A reevaluation of El Khiam (Desert of Judea)

J. González Echegaray – Santander
L. G. Freeman – Chicago

[The authors present a reevaluation of excavations at the prehistoric site of El Khiam (Judean Desert), undertaken in 1962. A new statistical study of the assemblages with modern multivariate techniques clarifies relationships between the levels. The debate concerning the reliability of the El Khiam assemblages is discussed, and the authors conclude that the slope of the sediments and the high microlithic proportions in some levels are by no means unusual. For that reason El Khiam must continue to be considered a key site in the regional evolution of prehistoric industries and human adaptations in the Near East.]

The site of El Khiam, in the Judean Desert, presents one of the most important long stratigraphic sequences in the Near East, encompassing as it does several levels attributable to Upper Paleolithic (Aurignacian = Antelian and Atlitian), Epipaleolithic or Mesolithic (Kebaran), Transitional (Khiamian) and pre-Pottery Neolithic complexes (in this case, including structures). The clear succession of these levels and the richness of their artifactual contents should make the site a touchstone for studies of the evolution of industrial complexes in the Southern Levant. It is now the type site for the Khiamian, a horizon documenting the regional transition from food-gathering to food-producing and as such crucial for the detection of early domesticants.

There is unfortunately no thorough English summary of the most recent information about the El Khiam stratigraphic sequence and industries. In reviewing the Near Eastern literature, we have become convinced there is a need for such a survey. Its preparation provides an opportunity for us to rectify some minor errors in the calculations of percentages and indices for the lithic assemblages, to examine relationships between the assemblages with statistical procedures that were not in general use by prehistorians when the monographic reports were written, and to explore the extent to which the characterization of industrial complexes can be based on the Khiam materials. The last point has become a subject of some interest in recent years.

The Khiam sequence, we believe, serves better than any alternative to exemplify certain aspects of the evolution of Paleolithic industrial complexes in the Levant, and in particular establishes the presence of bladelet-rich Paleolithic facies in the Southern Levant, a fact still not adequately appreciated by some authors (Marks 1981: 371).

Stratigraphy and History of Excavations

The site of El Khiam is a colluvial "terrace", formed by a combination of fine runoff deposits and coarser screes from thermoclastic decomposition of Cretaceous limestone cliffs cut by the Wadi Khareintun, in the Desert of Judea, some 10 km SSE of Bethlehem. The terrace extends for about 105 meters along the cliff; its highest part is some 12 meters above the present thalweg, and it gradually slopes downward to merge with the wadi floor some 75 meters from the cliff. The slope of the terrace is not uniform, but in its higher part where archeological deposits are concentrated it reaches 18 to 20 degrees, as can be seen in the published profile (González Echegaray 1964: 13, 22).

R. Neuville discovered and first excavated the site in 1933. Unfortunately, he became ill, and was unable to oversee the excavation as carefully as he would otherwise have done. His workmen cut arbitrary spits some 30-50 cm. deep, and consequently the natural strata from which the materials recovered proceed is not determinable. "Il ne fut pas possible lors de la fouille de distinguer les couches géologiques... C'est partout la même limoneuse d'un gris-brun plus ou moins foncé" (Perrot 1951: 134). In May, 1949, J. Perrot, at Neuville's suggestion, visited the site, cleaning a section that permitted him to see stratigraphic differences in its uppermost levels; he also studied and published Neuville's collections (Perrot 1951: 134-178). Despite unanswered stratigraphic questions, the work of Neuville and Perrot left no doubt of the richness of the site and the diversity of the industries represented.

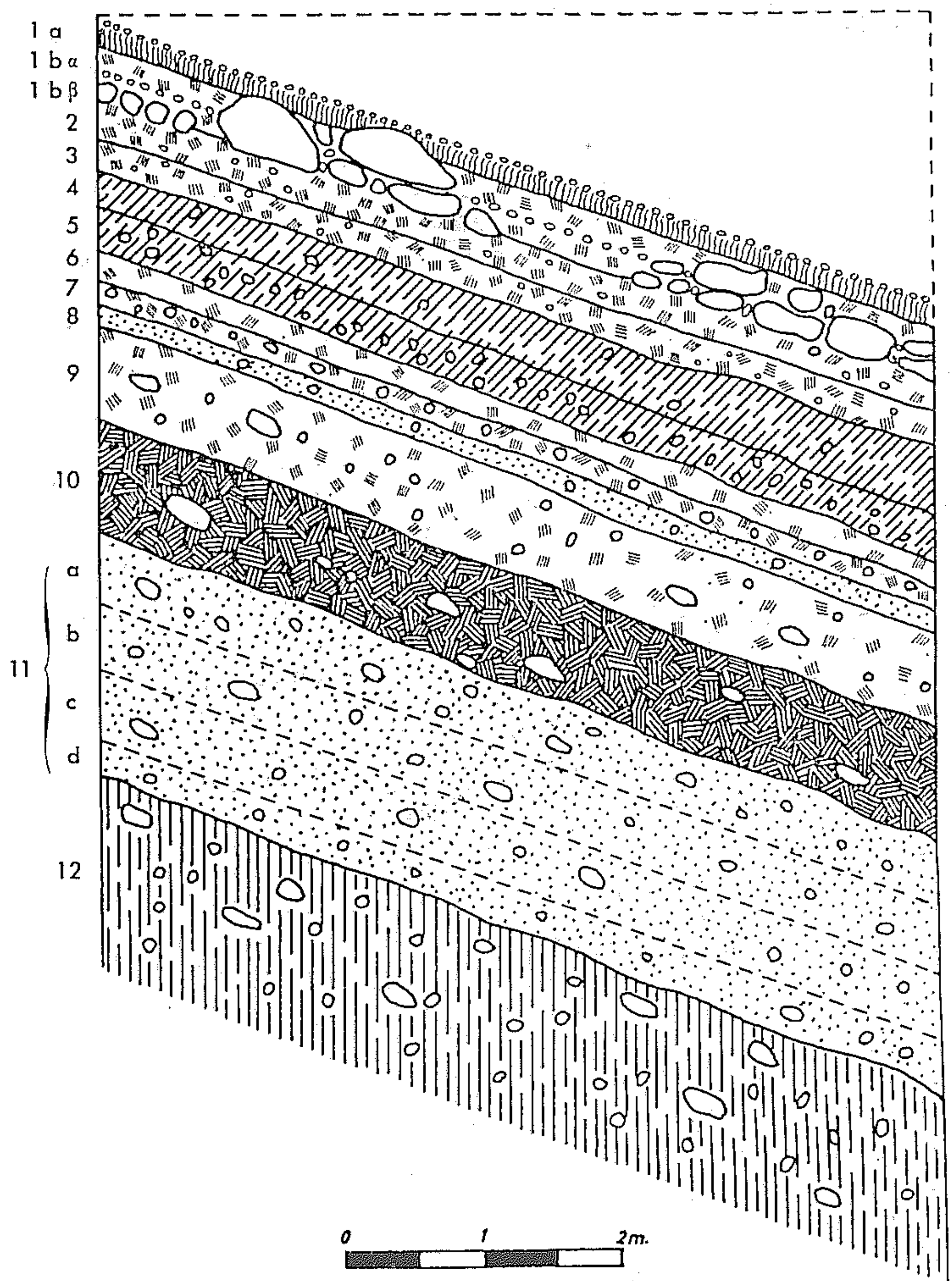
In May/June 1962, at Stekelis' suggestion, one of us (JGE) undertook new excavations at Khiam, opening some 36 square meters (of which only the 18 sq meters on the SW side of the square excavation were taken through the Paleolithic levels), and establishing for the first time a clear and lengthy succession of well-differentiated natural strata (Table 1; Fig. 1), from which nearly 165,000 lithic artifacts were recovered (González Echegaray 1964; 1966: 6). In contrast to previous and then still current practise at many excavations in the Levant, all deposits were screened. Ten of the strata recognized yielded assemblages attributable to Upper Paleolithic (Antelian I-III, called Aurignacian in the 1964 publication, and Atlitian), Epi-Paleolithic (Kebaran) and Prepottery Neolithic (so-called "Tahunian") phases. Two others, separating the Epi-Paleolithic from the Pre-pottery Neolithic levels, were so distinctive in artifact content that they were recognized as phases of a previously unrecognized complex baptised "Khiamian".

Sediments, Flora and Fauna

In the Khiam sequence the passage from Paleolithic to Epipaleolithic horizons (the Atlitian/Kebaran stratigraphic boundary) is marked by a clear change in the nature of the colluvial formation. Thermoclastic processes were apparently more effective in weathering during the Upper Paleolithic than in subsequent levels. Upper Paleolithic climates documented in this sequence were apparently somewhat cooler and moister than was later the case. Granulometry and mineralogy/morphoscopy of the sediments, undertaken by T. Alexaindre and J. Pérez Mateos, support this interpretation.

The fauna from Prepottery Neolithic levels 1 and 2, where bone is relatively well preserved, is dominated by domestic goat (85%), but includes hunted animals as well (14% *Gazella* sp., and traces of *Sus scrofa, Vulpes,* wild ass and a *Bos*). In level 2, bones of goats less than one month old constitute 35% of total caprine remains. Dr. Pierre Ducos, the faunal analyst, treating total bone counts as MNI's, contrasted this very high proportion with much lower expectations for proportions of very young individuals in free-ranging wild herds. In retrospect, while we recognize that his procedures might have been improved, we think that his conclusions may still be correct. Using this and other evidence (Ducos 1968: 133-136, 148) including the identification of 3 morphologically distinctive domesticated goat horn-cores (Vaufrey 1951: 198-217) in what may be even earlier levels (if the "Natufian" spits of Neuville/Perrot are really equivalent to the Khiamian) Ducos recognized the caprines from the Pre-pottery Neolithic at El Khiam as the earliest domestic goats in Palestine.

Fig. 1



Stratigraphic Section, El Khiam (After González Echegaray, 1964)

Bone is poorly and sporadically preserved in lower layers. In Khiamian Level 4, *Vulpes* cfr. *nilotica*, a caprine phalange, and two other bones of small ruminants are represented. There is more *Vulpes, Gazella* sp, and a caprine horncore that may also be from a domesticated goat in Khiamian Level 5. A gazelle horncore was recovered from Antelian II Level 11b (Ducos 1966: 158; 1968: 79-81). This evidence, however, is too scanty to warrant further discussion.

B. Madariaga (1966: 165-171) described the mollusca from El Khiam, finding all to be circummediterranean forms; the terrestrial species were those to be expected in desertic or semidesertic environments, except for a few land snails from coastal habitats. The occasional marine mollusc (*Dentalium, Columbella*), probably transported to the site for adornment, was recovered from Antelian, Atlitian, Kebaran and Prepottery Neolithic levels.

W. Van Zeist, in the first palynological analysis of a prehistoric archeological site in Palestine, recovered pollen from Prepottery Neolithic levels 1b and 2 and Khiamian Level 5. Samples from 1b and 2 were essentially similar, indicating a treeless environment, with abundant chenopods and lesser quantities of composites including many examples of forms appropriate to arid areas ("Noeaea" – type chenopods, *Artemisia,* etc.). Level 5 also yielded a desert-appropriate spectrum, with very abundant chenopods and very few other pollen types (Van Zeist 1966: 173-176).

Artifacts and Features

Important as is the evidence of domesticates and the potential of the site to provide information concerning the evolution of past environments, climates and lifeways, most authorities have treated El Khiam as though its major interest lay in the nature and stratigraphic integrity of its lithic artifact assemblages, subjects that have been and continue to be the focus of debate.

