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Résumé

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A COMPARATIVE STATISTICAL ANALYSIS OF PAINTED POTTERY FROM SEVEN HALAFIAN SITES

Steven A. LeBlanc
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ABSTRACT

The painted pottery from seven Halaf sites spanning almost the entire known range of the culture was examined. Motif similarity was compared by the S_j statistic of Sokal and Sneath. The results of this statistic were diagrammed by linking the most closely related sites together as clusters, then overlaying the results into one figure. This figure indicates that the patterns of site similarity were based primarily on geographical distance. In general, change is clinal in form, and dichotomous subgroups of sites were not observed, negating the suggestion of basic eastern and western variants of Halaf.

RESUME

Examen de la poterie peinte de sept sites halafiens. La similitude des motifs a été étudiée selon la méthode statistique S_j de Sokal et Sneath. Ces résultats statistiques ont donné lieu à des diagrammes rassemblant en faisceaux les sites dont la poterie est la plus semblable puis en réunissant ces résultats en une seule figure. Celle-ci a montré que la similitude des motifs d'un site à l'autre est dépendante de leur distance géographique. Il n'a pas été possible de distinguer de sous-groupes, ce qui permet de nier la suggestion de variantes fondamentales entre la culture halafienne de l'est et celle de l'ouest.

INTRODUCTION

In the past ten years there has been increasing interest in the nomothetic potentialities of the prehistoric archaeological record¹. This has been accompanied by a greater emphasis on quantification procedures, often computer-assisted. However, there is a very large corpus of archaeological data collected at various times in the past and reported with little or no attention to systematic quantification. Often it is highly desirable to use such material for comparative purposes, although this may be difficult to do. In the present paper we give an example of a procedure applied to ceramics which proved successful and which may be widely applicable. As part of the analysis of materials recovered from the Halafian site of Girikihaciyan in Southeastern Turkey² we wished to compare, in a quantitative way, the painted pottery from Girikihaciyan with that from the other known Halafian sites in order to assess the relative similarities and dissimilarities.

Sites containing Halafian painted pottery, the hallmark of the Halaf Culture, are spread across the northern part of the Fertile Crescent (see fig. 1). In so far as is presently known, these sites represent the first occurrence in Southwest Asia of a widespread cultural horizon. Within a relatively short time, in the early 5th millennium B.C., this pottery style became common over an extremely large area, and modified forms or influences of the style occur in adjacent areas, especially to the west. This similarity in painted pottery appears to be paralleled by common forms of other artifacts, for example stamp seals, and by architecture (tholos type of construction) at the various Halaf sites. The rapid distribution of a common style over a great geographic range—an horizon style—is a cultural phenomenon known to have occurred prehistorically many times both in the Old and New Worlds. However, the strong similarity among far distant sites which characterizes the Halafian period does not seem to have been equalled in Southwest Asia in the Hassunan or earlier periods. Because the nature of an horizon style is of general importance to our knowledge of culture and cultural process, and the Halafian is of particular importance in Southwestern

Asian prehistory, an understanding of the kind and degree of similarity among these sites is of great interest.

Halafian painted pottery is relatively homogeneous if one confines himself to sites within the Halaf area proper and ignores the "influence" areas. This is seen most clearly when one compares Halaf ware with other painted styles (Hassunan, Samarran, Ubaidian, Jemdat Nasr, etc.): the distinction is invariably quite sharp.

However, internal variation within the Halafian has not been intensively studied, although Perkins³ suggested that the Halaf can be divided into eastern and western divisions. She bases her suggestion on three factors:

(1) Western Assemblages are not as consistent as Eastern ones. For instance, pottery from Arpachiyah, Tepe Gaura Nineveh, and Hassunah shows less variation from site to site than pottery from Shagur Bazar, Tall al-Halaf, and Carchemish. (2) Eastern Assemblages show a clearer sequence; technical qualities, forms and designs indicate a constant progression from earlier strata to later ones. This might, of course, be accidental, since the manner of excavation of the Eastern sites has given us on the whole better stratification than that of the Western sites. (3) Eastern Assemblages are more highly developed than Western ones. Nowhere in the West is there anything comparable to the fine polychrome plates of Arpachiyah 6. (Perkins, 1949:44).

While this assessment cannot be lightly dismissed, it was based on rather limited selections of sherds from many of the sites, and was impressionistic and not quantified in any way. Furthermore, large collections of sherds from several Halaf sites not available to Perkins increases greatly the material now available for comparison, and adds to our knowledge of the areal distribution of the sites themselves. Thus, the degree of internal variability within the Halaf painted ware is worth re-examination.

Seven Halaf sites were chosen for study on the basis of their

1. BINFORD, 1962 : 217-225. FRITZ and PLOG, 1970 : 405-412. ISAAC, 1971 : 123-129. WATSON, LEBLANC and REDMAN, 1971.
2. BRAIDWOOD, ÇAMBEL and WATSON, 1969 : 1275-1276. BRAIDWOOD, ÇAMBEL, REDMAN and WATSON, 1971 : 1236-1240. LEBLANC, 1971.
3. PERKINS, 1949 : 44.

