1981a: 32-37; 1981b: 129-130) provides a study of 185 towns and villages in western Iran with similar mathematical results. Settlement area and population area correlated as follows:

$$p = 85 + 107.55 a.$$

These observations of higher population densities in smaller settlements are intriguing because they are unexpected, and may have implications for modern, and perhaps ancient, settlement systems. Sumner (1979) argues that the lower population densities of towns and cities reflect their proportionally larger public and non-residential areas. Johnson (1977: 495) notes more provocatively "that, in general, functional size per unit population seems to decrease in larger settlements" (see also Kramer 1980: 326). ("Functional size refers to the number of types of activities carried out in a settlement" [Johnson 1973: 15]). Therefore, the archaeological use of fixed population coefficients will tend to overestimate the populations of large settlements and the variety of economic and political functions attributed to their populations.

Variable densities expressed as linear regressions also imply that each value of (m) represents a hypothetical minimum population for a viable farming hamlet in its respective region. This concept is similarly reflected by the "rank-size cut point" (i.e., the site size at which a rank-size curve falls off rapidly), which hypothetically represents the minimum community size necessary for economic survival (Haggett 1965: 106; Johnson 1980: 253). These regression analyses suggest that traditional farming villages in western Iran require a minimum population on the order of 50-100 inhabitants (Schacht 1981b: 130; see the y-intercept for regression lines d. and e. in fig. 1). Traditional corporate land-tenure systems may determine the minimum population required for a viable farming village, resulting in a dearth of smaller single family farmsteads in modern southwestern Asia (see Gulick 1969: 123; and discussion below). Similar implications also may have applied to the ancient settlement landscape.

To return to the basic question of estimating populations, the data reviewed above suggest that the range of fixed or regression density coefficients to be applied in subsequent discussions should be bounded at approximately 100 and 250 persons per hectare.

Modern and Ancient Village Agriculture in Southwestern Asia

An operative assumption behind village ethnoarchaeology holds that "traditional" farming communities are informative modern analogues for ancient agricultural towns and villages. For the purposes of estimating ancient subsistence requirements and sustaining areas, the agricultural basis of this analogy must be specified further. Just as the previous discussion reviewed evidence for mean population densities, this discussion considers mean agricultural productivity. Toward this end regional differences that affect the comparability of various studies must be considered and controlled as well as possible.

"Traditional" farming regimes, as considered here, depend primarily on bovids and equids for traction, make little use of chemical fertilizers or mechanized equipment, and follow alternate year, or "niren," fallowing schedules, which have been virtually ubiquitous during the recent history of southwestern Asia (Grannott 1952: 215, 232; Poyck 1962: 18-19, 38; Clawson, Landsberg and Alexander 1971: 65; Antoun 1972: 6-13; Hillman 1973a: 217; 1973b: 226; Sweet 1974: 73-76; Watson 1978: 138; 1979: 293; Kramer 1982: 181). It is argued here that traditional farming is most appropriate as an analogue for ancient agricultural practices that similarly depended on simple plow technology and alternate year fallowing (see e.g., Jacobsen 1982: 67 on ancient fallowing).

This ethnographic analogy also concerns the community organization of subsistence agriculture in southwestern Asia. Until recently, village farming has been a collective enterprise, as reflected by traditional land tenure systems in which fields are worked in numerous small holdings. Garden and orchard plots immediately encircling a village (called *hawakir* by Palestinian Arabs) are cultivated intensively, and owned as private (*mulk*) property by individual families (Grannott 1952: 198-199; Lutfiyya 1966: 29; also see Zaccagnini 1979: 151 for ancient parallels). Most agricultural fields beyond the *hawakir* holdings were worked as *mesha^{c}a* (or *musha*, *masha^{c}*, *masha^{c}a*) land. *Mesha^{c}a* land is held jointly by the members of one family, among several families united in a *hamula*, or by the inhabitants of an entire village (Grannott 1952: 174; Poyck 1962: 27; Lutfiyya 1966: 104; Antoun 1972: 20; Sweet 1974: 48; Atran 1986). Families in a *hamula* have joint social and economic obligations and privileges (Grannott 1952: 217; Atran 1986). *Mesha^{c}a* land tenure exemplifies similar corporate organization in agriculture.

Parcels of *mesha^{c}a* land varied in quality (*e.g.*, according to soil type, topography, availability of water), and tended to be small and irregularly shaped (Grannott 1952: 202; Antoun 1972: 21-22). For example, the farmers of five "typical" Palestinian villages surveyed in 1944 worked more than 2500 parcels, of which almost 60% were 6000 square meters or smaller (Grannott 1952: 42, 175, Table 13). Under *mesha^{c}a* tenure these parcels were redistributed at regular intervals (Grannott 1952: 215; Poyck 1962: 27; Atran 1986), thereby equalizing long-term agricultural risks and opportunities among corporate landholders (Antoun 1972: 21; Kramer 1982: 35). Today, landholdings of village households usually include numerous small, non-contiguous parcels (Miller 1964; Hillman 1973a: 219; Watson 1979: 73-74), in some cases as vestiges of previous *mesha^c^a* land tenure (Antoun 1972: 20; Kramer 1982: 35).

Meshaᶜa land tenure was extremely pervasive in many parts of southwestern Asia. "Practically all land in Palestine and in Syria ... was held in *meshaᶜa* ownership" before the late nineteenth century (Grannott 1952: 174). Government programs under the Ottomans, beginning in 1860, and the British, legislated in 1933, attempted to convert corporate *meshaᶜa* holdings in Palestine to private property (Grannott 1952: 177, 193). These programs were intended to improve agricultural efficiency by consolidating the multitude of small plots. This immediate goal was realized, at the cost of reducing the agricultural "resilience" of rural populations. These reforms increased the number of landowners, reduced the amount of farmland available per family (Grannott 1952: 193-195, 201), and disintegrated many corporate safeguards against economic stress provided by the *meshaᶜa* system. By the end of the British Mandate, despite a century of concerted governmental coercion, almost half of the Arab villages in Palestine still officially held *meshaᶜa* lands (Grannott 1952: 178). These vestiges reflect the corporate character of village agriculture in its traditional form.

Palace archives from Ras Shamra, Syria (ancient Ugarit) dating to the fourteenth and thirteenth centuries B.C. suggest that the ancient Levantine landscape similarly was tilled by corporate agrarian villages. Both private and collective family ownership of farmlands are attested (Heltzer 1976: 84, 95), but the basic economic units of the Kingdom of Ugarit were approximately 200 villages with collective tax, military, and labor obligations to the crown (Heltzer 1976: 18-47). Within the limits of the Ugaritic textural evidence, the traditional corporate structure of modern village agriculture suggests one possible analogue for the ancient rural countryside.

Having established a basis for comparing modern and ancient farming and village organization, we can consider agricultural productivity and per capita sustaining areas.

Productivity of Rainfed Cereal Agriculture

Generally consistent productivity is reported for modern rainfed cultivation of wheat and barley in several regions of southwestern Asia. "Yield ratios" relating the volume of grain harvested to the volume of seed grain planted are best suited for regional comparisons of productivity. Average wheat yield ratios of 5:1 - 6:1 are reported ethnographically for the Kangavar and Hamadan areas of western Iran (Kramer 1982: 36; Lambton 1953: 365). Wheat and barley yield ratios in "good" years cluster between 10:1 and 15:1 over a broad region from Jordan (Antoun 1972: 8) to northern Syria (Sweet 1974: 74) and western Iran (Lambton 1953: 365; Watson 1979: 67, 292; Kramer 1982: 36).

Similar wheat and barley yield ratios are reflected in texts from ancient Nuzi (near modern Kirkuk, Iraq) dating to the fifteenth and fourteenth centuries B.C. Seeding and harvest rates are recorded for barley (še'u), emmer (kunāšu), wheat (kibtu; probably bread wheat or club wheat), and an additional unidentified cereal grain (gayātu) (Zaccagnini 1975: 184, 187, 190-192). Seeding rates are cited only for barley and emmer (see Table 4). Unfortunately, there are no apparent

Table 4. References to cereal grain seeding and yield rates at Nuzi, ca. 1500-1300 B.C. (Based on Zaccagnini 1975: 184, 187, 190-192.)

Cereal(s)	Seeding Rates		
	no. of refs.	mean in imēru/imēru	mean in liters/ha.
Barley	4	1.10	41.16
Emmer	1	1.00	37.42
Barley, Emmer Wheat, Gayātu (includes barley and emmer refs. above)	5	1.08	40.42

Cereal(s)	Harvest Rates		
	no. of refs.	mean in imēru/imēru	mean in liters/ha.
Barley	11	5.15	192.72
Emmer	10	5.81	217.42
Barley, Emmer Wheat, Gayātu (as above)	33	5.38	201.33

Cereal(s)	Yield Ratios mean in volume harvested:volume seeded
Barley	4.68:1
Emmer	5.81:1
Barley, Emmer Wheat, Gayātu (as above)	4.98:1

references to seeding and harvest rates for the same fields.

These texts also fail to specify which fields, if any, were irrigated (Zaccagnini 1975: 181-182). However, a collection of 79 land transactions/"inheritance contracts" (tuppi marūti) demonstrates the predominance of rainfed agriculture. Only 20 to 30% of the "hectarage" recorded in these texts was irrigated, or potentially irrigable (i.e., adjoining a water course) (Zaccagnini 1975: 211; 1979: 112-113). Indeed, the countryside surrounding modern Kirkuk remains the most important dry farming region in Iraq (Clawson, Landsberg and Alexander 1971: 18). Therefore, the documentary evidence from Nuzi is most pertinent to ancient rainfed agriculture in northern Mesopotamia, and in southwestern Asia generally.

The authors of the Nuzi agricultural texts used measures of grain volume in which one imēru consisted of ten sāti (singular form: sutu), and one sūtu was composed of eight or ten qa (see Hallock 1957: 204-206). One qa equaled 0.842 liters. Therefore, the imēru of 100 qa consisted of 84.20 liters, while that of 80 qa equaled 67.36 liters (see Zaccagnini 1975: 182). Field areas also were measured in imēru. Metric equivalents of 7,340 square meters (Meissner 1920: 358; Cross 1937: 12) and 18,000 square meters (Lewy 1938: 33-35) have been proposed.

In light of these ambiguities, Table 4 summarizes seeding and harvest rates from nine Nuzi texts as originally recorded in imēru, and in metric equivalents based on Zaccagnini's preference for the larger spatial imēru, and the 80 qa volumetric imēru, (see Zaccagnini 1975: 182, 193). These data show grain yield ratios of 5:1 to 6:1 very much in keeping with dry farming ratios reported ethnographically. On the basis of these similar yield ratios *per capita* sustaining areas for ancient dry farming are estimated on the basis of modern non-mechanized rainfed agriculture.

Per Capita Sustaining Areas: Rainfed Agriculture

A variety of ethnographic studies document farmland holdings (see Table 5) from which one can estimate *per capita* sustaining areas in traditional agricultural systems as described above. Subsistence requirements for modern village farmers are reported for cases of dry farming (Grannott 1952; Lutfiyya 1966; Watson 1978; 1979; Kramer 1980; 1982) and for regions with mixed irrigated and unirrigated agriculture (Poyck 1962; Gremliza 1962; 1967/68; Gremliza in Kramer 1982). Only the village of Baytin, on the West Bank of the Jordan, exemplified agricultural production below self-sufficiency (Lutfiyya 1966: 101).

Data on food consumption and dry farming productivity for the villages of Hasanabad and Aliabad, Iran suggest that, in favorable years, less than one hectare of arable land per person, half of which is fallow, can meet minimum subsistence requirements (Watson 1978: 138; 1979: 293; Kramer 1980: 328; 1982: 184, 191). However, a more reasonable, estimate of 1.5 hectares per person generally is cited for *mean* subsistence requirements (Allan 1972: 214; Kramer 1980: 330-331). Consistent data on productivity and subsistence landholdings suggest that this figure is appropriate for archaeological purposes in regions of ancient rainfed agriculture.

Table 5. Ethnographic examples of per capita village farmland holdings.

Ha./ Person	Database	References
0.4	village of Baytin, West Bank, Palestine	Lutfiyya 1966: 189
0.78	village of Kufr al-Ma, Ajlun district, Jordan (1959-60; 1965-67)	Antoun 1972 Kramer 1980: 323
<1.0	80 villages around Aliabad, Iran (1975)	Kramer 1982: 184
1.14	104 villages in Palestine (1930)	Grannott 1952: 66, 188
1.34	322 villages in Palestine (1936)	Grannott 1952: 41
1.4	village of Aliabad, Iran (1975)	Kramer 1980: 328; 1982: 181
1.4	28 villages in Dez River Area, Khuzistan, Iran	Gremliza (unpub.) cited in Kramer 1982: 189
1.53	villages in Hilla-Diwaniya Area, Iraq (1957-59)	Poyck 1962: Table 4.19 Kramer 1982: 189
1.7	55 villages in Dez River Area, Khuzistan, Iran after land reforms	Gremliza 1967/1968: 19 Kramer 1982: 189
1.9	55 villages in Dez River Area, Khuzistan, Iran before land reforms	Gremliza 1962: 39 Johnson 1973: 98 Kramer 1982: 189

Productivity of Irrigated Cereal Agriculture

Poyck reports average yield ratios in lowland Iraq, 8:1 for wheat and 6.5:1 for barley (1962: tables 4.7, 4.8), that only slightly exceed those cited above. In fact, on a national basis, present harvest rates in Iraq are inferior to those of countries in southwestern Asia that are more dependent on dry farming (see Table 6). These data inspire subsistence estimates for the irrigated agriculture of ancient lower Mesopotamia that are identical to, or only slightly different from, those for rainfed farming regions. Adams cites 1.5 hectares of arable land per person (Adams 1965: 41; Adams and Nissen 1972: 28, 29), while H. T. Wright uses 1.0 hectares per person (1969: 21) (see discussion in Kramer 1980: 328; 1982: 189).

However, excessive soil salinity in lowland Iraq, resulting from inadequate drainage of irrigated soils, impedes modern agriculture drastically (Clawson, Landsberg and Alexander 1971: 18, 37, 67). Clawson, Landsberg and Alexander (1971) expect much higher potential harvest rates throughout southwestern Asia if soil salinity is reduced and cultivation is intensified (e.g., by eliminating fallow, using chemical fertilizers, replacing irrigated barley with irrigated wheat, etc.) (see Table 6). Differences between national harvest rates expected under this standardized agricultural regime primarily indicate geographical differences in soil fertility. Table 6 shows that the potential harvest rate for irrigated wheat in Iraq is roughly 2.0 to 2.5 times that expected for rainfed wheat or barley in Iraq or elsewhere in southwestern Asia. This is a modern indication of the greater productivity that may have marked the irrigated lands of

Table 6. Cereal harvest rates in modern southwestern Asia. All figures are mean rates expressed in metric tons per hectare, ca. 1965. (After Clawson, Landsberg and Alexander 1971: tables 15-2 through 15-6.)

	Present Harvest Rate	Potential Harvest Rate
Iraq		
Wheat	0.48	
dry		2.7
irrig.		6.7
Barley	0.71	
dry		2.7
irrig.		-
Syria		
Wheat	0.90	2.8
Barley	0.90	2.6
Lebanon		
Wheat	1.00	3.4
Barley	1.20	3.2
Jordan		
Wheat	0.80	3.0
Barley	0.80	2.5
Israel		
Wheat	2.00	4.0
Barley	1.00	2.6

Mesopotamia in antiquity, despite indications of early salinization.

Numerous sporadic instances of salinization are documented in southern Babylonia by 2000 B.C. (Jacobsen 1982: 13). However, most agricultural records suggest yield ratios for irrigated lands that are much higher than those for modern or ancient dry farming. Agricultural reports and land leases from the Akkadian, Ur III and Old Babylonian periods provide modest samples of harvest rates and seeding rates for barley in lower Mesopotamia (see Table 7). When considered collectively, these data suggest yield ratios of 16:1 to 23:1. However, these references concern barley fields around several cities over a span of approximately 1000 years, and, as with the Nuzi texts, seeding and harvest data never pertain to the same fields.

This extraneous temporal and geographical variability is minimized by matching roughly contemporaneous seeding and harvest rates from the same city (see Table 8). A subset of data from Girsu and Sippar show barley yield ratios between 14:1 and 20:1. High harvest rates and low seeding rates for Girsu ca. 2400 B.C. produce a seemingly extraordinary yield ratio of more than 84:1. However, Maekawa (1974: 4) argues for an extremely high mean yield ratio of 76:1 in pre-Sargonic Sumer. Thus, the data presented by Jacobsen (1982; see tables 7 and 8) may portray ancient Mesopotamian agricultural productivity rather modestly.

Per Capita Sustaining Areas: Irrigated Agriculture

The potential of ancient and modern irrigated productivity shows that Adams and Wright underestimate the soil fertility that formerly characterized lowland Mesopotamia, and exaggerate the hectarage

Table 7. Textual references to barley productivity in ancient Babylonia. All dates are expressed in approximate years B.C. Seeding and harvest rates are expressed in liters per hectare. (Based on Jacobsen 1982: 64-65, Appendices 16-19.)

City	Seeding Rates: date of refs.	no. of refs.	mean rate	City	Harvest Rates: date of refs.	no. of refs.	mean rate	Yield Ratio harvested: seeded
S. BABYLONIA								
Shurrupak	2600	1	25	Girsu	2400	9	2540	
Girsu	2400	3	30	Girsu	2100-2050	24	1140	
Girsu	2100	3	69	Larsa	1700	90	897	
		7	46			123	1065	23:1
N. BABYLONIA				Dilbat &				
Sippar	2350	8	113	Sippar	1900-1730	20	2362	
Nippur	2100	4	40	"	1730-1600	40	979	
Sippar	1700	2	70					
		14	86			60	1440	17:1
(N. & S. BABYLONIA)		21	73			183	1188	16:1

Table 8. Textual references to barley productivity at Girsu and Sippar. All dates are expressed in approximate years B.C. Seeding and harvest rates are expressed in liters per hectare. (Based on Jacobsen 1982: 64-65, Appendices 16, 17, 19.)

City	Seeding Rates			Harvest Rates			Yield Ratio
	date of refs.	no. of refs.	mean rate	date of refs.	no. of refs.	mean rate	harvested: seeded
Girsu	2100	3	69	2100-2050	24	1140	17:1
Sippar	2350,1700	10	104	1900-1600	41	1569	15:1

necessary for per capita agricultural subsistence. If ratios of 15:1 to 20:1 reflect moderate mean barley yields in antiquity, the productivity of Mesopotamian irrigated agriculture was at least three times that of dry farming regions, in which wheat and barley returns probably averaged 5:1 to 6:1. Thus, Adams's estimate of mean per capita sustaining area can be reduced justifiably by a factor of three to 0.5 hectares for ancient lowland Mesopotamia. This would agree with Johnson's (1973: 96-98) estimates for Early Uruk subsistence agriculture on the Susiana Plain, Iran.

Boundaries of Community Sustaining Areas

A village sustaining area is determined by the collective subsistence requirements of its inhabitants. For purposes of archaeological spatial analysis, community sustaining areas are limited at a distance "beyond which modern farmers are reluctant to walk to reach fields producing their chief staple crops" (Kramer 1982: 246). Several studies assume arbitrary catchment ranges up to 5 kilometers in radius (Vita-Finzi and Higgs 1970; Flannery 1976; Rossman 1976; Renfrew 1984: 90), rather than derive them from ethnographic evidence. Archaeological analyses that do search for ethnographic parallels are influenced particularly by the locational analyses of Chisholm (1968). A locational approach assumes that agricultural behavior is dictated by "rational" maximizing decision-making, such that cultivation will be most intensive where production and transport costs are minimal, and will be curtailed when these costs exceed the value of agricultural return (Chisholm 1968: 45; Sallade and Braun 1982: 20-21).

This approach is predicated on the need for optimal use of scarce human labor. Non-productive time and energy spent traveling to and from agricultural fields are emphasized repeatedly as major cultivation costs (Grannott 1952: 200; Chisholm 1968: 44; Sallade and Braun 1982: 22), especially given the fragmentation of traditional landholdings in southwestern Asia. Travel costs to distant fields can be accommodated by planting less labor-intensive crops that require few visits during cultivation (Chisholm 1968: 54; Sallade and Braun 1982: 21). However, the essence of this locational approach is that the intensity and productivity of traditional agriculture decrease as travel time increases (Chisholm 1968: 51-58).

Indeed, traditional farming strategies are generally consistent with these expectations. Labor intensity decreases as fields become farther removed from a village (Grannott 1952: 198-199; Chisholm 1968: 58; Hillman 1973a: 219; 1973b: 227; Sallade and Braun 1982: 35, 37). In essence, traditional field systems with concentric hawakir gardens and orchards, and surrounding mesha`a lands, are spatial manifestations of this principle.

Citing data from Europe and Asia, Chisholm (1968: 48) notes that "... the average distance to the cultivated land is commonly of the order of one kilometre or more and very frequently rises to three or four." Chisholm's cost-benefit analyses suggest that, in general, distances up to one kilometer incur negligible travel costs, and require few agricultural adjustments. However,

> beyond about 1 kilometre, the costs of movement become sufficiently great to warrant some kind of response; at a

> distance of 3 - 4 kilometres the costs of cultivation necessitate a radical modification of the system of cultivation or settlement - for example by the establishment of subsidiary settlements, ... If the distances involved are actually greater than this, then it is necessary to look for some very powerful constraining reason which prevents the establishment of farmsteads nearer the land. (Chisholm 1968: 131).

Thus, the boundary of idealized agricultural sustaining areas may be hypothesized at a radius of approximately three to four kilometers. However, there are two general reasons to emphasize the flexibility of village sustaining areas and avoid overly rigid definitions. First, in the tradition of von Thünen, locational models are developed for idealized featureless landscapes in which settlement and agriculture are molded by market forces alone (Sallade and Braun 1982: 20). In practice, village sustaining areas are bounded by both natural and cultural topography. Kramer notes small sustaining areas in the Kangavar area, in part because the mean distance between villages is only two kilometers. Thus, impinging neighbors limit agricultural access for these communities to an average radius of approximately one kilometer (Kramer 1982: 242). The sustaining area of Aşvan, Turkey is similarly constrained by a natural barrier, the nearby Murat River (Hillman 1973a: figs. 1 and 2).

Secondly, locational models are predicated on cost-benefit analysis of cash cropping behavior. Farmers are expected to adopt an optimizing mini-max strategy by working a minimal amount to produce a maximal profit (Chisholm 1968: 45, 49-50; Sallade and Braun 1982: 21; following Zipf 1949). Yet, decision making in ancient and modern villages may be molded by the need for survival more than a desire for optimization (see discussion in Chapter 1). Agricultural sustaining areas are not necessarily bounded at an inelastic distance of three to four kilometers. The survival and perpetuation of the village community, particularly as a corporate entity, may provide the "powerful constraining reason" for non-optimal cultivation of more distant fields to which Chisholm alludes.

Hillman's work in the Turkish village of Aşvan (1973a; 1973b) documents agricultural behavior that would not be predicted by an optimizing locational model. Aşvan's sustaining area is truncated by nearby villages to the southwest, and by the Murat River to the north and west. In compensation, dry farming fields to the south and southeast extend from the village to a radius of seven kilometers. One-way travel to these fields requires up to three hours for a villager leading oxen (Hillman 1973a: 219, fig. 1). These travel costs are cut by eliminating double plowing and combining plowing and sowing in distant fields (Hillman 1973a: 220).

Thus, the elasticity of catchment boundaries is illustrated both by the constraints of the Kangavar villages and the far-ranging agriculture at Aşvan. The case of Aşvan is doubly important for showing that traditional farmers are willing to travel unexpectedly great distances to their fields if necessary for village subsistence. In light of this discussion, limits for ancient catchments may be estimated moderately at three to four kilometers, while recognizing the potential for significant catchment constriction or expansion.

Inference of Urban and Rural Site Sizes

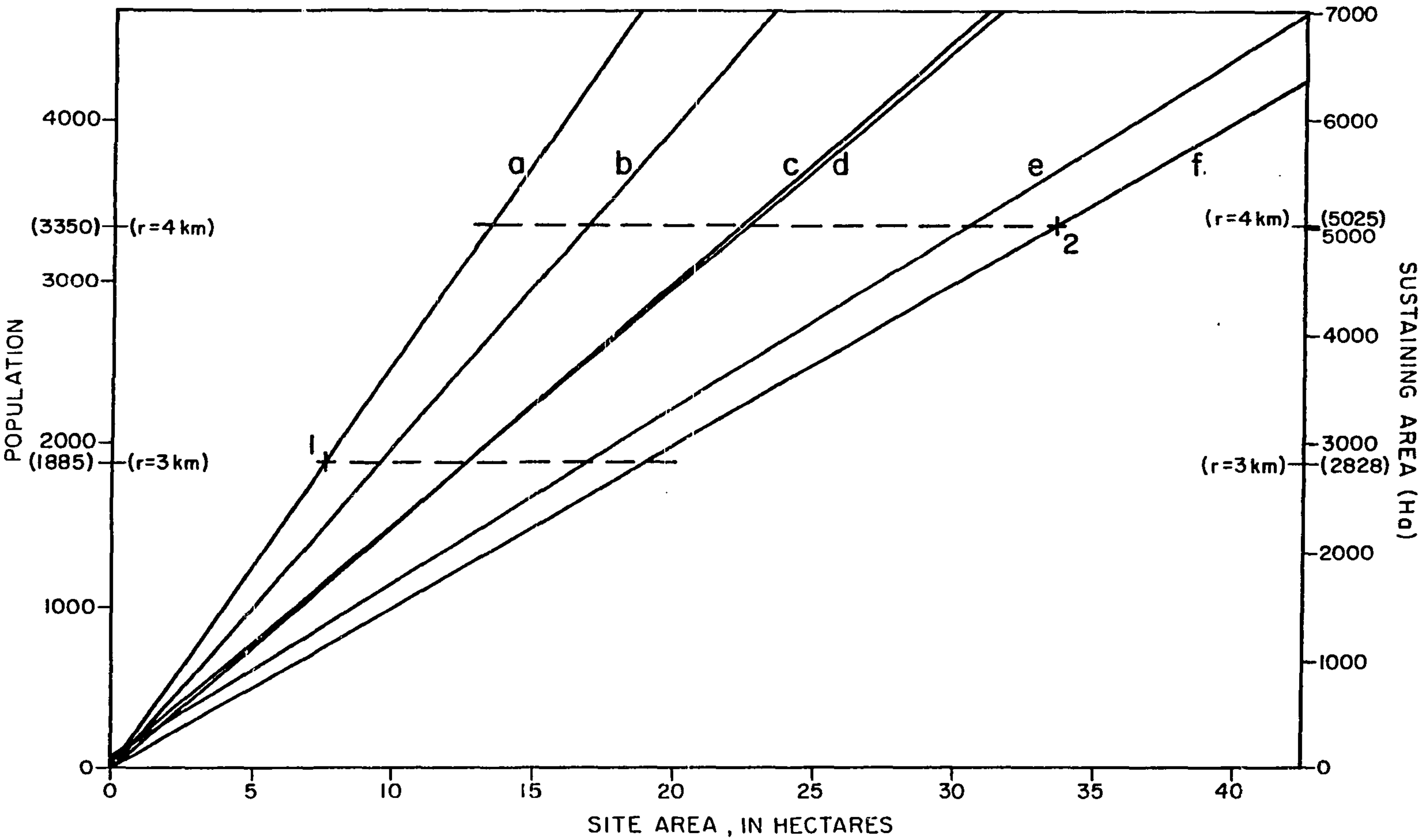
This study defines as "urban" those communities too large to meet their own agricultural subsistence requirements. Therefore, using the formula (s = K p), urban size "thresholds" can be inferred from the population range beyond which settlements unquestionably exceeded their ability to be agriculturally self-sustaining. Hypothetical sustaining areas (s) 3 or 4 kilometers in radius encompass 2827 or 5026 hectares, respectively. The *per capita* subsistence requirement (K) for regions with predominantly rainfed agriculture (1.5 hectares) suggests that these sustaining areas could support self-sufficient populations (p) up to 1885 to 3350 persons, assuming that all the land in a sustaining area is arable. The subsistence requirement (K) for regions with predominantly irrigated farming (0.5 hectares *per capita*) permits larger self-sufficient populations (p) up to 5654 - 10,052 persons.

A basic methodological dilemma follows from these calculations. How do these population levels relate to site sizes observable in archaeological surveys? Several possible relationships are represented by the variety of population density coefficients reviewed above. These alternatives are plotted as linear regressions correlating archaeological site area (a) with population size (p) (see figs. 1 and 2). In dry farming regions settlement sustaining area correlates with settlement population based on the formula (s = 1.5 p) (see fig. 1). In regions of irrigated farming, community sustaining area correlates with population based on the formula (s = 0.5 p) (see fig. 2). Both figures note sustaining areas with radii of 3 and 4 kilometers in particular. Figure 1 illustrates, for example, that a dry farming site

Figure 1. Alternative regressions of population and sustaining area on site size for regions of rainfed agriculture. (Sustaining area [s] = 1.5 x settlement population [p].)

---

a. p = 250 a.
b. p = 200 a.
c. p = 150 a.
d. p = 57 + 146 a (Gremliza 1962; Johnson 1980).
e. p = 85 + 107.55 a (Schacht 1981a).
f. p = 100 a.

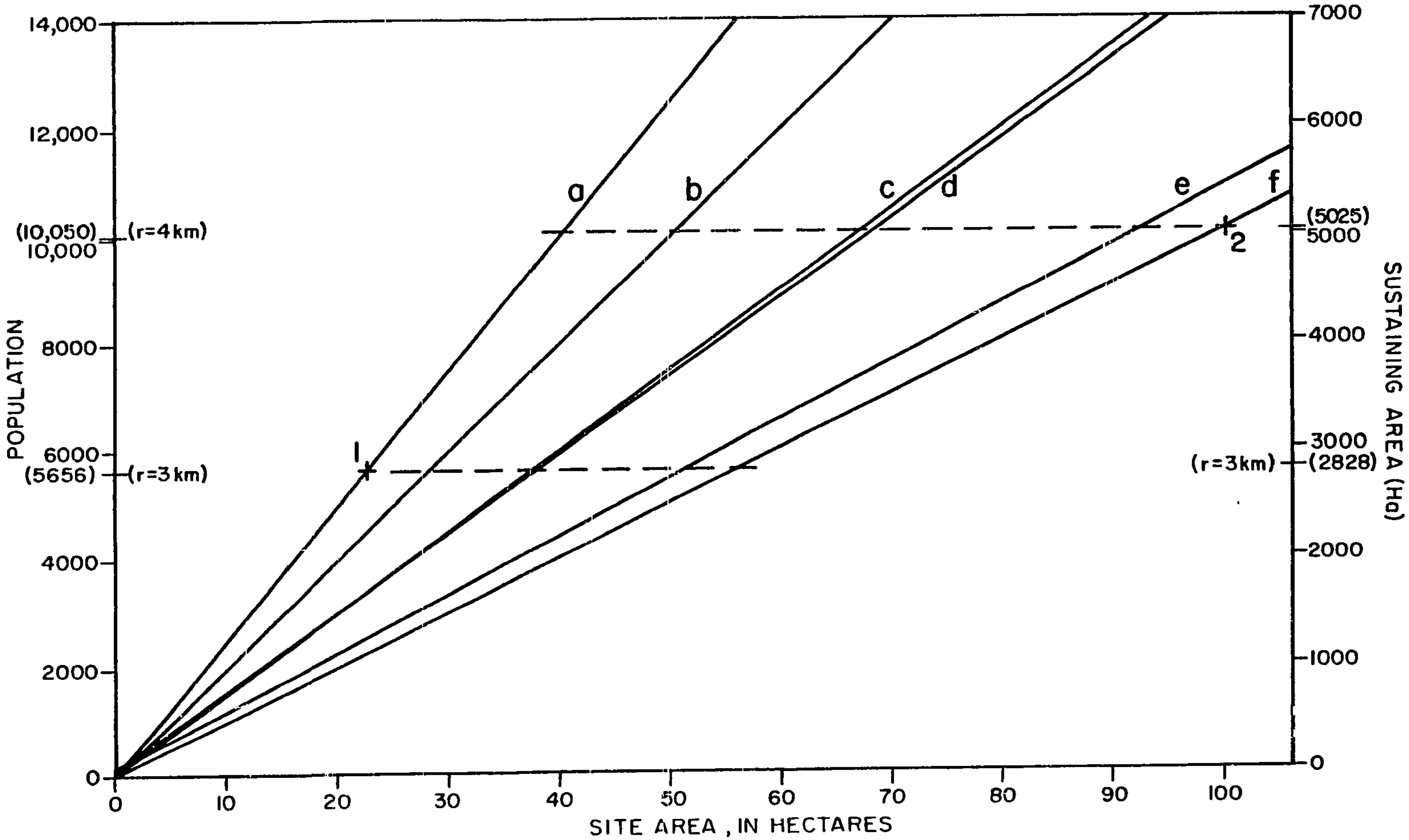


POPULATION
SUSTAINING AREA (Ha)
SITE AREA, IN HECTARES
a
b
c
d
e
f
1
2
(3350)—(r=4 km)
(1885)—(r=3 km)
(r=4 km)—(5025)
(r=3 km)—(2828)
0
1000
2000
3000
4000
5000
6000
7000
0
5
10
15
20
25
30
35
40

Figure 2. Alternative regressions of population and sustaining area on site size for regions of irrigated agriculture. (Sustaining area [s] = 0.5 x settlement population [p].)

---

a. p = 250 a.
b. p = 200 a.
c. p = 150 a.
d. p = 57 + 146 a (Gremliza 1962; Johnson 1980).
e. p = 85 + 107.55 a (Schacht 1981a).
f. p = 100 a.



POPULATION
14,000
12,000
(10,050)
(r=4 km)
10,000
8000
6000
(5656)
(r=3 km)
4000
2000
0
a
b
c
d
e
f
1
2
0
10
20
30
40
50
60
70
80
90
100
SITE AREA , IN HECTARES
7000
6000
(5025)
5000
4000
3000
(r=3km)
(2828)
2000
1000
0
SUSTAINING AREA (Ha)

measuring 10 hectares housed 1000 to 2500 inhabitants, requiring an agricultural sustaining area of 1500 to 3750 hectares. Likewise, a population of 2000 people, requiring a dry farming sustaining area of 3000 hectares, could have inhabited a site measuring between 8 and 20 hectares.

Clearly the wide variety of plausible density coefficients renders these correlations imprecise. Nevertheless, within the limits of ethnographic analogy, these data illuminate the economic differentiation of urban and rural settlement in ancient southwestern Asia based on agricultural subsistence. Figures 1 and 2 delineate site size classes appropriate for the comparison of urbanism and ruralism in regions of irrigation (e.g., lower Mesopotamia) and in dry farming regions (e.g., the southern Levant).

In addition to urban thresholds, we may infer size "ceilings" for rural sites. These ceilings are defined by the smallest conceivable site size that could have had a population large enough to require subsidiary villages for agricultural support. In other words, sites smaller than this "ceiling" would have been self-sustaining in the vast majority of cases. For regions of dry farming the highest density coefficient (250 persons per hectare) and a small sustaining area (3 kilometers radius) are used to calculate this rural size ceiling at 7.5 hectares (point 1 in fig. 1). Similarly, the rural size ceiling for irrigated regions is 22.6 hectares (point 1 in fig. 2).

These calculations assume that ancient settlements had unhindered access to surrounding agricultural land. However, a settlement immediately adjacent to hills, coastline, a river, or neighboring villages could have a very truncated sustaining area. If we consider that sustaining areas commonly might have been halved in this manner, the rural ceiling drops to 3.75 hectares in dry farming regions, and to 11.3 hectares in irrigated regions. Thus, dry farming sites of less than 4 hectares, and irrigated farming sites of 11 hectares or less, were, in all likelihood agriculturally self-sustaining (i.e., rural).

At the other extreme, urban thresholds are defined by the largest site size that might have had a population potentially able to feed itself. Sites larger than this threshold must have required subsidiary settlements to meet their agricultural needs. The lowest density coefficient (100 persons per hectare) and a large sustaining area (4 kilometers radius) produce this threshold at 33.5 hectares in dry farming regions (point 2 in fig. 1), and at 100.5 hectares in irrigated regions (point 2 in fig. 2). Thus, dry farming sites of 34 hectares or more, and irrigated farming sites of more than 100 hectares, were dependent on outlying agricultural communities, and therefore, were urban. Large intermediate categories of dry farming sites 4 to 35 hectares in size, and irrigated farming sites of 11 to 100 hectares, have less definite agricultural and urban/rural status.

Concluding Remarks

This discussion has deliberately avoided inflated population density coefficients and excessive estimates of agriculturally self-sufficient communities. The rural village population ceiling of 2,000 to 3,000 inhabitants calculated above falls well below Renfrew's suggested maximum of 4,000 persons (1984: 90), and is extremely conservative in light of some examples of modern agricultural towns. Numerous "agro-towns" in Sicily, Sardinia, southern Italy, and southern Spain subsist independently using rainfed agriculture, lack a network of subsidiary villages, yet are inhabited by up to 10,000 peasant farmers who commute daily to surrounding fields (Chisholm 1968: 55-58; Prestianni 1947: 98-99; le Lannou 1941: 188; Birot and Dresch 1953: 218). Median populations greater than 5,000 in villages immediately north of the Caucasus Mountains (Chisholm 1968: 59; Dovring 1965) suggest that these large agro-towns are not restricted to the peripheries of the Mediterranean. Likewise, cities in the recent history of southwestern Asia have housed large sub-populations that carry out "rural" functions in an urban setting (Abu-Lughod 1969: 159; Gulick 1969: 124). Nineteenth century Cairo provides a celebrated metropolitan example in which large proportions of the "economically active population" commuted regularly to fields at the city's fringes (Abu-Lughod 1969: 164; Issawi 1969: 105-106).

With respect to the evidence of antiquity, Renfrew (1984: 90) has maintained that "agglomerate settlement does not in itself define civilisation." This discussion argues similarly that, with regard to urbanism, "agglomerate settlement" is informative only as it signals the economic (in this case, agricultural) differentiation and interdependence characteristic of urbanized settlement systems. This argument is applied to the limited data available from major archaeological surveys in southwestern Asia. The discussions in chapters 1 and 2 argue that, on the basis of size, many ancient settlements can be identified with reasonable certainty as "urban" or "rural". The calculations above define site size classes that are intentionally extreme, and intended for broad regional analyses that cannot consider the particular characteristics of soils, topography, water sources, and natural vegetation that determine agricultural potential at each site. Indeed, some sites in the intermediate size class may be reclassified as urban or rural with more detailed reference to their agricultural sustaining areas.

In chapters 3 and 4 this approach and the resulting definitions of urban and rural settlements are applied to archaeological evidence for early urbanism in southwestern Asia. These chapters present regional survey data that illustrate the varying roles or urbanism and ruralism in Mesopotamia (Chapter 3) and the southern Levant (Chapter 4). The ways in which these data were originally classified constrain the application of urban/rural size classifications. Most surveys in southwestern Asia adopt arbitrary class limits, as exemplified by Adams's urban/rural "bifurcation" at 10 hectares (1981: 75), and report site frequencies and occupied hectarage accordingly. These published data can be accommodated only by modifying slightly the urban and rural size classes proposed above, as shown in Table 9.

Table 9. Rural and urban site size classifications proposed for ancient southwestern Asia.

Predominant Agricultural Regime	Rural Size Classification	Urban Size Classification
rainfed	*	$\geq$ 35 ha.
irrigated	$\leq$ 10 ha.	$\geq$ 100 ha.

* varies between < 4 ha. and $\leq$ 7 ha. depending on survey report. See figures 17, 21, 23, 27 and 28.

CHAPTER 3: URBANISM AND RURALISM IN THE SETTLEMENT RECORD OF MESOPOTAMIA

The archaeological record of past settlement in Mesopotamia describes trajectories of growth and collapse with a consistent underlying theme: the active and central involvement of cities. Data from a series of major surveys in lower Mesopotamia demonstrate processes of growth and collapse in regions of pronounced urbanism, and in characteristically rural areas lacking local urban centers.

Three fundamental parameters are of particular interest in this chapter, and in a similar overview of the southern Levant in Chapter 4: the locations, sizes, and occupational histories of human settlements. On a macroscopic level, these data illuminate processes of development and demise of both urbanism and ruralism.

Site "Visibility" in Mesopotamian Survey Archaeology

Ancient settlements are detected by regional surveys in proportion to their "visibility" on the archaeological landscape. This visibility is conditioned by the intensity of survey coverage, the original dimensions of the sites in question, and the constraints of the natural environment and modern cultural activity.

The topographic prominence of a site stems basically from its original size and duration as a locus of human activity. Large mounded *tells* are the most prominent archaeological features of southwestern Asia, and readily become prominent survey data. Thus, the significance of these sites, and the ancient communities they represent, can be overestimated easily at the expense of smaller settlements and limited activity sites that are detectable only with intensive reconnaissance.

Topographic prominence is modified by actions of nature and humanity that mask or obliterate archaeological remains. At multi-phase tell sites, the habitation areas of earlier strata tend to be obscured by subsequent cultural deposition (Adams 1965: 120). Modern habitations simply constitute the most recent strata masking both the spatial and temporal dimensions of previous settlement. Baghdad exemplifies a city whose archaeological parameters are not measured easily because of modern habitation (Adams 1965: 21). Similarly, intensive modern agricultural development, again with an appreciable ancient heritage, can mask or even destroy archaeological resources (Adams and Nissen 1972: 4; Adams 1981: 35-37; Ibrahim, Sauer, and Yassine 1976: 64-65).

The most significant natural masking process in Mesopotamia is alluviation. This affects the floodplain downstream of modern Hit on the Euphrates, and Samarra on the Tigris, thereby influencing all of the survey areas discussed below (Adams and Nissen 1972: 6; Adams 1981: 45; H. T. Wright 1981a: 300). The Susiana Plain is affected similarly by tributaries of the Tigris: the Karun, Dez, and Karkeh rivers (Johnson 1973: 17, 19). Alluvial deposition is cumulative, and becomes more pronounced as riverbed gradients decrease along the southward flow of Mesopotamia's watercourses. The effects of alluviation vary with a site's topographic prominence, and with the length of time alluviation has been endured. Substantial alluviation has characterized the lower Diyala drainage since 3000 B.C. (Adams 1965: 124) and the Ur-Eridu area since the second millennium B.C. (H. T. Wright 1981a: 298). Therefore, its impact is most significant on sites of great antiquity (<u>e.g.</u>, ^{c}Ubaid and Uruk sites) or limited duration (Adams 1981: 36). In lower Mesopotamia, Qal^{c}at Hajji Muhammad (Nöldeke 1934: 40-41; Heinrich and Falkenstein 1938: 37) and Ras al-^{c}Amiya (Stronach 1961) are celebrated examples of relatively small, limited duration ^{c}Ubaid sites that were blanketed with alluvium, and discovered only after river or canal cuts had exposed their archaeological stratification.

All of these characteristics significantly influence survey archaeology in southwestern Asia because they are pervasive and non-random. Mesopotamian surveys have concentrated on regions with limited habitation and agriculture in which archaeological reconnaissance can proceed with minimal hindrance. The ancient predecessors of modern urban metropoli have received understandably limited survey attention. At the other end of the settlement spectrum, small sites, particularly limited duration sites, escape detection most easily because of their relatively modest original dimensions, and because of the disproportionate effects of masking processes on small sites.

With these constraints in mind, this discussion of early urbanized settlement in Mesopotamia utilizes data from the archaeological surveys in Table 10 (see also fig. 3).

<u>Survey Methods in Mesopotamia</u>

Mesopotamian survey data are constrained geographically and chronologically by features of natural and human landscapes. Survey areas generally lie outside the frontiers of modern cultivation. Agricultural disturbances impede the location and accessibility of

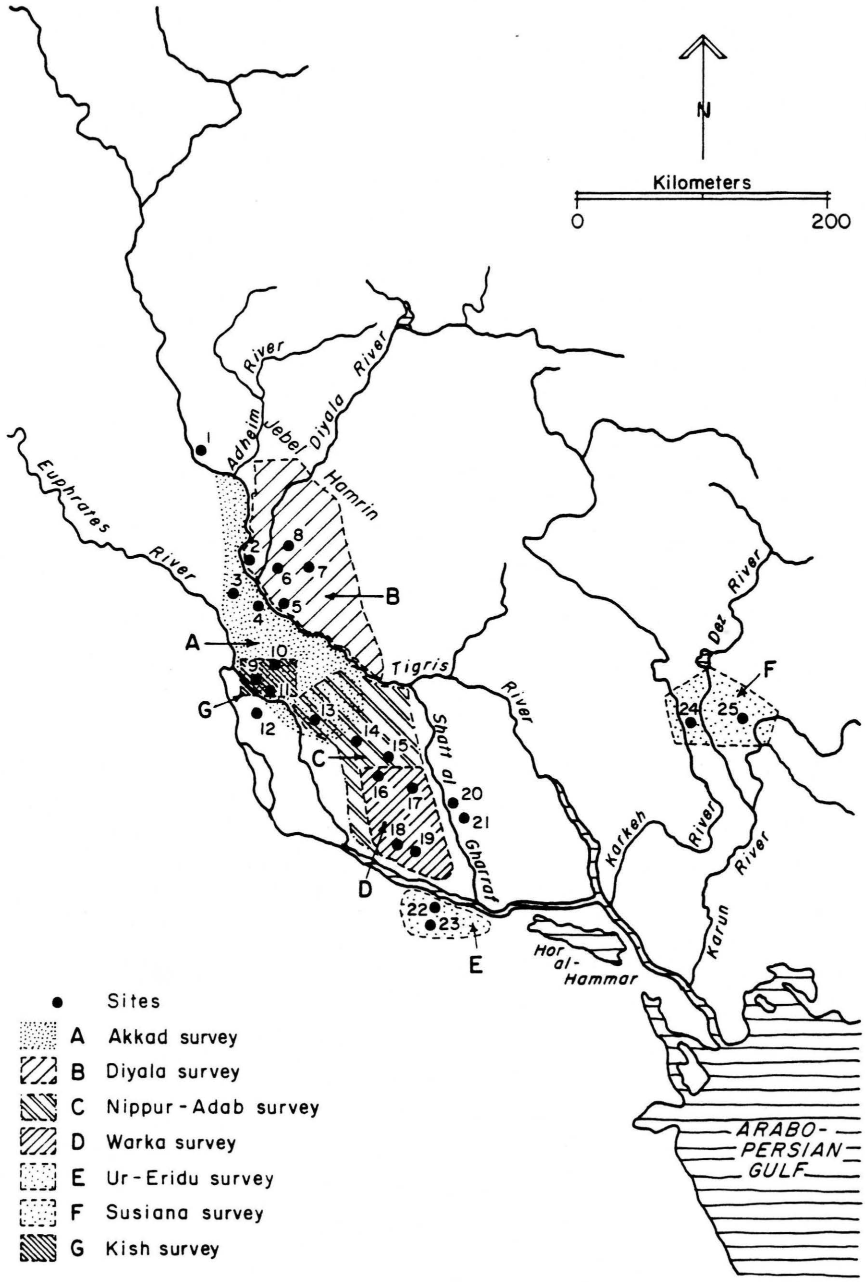
Table 10. Mesopotamian surveys.

Survey Area(s)	Primary Reference(s)
Warka and Nippur-Adab	Adams 1981
Warka	Adams and Nissen 1972; Adams 1981
Nippur-Adab	Adams 1981
Diyala	Adams 1965; Adams 1981
Akkad	Adams 1972b
Kish	Gibson 1972
Ur-Eridu	Wright 1981a
Susiana	Johnson 1973

Figure 3. Map of Mesopotamian cities and survey areas discussed in text. (Based on Adams 1965: Maps 1A-4B; 1972: Maps 1A-F; 1981: figs. 12 and 13; Gibson 1972: fig. 1; Johnson 1973: fig. 2; Wright 1981: fig. 1.).

---

1. Samarra
2. Baghdad
3. Sippar
4. Seleucia
5. Ctesiphon
6. Khafaje
7. Tell Agrab
8. Tell Asmar
9. Babylon
10. Kutha
11. Kish
12. Dilbat
13. Abu Salabikh
14. Nippur
15. Adab
16. Shurrupak
17. Umma
18. Uruk
19. Larsa
20. Girsu
21. Lagash
22. Ur
23. Eridu
24. Susa
25. Choga Mish


N
Kilometers
0
200
Adheim
River
Jebel
Diyala
River
Hamrin
Euphrates
River
Tigris
River
Shatt al Gharraf
Dez
River
Karkeh
River
Karun
River
Hor al-Hammar
ARABO-
PERSIAN
GULF
A
B
C
D
E
F
G
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Sites
A Akkad survey
B Diyala survey
C Nippur-Adab survey
D Warka survey
E Ur-Eridu survey
F Susiana survey
G Kish survey

ancient sites, particularly small ones. Thus, many stretches of irrigated land immediately paralleling the Tigris, Euphrates, and Shatt al-Gharraf have escaped intensive coverage (see Adams and Nissen 1972: 4; Adams 1981: 32-36). Large dune fields also curtail the Warka, Nippur-Adab and Ur-Eridu survey areas on the west (Adams and Nissen 1972: 5; Adams 1981: 30, 33).

The topical research concerns of the surveyor also constrain coverage geographically and chronologically. The Warka and Nippur-Adab surveys covered the heartland of Sumerian urbanism. However, centers of urbanism subsequently shifted elsewhere, rendering the same Warka/Nippur-Adab survey boundaries more arbitrary in later periods (see discussion in Adams and Nissen 1972: 5). Similarly, the Akkad survey concentrated on the settlements and watercourses of late prehistory through the Old Babylonian and Kassite periods. Much less attention was directed at post-Kassite remains (Adams 1972b: 183).

The Ur-Eridu survey encompassed territory surrounding Eridu in which ʿUbaid settlement patterns might have been ascertained. Initial fieldwork showed that fourth millennium B.C. land surfaces were obscured by alluviation, and the analytical focus shifted to the Early Dynastic I Period (H. T. Wright 1981a: 297-298).

The Susiana survey was designed to illustrate the initial rise of the state in Khuzistan, Iran (see Johnson 1973: 12). Accordingly, it centers on the locally-pre-eminent townsites of Susa and Choga Mish through the Late Uruk Period, but neglects later developments.

The Diyala survey considers the environmental and cultural impacts of agricultural development. In contrast to Johnson's concerns in the

Susiana, this study relies on great time depth, and centers on the lower Diyala River drainage, a region defined geomorphologically, rather than in terms of concentrated human settlement (see Adams 1965: vii-ix). In cultural terms, the Diyala survey region best exemplifies a hinterland of Babylonia, and, subsequently, of Baghdad in the Islamic periods.

In sum, the survey areas noted above (see fig. 3) do not necessarily conform to culturally defined regions of ancient Mesopotamia (see Adams and Nissen 1972: 5). Furthermore, the survey data from within these regions are not identical in quality. Therefore, these data are presented survey by survey as they provide somewhat arbitrary regional samples of the appearance and development of urbanism in Mesopotamia.

Despite research concerns that differ among surveys, archaeological reconnaissance in Mesopotamia has relied on various combinations of three complementary procedures. Sites identifiable on large-scale maps and aerial photographs were visited by jeep (Adams 1965: 120; 1972b: 182; 1981: 38-39). Less purposive vehicular reconnaissance was carried out in parallel transects (usually 0.5 - 1.0 kilometer apart) where topography and vegetation permitted (H. T. Wright 1981a: 298; Adams 1981: 38), and along river levees where they provided improved visibility (Adams 1965: 120; 1972b: 183). These procedures were adopted, particularly by Adams's surveys, for the purpose of extensive coverage, not exhaustive detail (Adams 1981: 47).

The criteria for defining sites rarely are made explicit on surveys in southwestern Asia. Adams identifies "dense" artifact scatters as sites, while "sparse" scatters are not sites unless accompanied by architecture or mounded archaeological deposition. He applies the least exacting requirements for identification of early period sites as compensation for their limited visibility. Thereby, in a manner probably consistent in all of these surveys, Adams intentionally avoids quantitative rigor in favor of flexibility (Adams 1981: 43).

Site areas were determined by plane table mapping (Johnson 1973: 24) or, more often, by pacing off major dimensions of length and breadth (Adams 1965: 125; 1981: 44). Except in the case of the Susiana survey (Johnson 1973), surface collections were purposive, and intended simply to indicate possible periods of occupation at each site (e.g., see Adams 1965: 120; 1981: 45).

These considerations of site visibility and survey method are particularly significant as they affect the data and interpretations derived from archaeological surveys. Mesopotamian survey reports generally claim that all sites of perceptible elevation were inventoried (e.g., Johnson 1973: 24; Adams 1981: 28). Wright (1981a: 298) expects that no site in the Ur-Eridu area with relief greater than 0.5 meters was missed.

As a formal test of the efficiency of jeep reconnaissance, Adams (1981: 40-42) restudied a series of 13 previously surveyed one-kilometer squares in uncultivated areas north and east of ancient Nippur. Nine sites had been identified originally. More intensive coverage revealed three additional sites, and required modification of the descriptions or dating of four others. These results suggest that site counts "may be deficient by as much as one-third" (Adams 1981: 42), at least for the Nippur-Adab survey. All of the newly identified sites were relatively small and low, suggesting further that for early periods characterized by small, low sites, settlement numbers are underestimated and average settlement size is overestimated.

Thus, we return to the observation that survey data are artifacts themselves, conditioned by the natural and cultural landscape, and by the ways in which they are identified and measured. Most importantly, these effects are not random, but tend to emphasize the evidence for larger, longer-term settlement at the expense of small sites, particularly those from earlier periods.

Mesopotamian Survey Chronologies

The data from major Mesopotamian surveys are classified chronologically to provide a diachronic perspective on ancient settlement systems. Periods of both prehistoric and historic occupation at any given site can be inferred from the presence of chronologically-specific "index fossils" (Adams 1965: 121; 1981: 44) or the relative abundance of less specific forms of material culture, primarily pottery. The chronological information derived from this material culture generally is based on stratigraphic relationships reported by previous excavations. For example, the Diyala, Akkad, and Kish surveys all relied on the ceramic sequences from several sites excavated much earlier in the Diyala drainage (Delougaz 1952). In essence, these indicators define the chronological framework in which the survey archaeologist infers changing patterns of regional settlement.

The archaeological record of Mesopotamia to be discussed here stretches from the late fifth millennium B.C. to the thirteenth century A.D. Discrete periods are bounded within this chronological continuum using radiocarbon determinations from prehistoric contexts, calendric dates from early Mesopotamian history, and extrapolations from both of these sources using ceramic seriation. Not surprisingly, the archaeological chronology for greater Mesopotamia is applied to archaeological surveys in a variety of manifestations (see fig. 4). These variations require commentary on several points.

First, material culture varies geographically, as well as chronologically. Therefore, periodization schemes for different subregions may not be equivalent. For example, upon the historic emergence of the Elamite kingdom, the archaeological sequence for the Susiana Plain diverges from that of lower Mesopotamia. However, the late prehistoric periods discussed below are in general alignment in these areas. Further, the ceramics for various periods in the Mesopotamian sequence are not equally well known (see discussions in Adams 1965: 126; Adams 1972b: 183; Gibson 1972: 159; H. T. Wright 1981a: 298). Follow-up excavations have clarified the material record of later historic periods (e.g., Adams 1970), and prehistoric index fossils. For example, continuing research has shown that clay sickles, previously thought to be limited to the ᶜUbaid period (Adams 1965: 36, 127; 1972b: 184), persisted through the Uruk Period as well (Adams

Figure 4. Mesopotamian Survey Chronologies.

A. Warka and Nippur-Adab (Based Adams 1981; Adams and Nissen 1972).

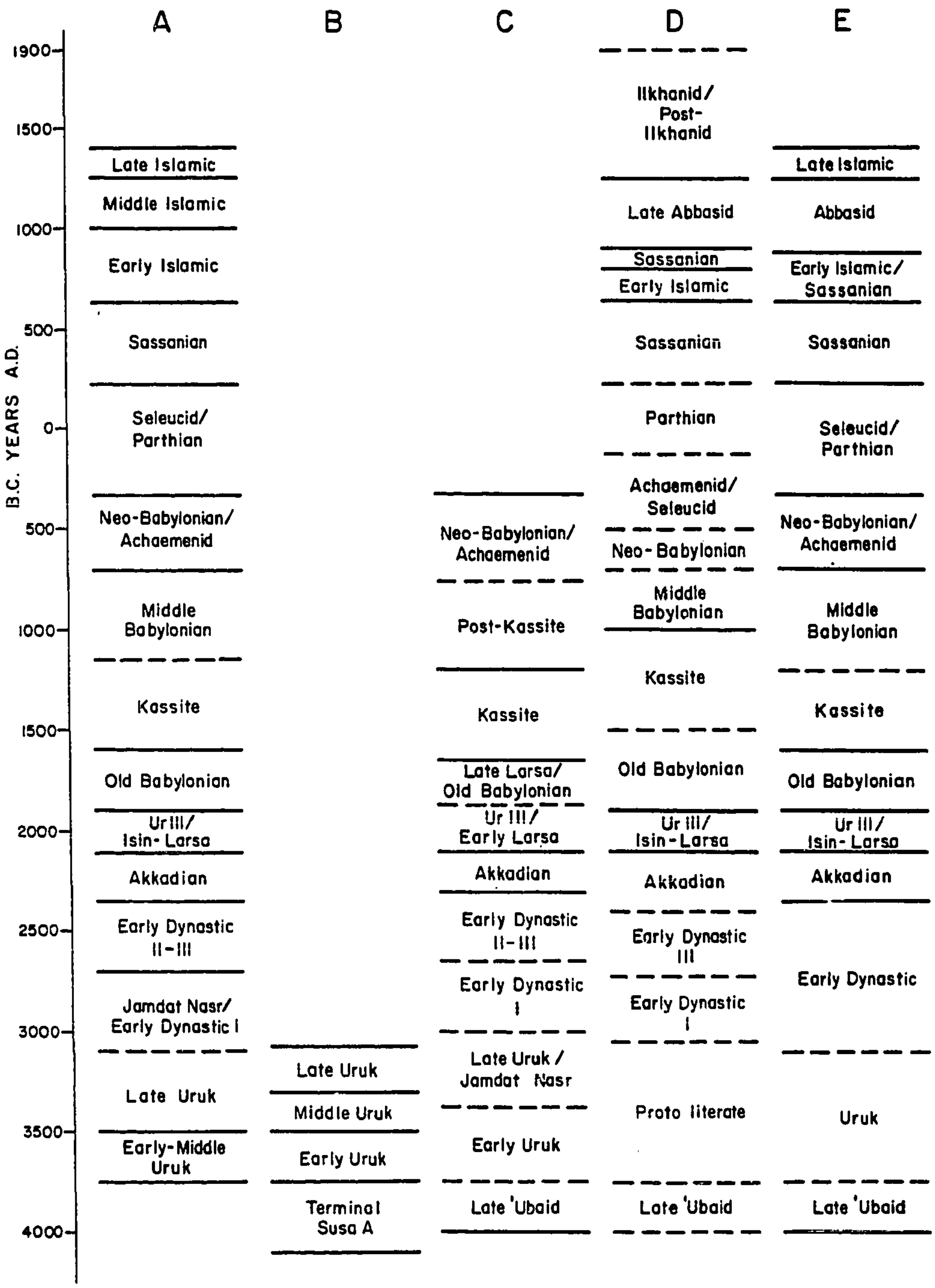
B. Susiana (Based on Johnson 1973: table 16).

C. Ur-Eridu (Based on Wright 1981).

D. Akkad and Kish surveys (Based on Gibson 1972).

E. Diyala (Based on Adams 1965; 1981).

Solid lines indicate chronological boundaries explicitly cited by surveyors. Dashed lines indicate boundaries extropolated by the author.


A
B
C
D
E
1900
1500
1000
500
0
500
1000
1500
2000
2500
3000
3500
4000
B.C. YEARS A.D.
Late Islamic
Middle Islamic
Early Islamic
Sassanian
Seleucid/ Parthian
Neo-Babylonian/ Achaemenid
Middle Babylonian
Kassite
Old Babylonian
Ur III/ Isin-Larsa
Akkadian
Early Dynastic II-III
Jamdat Nasr/ Early Dynastic I
Late Uruk
Early-Middle Uruk
Late Uruk
Middle Uruk
Early Uruk
Terminal Susa A
Neo-Babylonian/ Achaemenid
Post-Kassite
Kassite
Late Larsa/ Old Babylonian
Ur III/ Early Larsa
Akkadian
Early Dynastic II-III
Early Dynastic I
Late Uruk / Jamdat Nasr
Early Uruk
Late 'Ubaid
Ilkhanid/ Post-Ilkhanid
Late Abbasid
Sassanian
Early Islamic
Sassanian
Parthian
Achaemenid/ Seleucid
Neo-Babylonian
Middle Babylonian
Kassite
Old Babylonian
Ur III/ Isin-Larsa
Akkadian
Early Dynastic III
Early Dynastic I
Proto literate
Late 'Ubaid
Late Islamic
Abbasid
Early Islamic/ Sassanian
Sassanian
Seleucid/ Parthian
Neo-Babylonian/ Achaemenid
Middle Babylonian
Kassite
Old Babylonian
Ur III/ Isin-Larsa
Akkadian
Early Dynastic
Uruk
Late 'Ubaid

1981: 55). This cumulative interaction of survey and excavation requires periodic revisions that affect different regions or time periods to varying degrees (e.g. see Adams 1981: 54-60 on the ᶜUbaid along the Diyala).