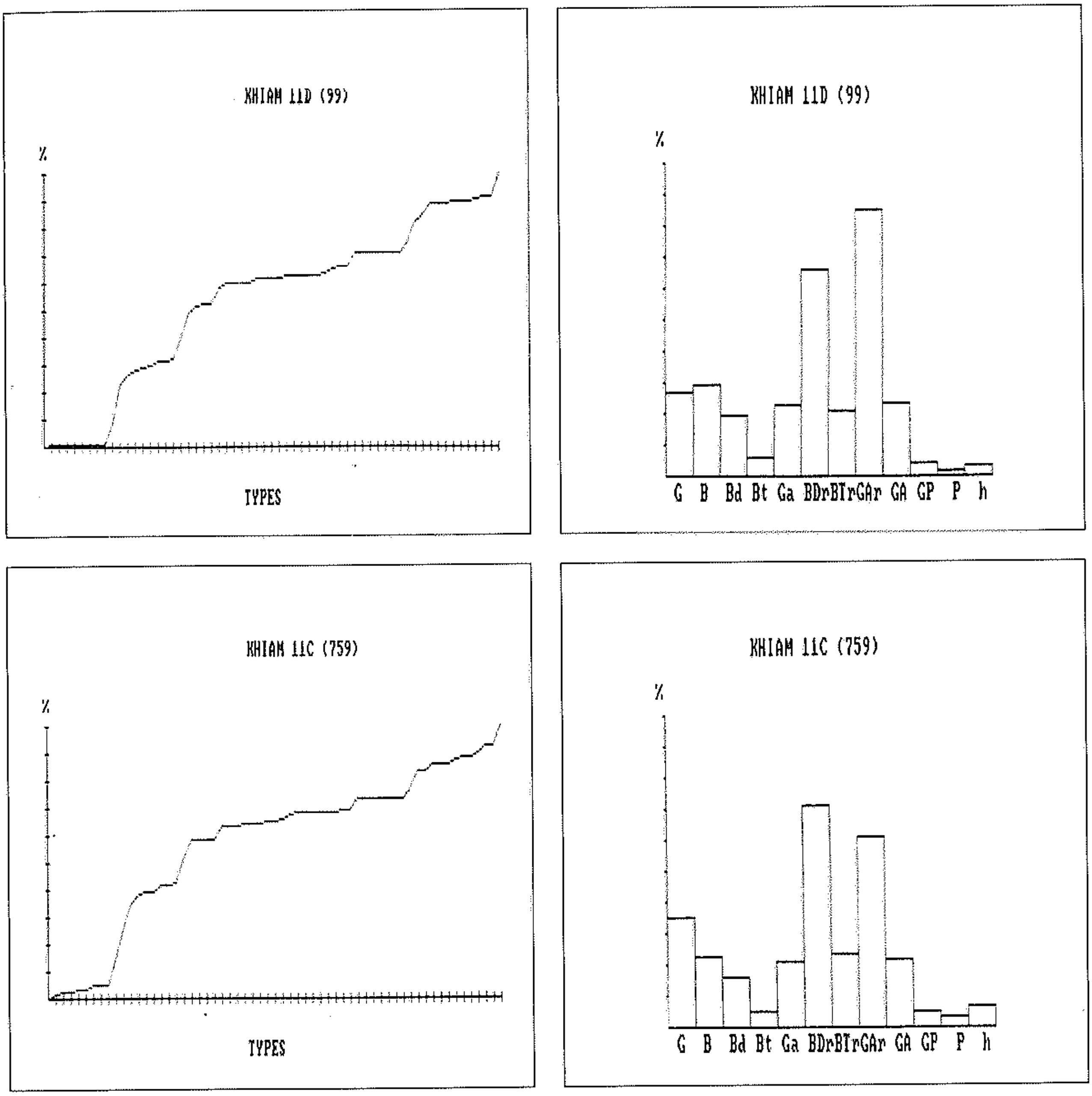
The Khiam stratigraphic sequence is remarkably complete. In superposition it provides a long and full Upper Paleolithic series with examples of all three phases of the Antelian, closing with an Atlitian horizon; these are followed by another well-developed Mesolithic series including three different phases of the Kebaran; the series continues with the two "Transitional" Khiamian levels and closes with three Prepottery Neolithic layers. El Khiam is on its own merits one of the very few basic stratigraphic sequences that are keys to the understanding of regional industrial developments and changing lifeways from the times of Upper Paleolithic hunter-gatherers through the earliest phases of food-production in this part of the Near East. We are not alone in noting the utility of the El Khiam sequence in systematizing the industrial sequence of Palestine (see, for example, González Echegaray 1964, 1966, 1978a, 1978b). As soon as the 1962 excavations were published, other authorities were quick to call attention to the site's fundamental importance (Hours 1966; Prausnitz 1966, 1970: 44 n., 171n.; Gilead, 1977).

I. THE PALEOLITHIC LEVELS

Levels 11d, with 99 retouched tools, and 11c with 759 (Tables 2 & 3, Figs. 2 – 5), both assigned to the Antelian I, are relatively homogeneous in content, though the proportion of burins in 11c is greater than in 11d. In both, the index of Aurignacian types (GA) is more than 4 times greater than the Perigordian index (GP), blades are relatively rare, and nosed and keeled endscrapers are the commonest types. Dihedral burins are also commoner than truncation burins. The microlithic component (Ih) is less than 10%. All these attributes are quite characteristic of some kinds of earlier Aurignacian assemblages in Western Europe as well as the Near East.

However, in Levels 11b (1238 tools) and 11a (1953 tools), assigned to Antelian II, this picture changes (Tables 4 & 5; Figs 6-9). In both levels, the Perigordian index is superior to the Aurignacian index, the index of Aurignacian endscraper types (IGA) has dropped by 50%, and the microlithic component has grown from 7% in 11c to 15.4% in Level 11b and 24% in Level 11a. Levels 11a and 11b have

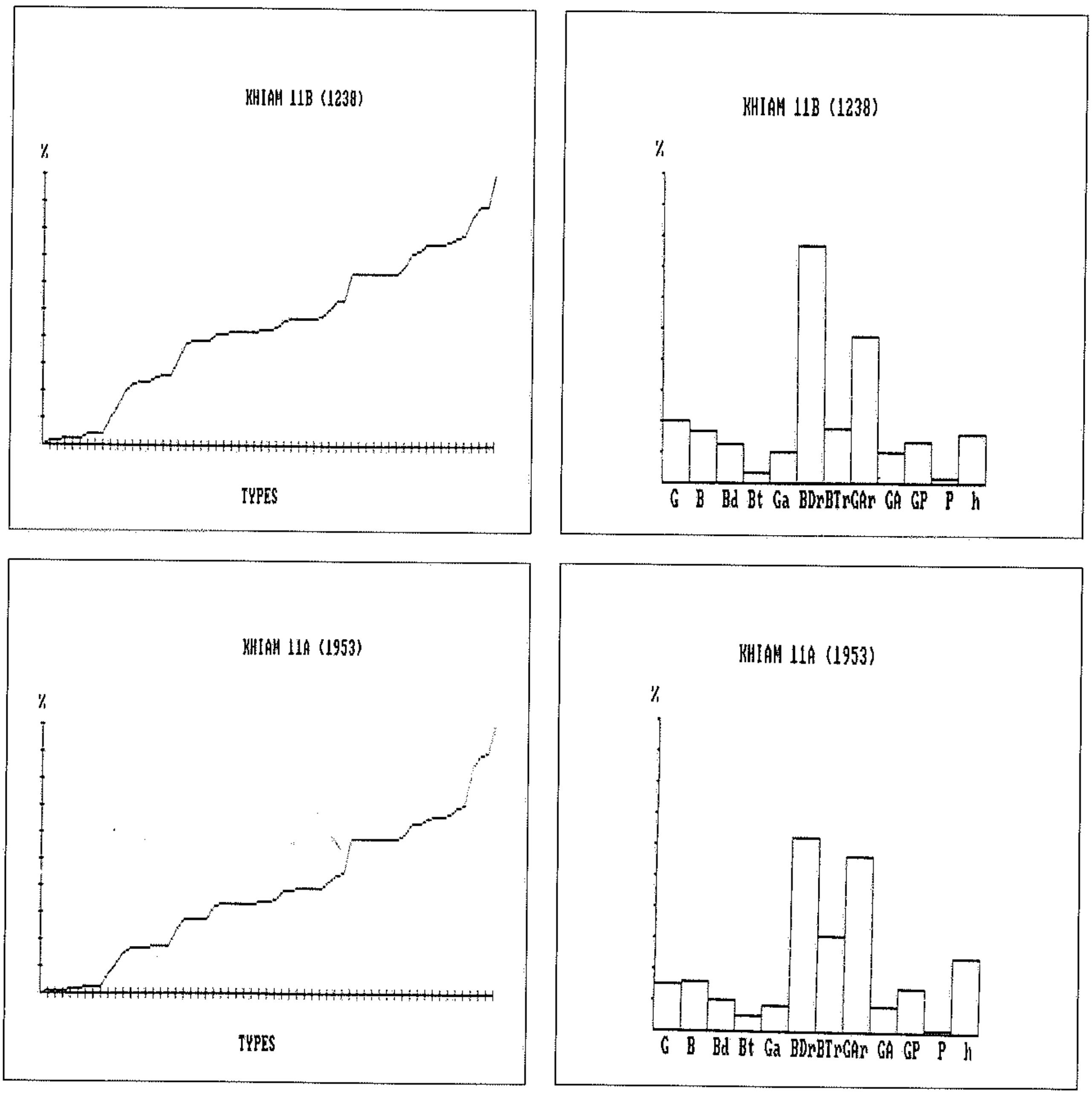
Fig. 2-5



characteristics reminiscent of a blend of what would be considered strictly Aurignacian and strictly Perigordian attributes in Western Europe; this state of affairs is quite common in other Near Eastern Antelian / Levantine Aurignacian assemblages.

Level 10, with 2772 tools, (Table 6; Figs 10 & 11) was assigned to Antelian III. It has some characteristics in common with Levels 11a and 11b – GP greater than GA, index of Aurignacian endscraper types below 9% – but truncation burins, in Western Europe a feature of Perigordian industries, have