DISTRIBUTION MAP OF THE SEVEN HALAF SITES

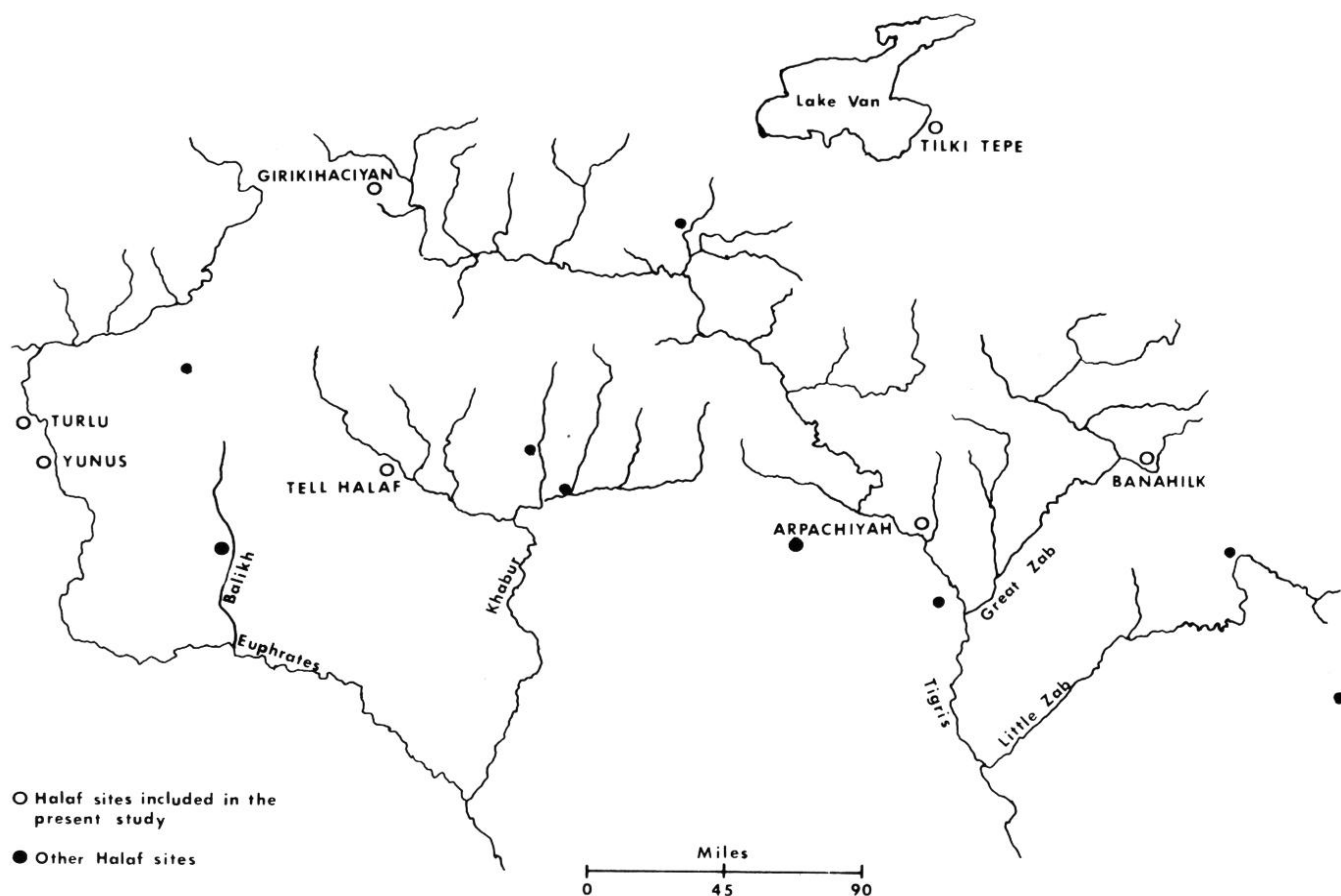


Fig. 1.

geographical positions and the amount of data available on their painted pottery. The problem was, essentially, to find the relative degrees of similarity among these sites so that conclusions could be drawn concerning the following questions: ¹ Is there really an East-West division of the Halafian style painted pottery? ² Do other clusters of sites exist? ³ What appear to be the main determinants of similarity for these sites? Ideally, the inclusion of material other than the painted pottery in the study would have been desirable; however, the painted pottery was the only artifact category that could be used to make valid comparisons because of the highly selective recovery and description of material from many of these sites. Further, for the purposes of the present study and in the absence of clear evidence one way or the other, we have assumed contemporaneity among the chosen sites. As more information accumulates, it may become apparent that this assumption is incorrect, but until that time we believe it more fruitful

to make the operating assumption be that of contemporaneity rather than noncontemporaneity.

In order to enable the reader to assess the nature and amount of data employed in this study and to define the nature of the sites themselves, we present a brief description of each of them.

1. Arpachiyah. This mound, excavated by Mallowan in the early thirties, is one of the best reported and most well-known of the Halafian sites. It is located northeast of Mosul on the Mesopotamian plain, and covers an area not much greater than 125 meters in diameter. Of its total depth of 10.5 meters, apparently about 8 meters belongs to the Halaf period, which is overlain by an Ubaid period occupation. Mallowan divided the Halaf occupation into at least five stages and felt that there was some evolution in the painted pottery through this interval.

The present analysis is based on the painted pottery illus-

trated in the published report ⁴ and that made available by the British Institute of Archeology in London: a total of over 4,000 sherds. This latter however, is certainly a selected sample of the total material recovered from this site.

The general quality of workmanship of the artifacts from Arpachiyah equals or exceeds that of any other Halaf site known. Because of the occurrence of items displaying this high quality of workmanship within an apparent workshop area, one must assume that the best Halaf material could be produced in sites no larger than modern villages in this region, and housing a population probably no greater than a few hundred people.

2. Banahilk. This site, located in the hills of Iraqi Kurdistan near modern Rawanduz, is only slightly smaller than Arpachiyah being 100 by 160 meters. It has very little later occupation and the depth of the Halaf material is about 3 meters. The sounding by Watson ⁵ was limited in extent, but the full range of Halafian artifacts was recovered. However, the variety of painted pottery forms, and the level of execution exhibited by them, is clearly less than that of Arpachiyah. Thus, while the size of the site compares favorably with Arpachiyah, Banahilk is in some ways more peripheral. About 2900 painted ware sherds from this site were available for study.

3. Girikihacian. Being situated at the northernmost part of the Fertile Crescent sixty kilometers north of Diyarbakir, Turkey, this site appears to be close to the north edge of the Halaf range (recent work in the Keban area further north possibly extends this range). Although it is near the headwaters of the Tigris drainage, it is almost directly north of Tell Halaf. Surface debris covers an area greater than 250 meters by 150 meters; the maximum depth is about 3.5 meters. It was surface — collected and sounded in 1968, and excavated in 1970 ⁷. Again the full Halafian artifact assemblage was found, but what appears to be an atypical pattern emerged. Of some 34,500 sherds recovered, only 12-13 percent were of the painted style (many of these were in poor condition, and only slightly over 1,000 sherds were usable for comparative purposes). This ratio contrasts strikingly with the 50-60% painted ware found at Banahilk, and the preponderance of painted ware over plainware reported for Arpachiyah.

A subjective impression of the pottery definitely suggests inferior craftsmanship in comparison with that of Arpachiyah or Tell Halaf. Here, then, is a case of variation from at least some other Halaf sites, and an indication that the site was probably a marginal one.

4. Tell Halaf. Located on the Khabur, a tributary of the Euphrates, almost at the present Syrian-Turkish border, this site was the first major Halaf site excavated. The huge mound, the central portion alone being 350 by 300 meters, is composed of material from many different periods. It is difficult to assess the extent of the Halaf occupation, but it can be no less than 250 meters in maximum diameter; and in places is at least over five meters in depth. The Khabur appears to be an area of dense Halaf occupation which includes the mounds of Chagar Bazar

and Tell Brak as well as others containing Halaf material ⁸. Unfortunately, little is known of the non-ceramic material or the proportions of painted ware to plainware at Tell Halaf. Thus while it appears to be a major Western Halaf site, it is virtually impossible to assess its relative size or sophistication with respect to the other sites. Except for a few sherds seen at the British Institute of Archeology in London, the entire sample was drawn from the published account of the site ⁹.

5. Tilki Tepe. (Samiramalti). The material from this site on the edge of Lake Van in eastern Turkey has been considered to represent an occurrence of Halaf material well outside its assumed range ¹⁰. Although this view must be modified with the discovery of Halaf material at Girikihacian, in the Elazig region, and near Siirt which extends the northern range of the culture, Tilki Tepe is certainly at the northeastern margin of the Halaf area. Nothing is known of either the extent of the area of occupation, the depth of deposits, nor the total range of the assemblage found at this site. Notes on some three hundred sherds from this site, which are housed in the Archeological Museum in Ankara, taken by Watson in 1955 were available.