On the matter of absolute chronology, discrete historical periods and those inferred from material culture may not be coterminous (e.g., W. Y. Adams 1979; R. M. Adams 1965: 122; 1981: 50). This difficulty is exemplified in Mesopotamia by historically distinct intervals (e.g., the Third Dynasty of Ur and the Isin-Larsa Period) that cannot reliably be segregated using archaeological material culture. Similarly, absolute chronologies for Mesopotamia based on late prehistoric radiometric dates and those inferred from early historic documents remain unreconciled, despite (or perhaps because of) the advent of calendric calibration of 14-C determinations (see Mellaart 1979; Munn-Rankin 1980).

Finally, since material culture and historical context do not change at a constant rate, archaeological data are not classified readily into standard temporal units. Archaeological periods of several decades, if not centuries, usually are the smallest chronological units into which Mesopotamian survey data can be divided. Conventional interpretations of these data cannot distinguish whether any given site was occupied for less than the full duration of the archaeological periods indicated by its material culture. Therefore, all sites occupied in a given period are assumed to have been contemporaneous (Adams 1965: 124; H. T. Wright 1981a: 300). Survey data are presented in discrete chronological units that are, of necessity, treated as comparable, although they may not be.

Weiss (1977) tackles these assumptions in a reanalysis of late prehistoric settlement data from Susiana. Rather than citing survey data according to conventional periods, Weiss proposes a "standardized" measure of sites and aggregate habitation area per unit time. The results contrast distinctly with those presented originally by Johnson (1973). However, Weiss merely imposes arbitrary chronological subdivisions where there were none before. In practice, his approach also assumes, a priori, that all sites were occupied for equivalent lengths of time, and that virtually none of these sites were occupied over the entire periods indicated by their material culture. Weiss exchanges conventional operative assumptions for untestable uniformitarian alternatives (see discussion in Adams 1981: 51). In so doing, his analysis points out, but is unable to resolve, a fundamental constraint on the diachronic interpretation of survey data.

In overview, the general congruence of Mesopotamian survey chronologies easily outweighs minor local differences in periodization or material culture. The following discussions do not interpret survey data primarily in terms of historical context or absolute time. Therefore, the difficulties of reconciling archaeological and historical intervals, and various absolute chronologies, may be minimized. Chronological "lumping and splitting" may differ somewhat between surveys, as seen in the various presentations of Early, Middle, and Late Uruk data. On the other hand, non-equivalent intervals of history and material culture are encountered in the same periods, and are resolved in similar ways, from survey to survey. Note the consistent combination of data from the Ur III/Isin-Larsa, and Achaemenid/Seleucid/Parthian sequences.

Most importantly, survey data portray early urbanized settlement in Mesopotamia and the southern Levant on a scale that encompasses and expands upon the more specific insights of history and excavation. As a complement to these other data sources, archaeological surveys empirically measure broader spectra of ancient communities, in wider regional or inter-regional settings, and with unparalleled time depth (see Adams 1981: 27).

Organization of Survey Data

Survey data are molded by the natural and cultural environments of Mesopotamia, and by archaeological reconnaissance methods. Analysis of these data is molded further by the problems of interest to the survey archaeologist. Basic survey data of site frequencies and sizes can be summarized in several dimensions that illuminate processes of urban and rural development. On a general level, trends of growth and decline are illustrated by increases and decreases in the density of sites and population.

Site Density

Histogram A in the following figures describes regional site density as the number of sites occupied contemporaneously (n) per 100 square kilometers of survey area:

$$\frac{n}{\text{total survey area}} \times 100 \text{ km}^2$$

Population Density

If we argue that the area of a site provides a relative indication of its population (see discussion in chapter 2), the aggregate area of all sites occupied contemporaneously provides a relative indication of regional sedentary population. In a manner consistent with site density, Histogram B expresses relative population density as the aggregate site area occupied per 100 square kilometers of survey area:

$$\frac{\sum x}{\text{total survey area}} \times 100 \text{ km}^2$$

Thus, the first two histograms in figures 5, and 7 through 12 illustrate trajectories in settlement frequency and population that can be compared between survey regions.

Mean Site Size

Histograms C - E in each of these figures specify the nature of various trajectories of growth and decline. Histogram C illustrates changes in mean site size ($\bar{x}$), a product of site frequency and aggregate site area for each time period:

$$\frac{\sum x}{n}$$

However, the area of the largest site in a region (x_1) can inflate mean site size. Median site size is not affected in this manner, and would provide a more appropriate measure of "mid-range" settlement size. Unfortunately, a median often cannot be identified in many surveys of Mesopotamia and the southern Levant because sizes are not always specified for all sites. Therefore, the exaggerated influence of particularly large primate sites is reduced by removing them from the calculation of an "adjusted" mean ($\bar{x}_1$):

$$\frac{\sum x - x_1}{n-1}$$

This adjusted mean is also shown in Histogram C. Since the sole distinction between mean and adjusted mean site size is the inclusion or exclusion of x_1, substantial differences between these means reflect a disproportionately large, potential primate, community.

Urban Population

Histograms D and E measure the relative importance of large vs. small settlements. These measurements can be based on the proportion of a regional population that is "urban" or "rural," or on the frequency of urban or rural sites. Adams (1981: 72) argues that "it was primarily the relative proportions of [a regional] population living in larger and smaller communities that influenced the nature of the society, not the relative numbers of settlements themselves." Relative population certainly provides a more sensitive measure of growth and decline in very large, but not often numerous, urban communities. Again using aggregate site area as an indicator of relative populations, Histogram D shows the percentage of each regional population living in "urban" settlements (i.e., sites 100 hectares or larger, see discussion in Chapter 2) using the calculation:

$$\frac{\sum x \text{ [for } x \geq 100 \text{ ha.]}}{\sum x} \times 100$$

Since urban sites are not always present, relative populations living in sites larger than 40 hectares, and larger than 10 hectares, also are shown in Histogram D in these figures.

Rural Site Frequency

In contrast to the evidence of urban settlement, growth and decline in numerous, but small, rural communities are measured more sensitively in terms of rural site frequency, rather than relative population.. Therefore, Histogram E presents the frequencies of rural sites (i.e., those 10 hectares or smaller, see discussion in Chapter 2), based on the calculation:

$$\frac{n\ [\text{for } x \leq 10 \text{ ha.}]}{n} \times 100$$

The frequencies of sites five hectares and smaller also are shown in Histogram E.

This measurement of rural settlement contrasts with Adams's general discussions that focus on relative urban populations (1981: 69-94). However, in keeping with Adams's synthetic approach to settlement in Mesopotamia, the importance of settlement data lies in the trajectories of change they describe, rather than the absolute values noted for any given time period or field of data (Adams 1981: 72). Thus, survey data from Mesopotamia and the southern Levant are best suited to the broad portrayal of urban and rural growth and decline, as presented in the balance of this chapter and in Chapter 4.

Mesopotamian Settlement: Late Prehistory-Middle Babylonian Period

Settlement data from the Warka and Nippur-Adab surveys describe two cycles of population growth and subsidence (see fig. 5). The first cycle runs from the Early and Middle Uruk periods to the urban nadir of

Figure 5. Warka/Nippur-Adab Survey.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites $\geq$ 100 ha =

% in sites > 40 ha =

% in sites > 10 ha =

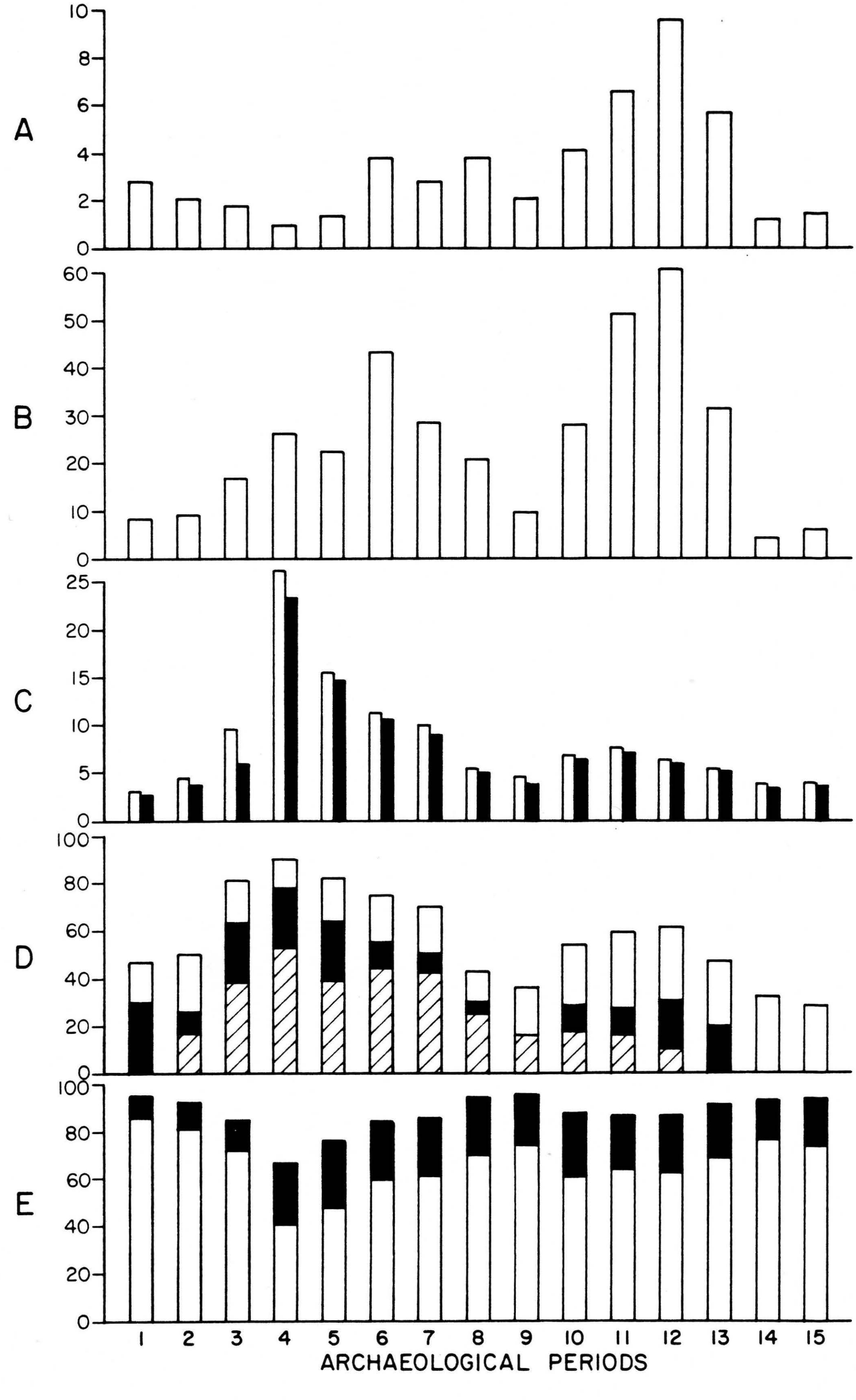
E. Rural Site Frequency:

% sites $\leq$ 10 ha =

% sites $\leq$ 5 ha =

PERIODS

1. Early-Middle Uruk
2. Late Uruk
3. Early Dynastic I
4. Early Dynastic II-III
5. Akkadian
6. Ur III/Isin-Larsa
7. Old Babylonian
8. Kassite
9. Middle Babylonian
10. Neo-Babylonian/Achaemenid
11. Seleucid/Parthian
12. Sassanian
13. Early Islamic
14. Middle Islamic
15. Late Islamic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0 20 40 60 80 100
0 20 40 60 80 100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
ARCHAEOLOGICAL PERIODS

the Middle Babylonian Period. A second cycle encompasses the ensuing periods through the Islamic archaeological sequence.

Urbanization as "Deruralization:" The Warka and Nippur-Adab Surveys

In the earlier cycle population density grows, then declines, with a peak in the Ur III/Isin-Larsa periods. Relative urban population and average site size peak in tandem in Early Dynastic II-III, before gradually declining. These three measurements describe a process of population growth and urbanization. This form of urbanization is specified further by contemporaneous decreases in site density and rural site frequency to minimum values in ED II-III. Thus, a growing regional population was accommodated in sites dwindling in number, but increasing dramatically in size. This growth toward a simultaneous urban maximum and rural minimum characterizes the process of urban demographic "agglomeration" (Adams 1981: 75, 90).

This agglomeration was centered on extremely large communities (e.g., ancient Uruk and Umma), as shown by several settlement characteristics. Sites over 100 hectares contribute over half (53%) of the settlement area during the ED II-III urban maximum. Noticeable differences between mean and adjusted mean site sizes attest to the significance of disproportionately large primate cities in ED I (Uruk, 400 hectares; Adams 1981: 85) and in ED II-III (Umma, 200 hectares; Adams 1981: Table 14). Uruk's primate status is demonstrated graphically by a rank-size plot of ED I settlement data (fig. 6).

Zipf (1949) originally noted that the cities of modern industrial nations, when ranked according to their populations, are distributed

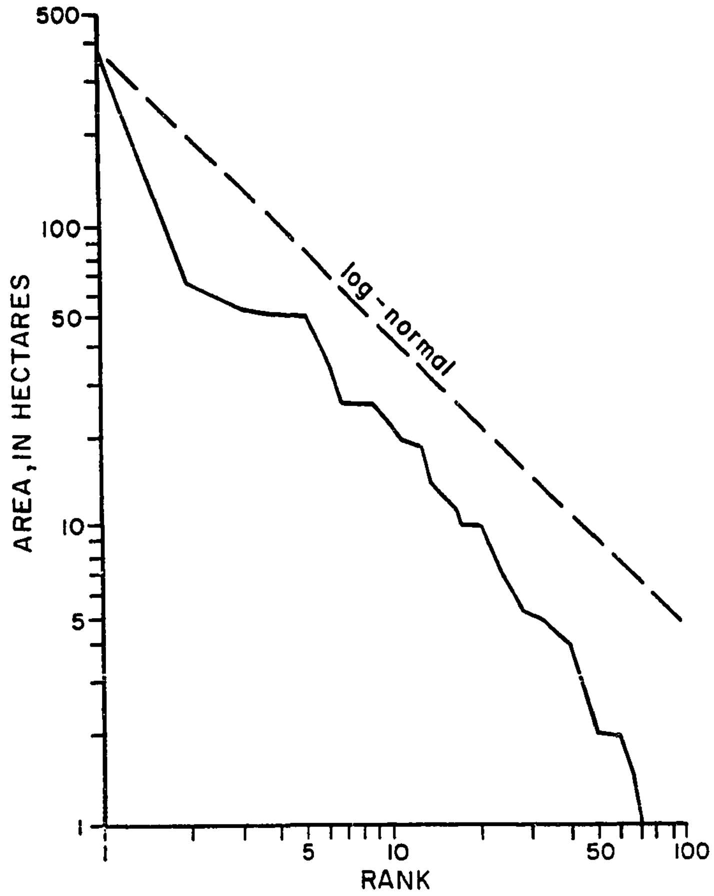


Figure 6. Warka/Nippur-Adab Early Dynastic I rank-size distribution (after Adams 1981: fig. 20).

such that the largest city has twice the population of the second-ranked city, three times the population of the third-ranked, and so on. The rank and population of cities following this "rank-size rule," when plotted logarithmically, describe a log-normal distribution that is manifested in a straight line with a negative slope of forty-five degrees (see the log-normal plot in fig. 6).

A log-normal distribution is thought to reflect a regional balance between an urban center and its rural peripheries (see discussion in Adams 1981: 72-74). Departures from a log-normal distribution indicate urban-rural "imbalance." A concave rank-size plot indicates urban primacy and "suggests either an extraordinary centralization of regional services or a role for the primate city that extends beyond its regional hinterland" (Skinner 1977: 238). A convex distribution conversely indicates relatively less integration of political and economic services among communities in a settlement system, particularly less "vertical" integration between large, possibly urban, communities and rural villages (see Johnson 1980b).

The pronounced urban primacy of Uruk by Early Dynastic I was achieved through the progressive collapse of smaller settlements in its immediate hinterland (Adams and Nissen 1972: 19-21; Adams 1972a: 743; 1981: 85). The agricultural subsistence needs of Uruk's 40,000 or more inhabitants clearly would have exceeded the city's independent agricultural capability (see discussion in Chapter 2). Therefore, an increasing sector of Uruk's population must have been engaged in secondary or tertiary economic activities, including the administration of those remaining outlying villages that <u>did</u> provide for the city's agricultural needs (Adams 1981: 85, 87).

Uruk's spectacular demographic nucleation has prompted Hassan (1978: 86-87) to characterize urbanization generally as a regional increase in the percentage of non-agriculturalists based on diminished rural settlement, or "deruralization." However, deruralization and its attendant decreased agrarian productivity contradict the tendency of central authorities in urbanized regimes to "promote dispersion of the agricultural population into the countryside, closer to the fields" (Adams 1981: 88). The term "urbanization" actually subsumes several trajectories whereby urban communities appear and urban populations grow. Deruralization in the Uruk countryside exemplifies only one path by which urbanization developed in antiquity. This path produced an essentially "hyperurbanized" community with minimal rural agrarian support (see discussion in Adams 1981: 138).

It is abundantly clear that settlement in the Uruk region was actively restructured by its primate urban center. This demonstrates the importance of distinguishing settlement changes that are promoted by local agents of change from those that are the indirect net result of more exogenous factors. The following discussion illustrates diverse histories of Mesopotamian settlement, and emphasizes the need to discern the catalysts, as well as the trajectories, of change.

"Residual Nucleation:" The Nippur-Adab and Susiana Surveys

Within the Warka/Nippur-Adab aggregate survey area two cases of early settlement nucleation developed in fundamentally different manners (see fig. 7). In the Warka area relative population density,

Figure 7. Warka and Nippur-Adab Surveys.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites ≥ 100 ha =

% in sites > 40 ha =

% in sites > 10 ha =

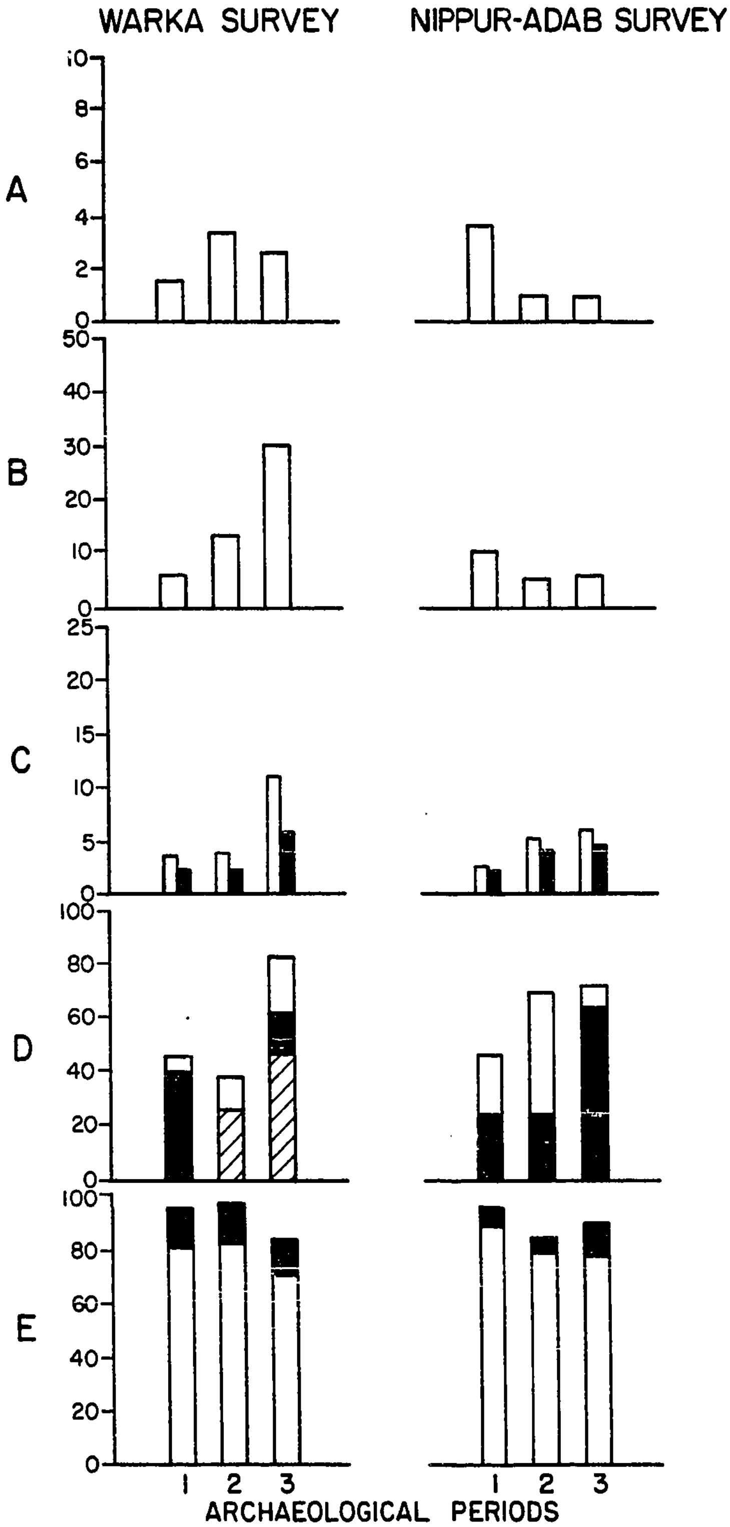
E. Rural Site Frequency:

% sites ≤ 10 ha =

% sites ≤ 5 ha =

PERIODS

1. Early-Middle Uruk
2. Late Uruk
3. Early Dynastic I



WARKA SURVEY
NIPPUR-ADAB SURVEY
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ARCHAEOLOGICAL PERIODS

average site size, and relative urban population increased substantially through the Uruk and ED I periods. The differences between mean and adjusted mean site sizes again reflect Uruk's primacy. After climbing in the Late Uruk Period, both site density and rural site frequency decrease in ED I. Thus, in keeping with the larger Warka/Nippur-Adab regional trends, urbanization in the Warka area was a process of population growth and nucleation focused on the city of Uruk.

In contrast, the Nippur-Adab data do not simply describe an equivalent subset of regional growth and agglomeration. This area shows three trends parallel to those centered on Warka: decreased rural site frequency, increased average site size, and increased significance of large communities (although no sites qualify as "urban," those larger than 40 hectares comprise 65% of ED I aggregate settlement area). However, sharp contemporaneous declines in population and site density show that this nucleation was not a growth process, but was achieved as the net result of a general settlement contraction around the 50 hectare sites of Nippur and Adab (see Adams 1981: 70, 75).

The archaeological record of fourth and third millennium settlement on the Susiana Plain documents parallel processes of nucleation on a smaller scale (see fig. 8). Settlement during Terminal Susa A was limited to three roughly linear clusters of five to six very small villages each (Johnson 1973: 87-88). The subsequent Early and Middle Uruk periods witnessed regional population growth in larger villages and towns, and a general expansion of settlement over the Susiana Plain (Johnson 1973: 90-103).

Figure 8. Susiana Survey.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites $\geq$ 100 ha =

% in sites $>$ 40 ha =

% in sites $>$ 10 ha =

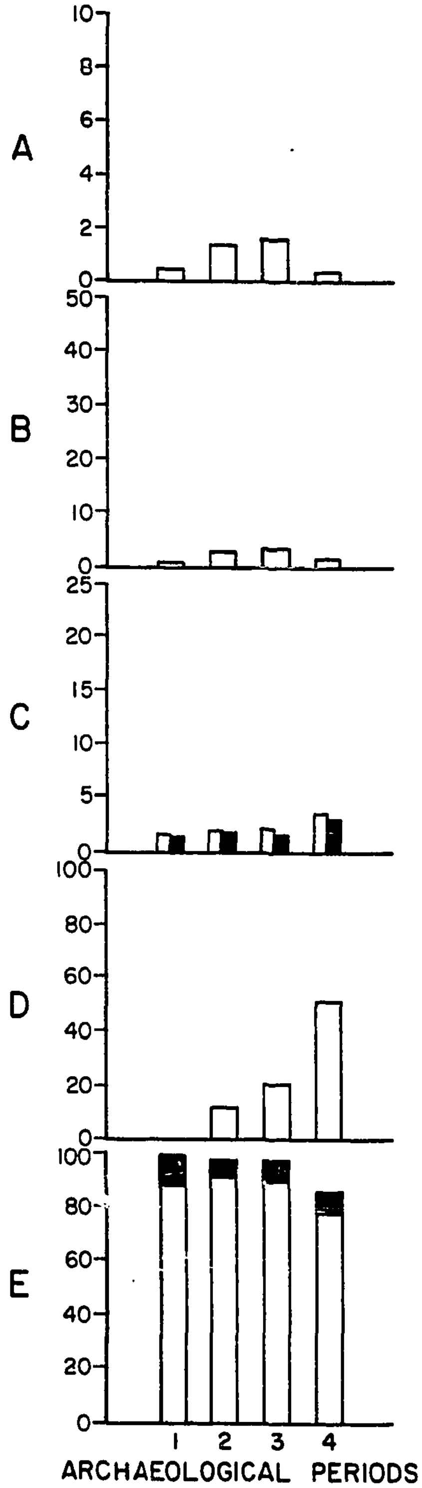
E. Rural Site Frequency:

% sites $\leq$ 10 ha =

% sites $\leq$ 5 ha =

PERIODS

1. Terminal Susa A
2. Early Uruk
3. Middle Uruk
4. Late Uruk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ARCHAEOLOGICAL PERIODS

In the Late Uruk Period rural sites were less frequent, and mean site size and the proportion of regional population in larger communities increased further (although no site exceeded 25 hectares during any of these periods). These trends paralleled those around Warka, and indicate nucleation, albeit on a more modest scale. However, as in the Nippur-Adab area, this case of nucleation was not the result of population growth. Decreased site and population density reflect the abandonment of the northern and eastern sections of the Susiana Plain that left only small village enclaves surrounding Susa and Choga Mish (see Johnson 1973: figs. 13, 14). Therefore, increased settlement in large sites was simply the residual product of a partial collapse of the Susiana settlement and exchange systems (Johnson 1973: 143, 145).

Thus, Hassan's characterization of "deruralization" subsumes two fundamentally different processes of settlement nucleation: "urbanization" based on regional population growth and agglomeration, and "residual urbanization" based on regional population decline that leaves a residual nucleated settlement pattern. Furthermore, in the case of Uruk, an urban center appears to have been the agent promoting change. That is, "urbanization," as exemplified at Uruk, denotes the active restructuring of the countryside by its own urban center. In contrast, early nucleations around Nippur and Adab and in Susiana require explanation in terms of larger, exogenous factors (see discussion in Johnson 1973: 155-156; and cf. Adams 1981: 88).

"Deurbanization" vs. "Ruralization:" The Warka and Nippur-Adab Surveys

Adams (1981: 130-132) argues that the centuries between Uruk's urban maximum and the Middle Babylonian Period were marked by persistent urban flux as competing centers rose and fell. However, the Warka/Nippur-Adab survey data summarized in figure 5 suggest trends of growth and collapse that follow in the wake of this early hyperurbanization.

Population density climbed to a new peak in the Ur III/Isin-Larsa periods. In contrast to the Uruk and Early Dynastic periods, this population expanded into increasing numbers of sites. Relative urban population remained high (near or above 40% through the Old Babylonian Period), but rural settlement rebounded, and mean site size fell sharply. In regional terms, these data reflect the fissioning of a growing population into multiple competitive urban polities and their associated villages (e.g., Lagash and Umma in Ur III; see Pettinato 1970-71; Jacobsen 1969). Thus, we see a general pattern of population growth and dispersal, in which the primary agents of change continued to be cities, the seats of localized, and only fleetingly centralized, authority (Adams 1981: 133).

Institutions of urban-based authority continued to rise and collapse in subsequent periods (see Yoffee 1977: 147-149 on the Old Babylonian "patrimonial bureaucracy"). The aggregate product of these endless struggles between central and local seats of power was a millennium of "urban collapse" through the Middle Babylonian Period. The regional sedentary population declined and urbanism likewise dwindled, but did not disappear. An increased proportion of settlement was dispersed in rural sites of smaller and smaller average size.

For the interval from Early Dynastic II-III through the Middle Babylonian Period these data show a long-term correlation of decreasing urbanism and increasing ruralism, but as the products of two different processes. Following the Ur III/Isin-Larsa periods this developed as the converse of the increased urbanism and population density seen during the "urbanization" of the Uruk and Early Dynastic periods. Therefore, it may be termed "deurbanization." However, between the Early Dynastic and Ur III/Isin-Larsa periods, decreased urbanism was not an aspect of collapse, but was coupled with a growing and increasingly rural population. Urbanism remained quite pronounced, as 40 percent or more of the Akkadian and Ur III/Isin-Larsa populace lived in cities. These data imply that rural development was promoted by these urban communities. In other words, a growing sedentary population may have been made more and more rural as the result of an urban strategy. As an aspect of growth, not collapse, this promotion of rural settlement may be termed "ruralization."

Growth Without Nucleation: The Ur-Eridu Survey

The discussion above suggests that settlement nucleation does not necessarily entail growth. The settlement history of the Ur-Eridu area demonstrates conversely that growth does not necessarily result in nucleation or urbanization (see fig. 9). Survey data show a relatively static pattern of site and population density from the Late ʿUbaid through the Akkadian Period. Exaggerated mean site sizes and large site populations are caused by very small sample sizes in the Early

Figure 9. Ur-Eridu Survey.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites $\geq$ 100 ha =

% in sites > 40 ha =

% in sites > 10 ha =

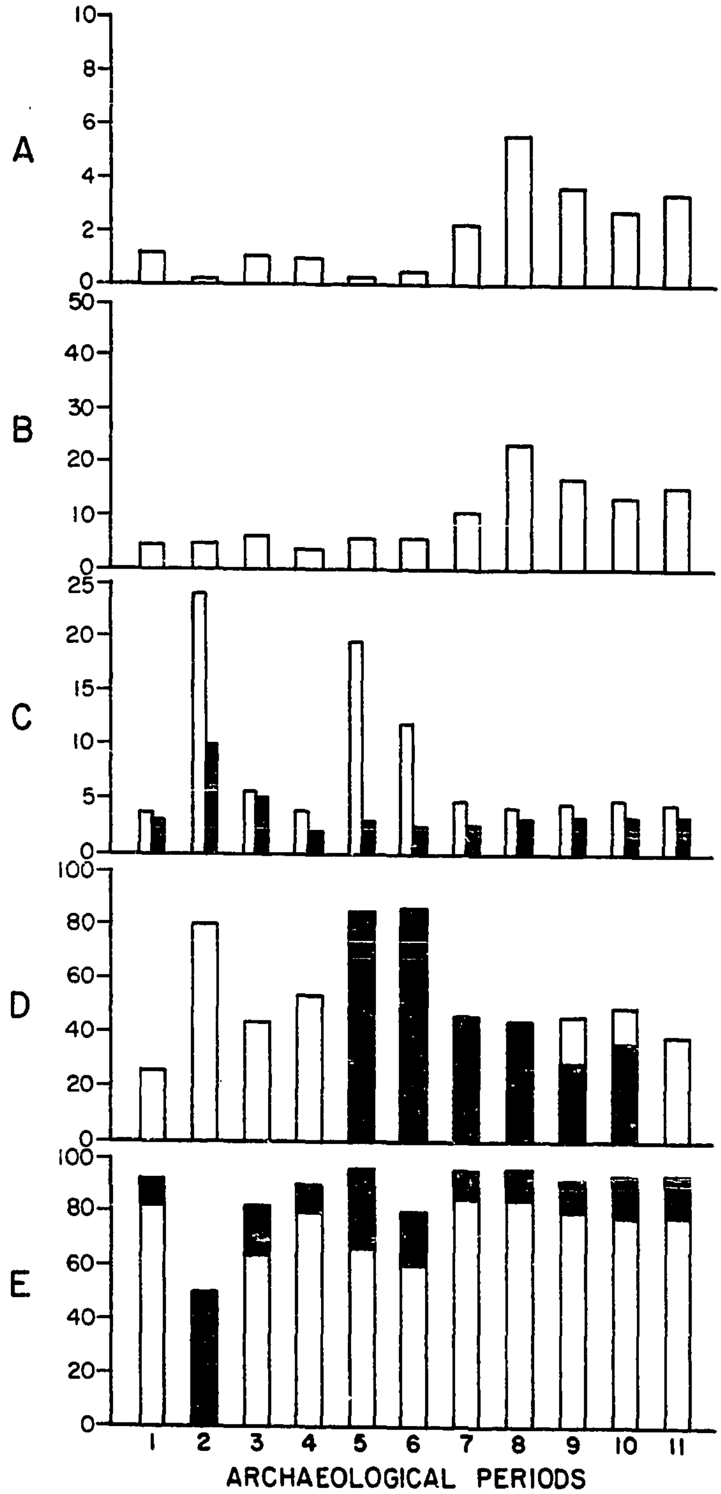
E. Rural Site Frequency:

% sites $\leq$ 10 ha =

% sites $\leq$ 5 ha =

PERIODS

1. Late ʿUbaid
2. Early Uruk
3. Late Uruk/Jamdat Nasr
4. Early Dynastic I
5. Early Dynastic II/III
6. Akkadian
7. Ur III/Early Larsa
8. Late Larsa/Old Babylonian
9. Kassite
10. Post-Cassite
11. Neo-Babylonian/Achaemenid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ARCHAEOLOGICAL PERIODS

Uruk, Early Dynastic II-III, and Akkadian periods. Heavy alluviation probably has obscured many sites occupied in these early periods, resulting in low site frequencies (see discussion of site visibility above).

In Wright's (1981a: 334) view, data from the subsequent Akkadian through Neo-Babylonian/Achaemenid periods describe a "cycle of growth and decay." Site and population density rise to a peak in the Late Larsa/Old Babylonian periods and decline thereafter. However, through this cycle mean site sizes and the relative significance of large and small settlements remained static. Settlement in sites greater than 40 hectares simply reflects the growth of Ur, which reached 50-60 hectares between ED II-III and the Post-Kassite Period (H. T. Wright 1981a: 327-333). Thus, substantial population growth in the Ur-Eridu region did not lead to nucleation, despite population and site densities comparable to those around Warka or Nippur-Adab, and in excess of those in Susiana (cf. figs. 7 and 8).

Episodic Urbanism: The Akkad and Kish Surveys

The settlement history of Upper Babylonia, as inferred from the Akkad survey, includes episodes of urbanism centered on Kish in the Early Dynastic Period, and on Dur Kurigalzu in the Old Babylonian and Kassite periods (fig. 10). Intensive survey of the vicinity surrounding Kish documents one local aspect of this urbanism in greater detail (see fig. 11).

The emergence of Kish as an Early Dynastic urban center, whether viewed on a local or regional scale, was a product of growing

Figure 10. Akkad Survey.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites ≥ 100 ha =

% in sites > 40 ha =

% in sites > 10 ha =

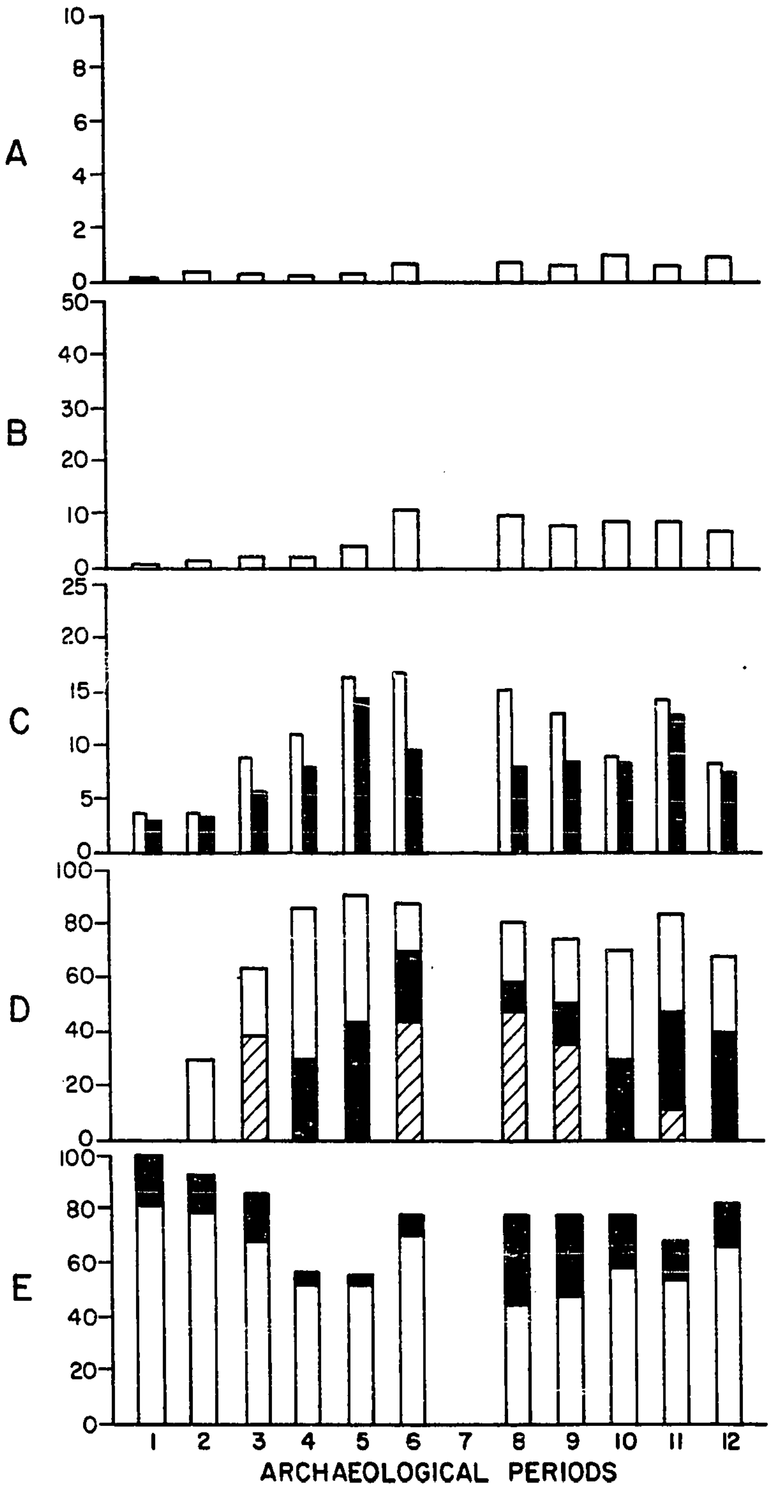
E. Rural Site Frequency:

% sites ≤ 10 ha =

% sites ≤ 4 ha =

PERIODS

1. Late `Ubaid
2. Uruk/Jamdat Nasr
3. Early Dynastic
4. Akkadian
5. Ur III/Isin-Larsa
6. Old Babylonian/Kassite
7. Middle Babylonian
8. Neo-Babylonian
9. Achaemenid (-Seleucid)
10. (Seleucid-) Parthian
11. Sassanian
12. Islamic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ARCHAEOLOGICAL PERIODS

Figure 11. Kish Survey.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites $\geq$ 100 ha =

% in sites > 40 ha =

% in sites > 10 ha =

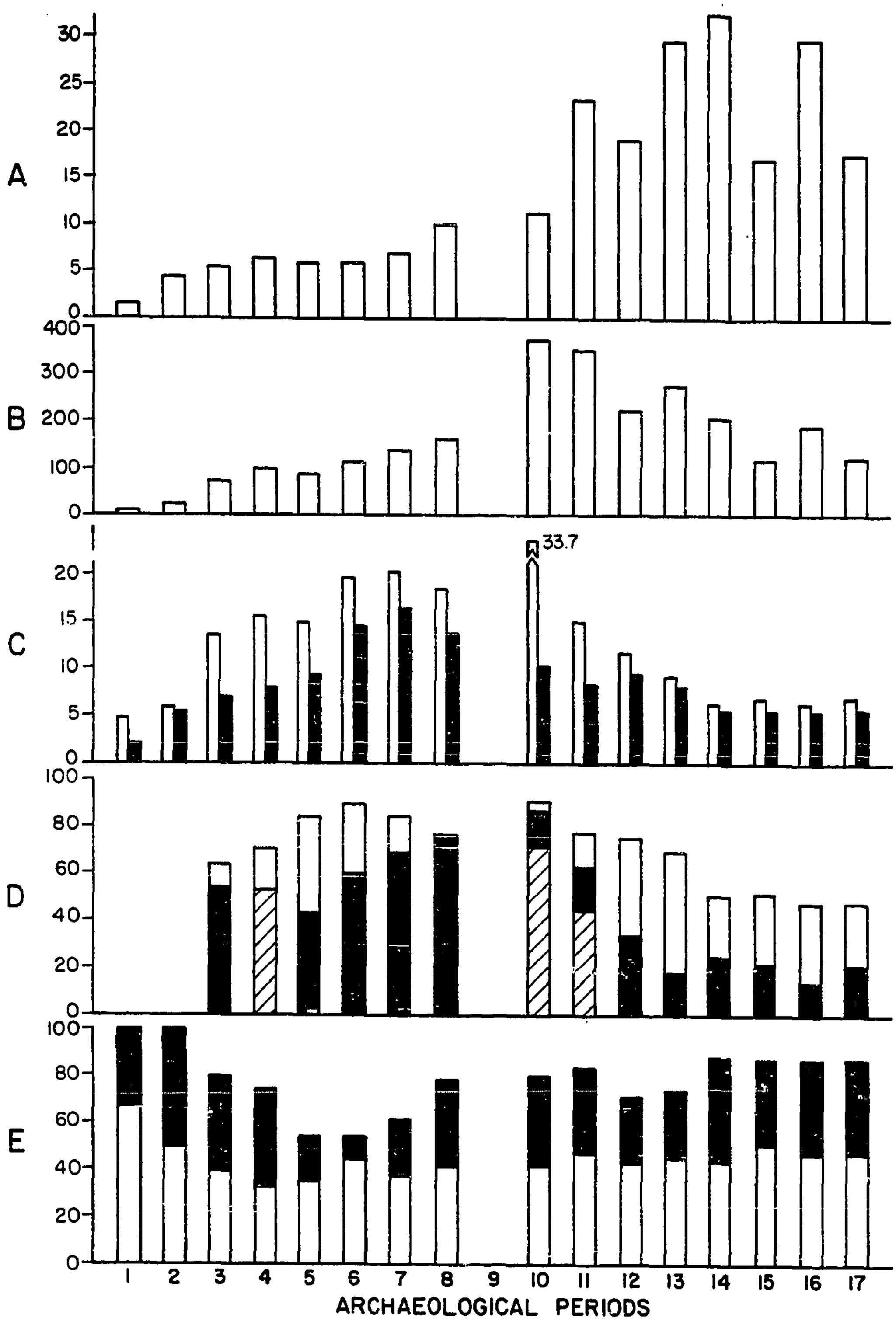
E. Rural Site Frequency:

% sites $\leq$ 10 ha =

% sites $\leq$ 4 ha =

PERIODS

1. Late `Ubaid
2. Protoliterate
3. Early Dynastic I
4. Early Dynastic III
5. Akkadian
6. Ur III/Isin-Larsa
7. Old Babylonian
8. Kassite
9. Middle Babylonian
10. Neo-Babylonian
11. Achaemenid/Seleucid
12. Parthian
13. Sassanian
14. Early Islamic
15. Samarran
16. Late Abbasid
17. Ilkhanid and Post-Ilkhanid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ARCHAEOLOGICAL PERIODS

population density, site density, and mean site size, accompanied by decreasing rural site frequencies (see Adams 1972b: 185; Gibson 1972: 48, 58, 112). This urbanization was similar to contemporaneous nucleation around Uruk, except that the Akkad region had substantially lower site and population densities, and experienced less severe deruralization (cf. figs. 5 and 10). Regional population and site sizes continued to grow through the Ur III/Isin-Larsa periods. During this interval Kish decreased to 65-70 hectares, but remained the region's largest community (Gibson 1972: 48, 50). The primacy of Kish also is suggested in figures 10 and 11 by substantial differences between mean and adjusted mean site areas from ED I to Ur III.

Site and population densities peaked in Akkad with the ascendancy of the Old Babylonian and Kassite dynasties (Adams 1972b: 186). The fortress city of Dur Kurigalzu attained monumental proportions (approximately 500 hectares) during the Kassite Period (Adams 1972b: 190-191). In contrast to earlier nucleation at Kish, rural settlement increased with the appearance of Dur Kurigalzu (Gibson 1972: 50). Both the Akkad and Kish surveys show a rise in rural site frequencies coupled with a drop in adjusted mean site sizes (see figs. 10 and 11). Thus, Old Babylonian/Kassite Akkad illustrates another short-lived case of ruralization, in which rural growth was linked with, and possibly instigated by, a particularly conspicuous regional urban center.

Growth and Ruralism: The Diyala Survey

The settlement record from the Diyala survey area contrasts remarkably with that of the neighboring Akkad region (see fig. 12).

Figure 12. Diyala Survey.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites ≥ 100 ha =

% in sites > 40 ha =

% in sites > 10 ha =

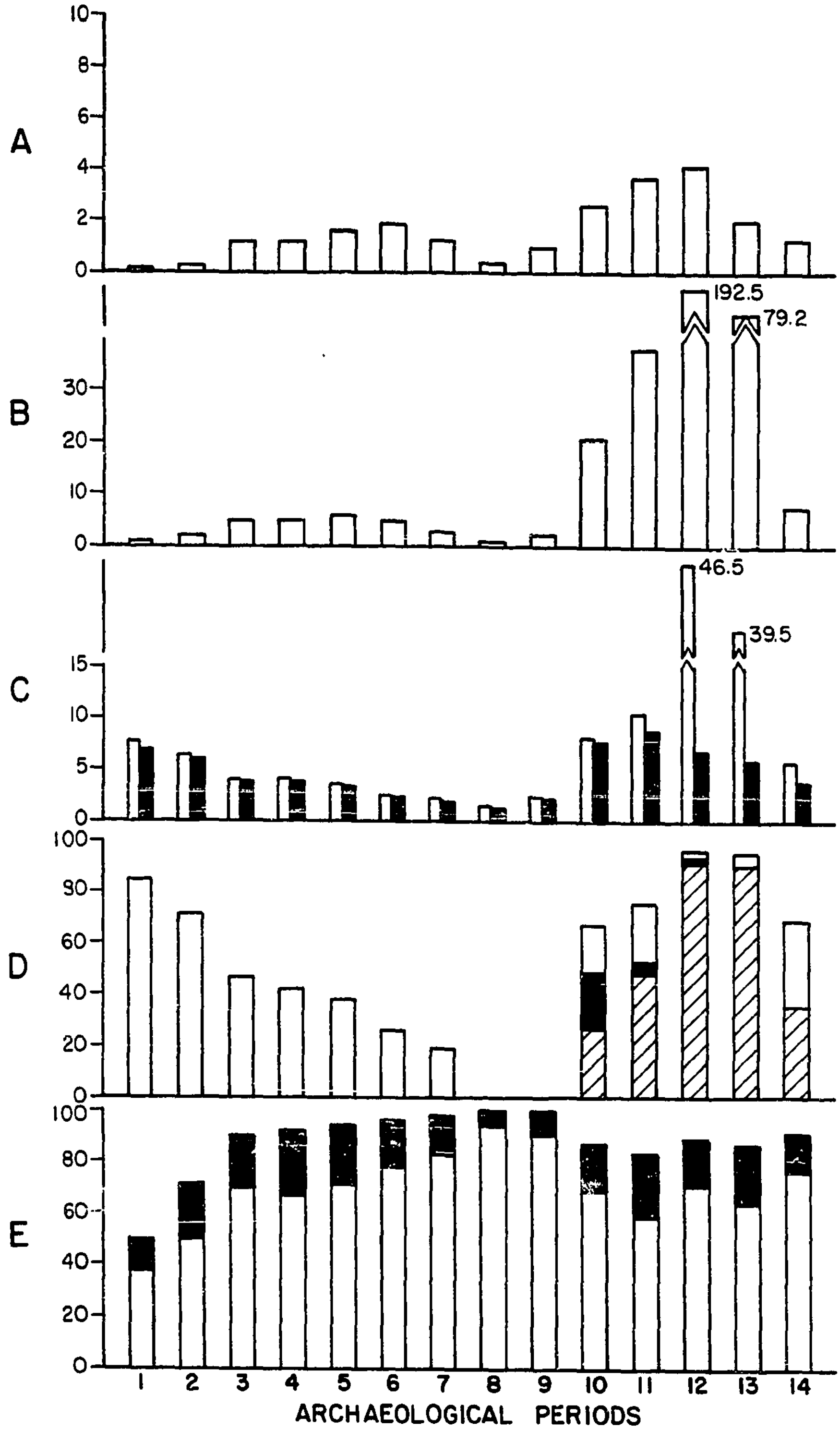
E. Rural Site Frequency:

% sites ≤ 10 ha =

% sites ≤ 4 ha =

PERIODS

1. Late ʿUbaid
2. Uruk
3. Early Dynastic
4. Akkadian
5. Ur III/Isin-Larsa
6. Old Babylonian
7. Kassite
8. Middle Babylonian
9. Neo-Babylonian/Achaemenid
10. Seleucid/Parthian
11. Sassanian
12. Early Islamic/Samarran
13. Abbasid
14. Late Islamic (Ilkhanid)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1 2 3 4 5 6 7 8 9 10 11 12 13 14
ARCHAEOLOGICAL PERIODS

Population density and site density increase, and then decrease, between the ^{c}Ubaid and Middle Babylonian periods. No site larger than 35 hectares is recorded for any of these periods. Most strikingly, unlike any of the regions reviewed above, this entire interval is marked by small communities (none more than 35 hectares) that steadily decreased in average size. The larger settlements among these (i.e., those greater than 10 hectares) dwindled and disappeared altogether by the Middle Babylonian Period. On the other hand, rural site frequency rose quickly to 90% by the Early Dynastic Period. This frequency continued its steady increase until the Middle Babylonian and Neo-Babylonian/Achaemenid periods when all sedentary settlement in the Diyala was rural.

This dramatic disappearance of town life coupled with a proliferation of rural settlements would seem to suggest an extreme example of ruralization. However, the Diyala area lacked settlements even remotely approaching urban size prior to the Seleucid/Parthian periods. Even at its very modest population peak in the Ur III/Isin-Larsa periods, there was little apparent integration of larger and smaller communities, as suggested by the distinctly convex rank-size distribution shown in Figure 13. Therefore, unlike the Warka/Nippur-Adab region in ED II-III through Ur III/Isin-Larsa (see fig. 5) or Akkad in the Old Babylonian and Kassite periods (see fig. 10), an indigenous center was not the agent of these changes, and this cannot be hypothesized as a case of ruralization.

Alternatively, the actions of external urban centers might have

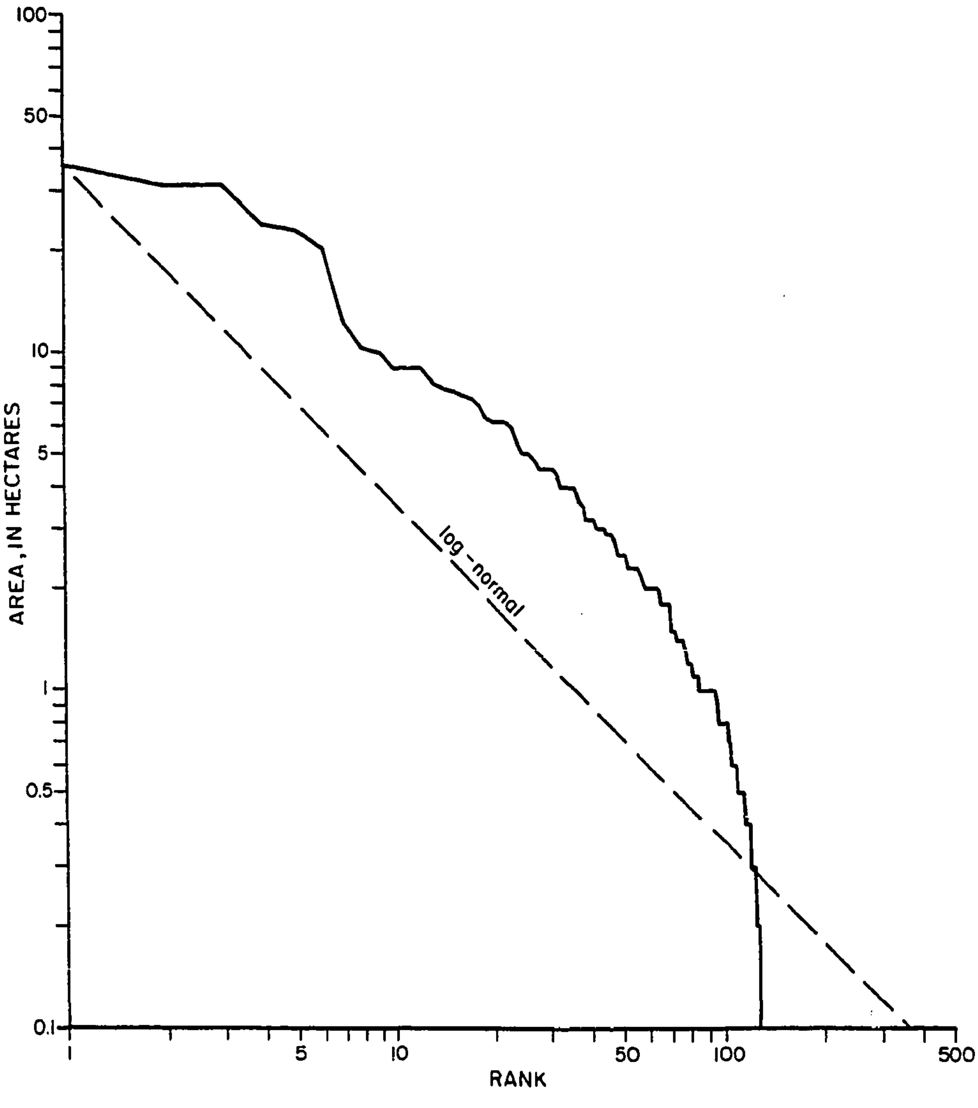


Figure 13. Diyala Region Ur III/Isin-Larsa rank-size distribution (based on Adams 1965: Table 12, Appendix C).

encouraged growth and increased ruralism in the Diyala, just as Early Dynastic deruralization around Uruk may have contributed to decreased populations and "residual" nucleation at Nippur and Adab, and in Susiana (see discussion above). Johnson (1980b:240-241) notes that settlement data from insufficiently large study areas may exclude regional centers and produce a misleadingly convex rank-size distribution. In this case, the Diyala may have been more closely integrated with Akkad and the south under the reign of Sargonic kings over a unified Mesopotamia in the Akkadian Period (Adams 1965: 43). However, Early Dynastic, Akkadian and Ur III/Isin-Larsa settlement patterns in the Diyala do not show significant alterations that might indicate the intervention of outside authorities. Site locations and size distributions changed little through this sequence, aside from short-term disruptions doubtfully associated with the Gutians at the end of the Akkadian Period (see Adams 1965: 43-47).

Significant external meddling did not appear until subsequent Babylonian, Assyrian and Elamite contention over the Diyala in the Old Babylonian and Kassite periods. These disintegrative influences contributed to a pervasive abandonment of irrigated agriculture and the decline of sedentism to a new low by the Middle Babylonian Period (Adams 1965: 46-56). However, the earlier settlement history of the Diyala is characterized best as the indigenous development of sedentary rural town and village life independent of urban intervention.

It must be emphasized that this early rural settlement was neither simply homogeneous, nor entirely agrarian. For example, Early Dynastic settlements differed in architectural complexity and presumed economic and political functions, as well as size. There may have been hierarchical clusterings of Early Dynastic villages around fortified towns at Tell Asmar (ancient Eshnunna), Tell Agrab, and Khafajah (Adams 1965: 38-40; Delougaz 1952). However, the emergence of modest fortified towns (e.g., in the Early Dynastic Period) found "little apparent reflection in the disposition of the remaining, smaller settlements over the countryside" (Adams 1965: 38). Many of these towns occurred in relative isolation, and were providing for their own subsistence without the support of outlying villages (Adams 1965: 41). Thus, neither changes in regional settlement nor integration between settlements was, in any sense, urban-based. It follows that the early development of Diyala town life can be characterized as a form of "complex ruralism" based on differentiation, but minimal integration, between towns and villages.

Mesopotamian Settlement: Middle Babylonian-Islamic Periods

A new developmental cycle began in the Diyala with a very slight increase in Neo-Babylonian/Achaemenid settlement that was limited to villages smaller than 10 hectares (see fig. 12). Subsequently, regional population density and urban settlement rose explosively to new highs in the Early Islamic/Samarran periods, before receding again by A.D. 1400.

Urban Hypertrophy, Ruralization and Deruralization: The Diyala Survey

The Diyala became a focus of Seleucid and Parthian trade and political administration with the founding of urban centers at Seleucia and Ctesiphon on the Tigris. Intensified irrigation, based on channelization of natural watercourses and construction of numerous lateral canals, transformed the lower Diyala into an artificially managed hydrological regime. Towns and villages, which in previous periods were confined to narrow stream-side enclaves, now expanded into broad newly-opened zones of irrigable land (see discussion in Adams 1965: 65-68).

Increasingly centralized rule in the ensuing Sassanian Period emanated from the enlarged capital of Ctesiphon (540 hectares at this time) and its suburbs along the east bank of the Tigris (Adams 1965: 69-70, Table 19; Reuther 1929: 437). Irrigation over virtually the entire lower Diyala region was intensified, and became increasingly dependent on the land management decisions of administratively-distant central authorities (Adams 1965: 74). The last years of Sassanian rule (after ca. A.D. 600) were marked by short-term deterioration of central authority and rapid abandonment of much arable land, possibly due to excessive salinization of fields, siltation of irrigation canals, and ineffective government responses to these problems (Adams 1965: 81).

In the Seleucid/Parthian and Sassanian periods, the Diyala's inhabitants expanded into communities that increased in average size, and ranged from several substantial urban centers to rural villages that remained abundant (i.e., greater than 80% site frequency). In the subsequent Early Islamic/Samarran periods, population growth was focused overwhelmingly in two cities of previously unparalleled size, Baghdad and Samarra. Baghdad was founded as a market town at the end of the Sassanian Period and mushroomed into a megalopolis of 6400 hectares (Le Strange 1900: 325; Adams 1965: 89, table 20). Samarra, intentionally designed as a political capital, had a separate and very brief florescence, growing to 6800 hectares when the central bureaucracy relocated there from Baghdad in the ninth century A.D. (Herzfeld 1948: 137; Adams 1965: 90, Table 20).

These cities epitomized an extreme case of urbanization in which fully 90% of the Diyala's population was urban, if Baghdad and Samarra were occupied simultaneously (see fig. 12). The distinctly concave size-rank distribution of Early Islamic/Samarran sites illustrates the extent of this urban hypertrophy (see fig. 14).

The tremendous populations of these cities must have drawn on immense agricultural sustaining areas, of which the Diyala was a part. Indeed, many Sassanian irrigation systems were renewed quickly under Early Islamic administration of the countryside. However, large areas that had dense earlier settlement were left unoccupied, in some cases because of salinization. Land area under cultivation in the Diyala shrunk by approximately 25% by the mid-ninth century A.D. (see Adams 1965: 99-102).

