

Uruk to Ubaid periods. Ubaid period at this site is well-attested, and 6 Ubaidian levels are clarified, which are with well-preserved structures in each level. Ubaid occupation has 6 meters thick, and more than 15 kilns for pottery manufacture are unearthed. Many potter's tools are found beside plenty of intact painted potteries, which exhibit that Tell al-Abr was a center of the production of the Western Ubaid pottery. These finds are now displayed in the prehistoric section of Aleppo Museum. First volume of the preliminary report on Tell al-Abr is in press<sup>2</sup>.

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<sup>1</sup>See AAAS XXXVIII (1989), pp. 15-40 : Hammade, H. « Syrian Archaeological Expedition in Tishreen Dam Basin » (in Arabic) ; AAAS XXXIX (1991) : Hammade, H. and Koike, Y. « Syrian Archaeological Expedition in Teshreen Dam Basin » (forthcoming).

<sup>2</sup>Damaszener Mitteilungen vol. VI (1992) : Hammade, H. and Koike, Y. « Two Season's excavations at Tell al-Abr, Tishreen Dam Basin » (in press).

## Recherches en cours

### Tell Leilan « sila bowls » and the Akkadian Reorganization of Subarian Agricultural Production

[N.D.L.R. : A la demande expresse de H. Weiss, nous publions cet article qui est plus long qu'à l'habitude. Nous rappelons cependant que les contributions pour *Orient-Express* ne doivent pas dépasser deux pages (hors illustrations)]

#### *Akkadian imperialism on the Habur Plains*

In the third of four stages of third millennium Subarian development, the Leilan IIB period (2460-2280 BC radiocarbon calibrated range, 1 s.d., n=10), the conflict between Sumer and Subir, begun at least as early as the reign of Eanatum, was resolved with the installation of Akkadian political and economic hegemony over the northern region (Weiss 1990b ; Weiss et al., n.d.). Thus ended ca. 300 years (Leilan IIId-IIa) of autonomous regional urban growth among the three equidistant Habur Plains centers : Brak (Nawar) to the south, Mozan (Urkish) to the north, and Leilan (Shekhna) to the east. Although documented in more detail than the preceding late ED II/III southern Mesopotamian expansion to the Habur Plains (Weiss 1990a, 1991a), the forces which generated the responsive Akkadian expansion, as well as those which ultimately determined its form and its success, remain unknown.

Tell Brak data (Oates and Oates 1989 ; 1992 ; Loretz 1969 : no. 69 ; Finkel 1985 : no. 5) outline the sukkal-headed extractive organization imposed upon the urbanized Habur Plains landscape from the Brak fortress. This outline agrees in many ways with the picture of Akkadian hegemony observed epigraphically at other loci, such as Susa and Gasur, which served as bases for Akkadian imperialism (Foster 1982a, 1987b, n.d.). The imposition of Akkadian hegemony upon the Habur Plains raises, however, specific questions about the causes, nature, and effects of Akkadian imperialism, and its implementation within a multi-city region. For instance, how was Akkadian control of Subir effected, and towards what ends was it directed? The method of generating, as opposed to (ac)counting, resources to be diverted to southern Mesopotamia for Akkadian use or exchange remains to be defined : Akkadian excises could have been extracted and diverted from indigenous, Akkadian-intensified, and/or Akkadian-extended state agro-production.

#### *Akkadian intensification of Tell Leilan agro-production*

Five possible features of the Akkadian reorganization of Subarian agro-production have been identified at and around Tell Leilan during Leilan IIB : regional population centralization, city wall construction, channelization, ration-fed agricultural labor, and Akkadian mensuration by means of « sila bowls » (Weiss 1991b ; Weiss, et al. n.d.). In the Leilan Lower Town South, terminal Leilan IIB phases 4 and 5, standardized bowls, bowl sherds and stacked kiln wasters of these bowls, occur in considerable quantity. Similar bowls, sherds and wasters occur in all other Leilan IIB contexts, except the Leilan

Acropolis where, however, the excavation sample for this period is quite limited. We find that the standardized bowls have a tri-modal distribution, and hypothesize « sila bowl » manufacture for « Akkadian standard » labor rationing (Finkel 1985 : no. 5) as part of the Akkadian reorganization of Subarian agro-production.