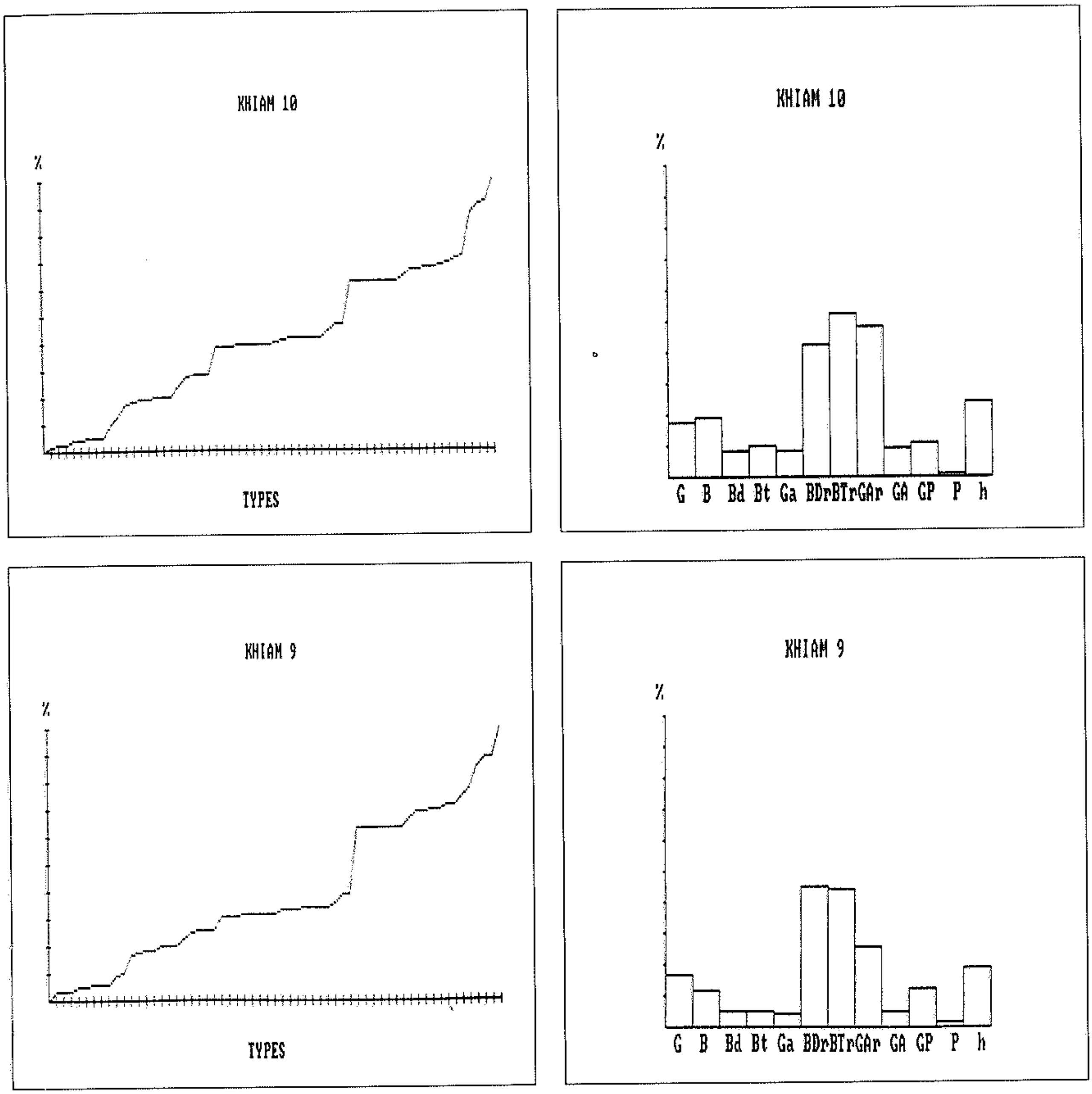
Fig. 6-9



become more abundant than dihedral burins, giving the collection a more markedly "Perigordian" allure. The bladelet index, Ih, remains high (24%).

In the Atlitian level, 9 (1483 tools), while endscrapers (IG) are more abundant than burins (IB), the Perigordian group has risen to almost three times that of the Aurignacian group, and the proportion of Aurignacian endscraper types has been halved again (Table 7; Figs. 12 & 13). The proportion of microlithic pieces has fallen noticeably, however. This phase, also represented at el-Wad, is rejected by

Fig. 10-13



Bar-Yosef (1975), who considers the artifacts from Level 9 to be Kebaran Geometric A. But continuities between the collections from this and earlier levels seem too marked to warrant a separation of this horizon from the preceding Upper Paleolithic manifestations.

The Paleolithic artifact assemblages recovered from the Khiam levels in 1962 are crucial to understanding the development of, and relations between, endscraper/burin-rich and bladelet-rich Upper Paleolithic industries, and the blend of Aurignacian and Perigordian-like features so often found in Upper Paleolithic assemblages in the Near East – features also familiar to the European prehistorian, as hallmarks of what are usually considered different traditions or trajectories of artifact evolution.

I(A). STATISTICAL ANALYSIS OF THE PALEOLITHIC COLLECTIONS

At the time the monographs describing the 1962 excavations appeared, the use of multivariate statistical analyses was only beginning find acceptance in the discipline of prehistory. We have found that these procedures are an indispensable complement to the study and classification of artifact assemblages and levels. The tests we used are described in familiar works by Siegel (1956), Torgerson (1958) and Anderberg (1973). Tests were performed using programs written by Freeman and the SYSTAT package, using an "AT-compatible" desktop computer. The reader who wants further information on those procedures should consult those sources.

The result of these quantitative procedures is not by itself sufficient grounds for proposing or revising the classification of an assemblage; they will only analyze quantifiable data among collections whose attributes have been defined in comparable terms, and many of the morphological criteria employed by a sophisticated classifier are not reflected in any generally applicable quantitative scheme that has yet been developed. If the proportions of different kinds of stone tools are similar in a Bronze Age artifact collection and a Paleolithic collection, statistical analysis might quite reasonably show the two to be very much alike, but no reasonable prehistorian would assign them to the same industrial complex.

On the other hand, certain very useful tests are designed to show whether or not the differences between two artifact collections are too great to be the result of chance, or "sampling error". In this case, the larger the available sample, the more likely it is that relatively small differences will prove statistically significant. This need not mean that the two samples are not related, just that they differ significantly in some respect. A sample of sewing implements including 50 percent needles and 50 percent thimbles is not significantly different from another with 40% needles when the first only includes 16 items and the second only 20. Chance alone could very likely explain such a difference, all other things being equal. But increase the first sample to 1600 items and the second to 2000 and the same percentage difference becomes highly significant. Yet in both cases we are dealing with the same kinds of sewing materials.

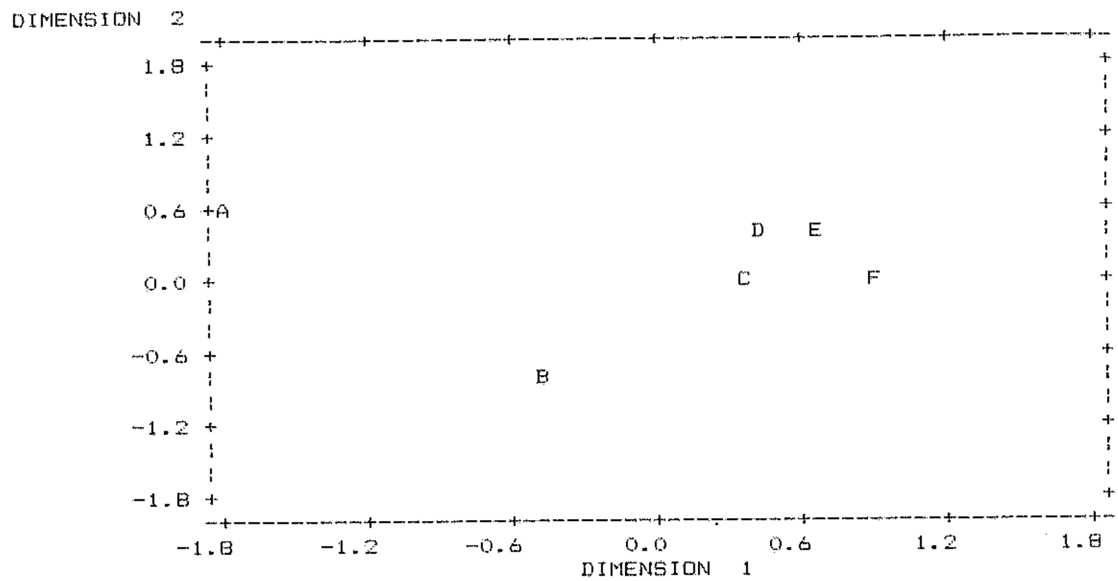
This all means that the results of statistical analyses are worthless unless they are evaluated intelligently. They are simply one more kind of evidence that must be considered together with all else that is known, giving due weight to each. When that guideline is followed, statistical tests are a helpful and important tool for the analysis of artifact assemblages.

As a first step in the statistical study of the Khiam Paleolithic collections, the lists of cumulative percentages that we used to construct the graphs of each collection were compared with each other, using the Kolmogorov-Smirnov two-sample test, to determine the likelihood that observed differences between the proportions of each artifact type in the different collections could be due to chance. In every case but one, the differences between assemblages were so great that there is less than one chance in a thousand that they are simply due to accidents of sampling error. Only in the case of assemblages from level 11d and level 11c was similarity rather than difference observed (one can expect to find as great a difference between samples of these sizes drawn from a single original "population" more than 20% of the time). In this case, similarity reflects the undeniably close relationship of 11d to 11c, not just the relatively small size of the 11d sample.

As we have noted, when samples are large, as they are for the rest of the Upper Paleolithic levels at Khiam, even relatively small apparent differences are significant, and that is what we found in this case. The samples are statistically quite different, no matter how obvious may be the relationships between them.

To detect these relationships where they exist, other procedures, specifically designed for this task, are called for. One measure of relationship is the family of correlation coefficients. For the Khiam case, we performed a rank-order correlation analysis (using Spearman's "r" as the measure of correlation) on the representation of artifacts of each type in each assemblage. Bivariate correlation searches for relationships between pairs of variables (in this case, the Khiam collections). Rank-order correlation tests are distribution-free or non-parametric tests, well suited to data such as these, where sample sizes vary widely

Fig. 14



and the shape and general characteristics of the underlying distribution cannot be predicted before sampling. Since paired zeros would result in many "tied" ranks, weakening the test, all types that were not represented in any collection were first eliminated from consideration, leaving a total of 82 tool types. Also, wherever pairs of zeros were encountered in the calculation of a single correlation coefficient, the types involved were eliminated from that particular calculation.

To get a first impression of the relationships between the levels, we subjected the matrix of correlation coefficients to a test known as multidimensional scaling, using the Kruskal scaling procedure. The data proved well suited to this analysis. The test generated a depiction of relationships that shows a sinuous linear arrangement of the levels, beginning with levels 11d and 11c in well-separated and isolated positions, followed by 11b, 11a and 10 in that order, closely followed in turn by 9 (Fig. 14). The linear trajectory of this plot coincides well with the temporal order of the levels and shows a closer internal resemblance between the Antelian II/III (or later Aurignacian) levels than exists between the two Antelian I (11d, 11c) collections. Atlitian Level 9, at the end of the distribution, is nevertheless quite close to levels 10 and 11a.

Another family of procedures that graphically depicts relationships between these collections, which was used to examine the Spearman correlation coefficient matrix further, is cluster analysis. Figure 15 is the tree diagram depicting relationships between the Paleolithic collections, using a "complete linkage" procedure for "cluster definition" or positioning of the branches. (The single-linkage, nearest neighbor algorithm gave the same results; other clustering procedures in SYSTAT require a different kind of input). The dendrogram gives a comparable idea of relationships, suggesting that the level least similar to the rest is 11d, and next 11c. Levels 10, 11a and 9 cluster together and are slightly offset from level 11b. The assignment of Level 9 to the same cluster as levels 11a and 10 is a point of interest.

These analyses suggest somewhat more continuity and intergradation for the upper part of the Khiam Paleolithic sequence than did previous evaluations, and additionally stress the separation between that part of the sequence and the earlier levels, 11c and particularly 11d. The later Khiam levels have generally higher microlith proportions than the earlier ones, of course, and that is certainly part of what is

Fig. 15

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LINKAGE METHOD IS FARTHEST NEIGHBOR
TREE DIAGRAM
                                        DISSIMILARITIES
     -1.000                                                                 .000
  KHIAM10    -----------
                        |
 KHIAM11A    ----------|
                        |------
   KHIAM9    -----------      |
                              |----------
 KHIAM11B    ---------------            |
                                        |------------
 KHIAM11C    -------------------------               |
                                                     |-----------------------------
 KHIAM11D    ---------------------------------------
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reflected in the diagram. That the value of the microlith component is not the principal determinant of collection relationships is shown by the clustering of the top three levels: were the contrary the case, one would expect a closer positioning of level 11b with 9. In sum, despite the fact that there are undeniable differences between the Paleolithic stages represented, these tests suggest that the levels at El Khiam represent several stages in a continuous trajectory of industrial evolution, and that there is considerable "family resemblance" among the upper levels at least. While enlightening, these results do not call for any substantial reevaluation of the earlier classification.

The Paleolithic collections were also examined with other tests, but the levels are so few in number and the underlying structure of their variation proved so uncomplicated that there is no call for any more elaborate analytical apparatus than this. That also proved true for the Mesolithic/Neolithic levels.