In larger terms, Sassanian administration was distinct for an urban-directed "immense expansion of cultivated area" (Adams 1981: 180). On the other hand, the Early Islamic urban explosion involved a disappearance of towns that integrated urban and rural settlements. Figure 12 shows that while rural site frequency changed little between the Seleucid/Parthian and Early Islamic/Samarran periods, the relative importance of mid-range sites (<u>i.e.</u>, those greater than 10, but smaller

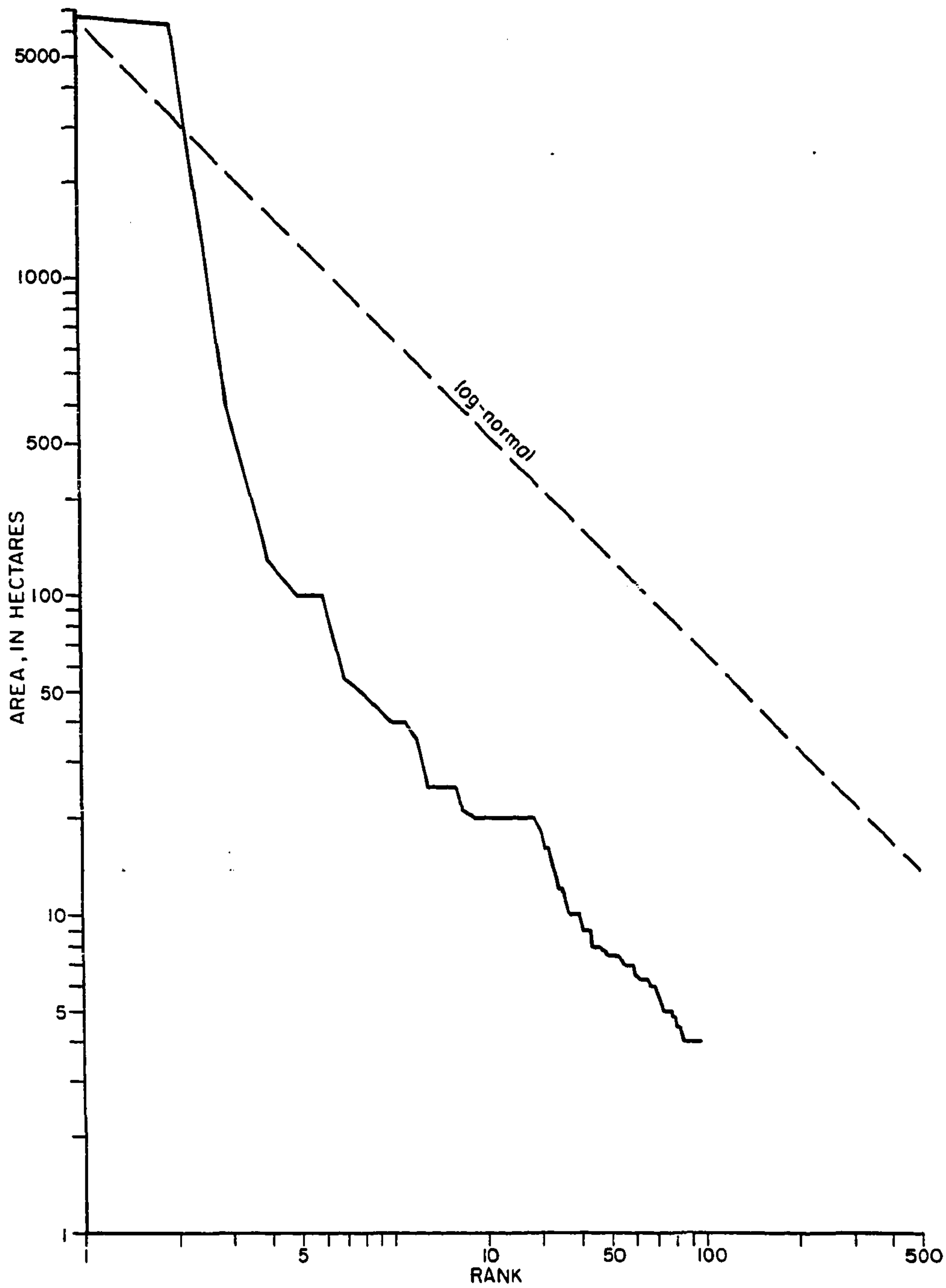


Figure 14. Diyala Region Early Islamic/Samarran rank-size distribution (based on Adams 1965: Table 20, Appendix C).

than 100, hectares) dropped sharply. Thus, the Diyala displays spectacular settlement changes in which urban investment in the countryside, or ruralization, gave way to Mesopotamia's most pronounced case of pre-modern urbanism based on a substantial <u>retraction</u> of that rural investment, or deruralization.

Baghdad persisted as an urban capital only slightly reduced to 5400 hectares after the Samarran Caliphate (see Adams 1965: table 23), but the transformation of settlement outside Baghdad was more drastic. Data for the Abbasid (<u>i.e.</u>, "post-Samarran") and Late Islamic (<u>i.e.</u>, Ilkhanid, or Mongol) periods describe tremendous drops in site and population densities that reflect a pervasive abandonment of sedentism over most of the Diyala. Agricultural settlement became polarized into a village enclave along the Diyala River at its exit from the Jebel Hamrin, and urban habitation focused on Baghdad, which remained the region's pre-eminent city, despite being sacked by the Mongols in the mid-thirteenth century and dwindling to 200 hectares or less (Adams 1965: 106-108; 1981: fig. 53).

Agricultural problems, including severe stream channel downcutting and siltation of canals and fields, contributed to this depopulation (see Adams 1965: 104, 109). More importantly, the Diyala's uniquely-precipitous urbanization and deurbanization best illustrate the effects of urban intervention into, and neglect of, settlement in the countryside.

Heartlands Become Hinterlands: The Akkad, Kish and Warka/Nippur-Adab Surveys

The Middle Babylonian Period represented not only a nadir in urbanism throughout Mesopotamia, but a "marked termination" of sedentary settlement in Akkad (Gibson 1972: 50). This situation is overemphasized in the Akkad and Kish surveys which relied on poorly understood ceramic indicators and reported no Middle Babylonian remains whatsoever (Adams 1972b: 183; Gibson 1972: 159). Urban settlement and political authority were revived at Babylon, which extended well over 200 hectares in the Neo-Babylonian and Achaemenid/Seleucid periods (see Gibson 1972: 112-113, figs. 13 and 14; Adams 1972b: 186-187).

Following a Neo-Babylonian peak in population density, urban settlement disappeared from the vicinity of Babylon. After the collapse of Achaemenid rule, much of this city's population was forcibly relocated in the new capital at Seleucia (Adams 1965: 61), and subsequently Kish enjoyed a brief Parthian expansion (Gibson 1972: 113). Only the Sassanian city of ᶜUkbara punctuated the general deurbanization of Akkad through the Islamic sequence (see fig. 10), as the focus of urbanism shifted north to cities on the banks of the Tigris and their hinterlands in the Diyala.

The Akkad survey shows relatively static regional site and population densities, and only a gradual increase in small villages (i.e., those 5 hectares or less). This deurbanization represented essentially a decapitation of the settlement system. The disappearance of cities in the Kish area was accompanied by a long term population decline, as settlement became increasingly confined to small communities (see fig. 11). Thus, in the former vicinity of urban authority, deurbanization involved a more pronounced collapse of midsized towns, as well as cities.

In the Warka/Nippur-Adab region, urbanism was truncated, but not terminated, in the Middle Babylonian Period. Mean site size rose in the Neo-Babylonian and Seleucid/Parthian periods with the appearance of towns and cities that had no Middle Babylonian antecedents. Adams suggests that these cities were products of "fairly abrupt, probably state-directed, policies of settlement formation" (1981: 178). However, none of these cities was a regionally-dominant center comparable to contemporaneous "creatures of state policy," Babylon, Ctesiphon or Baghdad, in the north (Adams 1965: 110; 1981: 180).

Subsequently, site and population densities rose to all-time highs in the Sassanian Period. In contrast to earlier agglomeration at Uruk in the Early Dynastic Periods, this growth took place overwhelmingly in the countryside with the dwindling participation of local cities that disappeared in the Islamic periods (see fig. 5). The convex rank-size distribution of sites dating to the apex of this late growth shows the absence of a pronounced regional center, and limited urban-rural integration (see fig. 15; Adams 1981: 183). By the end of the Sassanian Period, southern Babylonia had been made rural at the direction of Mesopotamia's later urban centers to the north. Thus, the settlement history of Mesopotamia came full circle. The primal deruralized urban heartland had become ruralized hinterland.

Summary

The settlement record of the urban "heartland" of Mesopotamia describes a mosaic of different processes of urban and rural growth and

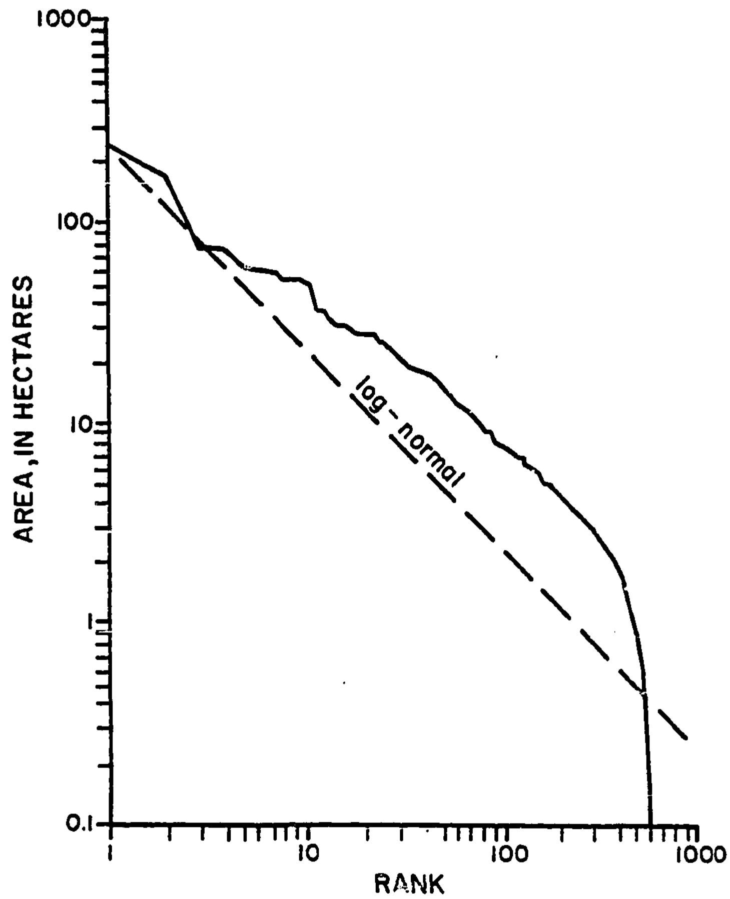


Figure 15. Warka/Nippur-Adab Sassanian rank-size distribution (after Adams 1981: fig. 38).

decline. Adams (1984: 81) has remarked that Mesopotamia's cities flourished only during "fleeting periods of integration and prosperity," amid "the longer and more frequent periods of stagnation or breakup." However, the history of settlement along the Tigris and Euphrates was characterized by the consistent molding influence of some element of urbanism.

The history of human settlement in Mesopotamia can be broken into two major time frames punctuated by the Middle Babylonian nadir of sedentary population and urbanism. Settlement during both before and after the Middle Babylonian Period was marked by a variety of developmental trajectories. The growth and collapse of Mesopotamian urban centers are interpreted above in terms of urbanization/deruralization, ruralization and deurbanization. The most spectacular examples of Mesopotamian urbanization were based on marked population growth and the decimation of rural towns surrounding early historic Uruk and, following the advent of Islam, Baghdad and Samarra. This process of hyperurbanization has been characterized aptly by Hassan (1978: 86-87) as "deruralization." A more modest example of urbanization as deruralization was centered on the Early Dynastic city of Kish where the pronounced growth of towns resulted in sharply reduced frequencies of rural settlement.

Regional population growth in Mesopotamia had an alternative expression with the opposite impact on rural settlement. This process of "ruralization" is exemplified most clearly in the Uruk/Nippur-Adab region where substantial urbanism continued after the Early Dynastic Period, but growth was expressed primarily in an abundance of small villages. Ruralization also characterized settlement around the Kassite center of Dur Kurigalzu and in the Sassanian hinterland of southern Mesopotamia.

Rural settlement increased in relative frequency in cases of "deurbanization," as well. However, these relative increases were the net results of urban recession, as seen around Uruk in the second millennium B.C., in Akkad following the collapse of Babylon, and in the Diyala after the Samarran Caliphate. In ancient Mesopotamia deurbanization was a process of urban collapse often based on declining regional population or dwindling sedentism. In distinct contrast, ruralization and deruralization were <u>urban</u> growth strategies whereby the <u>cities</u> of Mesopotamia vigorously restructured the configuration of towns and villages surrounding them. For example, during the Uruk and Early Dynastic periods, the primate center of Uruk absorbed or discouraged peripheral subsidiaries. Thereafter, competition and conflict between multiple Ur III/Isin-Larsa cities apparently encouraged very different behavior by urban authorities which actively <u>promoted</u> local ruralism.

For the sake of comparative analysis, our attention must also turn to the peripheries of Mesopotamia's urban heartland that periodically lacked cities and, therefore, their restructuring influence on regional settlement. Population growth in the Ur-Eridu region had little effect on the relative importance of rural villages or large towns (<u>i.e.</u>, those larger than 40 ha.). During the early history of the Diyala, no community even remotely approached urban size, and population growth simply led to an abundance of smaller and smaller villages. On the other hand, the inhabitants of the Nippur-Adab and Susiana regions did become concentrated in towns, but simply as part of a larger decline in population and abandonment of many villages. In contrast to the early deruralization and hypertrophy centered on Uruk, these examples of nucleation were not the results of an urban growth strategy.

Mesopotamian urban centers were not everlasting, as clearly indicated in this chapter's overview. Early urbanism peaked and subsided around ancient Uruk, only to be supplanted by later, and larger-scale, urbanized settlement centered at Kish, Babylon and Baghdad. Although the prime focus and specific influences of urbanism were ever-changing, most major episodes of growth were instigated by the actions of cities.

As Chapter 4 demonstrates, the southern Levant also contained early towns and cities. Nevertheless, in striking contrast to Mesopotamia, growth during the third and second millennia B.C. never was manifested by increased urbanism, and regional settlement systems were not molded by their urban elements. Thus, Chapter 4 reviews a very different settlement history, and directs our attention to complex society in the countryside.

CHAPTER 4: URBANISM AND RURALISM IN THE SOUTHERN LEVANT DURING THE BRONZE AGE

The archaeological record of the southern Levant in the Bronze Age (ca. 3000-1200 B.C.) is marked by the initial appearance of town life, its relatively brief abandonment, and its subsequent rejuvenation. The development of numerous large villages in the Early Bronze Age and the possible appearance of vague local polities in the Middle and Late Bronze ages are used as implicit evidence of a long era of "urbanism" associated with the Canaanites of the Old Testament and other historical sources. Currently prevailing archaeological interpretations hold that Canaanite cities grew, and exercised increasingly centralized economic and political functions as Bronze Age society developed to an apex of pre-classical urbanism by ca. 1500 B.C.

The urbanization of Canaanite society is inferred almost entirely from the development of relatively large, often fortified, communities. These Bronze Age towns measured only a fraction of the size of contemporaneous cities elsewhere, particularly in Mesopotamia. The small scale of Canaanite "urbanism" has been acknowledged, but only as the natural result of its introduction from distant foreign sources (de Vaux 1971; Lapp 1970). The discontinuous history of town development in the southern Levant also has encouraged numerous searches for external stimulation of Bronze Age town life. Foreign influences from Egypt and/or Syria have been inferred from interregional similarities in material culture (especially pottery) and in the distributions of large sites that are assumed to mark the routes along which urban traditions were introduced into Palestine. Thus, only phylogenetic relations are interpreted from the scale of "urban" phenomena in the southern Levant. Accordingly, the largest third millennium B.C. settlements of Mesopotamia (Uruk, maximum size = 400 ha.) and Palestine (Kabri, maximum size = 30 ha.) are interpreted as equally "urban," although they differed tremendously in size.

Chapter 2 presents an alternative approach to archaeological site sizes as indicators of urban-rural relations. Application of this approach to the archaeological record of the southern Levant shows that Canaanite complex society should not be interpreted simply as a scaled down case of regional urbanism. Instead, the basis of social and economic differentiation -- and the main arena of growth and development -- lay in the countryside. Therefore, Canaanite society is characterized more informatively in terms of "rural complexity," rather than urban pre-eminence.

The nature of Bronze Age villages and their roles in "rural complexity" are illuminated in detail by an analysis of excavated and survey data from several sites in the Jordan Valley, particularly Tell el-Hayyat and Tell Abu en-Ni^{c}aj. This local study is presented in chapters 5, 6 and 7. The broader regional and historical context of this study may be seen by reviewing the archaeological record of the southern Levant and previous attempts to interpret Canaanite society there. A revised perspective on Bronze Age urbanism is presented as part of this overview, based on settlement data compiled from numerous archaeological surveys within Palestine.

Constraints on Survey Data for Bronze Age Palestine

Survey operations in Palestine do not confront alluvial masking processes on the scale of those in Mesopotamia. However, the quality of survey data from Palestine is affected by many of the same factors summarized in Chapter 3. Cultural factors (e.g., modern settlement and agriculture) hamper archaeological reconnaissance. At stratified tell sites in both regions, the sizes of early occupations are obscured by later archaeological deposition. Topographic prominence again favors the detection of large tell sites at the expense of less visible ancient villages and encampments. Broshi and Gophna (1984: 41; 1986: 73, 88) estimate that up to twenty percent of the aggregate area of Bronze Age settlement remains undiscovered. They suggest that the likelihood of finding many more sites larger than five hectares is "practically nil" (Broshi and Gophna 1986: 88; 1984: 50). Thus, small settlements are expected to comprise the vast bulk of undetected habitation area.

With these constraints in mind, this chapter discusses Bronze Age settlement data from the southern Levant (see Table 11). Broshi and Gophna present data collected from a cumulative area of 14,000 square kilometers extending over most of modern Israel (excluding the Negev Desert and the Wadi Araba) and the West Bank of the Jordan River (1984: 41; 1986: 73) (see fig. 16). Joffe (1985) and Mabry (1984) consider the same general region, and their aggregate coverage also is estimated at 14,000 square kilometers here.

Gonen presents settlement data for 77 excavated Late Bronze Age sites, many of which also were occupied in the Middle Bronze Age (1984:

Table 11. Sources of Bronze Age settlement data for the southern Levant.

Time Period	Reference(s)
Early Bronze I-II	Joffe 1985
Early Bronze II-III	Broshi and Gophna 1984
Middle Bronze II	Broshi and Gophna 1986; Mabry 1984
Late Bronze I-II	Gonen 1984

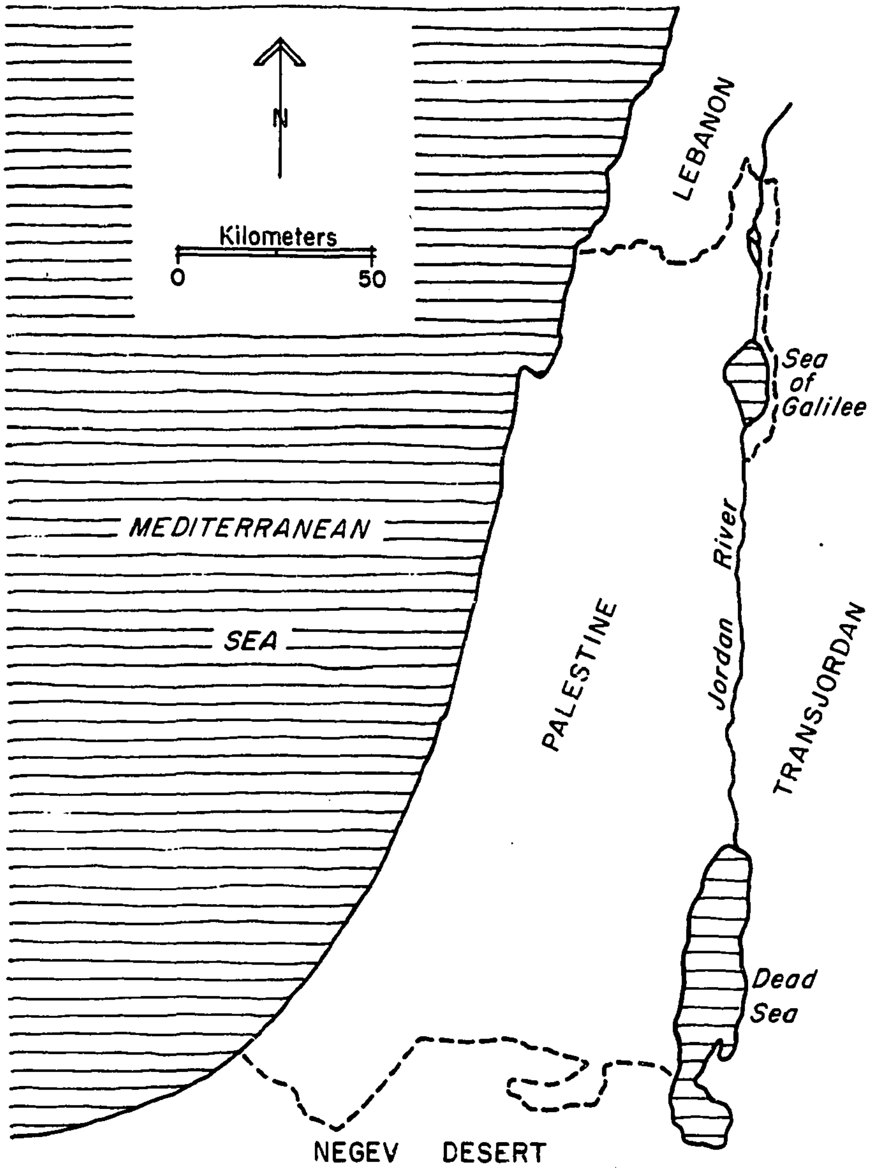


Figure 16. Cumulative survey coverage reported by Broshi and Gophna (1984; 1986).

63, Table 1). A simple tally of Middle Bronze and Late Bronze sites reported in ten surveys is provided, but Gonen makes no pretense of relatively complete regional coverage, as attempted by the four other authors above.

No significant conflict is apparent in the chronologies used by these authors. Terminology is consistent with that shown in Table 12. Gonen suggests that Late Bronze Age settlement began in the sixteenth, rather than the fifteenth, century B.C., but this flexibility is accommodated easily in the chronology of Palestine.

Unfortunately, the reconnaissance methods used by the numerous surveys in each compilation are left undiscussed. Only Joffe notes that survey intensity has varied between some areas within Palestine (1985: 6). Thus, these data constitute a first, relatively undigested, but important body of data on regional settlement in Palestine. Their interpretation here recognizes their limitations as noted above.

Regional Chronology

In best tripartite tradition, the Bronze Age of the southern Levant is divided into Early, Middle and Late components (see Table 12). The subdivisions of this chronology are particularly dependent on tie-ins with the early dynastic history of Egypt. Temporally-diagnostic Egyptian artifacts excavated in Palestine and Palestinian pottery found in Egyptian tombs permit interregional correlation of relative chronologies.

Correlation of foreign artifacts suggests that the appearance of sedentary town life, in late Early Bronze I (*ca.* 3000 B.C.), paralleled

Table 12. Palestinian Chronology.

YEARS B.C.	PERIOD
ca. 1200	
	Late Bronze II B
1300	
	Late Bronze II A
1400	
	Late Bronze I B
1450	
	Late Bronze I A
1500	
	Middle Bronze II C
1650	
	Middle Bronze II B
1800	
	Middle Bronze II A
2000	
	Early Bronze IV
2300	
	Early Bronze III B
2450	
	Early Bronze III A
2650	
	Early Bronze II
2900	
	Early Bronze I
3200	

the rise of the First Dynasty of Egypt (de Vaux 1971: 233). The subsequent Early Bronze II-III periods (ca. 2900-2300 B.C.) were marked by the growth of numerous communities atop the mounded tell sites of the southern Levant. This era was contemporaneous with the first centralized political authority in Egypt during Dynasties I-V of the Old Kingdom. Likewise, Early Bronze II-III is characterized as the first episode in the rise of Canaanite "urbanism" through the third and second millennia B.C.

The chronological definition of the subsequent Early Bronze IV Period stems from our knowledge of contemporaneous social and political conditions in the Nile Valley. At the end of the Fifth Dynasty (ca. 2300 B.C.), Egypt entered the "First Intermediate Period" commonly referred to as a dark age, but better understood as a period of decentralized political and economic organization during which Egypt exerted little influence in Palestine (e.g., Ward 1971: 45-46; Hallo and Simpson 1971: 237-244). The First Intermediate Period ended with the re-establishment of central authority by the Twelfth Dynasty, ca. 1991 B.C. (See also Hennessy 1967 and Weinstein 1975 on Egyptian-Palestinian relations at this time.)

The time range ca. 2300-2000 B.C. in Palestine has been characterized as an interlude of non-sedentary pastoral life between periods of urbanism and sedentary agriculture in the Early Bronze Age (i.e., Early Bronze II-III) and the Middle Bronze Age (i.e., Middle Bronze II, ca. 2000-1500 B.C.). This transitional era includes the archaeological periods originally labeled "Early Bronze IV" and "Middle Bronze I" by W. F. Albright (e.g., 1949; 1962; 1966). More recently

"Early Bronze IV" terminology has been suggested for the whole of Albright's old Early Bronze IV and Middle Bronze I by Olavarri (1969), Lapp (1970), G. E. Wright (1971), Oren (1973), Dever (1980) and Richard (1980). This body of opinion maintains that Middle Bronze I material culture really derived from Early Bronze traditions, and that "Middle Bronze" terminology is both inappropriate and misleading. The revised Early Bronze IV nomenclature is adopted here (see Table 13). To avoid excessive confusion, existing Middle Bronze II chronology and terminology will not be altered. It seems preferable simply to excise "Middle Bronze I" altogether (following Dever 1976: 9).

The duration of Middle Bronze Age town life roughly paralleled Egypt's Middle Kingdom. The beginning of this era in Middle Bronze II A was contemporaneous with the ascension of the Twelfth Dynasty, and marked the rebirth of settlement on large mounded tell sites in Palestine and Transjordan. The end of Middle Bronze II A correlated with the transition to the Thirteenth Dynasty, ca. 1800 B.C. The following periods, Middle Bronze II B and C are often analyzed jointly as the "zenith" of urban city-state development in the southern Levant prior to Roman imperial annexation (see Dever 1987). Middle Bronze II C (ca. 1650-1500 B.C.) was roughly contemporaneous with an interval of decentralized political authority in Egypt during which the Fifteenth Dynasty of "Asiatic" or "Hyksos" kings ruled much of Lower Egypt. Military disruptions associated with the collapse of Hyksos power, and possibly with their expulsion into Palestine, marked the end of the Middle Bronze Age.

Table 13. Early Bronze IV/ Middle Bronze I terminology (see Dever 1980: 31).

FORMER	YEARS B.C.	REVISED
	ca. 2000	
late Middle Bronze I		Early Bronze IV C
	2100	
early Middle Bronze I		Early Bronze IV B
	2200	
Early Bronze IV		Early Bronze IV A
	2300	

The Late Bronze Age encompassed the time span between these Hyksos-related disturbances and the appearance of the "Sea Peoples" along the eastern Mediterranean seaboard ca. 1200 B.C. Late Bronze I settlement (ca. 1500-1400 B.C.) followed the destructions of many large towns in the southern Levant. Late Bronze II A correlated with the "Amarna Age" of pharoahs Amenhotep III and Amenhotep IV (Akhenaten) during the fourteenth century B.C. Late Bronze II B commenced with the rise of the Nineteenth Dynasty, and the campaigns of Ramses I and Seti I into Palestine, and ended with the apparently calamitous arrival in Palestine of the Philistines during the reign of Ramses II just prior to 1200 B.C.

Previous Interpretations of Early Bronze Age Settlement

Discussion of Palestine's Early Bronze I Period rarely moves beyond chronological and geographical comparative analyses of pottery (e.g., de Vaux 1971). Reliable ceramic sequences are available from relatively few sites (e.g., Jericho [Kenyon's Phase J and tombs], Arad [Strata 4-3] and Bab edh-Dhra[c] [tombs]. Stratigraphic sequences from some Early Bronze sites (e.g.,[c]Ai, Tell el-[c]Areini [ancient Gath] and Tell el-Far[c]ah [N]) may begin in EB I (Kempinski 1978: 12-15). However, a cautious approach (e.g. Lapp 1970) to these data is prudent in light of stratigraphic uncertainties, most graphically exemplified in Megiddo Stratum XIX (cf. Loud 1948; Kenyon 1958; de Vaux 1971).

Regional overviews of Early Bronze I ceramics have hypothesized a mosaic of pottery groups and disjunct associated populations in Palestine (Hennessy 1967: 46; de Vaux 1971: 211-212; Kempinski 1978:

6). This emphasis on ceramic heterogeneity has encouraged assumptions of associated demographic changes. For example, ill-defined "ceramic developments" through the Early Bronze I sequence are offered as evidence of successive "population increments" (Lapp 1970: 109). The Early Bronze I sequence is capped by the appearance of "Esdraelon Ware," which has been seen variously as the indicator of yet another cultural group (Kenyon 1965a: 92-97; de Vaux 1971: 536) or simply an additional variant in the ceramic repertoire of northern Palestine (Hennessy 1967: 46). Unfortunately, much established literature on Palestine's Early Bronze Age resorts uncritically to immigrations as the causes of change, particularly population and settlement growth.

Dispersed settlement and regional variability in pottery in Early Bronze I gave way to a significantly different pattern of large town sites and generally homogeneous pottery in Early Bronze II-III. Hypotheses of invasions or "infiltrations" at this transition (e.g., de Vaux 1971: 233-234; Lapp 1970: 111) have been superseded by Amiran's proposal of an Early Bronze "population explosion" (Amiran, et al. 1978: 85) and Kempinski's (1978: 15) explanation of urbanism predicated on technological change.

Amiran emphasizes data from the thoroughly excavated, but modestly-sized site of Arad (maximum size = 9 ha.; Amiran, et al. 1978). Although the Early Bronze I-II interface is marked by growth at Arad, and more abundant sedentary settlements in Palestine (Broshi and Gophna 1984: 14; Joffe 1985), survey data do not describe a quantum leap that resulted in particularly dense regional population (see discussion below).

Kempinski (1978: 9, 15-16) hypothesizes a process of demographic nucleation from smaller Early Bronze I sites into larger, less numerous Early Bronze II "urban settlements" made possible by "a marked improvement in the means of production." He refers primarily to the metal industry, but also to the routinized manufacture of pottery (see also de Vaux 1971: 229). Kempinski (1978: 16) assumes too easily that such nucleation occurs "wherever urban society appears" as a result of decisions made by centralized social authorities. Discussion in Chapter 3 above demonstrated that even in Mesopotamia, where nucleation was prototypified around Uruk, growth and urbanization took a variety of forms. Furthermore, survey data for Palestine simply refute Kempinski's expectations (see discussion below).

The Early Bronze II-III Archaeological Record

The archaeological record from late Early Bronze I through Early Bronze III is marked by homogeneity in ceramics and the common appearance of defensive architecture in Palestine and Transjordan. Based on these two hallmarks, Early Bronze II-III traditionally are interpreted as the first periods of "urbanism" in the southern Levant. Late Early Bronze I (e.g. Lapp's Early Bronze IC = Kenyon's Proto-Urban C) simply represents an interval during which the latest versions of Early Bronze I ceramics and the prototypes of the Early Bronze II-III sequence were in use contemporaneously (see Hennessy 1967: 20; Lapp 1970: 110).

The ceramic industry of Early Bronze II perpetuated vessel forms and methods of decoration established in Early Bronze I. For example, the characteristic Early Bronze red slip was maintained through Early Bronze III A before dwindling in Early Bronze III B and disappearing in Early Bronze IV. Early Bronze III is set off from Early Bronze II most notably by the appearance of "Khirbet Kerak Ware" (see e.g. Hennessy 1967: 22-23). This very distinctive red and black polished, handbuilt ware takes its name from the site of Khirbet Kerak (= Beth Yerah) on the southern shore of the Sea of Galilee and is rare south of the Esdraelon Plain (de Vaux 1971: 213; Kempinski 1978: 30). Attempts have been made to link this ware with contemporary polished wares in Anatolia, Transcaucasia and the Balkans (see Hennessy 1967; Kelly-Buccelati 1974; 1978: 74-75; Kempinski 1978: 26, 30).

The Early Bronze II-III continuity in ceramics was accompanied by a growing number of commonly fortified villages (Broshi and Gophna 1984: 41). Settlement was most dense in northern Palestine along the coastal plain, and through the Jezreel, Beth Shan, Huleh and Jordan River valleys (Broshi and Gophna 1984: fig. 2; Joffe 1985: 14). Diffusionist explanations assume that the northern distribution of Early Bronze II-III sites, particularly of large town sites, reflects the spread of fortifications south from Syria in the wake of frequent immigrations and accompanying hostilities (Lapp 1970: 113-114, 119). However, fortifications became widespread over a relatively short period of time and appeared early in Early Bronze II at some of Palestine' southernmost sites (e.g., Tell el-ᶜAreini).

De Vaux emphasizes Early Bronze site locations along trade routes and the importance of international exchange, rather than population movements (1971: 229). He points to material culture excavated from Early Bronze sites in Palestine that suggests more substantial economic exchange with Egypt and Byblos than contact with, or invasion from, Syria or Upper Mesopotamia (de Vaux 1971: 229-231). Taking this to an extreme, Kempinski (1978: 17, 32) sees unspecified "initial activities" of Egypt's First Dynasty as the "impulse" for urbanization in Palestine.

It is commonly argued that the Early Bronze Age reflects not only the emergence of Palestine's first urban civilization, but also the beginning of city-state political organization (Lapp 1970: 112; de Vaux 1971: 234; Kempinski 1978; Joffe 1985). Current interpretations of Early Bronze Age urbanism depend on excavated data from a small number of sites, all of which have been interpreted as major towns or cities. At Jericho (Kenyon 1965b: 107) a pre-existing village added defensive walls as early as Early Bronze I. Most other cases of substantial village build-up and defenses developed first in Early Bronze II (e.g., Lachish [Kenyon 1965a: 118], Ta^{c}anach [Lapp 1967: 9-10]). The sites of ^{c}Ai (Marquet-Krause 1949; Callaway 1980) and Tell el-Far^{c}ah [N] (e.g., de Vaux 1962) provide the best excavated examples of domestic architecture, sometimes multi-storied (e.g., at Jericho, Garstang 1935: 152), in Early Bronze II-III "urban" contexts. This database of large excavated sites is unable to illuminate the differentiation and interdependence of cities and villages that lie at the heart of urbanism. This has obscured the roles of Early Bronze Age rural communities that were particularly abundant in the central hill country of Palestine.

The appearance of these generally small, sparsely distributed sites has been interpreted as a response to Early Bronze population growth (Amiran 1970; Broshi and Gophna 1984) or as a reflection of the ever-present role of pastoralists in Canaanite settlement and society (Joffe 1985: 15). Amiran et al. (1980) briefly discuss the relationship of Arad with its immediate hinterland. However, the attention of archaeological overviews of the southern Levant remains focused away from rural communities, providing a consistently "urbanocentric" perspective on Early Bronze Age settlement and society.

The Collapse of Early Bronze Age Towns

Many large settlements, particularly in northern Palestine, were deserted by the end of Early Bronze II for reasons not well understood. Occupation at a few southern sites continued through the first half of Early Bronze III (Early Bronze III A), suggesting a possible shift of sedentary populations into marginal areas near the Negev and in Transjordan. The beginnings of this transition to marginal settlements and seasonal encampments, which continued through Early Bronze IV, have been neglected archaeologically. Only the necropolis and a few domestic areas at Bab edh-Dhra^c on the Dead Sea have provided much evidence thus far (Lapp 1966; Rast and Schaub 1978; 1980; 1981; 1984).

It is now clear that occupation of numerous lesser tell sites in southern Palestine continued after the initial decline of sedentary town life. This situation had been suspected by some on the basis of late Early Bronze III evidence from Lachish (Tufnell 1958), Tell Beit Mirsim (Stratum J) (Dever and Richard 1977), ᶜAi (Marquet-Krause 1949), and several late tombs at Jericho (Kenyon 1965b). The recent excavation of stratified deposits from the fortified tell sites of Tell Yarmuth (Ben-Tor 1975), Tell Halif (Seger and Borowski 1977) and Tell el-Hesi (Fargo and O'Connell 1978; Fargo 1980; Ross 1980) has bolstered the likelihood that some towns persisted until 2300 B.C., at least in the south. However, all traces of occupation at these sites cease abruptly in Early Bronze IV, during which excavated evidence of towns west of the Jordan Valley/Wadi Araba is lacking. Complete abandonment is apparent through Early Bronze IV at most of the best known tells of Palestine (e.g., Ta^canach, Tell Far^cah [N], ^cAi, Gezer, Arad) (Dever 1980: 42).

Reassessing Early Bronze Age Settlement in Palestine

Recent reviews of Early Bronze Age settlement data permit broad macroscopic critique of prevailing concepts of Early Bronze Age urbanism. Joffe (1985) compares the spatial characteristics of Early Bronze I and Early Bronze II sites as they illustrate the growth of towns. Broshi and Gophna (1984) similarly discuss the sizes and distributions of Early Bronze II and III sites. Unfortunately, Broshi and Gophna combine, rather than segregate, the data from these two periods. By so doing they intend to illustrate the apogee of third millennium urbanism "after the beginning of the Early Bronze Age III, ca. 2600 B.C." (Broshi and Gophna 1984: 41).

> In our opinion, by this time most of the Early Bronze II-III settlements were in existence - both those that had survived from the Early Bronze Age II and had not yet been deserted, and those newly established in the Early Bronze Age III. It is our estimate that some 80 percent of the settlements of these two periods were flourishing (Broshi and Gophna 1984: 41).

The quote above demonstrates Broshi and Gophna's cognizance of Early Bronze II and III as separable time periods. By lumping these periods the authors ignore evidence for the initial abandonment of towns at the end of Early Bronze II in favor of presenting a "best case" argument for abundant urbanized settlement in Palestine.

This oversimplification must be recognized when comparing Broshi and Gophna's data with those of Joffe, who explicitly segregates the Early Bronze I and II periods. The following discussion uses the datum of early Early Bronze III suggested by Broshi and Gophna, but acknowledges that the lumping of these data is an additional source of imprecision. In particular, site and population densities probably are inflated.

Organization of Survey Data

The summary of Early Bronze Age settlement data is similar to that of Mesopotamian data in Chapter 3. Figure 17 presents five dimensions of Early Bronze I, Early Bronze II and early Early Bronze III settlement, as derived from Joffe (1985) and Broshi and Gophna (1984). Site density and relative population density again are measured per 100 square kilometers. Mean and adjusted mean site areas are calculated as in Chapter 4.

Joffe does not present a site inventory. Therefore, the site size classes used by him are retained here (see Joffe 1985: 8, fig. 1). Broshi and Gophna's data have been reorganized accordingly. Relative "urban" population is estimated as the proportion of aggregate site area in settlements 35 hectares and larger. Rural site frequency is

Figure 17. Survey Data for Early Bronze Age Palestine.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area = □

Adjusted Mean Site Area = ■

D. Urban Population:

% in sites $\geq$ 35 ha = ■

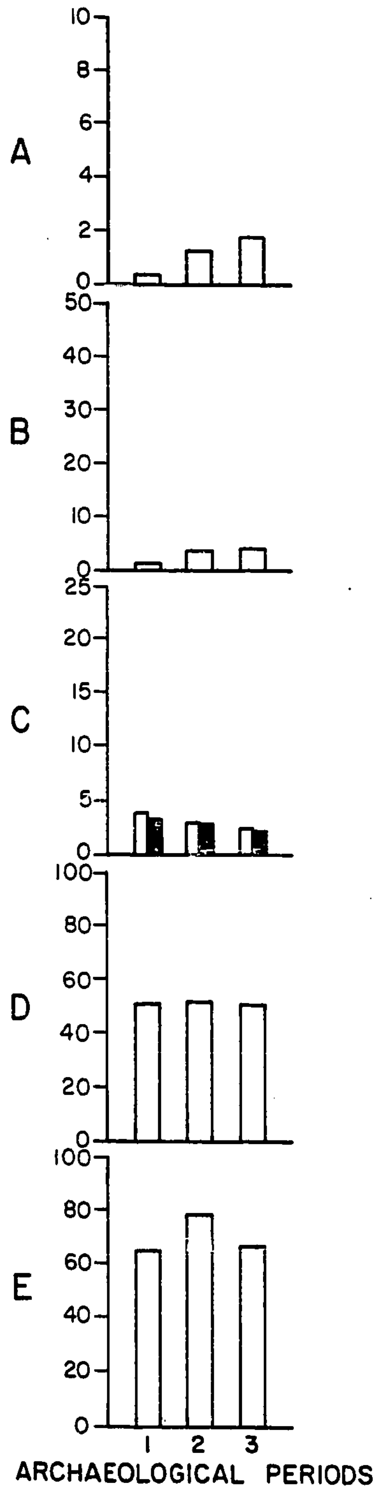
% in sites > 7 ha = □

E. Rural Site Frequency:

% sites < 4 ha

PERIODS

1. Early Bronze I (data from Joffe 1985)
2. Early Bronze II (data from Joffe 1985)
3. early Early Bronze III (data from Broshi and Gophna 1984)


A
10
8
6
4
2
0
B
50
40
30
20
10
0
C
25
20
15
10
5
0
D
100
80
60
40
20
0
E
100
80
60
40
20
0
1
2
3
ARCHAEOLOGICAL PERIODS

based on the abundance of sites less than four hectares in area. These size definitions are in keeping with the lower estimated productivity, and higher *per capita* sustaining areas of ancient rainfed farming in the southern Levant as compared to irrigated agriculture in Mesopotamia (see discussion in Chapter 2).

Early Bronze Age Ruralism

Early Bronze Age survey data, as assembled in Figure 17, describe a trajectory of population growth and increasingly abundant settlements. Settlement density grew noticeably, while population density only increased modestly. Strikingly, these data describe virtually no change in the relative importance of populations in larger communities. Approximately half of Palestine's inhabitants remained in settlements larger than 8 hectares through most of the Early Bronze Age. Significant change *is* noted in mean site size, which drops through this sequence. All of these trends, when viewed collectively, reveal a pattern of rural growth based on increasingly abundant small villages. This is reiterated by rural site frequencies that increase from Early Bronze I to Early Bronze II. Joffe (1985) shows that by Early Bronze II 55% of Palestine's settlements were one hectare or smaller. A subsequent drop in rural site frequency is described by Broshi and Gophna's data, but this may be skewed by the problems of chronological "lumping" noted above. Population growth, particularly in the countryside, did not parallel that seen in most cases of Mesopotamian urbanization. Amiran's population "explosion" appears unsubstantiated.

The lack of a regionally-predominant primate center is shown by the minimal differences between Early Bronze size means and adjusted means. A rank-size plot of Early Bronze II-III settlements (see fig. 18) has a pronounced convex distribution consistent with the limited pre-eminence of larger towns.

More significantly, these data show no growth in the populations of larger sites (i.e., sites at or above the very modest threshold of 8 hectares). In fact, not a single settlement attained urban size, as defined here, during the third millennium B.C. Thus, the Early Bronze Age requires interpretation in terms of a concept other than "urbanism."

Comparison with Mesopotamia

The Palestinian data can be compared with those for Mesopotamian settlement in terms of scale and developmental trajectories. Early Bronze site densities were similar to those in most Mesopotamian survey areas prior to the Middle Babylonian Period (cf. figs. 5, 8-12, and 17). However, Early Bronze population densities and mean site areas approximated only those in the margins of early Mesopotamian urbanism (i.e., the areas of Susiana; Ur-Eridu and the Diyala). The populations of larger Palestinian towns do not remotely approach those around the Mesopotamian urban centers of Uruk, Kish or Babylon. A total of only five Early Bronze II-III settlements, inhabited by perhaps 20% of Palestine's sedentary population, grew to 20 hectares or larger. Cities and large towns in Mesopotamia (i.e., those larger than 40

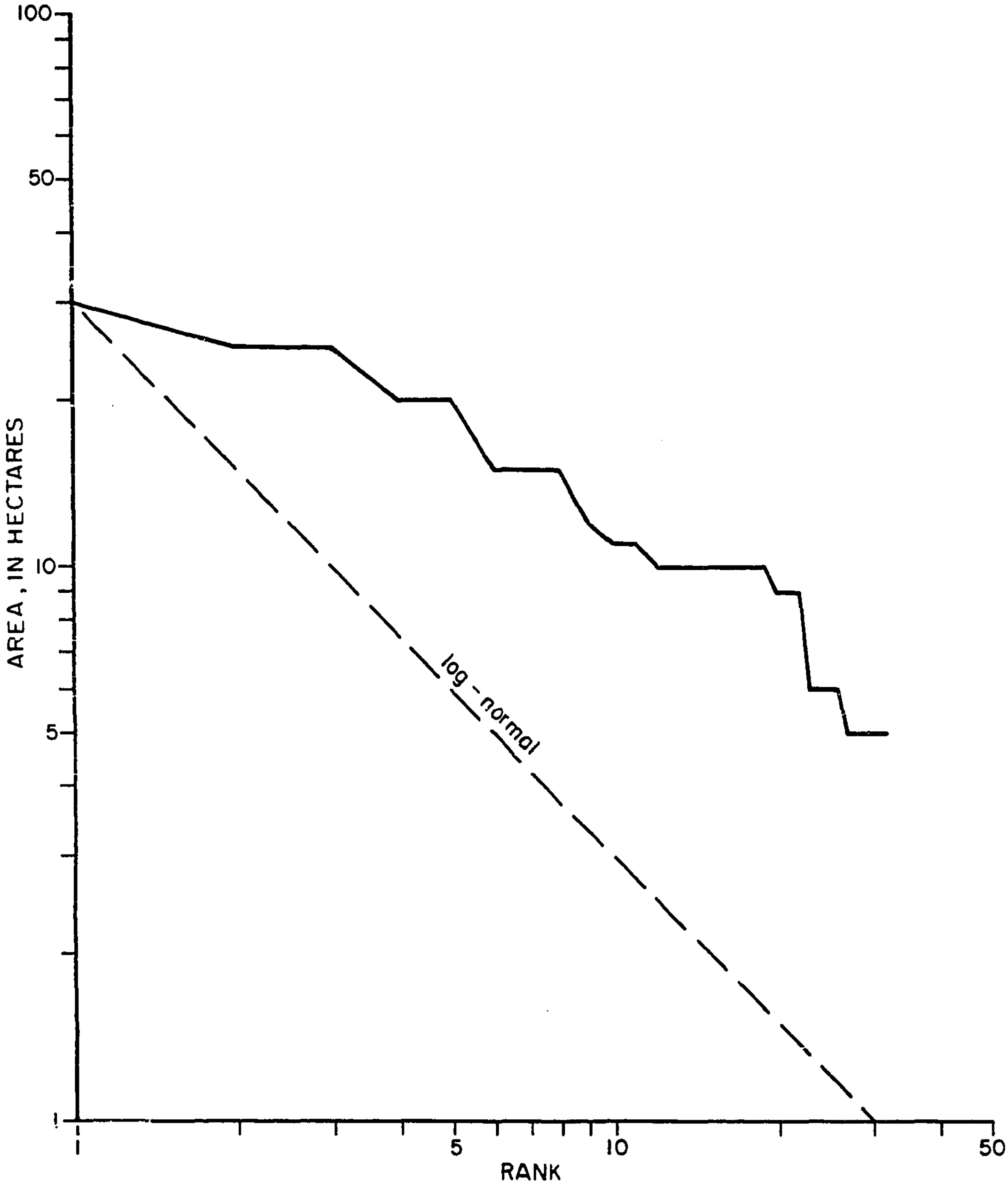


Figure 18. Rank-size distribution of Early Bronze II-III sites in Palestine (based on Broshi and Gophna 1984).

hectares) commonly contributed the majority of regional populations.

This situation is reiterated by Figure 18, which shows an Early Bronze Age rank-size distribution most similar to cases of non-urbanized regional settlement in Mesopotamia (cf. figs. 13, 15). These plots graphically demonstrate very modest size differences between sites, the lack of large predominant settlements and the primarily rural nature of Early Bronze Age settlement.

Perhaps most importantly, the data invalidate the argument that Palestine represented a scaled-down version of demographic nucleation, such as seen around ancient Uruk (see Kempinski 1978: 10). Centers for such agglomeration were lacking, and there was no dramatic increase in mean site area (cf. figs. 5 and 17). Kempinski's argument, built primarily on data from excavated towns, is refuted by larger trends of settlement primarily in rural villages.

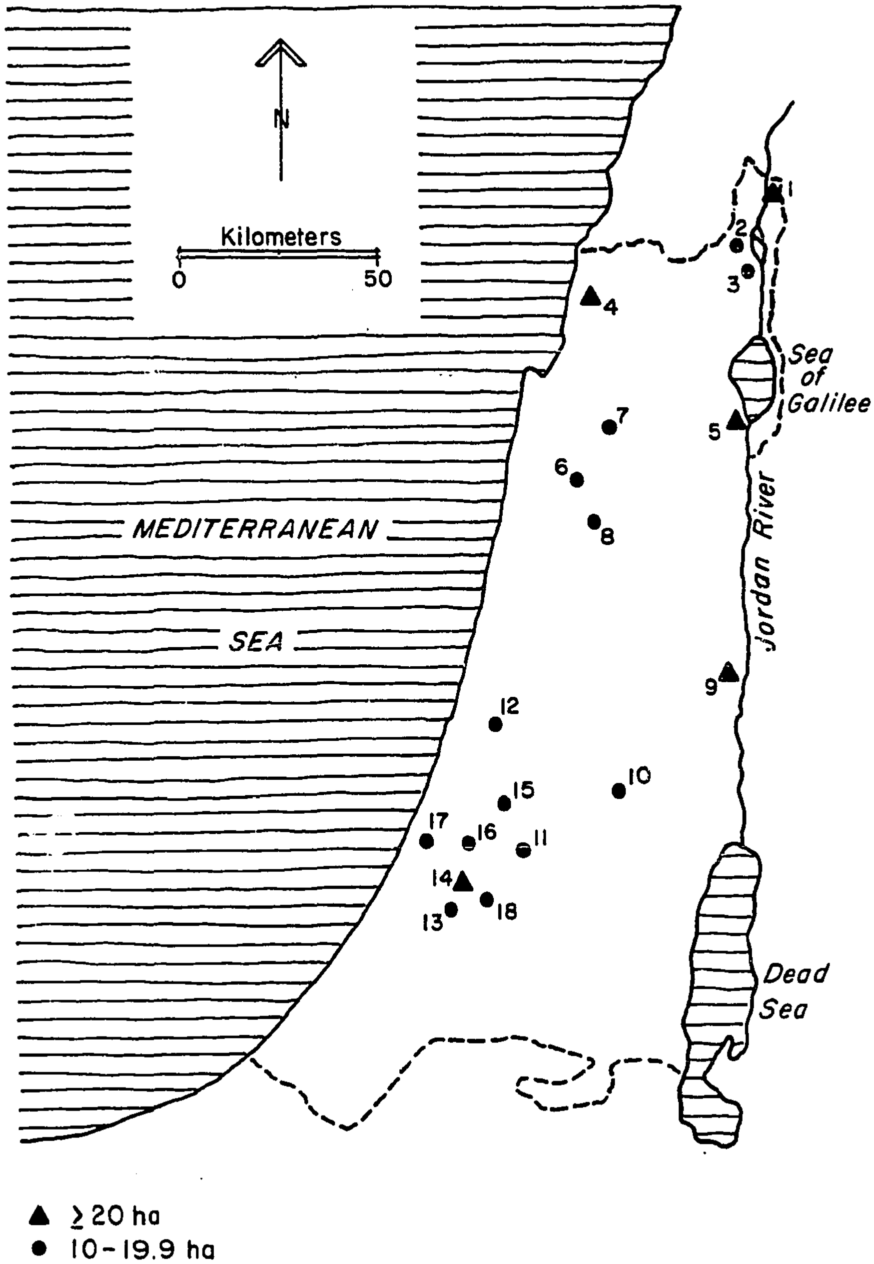
Settlement Distribution Within Early Bronze Age Palestine

The nature of population and settlement growth is clarified by the geographical distribution of Early Bronze Age towns and villages within Palestine. Figure 19 shows the locations of settlements ten hectares and larger. These modestly-sized towns are particularly sparse in the center of Palestine. Larger towns are restricted to the Coastal Plain (Tell Kabri, Tell el-^{c}Areini), the Jordan Valley (Khirbet Kerak, Khirbet el-Mahruq) and the Huleh Basin (Tell Dan).

Some of the implications of this distribution are made apparent by segregating settlement data from regions with the most abundant larger sites, the Huleh Basin and the Coastal Plain north and south of Mount

Figure 19. Early Bronze Age sites 10 hectares and larger.

1. Tell Dan (20 ha)
2. Tell Qadesh
3. Hazor
4. Tell Kabri (30 ha)
5. Khirbet Kerak (20 ha)
6. The Communal Orange Grove
7. Tell Shimron
8. Tell el-Mahfar
9. Khirbet el-Mahruq (25 ha)
10. ^{c}Ai
11. Tell Yarmuth
12. Aphek
13. Tell el-Hesi
14. Tell el-^{c}Areini (25 ha)
15. Tell Gezer
16. Tell es-Safi
17. Tell Poran
18. Lachish



N
Kilometers
0
50
MEDITERRANEAN
SEA
Sea
of
Galilee
Jordan River
Dead
Sea
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
≥ 20 ha
10-19.9 ha

Carmel (Broshi and Gophna 1984: fig. 1, regions 3, 8 and 9), from the balance of Palestine's more rural Central Hills and Jordan Valley (see fig. 20).

Site densities in the Huleh Basin/Coastal Plain and in the Central Hills/Jordan Valley were approximately equal, but lower population density and mean site area suggest that smaller settlements predominated in Palestine's interior (see fig. 21). Rural sites were more frequent here, while the populations of larger towns were more significant along the coast, and at Palestine's northern extreme. In short, the largest Early Bronze towns characterized Palestine's periphery, while this region's core was settled overwhelmingly in very small villages.

The peripheral distribution of larger towns has inspired the diffusionist hypotheses reviewed above that seek to explain the particulars of Early Bronze Age "urbanism." However, as regional survey data show, Early Bronze Age settlement was not characteristically urban. The contrasts between settlement in Palestine's central and peripheral regions are not peculiar to the Early Bronze Age, but are part of a longer term pattern of resilient growth and decline in which the main arenas of indigenous development and differentiation were rural villages in Palestine's Central Hills and Jordan Valley. The resilient nature of Bronze Age farming villages is reflected in the dramatic curtailment of sedentary town life in Early Bronze IV and its resurgence in Middle Bronze II. Survey and excavated evidence of Middle Bronze villages clarifies the case for "rural complexity," rather than urbanism, as the foundation of

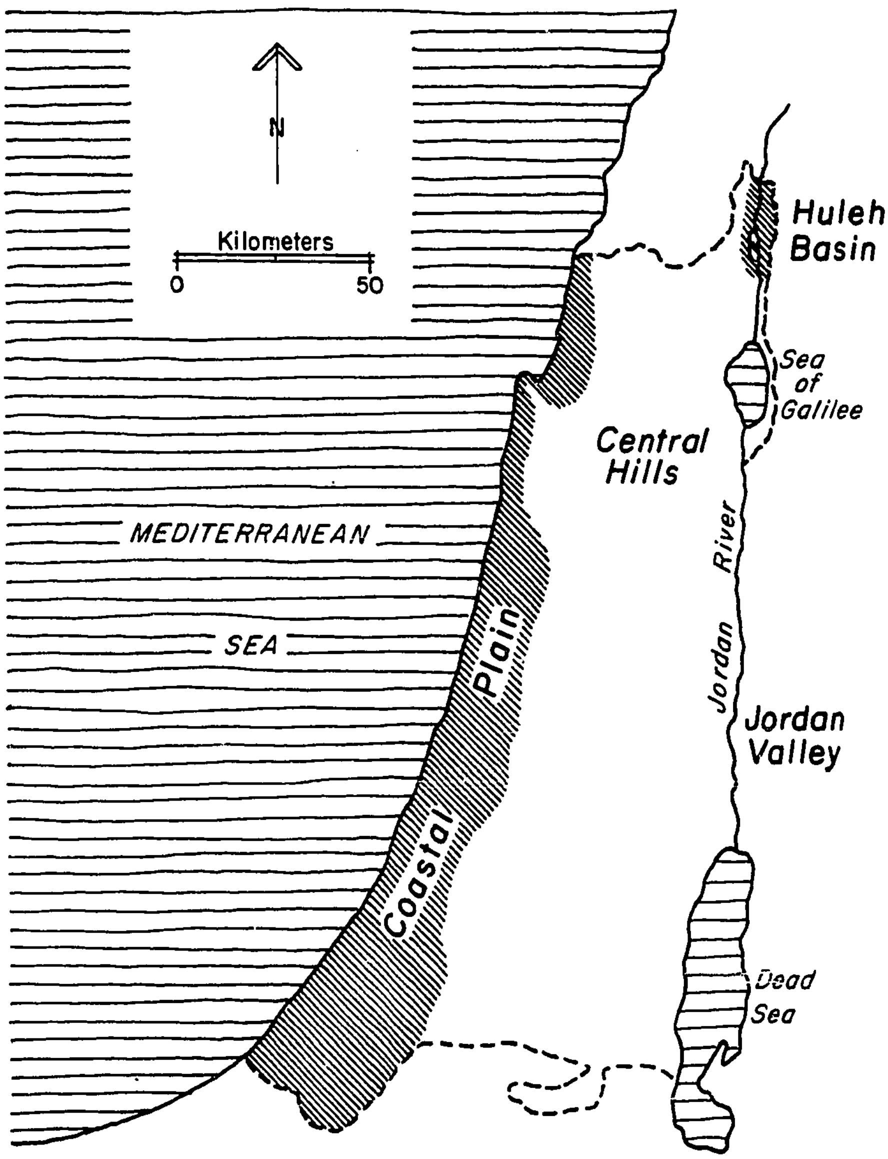


Figure 20. Regions of Bronze Age settlement in Palestine. Based on Broshi and Gophna 1984: fig. 1; 1986: fig. 1. The Huleh Basin and Coastal Plain encompass their regions 3, 8, and 9.

Figure 21. Survey Data for Central and Peripheral Regions of Early Bronze II-III Palestine (based on Broshi and Gophna 1984).

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area = □

Adjusted Mean Site Area = ■

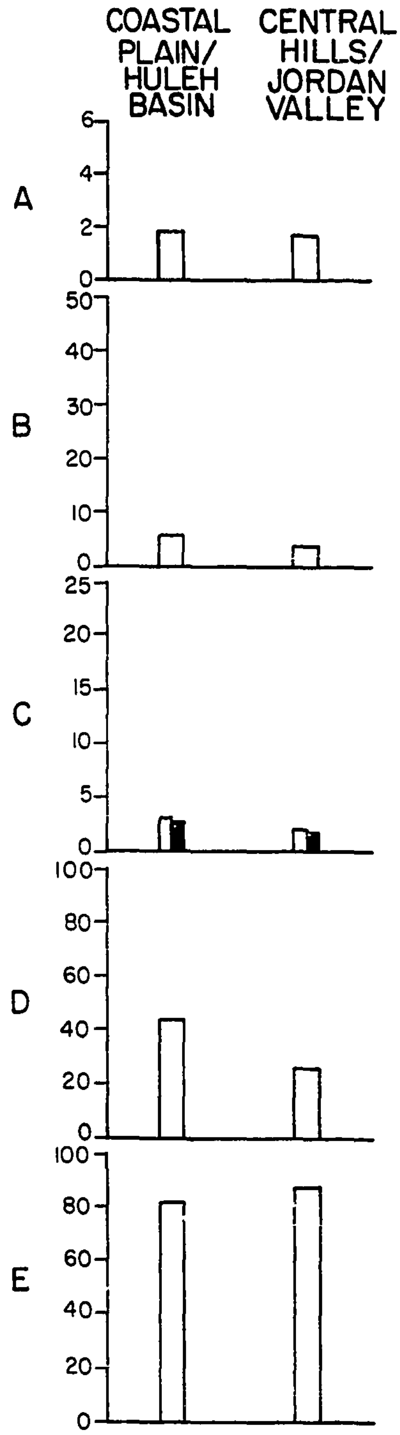
D. Urban Population:

% in sites $\geq$ 35 ha = ■

% in sites > 10 ha = □

E. Rural Site Frequency:

% sites < 5 ha


COASTAL PLAIN/ HULEH BASIN
CENTRAL HILLS/ JORDAN VALLEY
A
B
C
D
E
0
2
4
6
10
20
30
40
50
5
15
25
60
80
100

Canaanite social complexity.

The Abandonment of Towns in Early Bronze IV

The archaeological record for the Early Bronze IV Period stands in stark contrast to the episodes of sedentary town life in Early Bronze II-III and Middle Bronze II. The explorations of Nelson Glueck (e.g., 1934; 1935; 1939; 1951) provided the first systematic reports of Early Bronze IV sites distributed from southern Lebanon and Syria south through the Negev and Sinai deserts, as far as the Suez Canal, and east to the fringes of the Arabian desert. Highest site densities are found in northwestern Transjordan, the eastern Jordan Valley, the central Negev and northern Sinai.

Glueck's work revealed Early Bronze IV settlement patterns that implied extensive use of land outside the present limits of dry farming (see also Evenari et al. 1971: 97; 1961: 982). The limits of Early Bronze IV settlement extend as far as the present 100 millimeter mean annual rainfall isohyet, and to several sites in Sinai and southern Transjordan that receive even less than 100 millimeters annual precipitation (Prag 1974: 72). In contrast, Early Bronze II-III tell sites are usually restricted to areas with more than 300 millimeters annual rainfall, while Middle Bronze Age sites generally receive 400 millimeters or more (Raikes 1967; Prag 1974: 69-77) (see fig. 22). The average annual rainfall necessary for dry farming can be estimated at about 200 millimeters, though the requirement for wild food plant species to flourish is much higher (Raikes 1966: 68).