6. Turlu. This recently excavated site on the Euphrates near Nizip in Turkey lies near the western boundary of the Halafian culture area. Only a preliminary note has been issued on the excavation ¹¹; thus it is impossible to assess the nature of the deposits, although the total height of the tell is approximately 30 meters and apparently only two of the earlier levels were actually Halafian.

The assemblage appears to be typical, although no information is available on the painted ware to plainware ratio, and pottery as finely executed as some of that from Arpachiyah or Tell Halaf does not seem to occur. Permission was kindly granted by the excavator — Jean Perrot — for us to examine over a thousand painted pottery sherds from Turlu stored at the nearby museum in Gaziantep. While this collection may not have contained all the pottery that was excavated, it did probably include all sherds with recognizable motifs.

7. Yunus (Carchemish). This site is also situated near the Euphrates and lies on the Turkish-Syrian border. It was excavated early in the century by Woolley ¹², and little information is available on the non-pottery artifacts or on the nature of the deposits, except that the material did not seem to be overlain by later occupations. The pottery

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4. MALLOWAN and ROSE, 1935 : 1-178.
 5. WATSON, 1965 ; n.d.. BRAIDWOOD, HOWE et al., 1960.
 6. REDMAN and WATSON, 1970 : 279-291. BRAIDWOOD, ÇAMBEL and WATSON, 1969 : 1275-1276.
 7. WATSON et al, in prep... BRAIDWOOD, ÇAMBEL, REDMAN and WATSON, 1971 : 1236-1276.
 8. MALLOWAN, 1936 : 91-177.
 9. OPPENHEIM, 1943.
 10. MELLAART, 1965 et 1967.
 11. PERROT as reported by MELLINK, 1964 : 156.
 12. WOOLLEY, 1934 : 146-162.

was found associated with what are called kilns by the excavator, some of which may actually have been small tholoi.

The material from these seven sites can be summarized in terms of the quantities of sherds we were able to observe, and the degree to which the available sample probably represents the true range of the pottery that occurred at the sites.

Arpachiyah: Largest sample, selected collection but probably representative.

Banahilk: Large sample, unselected, very likely representative except for very rare occurrences.

Girikhaciyan: Large sample, unselected, very likely representative except for very rare occurrences.

Tell Halaf: Small sample, highly selected, does represent a wide range of the pottery, but probably is not complete.

Tilki Tepe: Very small sample, unlikely that it represents the full range of pottery.

Turlu: Large sample, probably not highly selected, probably does represent most of the variation.

Yunus: Small sample, highly selected, probably does not represent the full range of pottery.

These seven sites provide a good sample of the geographical distribution of the Halafian materials. However, there is not sufficient information on most of them to enable one to assess the variation of the entire Halaf assemblage among them. In fact, there is not enough information even to compare the pottery from these sites. To do this properly one would need at least a knowledge of the painted ware to plainware ratios and the percentage occurrence of the various vessel shapes at these sites, but this information is generally unavailable. The one item that did not appear to be greatly biased by selective saving of artifacts was the nature of the designs on the painted pottery (although rare motifs may be overrepresented), and they more accurately reflect the true nature of the universe from which they were removed than does any other available category at these sites.

Thus, an initial assumption was made: the design elements included in the data from each site were an unbiased sample of the design elements present at that site. Although this was probably not completely true it did appear close enough to reality to make the analysis valid and worthwhile. It was also felt that sherds might have been selectively retained by excavators on the basis of sherd size, skill shown in the painting, and how well the sherd had been preserved. However, it appears unlikely that selection was based on the location of design elements on the vessels. Therefore, it was considered valid to include in the analysis data concerning location of motifs as well as their presence or absence from a collection.

The analysis then consists of comparing these seven sites on the bases of the presence and absence of design motifs and the location of these motifs on the vessels.

METHOD

The Halafian pottery was divided into five distinct vessel forms. While others have classified this pottery differently or more finely¹³, the forms defined here are easily distinguishable at all the sites, and are few enough in number so that the sample size in each form class did not become impossibly small. These five shapes were (1) Concave Sided and Straight Sided Bowls, (2) Flare Rim Bowls—a general class that includes the well-known "cream bowl" form; (3) Round Sided Bowls, with or without flat bases; (4) Jars, including a distinctive form of very squat jar or closed bowl called by Schmidt a "Büchse"; and (5) Hole Mouth Vessels. (fig. 2).

The design elements found to occur for each vessel category were then defined. A total of 78 motifs were included in the final analysis, and these are listed in fig. 3. Some shapes such as round sided bowls were not present in great quantities, so for these shapes several closely related motifs were combined for purposes of the analysis. For example, four different forms of cable motif were defined (designs 2, 3, 4 and 5 in fig. 3) but these were combined into one category for the analysis of the Round Sided Bowls¹⁴.

Other motifs or particular variants of these 78 motifs did occur on some vessels. However, in order to avoid including motifs represented at only one site, or resulting from idiosyncratic behavior, it was necessary to formulate a cut-off point for inclusion of motifs in the analysis. First, to be of any use in comparison a motif must occur in at least two sites. Secondly, in order to exclude rare variants and accidents in painting, a motif had to occur twice at two different sites before it could be included in the analysis. Once a motif met this inclusion test—occurring at least twice at two different sites—it needed to occur only once at any of the remaining sites to be counted as present for that site. This inclusion test was made for each vessel shape independently. Thus motifs were included in the jar analysis which were excluded from the concave bowl analysis, etc.

It can be validly argued that if a motif was considered valid for the jar class, then it very likely represented a valid motif and could have been used with the other form classes. On the other hand, any motif that did not occur at least twice in two different sites for a particular shape was certainly a rare motif *for that shape*. Excluding these extremely rare motifs helped compensate for the small samples of sherds from some of the sites. A motif that occurred only once out of 4,000 sherds at Arpachiyah and once out of 1,000 sherds at Turlu was almost certain not to turn up in

13. PERKINS, 1949. MALLOWAN, SCHMIDT in OPPENHEIM, 1943.

14. This shape is considered early Halaf by PERKINS, theoretically occurring at Arpachiyah with the tholoi without dromos entrances; however, at Girikinaci, they occur with dromos tholoi, and therefore this distinction does not appear universally valid.