II. THE MESOLITHIC (KEBARAN) AND TRANSITIONAL (KHIAMIAN) INDUSTRIES

As already noted, the sediments from levels 8, 7 and 6 are markedly different in size and morphology from earlier levels; the sedimentological/paleoenvironmental change is paralleled by a notable break in the nature of artifact collections beginning at this point.

The lithic collection from level 8 (541 tools), is characterized by the presence of many endscrapers on blades (though keeled and nucleiform types persist as well), an absolute preponderance of dihedral burins over truncation burins, a significant increase in the abundance of blades, and especially the microlithic component (almost 40% of total tools), and an increase in abundance and variety of point forms and geometric microliths. Levels 7 (277 tools) and 6 (383 tools) share these characteristics, though the proportion of microliths they contain is not quite so high (33.25% for 7 and 33.19% for 6). Font-Yves points are represented in levels 8 and 7, and Sauveterre points, "Type C" points (Tardenois-like, and a good candidate for a formal precursor of the later "Khiam" points) are found in all three levels. "Type B" points (Zonhoven-like) are represented in levels 8 and 6 but not in 7. The proportional representation of points increases from less than 4% in level 8 to 7%+ in level 7 and 5%+ in level 6. Points of Khiam, Byblos, Jericho and Amuq types are absent. In general makeup, these three levels are cleary closely similar, and, we believe, quite different from the levels that follow.

The lithic materials represented in Levels 8-6 were classified by Echegaray as pertaining to various phases of the Kebaran (1966, 1978a: 35). Bar-Yosef's diagnosis of the Khiam levels has evolved greatly over the years. When he admitted the existence of the Kebaran Geometric B as co-extant with the Natufian in Palestine (Bar-Yosef 1970), he attributed levels 9 and 8 to the Kebaran Geometric A, levels 7-5 to the Kebaran Geometric B, and level 4 became Prepottery Neolithic A, with levels 3 and 2. In a later revision (1975), only level 9 remained Kebaran Geometric A, levels 8-5 were Natufian (despite the fact that the peculiar Natufian retouch that characterizes this phase is never represented in those levels), and levels 4, 3 and 2 were called PPNA. Still more recently Bar-Yosef (1981: 402, 562) considers the Khiamian (apparently level 4 alone) both with late Epipaleolithic and Prepottery Neolithic (A) industries, and although this reflects the transitional position of the Khiamian between the Mesolithic and the Neolithic, it nevertheless is somewhat inconsistent.

There are characteristically certain continuities in the types represented in Kebaran, Khiamian or Natufian and Prepottery Neolithic horizons throughout the Levant, not just at Khiam. It is often differences in proportional representation coupled with the appearance of a few artifacts of relatively rare types that distinguishes one from another. In the case of the passage from Khiamian to the full Prepottery Neolithic at Khiam, different decisions are possible, depending on whether one weights continuities in appearance and characteristics of the flaked stone inventory (as we do) or secondary evidence thought to indicate food-production, such as abundant grindstones and the appearance of sickle sheen, more heavily (as does Bar-Yosef). Differences in approach to the taxonomy of industrial complexes at Khiam are, then, quite legitimate and their results less symptomatic of radical opposition than they might superficially seem.

The industry from the next levels, 5 (255 tools) and 4 (320 tools), was originally considered by Neuville and Perrot to be a sort of final Natufian (Perrot 1951). Strictly speaking, we should say that was Perrot's opinion of what we call level 4, since in the 1933 excavations level 5 (Perrot's "C") was apparently sterile. The peculiar nature of the assemblages, with a substantial increase in backed bladelets and geometric microliths (particularly segments of circles and isosceles triangles), the abundance of perforators, and the appearance of El-Khiam points (small triangular side-notched points with truncated bases that first appear in more rudimentary form as "proto-El-Khiam points" in Level 5) sets these levels off from levels 6 and earlier. Kathleen Kenyon, who examined Echegaray's materials, suggested to him that levels 4 and 5 be designated "Khiamian", a usage he adopted and that has been accepted by Prausnitz (1966) and others, including (at least for Level 4) Bar-Yosef himself. However, as we have noted, Bar-Yosef has also stipulated that, while other data from the Salibiyeh basin tend to confirm the peculiar identity of the Khiamian, the "detailed techno-typology of the Khiamian has yet to be worked out" (1981a: 402); elsewhere he says: "in view of the natural mixtures at El Khiam and Nahal Oren, the term might be retained but the lithic characteristics should be drawn from other sites" (Bar-Yosef 1981b: 562). Bar-Yosef's reservations about the representativeness of the Khiam assemblages will be discussed further, below.

In Level 4, endscrapers become more abundant than they were in Level 5, and the first sickle-blades with characteristic sheen appear. Mortars and pestles are also found in abundance, and a single unbaked clay "female" figurine was found. Bar-Yosef classifies this level as Prepottery Neolithic A, but in other respects its contents are identical to those of Level 5, including the abundance of microliths and the characteristic Khiam points, and we prefer to regard both levels as variants of a single complex in the course of its development. These levels have the potential for providing much information on the early stages of introduction of domesticants into the southern Levant.

III. THE PREPOTTERY NEOLITHIC

Echegaray (1966) classified levels 2 (1138 tools) and 3 (397 tools) as Prototahunian (Pre-pottery Neolithic A); to Bar-Yosef, they are also PPNA. In Level 3, not counting points, over 11% of the flake tools are backed bladelets, but geometric microliths (here segments of circles) have dropped in frequency to just 12%. Perforators become rarer, but burins, of which most are dihedral, increase to 20% of the collection. There is a single sickle blade, and no grindstones were recovered – an indication of the difficulties in using such evidence to indicate industrial affinities. There are a few Khiam points, as well as an invasively-trimmed partly bifacial stemmed form like those more abundantly represented in later levels. A single example of a "Type A" point (acutely oblique transverse truncation extending from tip almost to base) was found in level 3.

Level 2 shows an increase in bifacially trimmed pressure-flaked stemmed and foliate points, and a much finer, thinner variant of the Khiam form, in an assemblage in which burins (23%) and endscrapers (15%) continue dominant. Backed bladelets are as numerous, and geometric microliths about as abundant, as in Level 3. The total microlithic component in these levels is high, and the abundance of microburins in Level 2 particularly notable. Jericho, Byblos and Amuq points are represented in level 2 as they are also in level 1. For Bar-Yosef, both these levels are Prepottery Neolithic A, and so far as age and evolutionary stage represented are concerned, this does not disagree with Echegaray's assessment.

The lower units in Level 1 (1848 tools), both containing structures, were classified by Echegaray as "Tahunian" (a regional variant of what is elsewhere called Prepottery Neolithic B). The assemblages contain points of Jericho, Byblos and Amuq I types, large bifacially trimmed foliate blades, the occasional Khiam point, endscrapers in good numbers and even more abundant burins, grindstones, sickle blades, and some 40% microliths (including microgravettes and "microchatelperrons"). Bar-Yosef has also expressed reservations about the observed high microlith proportions in the Pre-pottery Neolithic at Khiam (as at Nahal Oren).

III(A). STATISTICAL ANALYSIS OF POST-PALEOLITHIC LEVELS

The same set of statistical procedures used to examine relationships between the Upper Paleolithic levels was also used in the analysis of levels 8 through 1.

The results of the first of these, the Kolmogorov-Smirnov two-sample test, are presented in Table 8. As was the case for the earlier levels, relatively small differences between some of the Mesolithic/Neolithic levels proved to be statistically significant, due to large sample sizes. Level 1 proved different from all other levels, according to this test, and level 8 from all levels but 7. Since these levels occupy the ends of the series, it is not surprising to find that they differ, nor is the relationship between levels 8 and 7 in any way striking. However, the relationships indicated for the other levels are frankly perplexing. Level 7 resembles all the other levels but level 1; level 5 proves statistically dissimilar from level 4 and only like level 7; level 4 is like levels 7, 6 and 3, and level 2 only like levels 7 and 6. All that can be legitimately affirmed from these data is that there is more apparent intergradation and continuity between the earlier and later part of the post-Paleolithic sequence than one would originally have predicted. Relationships between other levels are harder to assess because the generally large sample size obscures them. As we pointed out earlier, the Kolmogorov-Smirnov test was designed to detect significant difference, a job it has done all too well. We must look to other tests to define relationships.

Using the Kruskal algorithm for scaling the matrix of Spearman rank-order correlation coefficients, we obtained the graphic plot of relationships shown in Fig. 16. The diagram shows that level 8 stands alone, as does level 1. Levels 7, 6, and 5 form a small and tight-knit group. Levels 3 and 2 form another, separated from the rest. Level 4 is set apart as something quite different. The plot suggests that level 8, the Kebaran I, is quite different from the later Kebaran (7 & 6), and that level 5 is a further step in the evolution of these levels. The Prepottery Neolithic levels are different from all of these, and fall into two groups, levels 3 and 2 on the one hand, and level 1 on the other.

The complete linkage cluster analysis (Fig. 17) shows these relationships perhaps more clearly. The dendrogram sets level 8 apart from all the rest. In the remaining levels, 4 is different from the rest. Levels 6 and 7 go together, and with level 5. Levels 3 and 2 go together, and they with level 1. The following interpretation is indicated by these observations: the postpaleolithic sequence begins with a level (8: Kebaran I) that is quite distinctive. The remaining levels are all more closely related, suggesting that they may represent the *in situ* evolution of a related series of industrial complexes.

Fig. 16

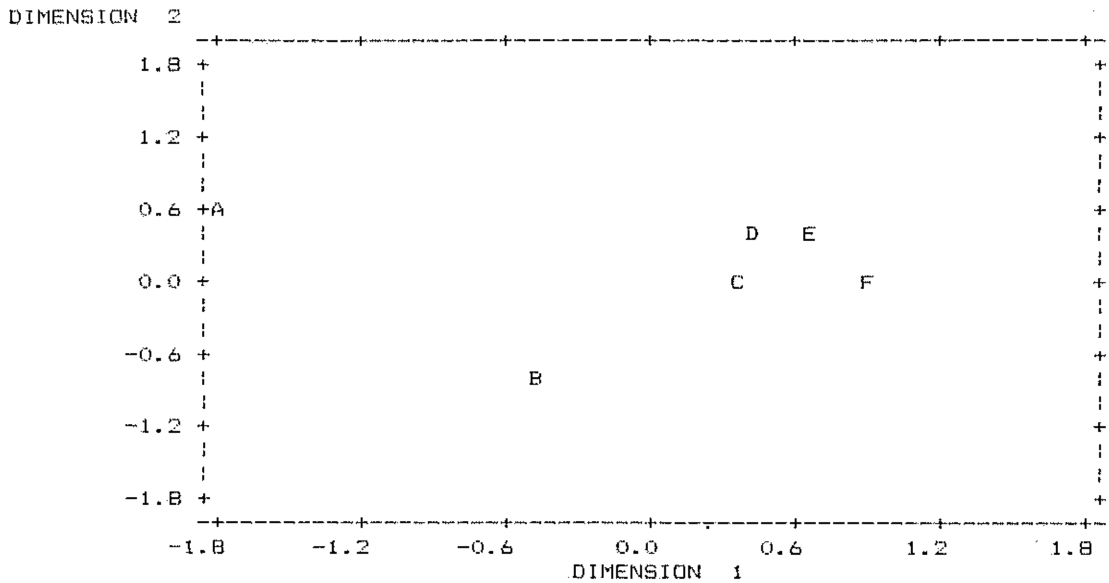
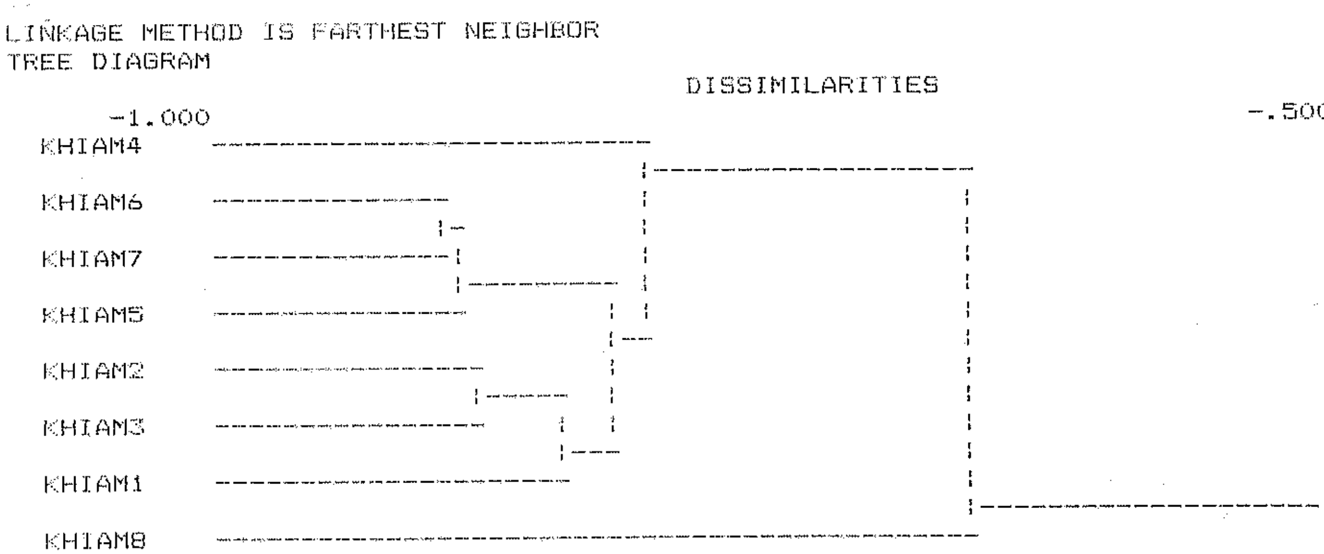