#### *Ceramic Data Analyses*

Two groups of ceramics were analyzed from the Tell Leilan period IIB assemblages in order to assess occurrence and significance of standardized ceramic production as a function of state imposed standard capacity measures : 1) fused, stacked kiln wasters (SKWs) and 2) rim, base and full-profile « sila bowl » sherds that appear to be of the same form, texture and material as the SKWs. Metric assessment of the whole SKWs was performed first ; volumetric capacity was compared to rim and base diameter measurements. Next the fragmented assemblage was examined in light of the correlations found between SKW capacity, rim and base diameter data.

#### *Description of Assemblage : Identification of Leilan Sila Vessels*

The stacked kiln wasters are open, everted, simple-rimmed, straight-sided bowls stacked one inside another for firing (see Figure 1 a-c, and Blackman et al. n.d.). « Sila bowl » sherds were selected on the basis of their color, texture and form. They are green, dark green, and occasionally green-buff, with no visible temper (Munsell value range : 5Y 8/1-8/4, 7/2-7/4, and 6/2-6/4). Most appeared to have been very well sintered but do not exhibit the melting, warping or bubbles indicative of wasters. Many contained calcium carbonate inclusions (« lime pops »). All were obviously wheel manufactured. The « sila bowl » base type is flat, string-cut and unsmoothed ; it usually shows obvious wheel marks where it was cut off the hump. Although these sherd types are noted within a significant range of color and textures (orange, red, buff, and gray, as well as the greens), this study was restricted to sherds most closely resembling the waster stacks in color, texture, and form.

#### *SKWs*

Twenty-seven separate fused kiln waster stacks (SKWs) have been excavated from various loci at Leilan. Thirteen provide height, rim and base diameter measurements, and hence volumetric capacity. SKWs range from two to 69 vessels, all broken in antiquity, and none yet recovered inside a kiln or in any other original context. Altogether, the SKWs assessed in this study contained a total of 338 vessels. SKW capacity is essentially trimodal (see Figure 2), with 56.8% of the assemblage yielding capacities less than 800 cc, 37.6% between 800 and 1200 cc, and 5.6% of capacities over 1200 cc. The histograms in Figure 2 display these data as sample density plots ; though this display lumps these data into groups, we emphasize that these are continuous data. Smoothing has been used to enhance data presentation. The continuous plot superimposed on the histogram was derived through Systat (Sygraph) using the nonparametric Epanechnikov density estimator (Silverman 1986 ; Wilkinson 1990 : 185) which « smooths » the histogram data and reveals the modal nature of this data set.

Base and rim diameter measurements from the SKWs pattern in bimodal rather than trimodal distributions. Were more of the large (ca. 1.5 liter) SKWs found, then a third mode of rim and base diameter measurements may become evident ; in the data presented here, the large (ca. 1.5 liter) SKW measurements are indistinguishable from the 1-liter SKWs.

Figure 3 displays a bubble plot of SKW capacity against a two-dimensional plot of SKW base and rim diameters. The size of the circle (or « bubble ») is directly proportional to the capacity of the SKW that it represents. Thus, figure 3 demonstrates that vessel capacity is directly related to SKW rim diameter ; base diameter, on the other hand, is a less sensitive indicator of vessel capacity. Rim diameter is probably the most important variable with which to measure « sila bowl » capacity in a highly fragmented assemblage.

The SKW data were analyzed in three vessel capacity groups to ascertain capacity group rim and base diameter averages (Table 1).

Since rim and base sherds are considered « diagnostics » in Near Eastern archaeology, and thus generally saved and studied, it is important to derive statistical descriptors that may correlate fragmented remains with these whole vessels found at Leilan. As can be noted from table 1, the median rim radius of 8.17 (rim diameter = 16.34 cm) and base radius 3.857 (base diameter = 7.7 cm) are correlated to vessels of approximately 1 liter capacity. Interestingly, these figures correspond to the exceptionally strong central

tendencies of the fragmented assemblage discussed below.