The arid settings of many Early Bronze IV sites are tempered by

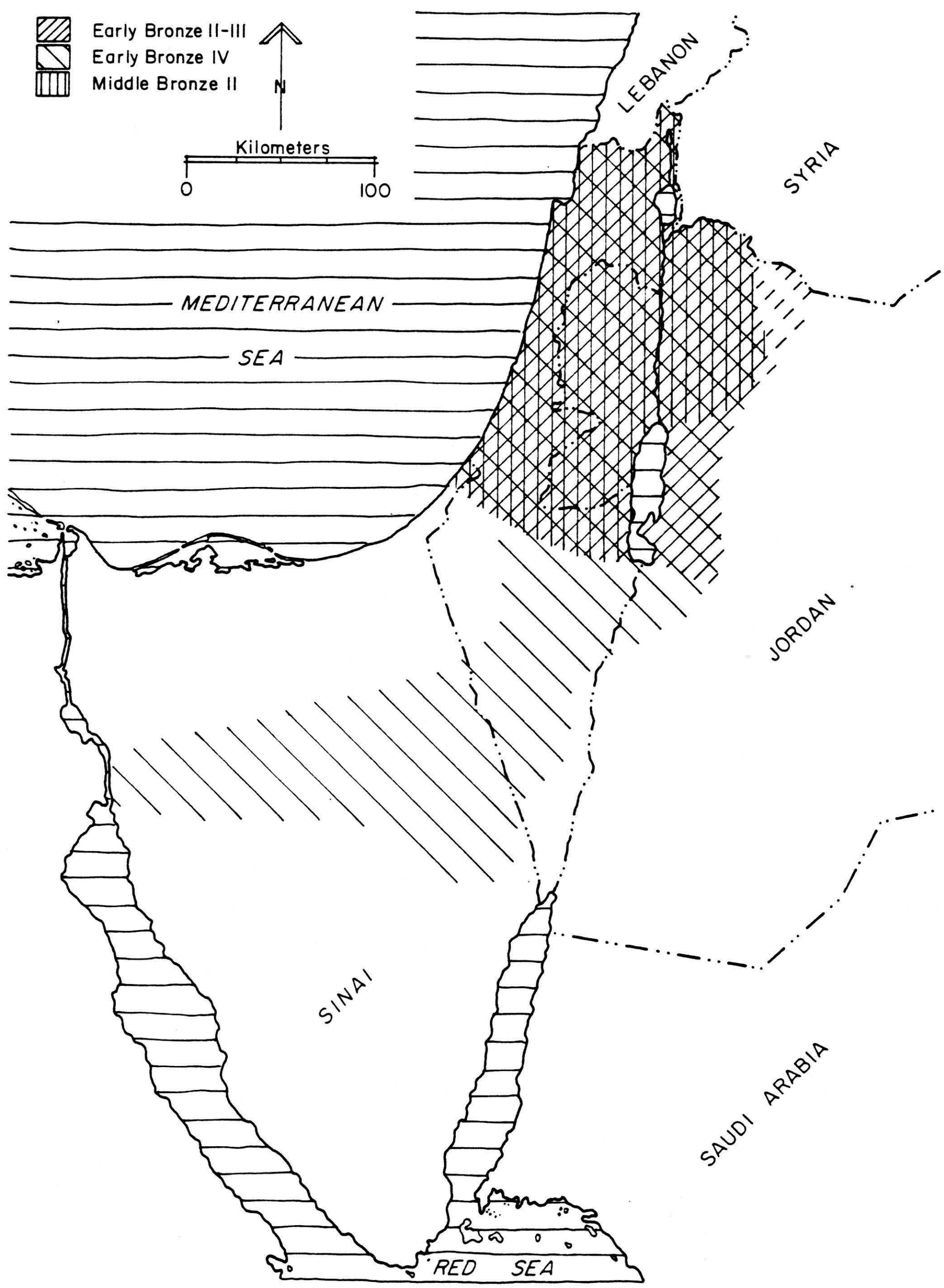


Figure 22. Bronze Age site distributions in Palestine and Transjordan (after Prag 1974: 80).

the presence of nearby springs, perennial streams or seasonal wadis (Glueck 1939: 171-172). Nevertheless, most authors have argued that these sources were insufficient for agriculture (Prag 1974: 73). Even in areas with water and soil conditions conducive to dry farming, evidence from tell sites and caves is limited to burials (Kenyon 1957: 189-194; 1965b; Lapp and Lapp 1974). More recently, excavations in the Negev at Har Yeruham (Kochavi 1963; Cohen 1974), and excavations and survey centered on Be[c]er Resisim (Cohen and Dever 1978; 1979; 1981) have provided the first exposures of Early Bronze IV seasonal settlements.

Thus, Early Bronze II-III was followed by a period of dramatic site relocation in areas of minimal, unpredictable rainfall. As early as the 1930's Early Bronze IV archaeological evidence was associated with late third millennium Akkadian and Sumerian references to supposed expansions of Amorites in Syria and Upper Mesopotamia. The Amorite invasion hypothesis became an acceptable explanation for the collapse of Early Bronze III with the successive analyses of Albright (1961), Glueck (1955), de Vaux (1965) and especially Kenyon (1966).

However, concurrent textual analyses pointed out the variety of social and political roles associated with Amorites in Syria and Mesopotamia (e.g., Kupper 1959; Gelb 1961; Luke 1965; Buccellati 1966; Liverani 1973), suggesting that the hypothesis of incursions by ethnic "Amorites" is inappropriate, as well as inadequate, for the explanation of deurbanization in Early Bronze Age Palestine. This is especially clear in light of the highly urbanized nature of Syrian society in the late third millennium B.C. The cities at Tell Mardikh (ancient Ebla)

(Matthiae 1976; 1978a; 1978b; 1979; Pettinato 1976), Hama (van Loon 1979), Tell Hadidi (Dornemann 1979) and other major tells stand in marked contrast to the absence of contemporaneous urban centers in Palestine.

Material culture differences between the two regions also overshadowed any similarities, and these differences became more accentuated in Early Bronze IV than in Early Bronze II-III or Middle Bronze II. Syrian pottery was commonly wheel-thrown, while Palestinian ceramics were largely hand-built. Likewise, innovation in tin-bronze metallurgy appeared in Syria while metallic artifacts from Palestine remained wholly copper (Dever 1980; Prag 1974).

Therefore, although certain ceramic wares (e.g., "Caliciform"-type wares, see below) have close parallels in Syria (e.g., Dever 1970: 145; 1971: 209-214), the changes associated with the Early Bronze IV period in Palestine cannot be explained in terms of intrusive cultural influences or populations from Syria.

The Current Hypothesis for Early Bronze IV "Pastoralization"

Reaction to invasion theories has engendered an opposing view of Early Bronze IV society, first seen in the works of G. E. Wright (1937) and Amiran (1960), that emphasizes continuities in the material culture of Palestine in Early Bronze II, III and IV. Building on this foundation, more recent syntheses (e.g., Oren 1973; Prag 1974; Dever 1980) portray pastoral nomadism as an indigenous economic adaptation to arid zones on the fringes of, but in steady contact with, settled populations in Palestine.

The most influential working model of Palestinian society (see Prag 1974; Dever 1980) explains Early Bronze IV cemeteries and isolated tombs as "the seasonal burying grounds for groups of semi-nomadic pastoralists" who "frequented the abandoned Early Bronze II-III tell sites during the latter part of Early Bronze IV but did not settle permanently" (Dever 1980: 39, 42). The increasing element of pastoralism at this time should be seen as an effect, not a cause, of the common abandonment of towns.

Dever (1980) envisions non-sedentary Early Bronze IV populations similar to West Semitic pastoral nomads documented in the Mesopotamian Ur III period and later at Mari (Luke 1965; Bucellati 1966; Matthews 1978), and paralleling the modern Rwala Bedouin of south Syria and north Jordan (D. L. Johnson 1969: 38-46, 165-170; Musil 1928a; 1928b). Using these analogues Dever hypothesizes a yearly round with winter encampments in the central Negev/northern Sinai (e.g., at Har Yeruham, Be^{c}er Resisim) and summer camps in the Hebron Hills (e.g., at Jebel Qa^{c}aqir, Khirbet Kirmil). The bodies of deceased members would have been carried until traditional cemeteries in the Hebron Hills could be reached for interment (for a Pashtun parallel see Leshnik 1972: 151).

The Dever/Prag model hypothesizes a shift from Palestinian tells to smaller sites in more marginal zones, first in southern Palestine (Early Bronze III B), and later in Transjordan and the Jordan Valley (Early Bronze IV A). The final episode of Early Bronze IV (Dever's Early Bronze IV B-C) involved a settlement shift to the deserts of southern Palestine, especially the Negev, while habitation in the

Jordan Valley dwindled (see Dever 1980: 42; Prag 1974: 75-85).

While the Dever/Prag model marks the greatest progress on the social transitions of the Bronze Age since Kenyon proposed "invasions," it relies on the inappropriate analogues of Mesopotamian pastoralists and modern camel-herding Bedouin (see discussion above) that originally gave rise to the Amorite invasion hypothesis. To be sure, Dever and Prag tackle the drastic social and economic readjustments of Early Bronze IV systematically, but they continue our preoccupation with evidence from cemeteries and seasonal camps, while offering little discussion of the sedentary agrarian populations that must have existed.

It has become increasingly clear that agriculture and networks of exchange continued in Early Bronze IV, and that a growing number of village sites in Transjordan must be recognized as a significant component of society at that time. Excavations at Ader (Cleveland 1960), Khirbet Iskander (Parr 1960), ^{c}Aro^{c}er (Olavarri 1965; 1969) and Ikhtenu (Prag 1974) along the eastern flank of the Jordan Valley first produced evidence of stratified Early Bronze IV sites. These isolated sites originally were noted as campsite or "squatter" occupations that have figured only marginally in assessments of Early Bronze IV society. However, continued work at Bab edh-Dhra^{c} (Rast and Schaub 1978; 1980; 1984) and Khirbet Iskander (Richard and Boraas 1984), and recent excavations at Umm Hammad (Helms 1984; 1986) and Tell Abu en-Ni^{c}aj [N] (see Falconer in press) have demonstrated the existence of moderately-sized sedentary agricultural villages. Khirbet Iskander and Abu en-Ni^{c}aj are approximately 2.5 hectares in size, while Umm Hammad stretches over 44 hectares, varying portions of which may have been used during its history of occupation (Helms 1986). Multiple strata representing sedentary agricultural villages are clear at all four sites, and Iskander was encircled by a town wall during Early Bronze IV (Richard and Boraas 1984: 68-69).

Most of these sites were not occupied over the Early Bronze III/IV transition. Although Bab edh-Dhra[c] and Khirbet Iskander were occupied during Early Bronze III, they subsequently expanded into larger communities, involving relocation of the Early Bronze IV settlement at Bab edh-Dhra[c] (Rast and Schaub 1984: 55). In addition, none of these sites was occupied into Middle Bronze II. Therefore, these Early Bronze IV villages cannot be viewed simply as residual communities left by the collapse of Early Bronze II-III towns. Nor can they be viewed as the village-level foundation to which larger Middle Bronze II towns were added. In other words, sedentary settlement in the Middle Bronze Age did not simply grow in situ, but developed anew, particularly in the rural countryside of the southern Levant.

The Reappearance of Towns in the Middle Bronze Age

Once past the Early Bronze/Middle Bronze transition, the continuity of material culture through the entire Middle Bronze Age is striking (e.g. see Dever 1976: 9; Kenyon 1973: 84) and has given rise to arguments for the continuity of Canaanite culture through the Middle Bronze and Late Bronze ages (Mazar 1968: 96; Kenyon 1973:86). The most celebrated archaeological evidence for Middle Bronze Age society comes from reoccupied tell sites that had been abandoned during Early Bronze

IV (by Early Bronze III B at some sites). The archaeological record for Middle Bronze II represents "a major break in terms of technology, trade, and social and political institutions from the preceding period" (Gerstenblith 1983: 123). Traditionally, Middle Bronze II A is interpreted as a formative period during which Palestine witnessed a resurgence of sedentary village life and developed the foundations for "reurbanized" society. This view holds that modest Middle Bronze II A towns expanded into massively fortified Middle Bronze II B/C cities during five centuries of considerable population increase, and urban-based economic and political development.

Theories for Exotic Sources of Urbanism

The beginning of the Middle Bronze Age is marked by abrupt changes in material culture. For example, bronze tools augmented a metal industry previously limited to copper, and the hand-built pottery of Early Bronze IV was replaced by distinct new wheel-thrown vessel forms in Middle Bronze II (Mazar 1968: 77, 86; Kenyon 1973: 78; Gerstenblith 1983: 118). Recent research emphasizes that "the break between [Early Bronze IV and Middle Bronze II] in terms of their material culture is one of the most abrupt and complete in the entire cultural sequence of Palestine (Dever 1976: 5). Transitional characteristics between Early Bronze IV and Middle Bronze II pottery are discernible in inland Syria, but are elusive in Palestine (Gerstenblith 1983: 52, 107, 124), as shown by the rather shaky correlation of Early Bronze metal prototypes for Middle Bronze pottery forms (Kenyon 1973: 83).

Because of the lack of indigenous transitional material culture, technically sophisticated trade wares (e.g. Syro-Cilician painted wares, band-painted storejars, Khabur Ware) (Gerstenblith 1983: 118; Dever 1976: 13; Kenyon 1973: 80; Mazar 1968: 77) are used as evidence of the exotic origins of Middle Bronze II urbanism. Dever (1976:12), building on previous arguments by Mazar and Kenyon, has concluded that "the rapid renascence of urban life in Syria-Palestine was due to both the cultural impetus of new elements of population from Mesopotamia (the "Amorites") and to the prosperity brought about by the renewed political and economic interests of the Egyptian Twelfth Dynasty in Asia."

Gerstenblith (1983: 116-119) attempts to distance herself from invasion models by widening the region of origin for Middle Bronze II A urbanism to include inland sites like Alalakh, Hama, Qatna and Ebla, and by suggesting trade as the driving force behind its introduction. Following this hypothesis the locations of major Middle Bronze II A towns along the coastal plain and the Jordan Valley were determined by trade ties with Anatolia and Mesopotamia. This argument is an echo of Kenyon's emphasis on the roles of Ugarit and Byblos as "emporia for trade and communication" (Gerstenblith 1983: 118) with the agent of northerly influence taking the more benign form of trade rather than immigration.

While the renewal of centralized authority in Egypt may have encouraged reurbanization in Palestine, all of these explanations are flawed in their concentration on exotic elements of material culture. The exotic origins of some crucial pottery types may not be as selfevident as previously assumed. For example, Tubb (1983) disputes the connection of Khabur Ware with Palestinian Middle Bronze painted wares. More importantly, renewed invasions constitute logically insufficient explanation for the drastically different "pastoralization" of Early Bronze IV and the renewed sedentism of Middle Bronze II. Attempts to mitigate this difficulty by arguing that Syrian Amorites were semi-nomads in Early Bronze IV, but had been urbanized by Middle Bronze II (Dever 1976: 15), continue to run afoul of the ethnic ambiguity and multiple social roles of Amorites noted previously.

Current Approaches to Middle Bronze Age Urbanism

Palestine is described as a "backwater" in comparison to Egypt, Syria or Mesopotamia in the second millennium B.C. (Dever 1976: 12; Kenyon 1973: 115). Nevertheless, the Middle Bronze Age is consistently interpreted as a "truly urban" era in which, most importantly, massive Middle Bronze II B-C fortified cities developed from smaller Middle Bronze II A towns and villages (e.g., Kenyon 1973: 81; Dever 1976: 9; Mazar 1968: 72). The walls surrounding many towns originally were dated to the beginning of the Middle Bronze Age (e.g., at Megiddo, Tell Beit Mirsim, Tell Poleg, Tell Zeror, Yabneh Yam), but have been reanalyzed as late Middle Bronze II A or Middle Bronze II B (Kenyon 1973: 8, 14; Eitan 1972; Dever 1976: 9; Yadin 1978). Many open towns were destroyed at the end of A/early B, perhaps by Egyptian military campaigns (e.g., Tell Beit Mirsim [Albright 1938: 26, 27]; Shechem [G. E. Wright 1965: 112-122, 237]). Subsequently, more commonly fortified Middle Bronze II B-C towns and cities grew along the coast, at the edge of the Shephelah foothills, and in the Huleh Basin (e.g., Hazor, Megiddo, Gezer, Tell el-Ajjul, Tell el-Far^{c}ah [S]) (Kenyon 1973: 115; Mazar 1968: 82-83).

The common appearance of massive fortifications is thought to signal significantly increased levels of population and prosperity made possible by the flourishing of town life (Dever 1976: 9, 16; Mazar 1968: 86). In fact, the subdivision of the Middle Bronze Age is based on the spread and elaboration of town fortifications. The introduction of rampart fortifications (i.e., with a bank constructed against the town walls or tell slope) provides the major criterion for differentiating Middle Bronze II A vs. B-C urban architecture (Dever 1976: 16). The beginning of Middle Bronze II C, in particular, is marked by the construction of Cyclopean town fortifications (i.e., massive walls of large unhewn stonework with a mudbrick superstructure) following the destruction of many communities in the late 17th and early 16th centuries B.C. (Mazar 1968: 91). The Middle Bronze Age chronology implicitly correlates region-wide fortifications with urbanism and centralized authority. Carried to its logical extreme this urban preoccupation leads to interpretations of Middle Bronze II B-C urbanism in Palestine as comparable to that found elsewhere in southwestern Asia (e.g., Syria; Gerstenblith 1983: 115), despite obvious differences in scale, and probable differences in structure.

Middle Bronze Age urbanization has been inferred from the regional distribution of larger sites. Towns first developed along the Mediterranean coastal plain and inland valleys communicating with the coast (Gerstenblith 1983: 118; Mazar 1968: 72-75). Kenyon envisioned a region-wide Middle Bronze II A settlement pattern of walled towns along the Levantine coast from Ras Shamra in the north to Tell el-Ajjul in the south (1973: 84). In contrast, inland towns did not appear until later in Middle Bronze II A (e.g., Shechem) or in Middle Bronze II B (e.g., Jericho) (Gerstenblith 1983: 118-119).

The coastal distribution of towns has been attributed to the mercantile influence of Egypt exerted through maritime contacts with Byblos (e.g., Mazar 1968: 73-75; Kenyon 1973: 82-85). Traditional views (e.g., Albright 1928) suggest that strong direct political ties were fostered by Egyptian "imperialistic aspirations" (Mazar 1968: 73; Posener 1971). Egyptian missions to represent the government and supervise commercial transactions are interpreted from Egyptian statuary found at Palestinian sites along the coast and Egyptian documentary evidence (Posener 1971: 549). Thus, the rulers of Byblos and Ugarit are seen as vassals of the Egyptian crown, and Megiddo, Gezer, Tell el-Ajjul, Shechem, Lachish and Beth Shan are described as archetypal Egyptian outposts (Mazar 1968: 73-75; Posener 1971: 545-547).

More critical reviews point out the very limited amount of well-excavated archaeological data, especially from Middle Bronze II A or the Middle Bronze II A/B transition, on which these arguments are built (e.g., Weinstein 1975). Extensive Egyptian material at the Syrian sites of Byblos and Ugarit does suggest "an active, well organized, commercial and diplomatic relationship" (Weinstein 1975: 11-12). However, the considerable Egyptian contacts evidenced there do not typify the more peripheral role of Palestine in Eastern Mediterranean commerce (see e.g., Dever 1976: 12).

Later documentary evidence of Egyptian foreign relations is available from the Execration Texts, which are sherds (the "Berlin" Texts) (Sethe 1926) and statuette fragments (the "Brussels" Texts) (Posener 1940) inscribed with lists of Asiatic localities (cities or regions) and their rulers, who were cursed as adversaries of Pharoah. The Berlin Texts, dated to the reign of Sesostris III (Posener 1971: 541) have been correlated with Middle Bronze II A in Palestine (Mazar 1968: 75). These texts enumerate 20 territories associated with 30 "rulers." The larger collection of Brussels Texts date approximately one generation later, and enumerate 62 territories and a similar number of rulers (Posener 1971: 541, 555). A trend toward more centralized authority and "city-state" organization in Middle Bronze II B Palestine has been inferred from the greater frequency of single rulers in the Brussels Texts (Posener 1971: 541; Mazar 1968: 75, 81). However, regional survey data from Palestine describe urbanized settlement only on a modest level (see discussion below).

A select group of Middle Bronze II B sites in Palestine is also noted in the Mari archives. Letters and economic texts record commercial missions between Mari and the Syrian cities of Ugarit, Apum (ancient Damascus), Yamhad (ancient Aleppo) and Qatna, as well as Hazor and Laish (Dan) in northern Palestine (Malamat 1970; 1971; 1983). The commercial and diplomatic relations apparent in these documents have encouraged a provincial viewpoint that settlement and exchange in Palestine might have been on a scale comparable to that of Syria

(Malamat 1970: 166-168). However, the large size of Hazor, the prime datum in this argument, may have resulted from this city's proximity to Syria. Thus, Hazor is interpreted most parsimoniously as an atypical community in extreme northern Palestine, rather than a typical example of a Middle Bronze urban center.

Reassessing Middle Bronze Age Settlement in Palestine

Survey data compiled by Broshi and Gophna (1986) and Mabry (1984) describe the growth of Middle Bronze Age urban and rural settlement. These data permit a critique of previous overviews based on excavated evidence from cities and large towns. Both authors segregate evidence from Middle Bronze II A and Middle Bronze II B-C.

Organization of Survey Data

Figure 23 follows the conventions for Mesopotamia and Early Bronze Age Palestine in presenting site density, relative population density, relative urban population, and mean and adjusted mean site areas. Broshi and Gophna group data for sites less than five hectares, and rural site frequencies are presented accordingly. Mabry does not provide a site inventory. He groups data for sites seven hectares and smaller. This size class is retained in presenting his rural site frequencies. The proportion of aggregate area in sites larger than seven hectares is used as a tertiary measure of populations in large sites.

Middle Bronze Age Urbanism and Ruralism

Survey data derived from Broshi and Gophna (1986) and Mabry (1984)

Figure 23. Survey Data for Middle Bronze Age Palestine.

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites $\geq$ 35 ha =

Data from Mabry 1984:
% in sites > 8 ha =

Data from Broshi and Gophna 1986:
% in sites > 10 ha =

E. Rural Site Frequency:

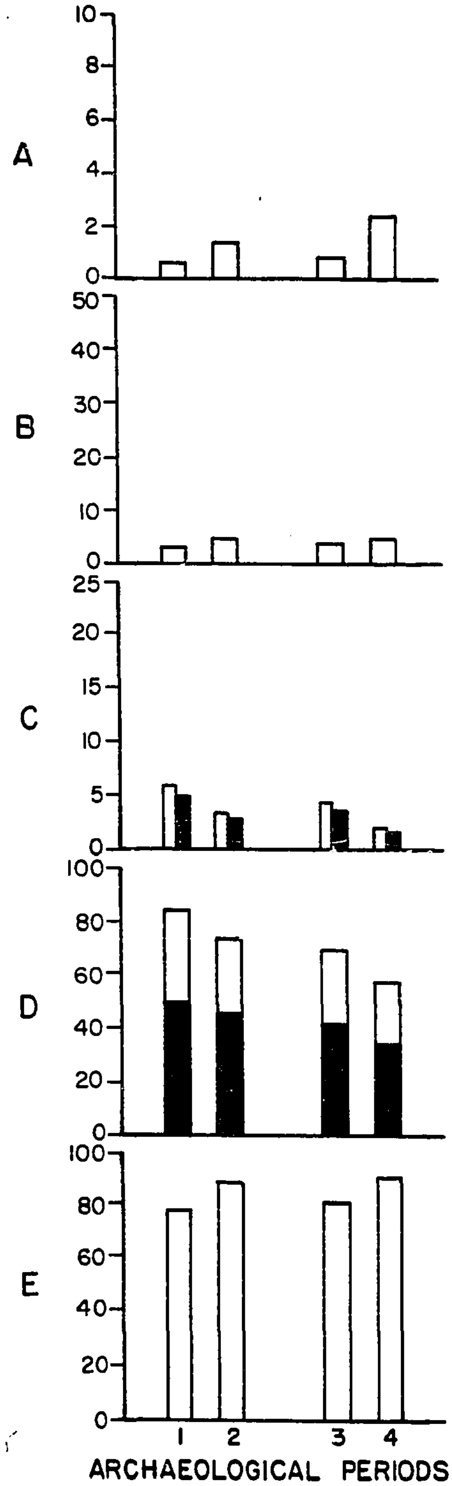
Data from Mabry 1984:
% sites $\leq$ 7 ha

Data from Broshi and Gophna 1986:
% sites < 5 ha

PERIODS

1. Middle Bronze II A (data from Mabry 1984)
2. Middle Bronze II B/C (data from Mabry 1984)

3. Middle Bronze II A (data from Broshi and Gophna 1986)
4. Middle Bronze II B/C (data from Broshi and Gophna 1986)


A
B
C
D
E
1 2 3 4
ARCHAEOLOGICAL PERIODS

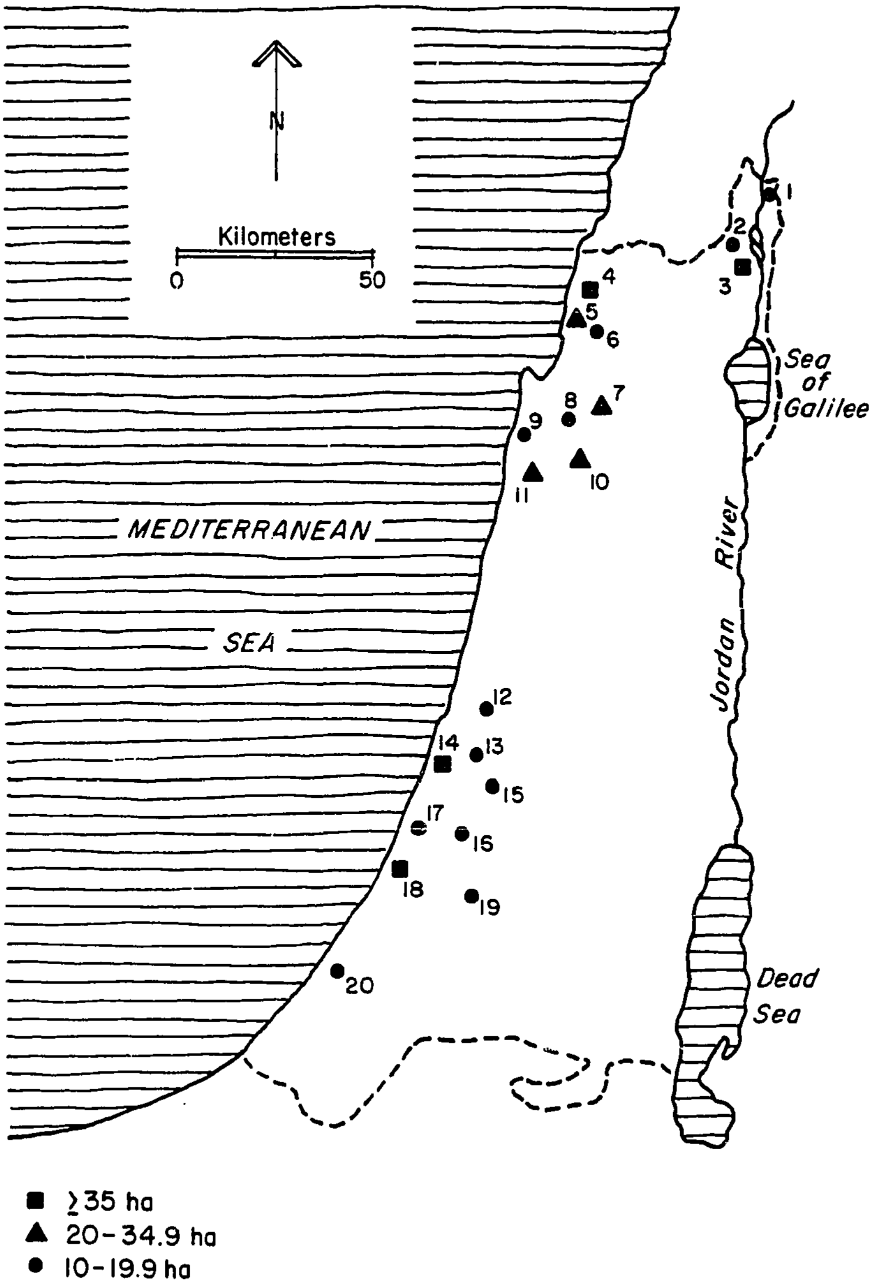
show identical trends in all dimensions summarized in Figure 23. These data describe settlement trends very similar to, but more pronounced than, those of the Early Bronze Age. Middle Bronze II B-C site density increased noticeably over that of Middle Bronze II A, but this produced only a slight rise in population density. In addition, mean site sizes dropped sharply. These characteristics indicate a form of growth primarily involving smaller settlements. This inference is corroborated by a substantial drop in the relative size of Palestine's town and city populations that was accompanied by more abundant villages in the countryside. Mabry (1984) shows that by Middle Bronze II B-C fully two-thirds of Palestine's settlements measured one hectare or smaller. In contrast to the Early Bronze Age, an appreciable Middle Bronze urban population is indicated. However, this population declines into the presumed urbanized florescence of Middle Bronze II B-C.

The cities of Palestine (Hazor, Kabri, Yabneh-Yam, Ashkelon) were neither sufficiently large nor centrally located to provide regional urban dominance (see fig. 24). Mean site size differs only slightly from the adjusted means in Figure 23, reflecting the absence of a regional primate center. Rank-size plots of Middle Bronze Age settlements (figs. 25, 26) show less convex distributions than did Early Bronze sites, but they clearly depart from log-normal. These distributions reflect relatively low "vertical" integration between higher and lower ranking settlements. This convexity also may result from Early Bronze and Middle Bronze analyses that (1) exclude external economic and political centers (e.g., in Eqypt) or (2) pool relatively

Figure 24. Middle Bronze Age sites 10 hectares and larger.

---

1. Tell Dan
2. Tell Qadesh
3. Hazor
4. Tell Kabri
5. Acre
6. Tell Bira
7. T. Shimron (MB IIA only)
8. Tell Yoqne^{c}am
9. Tell Dor
10. Megiddo
11. Tell Burga (MB IIA only)
12. Aphek
13. Nebi Rubin (MB IIB-C only)
14. Yabneh-Yam
15. Tell Gezer
16. T. es-Safi (MB IIB-C only)
17. Tell Poran
18. Ashkelon
19. Lachish (MB IIB-C only)
20. Tell el-^{c}Ajjul


N
Kilometers
0
50
MEDITERRANEAN
SEA
Sea
of
Galilee
Jordan River
Dead
Sea
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
≥35 ha
20-34.9 ha
10-19.9 ha

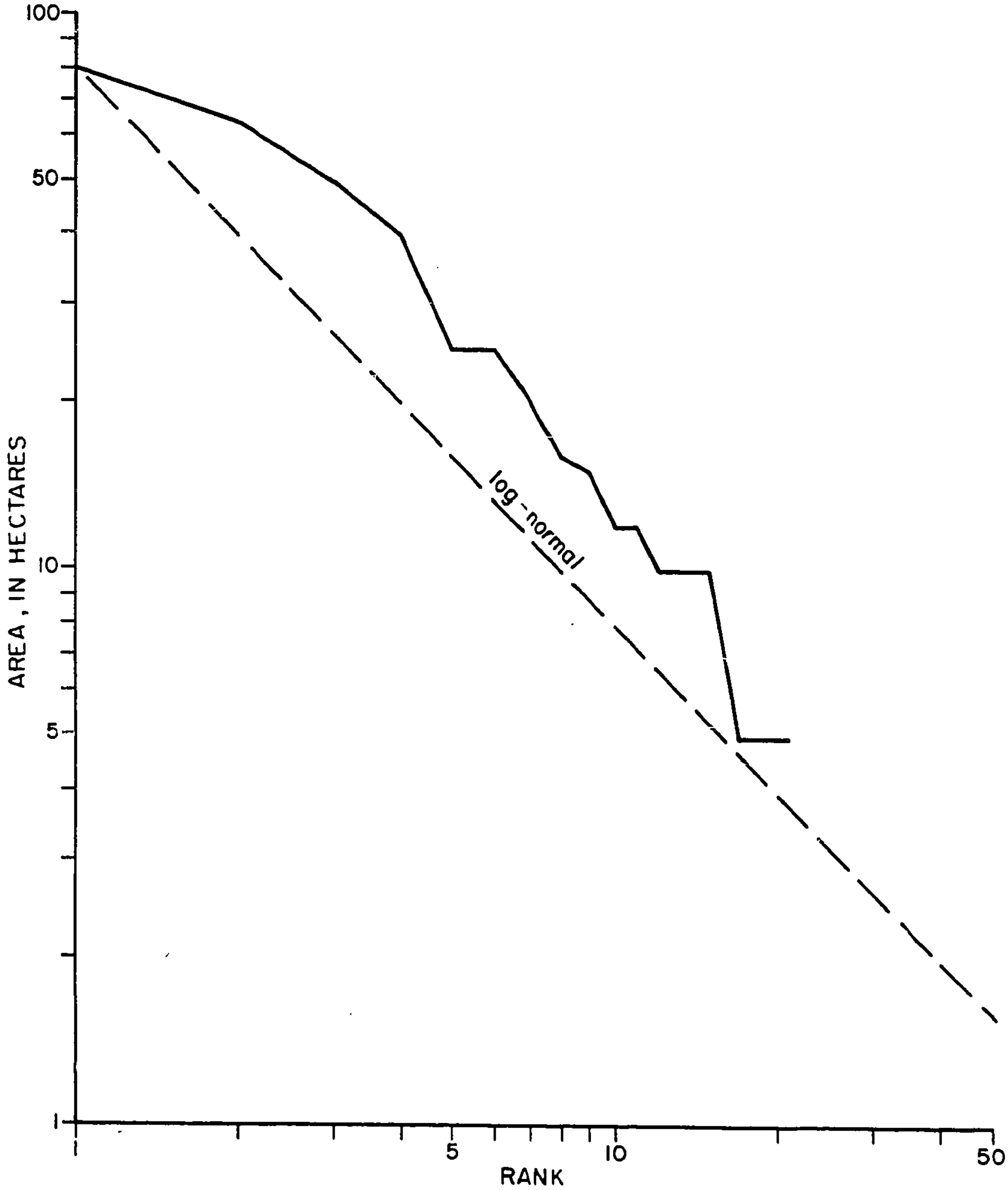


Figure 25. Middle Bronze II A Palestine rank-size distribution (based on Broshi and Gophna 1986).

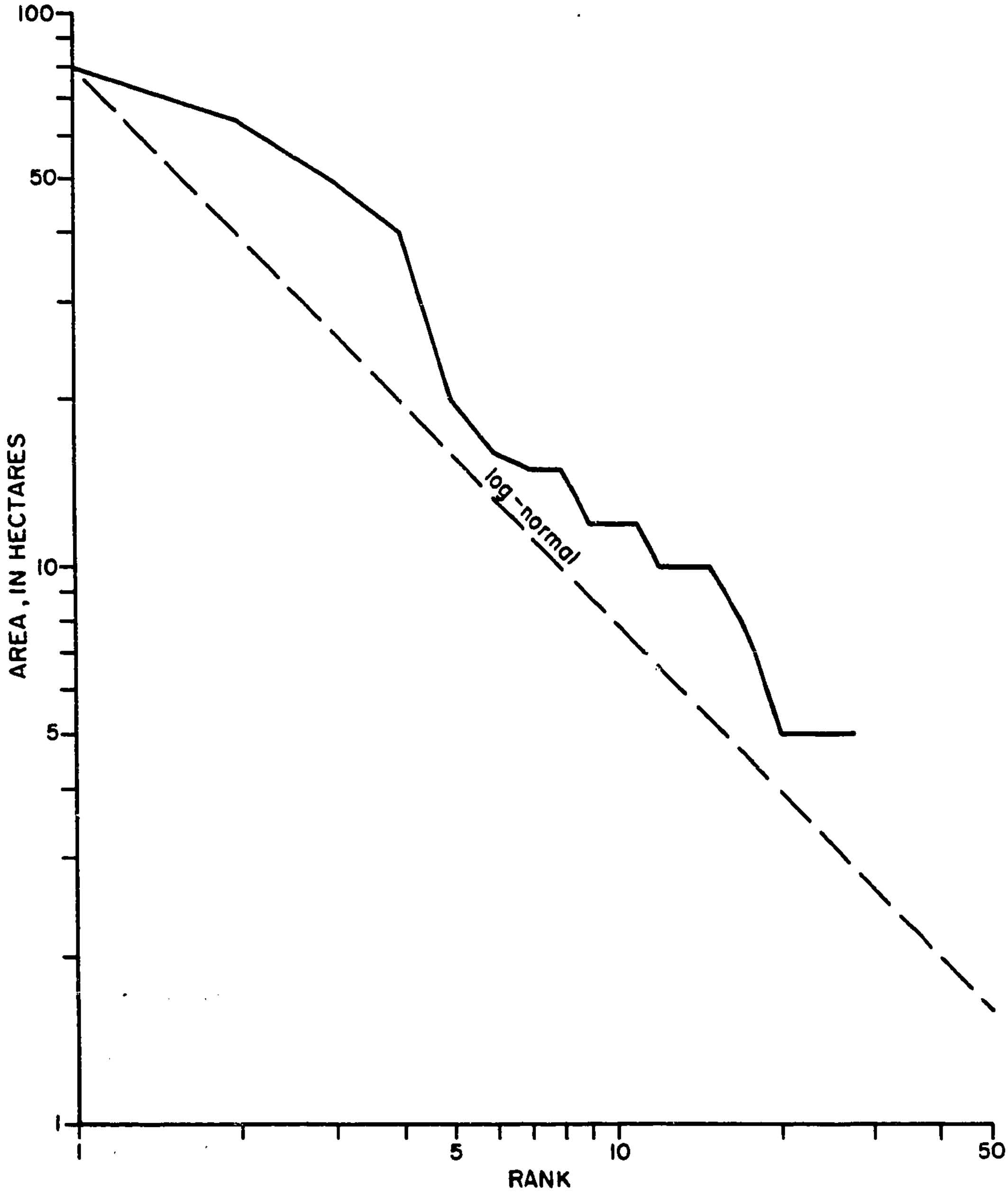


Figure 26. Middle Bronze II B-C Palestine rank-size distribution (based Broshi and Gophna 1986).

autonomous settlement systems or sub-systems (see Johnson 1980b). Interpretations of an Egyptian political or military empire in Palestine during the Middle Kingdom (Albright 1928; 1960) would support the former possibility. However, detailed criticism of material evidence for an Egyptian presence in Palestine argues that this supposed empire "appears to be a complete fiction" (Weinstein 1975:9). The latter possibility may be valid in light of the contrasts drawn between settlement in the Coastal Plain/Huleh Basin vs. the Central Hills/Jordan Valley (see Early Bronze discussion above; Middle Bronze discussion below). Most importantly, these convex rank-size patterns cast doubt on normative expectations of cohesive urbanized settlement systems in Early and Middle Bronze Age Palestine. The nature of Middle Bronze Age settlement is elucidated further by comparisons with growth trajectories in Mesopotamia and consideration of settlement distributions within Palestine.

Comparison with Mesopotamia

Many of the comparative observations based on Early Bronze Age data also apply to the Middle Bronze Age. Site density reached a new peak in Middle Bronze II B-C (Broshi and Gophna 1986: 73), but population densities and mean site areas continued to approximate only those in Mesopotamia's margins (cf. figs. 8, 9, 12, 23).

The proportion of Palestine's population living in cities (Mabry [1984] shows a maximum of 50% in Middle Bronze II A) may have been comparable to some periods of Mesopotamian urbanism (*e.g.*, during the Early Dynastic through Old Babylonian periods in the Warka region).

However, all of Mesopotamia's urban maxima had relatively depressed rural site frequencies. In contrast, rural settlement was extremely abundant in Palestine, and peaked during the supposed urban "zenith" of Middle Bronze II B-C. Figures 25 and 26 show rank-size distributions most akin to those of deurbanized periods in Mesopotamia, and describe little difference between distributions early and late in the Middle Bronze Age. These figures reiterate minimal urban growth and Palestine's lack of regionally prominent cities.

As was true for third millennium Palestine, the Middle Bronze Age data invalidate any hypothesis of urban nucleation, or urbanization of any kind. Instead, settlements proliferated, while Palestine's population grew very modestly. Mean site size dropped sharply to the lowest value indicated through the entire Bronze Age (two hectares) in Middle Bronze II B-C. Therefore, we must conclude that Middle Bronze Age settlement was characterized by growth in the countryside. Because this era, unlike the Early Bronze Age, was marked by at least a handful of cities, one might ascribe this growth to ruralization directed by Palestine's cities. This possibility is considered in a regional comparison of settlement within Palestine.

Settlement Distribution Within Middle Bronze Age Palestine

Figure 24 shows that the distribution of Middle Bronze Age cities along Palestine's peripheries was even more pronounced than in the third millennium B.C. Urban settlement clearly was a peripheral phenomenon restricted to the coastal plain (Tell Kabri, Yabneh-Yam, Ashkelon) and the Huleh Basin (Hazor). Additional larger towns (i.e., 20 ha. and larger) clustered along the coast (Acre, Tell Burga) and in the adjacent Jezreel Valley (Megiddo, Tell Shimron). Even modestly-sized towns (i.e., 10 ha. and larger) were exceedingly sparse over most of Palestine's interior landscape, accounting for only 15% of the inhabitants of the Central Hills and Jordan Valley by the end of the Middle Bronze Age.

Segregation of settlement data from Palestine's central and peripheral regions (see fig. 20) shows further contrasts more striking than those of the Early Bronze Age (see fig. 27). The Coastal Plain and Huleh Basin encompass only 23% of surveyed hectarage in Palestine, but contain an inordinate proportion of Middle Bronze Age aggregate site area (71% in Middle Bronze II A, 61% in Middle Bronze II B-C). Figure 27 shows population densities indicative of this contrast. It also indicates only very modest population growth in both regions through these periods.

The most significant arena of growth was a proliferation of settlements, primarily small rural sites, in the Central Hills and Jordan Valley. By Middle Bronze II B-C 95% of the settlements in these central areas were rural, and mean size had fallen to one hectare. Meanwhile, in the peripheries urban population dropped slightly, while rural settlement remained static. It is most significant that Palestine's cities do not appear to have structured settlement in their immediate hinterlands. Instead, the primary expression of growth was precisely in the underpopulated central areas of Palestine, well removed from urban authority, where villages and hamlets multiplied, and even modestly-sized towns disappeared. Thus, we are witness not to

Figure 27. Survey Data for Central and Peripheral Regions of Middle Bronze Age Palestine (based on Broshi and Gophna 1986).

A. Site Density (n/100 km^2)

B. Population Density (ha/100 km^2)

C. Mean Site Area = □

Adjusted Mean Site Area = ■

D. Urban Population:

% in sites $\geq$ 35 ha = ■

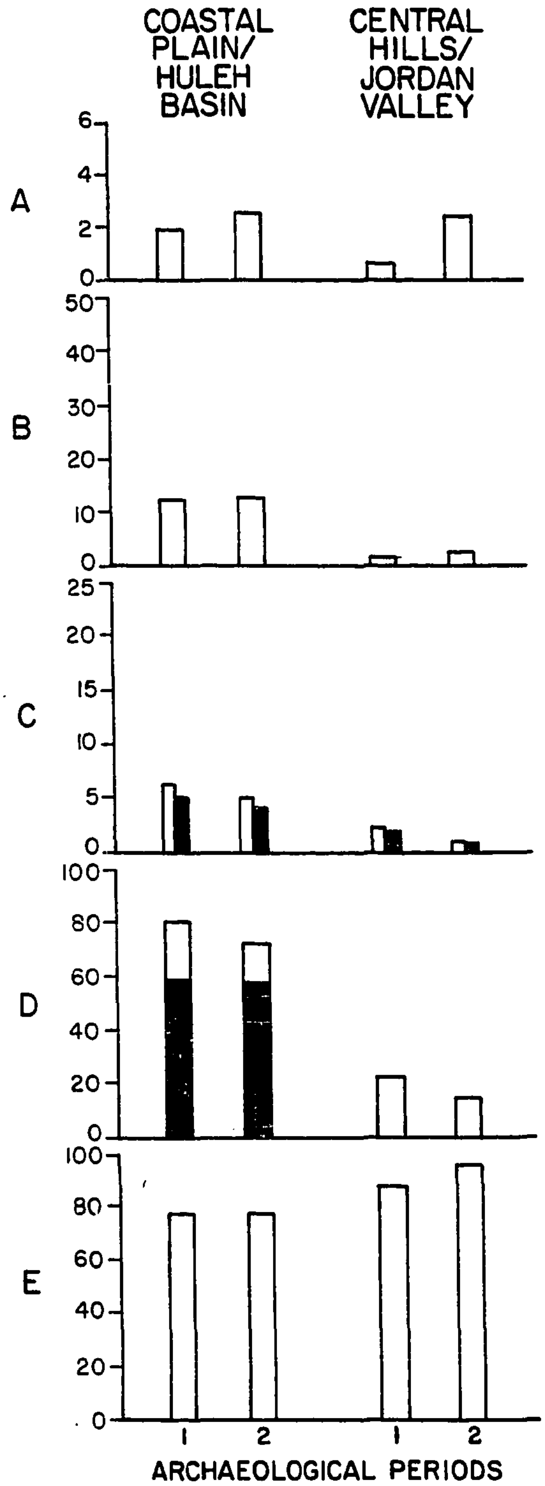
% in sites > 10 ha = □

E. Rural Site Frequency:

% sites < 5 ha

PERIODS

1. Middle Bronze II A
2. Middle Bronze II B/C



COASTAL PLAIN/ HULEH BASIN
CENTRAL HILLS/ JORDAN VALLEY
A
B
C
D
E
0
2
4
6
10
20
30
40
50
5
15
25
60
80
100
1
2
ARCHAEOLOGICAL PERIODS

a case of urban-based ruralization, but to rural-based growth and development, or "rural complexity."

Late Bronze Age Deurbanization

The Middle Bronze Age was capped by historically documented Egyptian military campaigns that left many Palestinian towns heavily damaged or deserted (Kenyon 1973; Ahituv 1978; Weinstein 1981). The nature of Canaanite society after these expeditions is a matter of some disagreement. The Amarna Letters, correspondence from Canaanite rulers to the pharoahs Amenhotep III and IV (Knudtzon 1915), imply a political system involving relatively autonomous control of local territories by numerous, competitive petty rulers (e.g., Albright 1971). These authorities refer to their "cities" and other local holdings (e.g., see EA 227 from Hazor, EA 252 from Shechem), as well as to alliances between towns, and minor power struggles among polities for material holdings or the favor of the pharoanic authorities in Egypt. The basic political unit in Palestine at this time is again seen as the "city-state" in which territorial authority resided with these rulers in towns and cities like Megiddo, Gezer, Shechem and Hazor (Albright 1971; Campbell 1965; Ross 1967).

Albright (1960: 99) argues that Palestine remained "an integral part of the Egyptian Empire" throughout the Late Bronze Age. While this view appears overstated, settlement systems probably became increasingly constrained by Egyptian interests and actions. Prior to the campaign of Thutmose III against Megiddo in the 15th century B.C., imperial intervention in the southern Levant was minimal (Redford 1967;

Weinstein 1981: 10), and centered on "the coastal plains and along the caravan routes," ... "leaving the hill country to itself" (Ahituv 1978: 105). Subsequently, Egypt established garrisons and administrative outposts to extract economic resources and maintain rather loose colonial ties. (Na'aman 1981: 177; Weinstein 1981: 12-17). Increased military and political investment at the end of the Late Bronze Age solidified Palestine's quasi-colonial role in Egypt's imperial economic system (Na'aman 1981: 184; Weinstein 1981: 17-18). A growing Egyptian bureaucracy might be expected to bolster at least a few coastal towns (Na'aman 1981: 185). However, imperial economic demands had a powerful negative impact on Palestinian town life that is dramatized by the settlement history of the Late Bronze Age.

Late Bronze Age Settlement in Palestine

Amid this turbulent history, archaeological attention again should be directed to developments in the countryside. Late Bronze "city-state" Palestine experienced a process of "deurbanization" (see discussion on Chapter 3) in which urban populations dwindled as part of a conspicuous decline in throughout the southern Levant (Kenyon 1971: 555; Gonen 1984: 63, 66). Occupation at very few sites continued from Middle Bronze II into the Late Bronze Age (Gonen 1984: 69). Most large Late Bronze settlements also lacked defensive walls or had substantially more modest fortifications, (e.g., Gezer, Dever 1982), despite the tone of internecine warfare in the Amarna Letters. An inventory of excavated sites by Gonen (1984) demonstrates a process of deurbanization from the end of the Middle Bronze Age through the Late Bronze Age.

Organization of Survey Data

Figure 28 summarizes data for Lat Bronze Age settlement in the sixteenth through thirteenth centuries B.C., and compares aggregate data for Middle Bronze II and the Late Bronze Age (calculated from values in Gonen 1984: Table 1). These data are derived from a sample of 77 Late Bronze Age sites, many of which also were inhabited during the Middle Bronze Age. Gonen makes only limited use of Middle Bronze and Late Bronze site frequencies as reported by ten surveys covering much of Palestine and the Jordan Valley. Figure 28 includes a second measure of site density based on these surveys (based on Gonen 1984: Table 2). As Gonen (1984: 62-63) herself notes, these data are not regionally comprehensive, and constitute a sample of second millennium settlements that is biased toward larger communities.

For the sake of consistent presentation site density, relative population density, relative urban population, and mean and adjusted mean site areas are presented in the format used for previous discussions of Palestine and Mesopotamia. Gonen's smallest size classes include sites five hectares and less, and rural site frequencies are presented accordingly. Her largest size classes group data for sites greater than ten hectares. The aggregate area of these sites provides a secondary measure of large site populations.

Gonen's limited sample of excavated sites produces underestimated values for rural site frequencies, and site and population densities. Urban populations, and mean site areas are exaggerated by a bias towards larger sites. For example, compare the highly inflated Middle

Figure 28. Settlement Data for Late Bronze Age Palestine (based on Gonen 1984).

A. Site Density (n/100 km^2)

based on survey data =

based on Gonen's sample of excavated sites =

B. Population Density (ha/100 km^2)

C. Mean Site Area =

Adjusted Mean Site Area =

D. Urban Population:

% in sites $\geq$ 35 ha =

% in sites > 10 ha =

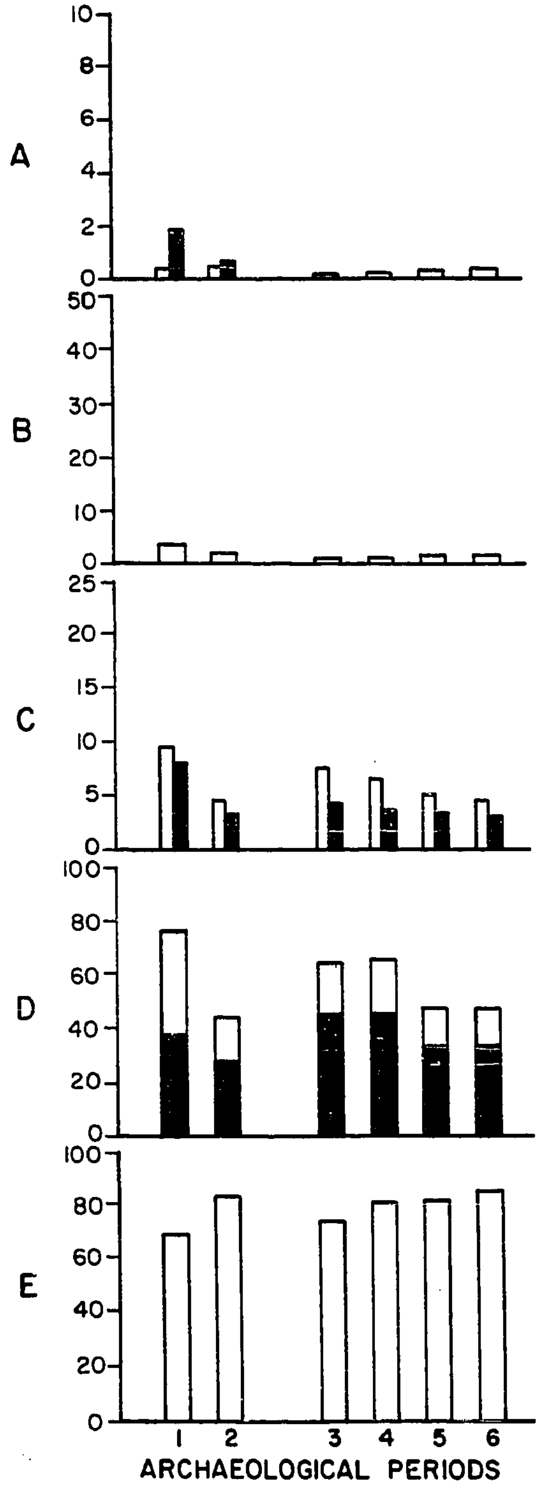
E. Rural Site Frequency:

% sites $\leq$ 5 ha

PERIODS

1. Middle Bronze II
2. Late Bronze I and II

3. 16th Century B.C.
4. 15th Century B.C.
5. 14th Century B.C.
6. 13th Century B.C.



A
B
C
D
E
10
8
6
4
2
0
50
40
30
20
10
0
25
20
15
10
5
0
100
80
60
40
20
0
100
80
60
40
20
0
1
2
3
4
5
6
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Bronze Age mean site size of 9.5 hectares with the mean values based on Broshi and Gophna (1986) or Mabry (1984). Site densities calculated from Gonen's compilation of survey data are perhaps less biased, but still less comprehensive than those discussed previously in this chapter.

Late Bronze Age Urbanism and Ruralism

Data derived from Gonen (1984) suggest a population decline into the Late Bronze Age that was most pronounced in cities and larger towns. Increasingly abundant small villages provided the only aspect of growth. Only Lachish and Hazor persisted as "very large settlements" (i.e., 20 ha. and larger) through the Late Bronze Age, and Hazor emerged once again as enigmatically large at a time of marked deurbanization (Gonen 1984: 68). After the political disruptions at the end of the Middle Bronze Age, urbanism failed to recover and the rural character of Palestinian settlement again became more pronounced.

Several trends show that Late Bronze Age communities dwindled in number and size. Survey data show Late Bronze Age site density much lower than that of the Middle Bronze Age. Settlements revealed through excavation suggest that regional population density, urban population and mean site size dropped dramatically, as Late Bronze Age towns tended to be much smaller, and less commonly fortified, than their Middle Bronze Age predecessors.

Once into the Late Bronze Age, site and population densities increased modestly from the 16th through the 13th centuries B. C. However, as in the Early and Middle Bronze ages, this growth was manifested in increased ruralism, not urbanization. Urban populations and average settlement sizes dropped substantially through the four centuries that Gonen ascribes to the Late Bronze Age. Over the same interval rural villages increased in absolute number and relative frequency.

In this age of imperialism and international trade, settlement and society developed primarily in the countryside of the southern Levant. Rural growth was not at the behest of declining seats of local authority, but may have been encouraged or forced by urban collapse and Egyptian imperial interests. When viewed on a local scale, the society of Late Bronze Age Canaan appears to be a persistent example of "rural complexity." However, in a larger sense it may exemplify "ruralization" in Egypt's imperial periphery.

Summary

The course of Bronze Age growth and development in the southern Levant has been charted on the basis of changing material culture and the appearance of large, presumably "urban" communities. Oswald Spengler's axiom that "Weltgeschichte ist Stadtgeschichte" (1922 in Wheatley 1971) has proven very seductive in the study of Canaanite society. A long-standing emphasis on data excavated from ancient towns and cities has generated consistently "urbanocentric" interpretations of this complex society. However, it is abundantly clear that if urbanization simply entails the growth of metropoli, Palestine was urbanized only in a very marginal sense. Concentration on the lower tier of Palestine's settlement hierarchies may prove a more informative approach to interpreting urbanism and ruralism in the Bronze Age.

Basic clues to the structure of Bronze Age society lie in regional settlement pattern data, which have long been recognized as fundamental to our understanding of Early Bronze IV "pastoralization." Bronze Age urbanism is reconsidered by comparing avenues of settlement growth and development during various eras in Palestine and Mesopotamia. Contrasts in the scale of urban phenomena at different times and in different regions have been noted previously. However, structural differences between various complex societies have been obscured by the quasi-taxonomic use of urbanism as a uniform, normative concept -- a Platonic essence.

Settlement data from Palestine demonstrate that normative concepts of urbanism characterize Bronze Age society inadequately, and that the basis of growth and development there lay more in rural complexity than in urban pre-eminence. Many of the evolutionary processes by which settlement and society developed in Mesopotamia were not at work in Palestine and Transjordan. Thus, early town life in the southern Levant is intriguing not because it was a scaled down, structurally equivalent, version of that seen in urban heartlands like Mesopotamia, but because it was structurally different from that of Mesopotamia. The basis of this difference lay in the countryside of the southern Levant and the minimal impact of Bronze Age cities on that countryside. Therefore, this study proposes that the southern Levant can be interpreted most informatively as a "heartland of villages." The remaining chapters specify how this concept may be appropriate by discussing excavated evidence from the Bronze Age village sites of Tell el-Hayyat and Tell Abu en-Ni^{c}aj in the Jordan Valley.

CHAPTER 5: EXCAVATIONS AT THE BRONZE AGE VILLAGES OF TELL EL-HAYYAT AND TELL ABU EN-NI^{c}AJ IN THE JORDAN VALLEY

The discussion in chapter 4 argues that normative concepts of urbanism and non-urbanism characterize Bronze Age society in the southern Levant inadequately because the structural basis of this complex society lies more in rural complexity and differentiation than in urban pre-eminence. Therefore, Bronze Age Palestine may be reconsidered as a "heartland of villages," in which the dimensions of complexity can be explored most effectively through detailed analysis of communities in the countryside. A case study of ruralism in the Jordan Valley is presented in chapters 5, 6 and 7 as it illustrates how this argument may be appropriate.

The Tell el-Hayyat Project

The University of Arizona Tell el-Hayyat Project is designed to investigate the roles of villages as they affected, and were affected by, the reappearance of towns ca. 2000 B.C. that marks the transition between the Early and Middle Bronze ages (see Falconer and Magness-Gardiner 1984:49-52). A long tradition of archaeological surveys (Glueck 1951; Mellaart 1962; Ibrahim, Sauer and Yassine 1976) points out the wealth of ancient villages in the Jordan Valley. Building on these surveys, several recent excavations at smaller sites complement on-going research at the larger tells of the valley. This multi-faceted database encourages investigation of economic continuities and discontinuities, and of the changing relations between towns and villages through the Bronze Age.

Field investigations by the University of Arizona concentrated on Tell el-Hayyat, and have been complemented by brief excavations at the nearby Early Bronze IV site of Tell Abu en-Ni^{c}aj (see fig. 29). This chapter presents a brief overview of the design and preliminary results of this research. More detailed reports of the first and second excavation seasons have appeared elsewhere (Falconer and Magness-Gardiner 1983a; 1983b; 1984). Further publications will summarize the third season of excavations at Hayyat, and summarize final project results.

Tell el-Hayyat exemplifies the small communities that provided the foundation for "urbanized" complex society, but rarely have been excavated. Regional surveys indicated a history of occupation at Hayyat spanning Early Bronze IV and Middle Bronze II, thus, providing an unusual opportunity to study transitions in village economy at one site (see Glueck 1951: 259; site 154; Mellaart 1962: 144-145; Ibrahim, Sauer and Yassine 1976: 49, 54; site 56). measuring only 0.5 hectare, Tell el-Hayyat was, and is, in danger of destruction as part of the on-going development of irrigated agriculture in the Jordan Valley (Ibrahim, Sauer and Yassine 1976: 64-65; Mellaart 1962: 145). This small site was expected to represent a relatively undifferentiated agrarian community with, for example, no fortifications or public architecture. Therefore, it was seen as ideal for the comparison of Early Bronze and Middle Bronze subsistence and material culture in a setting of homogeneous domestic architecture.