DIMENSION 2
1.8
1.2
0.6
0.0
-0.6
-1.2
-1.8
A
B
C
D
E
F
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
DIMENSION 1

Fig. 17


LINKAGE METHOD IS FARTHEST NEIGHBOR
TREE DIAGRAM
DISSIMILARITIES
-1.000
-.500
KHIAM4
KHIAM6
KHIAM7
KHIAM5
KHIAM2
KHIAM3
KHIAM1
KHIAM8

Levels 7 and 6 (Kebaran II and III) represent the next stage in the sequence, with level 5. If we take as facts of primary importance the morphology of certain pieces that appear for the first time in level 5 and continue in level 4: the "Khiamian" perforators, stone bowl, pestles and the "proto-Khiamian" point, level 5 can legitimately be called "Khiamian I"; if on the other hand, the overall similarity of Level 5 to levels 6 and 7 is our guide, we might equally admit level 5 to that group. We now see more clearly the justification of Bar-Yosef's classification of level 5 with levels 7 and 6 (but *not* level 8!) as members of a single industrial complex, whatever one chooses to call it.

That is not the case for level 4, however. It stands by itself. We believe that it is level 4 at Khiam that should serve as the type-collection for the definition of the Khiamian; El Khiam is, in the first place, the eponymous site for the complex as it was first defined; the collection from level 4, with 320 pieces, is the largest Khiamian assemblage known, and the difference shown in these plots between level 4 and the other levels is an adequate guarantee that the collection is uncontaminated by admixture with overlying or underlying horizons.

The segregation of levels 3, 2 and 1 from the rest corresponds nicely to their unique position in the evolutionary sequence: they are the pre-pottery Neolithic levels. What is more, the union of 3 and 2 and their separation from 1 confirms the diagnosis of the former levels as one kind of pre-pottery Neolithic (A = local "Prototahunian"), and level 1 as another (Pre-pottery Neolithic B; in this case so-called "Tahunian").

In this case, the statistical tests do suggest the possibility of a defensible modification of the earlier classification of these levels. That involves the union of level 5 with levels 7 and 6, and its distinction from level 4, here proposed as the formal type of the Khiamian. The reanalysis implies that, based on the quantitative evidence, we now better understand Bar-Yosef's assignment of level 5 to another complex, also including levels 7 and 6 – from this perspective, his position is not unreasonable. It is nonetheless a fact that the qualitative evidence (a kind of evidence not really reflected in these statistical tests) of the first appearance of the traits that characterize the Khiamian of level 4 – stone bowls, pestles, particular kinds of perforators, and the proto-Khiam point – first makes its appearance at the end of that earlier developmental trajectory represented by levels 7, 6, and 5.

Reservations and Response

The publication of the 1962 excavation was generally very well received, despite the fact that they produced a good many new interpretations of the stratigraphy and assemblages: there was in fact visible stratigraphy in the lower part of the sequence; instead of a two deep, intergrading and indivisible Upper Paleolithic horizons there were several thinner, differentiated strata with distinctive industrial contents; one level earlier thought sterile (5 = Perrot's "C") proved a rich source of artifacts; levels previously assigned to the Natufian were idiosyncratic enough to be assigned to a new Khiamian complex; and, perhaps most important, there proved to be large numbers of microliths in Upper Paleolithic, Transitional/Khiamian and Prepottery Neolithic levels. Inevitably, the new results required a revision of the interpretation published by Perrot almost 15 years earlier – an interpretation based on material excavated in the 1930's (Perrot 1951).

There were about 50 microliths in Neuville's 1933 collection from the poorly-stratified higher Upper Paleolithic level Perrot called "E", but since the overlying "Natufian" level, D, contained bladelets of the same sort, Perrot rejected these pieces as intrusive (Perrot 1951: 146-7). Even in the 1960's, there was still some misplaced skepticism that assemblages with a high microlithic component could really be Paleolithic – microliths, it was thought, became common only in the Mesolithic, and, at the time, the collections from levels 11b-9 were remarkable in the Near Eastern Upper Paleolithic for their high proportions of trimmed bladelets. However, it is not hard to find an obvious explanation for their supposed absence from Near Eastern collections made prior to the 1960's, and for their relative abundance in the 1962 excavation – sediments from prehistoric sites were screened only rarely, but in 1962 all the excavated Khiam deposits were assiduously passed through finemesh screens.

In the 1950's, bladelets and other microliths were also wrongly supposed to be absent from or rare in Western European Upper Paleolithic collections; there was a widespread equation of microlithic assemblages with Mesolithic industries, not Upper Paleolithic ones. This opinion was, however, soon to change; now, of course, it is generally realized that they are a common component of carefully excavated Upper Paleolithic assemblages.

In her masterful systematization of the Upper Paleolithic of the Perigord, D. de Sonneville-Bordes reported Upper Paleolithic levels – even very early ones – with proportions of backed bladelets that exceed those from the Khiam Antelian/Aurignacian (Level F at Laugerie Haute had 28% of such pieces), and in Aurignacian Level 8b in our own excavations at Morin they were 26% of retouched tools (de Sonneville-Bordes 1961; González Echegaray and Freeman 1978). In later levels, they are often even more numerous: in our recent excavations at the Cantabrian Lower Magdalenian site of El Jugo in Spain (see Barandiarán, *et al.* 1987), tiny retouched bladelets are usually 25-30% of the retouched tool assemblages, and in level 6 constitute 41% of the 602 retouched tools recovered at this writing. Even geometrics, such as triangles, occur with some frequency in levels as early as the Upper Perigordian (González Echegaray 1987 provides more information on this subject). In short, finding large proportions of microlithic pieces in Western European Upper Paleolithic levels no longer provokes astonishment.

Accumulating evidence indicates that microliths are no more out of place in the Near East. Yet when such discoveries are made in Near Eastern sites – as, for example, in Tixier's 1971-75 excavations at Ksar ᶜAqil (Tixier and Inizan 1981), or in the case of the bladelet-rich assemblages from Kadish Barnea, Gebel Maghara, Ain Aqev East, Wadi Sudr, Erq-el-Ahmar and the Lagama occurrences assigned by I. Gilead (1981) to the Ahmarian – they are still considered unusual enough to warrant special discussion. As one might have predicted, the abundance of microliths in the Upper Paleolithic levels at El Khiam soon drew critical comment.

Apparently, the equation of microliths with Mesolithic industries led to an extension of this criticism to the Transitional (Khiamian) and Prepottery Neolithic levels at the site. Most important and vocal of the critics was Perrot himself, who observed: "les difficultés d'ordre stratigraphique que présente la terrasse d'el Khiam ne paraissent pas d'avoir été résolues par la fouille qui y fut conduite en 1962... Dans les conditions de dépôt qui sont celles de cette terrasse en forte pente, lés mélanges sont inévitables. Introduire l'appellation de Khiamien pour un matériel qui, selon toutes les apparences, n'est pas exempt de mélanges, ne contribue pas à la solution du probléme" (Perrot 1968: 367). In 1951, Perrot, who had examined the inclination of the terrace beds – even more marked in Neuville's excavations than in Echegaray's – did not note it as an obstacle to his analysis. The tone of Perrot's comments is not that of a fair and impartial investigation; it sounds rather like reproof of research that reconsidered some of his own earlier work.

Other modern workers, among whom Bar-Yosef has been most influential, have not been inclined to investigate or challenge Perrot's assessment, opting instead to repeat it as if it were their own: "...the reader is reminded of the difficulties, even when the most accurate methods of excavation are practised, to recognize possible natural mixtures of microlithic pre-Khiamian industries with the later one in terraces where slope deposits are mixed due both to natural and to human activities, such as levelling, building, etc."; it is asserted that, given the difficulties of the stratigraphy, the "detailed techno-typology of the Khiamian has yet to be worked out" (Bar-Yosef 1981a: 403; 1981a: 557). It should be noted that Bar-Yosef does not mean to suggest that the Khiamian does not exist: the validity of the phase is commonly accepted, as is the name "Khiamian". He only questions the use of the Khiam collections to typify the phase, because: 1) the sediments accumulated on an exaggerated slope; and 2) there are buildings in the Prepottery Neolithic levels, whose foundations might have penetrated Mesolithic horizons.

These assertions have been repeated by many others. The most recent case that has come to our attention is that of Schyle and Uerpmann (1988), who state: "the most complete sequences at Nahal Oren and El Khiam are however the most problematic ones as well: most scholars accept that at El Khiam the terrace slope has resulted in mixed industries".

These allegations about the El Khiam sequence raise a truly significant general issue: that of establishing and verifying the reliability of any archeological assemblage. The implications of this issue are or should be disturbing as well as interesting to us all. We all know that collections that are untrustworthy because they were naturally disturbed or incompetently excavated do in fact exist. It would certainly be misleading to build interpretation on such untrustworthy collections. But we will be led equally far astray from the truth if, for insufficient or inappropriate reasons, we refuse to give proper weight to valid and well-excavated assemblages.

Unfortunately, it is always much easier to cast doubt – even unjustified doubt – on a body of data than it is to dispell doubts once they have spread. We had hoped by this time to verify the Khiam stratigraphy and assemblage compositions through further excavations, but it now seems unlikely that we shall be able to do so in the near future; for the moment the case rests on the data in hand. We believe that, if fairly heard, they are sufficient.

In fact, the slope of the deposits at El Khiam is not so great as to lead one to suspect wholesale admixture between levels. Clearly, the strata do slope: their inclination attains 20 degrees in places. Even on slopes as small as 5 degrees, there is inevitably some downslope movement of unprotected and unconsolidated material – creep and gliding due to gravity. However, to result in mass movement such as slumping or solifuction that might produce major mixture of the contents of different levels in such midslope gradients as that of Khiam, the sediments must be moisture-saturated, and despite increased precipitation during the Upper Paleolithic occupations, there is no evidence that rainfall was ever so intense as to produce this effect. Massive slumping or debris slides are not expected on gradients like that at Khiam under the applicable climatic/environmental conditions of deposition. The angle of repose of unlubricated sandy sediments – the slope angle at which the friction of dry particles prevents the deposits from slumping – is attained when the slope reaches 28 to 30 degrees, and for coarser sediments is about 30-35 degrees (see Lahee 1961: Butzer 1976). The gradient of the Khiam terrace deposits is not nearly as steep as these figures. There is not sufficient reason to suspect that the Khiam gradients would result in wholesale mixing of the sediments, as Perrot and Bar-Yosef evidently suppose.