BASIC HALAFIAN VESSEL SHAPES

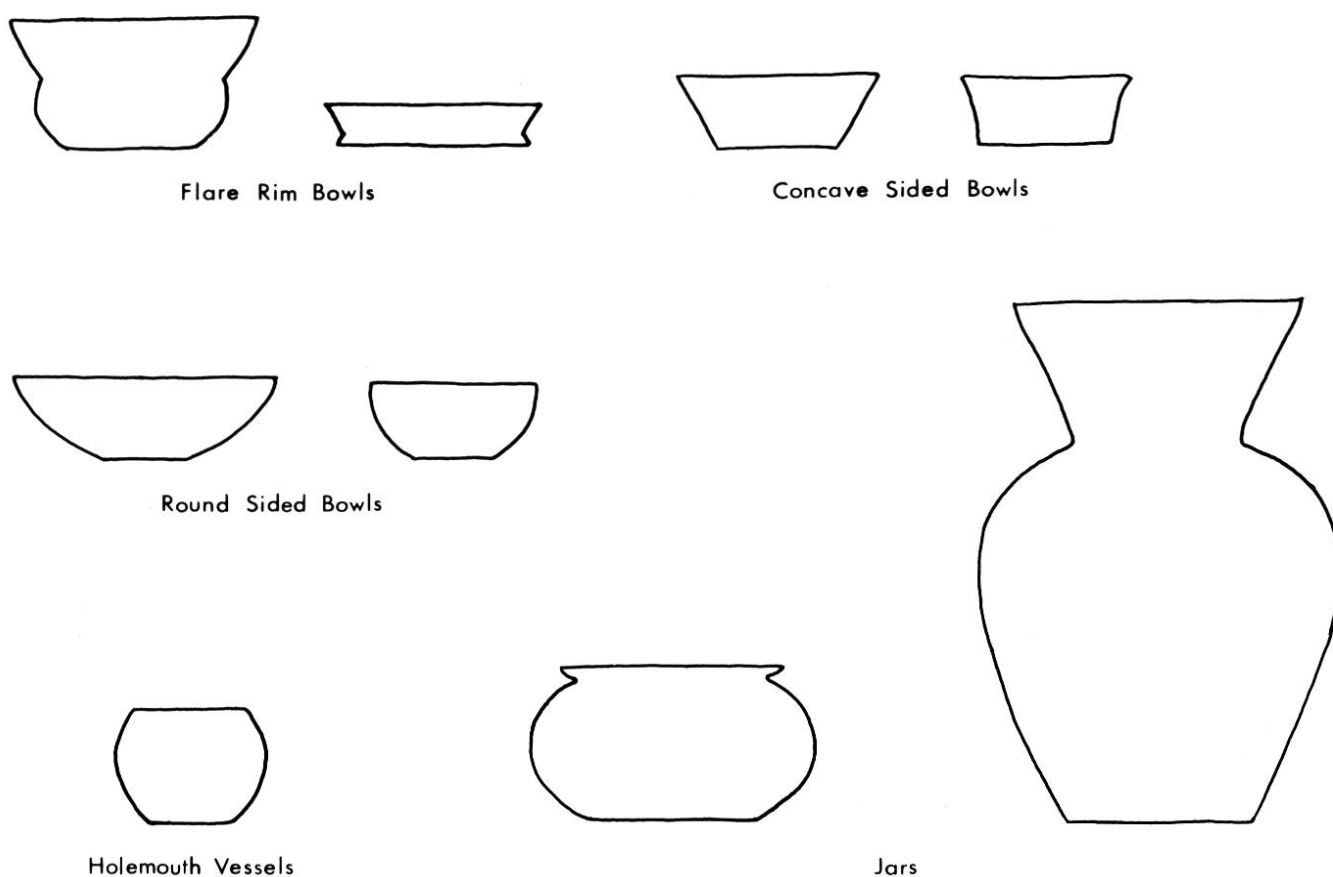


Fig. 2.

the samples from Yunus, Tilki Tepe, or Tell Halaf, even if it was present on these sites at the same frequency as it was for Turlu or Arpachiyah. By including very rare motifs one would essentially be measuring the effects of varying sample size, and not really getting at motif differences. This bias was certainly not eliminated in this analysis, but it was reduced as much as possible.

STATISTICS EMPLOYED

Once the presence and absence of motifs had been recorded for each shape, it was necessary to quantify the degrees of similarity represented by these data. It was decided to employ the methods of cluster analysis or numeric taxonomy to assess this similarity. These techniques, popularized by Sokal and Sneath (1963), provide ways of finding patterns in the morphological similarity of any collection of items. The basic assumption underlying this approach is that all morphological differences are equally valid for assigning overall rankings of similarity; no traits are given greater weight than any others. A correlate of this assump-

78 HALAFIAN PAINTED POTTERY MOTIFS

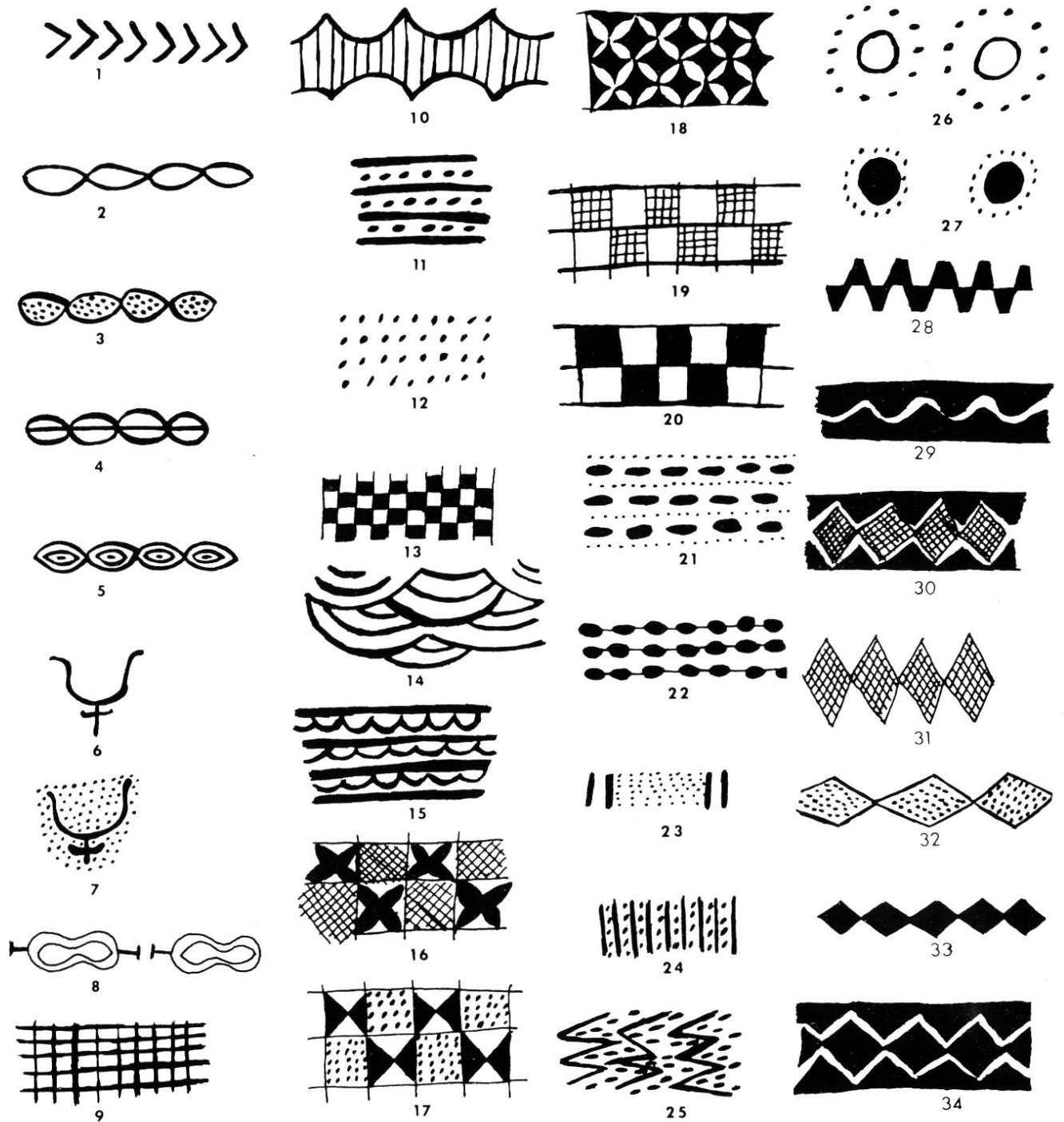
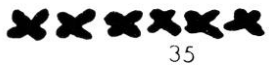


Fig. 3.