The research program for Hayyat and Ni^{c}aj was tailored especially to investigate subsistence strategies. Floral and faunal assemblages

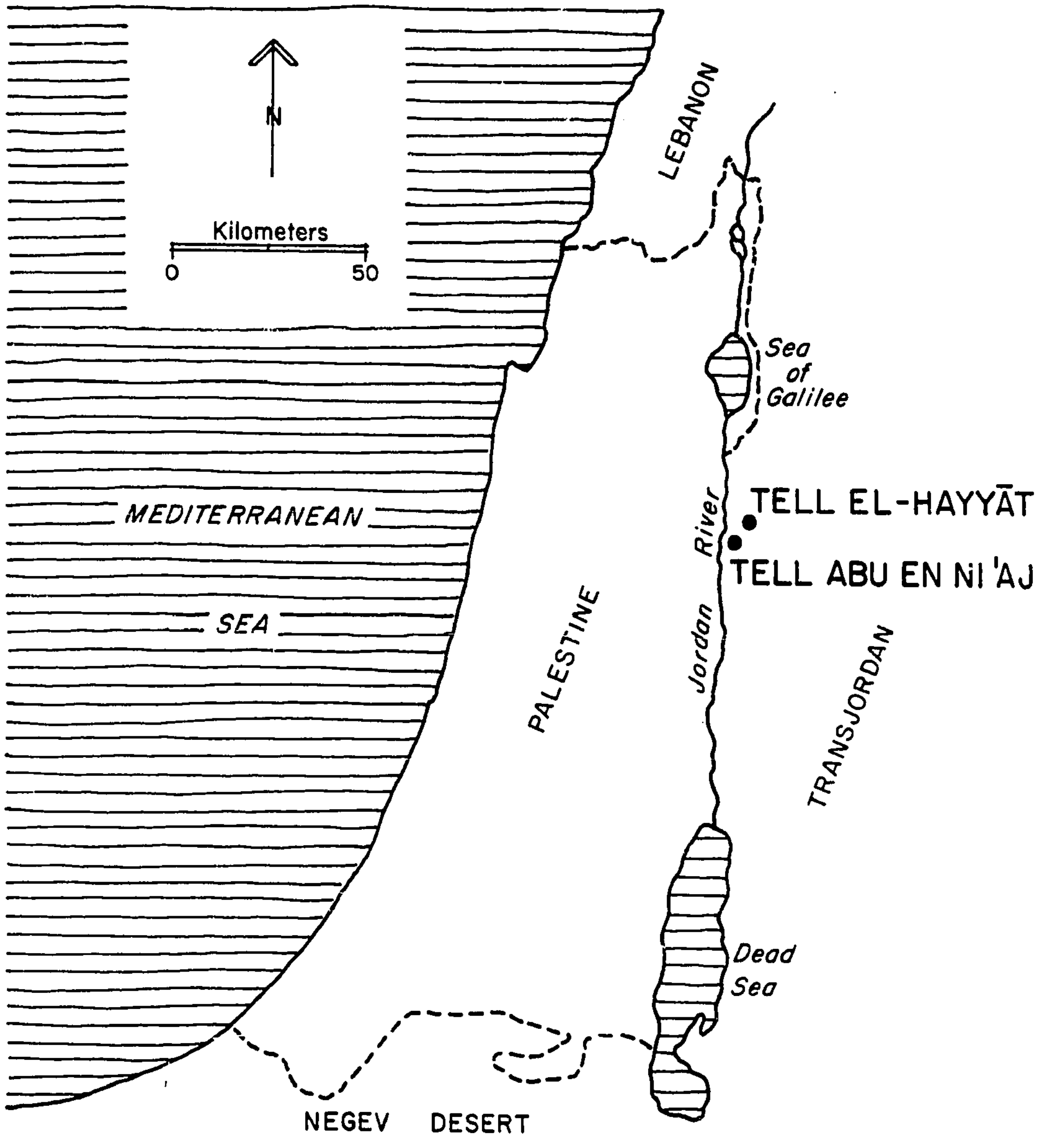


Figure 29. Map showing locations of Tell el-Hayyat and Tell Abu en-Ni[c]aj in the Jordan Valley.

were expected to reflect the pervasive pastoralism of Early Bronze IV, and the profound economic changes anticipated for the growth of Middle Bronze II city-states. These excavations have indeed illuminated village life, but in ways unexpected at their outset. Tell Abu en-Ni^{c}aj illustrates the importance of sedentary agricultural villages during climax of the Early Bronze Age. Tell el-Hayyat provides a sequence of four Middle Bronze Age temples in a community that amounted to little more than a farming hamlet. Neutron activation analysis of ceramics from the Jordan Valley indicates specialized, perhaps centralized, pottery production in Early Bronze IV and Middle Bronze II A villages, not simply in larger urban centers. These data are significant because they are not consistent with currently-accepted models of Bronze Age settlement and complex society. Therefore, they require a shift in our views of early urbanism and ruralism in the southern Levant.

Excavations at Tell el-Hayyat and Tell Abu en-Ni^{c}aj

Three seasons of fieldwork at Tell el-Hayyat, in cooperation with the Department of Antiquities of Jordan, have corroborated the chronological interpretations of previous surveys. Excavations over eight percent of Hayyat's surface area during 1982, 1983 and 1985 proceeded through 4.5 meters of cultural deposition (see fig. 30). Habitation at Tell el-Hayyat began in late Early Bronze IV and continued without interruption through six stratigraphic/architectural phases to late Middle Bronze II C (see Table 14).

Early Bronze IV and early Middle Bronze II A ceramics both

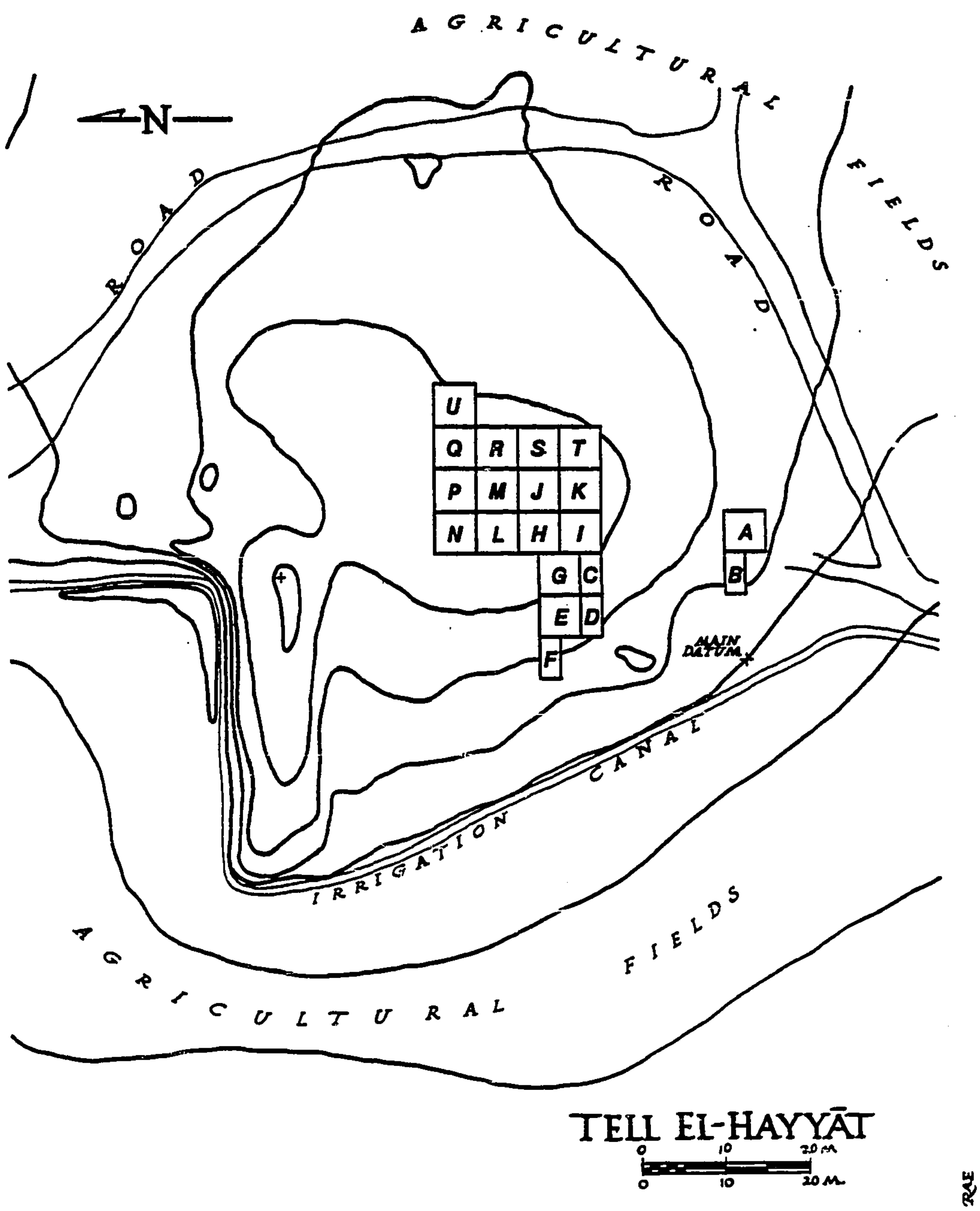


Figure 30. Topographic site map of Tell el-Hayyat. Lettered squares indicate 5x5 meter excavation areas. Main datum lies at approximately 240 meters below mean sea level.

Table 14. Phases of prehistoric occupation at Tell el-Hayyat, Jordan Valley, Hashemite Kingdom of Jordan. Absolute chronology based on stylistic ceramic analysis.

Years B.C.	Phase Designation	Archaeological Period
ca. 1500	-------	-------------
	Phase 1	late MB II C
ca. 1550	-------	-------------
	Phase 2	MB II C
ca. 1650	-------	-------------
	Phase 3	MB II B
ca. 1825/1800	-------	-------------
	Phase 4	MB II A
ca. 1925	-------	-------------
	Phase 5	early MB II A
ca. 2000	-------	-------------
	Phase 6	EB IV
ca. 2150*	-------	-------------

* No earlier than 2200 B.C., no later than 2000 B.C.

occurred in Phase 5. Unmixed Early Bronze IV ceramics (Phase 6) were found in limited deposits toward the center of the tell (in excavation areas H, J, L and M). Any architecture that might have been used in Phase 6 apparently was leveled for the subsequent construction of a small temple in early Middle Bronze II A (Phase 5), which was the first in a stratified sequence of four mudbrick temples (Phases 5-2) (see fig. 31). An enclosure wall was constructed in Phase 5 and rebuilt in tandem with each subsequent temple. Aside from a single mudbrick wall toward the western edge of the village, domestic architecture was absent in Phase 5. In phases 4 through 2, single- and multiple-room houses, walled courtyards, and alleyways outside the temple compound characterized the settlement. Isolated remnants of the Phase 1 village included stone wall foundations and pebbled floors. This uppermost stratum has been disturbed considerably by Byzantine pits and the activities of modern farmers.

Middle Bronze Age Temples

Figure 31 presents four phase by phase plan views of the domestic and temple architecture excavated in squares C through T at Tell el-Hayyat. The Phase 5 temple and temple enclosure show several traits repeated in subsequent phases. The remains of this earliest temple consist entirely of molded earth foundations in a simple rectilinear plan with projecting anterior "buttresses." The Phase 4 temple is constructed entirely of mudbrick following a more elaborate plan with exterior pilasters and inset-offset niching around the entry. The Phase 3 temple is built on a single-course stone foundation placed

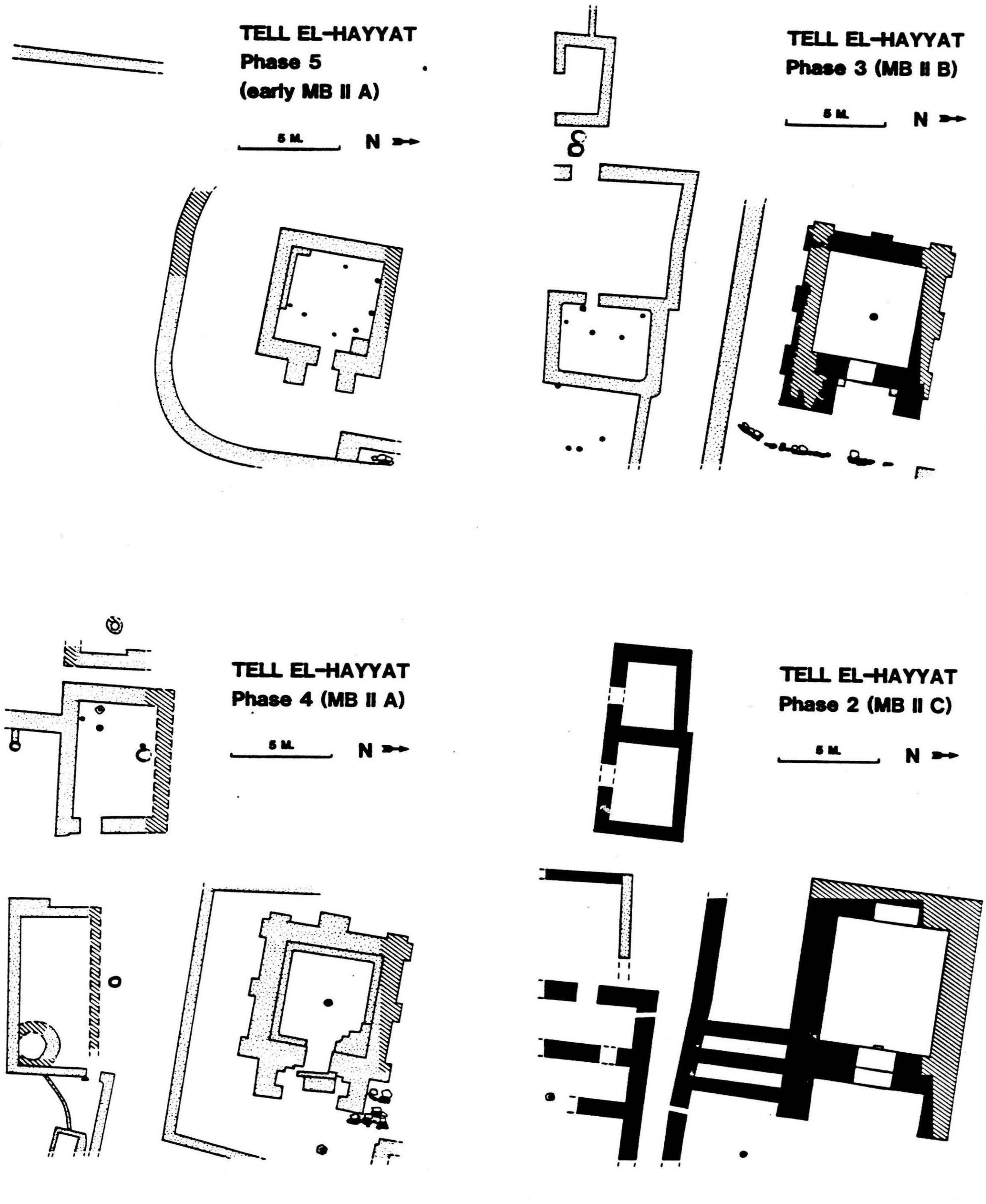


Figure 31. Temple and domestic architecture at Tell el-Hayyat, phases 5-2. Stippled areas indicate molded earth in Phase 5, mudbrick in phases 4-2. Black areas indicate stone. Cross-hatched areas and dashed wall faces are reconstructed.

directly on the remains of the lower mudbrick courses of Phase 4. These two temples are almost identical in plan, aside from the Phase 3 buttresses, which are rectilinear, asymmetrical and shifted to the temple's anterior corners. Mudbrick domestic construction in phases 4 and 3 gives way in Phase 2 to single-course stone-founded houses and a temple that is simple in plan, but rises above massive multi-course stone foundations. The Phase 2 temple buttresses are augmented by foundations linking the temple to its enclosure wall.

The floors of the Phase 5 temple are marked by numerous shallow, pebble-lined depressions that may have served as pot stands. This temple also is marked by a low interior bench or curb, and by a mudbrick platform or "altar" in its northeastern corner. These features are repeated and slightly elaborated in the Phase 4 temple. The last three temples all apparently incorporated a stone pedestal as a central feature. A carved basalt pedestal was recovered in situ as part of the southern forecourt of the Phase 2 temple. Shallow depressions with identical dimensions in the floors of the Phase 4 and Phase 3 temples suggest earlier uses of this stone, or other similar pedestals.

Major exterior features also are repeated through time. Domestic architecture never bonds or abuts with a temple enclosure wall. However, the forecourts of the first three temples include cornering walls of structures that were apparently associated with the temples. Each of these forecourts also contains one or more small undecorated standing stones accompanied by flat-lying stones. These standing stones are a traditional feature of Canaanite ritual architecture best known from later Middle Bronze and Late Bronze Age contexts at Hazor (Yadin 1972: 74), Tell Kittan (Eisenberg 1977: 80) and, on a megalithic scale, at the Gezer "High Place" (Dever et al. 1971: 120-124; Dever 1973) (see also Graesser 1972).

In overview, these four directly-superimposed architectural phases describe a remarkable sequence of temple and village development. The Hayyat temples conform to the general category of "Langbau" or "Langraum" temples (G. R. H. Wright 1971). In particular, they are temples in antis that demonstrate the antecedent forms of the "Migdal" or "Fortress" temples known at Megiddo (Temple 2048; Loud 1948: 103, fig. 247; Epstein 1965; Dunayevsky and Kempinski 1973: figs. 2, 15-19), Shechem (Temples 1a and 1b; G. E. Wright 1965: figs. 41, 48) and Hazor (Area H temples; Yadin 1972: 75-79). The parallel foundations linking the Phase 2 temple with its enclosure wall could have supported a tower, such as that hypothesized for the temples at Shechem (G. E. Wright 1965: fig. 47) and Megiddo (Dunayevsky and Kempinski 1973: figs. 17 and 18).

These temples are interesting of themselves, but for this study it is also important to consider why they were part of this tiny hamlet, and what they suggest about Bronze Age rural settlement. Temples in antis are known primarily from the larger towns and cities of Palestine, Syria (e.g., Ebla Temple D [Matthiae 1981: 130-132]) and the eastern Nile Delta (e.g., Tell el Dab^{c}a [Bietak 1979: 247-253]) (see fig. 32). These edifices normally are seen as manifestations of urban Canaanite religious institutions (e.g., see G. E. Wright 1974).

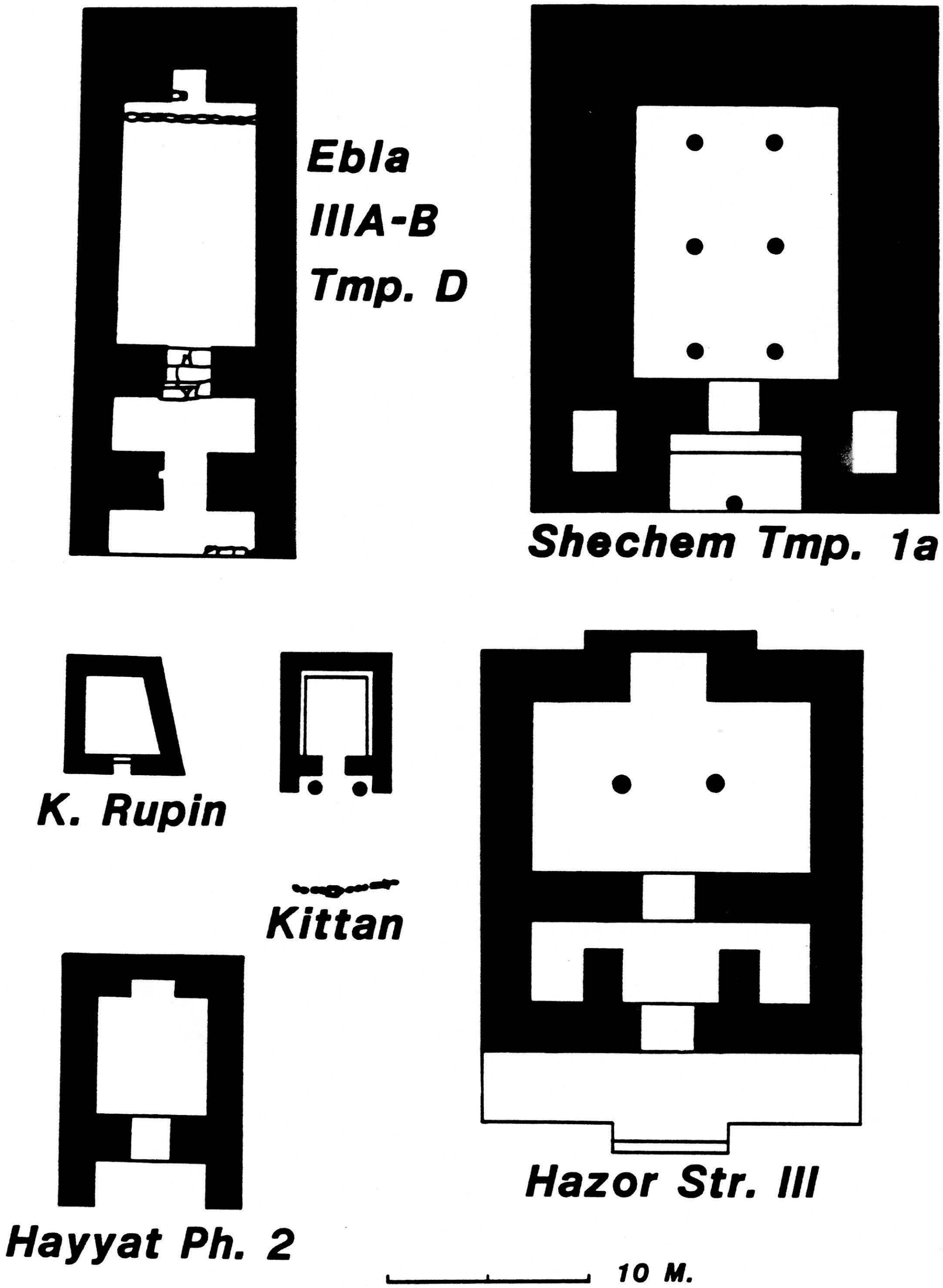


Figure 32. Town and village temples in antis: Shechem Temple 1a (Wright 1965: fig. 41); Hazor Area H Temple (Yadin 1972: 76, figs. 18, 19); Ebla Temple D (Matthiae 1981: 130, fig. 30); Kfar Rupin (Gophna 1979: 30, fig. 2); Tell Kittan Stratum V Temple (Eisenberg 1977: 80).

Therefore, the scaled-down temples at Hayyat present an intriguing juxtaposition of a presumedly urban institution in a distinctly rural setting.

The Hayyat temples might be seen as atypical, signifying this community as a special function site. However, Tell el-Hayyat is not an isolated example of a village with temples. The sites of Kfar Rupin (Gophna 1979: 29-30; site size < 0.4 ha.) and Tell Kittan (Eisenberg 1977; site size = 0.8 ha.) have temples of the same architectural form that are contemporaneous with Hayyat's Phase 2 temple (see figs. 32 and 33). Rupin and Kittan are among the very few excavated Middle Bronze Age villages in the southern Levant, and both are relatively near Tell el-Hayyat in the Jordan Valley.

It might be tempting to interpret these extremely small sites as isolated shrines or sanctuaries similar to other Bronze Age temples that essentially were outbuildings very near towns or cities. For example, the Middle Bronze Age shrine at Nahariya (Ben-Dor 1950; Dothan 1956) is less than one kilometer from Tell Nahariya (Dothan 1981: 74), and the hilltop temple on Mount Gerizim (Boling 1969) overlooks nearby ancient Shechem. In contrast, Tell el-Hayyat lies seven kilometers from Pella, the nearest substantially larger site. Kfar Rupin and Tell Kittan are comparably distant from Pella or Beth Shan.

Abundant evidence of domestic architecture also differentiates these village temples from isolated extramural temples elsewhere. All three of Tell Kittan's temples (Strata V-III; Middle Bronze II B/C-Late Bronze I) were surrounded by houses (Eisenburg 1977: 78-80). The Middle Bronze Age architecture at Kfar Rupin lies at the bottom of a

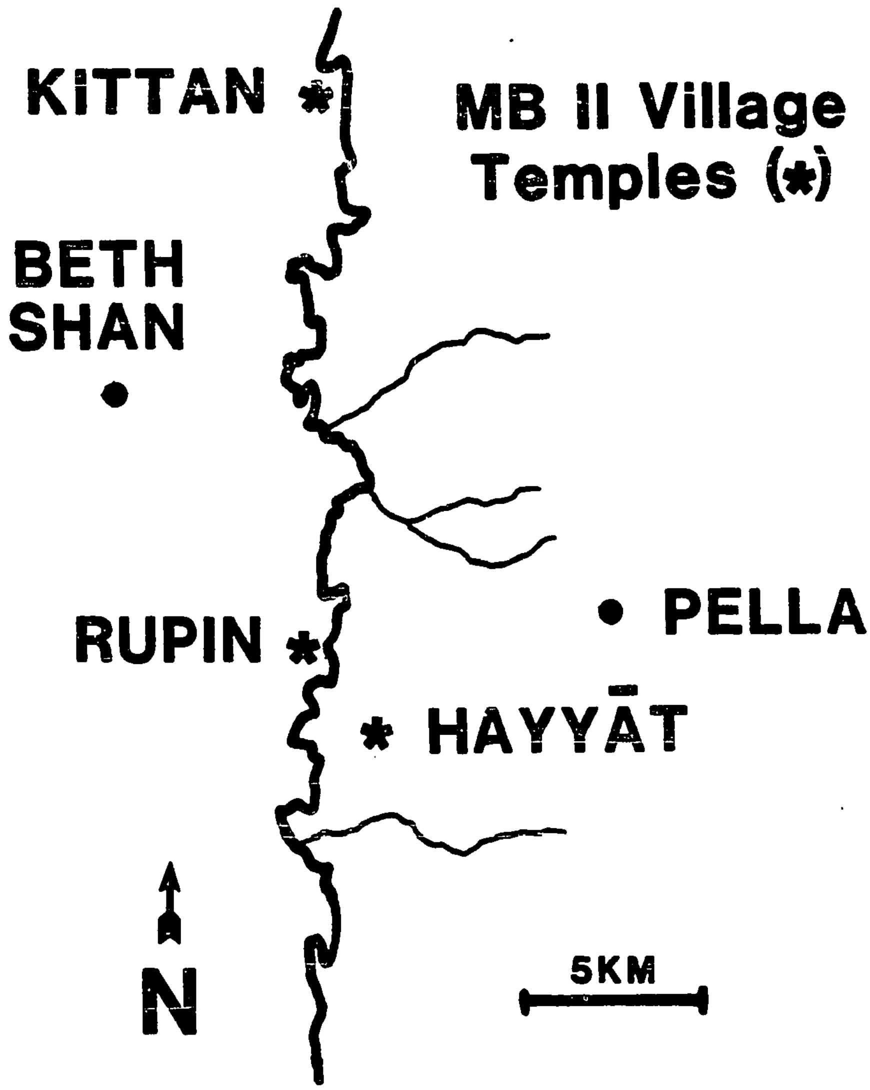


Figure 33. Map showing locations of Middle Bronze Age village temples in the Jordan Valley.

fish pond and has been mapped, but not excavated. Here again, the clear plan of a village temple is surrounded by the stone foundations of distinct, presumably domestic, buildings (Gophna 1979: fig. 2).

While Tell el-Hayyat also is marked by houses outside the enclosures of phases 4-2, the apparent absence of Phase 5 houses suggests that Middle Bronze Age settlement at Hayyat was initiated with the construction of a temple. To consider the implications of these villages and temples regarding rural complexity, we require a perspective on villages in periods both with and without urban settlement. For this we turn to further data from Tell el-Hayyat and Tell Abu en-Ni^{c}aj.

Floral and Faunal Evidence

Soundings along site perimeters at both Tell Abu en-Ni^{c}aj and Tell el-Hayyat recovered abundant floral and faunal remains, particularly from trash deposits. Preliminary analyses of these assemblages reveal more similarities than differences between the subsistence economies of Early Bronze IV Ni^{c}aj and Middle Bronze II Hayyat.

The sedentary nature of the Middle Bronze Age farmers at Tell el-Hayyat is indicated by their substantial domestic and temple architecture, their use of plants requiring relatively long-term cultivation (e.g., grapes, olives; Fall 1983), and by the significant role of non-herding livestock in their animal husbandry (e.g., pigs; Metzger 1983a; 1983b; 1984). The nature of Hayyat's Early Bronze IV settlement is less clear. However, evidence from Tell Abu en-Ni^{c}aj (North) provides supplementary information on Early Bronze IV village life.

Tell Abu en-Ni^{c}aj is a low 2.5 hectare mound 1.5 kilometers southwest of Tell el-Hayyat (see Ibrahim, Sauer and Yassine 1976: 49, 51; site 64). Brief test excavations in 1985 revealed 2.5 meters of cultural deposition with three phases of Early Bronze IV mudbrick domestic architecture. The lower phases at Ni^{c}aj were investigated in two deep soundings, while the upper phase was excavated in three broader exposures totaling 160 square meters. The cultural debris excavated from Abu en-Ni^{c}aj is solely Early Bronze IV. The faunal assemblage for Ni^{c}aj's upper phase reflects sedentary agriculture with a reliance on sheep, goat, cattle, and pig similar to that of Middle Bronze Age Tell el-Hayyat (phases 5-2) (Metzger n.d.).

Table 15 shows raw frequencies of major plant taxa found in flotation samples (see also Fall 1983). All of these taxa are morphologically domesticated. In keeping with post-Neolithic economies in southwestern Asia, the remains of annual cereals and legumes are abundant. Perennial species that required multi-year cultivation also are abundant at both sites. These data do not show the distinctions in plant use expected between Early Bronze IV pastoralism and Middle Bronze II sedentary agriculture.

Likewise, Table 16 shows general inter-site similarities in animal exploitation (based on Metzger n.d.). The remains of sheep and goats, the primary herded species of southwestern Asia, are abundant at both sites (see also Metzger 1983a; 1983b; 1984). More importantly, the remains of pigs, animals not suitable for pastoral herding, are surprisingly abundant at Tell Abu en-Ni^{c}aj. Therefore, these floral

Table 15. Floral assemblages excavated from Tell el-Hayyat and Tell Abu en-Ni^{c}aj. Data expressed as percentages of floatation samples with each taxon present. N refers to the number of floatation samples analyzed.

Taxon	Hayyat (n=53)	Ni^{c}aj (n=16)
Wheat/Barley	96%	100%
Pea	45	38
Lentil	43	44
Fig	81	81
Grape	15	50
Pomegranate	20	44
Olive	29	13

Table 16. Faunal assemblages excavated from Tell el-Hayyat and Tell Abu en-Ni^{c}aj. Data expressed as raw bone element frequencies. N refers to the number of identifiable bone elements analyzed.

Taxon	Hayyat (n=35,000)	Ni^{c}aj (n=1000)
Sheep/Goat	63%	60%
Pig	21	28
Cattle	11	11
Wild	5	1

and faunal data provide at least circumstantial evidence that the Early Bronze IV inhabitants of Abu en-Ni^{c}aj practiced sedentary agriculture and animal husbandry.

Preliminary faunal analysis also permits a note on village activities centered on temples. Tremendous numbers of animal bones were deposited in the forecourt of each of the Hayyat temples. The frequency of sheep/goat bone elements follows a simple spatial fall-off pattern around each temple, and the density of bone deposition parallels this pattern. When faunal data for phases 5-2 are combined, sheep/goat constitute 92% of identifiable bone elements in the forecourts. This frequency falls off to 83% in temple interiors, and to 80% to the south side of each temple. In turn, bone deposition in domestic contexts outside the temple compounds is much less abundant, and contains only 60% sheep/goat (Metzger, personal communication).

Akkadian texts from the Syrian site of Meskene (ancient Emar) suggest one form of communal behavior that could have caused this bone deposition. These texts describe the installation of an Entu-priestess as the spouse of the Storm-God at Emar in the late second millennium B.C. (Arnaud 1982; 1986). Participants included the King and Elders of Emar, the designated Entu-priestess and her family, prior Entu-priestesses and priestesses of other cults, diviners and singers. Activities over several days centered on sacrifices to the Storm-God at temples, at temple gates and at the home of the Entu-priestess. Sacrifices usually involved a cow and several sheep, as well as beer, wine and bread. In some cases the participants feasted on cuts of meat after they had been offered in sacrifice, while at other times these goods were stored, apparently for later consumption (see Arnaud 1982: 47-50).

The patterning of bone deposition at Tell el-Hayyat may similarly suggest the larger communal nature of behavior focused on its Middle Bronze Age temples. Thus, the village temples of the Jordan Valley, particularly as seen at Hayyat, suggest that these sites were not simply limited function hamlets dedicated to agriculture. The evidence from Tell el-Hayyat suggests the larger importance of village temples as introduced focal points for original sedentary settlement, and for subsequent integration of village populations with larger, diverse communal (and perhaps extramural?) interests.

Concluding Remarks

Tell el-Hayyat and Tell Abu en-Ni^{c}aj are most intriguing as counterintuitive examples of Bronze Age settlement in the countryside. Tell Abu en-Ni^{c}aj is one of a growing number of sedentary villages reported in recent surveys (Ibrahim, Sauer and Yassine 1976: 51, 54) and excavations (Richard and Boraas 1984; Helms 1984; 1986; Rast and Schaub 1984) that formed a significant component of Early Bronze IV society, particularly in the Jordan Valley. Tell el-Hayyat apparently exemplifies the diverse behaviors and interests that effected even extremely small villages in the Middle Bronze Age.

This reconsideration of ruralism is expanded in chapters 6 and 7 with an analysis of economic relations <u>between</u> towns and villages in the Bronze Age. Excavations on the southern flank of Tell el-Hayyat (in Area A), primarily intended to recover floral and faunal remains from midden deposits, revealed an intact simple updraft pottery kiln (Falconer and Magness-Gardiner 1984: 54-55; 1983a: Pl. VI, 2; Pl. VII, 1); cf. Rye 1981: fig. 88). The original dating of this kiln to Phase 5 (Falconer and Magness-Gardiner 1983a: 92) has been revised to Phase 4 (Middle Bronze II A). This direct and unexpected evidence of pottery manufacture at Tell el-Hayyat was supplemented by considerable manufacturing debris excavated from the kiln and from Hayyat's houses and temple compounds. This debris includes naturally bedded clays, fragments of tempered, but unfired, ceramic vessels, pottery wasters and ceramic slag. Wasters are fragments of pots that experienced some form of structural failure during firing. Failure often results from "bloating" or "slumping." Bloating occurs when pockets of gas or liquid in poorly prepared clays expand and explode during firing. Overfiring makes pottery excessively plastic and causes it to "slump" or collapse during firing (see Cardew 1969: 63-64, 211).

Most importantly, this manufacturing debris embodies the raw materials used in pottery manufacture at Tell el-Hayyat. The chemical composition of these raw materials and of pottery from Hayyat, Ni^{c}aj and neighboring sites can be compared to determine patterns of chemical similarity between specific pots and known sites of manufacture (e.g., Tell el-Hayyat). On this basis we may infer networks of pottery production and exchange.

The following chapters review the design, methods and results of a neutron activation analysis of Early Bronze IV and Middle Bronze II A pottery production and exchange involving ceramic evidence from Tell el-Hayyat, Tell Abu en-Ni[c]aj and several additional sites in the Jordan Valley. Chapter 6 considers the nature of ceramic bodies and the methods with which they can be analyzed most appropriately. Chapter 7 describes how these methods are applied in a neutron activation comparison of intersite economic relations before and after the rejuvenation of towns ca. 2000 B.C. As with Tell el-Hayyat's temples, the results of this study are most intriguing because they are unexpected, and further encourage the reconsideration of early urbanism and ruralism in the southern Levant.

CHAPTER 6: EXCURSUS: AN EXPERIMENTAL STUDY OF APPROPRIATE METHODS AND INFERENCES IN ARCHAEOLOGICAL NEUTRON ACTIVATION ANALYSIS

The excavations at Tell el-Hayyat have revealed evidence appropriate to the study of village craft industry and local economic relations between towns and villages. Direct evidence of pottery production is provided by the remains of a Middle Bronze II A kiln on the site's southern periphery, and, more importantly, by a variety of manufacturing debris excavated from five phases of Middle Bronze II A through Middle Bronze II C occupation. This manufacturing debris includes clays and wasters that are particularly informative because they embody the raw materials used in ceramic manufacture at this Bronze Age village. Therefore, these data are well suited as the basis for a case study of local pottery production and distribution centered on Tell el-Hayyat and the Bronze Age archaeological sites that neighbor it in the Jordan Valley.

This chapter argues that in any such case, and particularly in local ceramic studies, the archaeologist must consider how clays and ceramics can provide data most appropriate for inferring manufacture and exchange. Specifically, this chapter investigates a fundamental methodological assumption that commonly underlies production/distribution studies based on neutron activation analysis. This assumption holds that chemical compositions of archaeological ceramics are indicative of the clays used in their manufacture (see Perlman and Asaro 1969: 30, 35; Harbottle 1976: 42-43; Wilson 1978: 220). An experimental investigation proposes that the <u>heterogeneous</u>

components of clay and non-clay inclusions in ceramics must be explicitly acknowledged and accommodated in archaeometric studies of production and distribution (see discussions in Bromund, Bower and Smith 1980; Bishop, Rands and Holley 1982: 280-281). Non-clay inclusions may be present in unmodified natural clays, or they may be added as temper by potters. The experiments below demonstrate that serious attention to ceramic heterogeneity is warranted (contra Wilson 1978: 224), and proposes a revised method with which chemical composition data most pertinent to the clay(s) in ceramics may be derived. This revised method is applied in a neutron activation analysis of Bronze Age pottery production and distribution in the Jordan Valley that is presented in Chapter 7.

The Nature of Ceramic Evidence

Archaeological inferences of pottery production and distribution patterns commonly rely on chemical characterization and comparative analysis of ceramics. A variety of archaeometric methods can be used to estimate concentrations of major, minor and trace elements in clay bodies. In chemical terms, clays are hydrous aluminum silicates (Grim 1968: 35; Blatt, Middleton and Murray 1972: 241-242; Folk 1980: 89). Major elements in ceramics, occurring in concentrations greater than 2 percent, can include aluminum, silicon, and magnesium. Minor elements, occurring in concentrations between 0.1 and 2 percent, can include sodium and potassium. A wide variety of trace elements occur in concentrations less than 0.1 percent (Grim 1968: 35-45; Rado 1969: 13-14; Meschel 1978: 15).

Trace elements are of particular diagnostic interest to archaeologists. Since they are not essential structural components of clay as an aluminum silicate, trace elements can include a variety of members, and can vary considerably in concentration. Furthermore, these differing trace element compositions reflect the differing geochemical environments of specific clay deposits (Perlman and Asaro 1969: 21; Shepard 1965). Therefore, in archaeological analyses, the trace element compositions of clays are viewed as "source-specific."

On this basis, archaeometric ceramic studies proceed from the assumption that clays from a common source, and the pottery made from those clays, can be identified through comparative analysis (Perlman and Asaro 1969: 21). Ceramics produced at a given site or in a given region are expected to have highly similar trace element compositions when compared to ceramics produced at other sites or in other regions. However, a fundamental difficulty arises if it is assumed that trace element concentration data pertain only to the clay(s) present in archaeological ceramic samples.

Potters routinely enhance the chemical heterogeneity of ceramic bodies by adding non-clay minerals (i.e., temper) (Shepard 1965; Wilson 1978: 220). Therefore, clays that lack temper, and pottery made of clay and temper, potentially can provide inappropriate non-comparable data for archaeometric analysis. Likewise, the varying functions and desired physical properties of pottery types manufactured at a common site may dictate the incorporation of very different types and amounts of temper (see Cardew 1969: 51-63; Rado 1969: 23-37). Thus, archaeometric analyses should not assume that patterns in trace element data directly indicate differences in clay sources and production sites unless the extraneous "noise" from non-clay mineral inclusions is eliminated, or at least reduced to acceptable levels. In trade studies over large regions, tempering noise may be relatively insignificant compared to more substantial trace element differences between clays and pottery from widely divergent sources. However, the success of equally important, more localized studies requires a careful consideration of appropriate analytical methods to permit optimal measurement of clays with minimal extraneous interference from non-clay temper.

This chapter considers this methodological dilemma as it pertains to the clays and pottery of Tell el-Hayyat, and proposes revised methods to be used in a neutron activation analysis of Bronze Age ceramic production and exchange in the Jordan Valley.

Neutron Activation Analysis

Neutron Activation analysis is used commonly to determine trace element concentrations in archaeological ceramics (see Perlman and Asaro 1969; Harbottle 1976). This radiometric technique is attractive for archaeological purposes because it requires only modestly-sized samples (e.g., less than one gram), and calculates mean trace element concentrations with relatively high precision, even for concentrations less than one part per million (Bishop, Rands and Holley 1982: 292-293). Standard deviations often are less than five percent of their associated mean.

Each ceramic sample to be analyzed using neutron activation is powderized and loaded into a sterilized plastic polyvial or high-purity quartz tube. Most commonly samples are powderized with a diamond, sapphire or tungsten carbide drill bit or burr (Perlman and Asaro 1969: 21; Wilson 1978: 224). An array of "standard" samples (e.g., liquid chemical standards prepared by specific laboratories, more widely-used standard clays, National Bureau of Standards standard rocks) for which chemical compositions have been determined previously, also are loaded in polyvials or quartz tubes.

Sample groups including standards and archaeological samples are irradiated in an atomic reactor. The samples analyzed for the experiments of this chapter and the case study presented in Chapter 7 were irradiated in groups of forty. Eight to ten standards were included with thirty to thirty-two archaeological samples. During irradiation, samples are bombarded with neutrons, "activating" radioisotopes indicative of the chemical composition of each sample (see Kruger 1971; Harbottle 1976; 1982a: 22-24). Upon activation, these isotopes begin to decay and emit gamma radiation. This radiation is measured by multichannel analyzers that segregate gamma ray emissions along a low-to-high energy spectrum. The energy levels at which gamma rays are emitted vary from isotope to isotope. Therefore, the locations of emission peaks along a gamma radiation spectrum indicate the isotopes present, and the sizes of these peaks indicate their concentrations. Standards with known trace elements concentrations produce emission peaks that are used to calibrate gamma ray spectra for archaeological samples. Once calibrated, these archaeological gamma ray spectra are analyzed to identify trace elements and determine their concentrations (see Perlman and Asaro 1969: 21-28; Harbottle 1982b).

This experimental study considers the appropriateness of 1) archaeological methods used to prepare ceramic and clay samples for radiometric analyses like neutron activation, and 2) archaeological inferences based on comparisons between clay and pottery samples, and between pottery samples with varying temper. Specifically, this study proposes that the trace element "fingerprint" of any ceramic sample is a product of the non-clay mineral inclusions as well as the clay(s) present in that sample. If an archaeologist desires a trace element "signal" pertaining to clays and clay sources indicative of manufacturing sites, the trace element "noise" introduced by temper should be identified and minimized. This study investigates if such noise exists, how significant it appears to be, and how it might be minimized without interfering with the trace element signal pertaining to potting clay(s).

Experimental Design

Clays may be defined in terms of chemical composition or sedimentary particle size (see Folk 1980: 89). Following the Wentworth classification of sediment types based on grain size, clays consist of very fine-grained particles smaller than four microns (8.5 phi) (Wentworth 1922; Krumbein 1934; Blatt, Middleton and Murray 1972: 45: Folk 1980: 23). Silts constitute the next major size grade of sediments, and are made up of particles only as large as 62.5 microns

(4 phi). Together, clay and silt sediments comprise the major sediment grade of "muds," from which most potting clays are drawn.

The experimental methods used here are proposed as a simple means of mechanically segregating the fine-grained particles of potting clays from larger-grained temper in ceramic samples. Number 300 mesh stainless steel sieves (with openings of 45.7 microns) were used to segregate clay and medium-to-fine silt from larger silt- and sand-sized particles in powderized ceramic samples. These sieves were not sufficiently fine to segregate silt from clay. Pipette techniques permit extraction of clay in liquid suspension (e.g., after centrifuging a powderized sample in distilled water). However, this procedure was avoided in order to keep laboratory methods simple, easily replicable and minimally susceptible to laboratory contamination.

Eight samples of clay and pottery from Tell el-Hayyat were chosen for experimentation (see Table 17). This group includes examples of a variety of clay and pottery types likely to be of interest to archaeologists regardless of geographical location. Four samples of Ohio Red Clay (Brookhaven National Laboratory standard ceramic, provided courtesy of G. Harbottle) also were included as good examples of untempered clays, and as "standards" which are particularly appropriate for archaeological neutron activation analysis.

Sample 1 was taken from one of several tabular chunks of naturally bedded clay, probably kaolinite, found lining a Middle Bronze II A (Phase 4) pit in Area F at Tell el-Hayyat. It is included as an example of unaltered clay possibly indicative of some raw material used

Table 17. Designations and brief descriptions of Ohio Red Clay samples and Tell el-Hayyat clay and pottery samples used for experimental investigation.

Sample Number	Sample Description
R51	Ohio Red Clay
R52	Ohio Red Clay
R53	Ohio Red Clay
R54	Ohio Red Clay
1	unfired bedded kaolinite clay (two pieces from this sample were analyzed, "1A" and "1B")
2	unfired loom weight
3	unfired tempered potting clay
4	overfired pottery waster (Middle Bronze II storejar)
5	Early Bronze IV sand-tempered jar
6	Middle Bronze II A cooking pot (large angular calcite tempering)
7	Middle Bronze II A sand-tempered storejar
8	Middle Bronze II A lightly-tempered carinated bowl

for potting at Tell el-Hayyat. Even in this raw form, Sample 1 contains a substantial volume of marine microfossils as non-clay inclusions (see Table 18).

Samples 2, 3 and 4 are tempered examples of unfired and overfired debris indicative of the clay sources used for ceramic manufacturing at Tell el-Hayyat. In contrast to Sample 1, they show very modest amounts of marine microfossils and calcite, the mineral to which these microfossils break down upon firing.

Samples 5 through 8 exemplify the tempered pottery types analyzed in the Jordan Valley case study presented in Chapter 7. These include Early Bronze IV and Middle Bronze II A jars (samples 5 and 7, respectively) with substantial volumes of non-clay inclusions. Upon excavation, both samples were classified simply as "sand-tempered." More detailed thin-section analysis shows sample 5 to contain a large amount of vitric volcanics (i.e., volcanic glass), probably from basaltic tuffs. Sample 7 contains a large volume of micrite (i.e., calcium carbonate). The most pronounced temper component of Sample 6, a Middle Bronze II A cooking pot, is calcite. In contrast to all three of these ceramics, Sample 8, a Middle Bronze II A fine ware carinated bowl, contains relatively little tempering of any sort.

Sample Preparation

Initial sample preparation was intended to eliminate any extraneous minerals or decoration adhering to these samples. Ragged edges, large pores and exterior faces on all samples, particularly those with slip or painted decoration, were sanded away using a

Table 18. Estimates of clay and non-clay volumes in eight clay and pottery experimental samples. Percent estimates based on petrographic thin-section point counts conducted by J. Lombard, Department of Geosciences, University of Arizona.

	Sample Number							
Mineral Type	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sherd (grog)	-	1.3	-	-	-	-	-	-
Calcite	0.7	1.1	2.5	3.7	-	14.5	-	1.2
Marine Microfossils*	22.3	0.4	1.2	-	0.4	0.6	0.4	2.9
Micrite (calcium carbonate)	-	4.2	5.5	-	-	2.4	25.3	0.7
Quartz (from sandstone)	-	0.4	0.6	1.2	0.4	0.8	5.5	1.5
Polycrystalline Quartz (from siltstone)	-	-	-	-	-	-	0.6	-
Plagioclase^	-	-	0.4	0.5	0.2	-	0.2	-
Pyriboles^	-	-	-	-	0.7	-	-	-
Microlitic Volcanics^	-	-	3.9	0.2	8.6	-	0.2	-
Vitric Volcanics (volcanic glass)	-	0.2	1.6	1.5	28.9	-	-	0.2
Opaques~	-	0.7	0.4	-	0.4	-	0.2	0.1
% Clay Matrix	77.0	91.6	83.8	92.8	60.4	81.7	67.7	92.4
Point Counts	431	455	489	403	454	509	529	409

* Marine microfossils will break down to calcite upon firing.
^ Minerals from basalt
~ Opaques can be from many sources, including basalt, FeO, and MnO.

GCA/Precision Scientific Astro-Met. Rotary Polisher and high purity metallurgical analysis sand paper (no. 600 grit). After sanding, clay and sherd samples were dried in a Lab-Line Imperial III Radiant Heat Oven for at least twelve hours at 100 degrees Celsius. Subsequently, each sample was powderized in an agate mortar and pestle to avoid trace element contamination that can result from the use of drill bits or burrs (see Carriveau 1980; Harbottle 1976: 39).

Unsieved specimens of each sample were loaded directly into sterilized polyvials for irradiation. In addition, three sieved specimens of each sample were prepared. Each specimen was powderized in an agate mortar, and poured into a sterilized stainless steel sieve holder. Dry-sieved specimens were produced by shaking the sieve holder vigorously, permitting clay- and silt-size particles to fall through the sieve screen. This fine-grained sediment was loaded into polyvials for irradiation. Water-sieved specimens were prepared using a fresh sterilized sieve screen. The powderized ceramic was washed with a fine jet of distilled water, permitting clay and finer silts through the screen. Methanol-sieved specimens were produced similarly, again using a fresh sterilized sieve screen, and high purity "Nanograde" methyl alcohol. Water- and methanol-sieved specimens, collected in 150 milliliter beakers, were heated at 100 degrees Celsius until all liquid had been driven off. The dried specimens then were loaded into polyvials for irradiation. All neutron activation samples reported in this chapter and Chapter 7 were prepared in the Laboratory of Traditional Technology, Department of Anthropology, University of Arizona.

Concentrations of twenty trace elements were determined for unsieved specimens (designated "n"), dry-sieved specimens (designated "nS"), water-sieved specimens (designated "nW"), and methanol-sieved specimens (designated "nM") of each sample using neutron activation analysis. Two unsieved specimens of Sample 1, labeled "1A" and "1B" were analyzed. Four unsieved, and two dry-sieved, water-sieved, and methanol-sieved specimens of Ohio Red Clay were analyzed. All specimens were irradiated in the TRIGA reactor, Department of Nuclear Engineering, University of Arizona. Analysis of gamma ray spectra and determination of trace element concentrations were performed in the Gamma Ray Analysis Laboratory, Department of Planetary Sciences, University of Arizona.

Test Expectations

Test Expectation 1. Each of the various forms of sieving is intended to segregate a clay and silt fraction from sand- and larger-size temper in ceramics. Specimens lacking significant amounts of sand- and larger-size temper (*e.g.*, all versions of Ohio Red Clay) are expected to provide similar trace element concentrations regardless of specimen preparation technique. In other words, it is expected that the process of sieving itself will not significantly distort trace element concentration data or introduce a significant amount of contamination.

Test Expectation 2. The primary independent variable under scrutiny is the presence or absence of temper. If Test Expectation 1 is satisfied, trace element data will be very similar among unsieved and sieved specimens of untempered clay samples. On the other hand, specimens of tempered ceramics (samples 2-8), are expected to differ more frequently because of the presence of temper in unsieved specimens and its exclusion from sieved specimens. A greater frequency of significant differences is expected to demonstrate that sieving removes a substantial amount of non-clay mineral inclusions, and thereby produces an adjusted trace element "fingerprint" more indicative of the clay(s) present in a pottery sample.

Test Expectation 3. The efficiency with which fine- and coarse-grained sediments are segregated will vary between sieving techniques. Liquid sieving agents, particularly distilled water, aid the dispersal of electrically-charged clay particles and permit more effective sieving (Folk 1980: 16-18). Therefore, the various sieved specimens of any tempered sample will provide differing trace element concentrations. It is expected that one technique will satisfy test expectations 1 and 2 most effectively in removing particles of temper and the trace element noise they introduce. This should be reflected in two ways when comparing unsieved and sieved data: 1) minimal differences between untempered specimens using a particular sieving method, and 2) frequent differences between tempered specimens resulting from clean segregation of coarse-grained inclusions using the same method.

Testing Procedure

Final concentration data consist of mean element concentrations and their standard deviations (see Table 19). For purposes of

Table 19. Mean trace element concentrations and standard deviations for clay and pottery samples used in experimental neutron activation analysis.

Sample	Na	s.d.	K	s.d.	Sc	s.d.	Cr	s.d.	Mn	s.d.	Fe	s.d.	Co	s.d.
ORC	1365	53	34117	1774	20.02	0.84	91.00	4.8	247.8	9.9	5.308	0.170	19.95	0.80
R51	1483	15	34581	346	18.45	0.18	96.52	1.12	257.3	2.6	5.532	0.055	21.39	0.21
R52	1473	15	34072	341	18.37	0.18	95.64	1.02	255.8	2.6	5.529	0.065	21.63	0.22
R53	1495	15	40612	629	17.77	0.18	92.09	0.92	244.4	2.4	5.215	0.052	20.70	0.21
R54	1405	32	32128	614	17.66	0.18	93.15	0.93	254.8	3.1	5.115	0.051	20.18	0.20
R51S	1499	18	33877	339	17.84	0.18	92.82	1.34	248.9	2.5	5.259	0.053	19.84	0.20
R52S	1458	15	33260	333	17.41	0.17	89.82	3.00	242.5	3.2	5.117	0.051	19.10	0.19
R51W	1540	15	33434	334	18.02	0.18	92.36	2.27	246.8	2.5	5.293	0.053	19.92	0.20
R52W	1592	16	33801	338	18.20	0.18	93.09	2.98	249.9	2.5	5.334	0.053	19.94	0.20
R53M	1504	15	41059	657	17.90	0.18	94.70	0.98	289.7	2.4	5.163	0.052	19.83	0.20
R54M	1485	15	34466	431	17.93	0.18	92.63	1.07	251.0	3.2	5.139	0.051	19.77	0.20
1B	2518	25	6597	137	6.546	0.065	514.5	5.1	41.15	0.66	1.555	0.016	2.404	0.068
1A	2617	26	5825	102	6.579	0.066	532.1	8.5	47.82	0.73	1.735	0.019	2.951	0.054
1AS	2456	25	5503	78	6.288	0.063	494.4	7.1	45.73	0.49	1.794	0.027	2.834	0.096
1AW	5822	58	8767	141	6.448	0.064	519.2	9.3	47.74	0.63	1.772	0.042	3.146	0.058
1BM	4075	41	6711	172	6.395	0.064	494.4	4.9	44.55	0.74	1.554	0.016	2.747	0.072
2	3387	42	17721	177	11.50	0.12	197.0	2.0	567.2	5.8	3.603	0.036	14.45	0.14
2S	3747	37	17660	177	11.00	0.11	189.3	3.8	709.9	7.1	3.451	0.035	17.94	0.18
2W	5324	76	19546	205	11.97	0.12	211.5	3.0	713.5	7.1	3.812	0.047	18.09	0.18
2M	7393	74	15323	697	10.54	0.11	185.0	1.9	700.1	8.3	3.229	0.032	18.17	0.18
3	5378	136	14808	161	10.53	0.11	144.6	1.4	445.2	5.3	3.573	0.036	13.00	0.16
3S	5310	195	15638	158	10.12	0.10	147.7	1.5	555.2	5.6	3.399	0.040	15.46	0.17
3W	6646	66	17649	191	10.55	0.11	148.9	2.2	506.6	7.5	3.494	0.035	11.83	0.18
3M	8927	89	14520	378	10.14	0.10	145.3	1.5	515.9	8.4	3.330	0.033	12.87	0.13
4	12537	125	8916	226	10.93	0.11	112.3	1.8	385.6	4.2	3.611	0.036	14.69	0.15
4S	18546	185	12472	281	11.43	0.11	114.4	1.3	464.7	5.3	3.665	0.037	16.25	0.16
4W	15153	152	8013	257	11.44	0.11	113.9	1.8	458.3	8.7	3.755	0.038	15.70	0.16
4M	15557	156	7907	583	10.65	0.11	112.8	1.4	495.2	8.9	3.471	0.034	15.33	0.15
5	6332	103	10634	200	15.57	0.16	190.2	1.9	591.4	5.9	3.999	0.040	22.21	0.22
5S	5739	57	11803	129	14.45	0.15	174.0	1.7	604.5	6.2	3.459	0.043	20.03	0.20
5W	6012	72	12652	139	14.03	0.14	156.8	4.2	630.6	6.8	3.116	0.039	18.97	0.19
5M	5246	420	12343	338	14.47	0.14	168.1	2.1	694.2	7.6	3.141	0.031	19.71	0.20
6	6145	61	22111	221	10.21	0.10	180.1	3.2	504.2	5.1	3.079	0.031	12.92	0.13
6S	4828	93	17118	171	8.498	0.085	165.5	3.0	454.8	4.5	2.532	0.038	11.95	0.12
6W	6884	69	19294	247	9.030	0.090	172.3	1.7	498.8	5.0	2.695	0.027	12.63	0.13
6M	4892	100	16110	329	8.458	0.085	166.2	1.7	514.1	11.9	2.433	0.024	12.94	0.13
7	2326	29	9710	97	11.70	0.12	155.5	4.0	356.1	3.6	3.686	0.041	14.36	0.15
7S	2811	28	12076	121	12.75	0.13	173.9	1.7	479.0	4.8	4.083	0.041	18.45	0.18
7W	4148	41	12045	120	12.18	0.12	164.0	2.7	458.6	4.6	3.844	0.038	17.42	0.17
7M	2736	64	11926	355	12.63	0.13	173.1	1.7	500.3	11.4	3.923	0.042	17.62	0.27
8	2756	28	11806	118	9.841	0.098	246.1	2.5	254.3	2.5	2.039	0.020	7.686	0.077
8S	2942	31	12573	126	10.14	0.10	258.0	2.7	275.5	2.8	2.079	0.023	7.916	0.079
8W	3870	47	13066	131	10.20	0.10	264.4	2.6	287.6	2.9	2.114	0.021	8.565	0.086
8M	3062	112	11235	325	10.21	0.10	265.6	2.7	305.4	3.4	2.069	0.021	9.082	0.121

Table 19. (Continued)

Sample	Zn	s.d.	Rb	s.d.	Cs	s.d.	Ba	s.d.	La	s.d.	Ce	s.d.	Sm	s.d.
ORC	96.41	9.45	174.7	17.1	10.20	0.72	703.1	51.3	49.97	1.90	110.7	4.4	8.30	0.46
R51	117.7	2.6	214.9	3.1	10.67	0.14	737.6	105.5	45.41	0.45	112.4	1.1	7.657	0.077
R52	107.3	2.4	184.7	2.7	10.45	0.14	688.8	62.2	45.13	0.45	99.08	0.99	7.868	0.079
R53	98.87	1.60	179.8	2.4	10.09	0.11	611.9	62.3	46.83	0.47	103.7	1.0	7.925	0.079
R54	99.05	3.46	177.6	2.1	9.624	0.11	639.4	14.9	49.94	0.50	105.8	1.1	8.247	0.082
R51S	103.7	1.7	183.2	2.1	10.06	0.16	640.2	34.4	44.22	0.44	92.99	3.2	7.681	0.077
R52S	101.3	1.6	176.9	4.3	9.709	0.276	625.3	46.4	43.31	0.43	89.11	4.21	7.489	0.075
R51W	109.8	1.7	186.5	2.1	10.32	0.17	647.7	42.0	44.43	0.44	92.81	2.41	7.687	0.077
R52W	108.9	2.1	183.5	4.1	10.49	0.35	658.0	63.1	44.26	0.44	92.97	3.38	7.742	0.077
R53M	96.63	4.1	184.4	2.7	10.07	0.13	648.5	34.1	47.20	0.47	104.9	1.0	7.986	0.080
R54M	101.3	4.0	186.3	3.7	9.640	0.269	620.9	16.7	47.50	0.48	105.0	1.1	7.969	0.080
1B	155.6	2.3	12.08	0.71	0.8765	0.0467	101.0	35.7	15.18	0.15	23.33	0.30	4.049	0.080
1A	181.4	7.5	13.44	1.0	0.9097	0.0710	76.59	18.26	14.55	0.20	21.83	0.47	4.115	0.059
1AS	182.9	4.1	12.08	0.74	0.7874	0.0602	105.9	9.1	13.51	0.19	20.63	0.28	3.890	0.043
1AW	181.4	8.2	13.37	0.68	0.8851	0.0454	94.52	11.81	14.16	0.29	21.70	0.44	4.111	0.041
1BM	151.1	2.5	11.79	1.03	0.8757	0.0520	112.8	11.1	14.47	0.15	22.69	0.31	3.903	0.085
2	224.2	2.3	48.72	1.69	2.394	0.121	409.6	53.0	27.26	0.27	47.14	1.55	5.483	0.055
2S	214.8	5.8	46.31	1.05	2.216	0.067	334.4	32.2	26.58	0.27	48.54	2.00	5.449	0.054
2W	241.8	3.4	49.83	1.79	2.630	0.060	352.5	44.5	28.55	0.29	52.68	0.63	5.819	0.058
2M	182.5	5.1	42.94	1.18	2.208	0.093	339.0	11.3	27.72	0.28	53.36	0.56	5.362	0.057
3	146.0	3.2	42.50	1.29	1.908	0.051	331.5	40.8	22.29	0.22	39.38	0.77	4.474	0.044
3S	143.0	4.1	45.75	1.24	1.825	0.097	301.6	26.1	22.44	0.22	41.86	0.42	4.529	0.045
3W	152.0	1.9	47.73	1.23	2.046	0.054	272.2	31.4	23.36	0.23	41.67	1.56	4.684	0.047
3M	128.7	4.3	43.68	1.20	1.725	0.176	308.1	24.0	24.46	0.24	45.46	0.50	4.739	0.047
4	183.0	2.0	11.77	0.70	0.8321	0.0466	762.7	113.9	24.77	0.25	48.59	0.93	5.026	0.050
4S	144.8	3.6	16.70	0.60	1.374	0.055	306.3	32.7	26.13	0.26	51.07	1.39	5.423	0.054
4W	129.1	1.9	12.35	0.59	1.450	0.058	337.5	38.7	26.61	0.27	49.63	3.34	5.495	0.055
4M	100.4	3.9	13.23	0.84	1.206	0.073	234.1	10.2	29.36	0.29	58.29	0.59	5.923	0.059
5	179.5	2.4	29.95	0.69	1.807	0.055	995.4	113.9	31.33	0.31	49.70	2.18	5.642	0.056
5S	186.4	2.4	27.18	0.93	1.662	0.065	1552	128	32.74	0.36	53.61	0.65	5.758	0.058
5W	174.4	2.5	23.14	0.81	1.419	0.070	1729	65	32.11	0.32	50.65	2.67	5.664	0.057
5M	153.8	5.4	22.10	2.50	1.389	0.114	1673	111	35.85	0.36	62.06	0.62	6.057	0.061
6	199.6	3.5	30.74	0.74	1.398	0.047	441.1	52.0	24.37	0.27	41.28	2.19	5.088	0.051
6S	170.9	6.7	24.24	0.97	1.103	0.072	400.4	38.7	19.62	0.34	36.87	0.37	4.200	0.042
6W	173.1	5.7	25.90	0.74	1.116	0.052	431.7	44.1	20.65	0.27	37.91	0.58	4.407	0.044
6M	139.2	4.5	21.61	0.85	0.8772	0.116	438.0	17.7	20.90	0.21	39.20	0.39	4.274	0.043
7	118.0	3.4	24.82	0.66	1.614	0.084	101.5	16.7	25.23	0.25	32.85	1.95	4.487	0.045
7S	133.7	4.3	27.82	0.91	1.824	0.073	73.77	13.15	27.91	0.28	40.47	0.81	4.944	0.049
7W	123.8	4.3	24.43	0.75	1.502	0.061	96.87	25.53	26.95	0.27	39.67	1.84	4.751	0.048
7M	122.9	5.7	25.72	1.05	1.872	0.081	108.7	9.8	30.39	0.30	48.90	0.49	5.190	0.052
8	186.5	2.1	29.56	0.62	2.226	0.044	436.3	38.6	28.33	0.28	32.72	0.78	5.297	0.053
8S	191.9	5.0	32.40	1.48	2.308	0.065	442.8	39.1	29.82	0.30	35.86	0.36	5.538	0.055
8W	199.7	4.5	30.79	0.80	2.239	0.075	932.2	82.4	29.86	0.30	35.17	0.60	5.539	0.055
8M	172.5	5.2	30.29	1.03	2.090	0.072	663.5	48.0	32.73	0.33	39.59	0.40	5.784	0.058

Table 19. (Continued)

Sample	Eu	s.d.	Yb	s.d.	Lu	s.d.	Hf	s.d.	Ta	s.d.	Th	s.d.
ORC	1.76	0.09	4.29	0.25	0.77	0.09	6.28	0.33	1.79	0.25	15.51	0.56
R51	1.527	0.039	3.825	0.052	0.6364	0.008	7.692	0.084	1.550	0.058	17.27	0.17
R52	1.550	0.047	3.676	0.047	0.6368	0.0079	7.571	0.076	1.586	0.059	15.13	0.15
R53	1.563	0.042	3.832	0.044	0.5927	0.0097	6.732	0.067	1.608	0.038	14.98	0.15
R54	1.604	0.051	3.823	0.070	0.5789	0.0096	6.718	0.120	1.403	0.038	14.89	0.15
R51S	1.493	0.053	3.624	0.052	0.6307	0.0083	7.560	0.150	1.459	0.038	14.74	0.15
R52S	1.479	0.048	3.531	0.047	0.6161	0.0079	7.297	0.293	1.486	0.083	14.65	0.21
R51W	1.516	0.051	3.661	0.064	0.6181	0.0081	7.369	0.075	1.401	0.042	14.92	0.15
R52W	1.495	0.053	3.661	0.055	0.6265	0.0090	7.325	0.116	1.514	0.043	14.98	0.15
R53M	1.569	0.050	3.867	0.052	0.6224	0.0106	6.509	0.077	1.500	0.046	15.10	0.15
R54M	1.554	0.040	3.764	0.067	0.5963	0.0156	6.928	0.073	1.392	0.048	14.97	0.15
1B	0.6201	0.0109	2.033	0.034	0.3467	0.0156	0.7626	0.0256	0.2452	0.0239	2.288	0.036
1A	0.5917	0.0196	1.859	0.031	0.3800	0.0057	0.8793	0.0278	0.2156	0.0198	2.251	0.098
1AS	0.5559	0.0128	1.733	0.043	0.3570	0.0071	0.8536	0.0311	0.1912	0.0264	2.116	0.060
1AW	0.5958	0.0210	1.863	0.033	0.3637	0.0057	0.8960	0.0279	0.1995	0.0194	2.241	0.073
1BM	0.6190	0.0113	2.023	0.049	0.3361	0.0074	0.7743	0.0311	0.1814	0.0242	2.205	0.062
2	1.184	0.024	2.423	0.034	0.4253	0.0122	4.416	0.072	0.9973	0.0354	6.294	0.063
2S	1.190	0.039	2.475	0.043	0.4425	0.0070	5.405	0.162	1.087	0.034	6.470	0.098
2W	1.316	0.039	2.673	0.047	0.4587	0.0075	5.409	0.054	1.117	0.030	6.529	0.081
2M	1.210	0.030	2.533	0.071	0.4026	0.0091	4.197	0.107	0.9073	0.036	5.919	0.063
3	1.115	0.014	1.888	0.030	0.3260	0.0049	3.524	0.049	0.9991	0.0435	4.337	0.047
3S	1.117	0.015	1.917	0.056	0.3366	0.0108	3.948	0.042	1.088	0.044	4.629	0.055
3W	1.139	0.015	2.001	0.029	0.3391	0.0086	3.566	0.044	1.040	0.027	4.833	0.052
3M	1.177	0.018	2.087	0.047	0.3114	0.0073	3.398	0.051	0.9290	0.0378	4.563	0.063
4	1.147	0.011	2.304	0.050	0.3858	0.0052	7.923	0.079	1.210	0.028	6.191	0.062
4S	1.325	0.054	2.510	0.036	0.4090	0.0057	8.327	0.083	1.136	0.031	6.628	0.067
4W	1.360	0.054	2.421	0.036	0.3969	0.0060	7.787	0.280	1.174	0.033	6.572	0.149
4M	1.451	0.046	2.867	0.054	0.4163	0.0087	7.197	0.086	1.033	0.055	6.890	0.074
5	1.380	0.014	2.296	0.034	0.3895	0.0056	2.394	0.081	0.9449	0.0267	5.959	0.060
5S	1.398	0.014	2.466	0.036	0.4329	0.0068	2.272	0.113	0.8999	0.0324	6.130	0.066
5W	1.363	0.027	2.461	0.037	0.4273	0.0073	1.994	0.052	0.7369	0.0549	5.849	0.135
5M	1.532	0.029	2.798	0.072	0.4132	0.0090	2.302	0.168	0.7188	0.0620	6.085	0.074
6	1.063	0.025	2.246	0.033	0.3988	0.0082	3.799	0.116	0.9180	0.0246	5.466	0.090
6S	0.9046	0.026	1.944	0.034	0.3374	0.0054	3.309	0.053	0.7484	0.0534	4.386	0.113
6W	0.9372	0.021	1.954	0.041	0.3496	0.0065	3.227	0.041	0.7200	0.0364	4.712	0.054
6M	0.9253	0.023	1.960	0.040	0.3099	0.0071	2.767	0.040	0.6742	0.0365	4.382	0.053
7	1.066	0.021	2.205	0.038	0.3731	0.0090	3.054	0.077	0.9012	0.0428	4.746	0.073
7S	1.207	0.019	2.404	0.086	0.4321	0.0109	3.287	0.050	0.9267	0.0367	5.252	0.064
7W	1.128	0.021	2.345	0.035	0.4030	0.0076	2.932	0.061	0.8631	0.0313	4.923	0.056
7M	1.291	0.021	2.716	0.052	0.3928	0.0087	3.021	0.070	0.9112	0.0435	5.125	0.068
8	1.137	0.011	3.235	0.039	0.5648	0.0057	2.686	0.039	0.5311	0.0196	4.249	0.045
8S	1.210	0.027	3.406	0.065	0.6156	0.0073	3.230	0.044	0.5295	0.0291	4.720	0.069
8W	1.222	0.014	3.400	0.043	0.6083	0.0069	2.982	0.081	0.5882	0.0264	4.642	0.055
8M	1.327	0.035	3.709	0.066	0.5924	0.0097	2.989	0.084	0.5069	0.0333	4.691	0.059

comparison, concentrations for different specimens of each sample are listed together (e.g., 2, 2S, 2W, 2M). The essence of this experiment is simply identification of significantly different concentrations produced by sieving.