**Table 1 : SKW Data**

Capacity < 800 cc, N=192				Capacity 800 to 1200 cc, N=127			
	Base radius	Rim Radius	Capacity		Base radius	Rim Radius	Capacity
min	0.977	5.295	32cc	min	3.69	7.767	806
max	3.6	5.713	680	max	4.5	9.26	1165
mean	3.017	5.58	270	mean	4.0	8.259	1029
median	3.6	5.65	236	median	3.857	8.17	1059

Capacity > 1200 cc, N=19			
	Base radius	Rim radius	Capacity
median	4.15	9.07	1522

#### *Sherd Data*

A total of 557 « sila bowl »-type sherds were selected for analysis from secure Leilan IIb contexts (see Table 2). Of identified « sila bowl » sherds, 407 were rim sherds, 150 base sherds, and a small number were reconstructed profiles (containing both base and rims, N=19). « Sila bowl » sherd rim diameters essentially follow a normal distribution except for an extremely large and unexpected (in a normal population) quantity of rims with diameter of 16 cm. (Fig. 4). There is a similar « over abundance » of bases of 8 cm. (Fig. 5). Neither the rim nor the base diameter data appear strongly bimodal.

The extremely strong central tendencies of both Figures 4 and 5 are quantified by kurtosis (« peakedness ») statistics of 3.4 and 4.1, respectively. In addition, to test whether or not these populations conformed to the Normal distribution, the Lilliefors test was performed. This nonparametric test, a variant of the Kolmogorov-Smirnov (K-S) statistic, is a « goodness-of-fit » measure which tests normality without assuming a particular mean or standard deviation for the distribution. Additionally, K-S statistics are specifically designed for random samples from continuous populations; thus, this is a more appropriate goodness-of-fit test than the Chi-square test which is specifically designed for use with categorical data (Gibbons 1985 : 86-87). When either rim or base diameter measures were subjected to a Lilliefors test, the null hypothesis that the population was normally distributed was soundly rejected (p value was essentially zero). The original impression that the means of both the rim and base diameters are over-represented is thus statistically supported. The fragmented vessels most frequently represented in this assemblage probably correspond to vessels of approximately 1 liter capacity.

**Table 2 : Sherd Sample Examined in this Study**

Leilan Provenience	N Sherds examined	N Sila Sherds	% Sila
Op. 2	1693	29	1.7%
Op. 3	459	23	5.0%
Op. 4	144 (incomplete)	70	n.a.
Op. 5	7435	423	5.7%
Op. 6	81	1	1.2%
57F02	583	11	1.9%
TOTALS	10395	557	5.4%

#### *Discussion : Comparisons of data sets*

From analogy to the SKW measurements, it would appear that the majority of the « sila bowl » sherds were from vessels of the « medium » capacity (ca. 1 liter). Though it is surprising that the sherd data do not exhibit the same modal distributions as the SKW data, explanations are available. First, the SKW data are somewhat skewed because the stacks of smaller SKWs are longer than the others – they contain more vessels. More of these vessels may have been stacked in a single pile inside kilns because of their smaller size. In addition, long stacks of the larger SKWs may have been more likely to break in antiquity during transport because of their weight. Second, smaller vessels usually do not produce as many sherds – their rim diameters being smaller – so fewer rim sherds of the vessels enter the archaeological record.

The variance within modal values, e.g., 1 liter, also requires explanation. Rim diameters of rim sherds are derived from use of a rim diameter chart; interpretation of values is therefore observer-dependent, while a rim radius uncertainty within 1 centimeter can generate volume values ranging from 0.8

to 1.2 liters for a « typical » 1 liter Leilan « sila bowl » Nevertheless, Ur III 1-sila reductions of « head » heaped over the « nose » (storage vessel rim) suggest 1-sila vessels of little variance (Maekawa 1992 : 204-219) and reinforce the apparent disconformity between real and epigraphic capacity values.

#### *State potters*

State-sponsored, ration-dependent potters produced, presumably, the standardized capacity vessels for measurement, distribution, and receipt of state rations. The standardized capacities appear with Uruk IV and III proto-cuneiform (GAR, SILA ; Damerow and Englund 1987 ; Damerow and Englund 1989 : 24,25, 60 fn. 164 ; Green 1987 ; Powell 1990 : 492 ; Salonen 1966 : 293-296), as well as on the Warka vase (Amiet 1953) ; their state level definition and use preceded the economic expansion which determined the elaboration of simpler notation into writing. The epigraphic record for standard capacity vessels (Powell 1990 : 492-508) parallels an outline of the third-second millennium cuneiform record for ration-dependent potters :

#### *1. Late Uruk and Jemdet Nasr :*

- a. Uruk : Green 1987 : 179, 189, 272-275, *s.v.* bahar, sila<sub>3</sub> (including ligatures with sila<sub>3</sub> denoting capacity measures for various types of produce), and dug ; Damerow and Englund 1987 ; Englund 1988 ;
- b. Jemdet Nasr : Englund and Grégoire 1992 : 91, and *s.v.* gar, bahar<sub>2</sub>, sila<sub>3</sub> ; proto-Elamite : Damerow and Englund 1989) ;