Care has been taken by the artists to reproduce as closely as possible the manner in which these motifs were executed by the prehistoric potters, hence the unevenness and lumpiness of many of the lines.



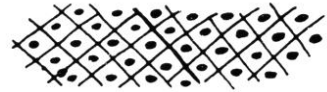
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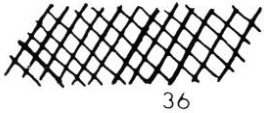
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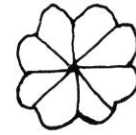
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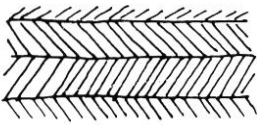
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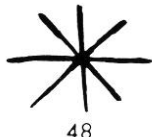
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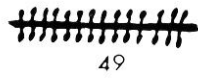


Rim Ticks

70



38



49



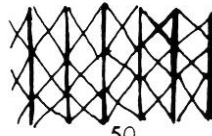
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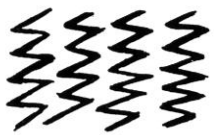
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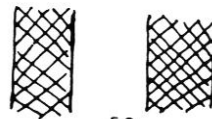
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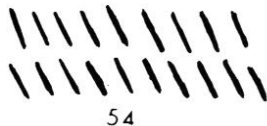
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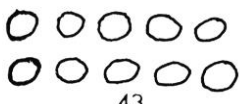
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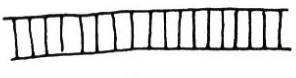
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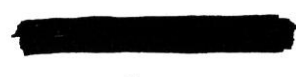
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tion is that the assessment of similarity must be based on many different independent characters. In certain cases the assumptions of this method are possibly questionable, but it is ideal for this particular problem. There is absolutely no basis for assigning some motifs greater importance than others in defining overall similarity, and the number of independent motifs was great enough to permit the valid use of this technique.

Sokal and Sneath present a list of possible coefficients of similarity for use with presence/absence information. For all these statistics, the data for each pair of items to be compared is arranged in a two by two table; in our case such tables were made for each pair of sites when analyzing shape class. These tables take the form:

		Site 1	
		Number of Motifs	
		Present	Absent
Site 2	Present	A	B
	Absent	C	D

In this diagram A represents the number of motifs that were common to both sites 1 and 2; B represents the number of motifs present at site 2, but absent at site 1. C is the reverse of B, and represents the number of motifs present at site 1 but absent at site 2; and D represents the number of motifs that did not occur at either site 1 or site 2. A represents the positive matches; B and C represent non-matches, and D gives the number of negative matches.

The major difference among the various statistics defined by Sokal and Sneath is whether negative matches (D) are included or excluded in their computation. The decision whether to include or exclude negative matches is not trivial. One must decide whether the absence of trait at two particular sites reflects real similarity between them. Traits can be imagined for which this would or would not be the case. Clearly the absence of steel from two Halaf sites does not demonstrate a common similarity between them, beyond the fact that they are both prehistoric. On the other hand, the common lack of rim ticks on Round Sided Bowls could well reflect a basic similarity between two sites. Even in this case, however, the common lack of rim ticks does not demonstrate similarity in as strong a way as the common occurrence of tholos type house construction does. Negative matches are valid measures of relationships in some circumstances, but in general, they are probably never so strong a clue as are positive matches.

In this particular case, because the samples might not completely reflect the actual occurrences of motifs at these sites and because of the general considerations just discuss-

ed, the use of negative matches in the assessment of similarity did not seem warranted.

This conclusion is much the same as that reached by Sokal and Sneath, and the statistic that they prefer—one that excludes negative matches from the computations—was employed. This statistic, labeled S_j can be defined as follows using the same symbols as above :

$$S_j = \frac{A}{A+B+C}$$

S_j is found by taking the number of positive matches (A) and dividing by the sum of the positive matches (A) and the non-matches (B and C). S_j results in a coefficient that ranges from 1 with perfect similarity between two sites, i.e. B and C are both zero, to zero when no traits are common to both sites.

It must be noted that all such similarity statistics are dependent on the definition and number of traits used in making the comparison, and one cannot assign meaning to the absolute value of the coefficient. A S_j equal to .5 represents neither a high nor a low degree of similarity, but is high or low only when compared with other sites in the same analysis. (It is clear then that one cannot compare statistics between sites based on different types of data.) It would *not* be correct to assert that if known Halaf sites showed an average similarity of .6 and Ubaid sites only .5, the Halaf was more homogeneous than the Ubaid. However, even with this limitation, a coefficient of similarity is still a very useful tool.

The results of the analysis of each shape class will be given separately, followed by an interpretation of the overall results.

Jars

Of all the vessel shapes, jars provided the best data on the relative similarity among the sites. This was because of the large number of different motifs that occur on jars and because they were a very common shape (approaching 50 percent of the vessels in most collections), so that a good sample was available from all the sites. A total of 66 motifs fit the inclusion criterion of two occurrences at two sites. However, 12 of these motifs were found at all seven sites, and thus could not provide us with any information on differences among the sites. Therefore, motifs 1,2,9,12,31, 36,38,39,41,48,56 and 64 were excluded from this step in the analysis. Fig.4 presents the data on occurrences of the motifs at the seven sites. The coefficient, S_j , was then computed for each pair of sites, and these values are given in Fig.5. The matrix of Fig.5 represents each coefficient twice; it is given once (below the diagonal) in fractional form where the numerator is the number of positive matches (A) and the denominator is the sum of A and the

FIG. 4
THE DISTRIBUTION OF DESIGN MOTIFS FOR JARS
AT SEVEN HALAF SITES

MOTIFS*	SITES						
	Arpachiyah	Banahilk	Tilki Tepe	Girikhaciyan	Tell Halaf	Turlu	Yunus
3	x	x		x	x	x	x
4	x			x	x	x	
5	x	x		x	x	x	x
6	x			x	x	x	x
7	x			x	x		
8	x				x	x	x
10	x	x		x	x	x	x
11	x	x		x	x	x	x
13	x	x			x	x	
14	x				x	x	x
15	x	x			x	x	
16	x				x	x	
17	x			x	x		
18	x	x		x	x		x
19	x	x		x	x		
20	x	x			x	x	x
21	x		x	x	x	x	
22	x	x					
23	x			x	x	x	x
24	x	x		x	x	x	
25							
26	x		x	x			x
27			x	x	x	x	
28	x	x					
29	x	x	x		x		
30	x	x			x	x	
32	x	x	x	x	x	x	
33	x	x		x	x	x	x
34	x	x		x			
35	x				x	x	
37	x	x		x	x	x	x
40	x			x	x	x	x
42	x		x	x	x	x	x
43	x	x		x	x	x	x
44	x	x		x	x	x	x
45	x			x			x
46	x				x		x
47				x	x		x
49		x		x	x		
50	x	x			x		
51	x	x		x	x		
52	x	x			x	x	
53	x			x	x	x	
54				x	x		
55	x	x			x	x	
57				x	x	x	
58					x	x	
59	x			x	x		
60	x				x	x	
61	x				x	x	
62				x	x	x	x
63					x	x	x
65						x	x
66	x	x			x	x	

* Numbers refer to the motifs in Fig. 3.