Concentration differences significant at the 5 percent level or better (*i.e.*, $P < .05$) were identified using Student's t-test in two-tailed paired comparisons (see Snedecor and Cochran 1980: 54-57). The 95 percent confidence interval for each mean concentration (mean $\pm$ [2 x standard deviation]) was calculated for each specimen, element by element. Paired comparisons (*i.e.*, tests of significant differences) were done simply by comparing the 95% confidence intervals of the different specimens from each sample (*e.g.*, sodium concentrations in 2 vs. 2S, 2 vs. 2W, 2 vs. 2M; potassium concentrations in 2 vs. 2S, 2 vs. 2W, 2 vs. 2M; etc.). If the confidence intervals overlapped, the concentrations were deemed not significantly different. If the intervals were mutually exclusive, the concentrations were judged significantly different.

Experimental Results: Frequency of Significant Differences Between Specimens of Untempered Clay

The results of element by element paired comparisons of untempered Ohio Red Clay specimens are summarized in Figure 34. These data are reviewed to see if Test Expectation 1 can be satisfied. These data also indicate which sieving technique interferes least with trace element determinations, and therefore provides the *best* means of fulfilling expectations 1 and 3. Table 20 summarizes the frequency of

Figure 34. Frequency of significant concentration differences in paired comparisons of Ohio Red Clay specimens.

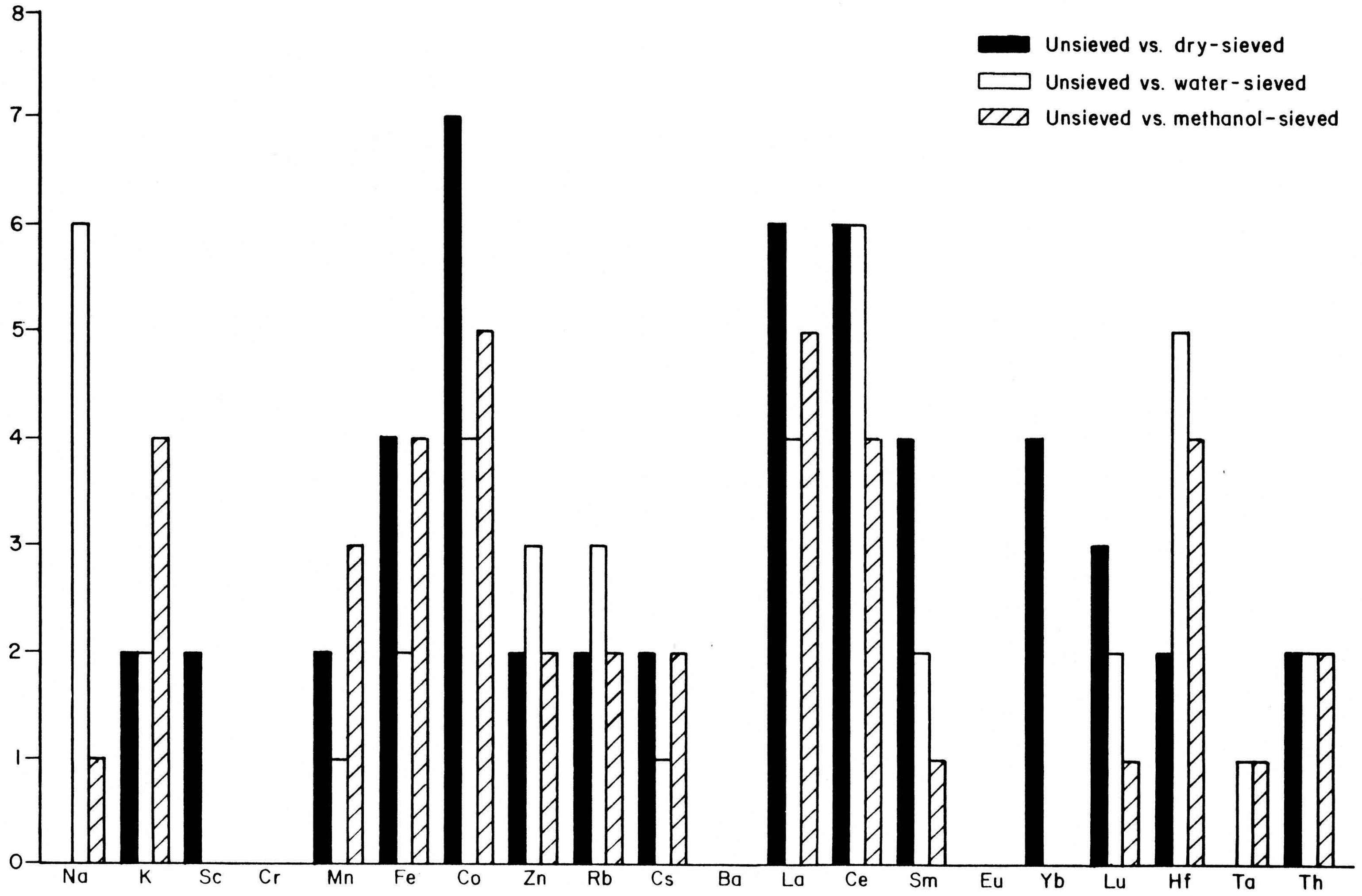


Table 20. Frequencies of significant differences between trace element concentrations in paired comparisons of Ohio Red Clay specimens, based on Student's t-test.

Type of comparison	Number of comparisons	Number of comparisons w/ significant differences	Frequency
Unsieved vs. Dry-sieved	160	50	31%
Unsieved vs. Water-sieved	160	44	28%
Unsieved vs. Methanol-sieved	160	41	26%

significant concentration differences in paired comparisons between unsieved and sieved specimens.

Paired comparisons were made between unsieved and dry-sieved, unsieved and water-sieved, and unsieved and methanol-sieved Ohio Red Clay specimens. One hundred sixty paired t-tests result from comparison of data for twenty elements in four unsieved specimens and two sieved specimens of each type (20 x 4 x 2 = 160). Significant differences range in frequency from 26 percent for unsieved versus methanol-sieved specimens, to 31 percent for unsieved versus dry-sieved specimens. Ideally these frequencies should be much lower to satisfy Test Expectation 1. However, there are at least two considerations to bear in mind when viewing these data:

A. The frequency of significant differences between sieved and unsieved specimens appears to be inflated by heterogeneity in the Ohio Red Clay itself. This was indicated by the result of 120 paired comparisons between unsieved Ohio Red Clay specimens (e.g., R51 vs. R52, R52 vs. R53, etc.). Forty percent of these comparisons showed significant differences.

For the purpose of determining which sieving technique is most preferable (i.e., produces the fewest significant differences due to sieving) we should consider that four "chunks" of Ohio Red Clay were used to produce the various specimens as follows:

Chunk #1: Specimens R51, R51S, R51W
Chunk #2: Specimens R52, R52S, R52W
Chunk #3: Specimens R53, R53M
Chunk #4: Specimens R54, R54M

The difficulty of chemical heterogeneity in Ohio Red Clay can be minimized by restricting paired comparisons to specimens from the same chunk (i.e., R51 vs. R51S, R51 vs. R51W, R52 vs. R52S, R52 vs. R52W, R53 vs. R53M, R54 vs. R54M). Figure 35 presents the frequency of significant differences determined in this manner element by element. Table 21 summarizes these data for comparisons between unsieved specimens and the three types of sieved specimens, and shows that methanol-sieving is the most effective way of avoiding significant concentration differences between sieved specimens (e.g., R53M, R54M) and their unsieved counterparts (e.g., R53, R54). Dry-sieving is clearly the least preferable sieving procedure due to the high frequency of significant differences it renders for Ohio Red Clay concentrations.

B. Comparisons of unsieved and sieved Ohio Red Clay specimens show more frequent significant differences for some elements than for others. Therefore, selective use of a subset of the 20 elements analyzed may minimize any detrimental effects from sieving.

Several salient characteristics are apparent in the Ohio Red Clay data. Wet-sieving (using distilled water or methanol) causes frequent distortion of cobalt, lanthanum, cerium and hafnium concentrations (see fig. 34). In addition, sodium values are affected by water-sieving, and potassium values are affected by methanol-sieving. Relatively frequent differences resulting from sieving also render zinc and rubidium of questionable value for analysis using water-sieving. Manganese and iron similarly are questionable for methanol-sieving.

These observations and the patterning of data seen in figures 34 and 35 suggest that certain elements are inappropriate for use with

Figure 35. Frequency of signficant concentration differences in paired comparisons of specimens from the same "chunk" of Ohio Red Clay.

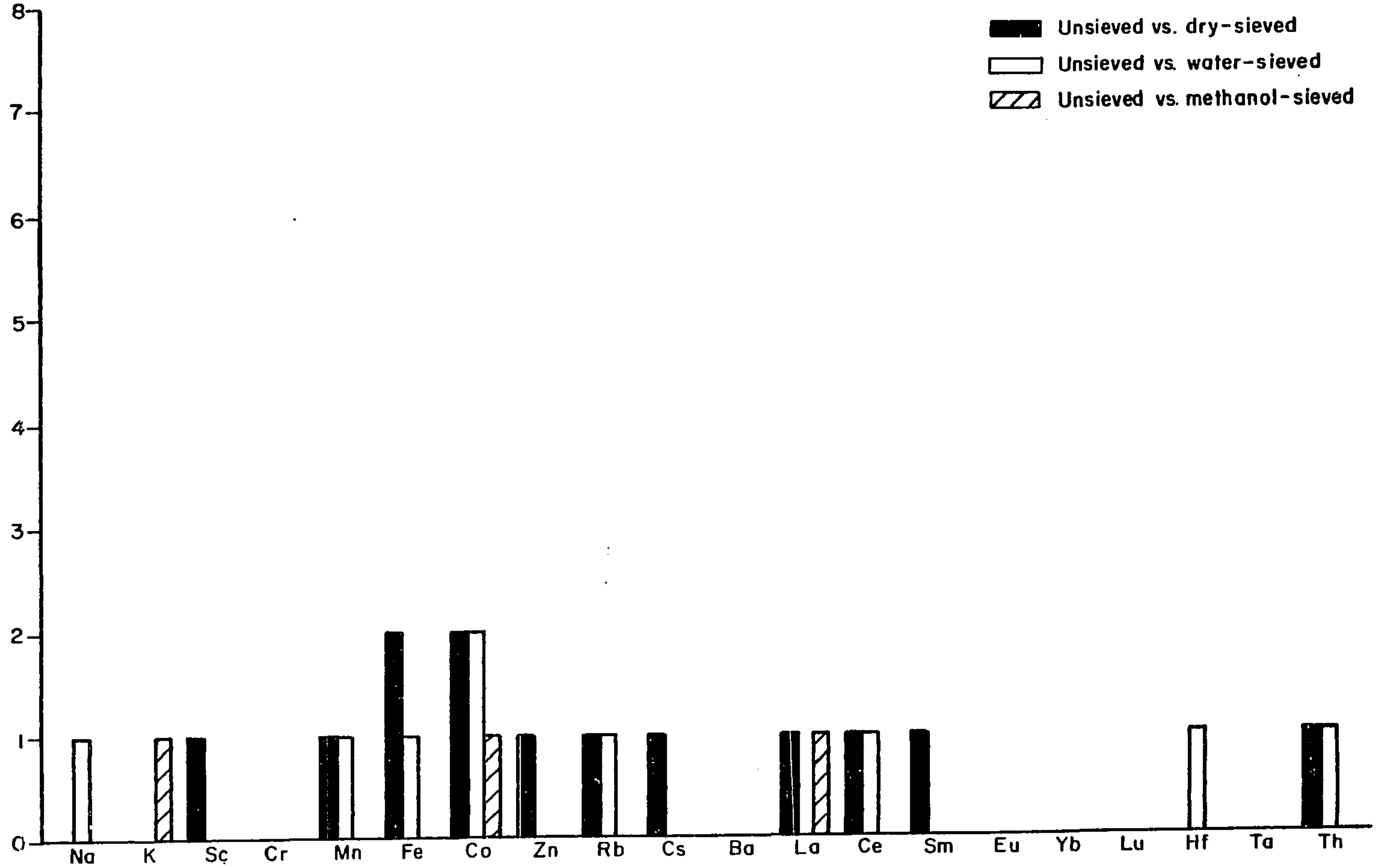


Table 21. Frequencies of significant differences between trace element concentrations in paired comparisons of specimens from the same "chunk" of Ohio Red Clay, based on Student's t-test.

Type of comparison	Number of comparisons	Number of comparisons w/ significant differences	Frequency
Unsieved vs. Dry-sieved	40	13	33%
Unsieved vs. Water-sieved	40	9	23%
Unsieved vs. Methanol-sieved	40	3	8%

each sieving technique if Test Expectation 1 is to be satisfied adequately. Exclusion of elements that differ most frequently (i.e., that show three or more significant differences in Figure 34) produces smaller arrays of elements for each sieving method that are optimal for satisfying Test Expectation 1 (Table 22).

When adopted for pairwise comparisons, these optimal arrays of elements produce many fewer significant differences between Ohio Red Clay specimens (see Table 23). Figure 36 presents an element by element breakdown of significant differences using the array of elements optimal for methanol-sieving. These data show that careful consideration of appropriate and inappropriate elements enables "clean" sieving and very little trace element distortion for untempered clay specimens. Significant differences can be minimized if paired comparisons are restricted to specimens from the same chunk of Ohio Red Clay (see Table 24 and discussion above). On this basis, none of the concentrations for twelve optimal elements differ significantly between unsieved and methanol-sieved specimens.

These data suggest that laboratory contamination and distortion of data due to sieving can be effectively minimized, thereby satisfying Test Expectation 1. Judicious selection of elements and sample preparation techniques are necessary to achieve this end. In keeping with Test Expectation 3, methanol-sieving appears to be the best method tested here for minimizing bias or contamination.

Table 22. Optimal arrays of elements for each sieving method.

Element	Dry-Sieving	Water-Sieving	Methanol-Sieving
Na	-	-	-
K	-	-	-
Sc	+	+	+
Cr	+	+	+
Mn	+	+	-
Fe	-	+	-
Co	-	-	-
Zn	+	-	+
Rb	+	-	+
Cs	+	+	+
Ba	+	+	+
La	-	-	-
Ce	-	-	-
Sm	-	+	+
Eu	+	+	+
Yb	-	+	+
Lu	-	+	+
Hf	+	-	-
Ta	+	+	+
Th	+	+	+

Table 23. Frequencies of significant differences between trace element concentrations in paired comparisons of all specimens of Ohio Red Clay using the "optimal array" of elements for each sieving technique.

Type of comparison	Number of comparisons	Number of w/ significant differences	Frequency
Unsieved vs. Dry-sieved	88	14	16%
Unsieved vs. Water-sieved	96	11	11%
Unsieved vs. Methanol-sieved	96	11	11%

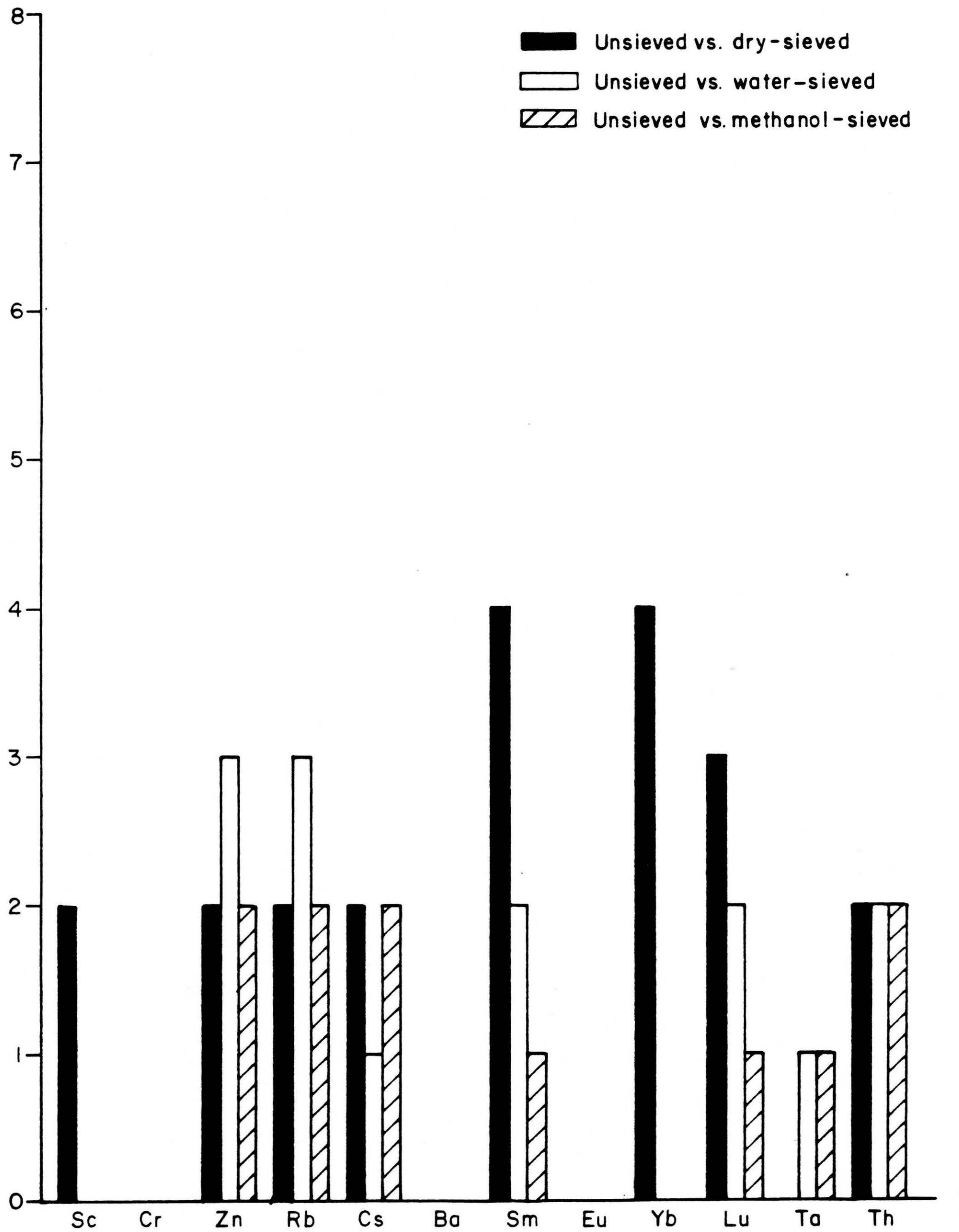


Figure 36. Frequency of significant concentration differences in paired comparisons of Ohio Red Clay specimens, based on an array of elements optimal for methanol-sieving.

Table 24. Frequencies of significant differences between trace element concentrations in paired comparisons of specimens from the same "chunk" of Ohio Red Clay using the optimal array of elements for each sieving technique.

Type of comparison	Number of comparisons	Number of comparisons w/ significant differences	Frequency
Unsieved vs. Dry-sieved	22	6	27%
Unsieved vs. Water-sieved	24	3	13%
Unsieved vs. Methanol-sieved	24	0	0%

Experimental Results: Measurement of Concentration Differences Between Specimens of Untempered Clay

While the *frequencies* of significant differences may suggest an optimal sieving technique and array of elements, *measurements* of these differences can suggest why certain sieving techniques or elements are appropriate or inappropriate. For this purpose, concentration differences were calculated element by element in pairwise comparisons between all unsieved and sieved specimens of Ohio Red Clay and Tell el-Hayyat clay sample 1. Each difference was expressed as a percentage of the unsieved concentration. Inflated sieved concentrations relative to unsieved data are expressed as positive values. Reduced sieved concentrations are expressed as negative values (see fig. 37).

All three sieving methods produce only modest concentration differences among Ohio Red Clay specimens. However, Table 25 points out the dramatically small average differences created by methanol-sieving. These concentration differences never exceed four percent and average well under two percent.

Relative concentration differences between specimens of the Tell el-Hayyat clay (Sample 1) also are generally modest (see fig. 38). However, some of the more pronounced differences seen in these data illuminate the discussion of appropriate and inappropriate elements above. For example, the substantial inflation of wet-sieved sodium and potassium values probably results from leaching of this unfired clay during the sieving process (Bieber *et al*. 1976; Sayre, Chan and Sabloff 1971). In a similar manner, rainwater or groundwater percolation could affect unfired or very low-fired clay material culture in

Figure 37. Differences in mean concentrations: Ohio Red Clay (specimens 51, 52, 53, 54, 51S, 52S, 53S, 54S, ...).

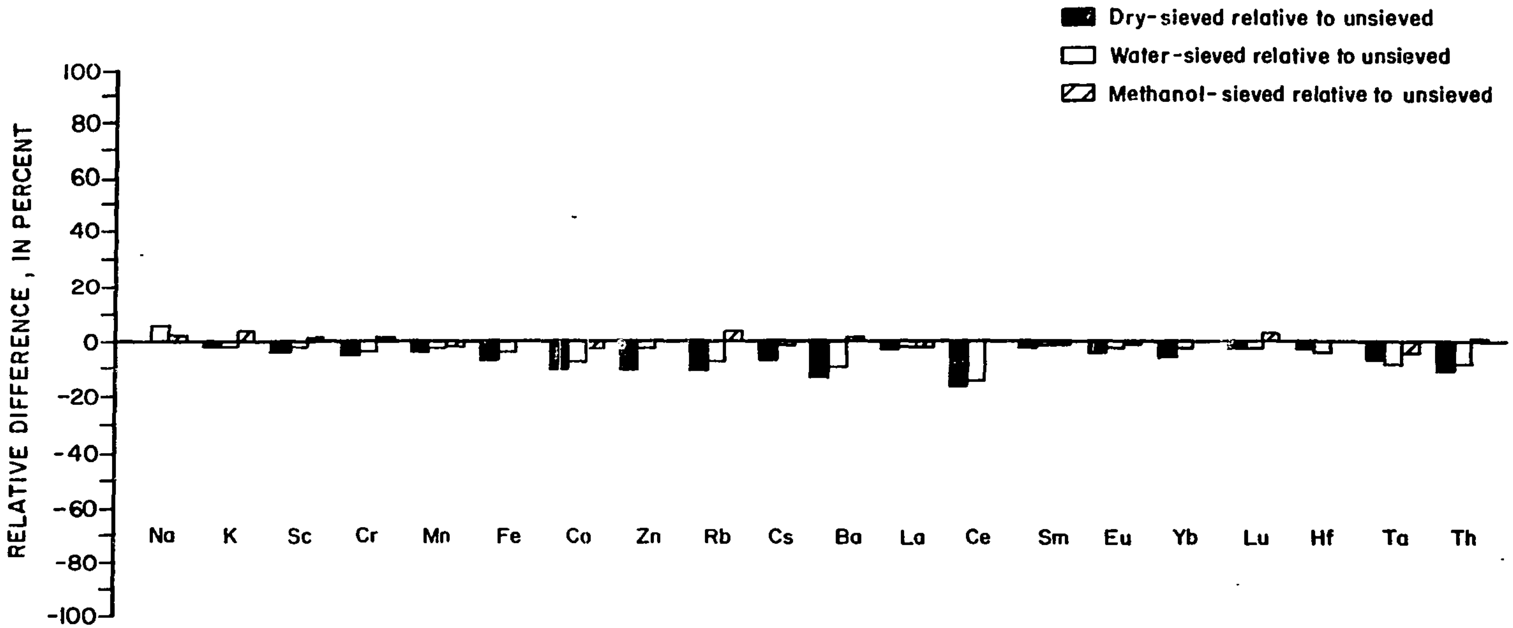
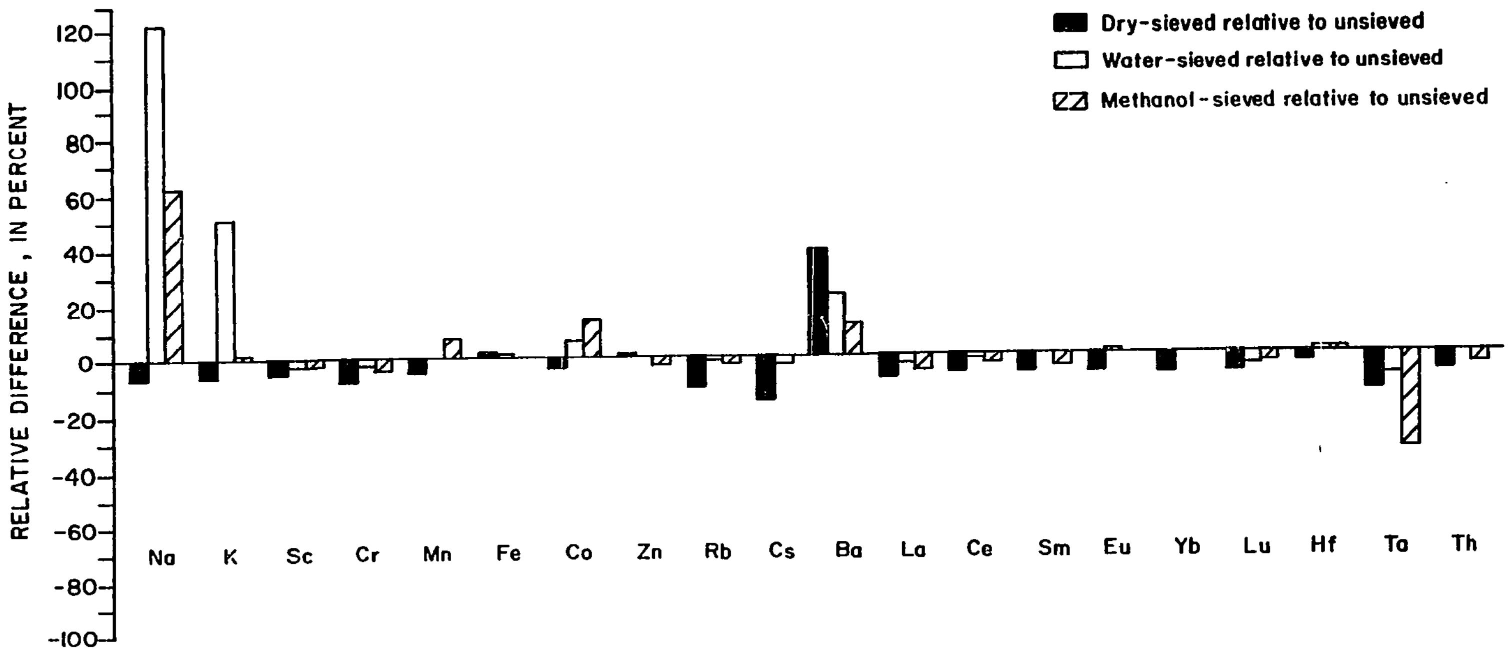


Table 25. Relative differences in trace element concentrations in paired comparisons of specimens from the same "chunk" of Ohio Red Clay.

Type of comparison	Average concentration differences for 20 elements	Average concentration differences for "optimal" elements
Unsieved vs. Dry-sieved	6.2%	7.0%
Unsieved vs. Water-sieved	4.7%	3.8%
Unsieved vs. Methanol-sieved	1.6%	1.5%

Figure 38. Differences in mean concentrations: Hayyat unfired clay sample TH 101 (specimens 2, 2S, 2W, 3, 3M).



archaeological deposits (Wilson 1978: 223; Hedges and McLellan 1976). These data suggest further that sodium and potassium should be viewed critically when included in archaeological neutron activation studies.

Manganese and cobalt, noted above as potentially inappropriate elements (see figs. 34 and 35), provide moderately inflated concentrations in the methanol-sieved specimen of sample 1. Freeth (1967) has noted than manganese and iron can be deposited on sherds in archaeological deposits and, therefore, may be problematic elements.

Barium and tantalum are also affected by methanol-sieving of Sample 1. The reasons for a deflated methanol-sieved tantalum concentration may be idiosyncratic to this clay sample. Tantalum usually shows infrequent significant differences between specimens, and appears among the optimal elements listed above for all three sieving techniques. Barium, on the other hand, is another element susceptible to leaching (Bieber et al. 1976) and commonly provides relatively imprecise mean concentrations through neutron activation (i.e., with standard deviations of usually five to ten percent of the mean; see Table 19). These sources of imprecision make barium less than optimal for archaeological neutron activation analyses.

Experimental Results: Frequency of Significant Differences Between Specimens of Tempered Ceramics

Unsieved and sieved specimens of seven tempered clay and pottery samples from Tell el-Hayyat (nos. 2-8, Table 17) also were analyzed for twenty trace elements using neutron activation analysis. Mean concentrations for sieved specimens were compared to those of unsieved specimens using pairwise t-tests to determine differences significant at the 95 percent confidence level, as described above for Ohio Red Clay. Figure 39 presents the frequencies of pairwise significant differences for all twenty elements. Table 26 summarizes the frequencies of these differences according to sieving method. Significant differences range in frequency from 56 percent for unsieved versus water-sieved specimens, to 65 percent for unsieved versus methanol-sieved specimens. These frequencies are well in excess of those noted in tables 19 and 20 for the same twenty elements in untempered specimens of Ohio Red Clay.

This striking pattern of very frequent significant differences is maintained even if this data set is restricted to the elements suggested above as "optimal" for each sieving technique (cf. tables 23 and 27). In particular, the concentrations of optimal elements for methanol-sieving show that unsieved and sieved tempered specimens differ much more frequently than do unsieved and sieved untempered Ohio Red Clay specimens (cf. figs. 36 and 40).

These highly frequent significant differences are in keeping with Test Expectation 2. Given the much lower incidence of significant differences seen for untempered samples, these higher frequencies most likely result from the successful removal of a substantial portion of non-clay inclusions by sieving. This interpretation is strengthened by the observation that methanol-sieving produces the least bias in untempered samples <u>and</u> the greatest incidence of significant differences among tempered samples. Test Expectation 2, involving the reduction of trace element noise from temper, appears to be satisfied,

Figure 39. Frequency of significant concentration differences in paired comparisons of tempered specimens.

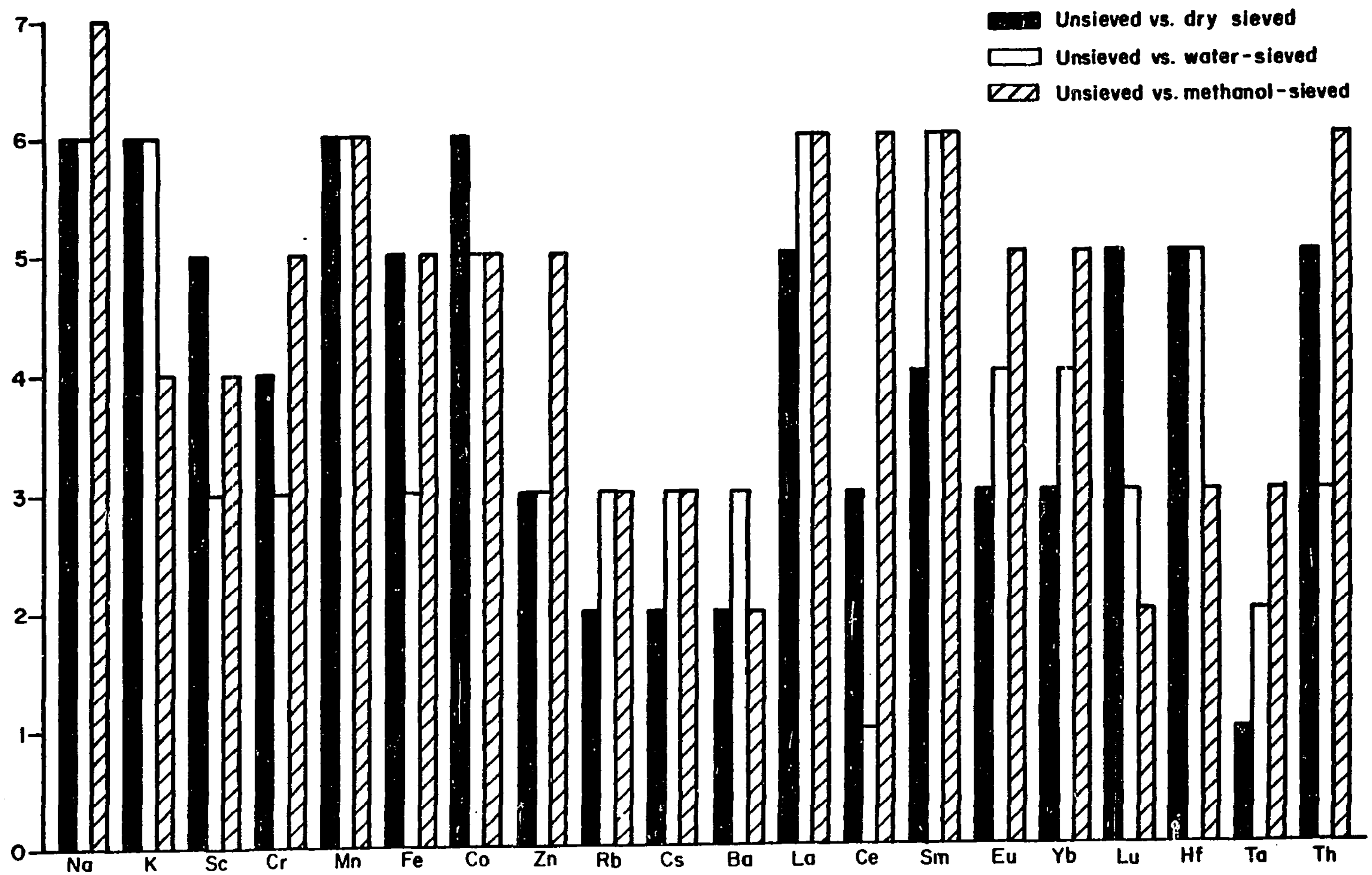


Table 26. Frequencies of significant differences between trace element concentrations in paired comparisons of tempered ceramic specimens, based on Student's t-test.

Type of comparison	Number of comparisons	Number of comparisons w/ significant differences	Frequency
Unsieved vs. Dry-sieved	140	81	58%
Unsieved vs. Water-sieved	140	78	56%
Unsieved vs. Methanol-sieved	140	91	65%

Table 27. Frequencies of significant differences between trace element concentrations in paired comparisons of tempered ceramic specimens using the "optimal array" of elements for each sieving technique.

Type of comparison	Number of comparisons	Number of comparisons w/ significant differences	Frequency
Unsieved vs. Dry-sieved	77	38	9%
Unsieved vs. Water-sieved	84	43	51%
Unsieved vs. Methanol-sieved	84	49	58%

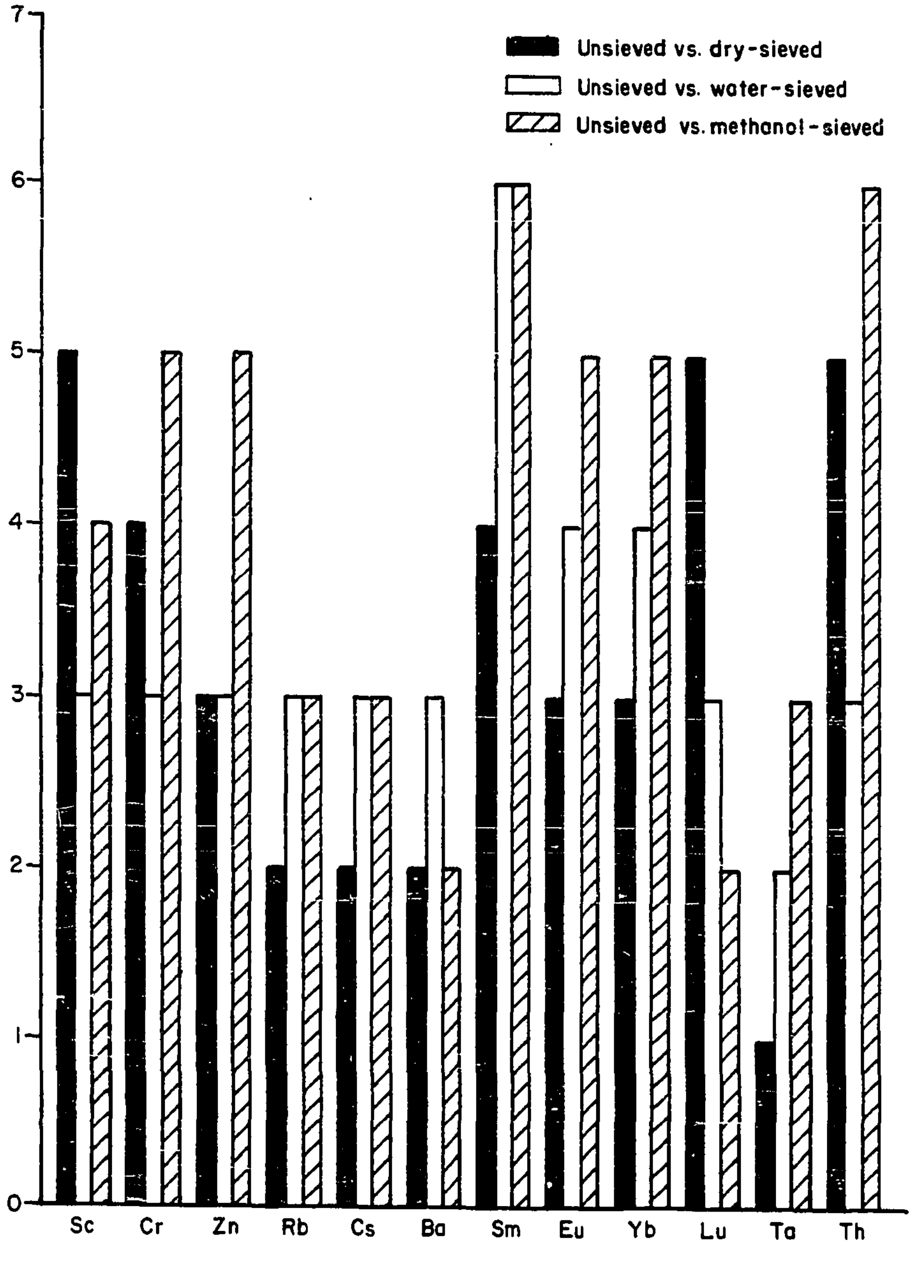


Figure 40. Frequency of significant concentration differences in paired comparisons of tempered specimens, based on an array of elements optimal for methanol-sieving.

and methanol-sieving again appears to be the best method considered here for achieving this.

Experimental Results: Measurement of Concentration Differences Between Specimens of Tempered Ceramics

The differences of sieved concentrations relative to unsieved data for seven tempered samples from Tell el-Hayyat are shown in figures 41 through 47. These concentration differences are substantially larger than those noted for Ohio Red Clay (see fig. 37) or Tell el-Hayyat Sample 1 (see fig. 38). Therefore, sieving may remove substantial amounts of temper, and thereby significantly reduce trace element noise associated with this temper. This inference is in keeping with Test Expectation 2.

Comparison of figures 41 through 47 also illustrates another important characteristic of these sieved data. The patterns of relative differences are quite distinct from sample to sample. For example, sample 6 shows reduced concentrations due to sieving for virtually all elements (see fig. 45), while samples 7 and 8 show enhanced concentrations due to sieving for most elements (see figs. 46 and 47). The remaining four tempered samples illustrate mixtures of reduced and increased concentrations. Therefore, it cannot be argued that sieving has a simple "across the board" diluting or enhancing effect on pottery and clay trace element data. The effect of sieving and removal of temper will vary from sample to sample and, as a result, should have a large impact on comparative analyses of pottery production and exchange.

It could still be argued that the potential impact of reducing the

Figure 41. Differences in mean concentrations: TH 103, unfired tempered potting clay from Hayyat (specimens 5, 5S, 5W, 5M).

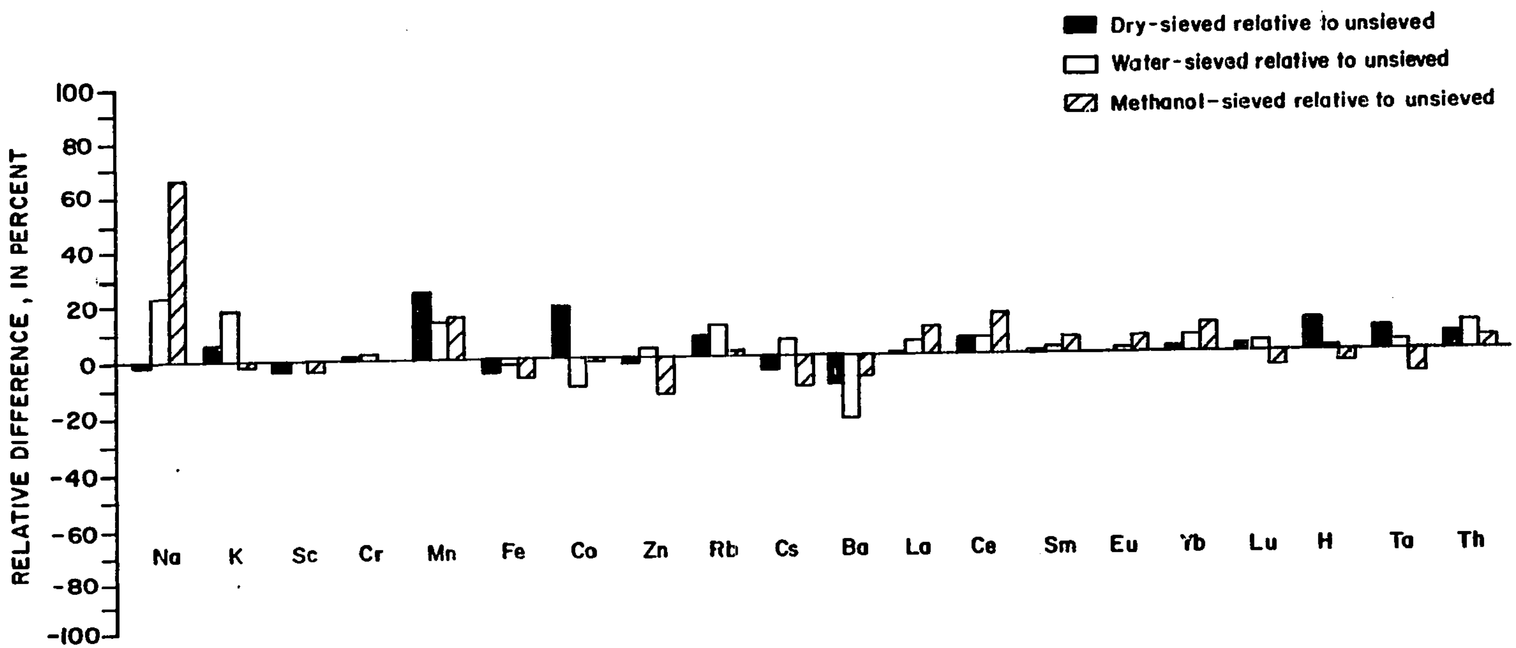


Figure 42. Differences in mean concentrations: TH 102, unfired clay loom weight from Hayyat (specimens 4, 4S, 4W, 4M).

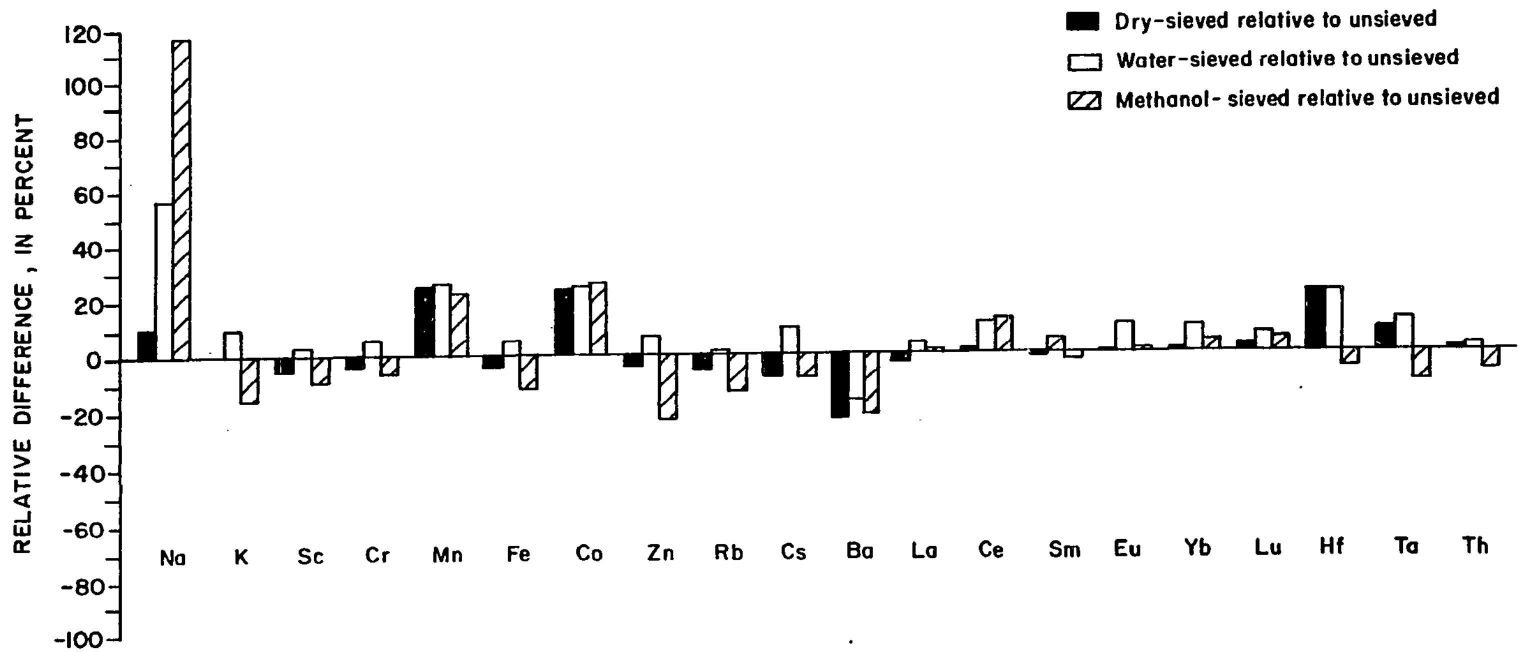


Figure 43. Differences in mean concentrations: TH 104, pottery waster from Hayyat (specimens 7, 7S, 7W, 7M).

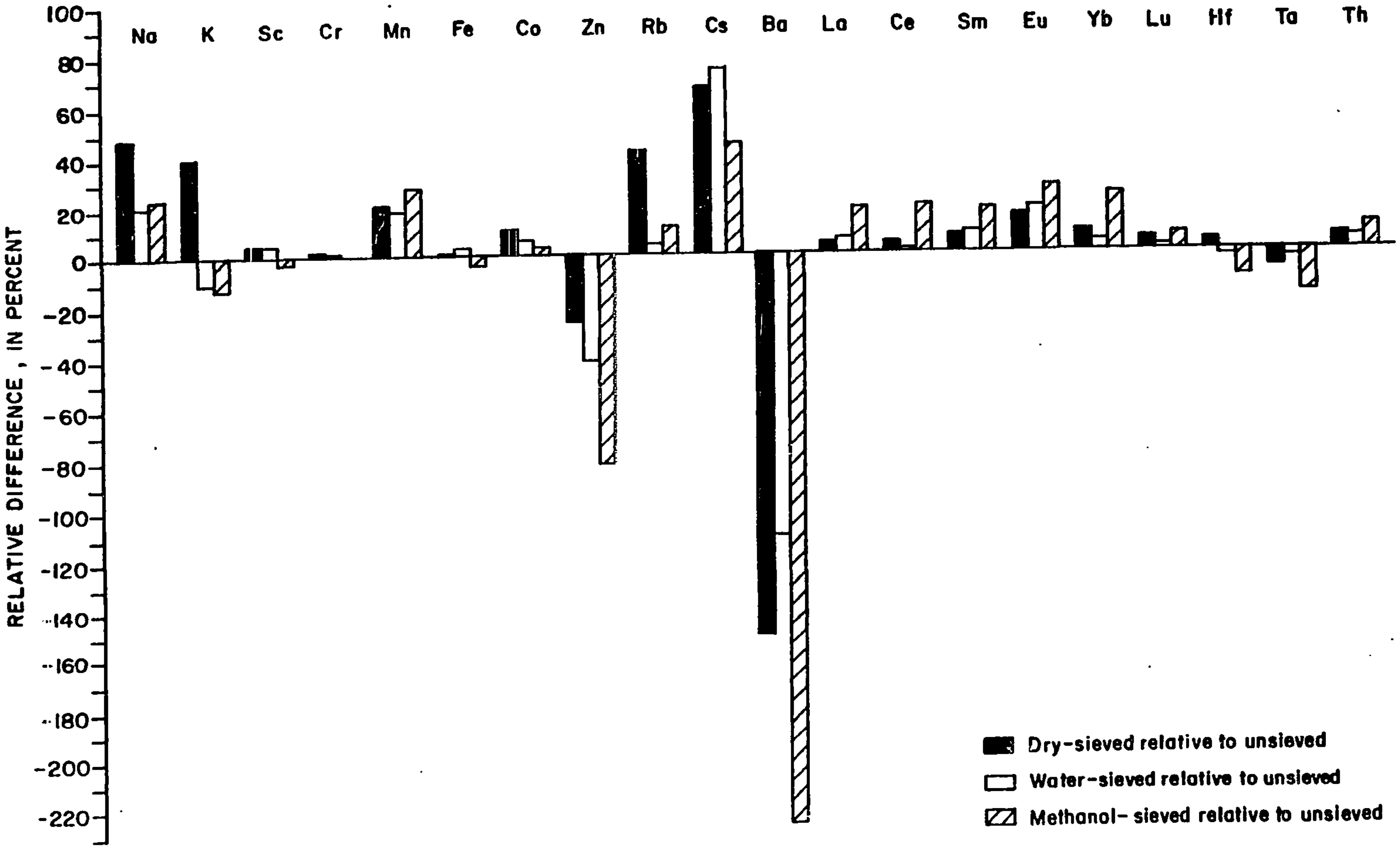


Figure 44. Differences in mean concentrations: TH 307, Early Bronze IV storejar from Hayyat (specimens 8, 8S, 8W, 8M).

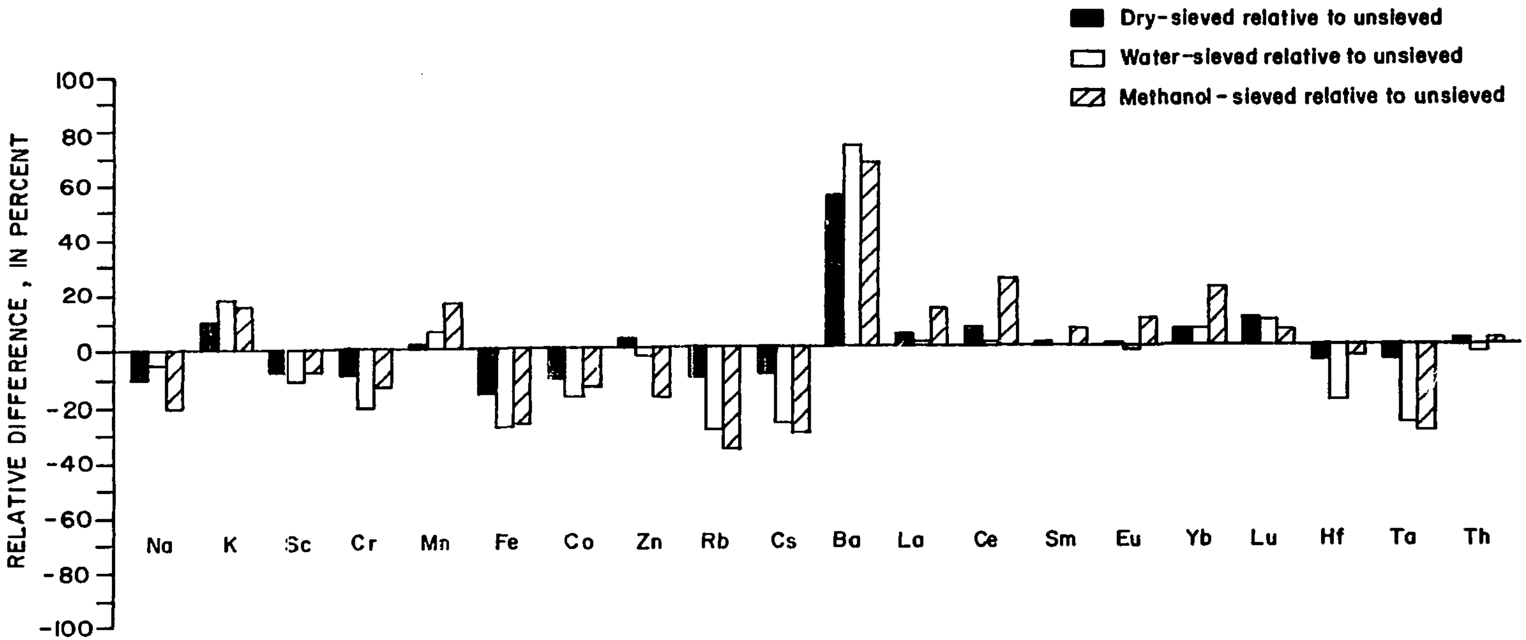


Figure 45. Differences in mean concentrations: TH 529, Middle Bronze II A cooking pot from Hayyat (specimens 10, 10S, 10W, 10M).