Nor is the slope of the Khiam deposits truly exceptional for a prehistoric site. Beds that incline as much as 20 degrees are by no means rare in prehistory. In fact, many well-known and universally accepted Paleolithic stratigraphies in Europe formed on slopes that are as great or greater than the El Khiam deposits, and they are not considered unreliable. That is true even for some sites that are commonly accepted as "type-localities" for the complexes they contain.

For example, the slope of sediments at Caminade also attains 20 degrees (de Sonneville-Bordes 1961: 75). The gradient at Badegoule reaches 22 to 25 degrees (de Sonneville-Bordes 1961: 299; Cheynier 1949); the slope at Pataud is often 24 degrees or more (De Sonneville-Bordes 1961: 75; Movius 1975); the Noaillian levels at the Roc de Gavaudun slope from 25-35 degrees (Tensorer 1981: 239-244); the Late Paleolithic site of Abri Gay has clearly stratified and supposedly reliable levels on a 22-30 degree slope – in fact gradients are sometimes even steeper (Bintz and Desbrosse 1979: 242; Bintz and Loebell 1976: 245). In some of the more striking cases, the excavators noted that some degree of downslope movement of lubricated sediments had in fact taken place, but the contents of the levels are still considered to be reliable assemblages. Those cited are just a few of what are a very large number of well-known and trusted Upper Paleolithic sites with gradients sometimes greater than those at Khiam. There are several other examples in the literature, and there would be more but for the fact that most excavators of shelters choose to publish frontal sections (paralleling the cliff face) since the strata viewed from that perspective are more horizontal and seem more legible than in sagittal profiles (perpendicular to the rock face) such as that published for Khiam. In short, were the profession to adopt the rule that strata on slopes of 20 degrees or more cannot be trusted we would have to throw away much of what has been learned about world prehistory.

As we have noted, there is no reason for surprise at the high microlith proportions in the Khiam levels. But even if there were, one would still have to explain them as coming from somewhere in the stratigraphy. However, there are no suitable sources either higher or lower in the section than the disputed levels themselves; it is very unlikely that the microliths could derive from either later or earlier deposits. The lowermost two levels – 11d and 11c – contain perfectly ordinary, unexceptional Antelian 1 materials, with small proportions of microliths. Microliths first appear in abundance in 11b and 11a. The stratigraphy is quite clear enough to demonstrate that these levels are almost two meters below the earliest Mesolithic horizon in the terrace. Mixture with Mesolithic levels in this case seems out of the question, and there are no earlier sources of the supposedly "intrusive" material.

Nor does the concentration of microliths by downslope movement and gravity sorting explain their high proportions. Since the 1962 excavations were sited above the steeper part of the terrace, where gradient is considerably gentler than in the area excavated by Neuville, downslope movement of sediments should have swept the light, small microliths away downslope from the area excavated by Echegaray, into the area excavated by Neuville and even beyond, but instead they were more numerous on the gentler upslope gradient. The self-contradiction in this explanation is obvious. We conclude that either size sorting was *not* marked or else the higher parts of the slope had absolutely incredibly dense concentrations of microliths before size assortment began. The second alternative is harder to accept than the moderately high microlithic proportions actually encountered in the 1962 excavations.

The assertion that high microlith representation in the Prepottery Neolithic is solely due to levelling and digging activities undertaken by PPN peoples in the course of building construction, activities that mixed PPN residues with microlithrich Mesolithic debris, seems on the face of it more reasonable. The PPN horizons do overlie microlith-rich levels. But, as the published sections and photographs (Echegaray 1964: 21, 22, plate 5; 1966: plates 1-3) indicate, the buildings in Level 1 are surface structures: they were built atop and conformable to the terrace slope, they are not dug into it. (As an aside, one cannot help but wonder why a slope sufficient to churn the archeological levels would not have destroyed the structural remains, as well). What is more, high concentrations of microliths were found in a fill atop the stone pavement of the floor of the walled structure in Level 1b (b). Unless this structure was deliberately filled with excavated earlier rubble (contrary to all evidence) instead of gradually filling with later garbage, one might logically suppose, as we do, that there was continued production of microlithic implements during the Prepottery Neolithic.

These observations seem to us effectively to undermine the objections to the El Khiam assemblages that we have summarized above.

The El Khiam Assemblages in Regional Context

The El Khiam assemblages potentially make an important contribution to our understanding of the evolution of regional artifact industries. Unless they are taken into consideration, reconstructions of local developmental trajectories are bound to be erroneous; these, in turn, will suggest a number of "false trails" for further investigation, leading competent professionals to invest their valuable time in fruitless research. The evidence suggests that this has already happened.

I. Gilead has observed that in the Sinai and Negev, the blade-bladelet rich assemblages he calls Ahmarian after Erq el-Ahmar seem to antedate the endscraper/burin assemblages assigned to the Levantine Aurignacian. (Though Erq-el-Ahmar, excavated and published by Neuville (1951) was relatively well excavated for a site dug in the 1930's, most of its levels yielded very small artifact collections; in this case, what we believe to be unreasonably small samples have been chosen to typify an early Upper Paleolithic industrial complex in the Near East). Others, such as A. Marks, have accepted the idea of a division of Upper Paleolithic assemblages in the Levant into two distinctive and parallel traditions: one blade/bladelet-rich, endscraper/burin-poor (Gilead's Ahmarian), the other with high proportions of endscrapers and burins (the "Levantine Aurignacian", or part at least of the Antelian).

Some well-excavated assemblages will not fit this pattern. Marks notes that many of the Ksar 'Aqil levels, dominated by blade and bladelet tools, nevertheless have higher endscraper/burin proportions than the Ahmarian as defined by Gilead, wondering whether this may suggest "a northern Levantine facies opposed to what we see in the south" (Marks 1981: 371) or a functionally different (cave-related?) Upper Paleolithic facies. If the Khiam assemblages are considered, however, there is already a parallel case in the south (Khiam 11b, 11a, 10) that is not "cave-related".

Chronological, non-temporal "stylistic", and functional relationships between so-called Ahmarian, "endscraper/burin-rich Antelian", and "bladelet-rich Antelian" assemblages are not in fact determined, and it is a mistake to think that they can be unless the long Khiam stratigraphy and its rich assemblages are considered. But authorities such as Bar-Yosef, or Marks, whose work has been responsible for the recognition of such assemblages in the Negev and Sinai, have not incorporated the Khiam Upper Paleolithic assemblages appropriately into their interpretive frameworks. In fact, I. Gilead himself (1981: 340, Table 1) cites only the Neuville excavation at Khiam, as though he were unaware that there had been any further work at the site in the last 35 years. The fact that the monographic publication of the Khiam excavations is in Spanish is scarcely an acceptable excuse for such omissions.

Broader Implications

The debate about El Khiam, however important from our perspective, is symptomatic of a much more fundamental philosophical problem with the broadest theoretical implications for syntheses of the evolution of industrial complexes. The artifact samples for the Antelian, Khiamian and Prepottery Neolithic levels at Khiam are relatively larger than comparable samples from many other sites. Yet, in our opinion with little or no justification other than unsubstantiated allegation, it has been suggested that the Khiam assemblages be ignored, and that smaller assemblages from other sites should be substituted as "type-assemblages" for the Khiamian as well as other phases represented at Khiam (see, for example, Bar-Yosef 1981c).

Such a practise runs counter to every basic theoretical and statistical principle of prehistoric research. Unless there are reasonable grounds for distrusting large assemblages, they are the asemblages of choice that must be used to establish the range of variation in the industrial facies they represent. When attempting to characterize different assemblage types, one's first resort should always be to the largest well-excavated assemblages available, rather than to smaller collections. Just because of their restricted size, small samples from a particular facies or industrial complex simply cannot represent the variability of artifact types and attributes that characterizes that complex as fairly as can bigger assemblages.

From the preceding presentation, the importance of the Khiam assemblages as they represent local industrial characteristics should be obvious. Incorporation of the Khiam assemblages in the larger picture of the evolution of artifact complexes and adaptations in the Near East can throw considerable light on such problems as the evolution of domestication, the adaptive significance of endscraper/burin-rich and bladelet-rich Upper Paleolithic industrial complexes, and the correlates of what from the standpoint of the European Paleolithic specialist seems to be a curious blend of Aurignacian and Perigordian features that appears in many Upper Paleolithic manifestations in the Near East. These are subjects of fundamental interest to a much wider audience than that of regional specialists. Dismissing or simply ignoring the Khiam results is not only unjustified but will prove dangerously misleading if, as we believe, the collections are trustworthy indications of real trajectories of cultural development.

TABLE I

STRATIGRAPHY AT EL KHIAM

The 1962 excavation revealed a total of 12 levels, distinguishable in sedimentology as well as in artifactual contents. From top to bottom of the section they are:

1. 60 cm of tan earth and fine gravel. 64,302 lithic artifacts, 2.87% finished tools. Divisible.

1a. 20 cm of humus rich, plowed soil with mixed artifactual contents.

1b (a). 20 cm. Level of circular, stone-walled hearths, 1 m in diameter, with Pre-pottery Neolithic B artifacts (old "Tahunian"). Hearths conform to slope.

**** Discontinuous level of gravel ***

1b (b). 20 cm level containing a 1 m thick stone structure wall – double row of large blocks, intervening space filled with smaller stones. Structure conformable to slope, not "dug in". More "Tahunian" material.

2. 20 cm of lighter tan earth with some rolled cobbles and scattered small gravel. 21,883 stone artifacts, 5.2% finished tools. Prepottery Neolithic A ("Prototahunian").

3. Ca. 20 cm of darker tan earth with abundant fine gravel. 5685 stone artifacts, 7% finished tools. Prepottery Neolithic A ("Prototahunian").

4. Between 30 and 45 cm (deepening downslope) of grey silts and small gravels. 3997 lithic artifacts, including 8% finished tools. Transitional (Khiamian II).

5. Ca. 30 cm of blackish-brown earth, apparently highly organic. 3706 artifacts including 7.4% finished tools. Transitional (Khiamian I).

6. 20 cm of light tan silts with sporadic larger and smaller "gravel". 4196 artifacts; 9.1% finished tools. Mesolithic (Kebaran).

7. Ca. 18 cm of darker tan silts and small gravels. 3341 lithic artifacts, including 8.3% finished tools. Mesolithic (Kebaran).

8. Ca. 13 cm of slightly sandy grey silt with scattered gravel-size inclusions. 6433 stone artifacts, of which 8.4% are finished tools. Mesolithic (Kebaran).

9. 70 cm of light silts with angular detritus and some large blocks. 9651 artifacts, 15.4% finished tools. Late Upper Paleolithic (Atlitian).

10. Ca. 95 cm of compact lighter tan silts, with angular detritus and large blocks. 14897 lithic artifacts include 18.6% finished tools. Upper Paleolithic (Late Aurignacian = Antelian III).

11. 1.8 meters of still lighter tan, slightly sandy silts with angular blocks and gravels. Subdivided.

11a. 50 cm. 10801 artifacts, 18.1% tools.

11b. 50 cm. 7698 artifacts, 16.1% tools.

(These levels contain a somewhat more "evolved" industry than the lower subdivisions. Both contain "Middle Aurignacian" = Antelian II industrial materials).

11c. 50 cm. 6433 artifacts, 11.8% tools.

11d. 30 cm. 1096 artifacts, 9.0% tools.