FIG. 5
THE VALUES OF S_j FOR SEVEN HALAF SITES
BASED ON ALL MOTIFS

	Arpachiyah	Banahilk	Tilki Tepe	Girikhaciyan	Tell Halaf	Turlu	Yunus
Arpachiyah		.532	.152	.529	.759	.574	.360
Banahilk	25/47		.100	.318	.451	.333	.263
Tilki Tepe	7/46	3/30		.147	.125	.098	.074
Girikhaciyan	27/51	14/44	5/34		.569	.489	.432
Tell Halaf	41/54	23/51	6/48	29/51		.755	.373
Turlu	31/54	16/48	4/41	23/47	37/49		.395
Yunus	18/50	10/38	2/27	16/37	19/51	17/43	

FIG. 6
DISTRIBUTION OF DESIGN MOTIFS ON FLARE RIM
BOWLS FOR FIVE HALAF SITES

MOTIFS*	SITES				
	Arpachiyah	Girikhaciyan	Tell Halaf	Turlu	Yunus
OUT:					
12	x	x			x
21	x	x			
73	x	x			
36	x	x	x	x	x
6,7,8	x		x	x	x
74	x	x	x		x
13	x	x	x		
1	x	x	x		
38	x	x	x		x
2,3,4,5	x	x	x		
24,25	x	x	x		
7		x	x		
23	x	x		x	
57	x	x		x	
41	x	x	x		x
33		x	x		x
IN:					
75	x	x	x	x	x
72	x	x	x	x	x
12	x	x	x		
14	x	x			x
76	x	x			x
6,7,8	x		x		
77	x	x	x		x
2,3,4,5	x	x	x	x	x
28	x		x		
1	x	x	x		
43,44,45, 46,47		x	x		
32		x	x	x	x

non-matches (B and C). By examining the coefficient as presented in this form, one can determine the actual number of common occurrences of these motifs and also the total number of motifs that occurred at either of the sites being compared. The other side of the diagonal of the matrix gives these fractions as decimals so that the relative degree of similarity can be assessed.

Flare Rim Bowls

For this shape several motifs were combined in order to increase the number of motifs that met the inclusion rule. Motifs that occurred inside the vessels were recorded separately from those occurring on the outside. In this case not only were motifs themselves being compared, but the location of the motifs was also considered. The numbers of Flare Rim Bowls from Banahilk and Tilki Tepe were so small that valid comparisons could not be made, so they were excluded from this part of the analysis.

A total of 30 motifs, 16 outside and 14 inside, meet the inclusion rule but two of these (36 and 38) occurred on the inside at all five remaining sites and were therefore ignored. This data is given as Fig.6. S_j was computed and presented as in the case of jars. These results are shown in fig.8.

Round Sided Bowls

The number of vessels in this shape class was not very great for most sites, and even though it presents a limited amount of information, the analysis of this class was performed. Only four sites had enough round sided bowls to be considered and for these 22 motifs met the inclusion rule, 8 occurring on the outside and 14 on the inside (one inside motif, a combination of motifs 2,3,4 and 5, occurred at all sites and was excluded). The tabulation of these data is given in fig.7 and the resulting coefficients are found in fig.9.

Hole Mouth Vessels and Concave Sided Bowls

The numbers of vessels in these shape classes were quite small for several sites, and at the same time the motifs found on these vessels were either very common or very rare. Thus, when the motifs were found that fit the inclusion rule and did not occur at all sites, their numbers were too small to permit the valid computation of S_j . Therefore, these two classes could not be used in the comparison of the sites.

All Motifs Combined

A final tally of the seven sites was made combining all vessel shapes and ignoring the location of the motifs on the vessels. These results are given in fig. 10 and the values of S_j are given in fig.11. It can be observed that there is little difference between these data and those for the jars. Only a few additional motifs could be included and there were only small differences in the resulting coefficients.

RESULTS

There are several ways of analyzing the coefficient matrices that are given in figs.5,8,9 and 11. The traditional approach

in numeric taxonomy is to use these coefficients to produce a dendrograph or hierarchical ordering of the sites. Such diagrams reproduce some but not all the information in the original matrix. They are made by finding the units that are most similar, then continuously adding new units to them. When these additional units are added they are compared to the clusters already formed and not to each unit as a distinct entity. Thus these methods result in greater and greater generalizations about the units (sites) in question. For many problems this procedure is desirable, and when there are great numbers of units there is little else that is feasible to do. However, in this particular case, because there are so few units involved, we can employ a graphic method that reproduces more of the information of the matrices and results in less generalization.

The method employed was to connect diagrammatically each site with the sites closely related to it; in all cases the number of closely related sites was limited to one or two. Thus the data on the jars showed that Tell Halaf was most closely related to Turlu and Arpachiyah, and the relationships were almost equal for both sites. Banahilk, however, was much more similar to Arpachiyah than to any other site, so only one connecting line was made for Banahilk. This procedure was continued until all the sites were connected. The resulting plot of the jar data is given in fig.12. While this figure does not carry all the information of the matrix, it does carry more of it than would a cluster diagram, and it clearly establishes the basic form of the relations among these sites. In this figure the values of the coefficients between the sites are represented by the type of line connecting the sites. Solid lines represent relatively high coefficients of about .7; heavy dashes represent the next highest group of coefficients .5, the light dashes are for weaker links of about .4; and the dotted lines give the weakest links.

The most obvious characteristic of this diagram is that the sites do not form two clusters. The most closely related sites are Turlu, Tell Halaf, and Arpachiyah; the other four sites relate primarily to them and do not form any other close groupings. As mentioned, Banahilk is more closely related to Arpachiyah than to any other site. Girikihaciyan, however, was equally related to the main cluster sites of Tell Halaf and Arpachiyah. Yunus has its closest affinities (but relatively not very close) with Turlu and Girikihaciyan. Tilki Tepe is unlike the other sites, but its strongest links are with Arpachiyah and Girikihaciyan.

These very interesting results do not necessarily fit with generally held ideas about the Halaf. The main cluster of sites—Turlu, Arpachiyah and Tell Halaf—includes both Western and Eastern sites, and this strongly indicates that there is not a major dichotomous division of the Halaf culture. Both Girikihaciyan and Banahilk were initially interpreted as being culturally peripheral in some fashion. This hypothesis is strengthened for Banahilk, and the single close bond with the geographically nearest site of Arpachiyah fits our intuitive expectation of the manner in which this marginal site should relate to the rest of the culture.