#### *2. Early Dynastic :*

- a. Shuruppak : potters as sale contract witnesses (correcting Deimel 1924 : 6\*, Adams 1966 : 143 ; see Edzard 1968 : 22 IV 2, 7 VII 2, 24 V 4 [courtesy R. Adams, L. Milano, B. Foster]) ;
- b. Girsu : potters receive grain rations, lances, fat rations (e.g., Nik. 2 XIII 14 ; Nik. 281 IV 4 2 ; Edzard 1968 : 31 V 13 ; Bauer 1967 : 352, no. 126 [courtesy B. Foster and L. Milano] ; list of two sila pot groups : 150 pots, 1200 pots (de Genouillac 1921 : 9307 [courtesy B. Foster]) ;
- c. Mari : delivery of malt rations to potter (Charpin 1987 : 82 no. 23, [courtesy L. Milano])
- d. Ebla : standardized pot production (Archi 1981 : 6, [seventy 20-*qu* jars of oil], Mazzoni 1988, 1992) ; local and southern capacity system (Milano 1990 : 349-352) ;

#### *3. Sargonic :*

- a. Umma : potter delivers 3000 pots (Donbaz and Foster 1982 : 42) ; Mesag archive potters' ration and distribution listings (Foster 1986 ; Bridges 1981 [courtesy B. Foster]) ; standardized pot production, with highest pot type outputs (300, 600, 4080) associated with sila-vessels (Steinkeller 1992 : nos. 26, 32) ;
- b. bronze sila bowl, possible « standard » (CAD Q : 289, Owen Lewis Coll, 97, iii,3) ;

#### *4. Ur III :*

- a. Umma : standardized pot production from palace-dependent, rationed, male potters, and records of sila-defined pot type output, including 75,652 1-sila vessels of 8 types, 1,088 5-sila vessels, 630 15-sila vessels (Waetzoldt 1971 ; 1987 : 121, 139) ;
- b. Lagash : boat transport of thousands of sila vessels (Virolleaud and Lambert 1968 : 16, 18) ;

#### *5. Old Babylonian :*

- a. Mari : potters (Bottero 1957 : 304) ; standardized pot production : *karpatum* as unit of capacity (Biro 1960 : 250) ; list of pot types by capacity (Biro 1964 : 740-746) ;
- b. Chagar Bazar : ration-dependent potters (Gadd 1940 : nos. 920, 989, 995) ;

#### *6. Nuzi : potters in palace archives (Dosch 1987 : 231 ; Mayer 1978).*

#### *Conclusions :*

Identification of the Leilan SKWs and « sila bowls » as tri-modal standardized administrative artifacts, i.e., capacity measures, of the Akkadians' Habur Plains hegemony expands several archaeological research frontiers :

1. Systematic volumetric investigation of standardized vessels within discrete context assemblages fulfills Powell's prescription for defining statistically « real capacity norms, » as opposed to describing their textual reflections, and hence invites comparative testing of contemporary assemblages in northern and southern Mesopotamia (Powell 1990 : 494 ; Postgate 1983 : 46). Ironically, the epigraphic (and

iconographic [Woolley 1934 : pl. 99a]) record for standardized vessel production is marred by the uncertainty of their real capacity values, much as the standardized vessel assemblages are of uncertain Sumero-Akkadian nomenclature (e.g., Girsu : k u l i, k u r) and real capacity categories.

2. SKWs and « sila bowls » extend the historical and functional contexts for ceramic standardization in the archaeological record beyond craft specialization, class and market development, or « private-sector » demand (e.g., standardized, ED III, stacked tomb vessels, [Watelin 1934 : 20, 32, fig. 5]), to the manufacture of standard capacity measuring or measured vessels for state promoted and regulated activities, such as agro-production.

3. The ambiguities of Mesopotamian historical chronology preclude definite congruence with radiometrically dated Leilan IIB. The relative chronology of Leilan IIB, presently the only period within which SKWs and « sila bowls » are documented at Leilan, therefore provides the association between SKWs/sila bowls and the Akkadian domination of the Habur plains (Weiss 1990b). Identification of these organizational alterations as Akkadian rather than pre-Akkadian, Shekhnite, innovations calls attention to an emergent Habur Plains research agenda : definition of the politico-economic structure, and developmental history of the Subarian states (Mazzoni 1991 ; Weiss 1990a). The capacity systems of Akkadian Gasur and Early Dynastic Ebla hint at « pre-contact » indigenous capacity systems in those regions (Foster 1982b ; Powell 1990 ; Milano 1990 : 349-352) ; the Leilan IIId-IIa system remains to be isolated, along with Subarian state features in general.