(These levels are lighter in color than the upper subdivisions. Both contain "Primitive Aurignacian" = Antelian I tools).

12. More than 1 meter: bottom not certainly reached. Darker brownish-tan silts with large stones and lenses of clay. Stone artifacts are only found in the upper part of this horizon, and are possibly intrusive from Level 11.

(Data from González Echegaray 1964: 19-25 esp., 1966).

TABLE 2

KHIAM 11D

TYPE	NUM.	PERCEN	CUM. PERCEN	TYPE	NUM.	PERCEN	CUM. PERCEN
1	1	0.0101	0.01010	41	0	0.0000	0.59596
2	0	0.0000	0.01010	42	0	0.0000	0.59596
3	0	0.0000	0.01010	43	2	0.0202	0.61616
4	0	0.0000	0.01010	44	0	0.0000	0.61616
5	0	0.0000	0.01010	45	0	0.0000	0.61616
6	0	0.0000	0.01010	46	0	0.0000	0.61616
7	0	0.0000	0.01010	47	0	0.0000	0.61616
8	0	0.0000	0.01010	48	0	0.0000	0.61616
9	0	0.0000	0.01010	49	1	0.0101	0.62626
10	0	0.0000	0.01010	50	0	0.0000	0.62626
11	6	0.0606	0.07071	51	0	0.0000	0.62626
12	1	0.0101	0.08081	52	0	0.0000	0.62626
13	10	0.1010	0.18182	53	0	0.0000	0.62626
14	5	0.0505	0.23232	54	0	0.0000	0.62626
15	3	0.0303	0.26263	55	0	0.0000	0.62626
16	2	0.0202	0.28283	56	0	0.0000	0.62626
17	1	0.0101	0.29293	57	1	0.0101	0.63636
18	0	0.0000	0.29293	58	0	0.0000	0.63636
19	0	0.0000	0.29293	59	1	0.0101	0.64646
20	0	0.0000	0.29293	60	0	0.0000	0.64646
21	0	0.0000	0.29293	61	0	0.0000	0.64646
22	1	0.0101	0.30303	62	1	0.0101	0.65657
23	1	0.0101	0.31313	63	0	0.0000	0.65657
24	0	0.0000	0.31313	64	0	0.0000	0.65657
25	0	0.0000	0.31313	65	4	0.0404	0.69697
26	1	0.0101	0.32323	66	1	0.0101	0.70707
27	5	0.0505	0.37374	67	0	0.0000	0.70707
28	3	0.0303	0.40404	68	0	0.0000	0.70707
29	0	0.0000	0.40404	69	0	0.0000	0.70707
30	9	0.0909	0.49495	70	0	0.0000	0.70707
31	2	0.0202	0.51515	71	0	0.0000	0.70707
32	1	0.0101	0.52525	72	0	0.0000	0.70707
33	0	0.0000	0.52525	73	0	0.0000	0.70707
34	0	0.0000	0.52525	74	4	0.0404	0.74747
35	5	0.0505	0.57576	75	8	0.0808	0.82828
36	1	0.0101	0.58586	76	2	0.0202	0.84848
37	0	0.0000	0.58586	77	4	0.0404	0.88889
38	1	0.0101	0.59596	78	0	0.0000	0.88889
39	0	0.0000	0.59596	79	0	0.0000	0.88889
40	0	0.0000	0.59596	80	0	0.0000	0.88889

TYPE	NUM.	PERCEN	CUM.PERCEN
81	0	0.0000	0.88889
82	0	0.0000	0.88889
83	0	0.0000	0.88889
84	1	0.0101	0.89899
85	0	0.0000	0.89899
86	0	0.0000	0.89899
87	0	0.0000	0.89899
88	0	0.0000	0.89899
89	1	0.0101	0.90909
90	1	0.0101	0.91919
91	0	0.0000	0.91919
92	8	0.0808	1.00000
	TOTAL	99	

INDICES	
IG	26.263
IB	29.293
IBd	19.192
IBt	6.061
IGA	22.222
IBdr	65.517
IBtr	20.690
IGAr	84.615
GA	23.232
GP	4.040
IP	2.020
Ih	3.030

TABLE 3

KHIAM 11C

TYPE	NUM.	PERCEN	CUM. PERCEN
1	8	0.0105	0.01054
2	3	0.0040	0.01449
3	5	0.0066	0.02108
4	3	0.0040	0.02503
5	7	0.0092	0.03426
6	1	0.0013	0.03557
7	0	0.0000	0.03557
8	11	0.0145	0.05007
9	0	0.0000	0.05007
10	2	0.0026	0.05270
11	59	0.0777	0.13043
12	16	0.0211	0.15152
13	61	0.0804	0.23188
14	23	0.0303	0.26219
15	64	0.0843	0.34651
16	28	0.0369	0.38340
17	5	0.0066	0.38999
18	0	0.0000	0.38999
19	0	0.0000	0.38999
20	0	0.0000	0.38999
21	1	0.0013	0.39130
22	0	0.0000	0.39130
23	20	0.0264	0.41765
24	0	0.0000	0.41765
25	0	0.0000	0.41765
26	4	0.0053	0.42292
27	52	0.0685	0.49144
28	19	0.0250	0.51647
29	16	0.0211	0.53755
30	33	0.0435	0.58103
31	0	0.0000	0.58103
32	2	0.0026	0.58366
33	0	0.0000	0.58366
34	4	0.0053	0.58893
35	26	0.0343	0.62319
36	3	0.0040	0.62714
37	5	0.0066	0.63373
38	1	0.0013	0.63505
39	0	0.0000	0.63505
40	1	0.0013	0.63636
41	1	0.0013	0.63768
42	0	0.0000	0.63768
43	5	0.0066	0.64427
44	2	0.0026	0.64690
45	1	0.0013	0.64822
46	5	0.0066	0.65481
47	2	0.0026	0.65744
48	8	0.0105	0.66798
49	2	0.0026	0.67062
50	0	0.0000	0.67062
51	5	0.0066	0.67721
52	5	0.0066	0.68379
53	0	0.0000	0.68379
54	0	0.0000	0.68379

TYPE	NUM.	PERCEN	CUM. PERCEN
55	0	0.0000	0.68379
56	0	0.0000	0.68379
57	0	0.0000	0.68379
58	0	0.0000	0.68379
59	0	0.0000	0.68379
60	1	0.0013	0.68511
61	2	0.0026	0.68775
62	0	0.0000	0.68775
63	0	0.0000	0.68775
64	1	0.0013	0.68906
65	17	0.0224	0.71146
66	14	0.0184	0.72991
67	1	0.0013	0.73123
68	0	0.0000	0.73123
69	2	0.0026	0.73386
70	0	0.0000	0.73386
71	0	0.0000	0.73386
72	0	0.0000	0.73386
73	1	0.0013	0.73518
74	23	0.0303	0.76548
75	51	0.0672	0.83267
76	1	0.0013	0.83399
77	17	0.0224	0.85639
78	2	0.0026	0.85903
79	0	0.0000	0.85903
80	0	0.0000	0.85903
81	1	0.0013	0.86034
82	0	0.0000	0.86034
83	0	0.0000	0.86034
84	13	0.0171	0.87747
85	6	0.0079	0.88538
86	1	0.0013	0.88669
87	0	0.0000	0.88669
88	5	0.0066	0.89328
89	7	0.0092	0.90250
90	14	0.0184	0.92095
91	0	0.0000	0.92095
92	60	0.0791	1.00000

TOTAL 759

INDICES

IG	34.651
IB	22.398
IBd	15.810
IBt	5.138
IGA	20.949
IBdr	70.588
IBtr	22.941
IGAr	60.456
GA	21.871
GP	5.138
IP	3.162
Ih	6.851

TABLE 4

KHIAM 11B

TYPE	NUM.	PERCEN	CUM. PERCEN
1	14	0.0113	0.01131
2	5	0.0040	0.01535
3	1	0.0008	0.01616
4	6	0.0048	0.02100
5	8	0.0065	0.02746
6	0	0.0000	0.02746
7	0	0.0000	0.02746
8	14	0.0113	0.03877
9	5	0.0040	0.04281
10	1	0.0008	0.04362
11	55	0.0444	0.08805
12	16	0.0129	0.10097
13	49	0.0396	0.14055
14	0	0.0000	0.14055
15	77	0.0622	0.20275
16	24	0.0194	0.22213
17	11	0.0089	0.23102
18	1	0.0008	0.23183
19	2	0.0016	0.23344
20	0	0.0000	0.23344
21	1	0.0008	0.23425
22	1	0.0008	0.23506
23	20	0.0162	0.25121
24	3	0.0024	0.25363
25	1	0.0008	0.25444
26	0	0.0000	0.25444
27	50	0.0404	0.29483
28	29	0.0234	0.31826

TYPE	NUM.	PERCEN	CUM. PERCEN
29	22	0.0178	0.33603
30	50	0.0404	0.37641
31	7	0.0057	0.38207
32	0	0.0000	0.38207
33	0	0.0000	0.38207
34	7	0.0057	0.38772
35	8	0.0065	0.39418
36	8	0.0065	0.40065
37	11	0.0089	0.40953
38	1	0.0008	0.41034
39	1	0.0008	0.41115
40	3	0.0024	0.41357
41	3	0.0024	0.41599
42	0	0.0000	0.41599
43	2	0.0016	0.41761
44	5	0.0040	0.42165
45	0	0.0000	0.42165
46	8	0.0065	0.42811
47	11	0.0089	0.43700
48	2	0.0016	0.43861
49	13	0.0105	0.44911
50	0	0.0000	0.44911
51	16	0.0129	0.46204
52	8	0.0065	0.46850
53	0	0.0000	0.46850
54	0	0.0000	0.46850
55	0	0.0000	0.46850
56	0	0.0000	0.46850
57	8	0.0065	0.47496
58	14	0.0113	0.48627
59	16	0.0129	0.49919
60	19	0.0153	0.51454
61	6	0.0048	0.51939
62	4	0.0032	0.52262
63	12	0.0097	0.53231
64	3	0.0024	0.53473
65	85	0.0687	0.60339
66	34	0.0275	0.63086
67	1	0.0008	0.63166
68	0	0.0000	0.63166

TYPE	NUM.	PERCEN	CUM. PERCEN
69	0	0.0000	0.63166
70	0	0.0000	0.63166
71	0	0.0000	0.63166
72	0	0.0000	0.63166
73	0	0.0000	0.63166
74	36	0.0291	0.66074
75	64	0.0517	0.71244
76	5	0.0040	0.71648
77	29	0.0234	0.73990
78	6	0.0048	0.74475
79	1	0.0008	0.74556
80	0	0.0000	0.74556
81	0	0.0000	0.74556
82	0	0.0000	0.74556
83	0	0.0000	0.74556
84	7	0.0057	0.75121
85	24	0.0194	0.77060
86	6	0.0048	0.77544
87	0	0.0000	0.77544
88	11	0.0089	0.78433
89	69	0.0557	0.84006
90	56	0.0452	0.88530
91	1	0.0008	0.88611
92	141	0.1139	1.00000
	TOTAL	1238	

INDICES

IG	20.275
IB	16.721
IBd	12.763
IBt	2.989
IGA	9.693
IBdr	76.329
IBtr	17.874
IGAr	47.809
GA	10.258
GP	13.732
IP	1.939
Ih	15.428