FIG. 7
DISTRIBUTION OF DESIGN MOTIFS ON ROUND SIDED
BOWLS FOR FOUR HALAF SITES

MOTIFS*	SITES			
	Arpachiyah	Banahilk	Tell Halaf	Yunus
OUT:				
10	x	x	x	
13	x	x	x	
36	x	x	x	x
6,7,8	x		x	
2,3,4,5	x	x	x	
38,39	x	x	x	
33	x		x	x
IN:				
78	x	x	x	x
12,21	x	x		
1	x	x	x	
10	x		x	x
75	x	x	x	x
13	x	x		
36	x	x		
9	x	x		
76	x		x	
77	x	x	x	
38,39	x	x		x
29	x	x		
70	x	x	x	x

* Numbers refer to motifs in Fig. 3.

FIGURE 8
THE VALUES OF S_j FOR FIVE HALAF SITES
BASED ON FLARE RIM BOWL MOTIFS

	Arpachiyah	Girikhaciyan	Tell Halaf	Turlu	Yunus
Arpachiyah		.750	.607	.280	.462
Girikhaciyan	21/28		.643	.269	.520
Tell Halaf	17/28	18/28		.261	.478
Turlu	7/25	/26	6/23		.375
Yunus	12/26	13/25	11/23	6/16	

FIGURE 9
THE VALUES OF S_j FOR FOUR HALAF SITES
BASED ON ROUND SIDED BOWL MOTIFS

	Arpachiyah	Banahilk	Tell Halaf	Yunus
Arpachiyah		.818	.636	.318
Banahilk	18/22		.455	.250
Tell Halaf	14/22	10/22		.400
Yunus	7/22	5/20	6/15	

Girkihaciyan does not show a similar pattern. Besides being most closely related to both Tell Halaf and Arpachiyah, it is linked with Tilki Tepe and Yunus. While Girkihaciyan is culturally peripheral in the sense that it does not have a high frequency of painted pottery nor is the pottery crafted in the best fashion, it does not have a particularly strong relationship to any one site in the present sample. It is geographically closest to Tell Halaf, and it is next closest to Arpachiyah (Girkihaciyan and Arpachiyah are both in the Tigris drainage); Girkihaciyan motifs are equally similar to both sites. Tilki Tepe is physically closest to Arpachiyah and Banahilk in terms of straight-line distance, but from the viewpoint of the actual terrain, it would be easier to move between Tilki Tepe and Girkihaciyan. Hence it is not surprising that Tilki Tepe is most similar to Girkihaciyan. Thus Girkihaciyan is not dyadically related to one site, but is variously related to several.

Yunus is predictably similar to Turlu, but is unexpectedly close to Girkihaciyan. It must be noted that all the coefficients for Yunus are relatively low. The same is true for Tilki Tepe, where they are extremely low, although the particular sites to which Tilki Tepe is related do not seem surprising. In these two cases the effects of small sample sizes are probably evident. An examination of the matrix of fig.9 shows that there is a tendency for the number of positive matches to decrease very rapidly as the total number of motifs decreases. Because the number of positive matches falls off so much more rapidly than does the total of motifs for these two sites, it is probably the case that sites with small samples and thus fewer total motifs had lower coefficients than would have been the case if bigger samples had been available.

What is not clear from these results is whether the relative order of similarities among these sites would have been affected by sample size. That is, would Tilki Tepe have been most similar to different sites if its sample had been doubled or would it still be closest to Girkihaciyan and Arpachiyah and only the magnitudes of the coefficients have been increased? A similar question might be asked for Yunus. Because it is not possible to answer this question, the positions of Tilki Tepe and especially Yunus must be viewed with some caution.

The above discussion has been based on the data given in the jar analysis. However, an examination of the results of the Flare Rim Bowl, Round Sided Bowl, and all motifs combined analyses show that exactly the same general results were obtained, although some variation in the size of the coefficients occurred. Each separate analysis placed the sites in the same relative positions, and thus the conclusions drawn concerning these relationships were considerably reinforced.

INTERPRETATION

From these results it appears that there is not a single major partition of all known Halaf sites. However, we may still ask if there are any other patterns underlying these similarity relationships. Are there any other facets of the pottery itself, or the sites in general that correlate well with the values of the S_j ? One obvious relationship is that Arpachiyah and Tell Halaf not only have high coefficients, but they also have been considered to have produced pottery of the finest quality. Although subjective assessments on the quality of craftsmanship are difficult to substantiate and the results of such assessments vary widely, the quality of design execution does not seem to be well correlated with patterns of motif similarity. Turlu is as similar to Tell Halaf as is Arpachiyah, but the quality of pottery manufacturing does not seem significantly superior to that of the remaining four sites. Furthermore, the range of variation at any one site is quite great. At Girkihaciyan the average level of expertise was probably lower than for the main cluster sites. However, a few vessels were found that very closely approximate what must be considered the better workmanship from the central cluster sites. In general, then, not only is the determination of quality somewhat difficult for these sites, but no pattern is seen that correlates with their motif similarities.

However, while collecting these data several interesting aspects of the painted pottery were noted. While no definite conclusion can be drawn, there is some indication that the relative proportions of the various vessel shapes vary remarkably from site to site. For example, Round Sided Bowls and Hole Mouth vessels made up over