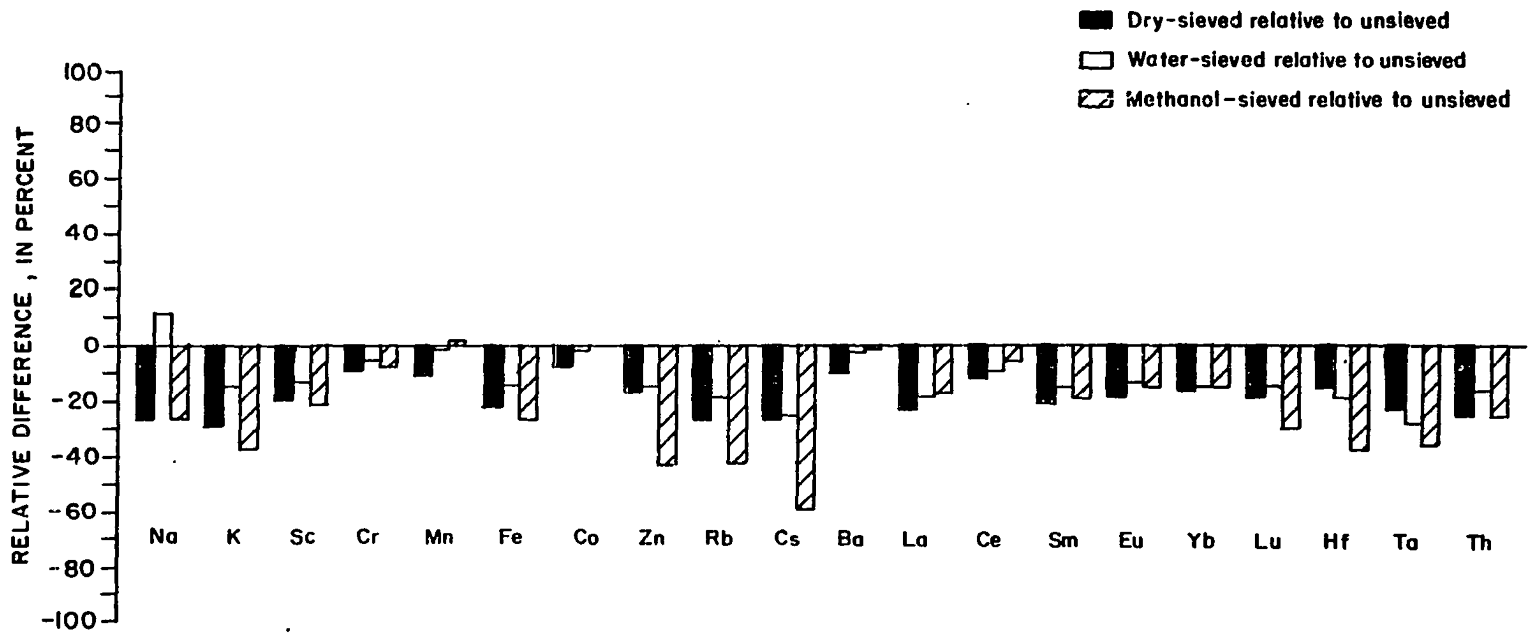


Figure 46. Differences in mean concentrations: TH 621, Middle Bronze II A storejar from Hayyat (specimens 13, 13S, 13W, 13M).

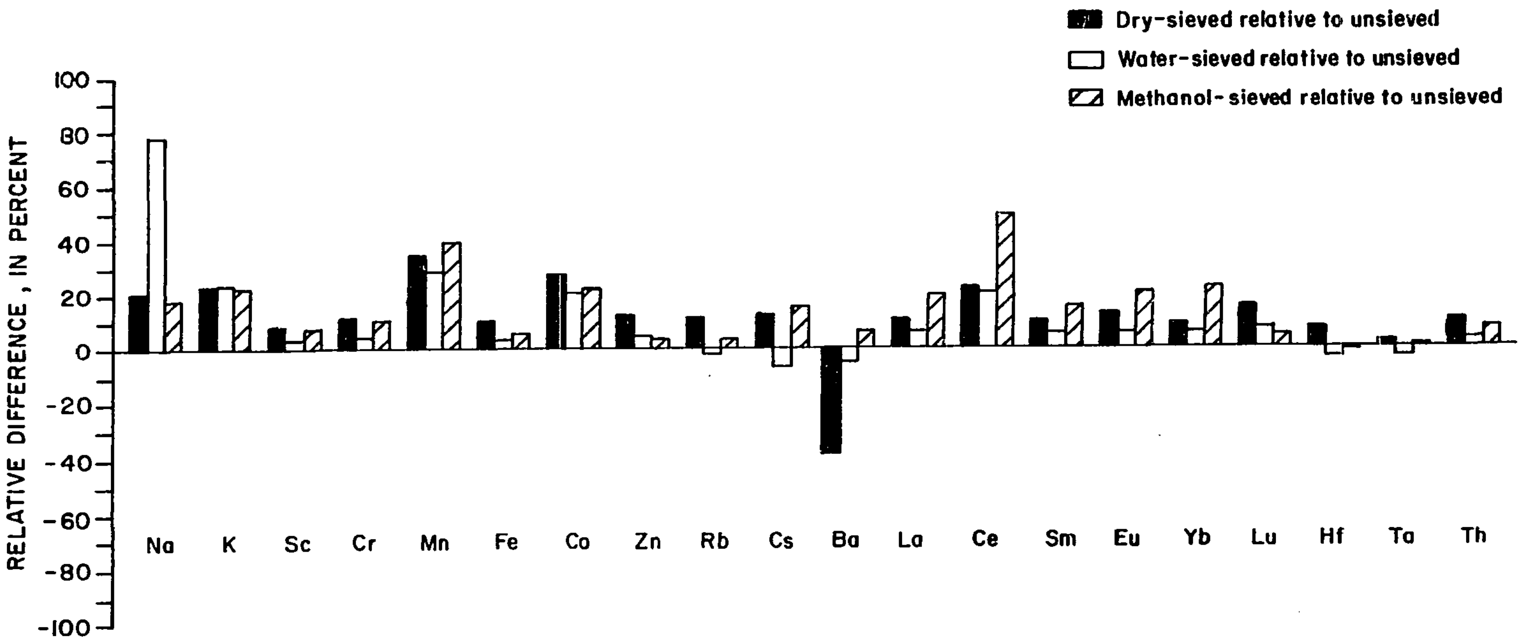
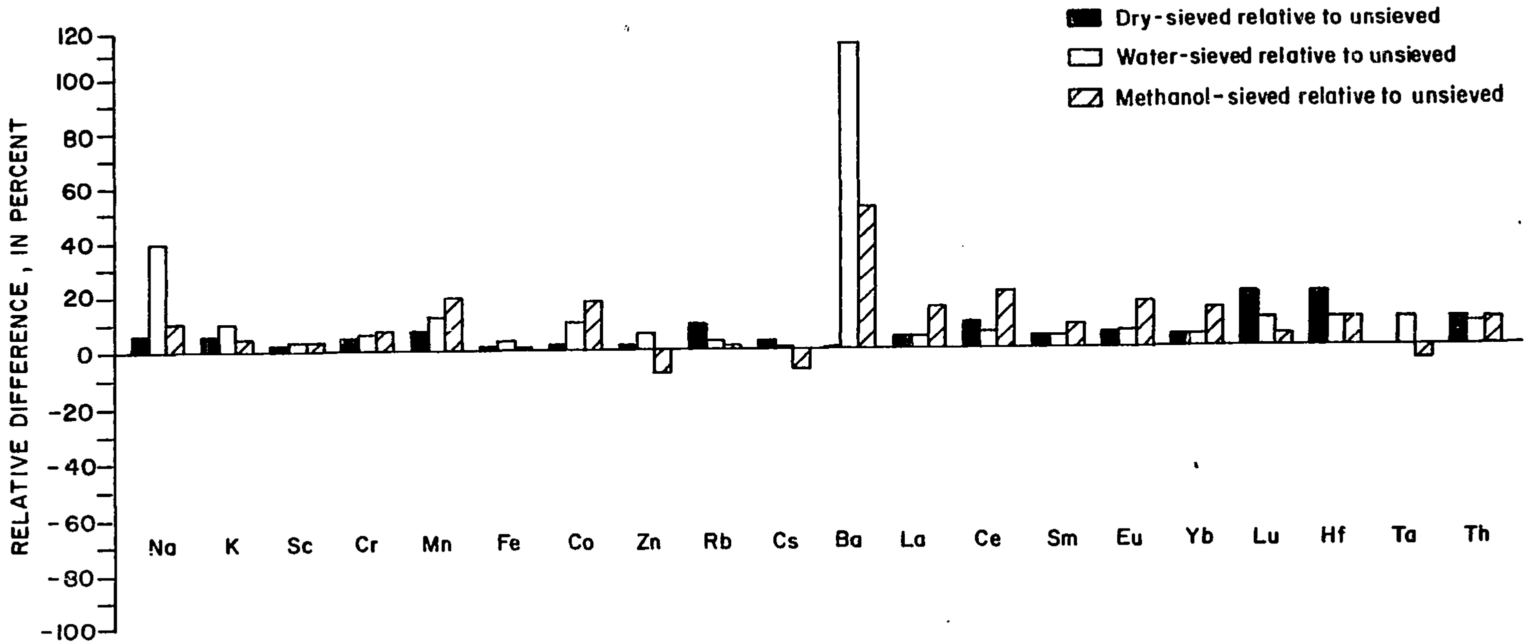


Figure 47. Differences in mean concentrations: TH 729, Middle Bronze II A carinated bowl from Hayyat (specimens 15, 15S, 15W, 15M).



trace element noise of tempering has not been demonstrated. Ultimately, the removal of this noise by sieving is significant only to the extent that it affects larger archaeological analyses and interpretations. The most convincing demonstration of this significance would be parallel neutron activation analyses in which unsieved and methanol-sieved versions of all clay and pottery samples are prepared and analyzed. The significance of removing temper could be assessed from the degree to which differing patterns in unsieved and methanol-sieved data lead to differing archaeological interpretations of production and distribution.

A modest facsimile of this approach using the eight clay and pottery samples from Tell el-Hayyat (samples 1-8) is presented graphically in Figure 48. Data sets of unsieved, dry-sieved, water-sieved and methanol-sieved trace element concentrations were standardized to Z-scores, and analyzed with centroid-linkage cluster analysis of cases using Euclidean distance as a measure of similarity (Engleman 1983). Cluster analysis is a heuristic method commonly utilized with neutron activation data to assess relative similarities between clays and pots. The measurement of relative similarities between samples permits the grouping of pots made from clays with very similar trace element signatures. The similar trace element signatures within any given cluster are hypothesized to indicate a common clay source and site of manufacture. By comparing the cluster analysis dendrograms for these modest data sets one can investigate the potential impact of alternative sample preparation methods on archaeological interpretations of pottery manufacture and distribution.

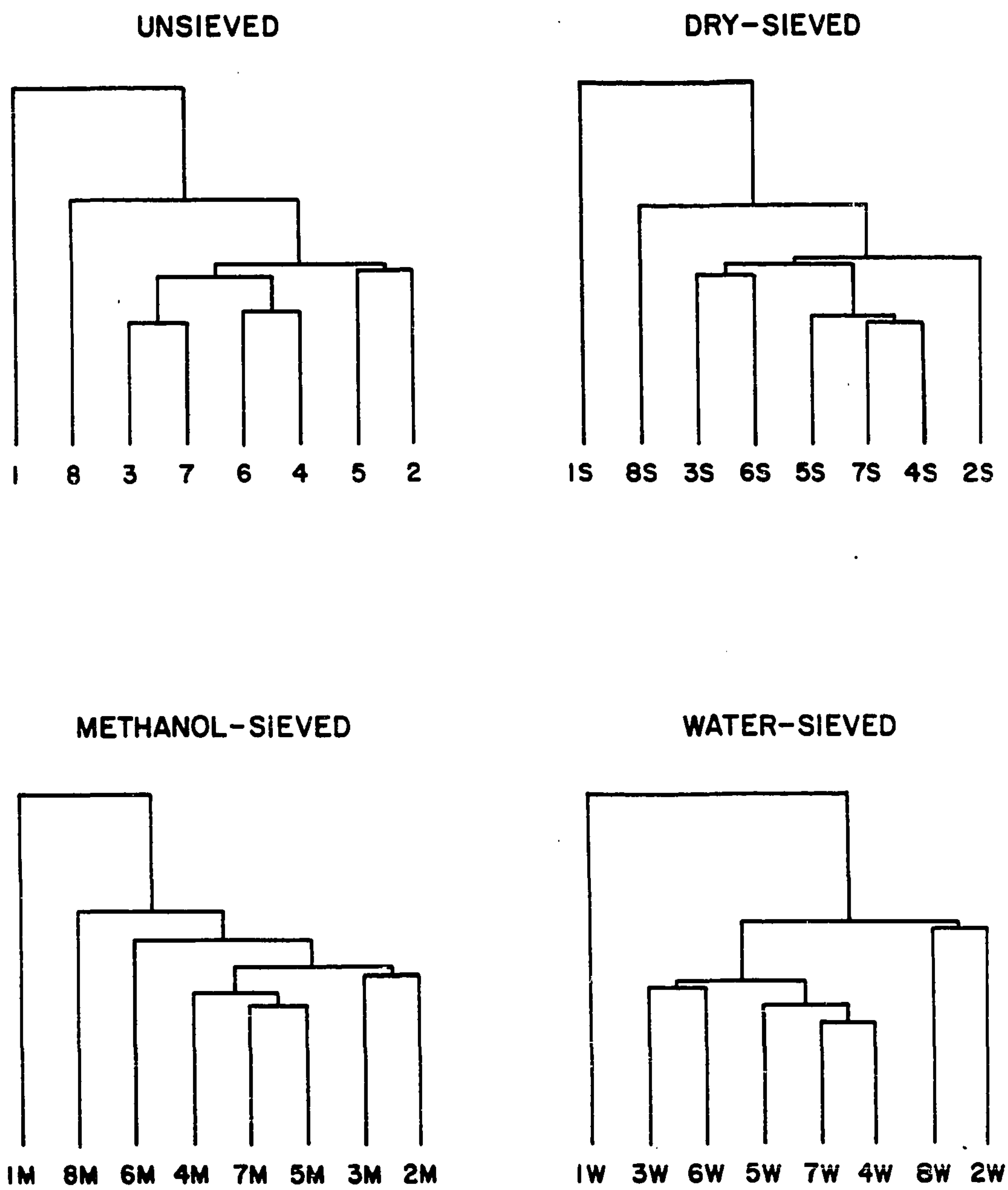


Figure 48. Cluster analyses of trace element concentrations for eight clay and pottery samples from Tell el-Hayyat prepared using different sieving techniques.

The most striking characteristics of these dendrograms are their basic contrasts, particularly as seen between unsieved and sieved data. Only one identical inference can be drawn from all four cluster analyses. The Tell el-Hayyat clay (Sample 1) is shown consistently as having the most distinct trace element composition among the eight samples. One other general similarity may be noted when comparing unsieved and sieved data. The unsieved, dry-sieved and methanol-sieved analyses all show Sample 8 as the second most distinct sample. In a slight variation, the water-sieved analysis shows samples 8 and 2 as distinct and clustering together.

All three sieved analyses differ from the unsieved analysis in grouping samples that are the most similar. Sieved data show samples 4, 5 and 7 as most similar, whereas samples 3, 4, 6 and 7 are clustered most closely according to the unsieved data. More detailed sample by sample comparison of these dendrograms shows the dry-sieved and water-sieved dendrograms to be quite similar. In contrast, the linkages in the methanol-sieved dendrogram, and particularly in the unsieved dendrogram, set them apart as significantly different.

These results reinforce the comparisons of untempered and tempered experimental data emphasized above. All of these data strongly suggest that the apparent removal of large-grained non-clay inclusions by sieving, particularly by methanol-sieving, has a significant impact on the determination of trace element concentrations in ceramics, and, therefore, on the archaeological interpretation of these data regarding pottery production and exchange.

Summary

The experiment presented in this chapter has demonstrated the importance of careful consideration of archaeological ceramics as heterogeneous forms of material evidence, and of appropriate methods for sampling chemical compositions in this heterogeneous evidence. The experimental data reviewed above show that non-clay mineral inclusions are significant sources of trace elements in ceramic bodies. Specifically, they introduce substantial "noise" in trace element concentration data that commonly are assumed to describe the clay(s) in ceramics and the clay source(s) from which those ceramics were made.

This experiment suggests that the noise introduced by mineral inclusions (*i.e.*, temper) in pottery can be sharply reduced, if not eliminated, for the purpose of neutron activation analysis by methanol-sieving clay and pottery samples through fine mesh screen.

This revised method of preparation renders trace element concentrations more pertinent to the clay(s) present in pottery, and, therefore, permits more justifiable inference of clay sources and manufacturing sites from neutron activation data. The intended effect of this revised approach is to enhance the precision of chemical characterization data and inferences, and to encourage fine-grained studies of local ceramic production and exchange. The methods proposed in this chapter are applied to this end in Chapter 7, which presents a case study of Bronze Age pottery production and exchange in the Jordan Valley.

CHAPTER 7: BRONZE AGE VILLAGE POTTERY PRODUCTION AND EXCHANGE IN THE JORDAN VALLEY

The following case study of ceramics from Tell el-Hayyat, Tell Abu en-Ni^{c}aj and neighboring Jordan Valley sites elucidates local economic ties between sedentary Early Bronze IV and Middle Bronze II communities. In particular, the economic roles of small villages before and after the reappearance of towns _ca_. 2000 B.C. are inferred from an investigation of pottery production and exchange.

Excavation of the south slope at Tell el-Hayyat revealed an Middle Bronze II A (Phase 4) pottery kiln (see Falconer and Magness-Gardiner 1984: 54-55; 1983a: Pl. VI, 2; Pl. VII, 1). More importantly, ceramic manufacturing debris was excavated from phases 5 through 2 in areas on the southern and western slopes, in and around the temple enclosures and, in greatest abundance, around the kiln itself. This evidence includes pottery wasters, tempered unfired potting clay, unfired clay toys, and hand-worked clay apparently prepared for potting. Some wasters are from failed storejars, but the vessel types for most wasters cannot be identified. It _is_ apparent that the characteristic coarse cooking pot wares of Early Bronze IV and Middle Bronze II are unrepresented among these wasters. Two pottery wasters also were excavated from the uppermost phase of Tell Abu en-Ni^{c}aj.

This evidence of pottery manufacturing provides a direct means of inferring patterns of Bronze Age pottery production and exchange in the Jordan Valley through the use of neutron activation analysis. Trace element "fingerprints" characteristic of potting clays used at Tell el-Hayyat and Tell Abu en-Ni^{c}aj are compared with trace element data for pottery from these villages and other carefully selected Bronze Age sites. Statistical assessment of these data permits the inference of pottery manufacturing sites and patterns of distribution. Specifically, this study tests the normative expectations that 1) during the "pastoralized" Early Bronze IV Period manufacture of commodities (e.g., pottery) was decentralized, largely due to the collapse of towns as economic centers, and that, 2) with the rejuvenation of town life in Middle Bronze II, towns re-emerged as manufacturing hubs of more centralized local and regional economic systems. The sampling of sites and pottery for this study follows directly from this problem orientation. The results of this case study can be used as the basis for general hypotheses regarding the nature of "rural complexity," as suggested by the participation of Tell el-Hayyat and Tell Abu en-Ni^{c}aj in local Bronze Age economic systems.

Selection of Sites

Within the Jordan Valley, sites and sample types are selected to provide comparable Early Bronze IV and Middle Bronze II data sets. Just as extraneous mineralogical variability is minimized for this study (see Chapter 6), sources of extraneous geographical and chronological variability in ceramic composition also are controlled as much as possible. While focusing on Tell el-Hayyat and Tell Abu en-Ni^{c}aj, this analysis incorporates comparative pottery samples from three Early Bronze IV sites and three Middle Bronze II A sites in the Jordan Valley. Early Bronze IV ceramic production is investigated on the basis of samples from Tell el-Hayyat, Tell Abu en-Ni^{c}aj, Khirbet el-Hammeh, Dhahret Umm el-Marar, and Tell Umm Hammad. Analysis of Middle Bronze II pottery manufacture is based on samples from Hayyat, Tell el-Arba^{c}in, Tabaqat Fahl (ancient Pella), and Tell es-Sa^{c}idiyyeh (see fig. 49). These sites provide the best collections from which abundant unambiguous examples of Early Bronze IV and Middle Bronze II pottery are available for analysis. In addition, the members of each group of sites lie at comparable distances from the geographical foci of this study, Hayyat and Ni^{c}aj. Khirbet el-Hammeh and Pella lie approximately seven kilometers north of Hayyat. Dhahret Umm al-Marar (to the south) and Tell el-Arba^{c}in (to the north) are approximately 15 kilometers from Hayyat. Tell es-Sa^{c}idiyyeh and Tell Umm Hammad lie twenty, and thirty kilometers to the south of Hayyat, respectively.

For the purpose of synchronic Early Bronze IV and Middle Bronze II analyses, the samples within each time period should be contemporaneous. While the limits of archaeological data and inference make this ideal unattainable, the potential difficulty of non-contemporaneous samples can be controlled to some extent by careful selection. Sherds from Hayyat to be included in the Early Bronze IV analysis are selected as often as possible from unmixed Phase 6 contexts. Unfortunately, a paucity of large, clearly recognizable cooking pot and fine ware sherds from Phase 6 requires the use of additional Early Bronze IV samples from Phase 5. All samples from Tell Abu en-Ni^{c}aj, including one waster, are from its upper phase. This is the phase at Ni^{c}aj most likely to be contemporaneous with Hayyat Phase 6.

For enhanced precision, the time frame considered within the

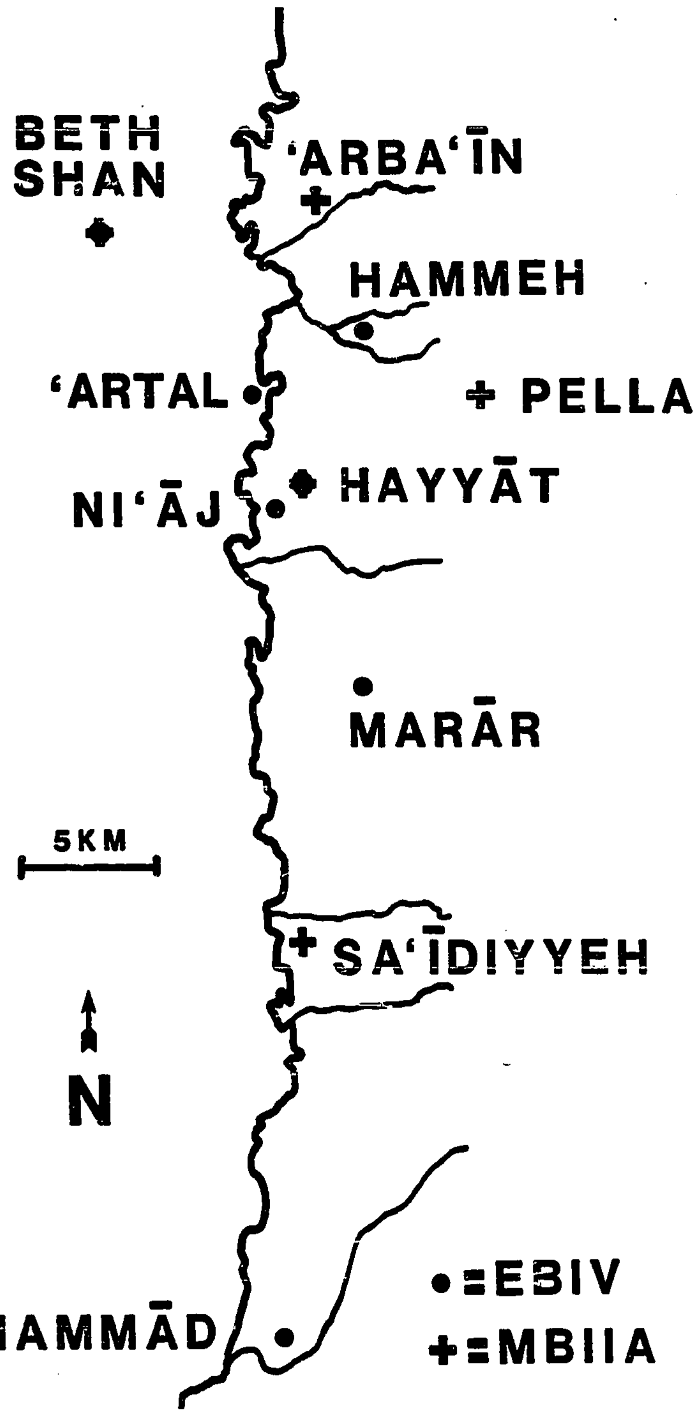


Figure 49. Jordan Valley study area. Beth Shan and Tell ᶜArtal are included only as reference points.

Middle Bronze Age is narrowed to Middle Bronze II A. This limits, at least to a modest extent, the extraneous influence of chronological variability within the Middle Bronze ceramic repertoire to be considered. It also provides a database best suited for investigating the immediate consequences of renewed town life after ca. 2000 B.C. Pottery samples from Tell el-Hayyat are drawn from Phase 4, which provides abundant, stylistically homogeneous Middle Bronze II A ceramics. A single additional sample was chosen from a partially restorable Middle Bronze II A storejar from Phase 3. In addition to pottery samples, ten clay and waster samples from phases 5-2 at Tell el-Hayyat are analyzed. Half of these are from the Middle Bronze II phase of interest, Phase 4. The additional samples exemplify the clay types used for potting at Hayyat over much of its duration. Unfortunately, no wasters or clays were excavated from Phase 6. Table 28 indicates the number of samples from Tell el-Hayyat according to phase and sample type.

Sample contemporaneity is less controllable among the collections from other sites. Middle Bronze II A jar and fine ware sherds from Pella provide the only samples from stratified contexts. However, other sites provide many sherds large enough to indicate similar vessel shapes and, therefore, similar ceramic dates within each time period. Tell es-Sa^{c}idiyyeh also contributed a horizon marker clearly diagnostic of Middle Bronze II A: the handle from a "double-handled" juglet. Table 29 summarizes the sites and sources from which sherd samples were obtained for this study.

Table 28. Analyzed samples from Tell el-Hayyat (n=33).

Phase	Clays/ Wasters	EB IV Pottery	MB II A Pottery
2	3	-	-
3	1	-	1
4	5	-	9
5	1	5	-
6	-	8	-

Table 29. Sites and sources for sherd samples used in Jordan Valley case study.

Period/Site	Source of Samples: Excavation by Tell el-Hayyat Project	Provided by site excavator*	Surface collection, Jordan Valley Survey^	Surface collection, Tell el-Hayyat Project
EARLY BRONZE IV				
Tell el-Hayyat	X			
Tell Abu en-Ni^caj	X			
Khirbet el-Hammeh			X	X
Dhahret Umm al-Marar			X	X
Tell Umm Hammad				
al-Gharbi		X		X
esh-Sharqi		X		
MIDDLE BRONZE II A				
Tell el-Hayyat	X			
Tabaqat Fahl (Pella)		X		X
Tell el-ʿArbaʿin			X	X
Tell es-Saʿidiyyeh			X	X

*Early Bronze IV surface sherds from Tell Umm Hammad provided courtesy of S. W. Helms and A.V.G. Betts. Middle Bronze II A sherds excavated from the "West Cut" at Pella provided courtesy of R. H. Smith.

^Jordan Valley Survey samples provided courtesy of M. Ibrahim, J. Sauer and K. Yassine. This loan was expedited with the help of R. A. Erskine.

Selection of Sample Types

Three vessel types are analyzed from the Early Bronze IV and Middle Bronze II A periods: cooking pots, storejars and fine ware cups and bowls. Tables 30 and 31 specify the numbers and types of samples from each site. Both analyses incorporate the ten clay and waster samples excavated from Tell el-Hayyat. Vessel types were chosen for analysis according to differences in construction technique, vessel form and vessel function. Based on these differences, one can hypothesize varying potential of each of these types for centralized vs. household by household manufacture.

Cooking pots from both periods were coarsely handbuilt, using thick walls to accommodate numerous mineral inclusions, particularly calcite and calcium carbonate. Large angular temper of this sort enhances ceramic resistance to thermal shock. Cooking pots are good candidates for local manufacture and use because their weight and morphology preclude easy distribution. Early Bronze IV cooking pots in the Jordan Valley appear in closed "globular" forms that contribute to vessel strength, but make them unsuitable for stacking and transport in quantity. Analyzed samples include everted rim versions (e.g., fig. 50, no. 1) from Hayyat, Ni^{c}aj and Marar, plus holemouth specimens (e.g., fig. 50, no. 2) from Marar and Hammad. Middle Bronze II A cooking pots from Hayyat have flat bottoms and straight sides characteristic of the period (e.g., fig. 50, no. 11). This form detracts from vessel strength, again rendering this an unlikely pottery type for regional exchange. The lone comparative Middle Bronze II A

Table 30. Early Bronze IV sites and pottery samples.

Site	Site Size (ha.)	Cooking Pots	Jars	Fine Ware
Hayyat~	< 0.5	5	5	3
Ni^{c}aj^	2.5	2	4	3
Hammeh^	2.5	-	6	1
Marar^	1.0	2	5	2
Hammad^	*	2	4	2

* Most Umm Hammad samples (seven of eight) come from a 2.0 hectare component of Tell Umm Hammad el-Gharbi, part of the overall Early Bronze IV settlement estimated at 44.75 hectares (Helms 1986).

^ Site size estimates based on maximum length and width as paced off by the author, fall 1985.

~ Site size measured from topographic site map (Falconer and Magness-Gardiner 1983: fig. 2; 1984: fig. 3).

Table 31. Middle Bronze II A sites and pottery samples.

Site	Site Size (ha.)	Cooking Pots	Jars	Fine Ware
Hayyat*	0.5	4	3	3
^{c}Arba^{c}in^	1.5	-	3	3
Pella*	7.0	-	5	1
Sa^{c}idiyyeh*	8.0	1	2	3

^ Site size estimate based on maximum length and width as paced off by the author, fall 1985.

* Site sizes measured from topographic site maps (Falconer and Magness-Gardiner 1983: fig. 2; 1984: fig. 3; McNicoll, Hennessy and Smith 1980: fig. 1; Pritchard 1980).

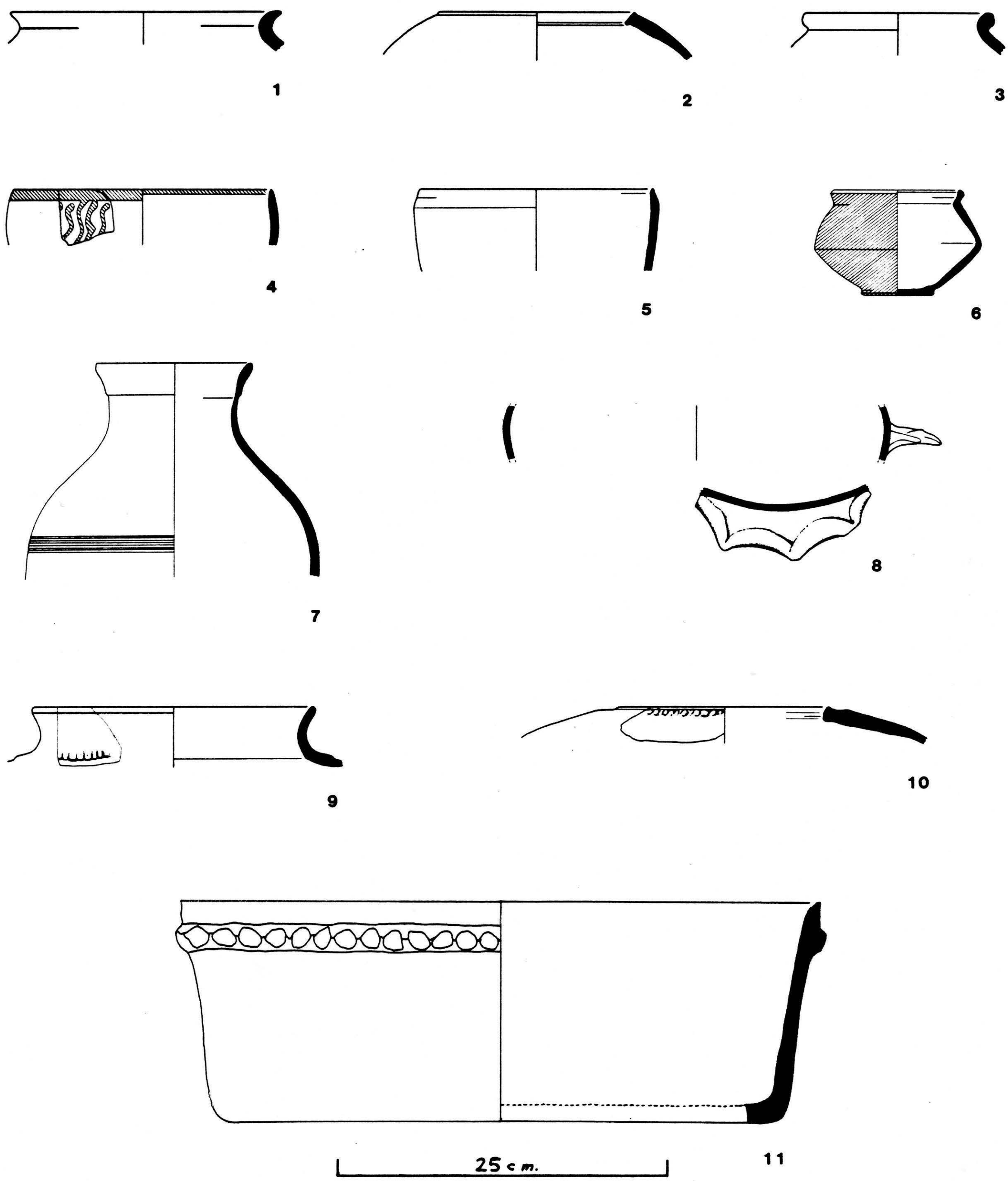


Figure 50. Early Bronze IV and Middle Bronze II A pottery types. Nos. 1, 4, 6, 7, and 11 from Tell el-Hayyat, nos. 2 and 5 from Umm Hammad al-Gharbi, no. 3 from Tell es-Sa^{c}idiyyeh, nos. 8 and 9 from Dhahret Umm al-Marar, no. 10 from Umm Hammad esh- Sharqi.

cooking pot specimen is an everted rim from Sa^{c}idiyyeh (fig. 50, no. 3).

Small fine ware vessels (Early Bronze IV "trickle painted" cups and bowls, Middle Bronze II "carinated" bowls) were chosen as more likely candidates for centralized production and broader distribution. These vessels are wheel-thrown (in Middle Bronze II A) or at least often wheel-finished (in Early Bronze IV). They require greater skill to manufacture and more time for common slipped (Middle Bronze II A) or painted (Early Bronze IV) decoration. They may also have been somewhat "stackable" and, therefore, reasonable commodities for transport in bulk. Early Bronze IV cups are analyzed in both trickle-painted and unpainted versions (e.g., fig. 50, nos. 4, 5). Middle Bronze II A fine ware samples come from carinated bowls (e.g., fig. 50, no. 6), and one double handled juglet from Tell es-Sa^{c}idiyyeh (not illustrated).

Storejars from both periods were chosen because they were apparently produced in large quantities. Diagnostic storejar sherds are abundant in the Hayyat collections and in surface collections from other Jordan Valley sites. Large jars, represented by Early Bronze IV ledge handles (e.g., fig. 50, no. 8), Early Bronze IV everted and holemouth rims (e.g., fig. 50, nos. 9, 10), and Middle Bronze II A rims (e.g., fig. 50, no. 7), were the most abundant vessels in the Jordan Valley surface collections. Storejars in both periods may have been transported from sites of manufacture to sites of deposition through exchange of the commodities they contained. Although it may be troublesome to distinguish exchange in commodities from exchange in pottery per se, analysis of storejars is a ready means of incorporating

Tell el-Hayyat and Tell Abu en-Ni[c]aj into local Bronze Age pottery production/distribution networks.

Expected Results

The apparent absence of local and regional economic centers (i.e., towns) in Early Bronze IV and the normative interpretation of a "reurbanized" Middle Bronze Age would lead one to expect accompanying contrasts in pottery production and exchange. Data from the Early Bronze IV Period would be expected to show minimal economic integration between communities in the Jordan Valley. The production of all three vessel types considered here should be autonomous, or redundant, from site to site. In contrast, the Middle Bronze II A analysis should show more centralized ceramic production. Smaller villages like Tell el-Hayyat would be expected to produce cooking pots and, perhaps, jars. Manufacture of fine wares, on the other hand, would have been concentrated in larger towns like Pella or Tell es-Sa[c]idiyyeh.

Methods of Analysis

The experimental results of Chapter 6 are applied in this study by preparing methanol-sieved specimens of eighty-five Bronze Age ceramic samples from the Jordan Valley. Nuclide concentrations were determined for eleven trace elements using neutron activation analysis. These eleven elements, along with barium, comprise the "optimal array" of elements for methanol-sieving. Barium is excluded from these data because of routinely imprecise concentrations and barium's possible susceptibility to leaching (see discussion in Chapter 6).

The trace element concentrations in each data set, expressed in parts per million, are standardized to Z-scores for centroid-linkage cluster analysis of cases using Euclidean distance as a measure of similarity (Engleman 1983). Cluster analysis is a heuristic method for creating classifications, such as pottery manufacturing groups (see Anderberg 1973; Everitt 1974). Cluster analysis of the Early Bronze IV data, and of the Middle Bronze II A data, measures relative similarities between clays and pots, permitting the grouping of pottery samples made from clays with very similar trace element signatures. The similar signatures within each group are hypothesized to indicate a common clay source and site of manufacture.

The samples used for these analyses are identified by a five-digit sample designation. The letters in this designation identify the site from which the sample was taken:

TH = Tell el-Hayyat
AN = Tell Abu en-Ni^{c}aj
KH = Khirbet Hammeh
DM = Dhahret Umm al-Marar
HG = Umm Hammad al-Gharbi (one sample, labeled "HS", is from neighboring component of the site, Umm Hammad esh-Sharqi)
P = Pella (Tabaqat Fahl)
TA = Tell el-^{c}Arba^{c}in
S = Tell es-Sa^{c}idiyyeh

The first digit of the subsequent numerals in each sample number identifies the sample type:

__1__ = Waster or clay sample
__2__ = EB IV cooking pot
__3__ = EB IV storejar
__4__ = EB IV fine ware cup (often trickle-painted)
__5__ = MB II cooking pot
__6__ = MB II storejar
__7__ = MB II fine ware carinated bowl

The final two digits of the sample numbers run serially within each site collection and vessel type to identify the specific vessel or sherd being analyzed.

Cluster Analysis

Cluster analyses were performed on several different combinations of samples from the Jordan Valley. The results of these analyses are presented as dendrograms in figures 51 through 55. Each group of analyzed samples is subdivided into clusters based on similarities and dissimilarities between trace element profiles. Relative dissimilarities between clusters or samples are measured as "amalgamated distances." Larger amalgamated distances denote greater differences between clusters or between samples than do smaller amalgamated distances.

Middle Bronze II A Pottery from Tell el-Hayyat. Figure 51 considers relationships between the ten clays and wasters, and ten Middle Bronze II A pottery samples, from Tell el-Hayyat. This dendrogram can be divided into three provisional clusters. Each of these clusters shows similarities and differences between samples that are reiterated in the larger Middle Bronze II A analysis discussed below. Cluster B demonstrates the great similarity of unfired tempered clay samples TH 103 and TH 109. A group of four cooking pots, a storejar and a fine ware carinated bowl are clustered in association with this evidence of manufacturing.

Cluster C includes five clay/waster samples showing similarities to two jars and another fine ware bowl. This cluster may be subdivided

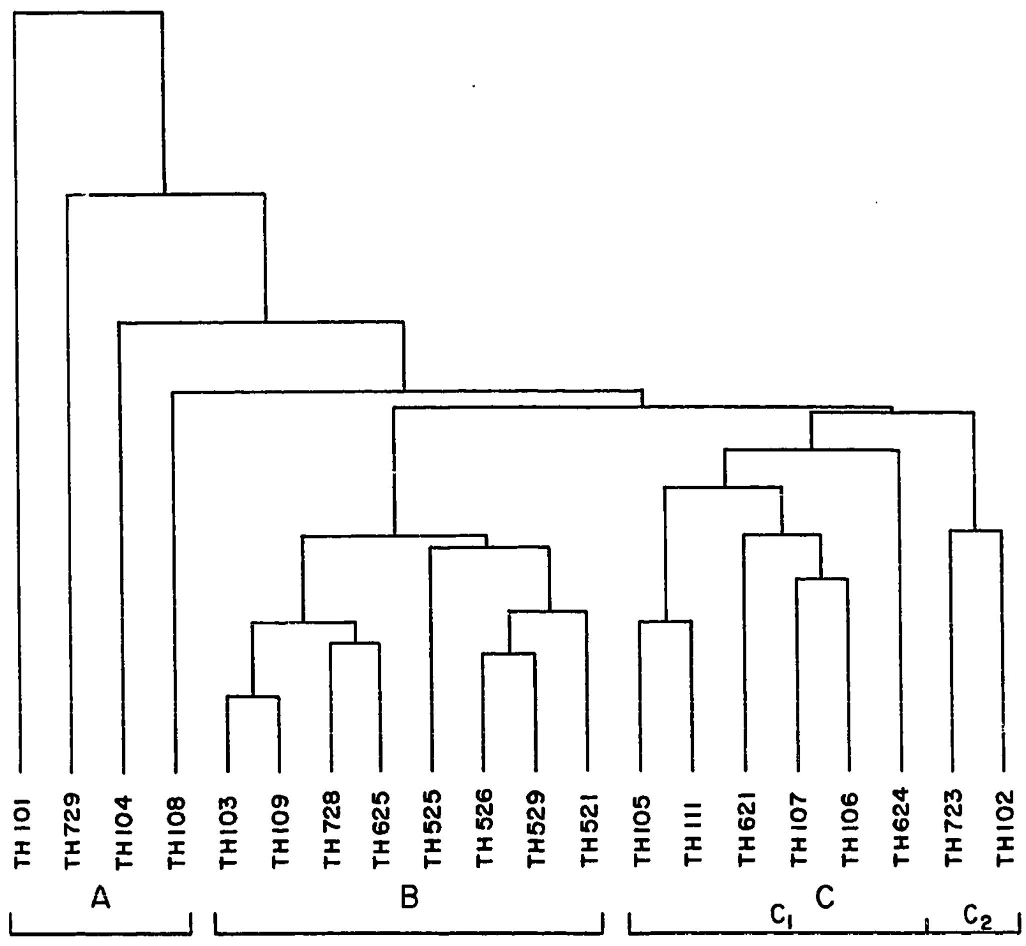


Figure 51. Dendrogram from cluster analysis of Middle Bronze II clays, wasters and pottery from Tell el-Hayyat (n = 20).

by segregating this bowl (TH 723) and a clay loom weight (TH 102) as somewhat dissimilar to the other samples. Cluster A includes the remaining four, relatively dissimilar samples, a bedded kaolinite clay (TH 101), two wasters (TH 104 and 108) and a fine ware carinated bowl (TH 729).

Several observations from this analysis may be used to guide further interpretations below. The closest similarities between samples possibly indicative of manufacture at Tell el-Hayyat are noted between clays TH 103 and 109, and between wasters TH 105, 106, 107 and 111. Close similarities possibly with the same implication are noted among cooking pots TH 521, 525, 526 and 529. On the other hand, bedded clay TH 101 and wasters TH 104 and 108 do not show affinities for any pottery considered so far. The diagnostic value of loom weight TH 102 remains to be seen.

Early Bronze IV Pottery from Tell el-Hayyat. These observations are reiterated if we consider the possible diagnostic value of Hayyat's clays and wasters for manufacturing at this site in the Early Bronze IV Period. Figure 52 relates data for ten Middle Bronze Age clays and wasters to thirteen Early Bronze IV sherd samples from Tell el-Hayyat. Four basic clusters suggest patterns much like those seen in Figure 51. The same relatively dissimilar clay and waster samples appear in Cluster D, as they did in Cluster A in Figure 51. Likewise, the four wasters previously associated in Cluster C reappear as members of Cluster E in Figure 52. Cluster F includes very similar clays TH 103 and 109, along with one jar and all five Early Bronze IV cooking pots

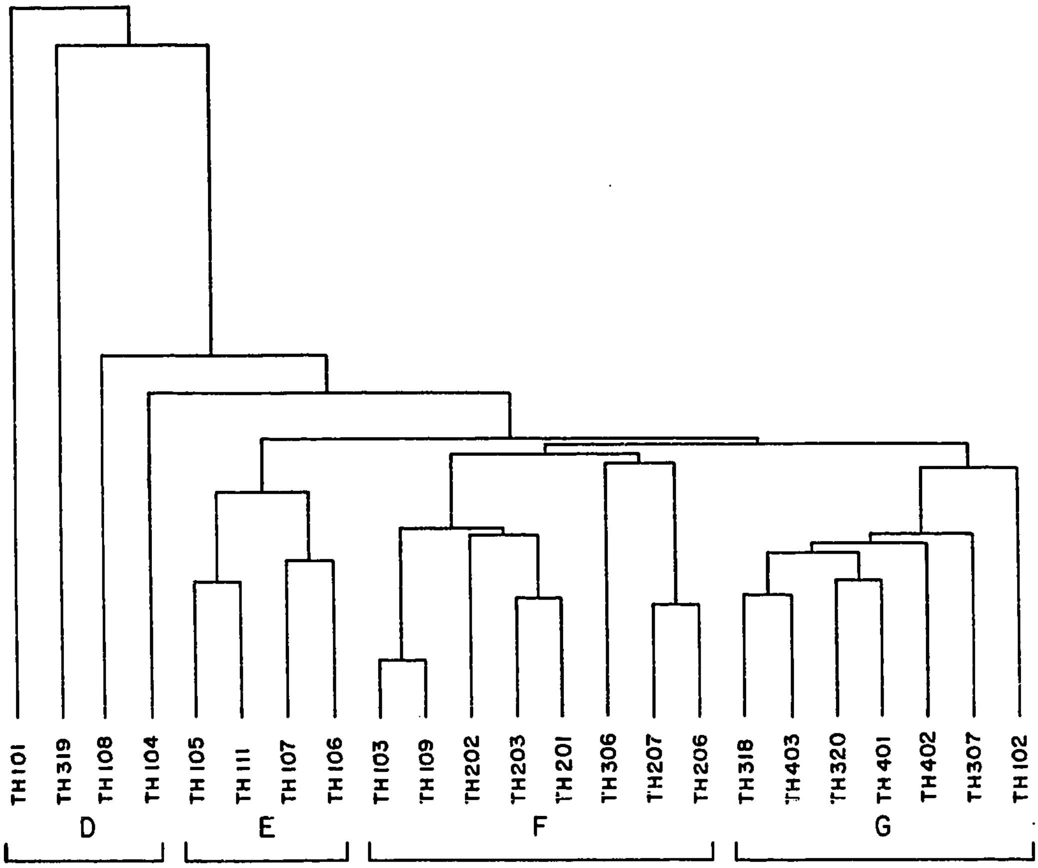


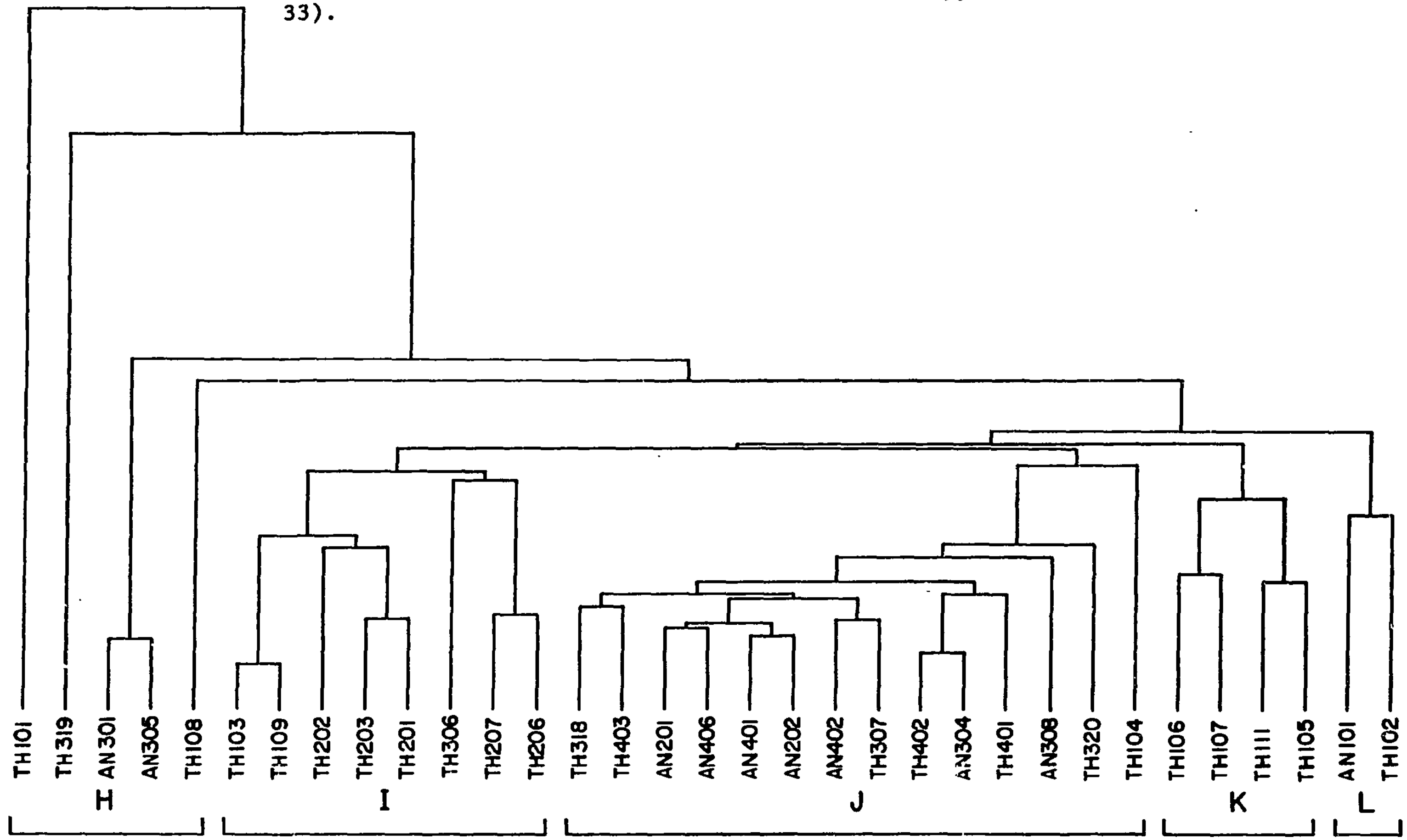
Figure 52. Dendrogram from cluster analysis of clays, wasters and Early Bronze IV pottery from Tell el-Hayyat (n = 23).

from Tell el-Hayyat. As in the case of Cluster B above, this may be indicative of production at Hayyat. In contrast, Cluster G includes jars and fine wares associated with only the less diagnostic loom weight sample TH 102. By virtue of its separation from more diagnostic clays and wasters, this cluster may suggest production away from Hayyat.

Early Bronze IV Pottery from Tell el-Hayyat and Tell Abu en-Ni^{c}aj. This discussion can be expanded to include all Early Bronze IV samples from Tell el-Hayyat and Tell Abu en-Ni^{c}aj, as well as the Hayyat clays and wasters (see fig. 53). Cluster H includes three of the relatively dissimilar samples seen previously in Cluster D, plus two jars from Ni^{c}aj. The other previous member of Cluster D, TH 104, now is included with an array of fairly similar cooking pots, jars and fine ware from Ni^{c}aj, and jars and fine ware from Hayyat. The fairly distant association of a minimally diagnostic waster (TH 104) with these pots does not suggest production at Tell el-Hayyat. The possibility that these pots were produced at Tell Abu en-Ni^{c}aj is explored below.

The other clusters in Figure 53 mirror patterns seen in previous dendrograms. Cluster I re-emphasizes the association of clays and cooking pots in Cluster F. Likewise, Cluster K reiterates the similarities between four wasters from Hayyat previously grouped in Cluster E. Cluster L suggests that the enigmatic loom weight sample TH 102 is most similar to an Early Bronze IV tempered clay from Ni^{c}aj (AN 101).

Figure 53. Dendrogram from cluster analysis of clays and wasters from Tell el-Hayyat, and Early Bronze IV pottery from Abu en-Ni'aj and Tell el-Hayyat (n = 33).

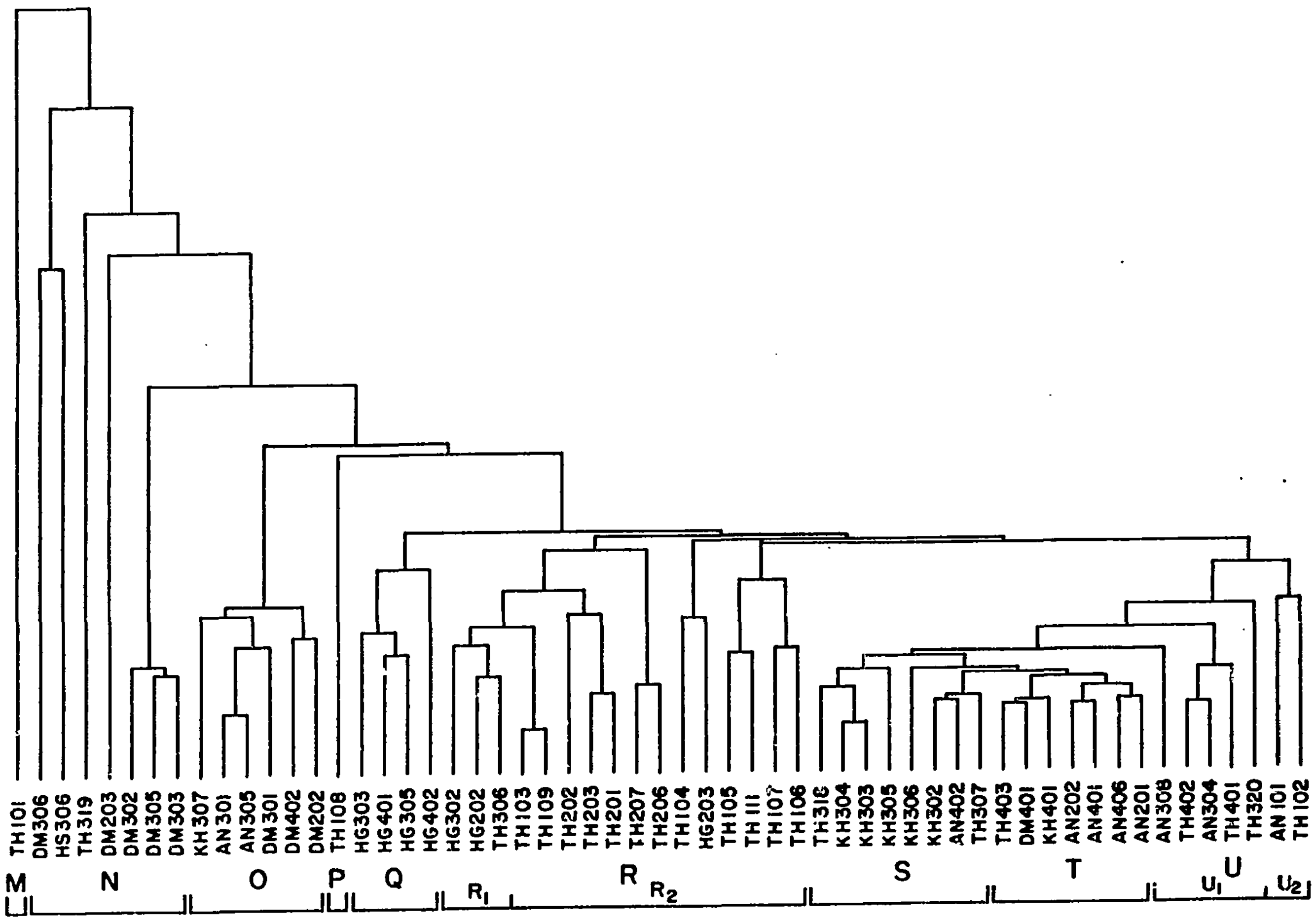


Early Bronze IV Pottery from Five Jordan Valley Sites. These observations are applied next to a cluster analysis of clays and wasters from Tell el-Hayyat, along with samples from all five Early Bronze IV sites considered in this study. The dendrogram in Figure 54 is broken down into a series of clusters that are interpreted in light of patterns in figures 52 and 53. Clusters T and U associate samples of all three vessel types from Tell Abu en-Ni^c^aj with one jar from Tell el-Hayyat, and fine ware cups from Hayyat, Dhahret Umm al-Marar and Khirbet el-Hammeh. This pottery also is associated with clay sample AN 101 from Ni^c^aj and loom weight TH 102 from Hayyat, as shown in cluster U_2. The predominance of pottery from Ni^c^aj including cooking pots, plus some association of a waster from that site, suggest that clusters T and U may relate to pottery production at Tell Abu en-Ni^c^aj.

Cluster S is comprised of five jars from Khirbet el-Hammeh, two jars from Hayyat and a trickle-painted cup from Ni^c^aj. The predominance of samples from Khirbet el-Hammeh suggests Hammeh as a possible production source for this pottery. Cluster R is comprised of clays, wasters and closely related cooking pots from Tell el-Hayyat that more strongly implicates pottery production at this site. Additional pottery in this cluster includes a jar from Hayyat, and two cooking pots and a jar from Umm Hammad al-Gharbi.

Cluster Q consists entirely of samples collected from, and perhaps produced at, Tell Umm Hammad al-Gharbi. Cluster N centers on three fairly similar jars from Dhahret Umm al-Marar that are supplemented by less closely associated samples from Umm Hammad esh-Sharqi, Hayyat and Marar. The predominance of samples from Dhahret Umm al-Marar suggests

Figure 54. Dendrogram from cluster analysis of clays and wasters from Tell el-Hayyat, and Early Bronze IV pottery from five Jordan Valley sites (n = 57).



these pots possibly were made at Marar.

Cluster O represents a mix of pottery from Khirbet el-Hammeh, Tell Abu en-Ni[c]aj and Dhahret Umm al-Marar for which a likely production source is not apparent. Isolated clay sample TH 101 and waster TH 108 ("clusters" M and P, respectively) do not cluster readily with any pottery samples. Therefore, they are excluded from further analysis of Early Bronze IV data. Table 32 summarizes the Early Bronze IV pottery groups and manufacturing sites inferred from these cluster analyses.

Middle Bronze II A Pottery from Four Jordan Valley Sites. A cluster analysis of Middle Bronze II A pottery from the Jordan Valley and ten clays and wasters from Tell el-Hayyat is summarized in Figure 55. As with the general Early Bronze IV analysis (fig. 54), this dendrogram can be subdivided into a series of clusters that are interpreted in light of previous patterns (see fig. 51).

Cluster BB includes a group of very similar Tell el-Hayyat cooking pots, originally associated in Cluster B, along with three clays and a waster all indicative of Hayyat as a production site. Other pottery in this cluster, probably made at Hayyat, includes a jar from Pella, and jars and fine ware from Tell el-Arba[c]in and Tell el-Hayyat. Further evidence of manufacture at Hayyat may be seen in Cluster Z, which includes a waster, and jars from Hayyat and Arba[c]in. Four additional wasters are grouped without any associated pottery in Cluster X. Unfortunately, the diagnostic potential of TH 105, 107 and 111, originally suggested in Cluster C, is not fulfilled.