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Figure 1a : HW#3,  
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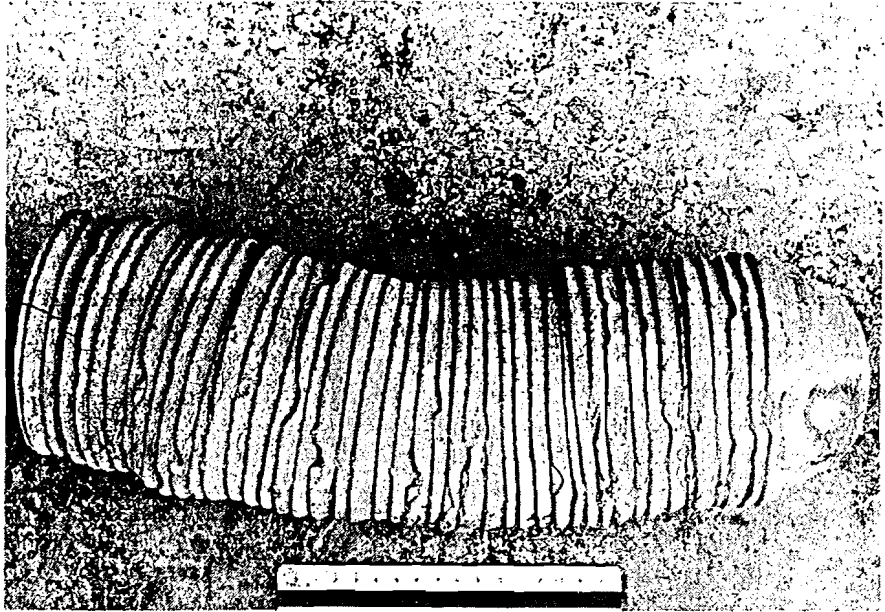


Figure 1b : HW#9,  
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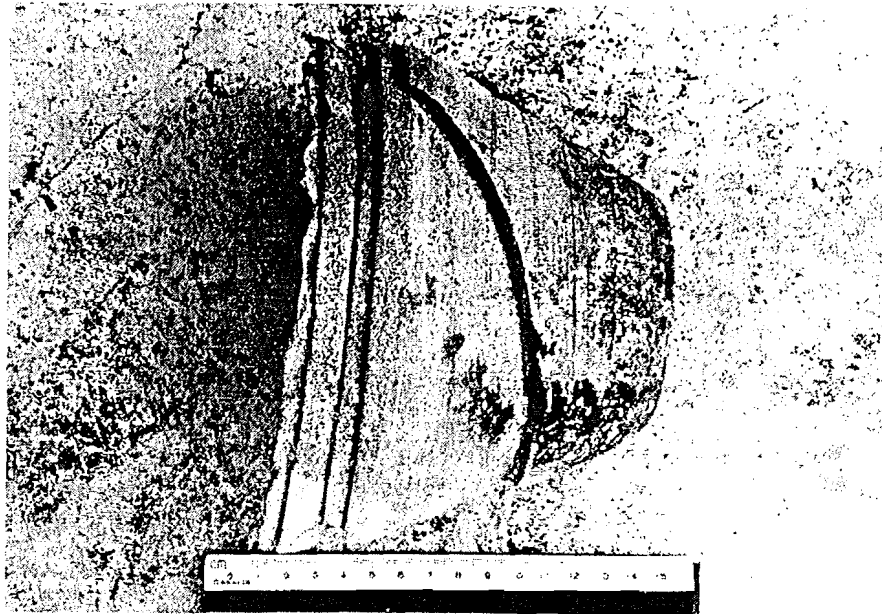
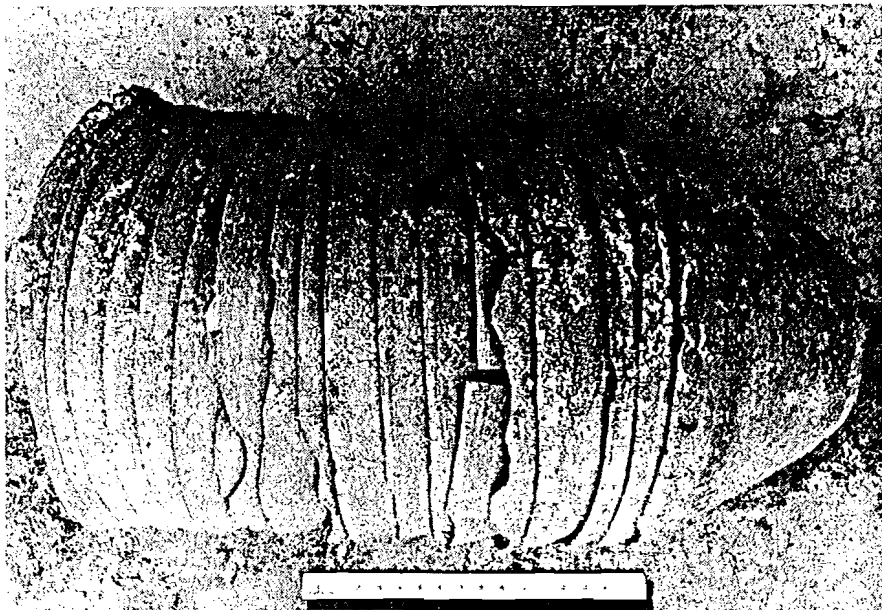