FIGURE 10
THE DISTRIBUTION OF DESIGN MOTIFS FOR ALL
VESSELS AT SEVEN HALAF SITES

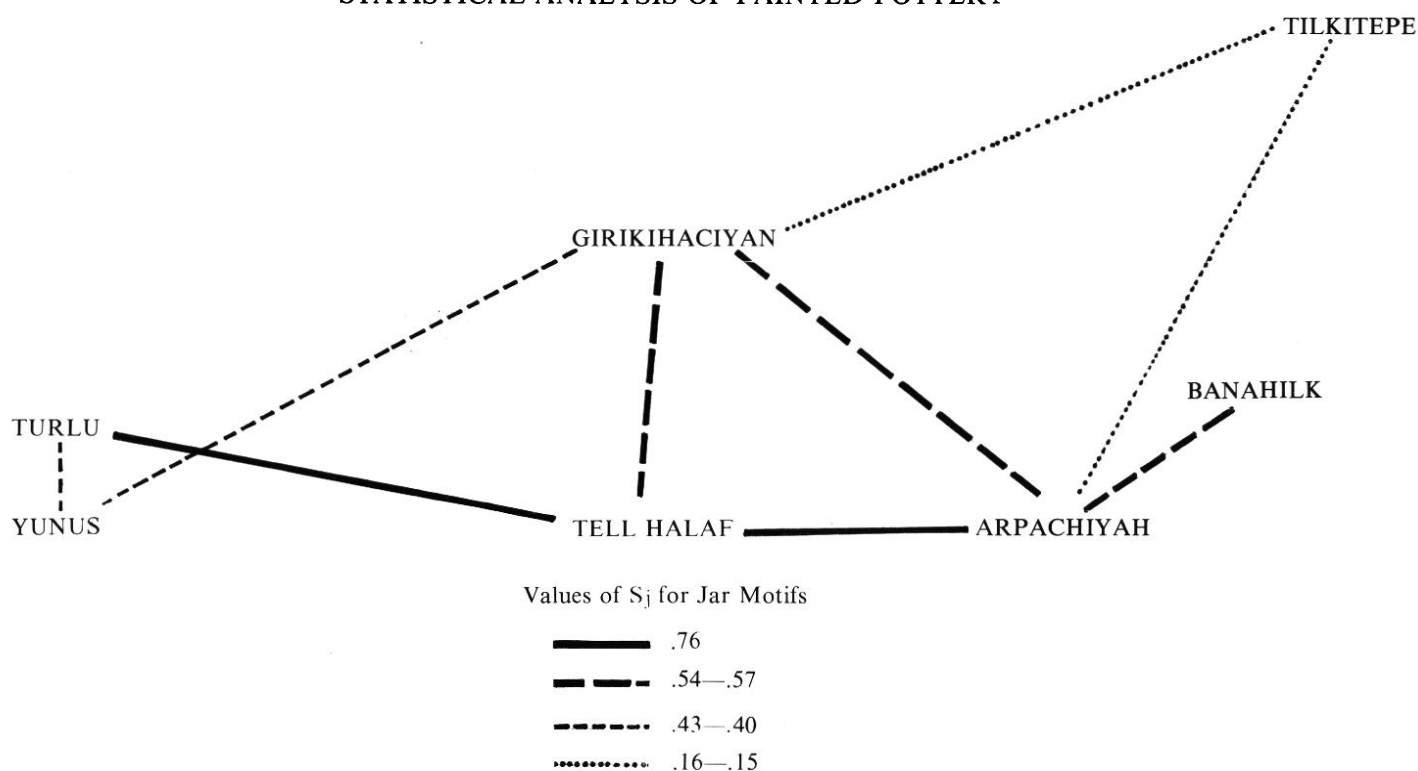
MOTIF*	SITES						
	Arpachiyah	Banahilk	Tilki Tepe	Girikihaciyan	Tell Halaf	Turlu	Yunus
3	X	X		X	X	X	X
4	X			X	X	X	
5	X	X		X	X	X	X
6	X			X	X	X	X
7	X			X	X		
8	X				X	X	X
10	X	X		X	X	X	X
11	X	X		X	X	X	X
13	X	X			X	X	
14	X				X	X	X
15	X	X			X	X	
16	X			X	X		
17	X	X	X	X	X	X	
18	X	X		X	X		X
19	X	X	X		X		
20	X	X			X	X	X
21	X		X	X	X	X	
22	X	X					
23	X			X	X	X	X
24	X	X		X	X		
25	X		X	X	X	X	
26	X		X	X			X
27	X		X	X	X	X	
28	X	X			X		
29	X	X	X		X		
30	X	X				X	X
32	X	X	X	X	X	X	
33	X	X		X	X	X	X
34	X	X		X			
35	X				X	X	
37	X	X		X	X	X	X
40	X			X	X	X	X
42	X		X	X	X	X	X
43	X	X		X	X	X	
44	X	X		X	X	X	X
45	X			X			X
46	X			X	X		X
47	X			X	X	X	
49		X		X	X		X
50	X	X			X		
51	X	X		X	X		
52	X	X			X	X	
53	X			X	X	X	
54				X	X		
55	X	X			X	X	
57	X			X	X	X	
58				X	X	X	
59	X	X		X	X	X	
60	X				X	X	
61	X				X	X	
62				X	X	X	X
63					X	X	X
65						X	X
66	X	X			X	X	
67				X	X		
68	X			X	X		
69	X	X		X	X	X	X
70	X	X		X	X		
71					X	X	
72	X			X	X	X	X
73	X			X			

*Numbers refer to the motifs in fig. 3

FIGURE 11
THE VALUES OF S_j FOR SEVEN HALAF SITES
BASED ON ALL MOTIFS

	Arpachiyah	Banahilk	Tilki Tepe	Girikhaciyan	Tell Halaf	Turlu	Yunus
Arpachiyah		.547	173	596	800	610	357
Banahilk	29/53		114	360	491	358	256
Tilki Tepe	9/52	4/35		.175	.143	.138	.065
Girikhaciyan	34/57	18/50	7/40		.603	.481	.409
Tell Halaf	48/60	28/57	8/56	35/58		.732	.362
Turlu	36/59	19/53	6/45	26/54	41/56		.404
Yunus	20/56	11/43	2/31	18/44	21/58	19/47	

FIGURE 12
THE RELATIONSHIPS AMONG SEVEN HALAF SITES INDICATED BY
STATISTICAL ANALYSIS OF PAINTED POTTERY



eighty percent of all the bowls found at Banahilk, while at Girikhaciyan both Round Sided Bowls and Hole Mouth vessels were almost non-existent. At Arpachiyah, these two forms were almost equally represented (although due to the selective retention of sherds this cannot be considered more than an overall impression). Also the number of Flare Rim Bowls seems to be greater at Turlu and Yunus than at sites in the eastern edge of the Halaf range. It is clear that important intersite differences in the painted pottery exist that are not detectable merely by examining the design motifs; however, only when sufficient unbiased samples of pottery are available can this extremely interesting variation be properly analyzed.

Various aspects of the sites other than the painted pottery were next considered as possible correlates of the motif relationships exhibited by these sites. Very little could be found that could account for the observed patterns. The three primary cluster sites were as large, but not significantly larger than the rest of the sites, and, although they might have had deeper Halafian deposits, there is not enough information to confirm this. The three sites whose dimensions we know best (Girikhaciyan, Banahilk, and Arpachiyah) seem remarkably similar and could not have

had greatly different populations. The location of the sites in either the foothills or the plains does not correlate well with their relative similarity. Yunus is as much on the plains as are Tell Halaf, and Arpachiyah, and Turlu is located more in the foothills than Girikhaciyan.

The one aspect of these sites that does seem to correlate remarkably well with the motif similarities is the geographical distances between them. Except for Yunus, all the sites are related to each other almost identically for both motifs and geographical position. While other aspects of these sites are surely related to other phenomena, the distribution of design motifs is certainly closely correlated with the geographic locations of the sites themselves.

It is necessary to point out that this study was concerned only with the variable aspects of the painted pottery from these sites. Although intersite variability is certainly present, one's overwhelming impression is that the overall similarity among these sites is tremendous. Eighty to ninety percent of the sherds from any of these sites would not appear out of place in the collections from any other site.

The point being made is that low coefficients of similarity do not reflect atypical sites or merely some vague form of

cultural «influence». The pottery from Tilki Tepe has completely typical Halaf motifs, it is simply less like the other Halaf sites considered here than they are to each other. Given that the known maximal range of the Halaf is over 360 miles (500 kilometers), and the differences among the sites are extremely slight (not only for pottery motifs, but for other artifacts as well), it is probably safe to conclude that the Halaf is one of the most homogeneous prehistoric cultures anywhere in the world. It should be a primary goal of Near Eastern archeology to determine carefully the overall similarities and differences within the Halaf culture, and also to try to explain the extremely high degree of similarity of the painted pottery designs.

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