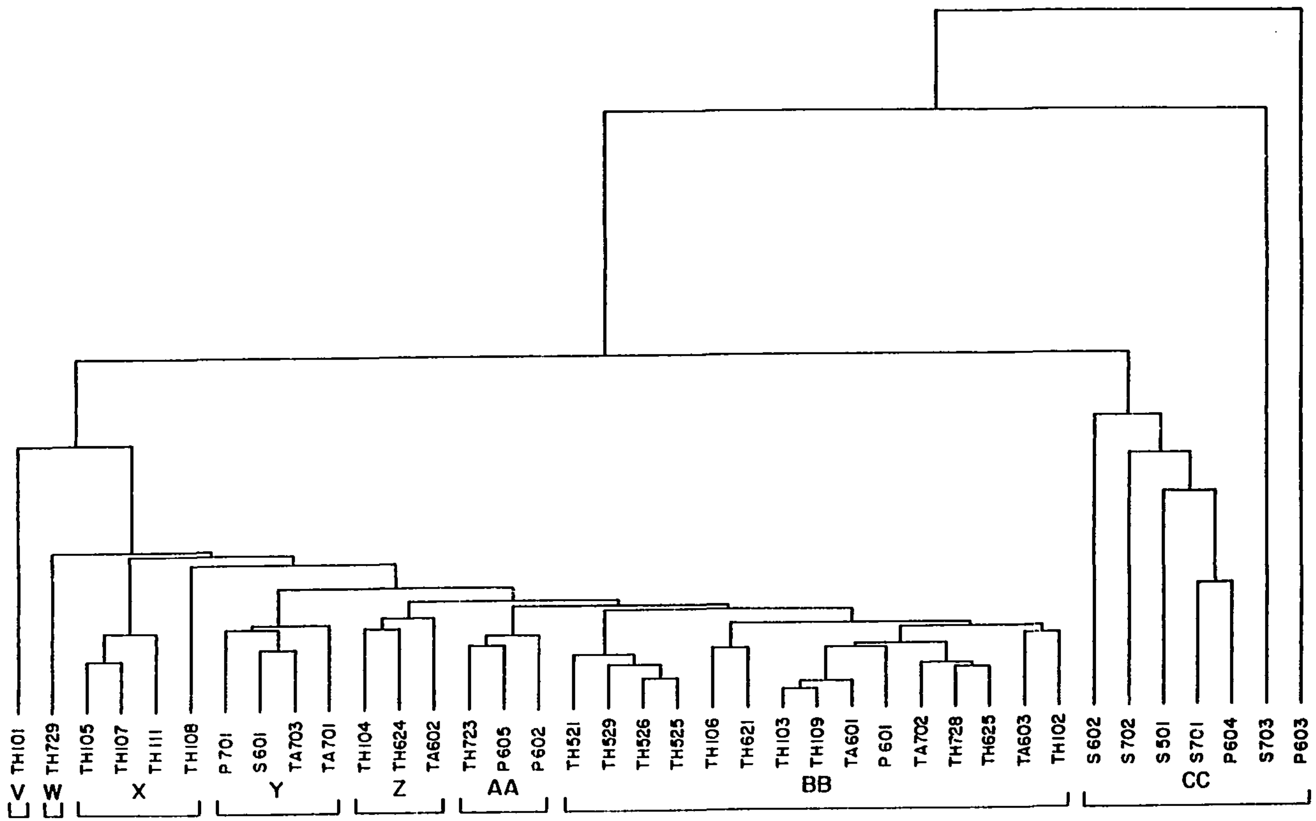
Cluster CC is quite distinctly comprised of five pottery samples

Table 32. Early Bronze IV pottery groups inferred from cluster analyses of trace element data (n = 55). Cooking pots are indicated by "C.P." Trickle-painted vessels are indicated by "(tp)."

Cluster designation and hypothesized manufacturing site				
R. Hayyat	T. Ni[c]aj	U. Ni[c]aj(?)	S. Hammeh	N. Marar
2 TH Clays	2 AN C.P.'s	1 AN Clay	5 KH Jars	4 DM Jars
5 TH Wasters	2 AN Cups (1 tp)	1 TH Clay	2 TH Jars	1 DM C.P.
5 TH C.P.'s	1 TH Cup (tp)	2 AN Jars	1 AN Cup	1 TH Jar
1 TH Jar	1 DM Cup (tp)	1 TH Jar (tp)		1 HS Jar
2 HG C.P.'s	1 KH Cup	2 TH Cups (2 tp)		
1 HG Jar				

Q. Hammad	O.Local(?)	Excluded
2 HG Jars	1 DM C.P.	TH 101
2 HG Cups	1 DM Jar	TH 108
	1 DM Cup	
	2 AN Jars	
	1 KH Jar	

Figure 55. Dendrogram from cluster analysis of clays and wasters from Tell el-Hayyat, and Middle Bronze II A pottery from four Jordan Valley sites (n = 38).



from Sa[c]idiyyeh and two jars from Pella, possibly reflecting manufacture at Sa[c]idiyyeh or another source to the south. The likely production sites for smaller clusters Y and AA are more difficult to hypothesize. Tell el-ʿArbaʿin is suggested tentatively for Cluster Y, based on two fine ware bowls from that site. Pella is suggested for cluster AA, based on the two Pella jars in this cluster and the inclusion of Hayyat bowl TH 723, which was shown to be relatively dissimilar to the tight clusters of Hayyat clays, wasters and pottery in Figure 51 (see cluster C_2).

A Hayyat fine ware bowl (TH 729) is left unassociated (in "Cluster" W) with other pottery in this analysis, as it was in Cluster A, Figure 51. In keeping with the Early Bronze IV analysis, Hayyat clay TH 101 is likewise unassociated. This sample does not appear to be representative of potting clays used at Hayyat, at least in its raw form. It is, therefore, excluded from further analysis. Table 33 summarizes the Middle Bronze II A pottery groups and manufacturing sites inferred from these cluster analyses.

Discriminant Analysis

Cluster analysis, when used alone, lacks any statistical test of whether hypothesized pottery manufacturing groups are significantly different (see Christenson and Read 1977; Aldenderfer and Blashfield 1978). In other words, a dendrogram may be subdivided into any number of clusters from one to n, based on an investigator's prior expectations and ability to explain subdivisions (see Wilson 1978: 230-232). As a response to this problem, discriminant analysis provides a

Table 33. Middle Bronze II A pottery groups inferred from cluster analyses of trace element data (n = 37). Cooking pots are indicated by "C.P."

Cluster designation and hypothesized manufacturing site

BB. Hayyat	Z. Hayyat	X. Hayyat	CC. Sa^{c}idiyyeh
3 TH Clays	1 TH Waster	4 TH Wasters	1 S C.P.
1 TH Wasters	1 TH Jar		1 S Jar
4 TH C.P.'s	1 TA Jar		2 S Bowls
2 TH Jars			1 S Double-handled juglet (S 703)
1 TH Bowl			
1 P Jar			
2 TA Jars			2 P Jars
1 TA Bowl			

AA. Pella(?)	Y. ^{c}Arba^{c}in(?)	W. Exotic	Excluded
2 P Jars	2 TA Bowls	1 TH Bowl	TH 101
1 TH Bowl	1 P Bowl		
	1 S Jar		

complementary statistical means of measuring differences between hypothesized clusters. Discriminant analysis is a multivariate technique for distinguishing mutually exclusive groups of samples and testing the statistical significance of differences between these groups (Lachenbruch 1975; Morrison 1976). The stepwise discriminant analysis used here calculates an F-statistic in pairwise tests of differences between group means (Jennrich and Sampson 1983). This analytical method determines whether the segregation of pottery manufacturing groups outlined above is statistically justified.

Stepwise discriminant analyses were conducted on the pottery groups summarized in tables 32 and 33. These analyses generated multivariate discriminant functions for classifying each sample into the group it resembles most closely. This provides an independent statistical test of the groups suggested by cluster analysis. Canonical discriminant functions are derived so that the first discriminant function describes as much of the variation between groups in the data set as possible. The second discriminant function accounts for as much of the remaining variation as possible. Subsequent discriminant functions account for decreasing amounts of the remaining variation.

Initial discriminant analyses suggested several modifications of the pottery groups hypothesized above. Based on the Early Bronze IV analysis, Cluster R_1 is regrouped with Cluster Q as part of a larger group of samples apparently manufactured at Umm Hammad al-Gharbi (see Table 34). Clusters T and U are combined to form a large body of evidence for pottery production at Tell Abu en-Ni^{c}aj. The Middle

Table 34. Early Bronze IV pottery groups as modified by stepwise discriminant analysis (n = 55).

Cluster number and hypothesized manufacturing site

1. Hayyat	2. Ni^{c}aj	3. Hammeh	4. Marar	5. Hammad
2 TH Clays	1 AN Clay	4 KH Jars	4 DM Jars	1 HG C.P.
5 TH Wasters	1 TH Clay	1 TH Jar	1 HS Jar	3 HG Jars
5 TH C.P.'s	2 AN C.P.'s	1 AN Jar		2 HG Cups
1 TH Jar	2 AN Jars	1 AN Cup (tp)		1 TH Jar
	2 AN Cups (1 tp)			
	1 TH Jar (tp)			
	3 TH Cups (3 tp)			
	1 DM Cup (tp)			
	1 KH Cup			

6. Local?
1 DM C.P.
1 DM Jar
1 DM Cup
1 AN Jar
1 Kh Jar

Bronze II analysis suggests the combination of clusters BB, Z and X relating to Tell el-Hayyat (see Table 35). In addition, carinated bowl TH 729 is reclassified as part of cluster AA, possibly relating to Pella. Pella jar P 603, on the other hand, is singled out as very different from any other sample, and an unlikely member of any of the manufacturing groups hypothesized here. A check of the trace element data for P 603 reveals extremely high chromium and zinc concentrations as the basis for this segregation.

A second stepwise discriminant analysis was conducted using these modified Early Bronze IV and Middle Bronze II pottery groups. The first two canonical discriminant functions produced by each of these analyses account for 96 percent of the variation among trace element concentrations in each data set. These results are shown graphically by figures 56 and 57. Trace element data for each sample are entered into discriminant functions 1 and 2 for each analysis. This produces canonical variables 1 and 2 for each sample, which are used to plot each sample in the two dimensional graphs. The members of each pottery group are circled for the purposes of illustration.

Results

Cluster analysis and stepwise discriminant analysis clearly distinguish groups of pottery, suggesting possible sites of manufacture in the Jordan Valley. The means of the six Early Bronze IV groups shown in Figure 56 differ significantly from one another at the 99 percent confidence level. The means for the five Middle Bronze II A groups shown in Figure 57 (sample P603 is the lone member of its group)

Table 35. Middle Bronze II A pottery groups as modified by stepwise discriminant analysis (n = 37).

Cluster number and hypothesized manufacturing site				
7. Hayyat	8. Sa[c]idiyyeh	9. Pella(?)	10. [c]Arba[c]in(?)	11. Exotic
3 TH Clays	1 S C.P.	2 P Jars	2 TA Bowls	1 P Jar
6 TH Wasters	1 S Jar	2 TH Bowls	1 P Bowl	
4 TH C.P.'s	2 S Bowls		1 S Jar	
3 TH Jars	1 S Double-handled juglet			
1 TH Bowl				
1 P Jar				
3 TA Jars	1 P Jar			
1 TA Bowl				

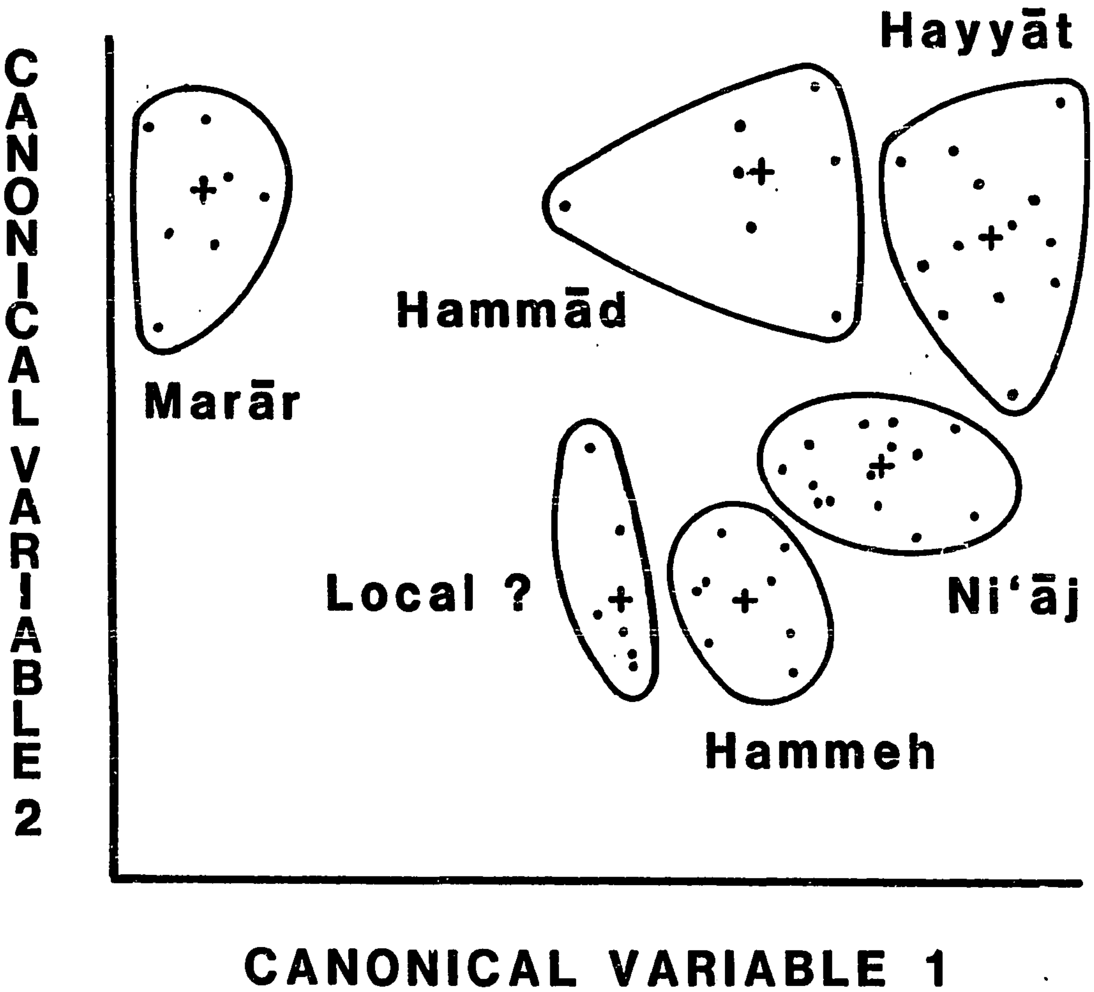


Figure 56. Discriminant analysis scatterplot of Early Bronze IV samples and groups. Crosses indicate group means.

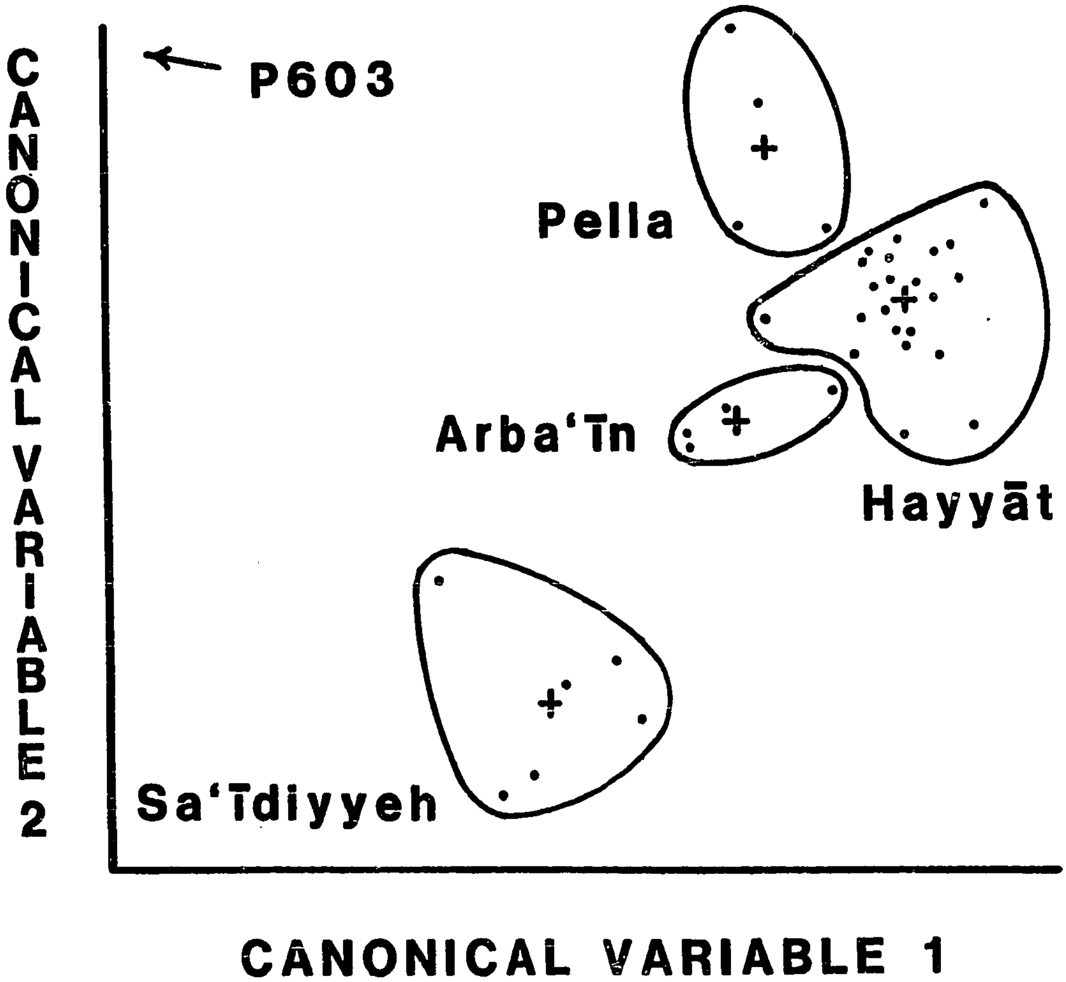


Figure 57. Discriminant analysis scatterplot of Middle Bronze II A samples and groups. Crosses indicate group means.

also differ significantly at the 99 percent confidence level, except the means for the Hayyat and ᶜArbaᶜin groups, which differ significantly at the 95 percent confidence level.

It is hypothesized that clays and manufacturing debris provide trace element profiles for a sample of the potting clays used at the site from which they were excavated. Most of the Hayyat clays and wasters group with one another, and with many of the pottery samples from Hayyat, providing an indication of the variety of vessels produced there (see groups 1 and 7 in tables 34 and 35). Clay sample AN 101 helps identify the array of pottery probably manufactured at Tell Abu en-Niᶜaj (Group 2).

If clays or wasters are not included in a pottery group, the site of manufacture is inferred to be the site that provides most of the constituent samples in a group (e.g., groups 3, 4, 5, 8). The small sizes and lack of a prominent contributing site in groups 6, 9 and 10 make identification of these manufacturing sources less certain, hence the question marks. Nonetheless, these analyses suggest that coarse ware cooking pots provide good trace element fingerprints for local potting clays. Fifteen of the sixteen cooking pots conform to a pattern in which samples from the same site cluster very closely with one another and with other pottery from the same site.

Patterns of local pottery manufacture and exchange are reconstructed by connecting the hypothesized site of manufacture with the known site of deposition for each sample (see figures 58 and 59). Figure 58 illustrates the possibility that Group 6 may have been

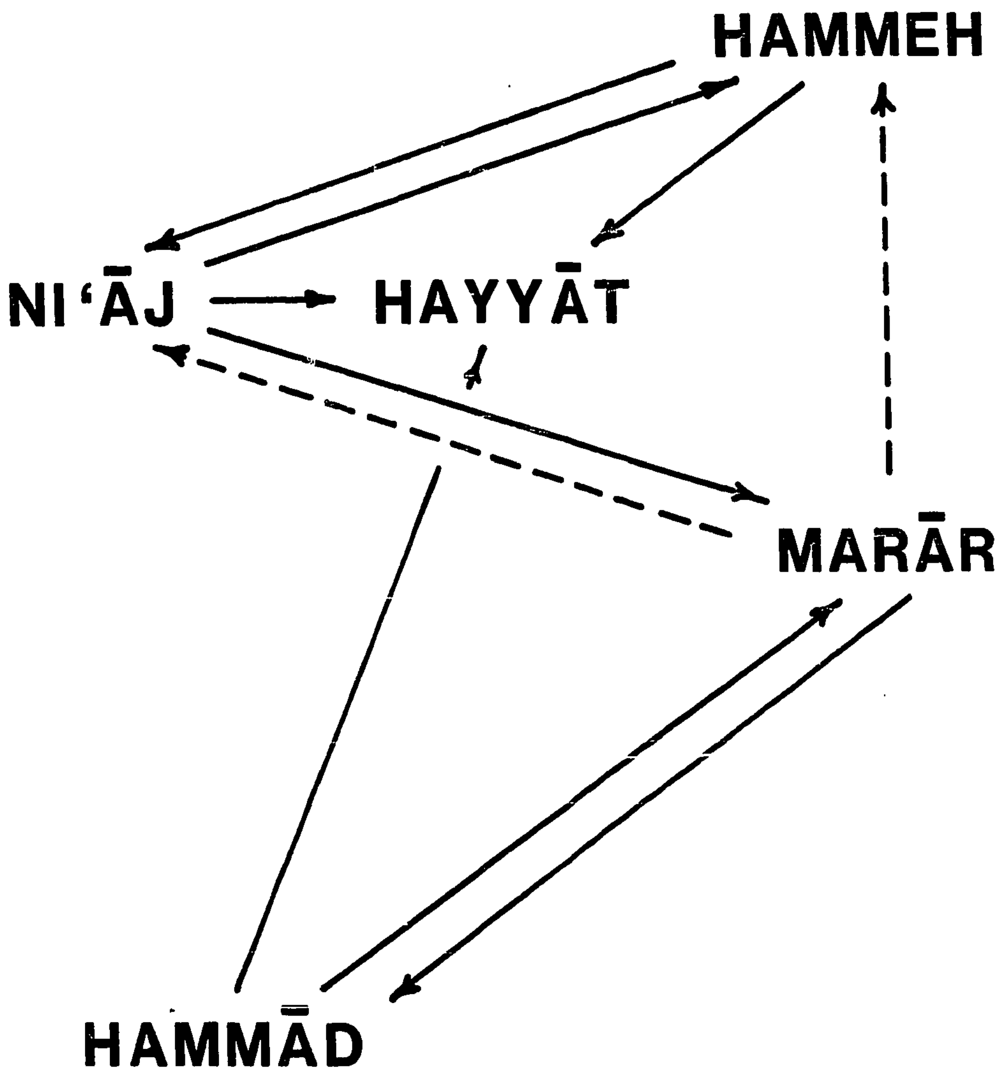


Figure 58. Hypothesized Early Bronze IV pottery exchange pattern. Dashed lines indicate exchange if Group 6 relates to Dhahret Umm el-Marar.

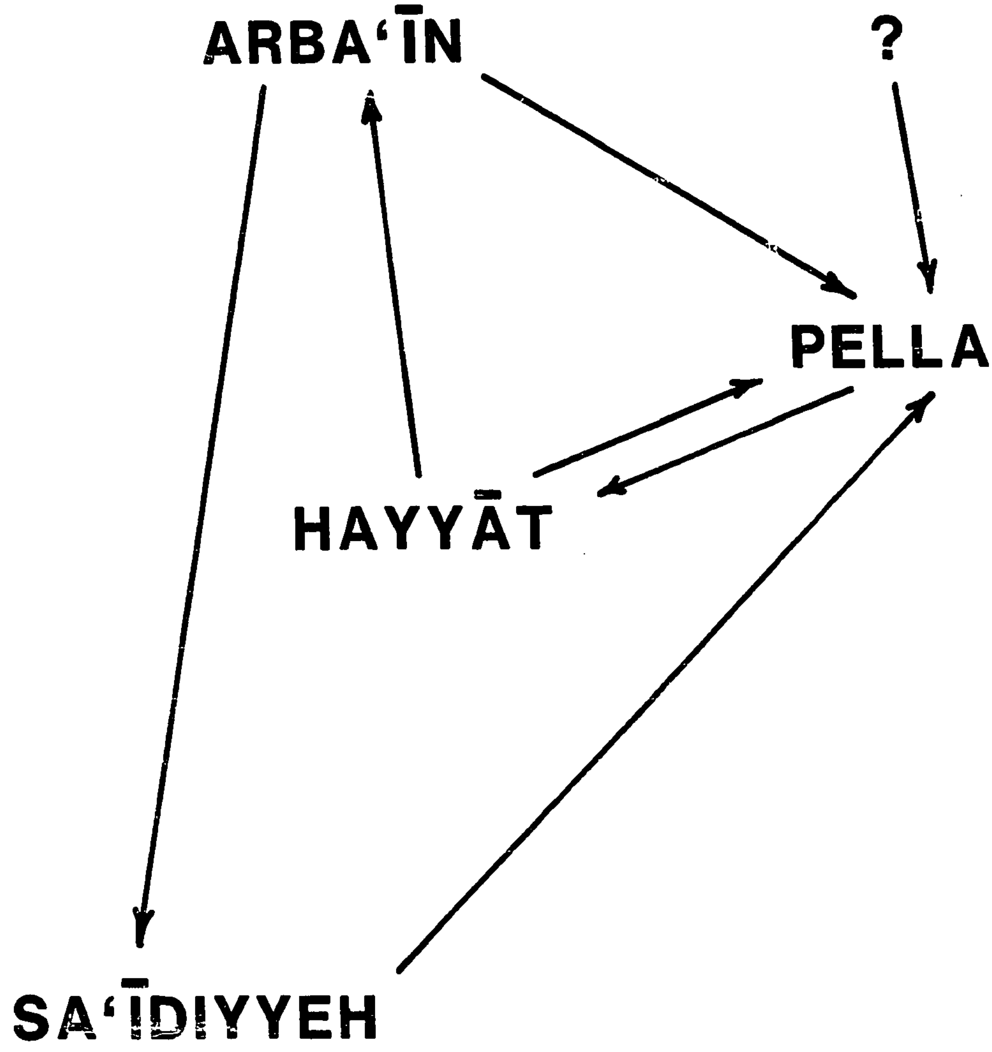


Figure 59. Hypothesized Middle Bronze II A pottery exchange pattern.

produced at Dhahret Umm al-Marar, although this would have required the use of two distinct potting clays at Marar (see Table 34). Group 6 simply could relate to an unidentified source. The use life of any ceramic vessel may include several episodes of transport between its manufacture and its incorporation into the archaeological record. Nonetheless, these economic communications, however indirect, exemplify the varying contributions of villages and towns to the local exchange networks in the Jordan Valley during the Bronze Age.

Discussion

The analyses above explore Bronze Age village economies using a modest preliminary database. However, these data describe unexpected patterns of pottery manufacture and exchange that merit discussion here, and expanded future investigation in the Jordan Valley and elsewhere in the southern Levant. Neutron activation analysis suggests that the Early Bronze IV occupants of Tell el-Hayyat produced cooking pots, and received abundant pottery from a variety of other sites, particularly jars and fine ware from Abu en-Ni^{c}aj. Only one sample from another site (HG 203) may have been produced at Hayyat. Thus, Tell el-Hayyat is shown in Figure 58 as receiving pottery from several sources, but "exporting" little. Production of pottery at Khirbet el-Hammeh and Dhahret Umm el-Marar is indicated by tight clusters of storejars from those sites, while production at Tell Umm Hammad is defined by a cluster seven samples from that site.

Tell Abu en-Ni^{c}aj distributed jars (and their contents?) and cups (most of them trickle-painted) to three of the four other sites considered here. The possibility of specialized production of trickle-painted pottery at Tell Abu en-Ni^{c}aj may be in keeping with that proposed for nearby Tell ^{c}Artal (see Table 34). Neutron activation analysis of nine pottery samples from ^{c}Artal, ^{c}En-Hanatziv and Megiddo, all located west of the Jordan River, suggests "the existence of a potter's workshop where products were manufactured for distribution throughout the Beth-shan area" (Hess 1984: 57). However, Hess offers only the impressionistic and untestable explanation that "an inspired craftsman," presumably at ^{c}Artal, "specialized in producing decorative designs that stood out against the background of monotonous decoration characteristic of the period" (1984: 57).

A revision of Hess' interpretation can be offered tentatively on the basis of the data reviewed here. For example, note that six of the seven trickle-painted vessels analyzed in this study were excavated from Ni^{c}aj or the nearby site of Hayyat. Nonetheless, an equally probable alternative explanation suggests that Ni^{c}aj and and ^{c}Artal were foci for a significant element of centralized manufacture of trickle-painted fine ware pottery in Early Bronze IV.

Middle Bronze II A potters at Tell el-Hayyat produced all three vessel types considered here, and distributed jars and well-crafted carinated bowls to other local communities. Group 7 ties Hayyat with Tell el-^{c}Arba^{c}in, and suggests exchange with Pella (see Table 35). The samples analyzed from Pella reflect a variety of production sources, including all three comparative Middle Bronze Age sites and an unidentified, but very distinct, manufacturing site represented by jar sample P603. This sample is plotted far from the other Middle Bronze II A samples in Figure 57, and its source is indicated by a question mark in Figure 59. Tell es-Sa^{c}idiyyeh is indicated as a manufacturing site by Group 8, which includes one jar distributed to Pella.

Groups 9 and 10 include vessels probably manufactured at Pella and Tell el-^{c}Arba^{c}in, respectively. The identification of these manufacturing groups is hindered by their small sizes and the paucity of Middle Bronze II A cooking pot samples. However, the best working hypothesis suggests that Tell el-Hayyat was receiving bowls from Pella, and that ^{c}Arba^{c}in was engaged in exchange with Pella and possibly with Tell es-Sa^{c}idiyyeh, over 25 kilometers to the south.

Analysis of Early Bronze IV neutron activation data describes a network of exchange in which the smallest sites (Hayyat, and perhaps Marar, if Group 6 does not relate to it) are limited partners, primarily producing utilitarian pottery for their own use. These small pottery-consuming sites contrast with larger pottery-producing villages, best exemplified in this study by Tell Abu en-Ni^{c}aj, which may have been a center for the manufacture and distribution of fine ware to an array of neighboring communities.

In Middle Bronze II A this situation is reversed. Tell el-Hayyat, still only a very small village, produced a variety of vessel types for use at home and exchange with other villages (e.g., ^{c}Arba^{c}in) and larger towns (e.g., Pella). The most interesting Middle Bronze II A pottery-consuming site is Pella, where vessels produced at small (Hayyat, ^{c}Arba^{c}in), large (Sa^{c}idiyyeh), and possibly distant sites were deposited.

Concluding Remarks

Archaeological interpretations of Bronze Age society in the southern Levant have long been based on the severe disjunction of Early Bronze IV and Middle Bronze II settlement patterns and material culture (Mazar 1968; Kenyon 1973; Dever 1976; Gerstenblith 1983). This perspective can be augmented in several respects based on insights provided by neutron activation analysis in conjunction with other data from recently published excavations and surveys.

Village communities can be figured into prevailing interpretations of Early Bronze IV "pastoralized" society that emphasize seasonal encampments and cemeteries (e.g., Prag 1974; Dever 1980). Similarly, regional excavation projects suggest the economic importance of villages in the development of complex society, as seen at the fortified towns of Early Bronze Age Arad (Amiran et al. 1980) and Middle Bronze Age Aphek (Kochavi 1975: 37-38).

As Amiran et al. (1980: 29) have argued for Arad, and as the discussion above illustrates, our understanding of Bronze Age urbanism and ruralism requires a perspective from the hinterland. The rural perspective adopted in this study suggests that the rebirth of town life was not marked by an inherent dependence of peripheral villages on urban centers. The Early Bronze IV patterns of exchange inferred above involve hierarchical dependence of small settlements (e.g., Hayyat, possibly Marar) on larger ones. This suggests that Ni^{c}aj was part of a differentiated rural economic network prior to the advent of urbanism. The Middle Bronze II A patterns of exchange suggest the active participation of small settlements (*e.g.*, Hayyat, ʿArbaʿin) in the production of pottery and its distribution to larger urban communities. Therefore, diversified rural pottery production may have persisted into, rather than arisen in, the "urbanized" Middle Bronze Age.

Bronze Age villages were not simply limited function agricultural suppliers. Nor were they necessarily dependent on larger central places for manufactured commodities. Rather, the rural countryside of the southern Levant apparently was marked by rather self-sufficient and important *small* places, like Tell el-Hayyat, that actually contributed these commodities to much more substantial towns like Pella. Thus, Tell el-Hayyat and Tell Abu en-Niʿaj exemplify the importance of diversified villages as the foundation of Bronze Age "rural complexity," which at times included, and at other times lacked, the fortified towns that have attracted inordinate attention.

CHAPTER 8: ALTERNATIVE FORMS OF SOCIAL COMPLEXITY IN SOUTHWESTERN ASIA

This dissertation considers the diverse expressions of early urbanism in ancient southwestern Asia. Archaeological analysis has been focused on the evolution of urban society as the basis for social complexity and the rise of early state level civilizations. This approach holds that urbanism is an adaptive evolutionary, usually indigenous, response to the pressures of population growth and information "stress." Moreover, the appearance and development of cities is an expected, and centrally important, manifestation of the increased social and economic differentiation that marks early complex societies.

From this perspective the development of urbanism is essentially isomorphic with that of early states. This engenders a view of cities as relatively uniform phenomena that are part and parcel of every ancient state-level society. It is not surprising, therefore, that the differing roles of early cities are usually obscured within studies of the rise and collapse of states.

This dissertation argues that early cities represent highly variable phenomena, and that archaeological attention should be directed at diverse expressions of urbanism and ruralism in early complex societies. This emphasis on diversity is merited for several reasons. Urbanism is not necessarily adaptive for all components of a growing society, or for society as a whole. Adams (1978) emphasizes the multitude of adaptive interests in differentiated societies and the variety of responses to stress they engender. Hoselitz (1955) contrasts the profoundly different interests and impacts of "generative" cities that foster local economic development and "parasitic" cities that detract from this growth for larger imperial reasons. Furthermore, archaeologists must entertain the possibility that some, perhaps many, ancient complex societies represent "largely extinct patterns of activity" to be explained in terms other than uniform concepts of urbanism (Clarke 1979:435).

Therefore, this dissertation focuses on the differences, rather than the commonalities, in the ways in which settlement systems in southwestern Asia grew, the differing roles cities played in this growth and the variety of urban-rural relations suggested by regional settlement growth and collapse. Chapters 3 and 4 compare settlement data from Mesopotamia and the southern Levant as they reflect different trajectories of regional growth and collapse, and the diverse roles played by cities in these changes. This comparison demonstrates that the Early and Middle Bronze ages of Palestine, normally interpreted in terms of early urbanism and city-states, actually represent eras of complex society in which growth and differentiation are expressed primarily in proliferations of rural villages. This "rural complexity" is intriguing because it is not simply a scaled-down reiteration of early urbanism seen elsewhere, particularly in Mesopotamia. It represents a different manifestation of complex society, one in which cities do not play a central role as catalysts of growth and change.

In order to compare the settlement records of Mesopotamia and Bronze Age Palestine, Chapter 2 discusses how we may define "urbanism" and "urbanization" on the basis of archaeological survey data. Urbanism commonly is misidentified through reference to settlement hierarchies or arbitrary size thresholds. The number of hierarchical tiers in a settlement system commonly is adopted as the prime index of social complexity. For example, three or more decision-making tiers in a settlement hierarchy commonly are assumed to denote ancient "states" (H. T. Wright and Johnson 1975:267; H. T. Wright 1977:220-222). This relativistic approach fails to define urbanism because it neglects the structural implications of differences in scale between various settlement systems. Urban size thresholds proposed in previous literature also are rejected because they do not specify what makes larger settlements "urban." In addition, these thresholds are determined arbitrarily or through indiscriminant use of ethnographic data.

As an alternative, "urbanism" is defined here by returning to the basic characteristics of growth and differentiation. It is argued that ancient cities can be identified as those communities whose populations exceeded their means of independent agricultural subsistence. This definition necessarily entails the social and economic differentiation emphasized by Childe (1950) and Weber (1958), based on the interdependence of "urban" and "rural" communities. "Urbanization" is defined as any process of change in which the urban proportion of a regional population increases.

For the purposes of identifying ancient urban settlements, subsistence agriculture is assumed to have occurred within a "sustaining area" surrounding any given archaeological site. The population of an ancient site can be estimated using population densities of between 100 and 250 people per hectare reported in ethnographic literature on modern farming villages in southwestern Asia. Ancient productivity of wheat and barley is estimated from ethnographic data and studies of Mesopotamian agricultural texts. These data suggest mean subsistence requirements of 1.5 hectares per person in regions of rainfall farming and 0.5 hectares per person in regions of irrigated farming. As an idealized construct for this study, sustaining areas are bounded at a radius of three or four kilometers, based on Chisholm's (1968) influential treatment of "traditional" agrarian communities in Europe and Asia.

Based on these estimates it is determined that, in the irrigable lowlands of Mesopotamia, sites 100 hectares and larger were urban, and sites 10 hectares and smaller were rural. In ancient Palestine, a region predominated by rainfall agriculture, sites 35 hectares and larger were urban, and sites smaller than 4 hectares were rural.

These urban and rural size categories are used to compare the processes in which urbanism and ruralism developed in ancient Mesopotamia and the southern Levant. Chapter 3 discusses data from seven major Mesopotamian surveys. These data describe a mosaic of settlement trajectories in the "heartland of cities". Prototypical examples of Mesopotamian urbanization were centered on the metropoli of ancient Uruk in the fourth and third millennia B.C., and Baghdad and Samarra in the Seleucid through Early Islamic periods. The growth process apparent in both cases involved "deruralization" (Hassan

1978:86-87) in which these cities absorbed populations from their surrounding hinterlands, resulting in massive demographic agglomerations.

In the periods following Uruk's Early Dynastic II-III urban maximum, regional population declined and then rebounded. However, this renewed growth around Uruk involved the encouragement of rural settlement by several competitive cities. This form of growth, "ruralization," does not stand in simple opposition to urbanization. Both processes are based on growth and the active restructuring of the countryside by the cities of Mesopotamia.

The settlement record of the Diyala between the ᶜUbaid and Middle Babylonian periods reflects population growth and decline in a region marked by hierarchically differentiated towns and villages, but no cities. This development and collapse of town life can be characterized as a form of "rural complexity," that stands as an alternative expression of differentiated society.

Thus, the early complex societies of Mesopotamia were marked by the periodic development and disappearance of cities. However, the archaeological record of Mesopotamia consistently incorporated some element of urbanism as the most significant catalyst of change in this region.

The archaeological record of Bronze Age settlement in the southern Levant also is interpreted most commonly in terms of early urbanism. The modestly-sized "cities" of ancient Canaan are perceived uncritically as scaled-down versions of those in Syria and Mesopotamia. However, analysis of regional settlement patterns suggests that Bronze

Age complex society can be most aptly interpreted in terms of rural, rather than urban, complexity.

The settlements of Early Bronze I-III included shows no unequivocal examples of urban-sized communities, as defined here. Town life dwindled, and largely collapsed, during the late third millennium B.C. Subsequently, contemporaneous with the rise of Egypt's Middle Kingdom, cities appeared along the coast of Palestine and in the Huleh Basin. Once it did appear, early urbanism was a distinctly peripheral phenomenon. More importantly, while the Early and Middle Bronze ages were marked by regional population growth, that growth was expressed primarily by proliferations of rural villages. These episodes of growth also were most pronounced in exactly those areas that lacked cities, the Jordan Valley and the Central Hills of Palestine.

Thus, in striking contrast to Mesopotamia, the impetus for change and development did not come from cities, but from a growing network of differentiated towns and villages. These data suggest that Canaanite society is most intriguing precisely because it does not simply recapitulate, on a reduced scale, the urbanism of other centers of early civilization, like Mesopotamia. This dissertation appeals for a reconsideration of the rural nature of complex society in the Bronze Age of the southern Levant. Chapters 5, 6 and 7 present a case study of ruralism in the Jordan Valley that illustrates how an alternative concept of rural complexity may be appropriate.

The University of Arizona Tell el-Hayyat Project was designed to investigate the impact of renewed town life in the Middle Bronze Age on rural communities. Excavated evidence from Tell el-Hayyat and Tell Abu en-Ni^{c}aj in the Jordan Valley was expected to reflect changes in subsistence from the pervasive pastoralism hypothesized for Early Bronze IV to renewed sedentary agriculture in Middle Bronze II. However, Tell Abu en-Ni^{c}aj emerged as a Early Bronze IV farming village, and part of growing evidence for substantial sedentism at that time.

Because of its extremely small size, Tell el-Hayyat was expected to exemplify an undifferentiated Middle Bronze II village entirely dedicated to agriculture. Instead, a remarkable stratified series of four Canaanite temples was revealed at a site that never amounted to more than a very modest hamlet. This highly unexpected evidence documents central social institutions, normally seen as urban, in distinctly rural settings. Thus, institutional authority was expressed at the most basic level of village settlement.

Further unexpected evidence of diverse social and economic activities was found though the excavation of a pottery kiln and abundant manufacturing debris at Tell el-Hayyat. These data formed the basis for a neutron activation analysis of village pottery production and exchange during the Bronze Age in the Jordan Valley.

A multi-stage experiment reported in Chapter 6 considers the heterogeneous mineralogy of ceramic evidence, and how trace element concentration data most indicative of clays, clay sources and manufacturing sites can be derived using neutron activation. It is argued that non-clay inclusions (especially temper) introduce significant "noise" in the determination of clay trace element signatures. Fine mesh sieving is proposed as a simple means of reducing this noise so that neutron activation analysis produces data most pertinent to the clays, not the temper, in ceramics.

A variety of traditional and sieving techniques are used to prepare a selection of clay and pottery samples. Controlled comparisons of trace element data for these samples demonstrates the importance of judicious selection of elements and preparation methods appropriate for the heterogeneous nature of ceramics. Several elements are shown to be susceptible to leaching processes likely to affect archaeological pottery. Tempering is highlighted as a significant source of trace element noise, and methanol-sieving is demonstrated as an effective remedy for this problem.

In Chapter 7 these revised methods for archaeological ceramics are applied to the manufacturing evidence from Tell el-Hayyat, and pottery from Hayyat, Tell Abu en-Ni^caj and other Early Bronze IV and Middle Bronze II A sites in the Jordan Valley. Neutron activation analysis was expected to reveal site-by-site autonomous production of coarse and fine wares during the absence of towns in Early Bronze IV. Evidence from Middle Bronze II A was expected to show more centralized production of fine wares as a consequence of the redevelopment of towns after 2000 B.C.

Once again, the data from Hayyat, Ni^caj and the Jordan Valley are provocative because they are counterintuitive. On the basis of cluster and discriminant analyses of neutron activation data, the village of Tell Abu en-Ni^caj can be interpreted as a central producer of trickle-painted fine ware during the absence of town life in Early Bronze IV.

Tell el-Hayyat at that time was largely a pottery-consuming, perhaps limited function, site. However, with the rejuvenation of towns in Middle Bronze II A, Hayyat produced fine ware carinated bowls for exchange with other villages and larger towns.

These data do not describe the site-to-site economic redundancy anticipated for Early Bronze IV, nor the hierarchical relations of town producers and village consumers expected in the Middle Bronze Age. Instead, rural complexity is indicated by differentiated networks of production and exchange of commodities involving even the smallest of rural sites.

This dissertation has reconsidered the archaeological concept of urbanism, as often applied to Mesopotamia, and found it inadequate for the interpretation of Bronze Age Palestine. As an alternative, we may emphasize the rural nature of complex society in the southern Levant as a means of highlighting the characteristics that make this record intriguing and insightful. The discussions above present this heterodox perspective of rural complexity as it is manifested on three levels: (1) in the informative juxtaposition of "urban" temples in rural communities; (2) in the complex local production and exchange systems of the rural Jordan Valley; and (3) in the demonstrably rural focus of regional growth and development in Bronze Age Palestine. Bearing in mind these perspectives, we may rebut Spengler's axiom that "Weltgeschichte ist Stadtgeschichte" by emphasizing that the cities of the southern Levant were rare peripheral aspects of early complex society in a region more aptly characterized as a "heartland of villages."

APPENDIX 1: SETTLEMENT DATA FROM MESOPOTAMIA

Warka and Nippur/Adab Surveys (6250 km^2)

(based on Adams 1981: figs. 15, 19, 25, 37; tables 3, 4, 7, 12-15, 17-19, 21; pp. 253-294)

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares). Values in parentheses are estimates by the author.
7. Name of largest site.
8. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

9. Constituted by sites larger than 10 hectares.
10. Constituted by sites larger than 20 hectares.
11. Constituted by sites larger than 40 hectares.
12. Constituted by sites 100 hectares and larger.

Site frequency:

13. Constituted by sites 5 hectares and smaller.
14. Constituted by sites 10 hectares and smaller.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
E.-M. Uruk	174	2.8	535.1	8.6	3.1	70	Uruk	2.7	47	40	30	0	86	95
L. Uruk	131	2.1	583.1	9.3	4.5	100	Uruk	3.7	50	39	26	17	81	92
ED I	111	1.8	1061.5	17.0	9.6	400	Uruk	6.0	81	72	63	38	72	85
ED II-III	63	1.0	1659	26.5	26.3	200	Umma	23.5	90	85	78	53	41	67
Akkadian	90	1.4	1416	22.7	15.7	(100)	-	14.8	82	72	64	39	48	76
Ur III-Larsa	239	3.8	2725	43.6	11.4	(200)	-	10.6	75	66	55	44	60	84
Old Bab.	178	2.8	1791	28.7	10.1	(200)	-	9.0	70	62	50	42	61	86
Kassite	237	3.8	1308	20.9	5.5	(100)	-	5.1	43	35	30	25	70	95
M. Bab.	134	2.1	616	9.9	4.6	(100)	-	3.9	36	31	16	16	75	96
Neo. Bab./Ach.	257	4.1	1769	28.3	6.9	(100)	-	6.5	54	38	28	17	61	88
Sel./Parth.	415	6.6	3201	51.2	7.7	(250)	-	7.2	59	42	27	16	64	87
Sassanian	597	9.6	3792	60.7	6.4	230	-	6.0	61	45	30	10	63	87
E. Islamic	358	5.7	1985	31.8	5.5	(100)	-	5.3	47	31	20	0	69	91
M. Islamic	74	1.2	288	4.6	3.9	(30)	-	3.5	32	11	0	0	77	93
L. Islamic	96	1.5	380	6.1	4.0	(30)	-	3.7	28	8	0	0	74	94

Warka Survey (2800 km^2)

Nippur/Adab Survey (3450 km^2)

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares).
7. Name of largest site.
8. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

9. Constituted by sites larger than 10 hectares.
10. Constituted by sites larger than 20 hectares.
11. Constituted by sites larger than 40 hectares.
12. Constituted by sites 100 hectares and larger.

Site frequency:

13. Constituted by sites 5 hectares and smaller.
14. Constituted by sites 10 hectares and smaller.

Warka Survey

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
E.- M. Uruk	44	1.6	173.1	6.2	3.9	70	Uruk	2.4	46	40	40	0	80	95
L. Uruk	95	3.4	382.5	13.7	4.0	100	Uruk	3.0	39	32	26	26	82	96
ED I	76	2.7	848.5	30.3	11.2	400	Uruk	6.0	83	73	62	47	70	83

Nippur-Adab Survey

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
E.- M. Uruk	130	3.7	362.0	10.5	2.8	50	al-Hayyad	2.4	47	39	25	0	88	95
L. Uruk	37	1.1	200.6	5.8	5.4	50	al-Hayyad	4.2	70	50	25	0	78	84
ED I	35	1.0	213.0	6.2	6.1	50	Nippur, Adab	4.8	73	65	65	0	77	89

Susiana Survey (3500 km^2)

(based on Johnson 1973: figs. 5, 10-14; tables 17-18)

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares).
7. Name of largest site.
8. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

9. Constituted by sites larger than 10 hectares.
10. Constituted by sites larger than 20 hectares.
11. Constituted by sites larger than 40 hectares.
12. Constituted by sites 100 hectares and larger.

Site frequency:

13. Constituted by sites 5 hectares and smaller.
14. Constituted by sites 10 hectares and smaller.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Term. Susa A	18	0.5	29.7	0.8	1.7	5.2	Abu Fanduweh	1.4	0	0	0	0	89	100
E. Uruk	49	1.4	96.4	2.8	2.0	12.0	Susa	1.8	12	0	0	0	92	98
M. Uruk	55	1.6	118.5	3.4	2.2	25.0	Susa	1.7	21	21	0	0	91	98
L. Uruk	14	0.4	52.8	1.5	3.8	18.0	Choga Mish	2.7	51	0	0	0	79	86

Ur-Eridu Survey (1010km^2)

(based on H. T. Wright 1981a: figs. 1, 17-25; pp. 338-345)

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares).
7. Name of largest site.
8. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

9. Constituted by sites larger than 10 hectares.
10. Constituted by sites larger than 20 hectares.
11. Constituted by sites larger than 40 hectares.
12. Constituted by sites 100 hectares and larger.

Site frequency:

13. Constituted by sites 5 hectares and smaller.
14. Constituted by sites 10 hectares and smaller.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
L. 'Ubaid	12	1.2	45.5	4.5	3.8	12	Eridu	3.0	26	0	0	0	83	92
E. Uruk	2	0.2	50.0	5.0	25.0	40	Eridu	10.0	80	80	0	0	0	50
L. Uruk/J. Nasr.	11	1.1	62.4	6.2	5.7	10	Ur	5.2	44	0	0	0	64	82
ED I	10	1.0	39.0	3.9	3.9	21	Ur	2.0	54	54	0	0	80	90
ED II-III	3	0.3	59.0	5.8	19.7	50	Ur	3.0	85	85	85	0	67	96
Akkadian	5	0.5	59.9	5.9	12.0	50	Ur	2.5	83	83	83	0	60	80
Ur III/E. Larsa	23	2.3	109.5	10.8	4.8	50	Ur	2.7	46	46	46	0	87	96
L. Larsa/Old Bab.	57	5.6	237.0	23.5	4.2	60	Ur	3.2	44	44	44	0	84	96
Kassite	37	3.7	174.0	17.2	4.7	50	Ur	3.4	46	29	29	0	81	92
Post-Kassite	28	2.8	139.0	13.8	5.0	50	Ur	3.3	49	36	36	0	79	93
Neo. Bab./Ach.	34	3.4	160.0	15.8	4.7	40	Ur	3.6	39	39	0	0	79	94

Akkad Survey (10,250 km^2)

(based on Adams 1972b: pp. 184-207; maps 1A-F, 2-9)

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares).
7. Name of largest site.
8. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

9. Constituted by sites larger than 10 hectares.
10. Constituted by sites larger than 20 hectares.
11. Constituted by sites larger than 40 hectares.
12. Constituted by sites 100 hectares and larger.

Site frequency:

13. Constituted by sites 4 hectares and smaller.
14. Constituted by sites 10 hectares and smaller.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
'Ubaid	11	0.1	40	0.4	3.6	10	-	3.0	0	0	0	0	82	100
Uruk/J. Nasr.	43	0.4	158	1.5	3.7	20	-	3.3	30	0	0	0	79	93
ED	29	0.3	259	2.5	8.9	100	Kish	5.7	64	39	39	39	69	86
Akkadian	21	0.2	230	2.2	11.0	70	Kish	8.0	86	30	30	0	52	57
UrIII/Isin-Larsa	27	0.3	439	4.3	16.3	64	-	14.4	91	55	44	0	52	56
Old Bab./Kassite	68	0.7	1135	11.1	16.7	500	Dur Kurigalzu	9.5	88	76	71	44	71	78
Neo. Bab.	69	0.7	1040	10.1	15.1	500	Babylon	7.9	81	68	59	48	45	78
Ach. (-Sel.)	64	0.6	828	8.1	12.9	300	Babylon	8.4	75	55	51	36	48	78
(Sel.-) Parth.	100	1.0	903	8.8	9.0	80	-	8.3	71	49	30	0	58	78
Sassanian	65	0.6	913	8.9	14.1	100	-	12.7	84	74	48	11	54	68
Islamic	90	0.9	736	7.2	8.2	75	-	7.4	69	46	41	0	66	82

Kish Survey (187.5 km^2)

(based on Gibson 1972: figs. 5-20, 25-33; Table 3; Appendix 1)

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares).
7. Name of largest site.
8. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

9. Constituted by sites larger than 10 hectares.
10. Constituted by sites larger than 20 hectares.
11. Constituted by sites larger than 40 hectares.
12. Constituted by sites 100 hectares and larger.

Site frequency:

13. Constituted by sites 4 hectares and smaller.
14. Constituted by sites 10 hectares and smaller.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
'Ubaid	3	1.6	14	7.5	4.7	10	-	2.0	0	0	0	0	67	100
Protoliterate	8	4.3	48	25.6	6.0	10	-	5.4	0	0	0	0	50	100
ED I	10	5.3	136	72.5	13.6	74	Kish	6.9	64	54	54	0	40	80
ED III	12	6.4	187	99.7	15.6	100	Kish	7.9	71	53	53	53	33	75
Akkadian	11	5.9	164	87.5	14.9	70	Kish	9.4	84	43	43	0	36	55
Ur III/Isin-Larsa	11	5.9	215	114.7	19.6	70	Kish	14.5	90	83	60	0	45	55
Old Bab.	13	6.9	262	139.7	20.2	66	Kish	16.3	85	80	69	0	38	62
Kassite	19	10.1	308	164.3	18.5	61	Kish	13.7	77	77	77	0	42	79
Neo. Bab.	21	11.2	707	377.1	33.7	500	Babylon	10.4	91	91	87	71	43	81
Ach.-Sel.	44	23.5	662.4	353.3	15.1	300	Babylon	8.4	78	73	63	45	48	84
Parthian	36	19.2	422.3	225.2	11.7	88	Kish	9.6	76	62	34	0	44	72
Sassanian	56	29.9	522.4	278.6	9.3	41	-	8.8	70	52	18	0	46	75
E. Islamic	61	32.5	393.1	209.7	6.4	50	-	5.7	51	44	25	0	44	89
Samarran	32	17.1	225.4	120.2	7.0	50	-	5.7	52	44	22	0	52	88
L. Abbasid	56	29.9	365.2	194.8	6.5	50	-	5.7	48	35	14	0	48	88
Ilkhanid/Post-Ilkhanid	33	17.6	234.2	124.9	7.1	50	-	5.8	48	32	21	0	48	88

Diyala Survey (8000 km^2)

(based on Adams 1965: tables 10-15, 20, 23, 24; Appendix C; 1981: fig. 10; Table 16; p. 182)

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares). Values in parentheses are estimates by the author.
7. Name of largest site.
8. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

9. Constituted by sites larger than 10 hectares.
10. Constituted by sites larger than 20 hectares.
11. Constituted by sites larger than 40 hectares.
12. Constituted by sites 100 hectares and larger.

Site frequency:

13. Constituted by sites smaller than 4 hectares.
14. Constituted by sites 10 hectares and smaller.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
'Ubaid	8	0.1	62.3	0.8	7.8	(15)	-	6.8	85	0	0	0	38	50
Uruk	24	0.3	153.6	1.9	6.4	(15)	-	6.0	71	(0)	0	0	54	71
ED	96	1.2	384	4.8	4.0	(20)	-	3.8	47	(0)	0	0	70	90
Akkadian	97	1.2	403	5.0	4.2	(25)	-	3.9	42	(6)	0	0	67	92
Ur III/Isin-Larsa	129	1.6	462	5.8	3.6	(25)	-	3.4	38	(5)	0	0	71	94
Old Bab.	152	1.9	380	4.8	2.5	(20)	-	2.4	26	(0)	0	0	78	96
Kassite	104	1.3	230	2.9	2.2	(25)	-	2.0	19	(11)	0	0	83	98
M. Bab.	34	0.4	53	0.7	1.6	10	-	1.3	0	0	0	0	94	100
Neo. Bab./Ach.	81	1.0	197	2.5	2.4	10	-	2.3	0	0	0	0	91	100
Sel./Parth.	205	2.6	1663	20.8	8.1	100	Ctesiphon	7.7	67	54	48	26	69	87
Sassanian	294	3.7	3076	38.5	10.5	540	Ctesiphon	8.7	73	58	52	47	59	83
E. Isl./Sass.	331	4.1	15,398	192.5	46.5	6800	Samarra	6.7	96	93	91	90	71	89
						6400	Baghdad							
Abbasid	159	2.0	6337	79.2	39.9	5400	Baghdad	5.9	94	90	89	89	64	87
L. Isl. (Ilkhanid)	101	1.3	590.5	7.4	5.8	200	Baghdad	3.9	64	39	34	34	77	91

APPENDIX 2: SETTLEMENT DATA FROM PALESTINE

Bronze Age Settlement Data from Palestine (14,000 km^2)

(based on Broshi and Gophna 1984; 1986; Gonen 1984; Joffe 1985; Mabry 1984).

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares). Values in parentheses are estimates by the author.
7. Name of largest site.
8. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

9. Constituted by sites larger than 7 hectares.
10. Constituted by sites 8 hectares and larger.
11. Constituted by sites larger than 10 hectares.
12. Constituted by sites larger than 20 hectares.
13. Constituted by sites 35 hectares and larger.

Site frequency:

14. Constituted by sites smaller than 4 hectares.
15. Constituted by sites smaller than 5 hectares.
16. Constituted by sites 7 hectares and smaller.
17. Constituted by sites 1 hectare and smaller.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
EB I (Joffe)	60	0.4	226.0	1.6	3.8	(30)	-	3.3	-	51	-	n.a.	0	65	-	-	45
EB II (Joffe)	183	1.3	553.0	4.0	3.0	(30)	-	2.9	-	52	-	n.a.	0	79	-	-	55
early EB III (B&G)	260	1.9	602.6	4.3	2.3	30	Kabri	2.2	-	51	47	13	0	65	82	-	49
MB IIA (B&G)	130	0.9	555.1	4.0	4.3	80	Hazor	3.7	-	-	70	51	42	-	82	87	-
MB IIB/C (B&G)	337	2.4	660.3	4.7	2.0	80	Hazor	1.7	77	-	58	35	35	-	91	94	-
MB IIA (Mabry)	78	0.6	451.5	3.2	5.8	80	Hazor	4.8	66	-	-	66	60	-	-	79	58
MB IIB/C (Mabry)	198	1.4	655.0	4.7	3.3	80	Hazor	2.9	84	-	-	60	46	-	-	89	67
MB II (Gonen)	54 (272)	0.4 (1.9)	513.0	3.7	9.5	84	Hazor	8.1	74	-	77	48	38	-	70	-	20
LB (Gonen)	67 (101)	0.5 (0.7)	298.5	2.1	4.5	84	Hazor	3.3	-	-	45	28	28	-	84	-	42
16th Century B.C.	24	0.2	183.5	1.3	7.6	84	Hazor	4.3	-	-	65	46	46	-	75	-	29
15th Century B.C.	28	0.2	181.5	1.3	6.5	84	Hazor	3.6	-	-	66	46	46	-	82	-	39
14th Century B.C.	48	0.3	245.5	1.8	5.1	84	Hazor	3.4	-	-	48	34	34	-	83	-	35
13th Century B.C.	56	0.4	249.5	1.8	4.5	84	Hazor	3.0	-	-	48	34	34	-	86	-	45

Bronze Age Settlement Data from Peripheral and Central Regions of Palestine (14,000 km^2)

(based on Broshi and Gophna 1984; 1986)

1. Number of sites occupied.
2. Number of sites occupied per 100 km^2.
3. Aggregate area of sites occupied (in hectares).
4. Aggregate site area per 100 km^2 (in hectares).
5. Mean site area (in hectares).
6. Area of largest site (in hectares).
7. "Adjusted" mean site area (in hectares).

Percentage of aggregate site area:

8. Constituted by sites larger than 10 hectares.
9. Constituted by sites larger than 20 hectares.
10. Constituted by sites 35 hectares and larger.

Site frequency:

11. Constituted by sites smaller than 5 hectares.

	1	2	3	4	5	6	7	8	9	10	11
EB II-III C. Plain/H. Basin	61	1.9	189.1	5.9	3.1	30	2.7	45	29	0	82
EB II-III C. Hills/J. Valley	199	1.8	413.5	3.8	2.1	25	2.0	27	6	0	88
MB IIA C. Plain/H. Basin	62	1.9	395.6	12.3	6.4	80	5.2	81	65	59	77
MB IIA C. Hills/J. Valley	68	0.6	159.5	1.5	2.3	25	2.0	23	16	0	87
MB II B/C C. Plain/H. Basin	79	2.5	404.4	12.6	5.1	80	4.2	73	58	58	77
MB IIB/C C. Hills/J. Valley	258	2.4	255.9	2.4	1.0	15	0.9	15	0	0	95

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