Figure 1c : HW#5,  
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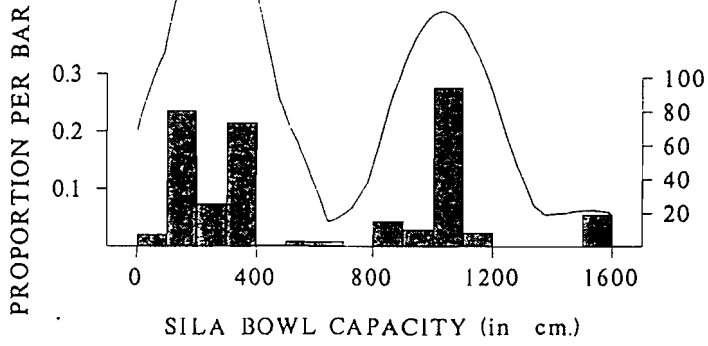


Figure 2

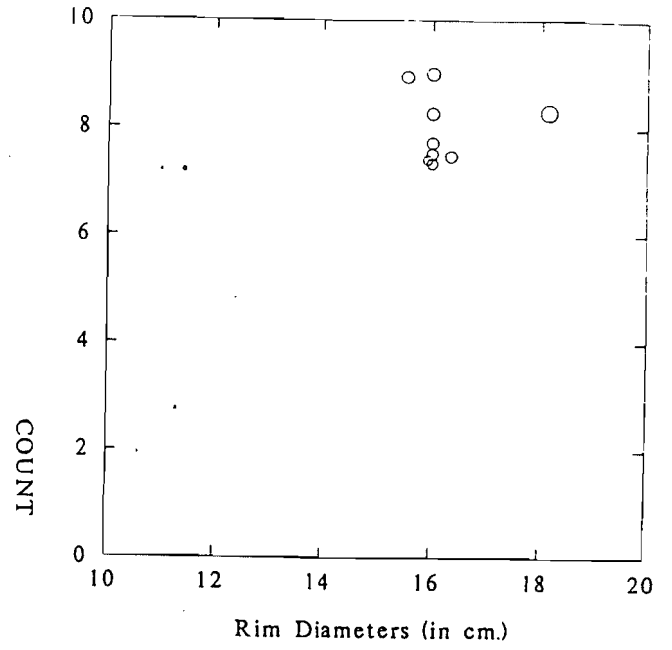


Figure 3

Sila Sherd Base Diameters, N = 150

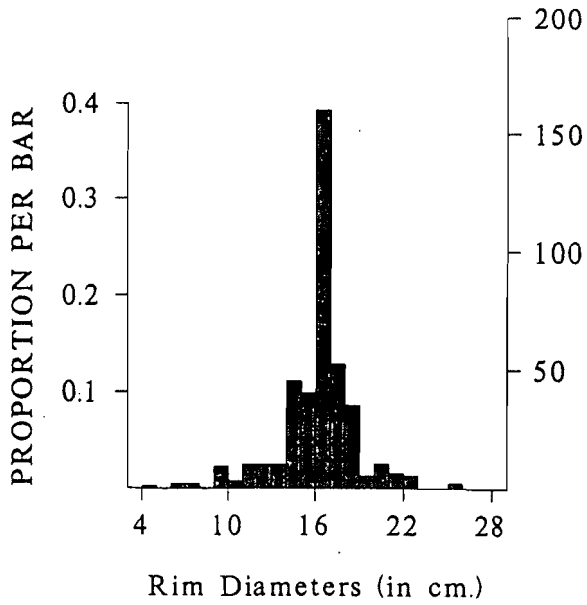


Figure 4

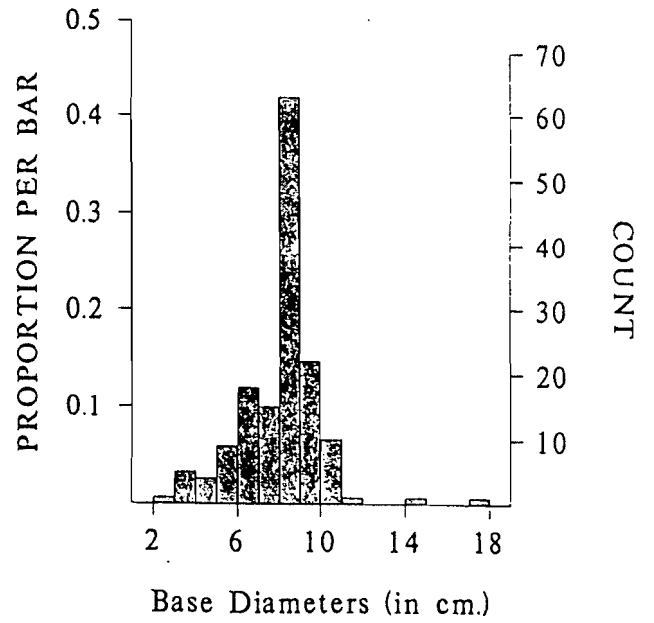


Figure 5



### Archaeobiological Sampling in the Khabur Basin (Syria)

Following the excavation of Halafian Umm Qseir in 1986, and survey in 1988, the Yale University team conducted archaeobiological sampling in 1990 and 1991 at twelve sites in the region centered on Hasseke where there have been a number of salvage excavations since 1984. In the spring of 1992, at the invitation of the excavators, additional samples were taken from the third millennium Tells Gudeda, Atij and Kerman. The purpose of the sampling is to obtain information on local economic practices involved in agriculture and animal husbandry, as well as on the condition of the environment as seen in vegetation and fauna. These data will complement the architectural and ceramic information produced through the numerous extensive, traditional excavations. We expect to document changes in the sizes of sites and population of the Khabur region, as well as to various types of agricultural specialization.

The sampled sites, which range in age from aceramic Neolithic to the third millennium, are spread across an environmental transect that includes both dry farming and irrigation. Sampling of these sites was facilitated by the use of previously exposed sections and it involved a minimum of excavation. Generally the