TABLE 5

KHIAM 11A

TYPE	NUM.	PERCEN	CUM. PERCEN	TYPE	NUM.	PERCEN	CUM. PERCEN
1	15	0.0077	0.00768	41	8	0.0041	0.33538
2	6	0.0031	0.01075	42	1	0.0005	0.33589
3	1	0.0005	0.01126	43	3	0.0015	0.33743
4	2	0.0010	0.01229	44	1	0.0005	0.33794
5	14	0.0072	0.01946	45	1	0.0005	0.33845
6	1	0.0005	0.01997	46	11	0.0056	0.34409
7	0	0.0000	0.01997	47	19	0.0097	0.35381
8	11	0.0056	0.02560	48	9	0.0046	0.35842
9	1	0.0005	0.02611	49	41	0.0210	0.37942
10	1	0.0005	0.02663	50	0	0.0000	0.37942
11	84	0.0430	0.06964	51	12	0.0061	0.38556
12	10	0.0051	0.07476	52	3	0.0015	0.38710
13	65	0.0333	0.10804	53	4	0.0020	0.38914
14	4	0.0020	0.11009	54	0	0.0000	0.38914
15	74	0.0379	0.14798	55	0	0.0000	0.38914
16	29	0.0148	0.16283	56	0	0.0000	0.38914
17	5	0.0026	0.16539	57	3	0.0015	0.39068
18	0	0.0000	0.16539	58	23	0.0118	0.40246
19	0	0.0000	0.16539	59	24	0.0123	0.41475
20	0	0.0000	0.16539	60	10	0.0051	0.41987
21	0	0.0000	0.16539	61	12	0.0061	0.42601
22	0	0.0000	0.16539	62	2	0.0010	0.42704
23	17	0.0087	0.17409	63	36	0.0184	0.44547
24	0	0.0000	0.17409	64	2	0.0010	0.44649
25	0	0.0000	0.17409	65	198	0.1014	0.54788
26	3	0.0015	0.17563	66	47	0.0241	0.57194
27	59	0.0302	0.20584	67	2	0.0010	0.57296
28	55	0.0282	0.23400	68	1	0.0005	0.57348
29	31	0.0159	0.24987	69	0	0.0000	0.57348
30	43	0.0220	0.27189	70	0	0.0000	0.57348
31	9	0.0046	0.27650	71	0	0.0000	0.57348
32	0	0.0000	0.27650	72	0	0.0000	0.57348
33	0	0.0000	0.27650	73	0	0.0000	0.57348
34	4	0.0020	0.27855	74	41	0.0210	0.59447
35	28	0.0143	0.29288	75	76	0.0389	0.63338
36	45	0.0230	0.31592	76	6	0.0031	0.63646
37	20	0.0102	0.32616	77	21	0.0108	0.64721
38	2	0.0010	0.32719	78	16	0.0082	0.65540
39	7	0.0036	0.33077	79	3	0.0015	0.65694
40	1	0.0005	0.33129	80	1	0.0005	0.65745

TYPE	NUM.	PERCEN	CUM. PERCEN
81	1	0.0005	0.65796
82	0	0.0000	0.65796
83	0	0.0000	0.65796
84	23	0.0118	0.66974
85	40	0.0205	0.69022
86	11	0.0056	0.69585
87	14	0.0072	0.70302
88	39	0.0200	0.72299
89	235	0.1203	0.84332
90	83	0.0425	0.88582
91	6	0.0031	0.88889
92	217	0.1111	1.00000
	TOTAL	1953	

INDICES	
IG	14.798
IB	16.231
IBd	10.087
IBt	5.018
IGA	8.346
IBdr	62.145
IBtr	30.915
IGAr	56.401
GA	8.653
GP	14.183
IP	1.024
Ih	23.963

TABLE 6

KHIAM 10

TYPE	NUM.	PERCEN	CUM. PERCEN	TYPE	NUM.	PERCEN	CUM. PERCEN
1	31	0.0112	0.01118	28	33	0.0119	0.24531
2	22	0.0079	0.01912	29	40	0.0144	0.25974
3	19	0.0069	0.02597	30	51	0.0184	0.27814
4	3	0.0011	0.02706	31	14	0.0051	0.28319
5	39	0.0141	0.04113	32	0	0.0000	0.28319
6	6	0.0022	0.04329	33	0	0.0000	0.28319
7	2	0.0007	0.04401	34	15	0.0054	0.28860
8	14	0.0051	0.04906	35	37	0.0133	0.30195
9	0	0.0000	0.04906	36	173	0.0624	0.36436
10	2	0.0007	0.04978	37	42	0.0152	0.37951
11	119	0.0429	0.09271	38	4	0.0014	0.38095
12	26	0.0094	0.10209	39	2	0.0007	0.38167
13	78	0.0281	0.13023	40	7	0.0025	0.38420
14	10	0.0036	0.13384	41	15	0.0054	0.38961
15	115	0.0415	0.17532	42	0	0.0000	0.38961
16	32	0.0115	0.18687	43	1	0.0004	0.38997
17	18	0.0065	0.19336	44	4	0.0014	0.39141
18	0	0.0000	0.19336	45	0	0.0000	0.39141
19	2	0.0007	0.19408	46	1	0.0004	0.39177
20	0	0.0000	0.19408	47	26	0.0094	0.40115
21	1	0.0004	0.19444	48	0	0.0000	0.40115
22	3	0.0011	0.19553	49	16	0.0058	0.40693
23	19	0.0069	0.20238	50	0	0.0000	0.40693
24	0	0.0000	0.20238	51	12	0.0043	0.41126
25	1	0.0004	0.20274	52	7	0.0025	0.41378
26	3	0.0011	0.20382	53	2	0.0007	0.41450
27	82	0.0296	0.23341	54	0	0.0000	0.41450

TYPE	NUM.	PERCEN	CUM. PERCEN
55	0	0.0000	0.41450
56	0	0.0000	0.41450
57	4	0.0014	0.41595
58	49	0.0177	0.43362
59	29	0.0105	0.44408
60	6	0.0022	0.44625
61	4	0.0014	0.44769
62	5	0.0018	0.44949
63	44	0.0159	0.46537
64	5	0.0018	0.46717
65	209	0.0754	0.54257
66	234	0.0844	0.62698
67	1	0.0004	0.62734
68	3	0.0011	0.62843
69	0	0.0000	0.62843
70	0	0.0000	0.62843
71	0	0.0000	0.62843
72	0	0.0000	0.62843
73	0	0.0000	0.62843
74	33	0.0119	0.64033
75	68	0.0245	0.66486
76	4	0.0014	0.66631
77	28	0.0101	0.67641
78	0	0.0000	0.67641
79	8	0.0029	0.67929
80	2	0.0007	0.68001
81	7	0.0025	0.68254
82	0	0.0000	0.68254
83	0	0.0000	0.68254
84	17	0.0061	0.68867
85	64	0.0231	0.71176
86	22	0.0079	0.71970
87	8	0.0029	0.72258
88	91	0.0328	0.75541
89	343	0.1237	0.87915
90	87	0.0314	0.91053
91	10	0.0036	0.91414
92	238	0.0859	1.00000

TOTAL 2772

INDICES

IG	16.453
IB	11.666
IBd	5.260
IBt	5.192
IGA	4.316
IBdr	45.087
IBtr	44.509
IGAr	26.230
GA	4.922
GP	12.744
IP	1.821
Ih	18.948

TABLE 7

KHIAM

TYPE	NUM.	PERCEN	CUM. PERCEN
1	29	0.0196	0.01955
2	18	0.0121	0.03169
3	3	0.0020	0.03372
4	2	0.0013	0.03506
5	22	0.0148	0.04990
6	3	0.0020	0.05192
7	0	0.0000	0.05192
8	13	0.0088	0.06069
9	0	0.0000	0.06069
10	0	0.0000	0.06069
11	39	0.0263	0.08699
12	6	0.0040	0.09103
13	15	0.0101	0.10115
14	4	0.0027	0.10384
15	90	0.0607	0.16453
16	14	0.0094	0.17397
17	13	0.0088	0.18274
18	0	0.0000	0.18274
19	1	0.0007	0.18341
20	1	0.0007	0.18409
21	0	0.0000	0.18409
22	0	0.0000	0.18409
23	23	0.0155	0.19960
24	3	0.0020	0.20162
25	1	0.0007	0.20229
26	0	0.0000	0.20229
27	23	0.0155	0.21780
28	14	0.0094	0.22724

TYPE	NUM.	PERCEN	CUM. PERCEN
29	9	0.0061	0.23331
30	25	0.0169	0.25017
31	7	0.0047	0.25489
32	0	0.0000	0.25489
33	0	0.0000	0.25489
34	8	0.0054	0.26028
35	23	0.0155	0.27579
36	34	0.0229	0.29872
37	12	0.0081	0.30681
38	0	0.0000	0.30681
39	0	0.0000	0.30681
40	0	0.0000	0.30681
41	11	0.0074	0.31423
42	1	0.0007	0.31490
43	6	0.0040	0.31895
44	0	0.0000	0.31895
45	2	0.0013	0.32030
46	2	0.0013	0.32165
47	13	0.0088	0.33041
48	1	0.0007	0.33109
49	4	0.0027	0.33378
50	0	0.0000	0.33378
51	2	0.0013	0.33513
52	2	0.0013	0.33648
53	2	0.0013	0.33783
54	0	0.0000	0.33783
55	0	0.0000	0.33783
56	0	0.0000	0.33783
57	0	0.0000	0.33783
58	17	0.0115	0.34929
59	9	0.0061	0.35536
60	7	0.0047	0.36008
61	10	0.0067	0.36682
62	2	0.0013	0.36817
63	33	0.0223	0.39042
64	1	0.0007	0.39110
65	256	0.1726	0.56372
66	101	0.0681	0.63183
67	4	0.0027	0.63452
68	0	0.0000	0.63452
69	0	0.0000	0.63452
70	0	0.0000	0.63452

TYPE	NUM.	PERCEN	CUM. PERCEN
71	0	0.0000	0.63452
72	0	0.0000	0.63452
73	0	0.0000	0.63452
74	51	0.0344	0.66891
75	30	0.0202	0.68914
76	0	0.0000	0.68914
77	17	0.0115	0.70061
78	0	0.0000	0.70061
79	2	0.0013	0.70196
80	4	0.0027	0.70465
81	14	0.0094	0.71409
82	0	0.0000	0.71409
83	0	0.0000	0.71409
84	5	0.0034	0.71746
85	49	0.0330	0.75051
86	31	0.0209	0.77141
87	2	0.0013	0.77276
88	15	0.0101	0.78287
89	113	0.0762	0.85907
90	44	0.0297	0.88874
91	0	0.0000	0.88874
92	165	0.1113	1.00000

TOTAL 1483

INDICES

IG	17.532
IB	18.759
IBd	7.937
IBt	9.885
IGA	8.405
IBdr	42.308
IBtr	52.692
IGAr	47.942
GA	8.874
GP	10.967
IP	0.830
Ih	24.206

TABLE 8

KOLMOGOROV-SMIRNOV KSD VALUES, KHIAM MESOLITHIC/NEOLITHIC

	Level							
	8	7	6	5	4	3	2	1
8		1.57	1.86	2.27	2.88	2.99	2.23	3.72
7	1.57		0.53	1.22	1.31	1.49	0.53	1.87
6	1.86	0.53		1.80	1.43	1.71	0.88	2.55
5	2.27	1.22	1.80		1.72	2.01	1.72	2.15
4	2.88	1.31	1.43	1.72		0.82	1.72	2.96
3	2.99	1.49	1.71	2.01	0.82		1.92	3.23
2	2.23	0.53	0.88	1.72	1.72	1.92		3.29
1	3.72	1.87	2.55	2.15	2.96	3.23	3.29	

Note: Underlined values fail to reach significance (a value smaller than 1.63 indicates a probability of more than one in a hundred that a difference this large could be expected between samples of this size drawn from the same original population; a value smaller than 1.36 indicates more than one chance in 20). The Kolmogorov-Smirnov statistic was calculated from cumulative frequencies in the de Sonneville-Bordes type list, an arbitrary order but one sanctioned by convention and in general use among those who use the de Sonneville-Bordes-Perrot classification. Justification for the use of this stastistic with discontinuous data is provided by Leo Goodman in the *Psychological Bulletin* 51 (1954): 160-168.

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