excavations entailed only the cleaning of sections and the excavation of sufficient earth to ensure stratigraphic integrity. To recover charred plant remains we targeted middens rather than architectural strata and we sought to obtain about 40 liters of ashy midden from each context for flotation. In all we recovered 175 flotation samples that are being studied at the Smithsonian Institution by Joy McCorriston.

In addition to seeds we recovered large quantities of bones which are under study by Melinda Zeder and Susan Arter, also at the Smithsonian Institution. The ceramics and lithics are at Yale University where Nicholas Kouchoukos and Frank Hole are in charge of the analysis. Neutron Activation Analysis of obsidian is being carried out by Lames Blackman at the National Bureau of Standards, and Robert Brakenridge, of Dartmouth College, is carrying out studies of flood deposits that he recovered from the base of Tell Mashnaqa. We expect to obtain AMS  $^{14}\text{C}$  dates for the samples by directly dating the charred plant remains.

The Khabur Basin Project is a collaborative effort involving the participants named above, as well as Dr. Youssef Barkoudah, a Syrian botanist who has helped with field collection and identification of a reference collection, and will be closely involved with the environmental interpretation of the charred remains. We are also collaborating in analysis and interpretation with the Danish team, headed by Dr. Ingolf Thuesen, that has concentrated on the excavation of 'Ubaid strata at Tell Mashnaqa.

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